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DO NON-CASH PAYMENTS AFFECT ECONOMIC GROWTH? EMPIRICAL EVIDENCE FROM EU COUNTRIES

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Purpose: 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.
Design/methodology/approach: 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 based on empirical analysis of panel data for the years 2005-2018 for the CEE and Western European countries. The following 10 CEECs participated in the research: Slovakia, Bulgaria, Poland, Czech Republic, Hungary, Romania, Lithuania, Latvia, Estonia, Slovenia and eight countries from Western Europe: France, Austria, Belgium, Germany, Netherlands, Luxembourg, Ireland, the United Kingdom.
Findings: in CEECs the value of transactions with payment cards had the largest impact on economic growth – an increase in the value of transactions using this payment instrument by one percentage point causes real GDP per capita increase by 0,23 percentage point. On the other hand, an increase in the value of transactions using credit transfers by one percentage point increased real GDP per capita by 0,10 percentage point. the direct debit transactions had a positive impact on the explained variable in the CEE countries – real GDP growth by 0,06 percentage point.
Research limitations/implications: The results of the empirical study, likewise in literature, indicated a significant, positive impact of non-cash payments on real GDP per capita growth. The impact on real GDP per capita is only effective for the CEE countries. In Western European countries the level of non-cash transactions reached a certain level of saturation. That was a 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.
Originality/value: analysis of current literature on the impact of non-cash payments on economic growth and an empirical analysis.

Keywords: household financial management, non-cash turnover, economic growth, real GDP per capita, public management.

Category of the paper: Research paper.

1. 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). Paul and Friday (Paul, Friday, 2012, pp. 31-32) formulated a similar definition. Therefore, non-cash settlements may be treated as substitute for cash because since they play various functions of real money: value measure, accumulation, exchange, unit of account (Arnold, 2007, pp. 574-581).

New payment instruments because of technological and IT development are enabling noncash payments. 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 may 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). Furthermore, non-cash payments are treated as 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 are considered hygienic for food sellers (Paul, Friday, 2012, pp. 31-36). Electronic payments are regarded as key factor in the growth of consumption, production, domestic product, and employment (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 (CEECs) and Western Europe. The following research hypothesis is 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 eight countries from Western Europe: France, Austria, Belgium, Germany, Netherlands, Luxembourg, Ireland, Great Britain. European Union (EU) countries were grouped according to the geographical classification of the United Nations (ONZ, 2019).

The study is structured as follows. 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 research methodology, and the fourth one– the results of the empirical study on the example of European countries – the CEE and Western European countries. The paper ends with concluding remarks with recommendations.

2. Impact of non-cash turnover on economic growth – a literature review

The impact of non-cash payments on the economy may be analyzed from the perspective diffusion of innovation theory. This concept appeared in 1962 and was developed by Rogers (Rogers, 1995). In this context, the dissemination of non-cash payments should occur right where consumers seek improvement, convenience during transactions, and companies search for new profit opportunities. The consequences of diffusion in non-cash payments depend on how the society may be ready to quickly accept non-cash payments at various stages of the innovation process including 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.

The literature review based on including 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 twenty-seven countries over the years 1995-2009. Their research results have shown that electronic retail payments (e-payments) stimulate overall economic growth, consumption, and trade (Hasan et al., 2012, 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 maybe treateda distinctive 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 indicated that checks had a 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 – due to the creation of the payment-integration area (SEPA) – was positively verified. In addition, research shows that the impact of retail payments on economic growth was more evident in euro area countries than in countries that do not belong to the euro area.

Cirasino et al. noticed a beneficial effect of non-cash transactions on economic growth (Cirasino et al., 2008, pp. 1-78). They reckoned that's system simplified commercial transactions not only for consumers, but also for businesses, which had a significant impact on the economy. The main advantages of using non-cash payment methods were speed of transactions and security (Cirasino et al., 2008, p. 21).

The positive impact of non-cash payments on the economy was also noticed by O. Slozko and A. Pelo. In their research, they proved that there was a positive correlation between the growth of e-payments and the growth of GDP. They concluded that the use of non-cash payments was closely related to the level of economic development of a given country (Slozko, 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 had a similar opinion on the previously mentioned issue. 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, pp. 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, 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) might 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 were published in the annual reports of the authors and analysts of the Moody's agency: V. Singh and M. Zandi (Zandi et al., 2016, pp. 1-31). Based on the research on the macroeconomic data of seventy countries in the world in 2011-2015, it was noted that retail payments contributed 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 was 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 corresponded 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 seventy surveyed countries by 2,6 million was 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. The empirical studies revealed that the development of electronic payments itself may not be enough to increase the welfare of the country. A developed financial system and a "healthy" economy are needed to ensure the economic and social welfare. With a view to promoting non-cash transactions, state authorities limit the regulations to the necessary minimum, favor the creation of developed financial infrastructure and support consumption growth were recommended. In addition, the adoption of an electronic

transaction had a significant meaning for the transparency of settlements between counterparties and encourages to reduce the fraud that accompanies transactions involving cash (Mieseigha, Ogbodo, 2013, pp. 11-16).

The research results presented above were 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, 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.

Even though non-cash payments have a positive impact on business activities, it should also be remembered that they may also create several 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 maybe treated as the part are just some of the shortcomings of non-cash payments (Oyewole et al., 2013). The risk of losing money weakened consumer confidence in making electronic payments. J. Park used economic data on70 countries from the least developed Bangladesh to the developed United States over the years 2002-2004 proved that the development of non-cash payments contributed 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, 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 unmistakable evidence of how the adoption of non-cash payments could affect the economy.

The Table 1 summarizes main findings from empirical studies on the impact on cashless payments on economic growth.

Table 1.
Review of current research on the impact on cashless payments on economic growth

Autor(s)	Main findings and/or conclusions
Zandi et al. (2013)	Cashless payments boost private consumption; the increase rise in consumption is found to contribute 0.17 percent to the GDP growth for a group of high-income countries.
Hasan et al. (2012)	A cash less transactions reduced costs connected to traditional paper-based transact thereby facilitating the operating costs for merchants. Subsequently operating costs would result in economies of scale among the merchants, leading to business expansion and greater level of investment in the economy, ineconomic growth.
Kearney, Schneider (2011, 2013)	Cashless transactions, may be beneficial for tax collection by the government and therefore more revenues may lead to an increase in government expenditures.
Hasan et al. (2012)	Electronic retail payments stimulate trade and consumption, resulting in higher economic growth in 27 European. Countries from to 2009. Growth enhancing effect for card payments was the strongest among different payment instruments. Cheque payments were found to have the least macroeconomic impact on growth due to the substitution effect with electronic cards.
Zandi et al. (2013)	That electronic card usage increased private consumption by 0.7 percent and subsequently leads to an increase in GDP growth by 0.17 percent per year across the 56 countries a future 1 percent increment in electronic card usage would result in generate an annual increase in consumption by 0.056 percent and subsequently improve growth by 0.032 percent.
Zandi et al. (2016)	Cashless payment had a positive impact on economic growth for a group of 70 countries from year 2011 to 2015.
Prabheesh, Rahman (2019)	Credit card affected consumption smoothing in Indonesia.

Source: own studies.

3. Research hypotheses and methodology

The panel data was analyzed for CEE and Western European countries and panel models were built using the ordinary 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…, 2013, p. 50; Tee, Ong, 2016, p. 4):

$realGDPpercapita_{it} = \alpha_1 + \beta_1 credit\_transfer_{it} + \beta_2 direct\_debits_{it} + \beta_3\ card\_payments_{it} + \beta_4\ e\text{-}money\_payments_{it} + vit$

where:

$realGDPpercapita_{it}$ – explained variable, real GDP per capita in the country i and in the period t,

α_1 – 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,

$\beta_1, \beta_2, \beta_3, \beta_4$ – structural parameters of the model,

v_{it} – total random error, consisting of a purely random part ε_{it} and the individual effect *ui* referring to a specific *i* unit of the panel (*vit* = *εit* + *ui*) (Kufel, 2007, p. 164).

Statistics such as R^2, 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 ten countries of Central and Eastern Europe[1] (112 observations) and for eight countries from Western Europe[2] (77 observations) in the years 2005-2018. The research includes a total of 189 observations. The variables used to verify research hypotheses are described in the Table 2 below.

Table 2.
Description of variables

Specification	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 one million inhabitants)
	direct_debits	EBC Statistical Data Warehouse, SDW EBC	value of transactions via direct debit (in million euro per one million inhabitants)
	cheques	EBC Statistical Data Warehouse, SDW EBC	value of transactions via checks (in million euro per one 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 one 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 one million inhabitants)

Source: own studies.

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, 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.

[1] Slovakia, Bulgaria, Poland, Czech Republic, Hungary, Romania, Lithuania, Latvia, Estonia, Slovenia.
[2] France, Austria, Belgium, Germany, Netherlands, Luxembourg, Ireland, Great Britain.

4. Result of empirical research and discussion

Empirical analysis was begun by identifying mean, median, minimum, maximum, standard deviation, coefficient of variation and coefficient of skewness for selected variables, Table 3.

Table 3.
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 one 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 one mln inhabitants	3 485,60	215,43	18,23	75 389,30	11 911,12	341,72	4,80
cheques	mln euro per one mln inhabitants	102,52	11,74	0,00	1 196,00	228,76	223,14	3,27
card_payments	mln euro per one mln inhabitants	1 240,79	954,63	50,46	4 843,25	971,71	78,31	1,05
e-money_ payments	mln euro per one mln inhabitants	23,57	2,11	0,00	836,37	116,94	496,18	6,86
real GDP per capita	euro per one 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 one 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 one 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 one 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 one 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 one 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 studies.

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 viacredit transfersproved 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 thenverified and the correlation between the explanatory variables (Table 4).

Table 4.
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 studies.

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 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 significant correlation between the value of transactions using a credit transfer 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.

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 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 5.

Table 5.
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 means of dependent variable 9,298177	Standard deviation of dependent variable	0,31871				
Residual sum of squares		2,333763	Residual standard error			0,147685
R^2 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 studies.

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

The estimated form of the model is as follows:

$$ln(realGDPpercapita_{it}) = 7,48 + 0,10\ ln\ (credit\_transfer_{it}) + 0,06\ ln\ (direct\_debits_{it}) + 0,23ln\ (card\_payments_{it}) + 0,14\ ln(realGDPpercapita_{it-1}) + Vit$$

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 $\alpha = 0,01$. Consideringthat $p < \alpha = 0,01$, 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 because 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 statistical hypotheses were formulated:

H0: all parameters are irrelevant.

H1: at least one parameter is relevant.

P-value for test F = 3,66e-10. Since $p < \alpha$, 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 $\alpha = 0,05$, about the lack of residual autocorrelation, the following hypotheses were formulated:

H0: □ = 0 (no residual autocorrelation).

H1: □ < 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: χ^2 with a probability of $\alpha = 0,05$ is 5,99146.

Since the calculated value of the χ^2 test was 0,510, and therefore the condition: $\chi^2 < \chi^2_{0.05}$, 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 GDPs 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 6.

Table 6.
Estimation results – Central and 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 means of dependent variable 10,60424	Standard deviation of dependent variable 0,336437					
Residual sum of squares		2,13198	Residual standard error			0,172078
R^2 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 studies.

It was not possible to statistically estimate the correct model for the Western EU countries. The greatest drawback of each estimated model was the incorrect distribution of residues. The model adjustment to empirical data was about 70%, This may be explained by 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 conclude, it maybe stated that the specified factors for the group of CEE countries clearly explain the level of real GDP per capita.

The author's findings indicated a strong impact of payment card transactions in CEE countries real GDP per capita The other payment instruments such as credit transfer and direct debit had a smaller impact on economic growth with regression coefficients of 0.10 and 0.06, respectively. The author's findings are consistent with I. Hasan et al (2012), O. Slozko and A. Pelo (2014), or Prabheesh and Rahman (2019), who highlighted the strong impact of electronic payments (which include payment cards) on economic growth.

While previous studies on the impact of non-cash forms of payment had referred to all countries in the European Union, our studies focus on division between Central and Eastern and Western European countries, which are characterised by a differentiated development of non-cash transactions.

5. Conclusion

Empirical analysis was begun by identifying mean, median, minimum, maximum, standard deviation, coefficient

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 considerable influence, for Western European countries not necessarily. The lower use of non-cash forms of payment in CEE countries compared to Western European countries is related both to the delay in economic development, due to the need to undergo a system transformation process, and to cultural and social considerations. The strong disparity in the level of development of non-cash transactions and the lower use of individual instruments within the European Union constitutes a certain obstacle to the free movement of payment services within the Community.

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 one 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 one 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.

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 means that these countries are moving directly from the past towards the future quicker than Western European countries.

It relatively advantageous position of Poland's results from the openness of consumers to several 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 because 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 five times higher in the analyzed period. Western European countries have more established payment networks, more developed infrastructure – most traders accept cards. 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 to match the economies with a higher level of GDP – promoting payment mechanisms, enabling merchants to accept electronic payments.

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. Furthermore, 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. We are still exploring the issue, 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.

Following Raya and Vargas (2022), exploring fraud and tax evasion "in terms of the preference of cashless instruments over cash" would have a significant value added. Our empirical studies would include the study could cover a wider set of countries and a longer list of control variables.

Additionally, to convince the public of the positive outcomes of a cashless society, it would be interesting to explain the evolution of fraud and tax evasion in terms of the preference of cashless instruments over cash. Finally, the same study could be replicated in different countries from various stages of cash dominance. By observing the differences between them, we can analyse the determinants of becoming a cashless society of potential economies, a very present concern in international markets. However, this could only be possible in other developed economies where there is availability of data and good financial institutions.

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