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Statistical evaluation of payment system development in Poland

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3.5. Statistical evaluation of payment system development in Poland (by Anna Kiłyk, Paulina Magierska, Agnieszka Parkitna)

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Abstract

Polish banks account for payment orders related to high quota payments by the Polish National Bank (NBP), and the payment orders related to retail payments by the National Clearing House (KIR). Each country has its own laws, which regulate operation of the financial institutions and usage of the payment instruments. This system is called the national payment systems and it covers all payments made in this country. The NBP ensures the proper operation of the payment system, which allows quick and secure money flow for individuals and economic entities alike.

The main goal of this paper is statistical evaluation of the payment system development in Poland. Above considerations have been started by analyzing the genesis of payment systems.

Keywords: statistical analysis, assessment development, payment system.

1. INTRODUCTION

The statistical evaluation of the Polish payment system development is one of the criteria for assessing the effectiveness of this system. This evaluation can be performed as a stage of scientific considerations and contribution to the assessment of the effectiveness and efficiency of those systems within the available data that may be disclosed,particularly during turbulent political and economic changes.

2. ORIGINS OF PAYMENT SYSTEMS

Initially, banks limited only to the intermediation in payments and repayment of debt and liabilities between traders. At the turn of XVII and XVIII century depository receipts (banknotes) appeared - they were issued by banks in exchange for deposited metal or coins. This triggered development of lending related activities[1] . The bankers quickly noticed, that they don't need to full backing in gold for the banknote emitted by them. They start to emit more banknotes that they can cover by treasury resources. This situation lead to the insolvency of many banks, which resulted in a loss of confidence in banks. In order to improve this situation countries

1. *Banking Law*, Journal of Laws of 2015. Pos. 128, Art.2. The Act of 29 August 1997

limited the number of emissions by introducing an obligation to maintain a certain relationship between the amount of emissions and the value of the deposited coins and metal or by setting a upper limit on emissions. Next step of regulating the banking system was creation of the bank of issue, which started to have the exclusive right to issue banknotes [2].

Poland started a serious change in its banking system in 1988. Nine commercial regional banks were separated from NBP structures, which together with specialized banks (eg. Bank PKO SA, Bank Handlowy, PKO BP) started to be a basis for the de-monopolization of the banking sector. Due to this changes, NBP has been reduced to the typical role of a central bank. The next changes of banking law, specifying the location of the central bank and the authorities in the political and economic system, allowed NBP to be recognized as an organization independent from the government [3].

In the era of European Union (EU), the objective of the European Systems of Central Banks is be to maintain price stability while implementing the objectives of the European Union. European Central Banks (ECB) are required to cooperate with institutions which are shaping economic and financial policy of the EU[4]. ECB implementation of the monetary policy is supervised by the Executive Committee. This institution is responsible for execution of the monetary policy, which is determined by the Board Governors - the most important decision-making organ of the ECB.

Political and national independence is an important aspect of ECB. This institution can't execute, similarly to the national central banks and the members of their decision-making organs, commands or suggestions from the members of the government or employees of the EU institutions[5] [5].

3. CHARACTERISTICS OF PAYMENT SYSTEM IN POLAND

According to the definition adopted by the Bank of International Settlements in Basil - The payment system is a set of instruments, banking procedures and the interbank funds transfer system that ensures money circulation. Monetary settlements can be made through banks, but when at least one part of settlement (debtor or creditor) has a bank account. They are carried out in cash or cashless by using paper or computer storage media [6]. Each country has its own legislation, which governs the operation of financial institutions and the use of payment instruments.

2 Skawińska E., Sobiech-Grabka K.G., Nawrot K.A., *Makroekonomia*. Teoretyczne i praktyczne aspekty gospodarki rynkowej, Polskie Wydawnictwo Ekonomiczne, Warszawa 2010.

3 Milewski R., *Podstawy ekonomii*, Wydawnictwo Naukowe PWN, Warszawa 1998.

4Iwanicz-Drozdowska M., Jaworski, W. L., Zawadzka Z., *Bankowość*. Zagadnienia podstawowe, Wydawnictwo Poltext, Warszawa 2010.

5 Mankiw N.G., Taylor M.P., *Makroekonomia*, Polskie Wydawnictwo Ekonomiczne, Warszawa 2009

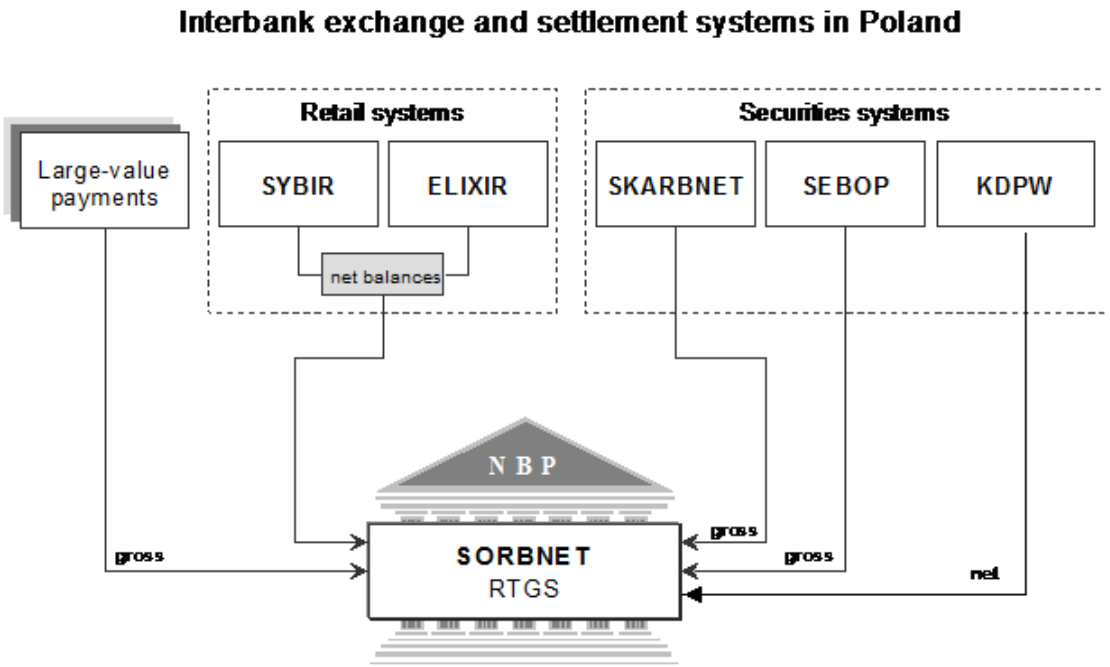
6 Niedźwiedzki M., *Wybrane problemy gospodarki elektronicznej*, Wydawnictwo Uniwersytetu Łódzkiego, Łódź 2007.

In Poland, NBP ensures the proper operation of the payment system. It enables quick and secure flow of money both between individuals and economic entities. The main task of NPB in this regard include:

- organizing and conducting the basic settlements,
- supervision over the settlement systems,
- regulatory actions.

Moreover, NBP guides the payment system, develops the rules which apply to the monetary settlements, gives permissions to start new payment systems and evaluates their work. In case of irregularities NBP gives recommendation to remove them [7]. That's why all polish banks are direct or indirect participants in the KIR. Most of the interbank payments (quantitatively) are settled through the clearing house. Interbank settlement takes place on banks current account held at the NBP. Additionally, NBP was the operator of two systems RTGS that were used to process of large-values interbank payments - SORBNET for payments in PLN and SORBNET-EURO for payments in EURO [8]. Those systems were replaced by SORBNET2 and TARGET2 (Plot 1).

Plot. 1. Interbank settlements and settlement system in Poland



Source: *www.nbp.pl/en/system_platniczy/payment_system.zip [09.12.2014]*.

7 18 June 2015, www.nbp.pl/home.aspx?f=/systemplatniczy/system_platniczy.html

8 18 June 2015, www.nbp.pl/systemplatniczy/system/system_platniczy_2008.pdf

In addition, the NBP is also entrusted (with accordance to art. 3, paragraph 2, point 1 and 6 of the Act on the NBP) with organizing monetary settlements and contributing to the stability of the national financial system. The purpose of supervising the payment system is to ensure its efficient and safe operation [9]. The payment system plays an important role in the functioning of national and international financial markets. Smooth operation of payment systems is a necessary prerequisite for the efficient conduct of monetary policy and it creates the basis of national financial systems. Therefore, the supervision of the payments system is an important task for any central bank, which is often included in the statuses of the worlds central banks. One of the crucial tasks of the European System of Central Banks (as well as NBP) is to promote the smooth operation of payment systems, which can help to preserve the stability of the financial systems.

3.1. The large-value payment systems

The SORBNET2 system is the most important polish payment system, in which monetary policy operations, interbank transaction, high quota customers orders and settlement of other payment systems are carried out. In this system (SORBNET2), the banks current accounts are maintained and interbank settlements are made for payments in PLN. In the SORBNET2 there are four types of accounts dedicated to carrying out settlements by its participants:

- the current banks accounts are used to collect funds in PLN, including the required reserve fund, as well as making interbank settlement with other banks or NBP,
- the auxiliary accounts for billing intermediaries (KIR and KDPW), by which the funds are moved from current account of the ELIXIR system participants, which are liable for payment due to exchange payment orders by KIR, to the current accounts of participants for which that payment is due,
- the KIR's escrow account for the purpose of settlement arising from the Immediate Payment Processing System (SRPN),
- the settlement account for the Bank Guarantee Fund (BFG) - the own NBP account intended to be used by the BFG operations supported by KDPW [10][10].

Starting from 1st of January 2012, NBP has launched a new system called NBP-PHA. It is an internal application of the NBP, which works with the TARGER2 (Trans-European Automated Real-Time Gross Settlement Express Transfer System) system. This application allows handling:

- the NBP own accounts in EURO,

9 18 June 2015, ww.nbp.pl/home.aspx?f=/systemplatniczy/nadzor_syst_platn/informacje_ogolne.html

10 18 June 2015, strategieibiznes.pl/artykuly/it/sorbnet2-glowny-system-rozliczeniowy-w-polsce

- the settlement of NBP customers in EURO, carried out in TARGET2-NBP,
- a loan in EURO granted to the direct participants of the TARGET2 system [11].

TARGET2 is a system of real time interbank EURO settlements. This system provides quick and secure settlement between banks from different countries, thereby strengthening the liquidity of the European financial system. It allows banks to reduce the cost of clearing and gives them the possibility of centralized payment management. This benefit for the banks is at the same time a gain for their customers[12].

Due to the modular platform architecture, TARGET2 on one hand provides an identical range of basic services to all systems participants (regardless of their location). On the other hand, allows flexible adaptation of the scope of services used for the current needs of the participant through the ability to choose from several offered optional modules.

Moreover, the significant characteristics of this system are:

- a high level of payment security and advanced mechanisms that ensure continuity of the system ,
- an uniform price structure - an uniform level of charges for domestic transaction and cross-border transactions and external systems,
- an advanced flexible liquidity management mechanisms, including the possibility of grouping of liquidity in the financial group[13].

3.2. Retail payment systems

ELIXIR (Electronic Clearing House) is a system of interbank settlements, under which payment messages are exchanged and information is stored exclusively in electronic form[14]. Operated by KIR, ELIXIR system enables the exchange of messages designed to support billing credit and debit payment instruments and messages, which aren't subject to settlement, ment to provide information, complaint realization and control. The EuroELIXIR system performs the following functions:

- settlement of internal system transaction in EURO,
- transfer payments to an external billing system,
- payments distribution received from the external billing system,
- initialing settlement on the TARGET2 platform.

Settlement of payments settled in the EuroELIXIR system are made on the net balances basis. That's why, like the settlements in PLN in ELIXIR system, at the end of the clearing session KIR calculates the net balance of individual participants[15].

11 18 June 2015, www.nbp.pl/home.aspx?f=/systemplatniczy/system/sorbneteuro.html

12 18 June 2015, www.bankier.pl/wiadomosc/Narodowy-Bank-Polski-w-systemie-TARGET2-1770957.html

13 18 June 2015, www.finanse.egospodarka.pl/30895,Narodowy-Bank-Polski-w-systemie-Target2,2,48,1.html

14 09 December 2015, www.kir.com.pl/main.php?p=komunikaty-platnicze

15 09 December 2015, www.kir.com.pl/main.php?p=poradnik-euroelixir

Express ELIXIR - is the system of instant money transfer, available 24 hours a day, 7 days a week. With to this system, funds are transferred from one bank account to another (even in completely different bank), only in few seconds. It is the fastest and completely secure type of payment. The money, which was transferred, doesn't leave the bank system - its because the clearing payments in Express ELIXIR are deposited in the NBP. Express ELIXIR system operator is KIR, which processes almost all interbank transfer in Poland. In the Express ELIXIR system, funds are transferred directly from the sender's account to the reciever's account, without using intermediary accounts[16] [16]. According to the data from KIR, the system has actually made more then 1 000 trades per day expressways. However, in comparison to the number of payments made by the standard ELIXIR (7-8 million per day), is still a small amount. It should be remembered that this service is not yet widely available. *"The emergence of each new bank in the Express ELIXIR system causes a leap, of even several-fold increase in the number of transactions"* - Jończyk stressed[17] [17].

3.3. SEPA

SEPA (Single Euro Payments Area) is an area, in which citizens, companies and other entities can make non-cash settlements in EURO within the EU, both across borders and withing country borders under the same conditions and principles. Current SEPA regulations in Poland work in the form of a consensus between banks. However, starting from 1 November 2016,in accordance to the Regulation of SEPA, each bank will be required to allow payments in EURO.

SEPA payment is a service that allows to send cash in EURO currency to the banks account from 33 European countries, which have concluded an agreement for the execution of payments in SEPA standards[18] [18].

3.4. Instant payment systems

BlueCash system was launched on 15 November 2012 by its operator - Blue Media company. This system runs 24 hours per day, 7 days a week and it supports remittances in money orders and cash payments (the orders are carried out online). The currency of the settlements is Polish zloty (PLN). Participants of this system can be banks, which are located and operating in Poland and have agreed to participate in it. At the end of 2014, the BlueCash system had 53 participating banks (including 49 cooperative banks) [19].

16 09 December 2015, www.expresselixir.pl/opis-uslugi.html

1718 June 2015, www.forbes.pl/ekspresowe-przelewy-beda-dostepne-w-wiekszosci-polskich-bankow,artykuly,155571,1,1.html

18 18 June 2015, www.sepapolska.pl

19 Zygierewicz M., Tylińska J., Pawlik K., *Raport o sytuacji ekonomicznej bankó*, BANKI 2014, Fundacja Warszawski Instytut Bankowości, Warszawa 2015.

4. METHODOLOGY OF THE STATISTICAL EVALUATION OF PAYMENT SYSTEM DEVELOPMENT IN POLAND

Statistic is one of several fields of science, that can deal with quantitative methods of phenomena description or bulk processes. The subjects of its research are repeatable phenomena, which concern groups (not only individuals) affected by the phenomenon studies[20]. The statistical analysis includes attempts to generalize the information that are represented by data - in this sense statistics is the science based on reasoning. It follows from the sample to the population, assuming that the sample is taken from a population in random way[21] - table 1.

Table 1. The concept of population and sample.

Population	A set of all measurements, in which researcher is interested.
Sample	A subset selected from the population for performing measurements .
Random sample	A subset of randomly selected measurements (every possible sample composed of 'n' items has equal chance to be selected).

Among the methods, which allows to draw conclusions about the parameters of a distribution which are describing a trait of the population, the most important are:

- condensation measurement: mean, median, dominant,
- differentiation measurement: variance, standard deviation,
- asymmetry measurement
- concentration measurement.

Those methods answer the question *"What are the values of basic parameters that describe the distribution of traits in a population?"* (what is the average value of the characteristics?, what is its dispersal?, what is the relationship between the population's traits, etc.)[22].

The goal of this paper was the evaluation of the statistical development of the payment system in Poland, based on the analysis of quarterly information of cash settlements and settlement between banks. The paper also analyses the 5 selected payment systems. The analysis was conducted in two planes, showing growth of the quantitative parameters and value of the transactions.

The vastness of this research made it impossible to present it completely, that's why this paper shows only those areas which describe the phenomenon. The choice

20 Starzyńska W., *Podstawy statystyki*. Wydanie II, Centrum Doradztwa i Informacji Difin, Warszawa 2009.

21 Aczel A. D., *Statystyka w zarządzaniu*, Wydawnictwo Naukowe PWN, Warszawa 2000.

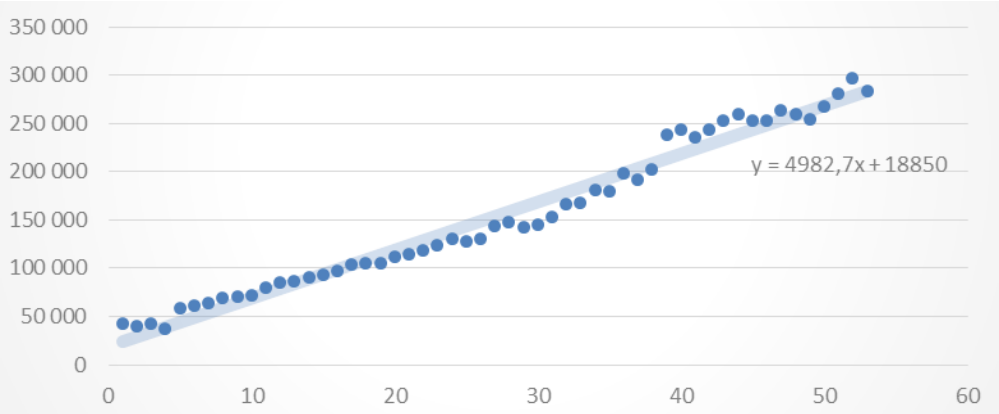
22 Żyżyński J., *Podstawy metod statystycznych dla zarządzania*, Wydawnictwo Naukowe Wydziału Zarządzania Uniwersytetu Warszawskiego, Warszawa 2004.

of statistical measures, adequate to attempt of the payments system evaluation, was narrowed to the quantifiable data represented by the value of completed transactions. Testing and measurement were narrowed down to the analysis of trends, average, variance, standards deviation and variation coefficient.

4.1. Analysis of large-value payment systems

The analysis of the average monthly number of orders in DSP (Department of Payment Systems) shows an upward trend, but it is not constant.

Plot.2. Average monthly number of orders in total DSP (pcs.)



The trend line, showed on plot 2, describes very well the growing importance of the subject of this study. The values of the monthly number of orders don't fluctuate too much. Year after year, the number of orders carried out by the SORBNET2 system is steadily increasing.

Table 2. Values of statistical measures for the average monthly number of DSP orders in total

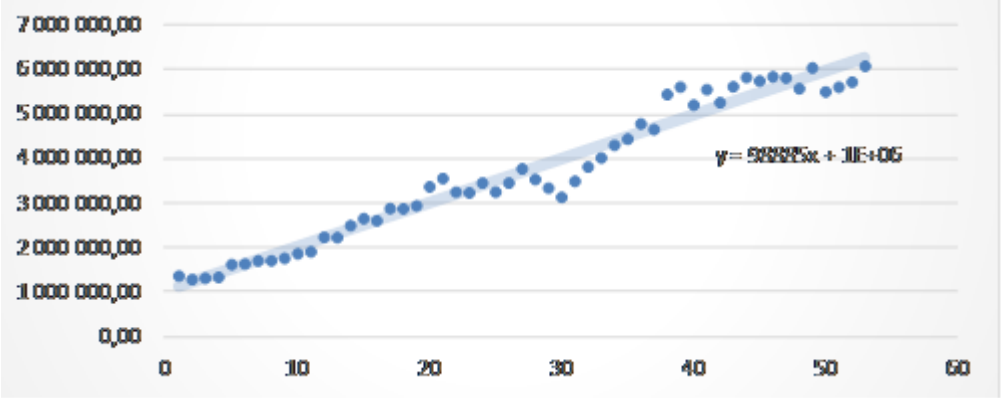
Mean	153 384
Median	142 331
Q1	89 694
Q3	237 319
Variance	5 959 614 746
Standard deviation	77 199
Variation coefficient	50,33%

The average number of orders per month doesn't exceed 155 thousands. The median value represents the fact that half of the analysed phenomenon is less then 142 331. A similar situation is presented for quartiles (this method divides the data set into 4 parts), where 25% monthly number of orders is less or equal to value Q1

(89 694). The standard deviation (square root of the variance) represents the average deviation of the measurement from the mean value. The distribution of the data depends on this parameter, the larger it is, the wider is the range where data is distributed and in this case the distribution range isn't very big. The variation coefficient is equal 50.33% and this value is in the range, where the variation of the characteristic is strong - table 2.

Analysis of the average monthly value of the DSP orders shows an upward trend, slight more diverse than the trend of the monthly order numbers (plot 1).

Plot.3. Average monthly value for DSP orders in total (PLN)



The trend line, shown on the plot 3, describes the studied phenomenon well. At the beginning of the analyzed time period it replicated almost exactly the monthly average value of orders.

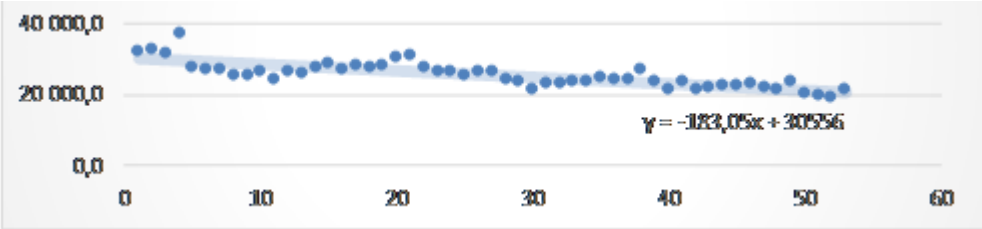
Table 3. Values of statistical measures for the average monthly values of DSP orders in total (million PLN)

Mean	3.7
Median	3.5
Q1	2.5
Q3	5.5
Variance	2 380 562
Standard deviation	1.5
Variation coefficient	41.58%

The average monthly value of orders amounted is about 3.7 million. The median value is about 3.5 million, so half of analyzed phenomena values is less then this value. About 25% of data is lower or equal to the value 2.5 million. The third quartile shows the relationship, in which 75% of the data is less or equal to the value

5.5 million. In this case, the standard deviation has a value of 1.5 million and it's not a significant deviation from the mean of the measurements. The coefficient indicates a strong diversification of characteristics - table 3. Data describing average order value doesn't change rapidly.

Plot.4. Average values of DSP orders in total (PLN)



The trend line for the average value of orders doesn't fully reflect the analyzed phenomenon in the SORBNET2 system. However, it clearly shows its downward trend - plot 4.

Table 4. Values of statistical measures for the average value of DSP orders in total (million PLN)

Mean	25.6
Median	25.2
Q1	23.2
Q3	27.3
Variance	12 176.0
Standard deviation	3.5
Variation coefficient	13.62%

The average value of the orders is slightly over 25 million. The measurement value deviate from the mean average for over 3 million. The variation coefficient shows a weak diversity of the analyzed feature - table 4.

4.2. Analysis of the interbank system of euro settlements in real time - TARGET2-NBP

The dynamics of the average transaction value allows for unambiguous statement about the direction of future changes.

Plot.5. Average monthly number of DSP orders in total (pcs.)

Table 5. Values of statistical measures for the average monthly value of transactions (billion EURO)

Mean	34.64
Median	41.53

Q1	17
Q3	49
Variance	292
Standard deviation	17
Variation coefficient	49.31%

The average monthly amount of the transactions is equal 34.64 billion EURO. The measured values deviate from the mean for about 17 billion euros. The variation coefficient shows the strong differentiation of the analyzed qualities - table 5.

Plot.6. Average transactions value (thousand EURO)

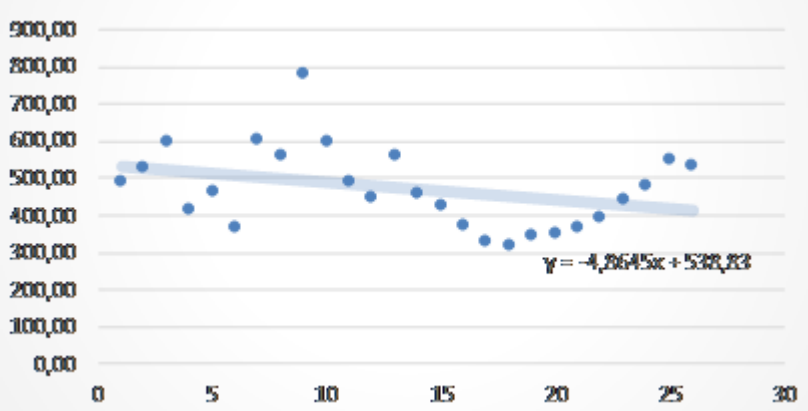


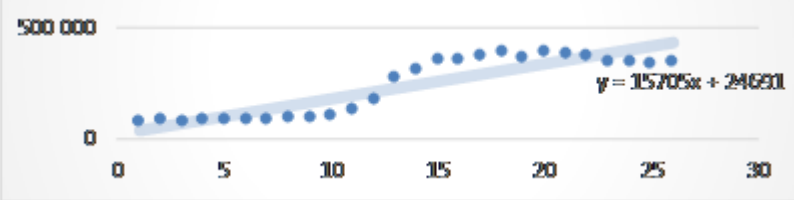
Table 6. Values of statistical measures for the average transaction value (thousand EURO)

Mean	**473.16**
Median	461.42
Q1	381
Q3	545
Variance	11 278
Standard deviation	106
Variation coefficient	22.44%

Average of the transaction amounts is more then 473 thousand EURO. The analyzed values diverge from the mean for about 106 thousand. The variation coefficient reflects moderate diversification analyzed characteristics - table 6. In the final stage of analyzed data, they remain at a similar level (from 2001, the number of

total transactions remains around 350 thousand (plot 5) and does not exceed 400 thousand transaction (plot 6)).

Plot.7 Total number of transaction (pcs.)



The trend line poorly matches the studied phenomenon - plot 7.

Table 7. Values of statistical measures for the total number of transaction (in thousands)

Mean	236.7
Median	292.6
Q1	90.8
Q3	360.5
Variance	17 169 683
Standard deviation	131
Variation coefficient	55.36%

The average number of transaction in the TARGET2 system is over 230 thousand. The standard deviation shows that the measurement values deviate from the mean average of about 130 thousand. The variation coefficient shows the strong differentiation characteristic of the characteristic - table 7 .

Table 8. Values of statistical measures of the average monthly number of transaction (in thousands)

Mean	78.9
Median	97.5
Q1	30.3
Q3	120.2
Variance	1 907 742.6
Standard deviation	43.7
Variation coefficient	55.36%

The average monthly number of transaction is more then 79 thousand. The measured value deviates from an average value for roughly 44 thousand. The variation coefficient has a value of 55.36%, which means that the analyzed trait exhibits strong differentiation - table 8.

4.3. Analysis of retail payment systems - ELIXIR

The ELIXIR system is based on 3 sessions, during which messages are exchanged between the participants of this system. The largest share in this structure, until 2003, was the afternoon session. In 2003, the morning and afternoon session accounted for 40% each in the session structure. In the following years, morning session share grew (to over 40%), and the afternoon session lost its share (about 35% with downwards trend). In 2003 year, there was a decrease in turnover in all sessions (largest in the afternoon session). This was the results of:

- starting from January 2003 it was mandatory for all banks to provide orders for more then 1 million PLN directly to the SORBET system,
- ELIXIR took over the low-value retail orders, settled so far by SYBIR [23][23].

From that moment the values of all the sessions began to grow, despite small fluctuations.

Plot.8. Sessions - total turnover - recognition (million PLN)

23 21 June 2015, www.nbp.pl/systemplatniczy/system/system_platniczy_2008.pdf

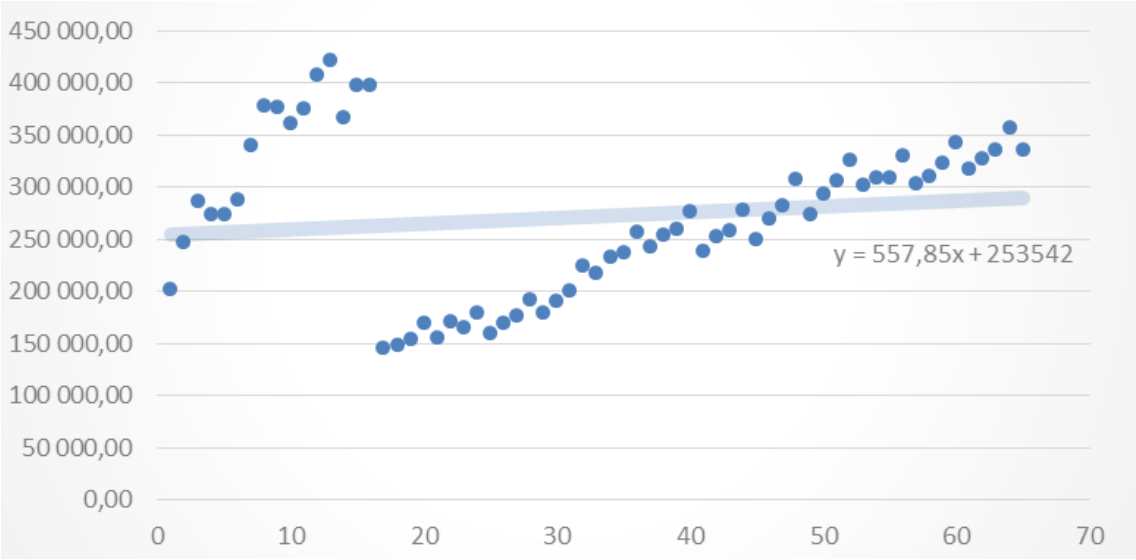


Table 9. Values of statistical measures for the sessions - total turnover (million PLN)

Mean	271.9
Median	273.8
Q1	217.4
Q3	325.9
Variance	5 333 740.8
Standard deviation	73.0
Variation coefficient	26.85%

The dynamics of the KIR turnover is similar to the dynamics of recognition. It was affected by the same circumstances as in the case of the total turnover in all three sessions.

Plot.9. KIR turnover (thousand PLN)

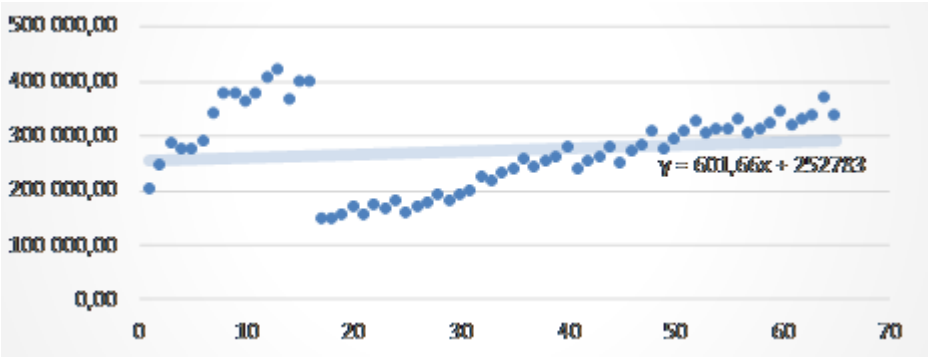


Table 10. Values of statistical measures for turnover (million PLN)

Mean	272 637.9
Median	274 445.9
Q1	217 435
Q3	327 354
Variance	5 393 774 863
Standard deviation	73 442
Variation coefficient	26.94%

The dynamics of KIR transactions represent a definite increase in the transaction value. From quarter to quarter were observed ups and downs of the transaction values. However, declines were much less frequent and were quite low in value, which in turn doesn't have a significant impact on the trend of this phenomenon - table 10

Plot.10. The KIR transaction (thousand PLN)

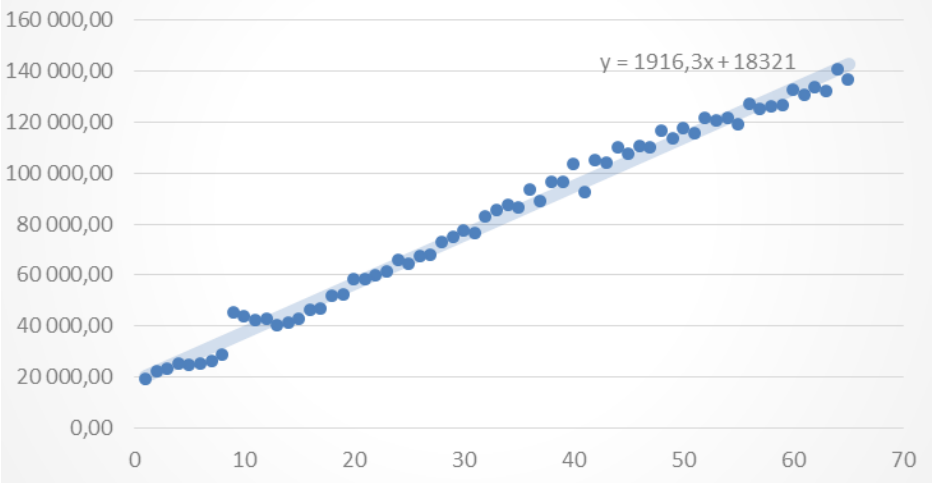


Table 11. Values of statistical measures for KIR transaction (in thousands of PLN)

Mean	81 559.1
Median	85 269.3
Q1	46 540
Q3	115 506
Variance	1 306 713 553
Standard deviation	36 148
Variation coefficient	44.32%

5. SUMMARY OF RESEARCH

The statistical evaluation of the payment system development in Poland, shows a clear upward trend. This reflects the adjustment function of the payment system elements to the challenges and requirements imposed by reality and Polish economy. A single plane of statistical evaluation does not allow to clearly assess its performance but is an adequate description of he system based on real data of its status during the period 1999 - 2015. Usage of such methods was dictated by the availability of data and the possibility of presentation (sensitive data). Authors hope this study will contribute to future discussion on the assessment of the payment system in Poland.

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