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The impact of inequalities in regional economic development on disparities in spatial distribution of cashless payment infrastructure in Poland

Abstract

The paper attempts to quantify the impact of inequalities in regional economic development on disparities in spatial distribution of cashless payment infrastructure in Poland at the voivodeship (NUTS 2 region) level. Our findings reveal that general patterns of spatial distribution of GDP per person and the composite index of cashless payment infrastructure development are similar. The richest regions – mazowieckie voivodeship and the regions of Western Poland have the most developed infrastructure, while the poorer eastern voivodeships are clearly lagging behind. The obtained results indicate that the impact of economic development on spatial distribution of cashless payment infrastructure is statistically significant.

Introduction

A strong feedback between the level of overall economic development and the quantity and quality of technical infrastructure in a given area results in a similar spatial distribution of these characteristics. In general, richer regions tend to have more developed infrastructure than poorer ones, as causality between incomes and infrastructure runs both ways [Fay et al. 2011, p. 334]. Higher incomes stimulate the demand for infrastructure-related goods and services and

simultaneously better developed infrastructure facilitates and supports economic activity and growth [Del Bo and Florio 2012, p. 1409].

Physical capital in Poland is highly concentrated in the most developed regions [Malaga and Kliber 2007, pp. 20-25]. This issue appears to apply also to the components of infrastructure used for cashless payments [Bolibok 2013, p. 242]. Given the above discussion it can be expected that regions characterised with higher levels of per capita income should offer their inhabitants better developed and more dense cashless payment infrastructure. This in turn might result in higher proclivity for cashless payments in richer societies.

The aim of the paper is to quantify the impact of inequalities in the level of regional economic development on the disparities in spatial distribution of cashless payment infrastructure in Poland at the voivodeship (NUTS 2 region) level. To our knowledge the present study is the first attempt to investigate the relation between the levels of regional economic development and cashless payment infrastructure in Poland empirically.

The remainder of the paper is composed of three sections. Section 1 discusses the components of modern cashless payment infrastructure and the impact of the level of economic development on their spatial distribution. The details of the methodological framework of the study are presented in Section 2. The key findings of the research are discussed in Section 3. The paper is closed with a brief summary presenting the concluding remarks, implications, and suggestions on directions of the future research.

1. Cashless payment infrastructure and regional economic development

The level of development and accessibility of infrastructure for cashless payments is an important factor influencing the dynamics of diffusion of such payments in a given society [Bolibok 2013, p. 242]. The research on attitudes of Poles towards cashless payments conducted in 2009 by Maison [2010, pp. 110--126] revealed significant disparities in the extent of cashless payments usage between Polish voivodeships, similar to inequalities in the overall level of economic development. According to Maison [2010, p. 127], substantially lower indices of cashless payments usage in the voivodeships of Eastern Poland suggest that one of the possible reasons of the observed disparities might be inequalities in the access to infrastructure used for performing such payments. An analogous research was conducted by the same author again in 2013, revealing that despite somewhat different pattern, the general disparities in the cashless

payments usage between the richer and poorer voivodeships could still be found [Maison 2013, p. 93]. The results of the latter edition of the research indicate however, that the impact of infrastructural barriers on the attitudes towards cashless payments in Polish society appears to decrease as currently psychological issues, like openness to new technologies and the "cult of cash", seem to be of highest importance [Maison 2013, p. 95].

From a bank client's perspective the following elements of cashless payment infrastructure seem to be of highest importance:

- automated teller machines (ATMs),
- EFTPOS terminals at the points of payment card acceptance,
- bank outlets,
- internet access network,
- mobile network.

The first two elements directly determine the possibilities of payment cards usage in terminal banking. Despite the fact, that the basic function of ATMs is enabling cash withdrawals for bank's clients, the density of ATM network is an important factor stimulating the diffusion of cashless payments by the increase of consciousness and the level of acceptance of electronic transactions in the society [Humphrey et al. 1996, p. 928]. Higher availability of ATMs induces people to open bank accounts and consequently to make more cashless transactions with payment cards or via internet banking. Furthermore, modern ATMs are often multifunctional devices, enabling not only cash operations, but also performing electronic funds transfer operations.

From the banks' perspective, the development and servicing of ATM networks is a cost-generating process. According to Snellman and Virén [2006, p. 14] an optimal solution for a bank functioning in a monopoly conditions would be therefore a reduction of the number of ATMs to zero. This suggests that the development of ATM network seems to be determined by the intensity of competitiveness in the banking sector in a given area, which in turn is stimulated by the level of income of the society. In the case of Poland the study by Ilnicki [2009, pp. 213-215] revealed that spatial distribution of ATMs corresponds closely to distribution of bank outlets that use to be highly concentrated in the largest cities and former voivodeship capitals.

Practical utility of payment cards is also strongly dependent on the density of points of sale that accept them. A higher number of these points in a given area results in a higher possibilities of using cashless payments and in increased diffusion of electronic banking technologies. An important factor influencing the dynamics of payment cards acceptance network is the relative cost of using the EFTPOS systems by retailers. The fact that necessary infrastructure tends to be

fairly costly [Polasik 2013, p. 81], in particular for smaller retailers, might result in slower development of the acceptance network in poorer regions, as the proclivity to use payment cards in Poland tends to increase in line with the level of household income [Koźliński 2013, pp. 67-68]. Simultaneously, the density of payment card acceptance network depends on the level of urbanisation of a given area, as it is much higher in large and medium-sized cities than in small towns and rural areas [Narodowy Bank Polski 2012, p. 21]. Given the above, it can be expected that higher level of regional economic development should positively influence the number of points of sale accepting payment cards.

As the number of ATMs and points of sale accepting payment cards in a given area grows, the users of cards are increasingly facing trade-offs between making payments via EFTPOS terminals and those with cash withdrawn form ATMs. The problem of substitution between these forms of payment has not been so far thoroughly explored in the related literature. To date some empirical investigations of this issue in the developed countries produced ambiguous results. Humphrey et al. [2001] did not find any statistically significant substitution effect for the Norwegian market, whereas the subsequent studies for the Spanish market by Scholnick et al. [2008] or Carbó-Valverde and Rodríguez-Fernández [2009], provided evidence of its existence.

Despite the constant development of self-banking technologies, the network of traditional bank outlets still remains an important component of modern cashless payment infrastructure. Thanks to a direct contact with bank's employees, the clients are not only able to realise even the most complicated cashless operations there, but also, which is particularly important in higher-value transactions, to minimise the risk of making some costly errors. Moreover, the density of bank outlets is significantly negatively correlated with the level of banking exclusion [Solarz 2013, p. 352]. Due to the fact, that bank outlets in Poland tend to be highly concentrated in the large and medium-sized cities, while their density in small town and rural areas is generally low [Narodowy Bank Polski 2013, p. 18], it seems likely that higher level of economic development of a given area should correspond with more dense networks of bank outlets.

The access to internet network enables households, enterprises, and other institution to perform cashless transactions using the internet banking solutions, payment cards or *homebanking* systems. Contemporarily, aside from traditional wire networks, an increasingly important role in worldwide communication is played by high-speed wireless transmission technologies (e.g. 4G LTE). Wireless networks enable the internet access via personal computers equipped with appropriate broadband modems, as well as modern cell phones.

The latest generations of smartphones equipped with NFC (*near field communication*) chips, become in fact close substitutes for payment cards, by enabling contactless cashless payments or even withdrawal of cash from appropriate ATMs. As a consequence, modern cell phones enable performing cashless transactions both through internet and terminal banking, which in addition to a high penetration of markets of developed countries by cellular networks, should stimulate their applications in this field [Bank for International Settlements 2012, pp. 31, 49].

Although internet and mobile networks in Poland became widespread, the results of the study by Matras-Bolibok [2011, pp. 450-460] indicate that at the voivodeship level the propensity of households and enterprises to use information and communication technologies is significantly positively correlated with regional economic development. It appears therefore that the level of economic development influences each of the identified components of cashless payment infrastructure.

2. Hypothesis development, data sources and research design

Following the conjectures of Maison [2010, 2013] and the discussion presented in Section 1, it can be expected that the level of overall economic development of a given voivodeship determines the accessibility of cashless payment infrastructure for its inhabitants and further results in disparities in proclivity for making such payments. Therefore, in general, the richer voivodeships are expected to be characterised with higher density of cashless payment infrastructure components per number of inhabitants than the poorer ones.

The aforementioned discussion has led to the formulation of the key research hypothesis of the present study:

H1: *The inequality in the level of regional economic development is a significant factor determining the disparities in spatial distribution of cashless payment infrastructure in Poland*

The analyses were based on the most recent publicly available data for voivodeships. The level of overall economic development of a particular voivodeship was assessed on the basis of the GDP per person (*GDPpp*) for the year 2012 provided by the Local Data Bank of the Central Statistical Office of Poland [2015]. On this basis the voivodeships were classified into five groups according to quintiles of the distribution of *GDPpp*.

Given the complex nature of cashless payment infrastructure, the assessment of its overall level of development requires construction of a composite measure combining many indicators that characterise diverse communication technologies employed. Therefore, following a slightly modified approach pro-

posed by Bolibok [2013, pp. 241-259], we decided to apply an index based on the Hellwig taxonomic measure of development.

In order to evaluate the extent of spatial disparities in the development of the elements of the infrastructure for cashless payments diffusion in each voivodeship the following set of indicators was used:

1) number of ATMs per 1 million inhabitants,
2) number of points of sale accepting payment cards per 1 million inhabitants,
3) number of bank outlets per 1 million inhabitants,
4) share of enterprises using the internet,
5) share of households furnished with a computer with access to the internet,
6) share of households furnished with a mobile phone.

The data on the number of ATMs and bank outlets per 1 million inhabitants in each voivodeship in 2012 were taken from the report on the state of development of cashless payments in Poland by the National Bank of Poland [Narodowy Bank Polski 2013, pp. 19, 34]. The number of points of sale accepting payment cards per 1 million inhabitants in each voivodeship was calculated on the basis of data provided by the NBP for the year 2011 in the report on cash back service in the Polish market [Rabong 2014, p. 39] and the data on the population of each voivodeship in that year provided by the Central Statistical Office of Poland [2014]. Finally, the data on the shares of enterprises and households using the internet and the share of households furnished with a mobile phone in 2012 were taken from the statistical yearbook of voivodeships by the Central Statistical Office of Poland [2014, pp. 343, 506].

In the further stage of the analysis, using the Hellwig taxonomic measure of development, we constructed a composite index of regional cashless payment infrastructure development. The starting point for calculation of this measure is construction of a matrix of standardised indicators representing the characteristics of cashless payment infrastructure:

$$Z = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1k} \\ z_{21} & z_{22} & \cdots & z_{2k} \\ \cdots & \cdots & \cdots & \cdots \\ z_{n1} & z_{n2} & \cdots & z_{nk} \end{bmatrix}$$

where:

- $z_{ij} = \frac{x_{ij} - \overline{x_j}}{s_j}$ is the standardised value of indicator j for voivodeship i,
- x_{ij} is the value of indicator j for voivodeship i,
- $\overline{x}_j$ is the arithmetic mean value of indicator j,

- S_j is the standard deviation of indicator j,
- $k = 6$ is the total number of indicators,
- $n = 16$ is the total number of regions (voivodeships).

The Hellwig taxonomic measure of development is based on the Euclidean distance of each region from the hypothetical "ideal" region – the leader in each of the analysed fields. Such "ideal" region (R_0) is defined as:

$$R_0 = [z_{01}, z_{02}, ..., z_{0k}], \text{ where } z_{0j} = \max_i \{z_{ij}\}$$

The composite index of cashless payment infrastructure development (hereinafter referred to as *CPIDI*) is given by the following formula [Zeliaś, ed., 2000, pp. 91-93]:

$$CPIDI_i = 1 - \frac{d_{i0}}{d_0},$$

where:

- $d_{io} = \left[\sum_{j=1}^{k} (z_{ij} - z_{0j})^2 \right]^{\frac{1}{2}},$

- $d_0 = \overline{d_0} + 3S_0, \quad \overline{d_0} = \frac{1}{n} \sum_{i=1}^{n} d_{i0},$

- $S_0 = \left[\frac{1}{n} \sum_{i=1}^{n} (d_{i0} - \overline{d_0})^2 \right]^{\frac{1}{2}}.$

CPIDI takes values between 0 and 1, inclusive. The higher the value of the index for a given region, the closer this region is to the 'ideal' one (so it has more developed infrastructure for cashless payments). The index allows ranking regions on the basis of the distance from the 'ideal' region (from the least to the most developed infrastructure for cashless payments), as well as their classification into groups of similar level of infrastructure development.

In the present study the voivodeships were classified into five groups according to quintiles of the distribution of *CPIDI*, analogously as in the case of *GDPpp*. This procedure enabled the comparative analysis and graphical illustration of patterns of spatial distribution of both features using tables and cartograms.

In order to quantify the impact of inequality in the level of economic development on the disparities in spatial distribution of cashless payment infrastruc-

ture at the voivodeship level, we employed correlation analysis using the Pearson linear correlation and the Spearman's rank correlation coefficients, and the linear regression analysis between *GDPpp* and *CPIDI*. Finally, all estimated results were tested for statistical significance.

3. Empirical results

The values of the selected characteristics of cashless payment infrastructure development in Polish voivodeships are presented in Table 1.

Table 1. Indicators of cashless payment infrastructure development in Polish voivodeships in 2012

Specification		ATMs per 1 million inhabitants	Points of sale accepting payment cards per 1 million inhabitants[*]	Bank outlets per 1 million inhabitants	Percentage of enterprises using the internet	Percentage of households furnished with:	
						a computer with internet access	a mobile phone
Voivodeship	dolnośląskie	482	6 549	470	95.0	62.6	90.4
	kujawsko-pomorskie	445	4 718	479	93.5	59.2	93.2
	lubelskie	401	3 637	464	94.4	59.5	91.7
	lubuskie	436	5 669	492	93.9	59.7	91.7
	łódzkie	462	4 184	472	91.6	59.2	92.3
	małopolskie	455	5 767	414	90.7	67.2	89.8
	mazowieckie	611	7 303	484	95.4	69.2	93.8
	opolskie	400	4 734	505	91.8	66.7	90.1
	podkarpackie	372	3 758	430	91.2	62.6	88.9
	podlaskie	432	3 997	477	92.3	59.4	86.9
	pomorskie	552	6 262	471	92.9	71.0	94.1
	śląskie	460	5 663	461	94.9	67.9	93.8
	świętokrzyskie	345	3 130	396	90.3	56.7	90.4
	warmińsko-mazurskie	405	4 681	472	91.7	58.2	90.5
	wielkopolskie	425	6 048	513	92.1	68.5	94.5
	zachodniopomorskie	513	6 327	482	93.1	64.0	92.3
Descriptive statistics	standard deviation	65	1175	30	1./5	4.4	2
	arithmetic mean	450	5152	468	92.8	63.2	91.5
	median	440.5	5198.5	472	92.6	62.6	91.7
	minimum	345	3130	396	90.3	56.7	86.9
	maximum	611	7303	513	95.4	71	94.5
	max/min	1.77	2.33	1.30	1.06	1.25	1.09
	variability coefficient	14.44%	22.81%	6.39%	1.62%	6.96%	2.19%

[*] data as of 2011

Source: Based on: Narodowy Bank Polski [2013, pp. 19, 34], Rabong [2014, p. 39] and Central Statistical Office [2013, pp. 343, 506; 2014].

Despite some differences, the patterns of spatial distribution of the components of cashless payment infrastructure appear to be generally similar. In general, the lowest values of the selected indicators were found in less economically

developed voivodeships, especially those of Eastern Poland (lubelskie, podlaskie, podkarpackie, świętokrzyskie, and warmińsko-mazurskie), while the richest regions (mazowieckie, dolnośląskie, śląskie, wielkopolskie, and pomorskie) usually took top ranks in each feature. The highest disparities between voivodeships, as indicated by the values of max/min and variability coefficients, were found in the number of points of sale and ATMs per 1 million inhabitants. On the other hand, the most equally distributed features were the shares of enterprises using the internet and households furnished with mobile phones. These results suggest that boosting the diffusion of cashless payments and decreasing of interregional disparities require intensification of activities towards the development of terminal banking infrastructure in Eastern Poland, in particular stimulating the development of payment cards acceptance network.

Table 2 presents the comparison of *GDPpp* and the values of *CPIDI* in 2012 for each voivodeship.

Table 2. Gross Domestic Product per person (*GDPpp*) and the Cashless Payment Infrastructure Development Index (*CPIDI*) in Polish voivodeships

	Specification	*GDPpp* [PLN]	CPIDI
Voivodeship	dolnośląskie	47 440	0.6268
	kujawsko-pomorskie	34 095	0.5375
	lubelskie	29 479	0.4386
	lubuskie	34 862	0.5667
	łódzkie	39 080	0.4697
	małopolskie	36 961	0.4224
	mazowieckie	66 755	0.8902
	opolskie	33 888	0.4885
	podkarpackie	29 333	0.3050
	podlaskie	30 055	0.3586
	pomorskie	41 045	0.7515
	śląskie	44 372	0.6685
	świętokrzyskie	31 459	0.1680
	warmińsko-mazurskie	30 065	0.4134
	wielkopolskie	44 567	0.6242
	zachodniopomorskie	35 334	0.6871
Descriptive statistics	standard deviation	9 277	0.1753
	arithmetic mean	38 049	0.5260
	Median	35 098	0.5130
	Minimum	29 333	0.1680
	Maximum	66 755	0.8902
	max/min	2.2758	5.2971
	variability coefficient	24.38%	33.33%

Source: Based on: Narodowy Bank Polski [2013, pp. 19, 34], Rabong [2014, p. 39], Central Statistical Office [2013, pp. 343, 506; 2014; 2015].

The data in Table 2 show that the values of *CPIDI* reveal significantly higher disparities between voivodeships than each of the indicators used for its

construction. This result is attributable to the aforementioned similarities in patterns of spatial distribution of those indicators' values, which have a cumulative effect on the composite index. The variability coefficient of *CPIDI* indicates that its values deviated on average by 33.3% from the value of arithmetic mean. This result is nearly 9 p.p. higher than the one observed for *GDPpp*. The ratio of maximal to minimal value of *CPIDI* exceeded 5 while the same ratio for *GDPpp* equalled 2.26.

The highest level of development of infrastructure for cashless payments was found in the richest region of the country, i.e. mazowieckie voivodeship, with *CPIDI* equal to 0.8902. Such a high value of the composite index indicates that this region was either the leader or a close runner-up in the majority of analysed criteria describing the cashless payment infrastructure development. At the same time more than five-times lower level of *CPIDI* was found in świętokrzyskie voivodeship (0.1680), that placed last in 5 out of 6 selected criteria.

The domination of mazowieckie voivodeship over the other regions of the country is clearly demonstrated by the fact, that the arithmetic mean of the composite index (0.5260) was equal 59% and its median (0.5130) 58% of the value achieved by the leader. These disparities are close to those observed for *GDPpp* with the arithmetic mean of 38.049 PLN and the median of 35.098 PLN, i.e. 57% and 53% of the value for mazowieckie voivodeship (66.755 PLN), respectively.

Figures 1 and 2 illustrate spatial distribution of *GDPpp* and *CPIDI*, respectively. In each figure the voivodeships were divided into quintiles of the distribution of the analysed feature.

Figure 1. Regional income inequality in Poland (GDP per person in PLN)
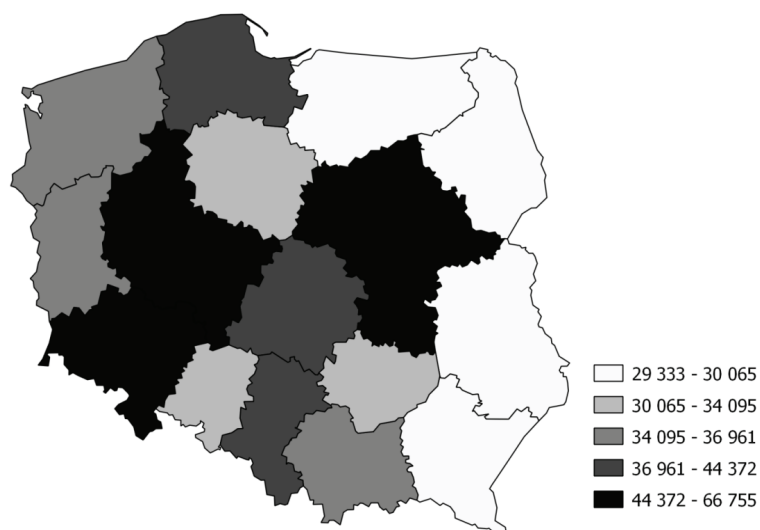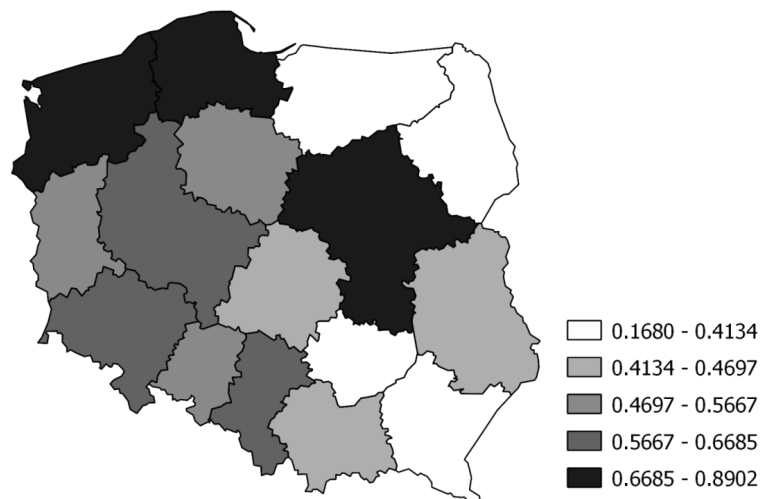
Figure 2. Spatial disparities in development of cashless payment infrastructure in Poland (*CPIDI*)

The division of voivodeships into quintiles of *CPIDI* allowed to classify them into groups according to the level of cashless payment infrastructure development. The most developed infrastructure was found in mazowieckie, pomorskie, and zachodniopomorskie voivodeships. The second class was formed by the voivodeships of an above-average level of infrastructure development – śląskie, dolnośląskie and wielkopolskie. An average level was found in lubuskie, kujawsko-pomorskie and opolskie voivodeships, while łódzkie, lubelskie, and małopolskie were classified below average. The most numerous group was the one constituted by four voivodeships of Eastern Poland that revealed the weakest development of the infrastructure for cashless payments – warmińsko-mazurskie, podlaskie, podkarpackie and świętokrzyskie.

The comparative analysis of regional disparities in the level of economic development and the development of the infrastructure for cashless payments reveals fairly similar patterns of spatial distribution of those features (Table 3).

Table 3. Classification of voivodeships according to *GDPpp* and *CPIDI*

Class	According to *GDPpp*	According to *CPIDI*
1	2	3
I	mazowieckie** dolnośląskie* wielkopolskie*	mazowieckie** pomorskie* zachodniopomorskie
II	śląskie** pomorskie* łódzkie	śląskie** dolnośląskie* wielkopolskie*
III	małopolskie* zachodniopomorskie lubuskie**	lubuskie** kujawsko-pomorskie* opolskie*

Table 3 cont.

| 1	2	3
IV	kujawsko-pomorskie* opolskie* świętokrzyskie*	łódzkie lubelskie* małopolskie*
V	warmińsko-mazurskie** podlaskie** lubelskie* podkarpackie**	warmińsko-mazurskie** podlaskie** podkarpackie** świętokrzyskie*

*   voivodeships in the neighbouring classes according to each criterion,
** voivodeships in the same class according to both criteria.

Out of all sixteen voivodeships six were assigned to the same classes according to both *GDPpp* and *CPIDI*, while eight other voivodeships were assigned to neighbouring classes. Only łódzkie and zachodniopomorskie voivodeships revealed some inconsistency in this respect. The former was assigned to the second class according to the level of *GDPpp* and to the fourth one according to *CPIDI*, while the latter was assigned to the third class according to *GDPpp* and to the first one according to *CPIDI*. In general, the obtained results suggest that the level of economic development is an important factor determining the development of cashless payment infrastructure in Polish regions.

In order to assess the impact of regional income inequality on the disparities in the development of the infrastructure for cashless payments more precisely an analysis of correlation and regression between the values of *CPIDI* and *GDPpp* for voivodeships was conducted. The scatterplot of *CPIDI* versus *GDPpp* is shown in Figure 3.

Figure 3. Scatterplot of GDP per person and CPIDI for Polish voivodeships
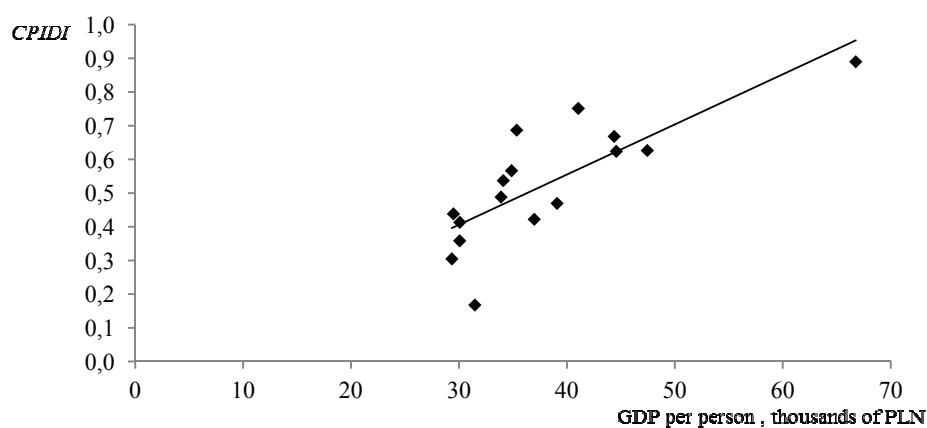
The conducted analyses indicate a strong positive association between the examined variables. The estimated value of the Pearson linear correlation coefficient equalled 0.787 while the value of Spearman's rank correlation coefficient equalled 0.797 and each of them was statistically significant at the 0.01 level.

The estimation of the parameters of linear regression between the level of *GDPpp* and the level of *CPIDI* in Polish regions yielded the following model:

$$\widehat{CPIDI} = 0.000015 \cdot GDPpp - 0.040128 \ (0.000003) \ (0,122028)$$

The estimated regression coefficient was statistically significant at the 0.01 level. On average, an increase in *GDPpp* of 10,000 PLN corresponded to 0.15 higher level of *CPIDI*. The R^2 of the model equalled 62.0% which means, that the variability of *GDPpp* was able to explain 62% of the variation in the level of development of infrastructure for cashless payments in the analysed period.

The results of our analyses indicate therefore that inequalities of regional economic development have statistically significant impact on the spatial disparities in distribution of cashless payment infrastructure in Poland which supports the main hypothesis of the present study.

Conclusions

The results of the research indicate that the level of overall regional economic development is a statistically significant determinant of spatial disparities in distribution of cashless payment infrastructure in Poland. The general patterns of distribution of *GDP* per person (*GDPpp*) and the composite index of cashless payment infrastructure development (*CPIDI*) across the regions of the country are fairly similar. The highest level of development of infrastructure for cashless payments was found in the richest voivodeships – mazowieckie and the regions of Western Poland, whereas the relatively less economically developed voivodeships of Eastern Poland appear to be clearly lagging behind. Furthermore, the classification of voivodeships according to quintiles of distribution of *GDPpp* and *CPIDI* revealed that of all sixteen voivodeships, six were assigned to the same classes according to both criteria and eight were assigned to neighbouring classes.

The conducted analyses of correlation and regression provided some additional arguments supporting the above results. Relatively high and statistically significant values of both Pearson linear correlation coefficient (0.787) and Spearman's rank correlation coefficient (0.797) indicate a strong positive relation between *GDPpp* and *CPIDI*. The subsequent analysis of linear regression confirmed that the level of overall economic development had a statistically

significant impact on interregional disparities in cashless payment infrastructure. The variability of *GDPpp* was able to explain 62% of the variation in *CPIDI* between Polish regions.

The existing disparities in regional distribution of cashless payment infrastructure in Poland arise primarily due to unequal densities of ATM and POS terminal networks, which are attributable to the nature of investment policies of banks, ATM operators, payment institutions, and sellers. Rationally, the investment processes of these entities continue until the marginal benefit from investment equals its marginal cost. Richer and more densely populated areas offer higher frequency of cashless transactions, greater opportunities of achieving related revenues, and therefore higher returns on investments. This in turn encourages the aforementioned institutions to invest in the cashless payment infrastructure primarily in those areas.

Analogously, even though the customers in less developed areas of the country might demand a broader access to ATMs or POS terminals, the expected returns on investments in those devices might not be as attractive as in the richer regions, which finally slows down the actual development of cashless payment infrastructure in the poorer ones.

The present study contributes to the existing literature by providing a direct empirical evidence of statistically significant impact of inequalities in regional economic development on the spatial disparities in distribution of cashless payment infrastructure in Poland which supports the conjectures put forth by Maison [2010, 2013] in the aforementioned studies on the attitudes towards cashless payments in the Polish society.

Given a wide variety of cashless payment instruments available and dynamically changing preferences of their users further research on the examined relationship might try to deepen the analyses conducted in the present study by applying more advanced methods of assessment of overall level of regional cashless payment infrastructure development, in particular, the ones able to capture the actual share of diverse payment channels in the volume of performed transactions.

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