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## **Assessment of Composite Leading Indicators Usefulness in Forecasting Loans and Deposits Cyclical Fluctuations**

### **Abstract**

The article has been focused on the application of the business cycle barometers for predicting the cyclical fluctuations of the two main categories in the banking market in Poland - PLN loans and PLN deposits. The barometers built for the first time for the Polish banking sector are based on sets of indicators, including both quantitative variables (official statistics data) and qualitative (among others derived from the business tendency survey conducted in the banking sector). Among the components of barometers both macro-economic indicators for the whole economy, as well as the variables from the financial sector and other sectors (including industry and trade) were used.

The main aim of the article has been an evaluation of the characteristics of various types of composite leading indicators constructed on the basis of differentiated sets of variables. Then an attempt to construct three types of barometers: with the short, medium and long lead was made. In addition, the best composite leading indicators for each reference variable - PLN loans and PLN deposits were chosen.

**Key Words:** cyclical barometers, banking sector, forecasting, composite leading indicators

## 1. Introduction

One of the basic economic tendency forecasting methods are economic barometers, which have been calculated for almost one hundred years for the U.S. economy<sup>30</sup>. During the last thirty years, barometers have become popular in many countries, especially in highly developed ones<sup>31</sup>. Together with the development of methodology, composite leading indicators, initially used for forecasting the future development of the whole economy, have begun to be used in various countries in relation to the most important macroeconomic indicators and sectors<sup>32</sup>. It is worth mentioning that even in the case of highly developed economies, for which usually several composite leading indicators are calculated, also new ones are being created. This results from periodical problems with accurate forecasting of developments in economic tendency<sup>33</sup>. What also leads to modifying the set of components of barometers is the appearance of new variables, with better leading characteristics than the current ones<sup>34</sup>.

The construction of composite leading indicators is possible because of the existence of cause and effect relations between the processes which take place in economy and which become visible with a time lag. In consequence, after identifying indicators the rise and fall of which regularly anticipates changes in the whole economy, or a given sectoral indicator, one may construct composite leading indicators

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<sup>30</sup> U. Fritsche, S. Stephan, *Leading Indicators of German Business Cycles: An Assessment of Properties*, DIW Discussion Paper No. 207, Berlin 2000, p. 2; W.C. Mitchel, A.F. Burns, *Statistical Indicators of Cyclical Revivals*, NBER, New York 1938; W.C. Mitchel, A.F. Burns, *Measuring Business Cycles*, NBER, New York 1946

<sup>31</sup> M. Drozdowicz-Bieć, *The Coincident and Leading Index for Poland*, Bureau for Investments and Economic Cycles, New York, 2001, Z. Matkowski (ed.), *Barometry koniunktury dla gospodarki polskiej*, Prace i Materiały IRG SGH, Warszawa 1999

<sup>32</sup> G. Matysiak, S. Tsolacos, *Identifying short-term leading indicators for real estate rental performance*, *Journal of Property Investment & Finance*, 2003 no. 3, p. 212-232; P. Dua, A. Banerji, *A Leading Index for India's Exports*, Centre for Development Economics, 2001, A. Rehder Harris, *Iowa Leading Indicators Index*, Iowa Department of Revenue, 2006, R. O. Mikkelsen, P. Tronstad, *Can Leading Indicators Be Used To Predict The Demand For Sea Borne Dry Bulk Activity In The Far East?*, Norwegian School Of Economics And Business Administration, Bergen, 2006, M. Idzik, *Application Of The Economy Barometer In Warning Forecasting In Agriculture And Food Industry*, *Electronic Journal Of Polish Agricultural Universities*, 2006 no. 9

<sup>33</sup> More details in: K.A. Kholodilin, B. Siliverstovs, *On the Forecasting Properties of the Alternative Leading Indicators for the German GDP: Recent Evidence*, DIW Discussion Paper 522, Berlin 2005

<sup>34</sup> For more, see: A. Klein, *The Leading Indicators in Historical Perspective in: Business Cycle Indicators Handbook*, The Conference Board, 2000, p. 23-28

of economic tendency (economic barometers). Composite leading indicators allow for forecasting future directions of a phenomenon's development; however, they do not inform directly either about its level or about quantitative changes. As a result, their basic use concerns defining the appearance of a turning point in development of a given phenomenon or the maintenance of a current direction of development. Because of the above, the basic criterion for the assessment of barometer's usefulness is its correct earlier signalling of the appearance of turning points for the reference variable for which the barometer was created<sup>35</sup>.

The aim of the article is to assess the usefulness of economic barometers for the forecasting of two major elements in the banking sector in Poland – PLN loans and PLN deposits. Therefore, proposals of composite leading indicators will be put forward (based on the sets of qualitative and quantitative variables) with short, medium and long leads.

## 2. Set of data for the construction of barometers

The principles of selecting the components of barometers are characterized in a relatively best way in publications and information materials of TCB and OECD, and, therefore, many authors of barometers adopt the methodology created by these institutions during the construction of their own composite leading indicators<sup>36</sup>. When assuming work on the creation of barometers, it is important to collect data for a large number of variables which relate to various spheres of economy<sup>37</sup>.

The search for the components of composite leading indicators for the banking sector in Poland covered a large set of quantitative financial variables, mainly relating to the banking sector (33 elements of banks' assets and liabilities and 1997 various indicators of banks' receivables and payables), but also 6 stock exchange indicators, 7

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<sup>35</sup> M. Drozdowicz-Bieć (ed.), *Forecasting with Composite Coincident and Leading Indexes and the CLIMA Model*, SGH, Warszawa 2007, p. 9

<sup>36</sup> For a more detailed description, see: R. Nilsson, G. Gyomai, *OECD System Of Leading Indicators*, 2007, p. 4-5; *Composite Leading Indicators For Major OECD Non-Member Economies And Recently New OECD Member Countries*, 2006

<sup>37</sup> The starting set of potential variables from among which the components of a barometer are being selected very often covers about 100 indicators. However, in some cases, the selection takes place from among over 300 variables, as it is the case for a composite leading indicator for the economies of Netherlands or Slovenia. For a more detailed description, see: J. Jacobs, R. Salomons, E. Sterken, *The CCSO Composite Leading Indicator of the Netherlands: Construction, Forecasts and Comparison*, CCSO Series No. 31, 1997, p. 9; T. Jagric, *Leading Indicators Of Aggregate Economic Activity Of Slovenia*, University of Maribor, 2003 ([http://www.cerge.cuni.cz/pdf/gdn/RRCII\\_16\\_summary.pdf](http://www.cerge.cuni.cz/pdf/gdn/RRCII_16_summary.pdf))

interest rates (of the central bank but also short-term interest rates for Poland, Switzerland, the US and the Eurozone), 26 rates and spreads for inter-banking deposits or 63 factors of money creation and the elements of money supply aggregates and 4 indicators of exchange rates for the most important currencies. Also available macroeconomic variables, such as GDP and its components (18), inflation (30), indicators referring to industrial output (73), as well as variables describing the situation in construction sector (3), transport (10), agriculture (14), labour market (40) and demographic variables (10) were taken into consideration.

Apart from statistical data, also qualitative data (business tendency balances) were included, resulting from the research carried out with the use of business tendency surveys in the banking sector by the Department of Marketing Research of the Poznan University of Economics (31 indicators)<sup>38</sup>, as well as the data from the research implemented by the Central Statistical Office in the sectors of industry (225), trade (279) and the indicators of consumer tendency and confidence (11).

As among the source data there are numerous different categories of variables available in monthly series, they were transformed into quarterly data. In the case of quantitative data this was carried out by adding up the values from all the months of a given quarter for categories which constitute a stream. In turn, for categories which constitute a pool, the value of a variable from the last month of a given quarter was adopted as the value for the whole quarter. Moreover, in the case of interest rates and exchange rates on the basis of monthly or daily data, their average was calculated for a given quarter. All the quantitative data were then transformed into indexes of changes on a year-on-year basis. Such a transformation eliminates a long-term trend which is present in the series of the variable and, to a large extent, seasonality. In turn, qualitative variables from the economic tendency research conducted by the Central Statistical Office on a monthly basis were transformed by calculating the average balance sheet values from all the months of a given quarter. Additionally, in order to obtain the data which could be compared to indexes, 100 was added to all economic tendency balances, after which transformation each of the qualitative variables assumed the values from the 0 to 200 range. On the basis of diagrams, the initial selection of the best potential components of barometers from among the whole set of

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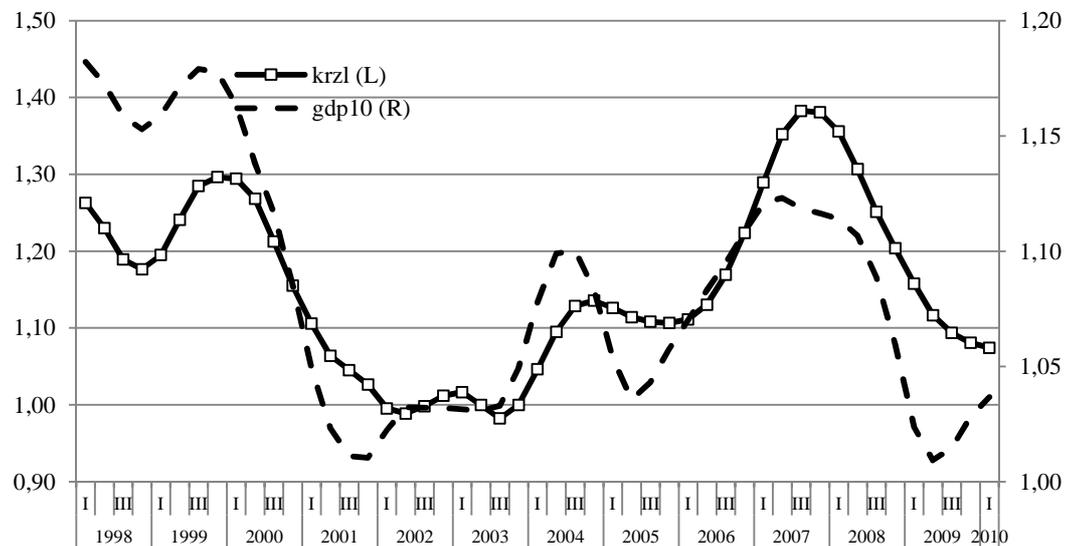
<sup>38</sup> The research is conducted on a quarterly basis starting from the 2nd quarter 1992 among banks' central offices and local branches. 400 banking outlets participate in the study which covers the area of the whole country. For more on methodology, see: J. Garczarczyk, M. Mocek, R. Matusewicz, *Koniunktura na rynku bankowym i ubezpieczeniowym*, Akademia Ekonomiczna w Poznaniu, Poznań 2001, p. 62-66

variables was carried out – separately for PLN loans and PLN deposits. The variables selected, in order to be able to identify their turning points correctly, had their irregular fluctuations and seasonality element removed with the use of Census X11/Y2K method, available in Statistica 8.0 package.

### 3. Barometers for PLN loans

#### 3.1. Components of barometers

From the initial set of variables, on the basis of the analysis of diagrams, a preliminary selection of 116 indicators was carried out. Then, after removing random fluctuations and seasonality, the turning points for cycles were defined and, after the lead lengths were established, the final selection of variables was carried out, as a result of which the set of components for the creation of a barometer was reduced to 20. Selected variables are characterized by cycle development which is usually convergent with the cycle development for PLN loans and correlation with reference value which amounts to (with one exception) at least 0.6.



**Figure 1.** PLN loans (krzl) and domestic demand (gdp10)

Source: Own calculations

**Table 1.** Set of components of PLN loans barometers

<b>Variable</b>	<b>Code of variable</b>
Overnight deposits of MFIs to households (PLN + foreign currency)	zgd10
Overnight deposits of MFIs to households (PLN)	zgd8
Overnight deposits of the other domestic residents	p5
Deposits and other liabilities of MFIs to private corporations (PLN + foreign currency)	zptry3
Overnight deposits of MFIs to other domestic residents (PLN + foreign currency)	zsk11
Other MFIs holdings of debt securities issued by central government (foreign currency)	dp122
Other MFIs securities (foreign currency)	papw9
Currency in circulation (excluding vault cash)	pm1
Overnight deposits and other liabilities	pm4
M1 money supply	m1
Other MFIs housing loans to individuals for the purchase of real property (PLN)	kop10
Gross fixed capital formation	gdp6
Domestic demand	gdp10
PLN loans value (balance)	bokz
Assessment of a number of clients served – legal persons (balance)	bolp
WIG20 stock exchange index	wig20
General economic situation of the retail trade units - motor vehicles (balance)	hm1samoch
Order-books (domestic and foreign) in industry (balance)	przem2og
Expected selling prices of products in industry – in units with 250 and more employed persons (balance)	przem12duze
General business tendency climate in industry (balance)	przem15og

In this final, reduced set, components for the construction of a barometer which relate to the banking sector are dominant (11 indicators) while there are few variables which characterize the situation in other sectors of economy. The analysed set also included the aggregate of money demand and its elements (3), GDP elements (2) as well as indicators for industry (3) and trade (1) as well as WIG20 stock exchange index. Quantitative variables – totalling 14 – dominate in the whole set.

Among the remaining 6 qualitative variables, there are 2 banking tendency indicators which were obtained via business tendency surveys conducted by the

Department of Marketing Research of the Poznan University of Economics and 3 indexes of economic tendency in industry and 1 indicator of business tendency in the trade sector resulting from the research implemented by the Central Statistical Office. It is also worth noting that among the quantitative variables from the banking sector, there were 1 indicator concerning loans, 5 deposit categories (or banks' payables) and 2 categories of securities owned by banks. In the above set, 10 variables reflect the development of at least 7 out of 8 turning points of the reference variable, the remaining ones usually overlook one of the cycles of PLN loans.

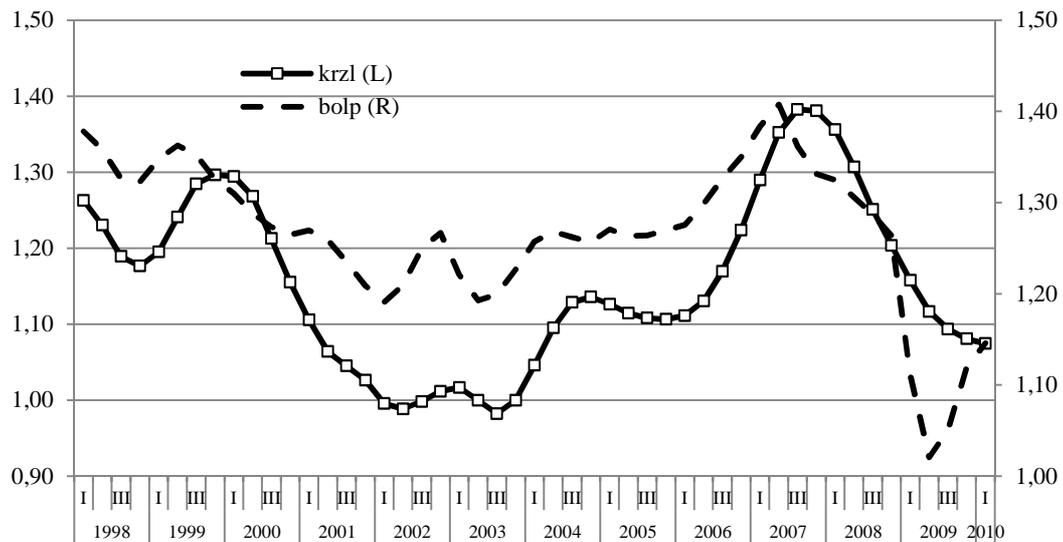
**Table 2.** Lead of components of a barometer in relation to KRZL referential variable

Indicator code	Peaks and troughs in total			Correlation in relation to referential indicator	
	median	mean	standard deviation	correlation coefficients	lead (-)
zgd8	-5.5	-5.5	1.94	0.83	-4
zgd10	-2.5	-3.0	1.73	0.83	-4
p5	-5.0	-3.7	2.34	0.67	-4
zppry3	-3.0	-2.0	1.98	0.72	-3
zsk11	-5.0	-3.7	2.34	0.67	-4
dp122	-4.0	-3.3	1.63	0.81	-6
papw9	-4.0	-3.3	1.63	0.79	-5
pm1	-4.0	-4.3	1.11	0.58	-4
pm4	-5.0	-3.7	2.34	0.68	-4
m1	-4.5	-4.5	2.07	0.68	-4
kop10	-0.3	-0.5	1.21	0.87	-1
gdp6	-2.0	-2.0	2.61	0.93	-2
gdp10	-1.5	-1.3	0.93	0.86	-1
bokz	0.0	-1.0	1.37	0.93	-2
bolp	-1.0	-0.8	0.99	0.94	-1
wig20	-3.0	-2.5	2.26	0.60	-2
hm1samoch	-1.0	-1.5	2.16	0.76	-2
przem2og	-1.5	-1.5	1.05	0.63	-3
przem12duze	-1.0	-1.0	1.26	0.66	-1
przem15og	-1.5	-1.5	2.04	0.69	-2

Source: Own calculations

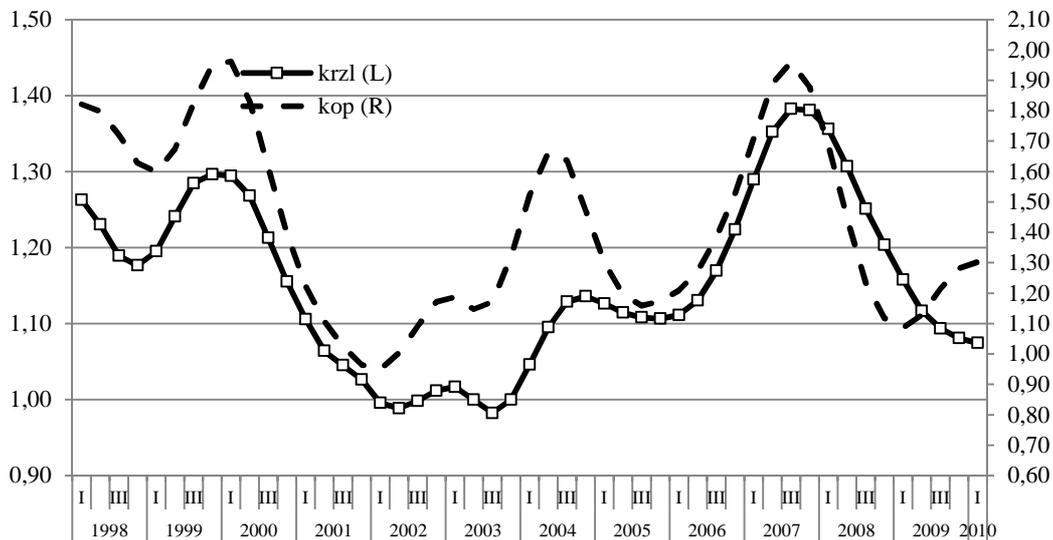
The leads in particular turning points of the referential variable did not exceed 7 quarters, while most frequently they amounted to 1 to 4 quarters. As a result, for 12 variables the standard deviation of leads is lower than 2 quarters and for the remaining 8 amounts to 2 to 2.61 quarters. The lowest standard deviation of the leads – less than 1 quarter – was observed in the case of 2 variables – domestic demand and the number of customers served.

The results of correlation analysis indicate that 9 variables demonstrate leads in relation to PLN loans which do not exceed 2 quarters. In the case of the following 9 indicators, in turn, the leads amount to 3-4 quarters and reach the length of 5 or 6 quarters only in the case of 2 indicators. Correlation coefficients in the case of 3 variables only exceed 0.9 and for 5 variables they amount to from 0.81 to 0.87. In the case of 9 indicators they reach the level of 0.66-0.79 and for 3 indicators they assume the value of 0.58 and 0.63.



**Figure 2.** PLN loans (krzl) and assessment of a number of clients served – legal persons (bolp)

Source: Own calculations



**Figure 3.** PLN loans (krzl) and other MFIs housing loans to individuals for the purchase of real property (PLN) (kop10)

Source: Own calculations

### 3.2. Barometers for PLN loans

On the basis of selected variables, 18 composite leading indicators were constructed for PLN loans. Different barometer variants – from those with 2-3 components to those with up to 10 components – were tested, including in their makeup qualitative and quantitative indicators related both to financial sector and other sectors as well as to the whole economy. Moreover, as a result of a lack of components with long leads, barometers with short and medium leads in relation to the reference value were created. Short-lead barometers were constructed on the basis of variables with leads shorter than three quarters and medium-lead barometers on the basis of the remaining variables.

Only 5 out of 18 constructed barometers omit one cycle of the reference variable, the remaining ones signal with a lead at least 7 out of 8 turning points of PLN loans. However, only in 6 composite leading indicators all the turning points appear earlier than in the reference variable. The maximum lead of the turning point amounts to 6 quarters while in the majority of cases the leads exhibit relatively small differentiation, which is confirmed by quite a low value of the standard deviation of the lead length,

which is less than 1 quarter in the case of 6 barometers and in the case of other 11 stays in the range of 1.05-1.60 quarters while only for 1 barometer exceeds 2 quarters.

**Table 3.** PLN loans barometers and their components

Barometer	Components
BK1	gdp10, bolp
BK4	gdp10, bolp, pm1
BK5	gdp10, bolp, m1
BK6	gdp10, bolp, m1, wig20
BK7	gdp10, bolp, bokz
BK8b	zgd8, zppry3
BK9b	gdp10, bolp, zgd8, zppry3
BK10b	gdp10, bolp, pm4, hm1samoch, przem2og, przem12duze, przem15og
BK12	gdp10, bolp, kop10, pm4, hm1samoch, przem2og, przem12duze, przem15og
BK13b	gdp10, bolp, pm4, pm1, zgd8, hm1samoch, przem2og, przem12duze, przem15og
BK15b	gdp10, bolp, kop10, pm4, pm1, zgd8, hm1samoch, przem2og, przem12duze, przem15og
BK16b	gdp10, bolp, pm4
BK18	gdp10, bolp, kop10, pm4
BK19b	pm1, zgd8
BK20	pm1, p5
BK22b	gdp10, bolp, pm4, pm1, zgd8
BK23b	gdp10, bolp, pm4, pm1, p5
BK24b	gdp10, bolp, kop10, pm4, pm1, zgd8

Barometers leads on the basis of correlation analysis and the median and average lead in turning points in the majority of cases exhibit a high level of convergence and relatively often amount to 1-2 quarters. Only in the case of 6 barometers there are longer leads of 3-4 quarters. The constructed barometers have relatively high correlation coefficients with the reference variable, amounting to at least 0.90 for 12 indicators while for the remaining ones (with two exceptions) they stay in the 0.80-0.86 range.

Among the barometers with the shortest – one-quarter – leads in relation to PLN loans, BK1 indicator looks best, as it obtains the correlation coefficient of 0.96 with a quarterly lead. Two variables constitute this barometer – domestic demand and the assessment of the number of customers served. Particular turning points of PLN loans are signalled by BK1 indicator with a lead of 1 to 2 quarters.

Among the barometers with slightly longer leads – amounting to two quarters – one should focus, both because of its features and its structure, on BK24b indicator, constructed on the basis of 6 variables, among which there are, apart from domestic demand and the number of customers served also mortgage credits and loans for individual persons, cash in circulation (excluding the banks' vaults) as well as 2 categories of banks' payables. The indicator is characterized by a relatively high correlation with PLN loans (0.92) with a lead of 2 quarters.

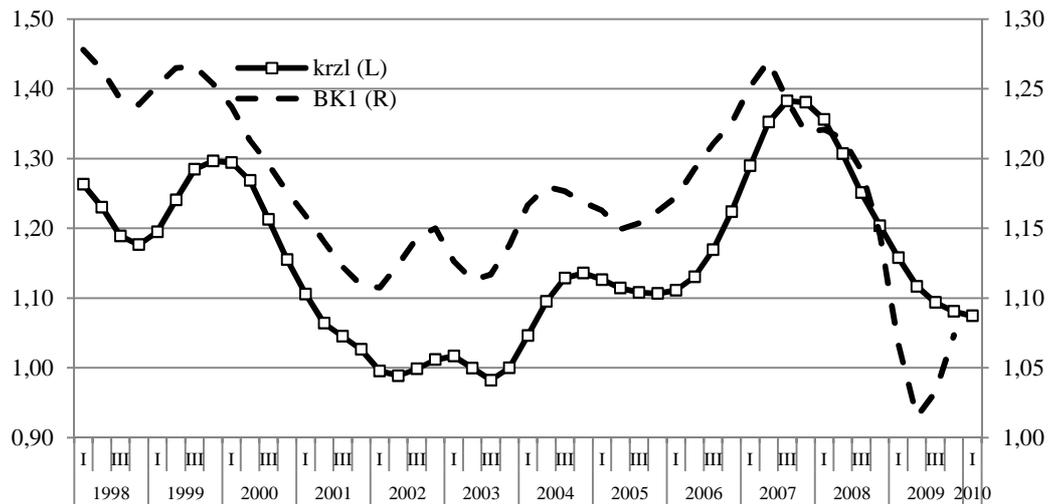
**Table 4.** Barometer lead in relation to KRZL referential variable

Barometer	Peaks and troughs in total			Correlation in relation to referential indicator	
	median	mean	standard deviation	correlation coefficients	lead (-)
BK1	-1.5	-1.4	0.74	0.96	-1
BK4	-2.0	-2.3	1.39	0.91	-2
BK5	-1.0	-1.6	1.06	0.92	-2
BK6	-2.5	-2.3	2.12	0.8	-2
BK7	-1.0	-0.8	0.41	0.96	-1
BK8b	-3.0	-3.3	0.95	0.86	-3
BK9b	-2.0	-2.7	0.95	0.93	-2
BK10b	-1.5	-1.7	1.37	0.92	-2
BK12	-1.0	-1.0	0.89	0.92	-1
BK13b	-1.5	-1.8	1.47	0.92	-3
BK15b	-1.5	-1.5	1.05	0.93	-2
BK16b	-1.5	-1.6	1.19	0.91	-2
BK18	-1.0	-1.0	0.76	0.92	-1
BK19b	-3.0	-3.5	1.41	0.77	-4
BK20	-3.0	-3.1	1.46	0.65	-4
BK22b	-2.0	-2.5	1.60	0.85	-3
BK23b	-2.0	-2.4	1.60	0.81	-3
BK24b	-1.0	-1.6	1.06	0.92	-2

Source: Own calculations

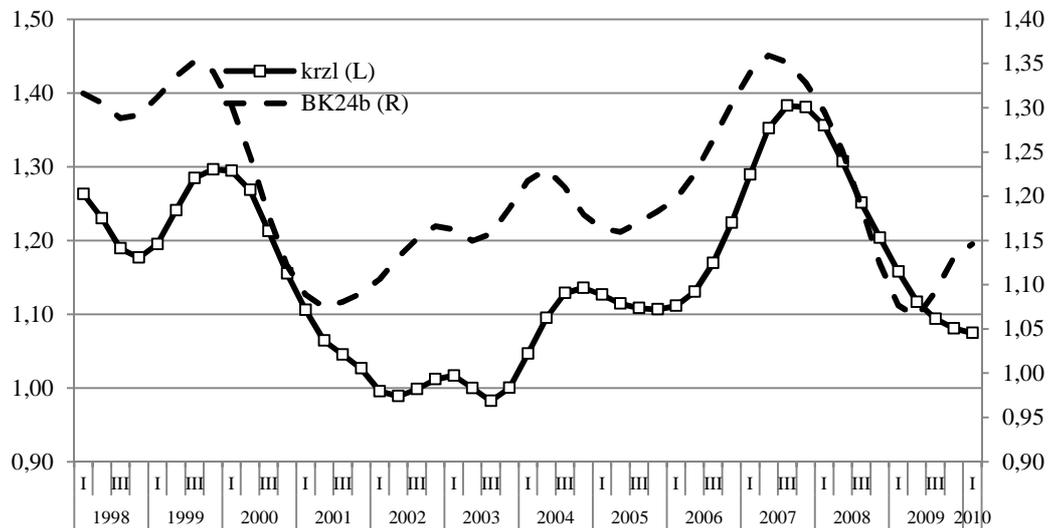
Relatively few barometers for PLN loans had leads longer than two quarters. Among them, however, one should focus on BK19b and BK22b. BK19b barometer was created on the basis of a set of 2 variables which included cash in circulation (excluding the banks' vaults) and current deposits of households (PLN). In turn, BK22b consists of 5 components – domestic demand, number of customers served, cash in circulation (excluding the banks' vaults) as well as 2 categories of payables.

The leads of the above barometers amount from 3 to 4 quarters with correlation coefficients in the range 0.77 - 0.85.



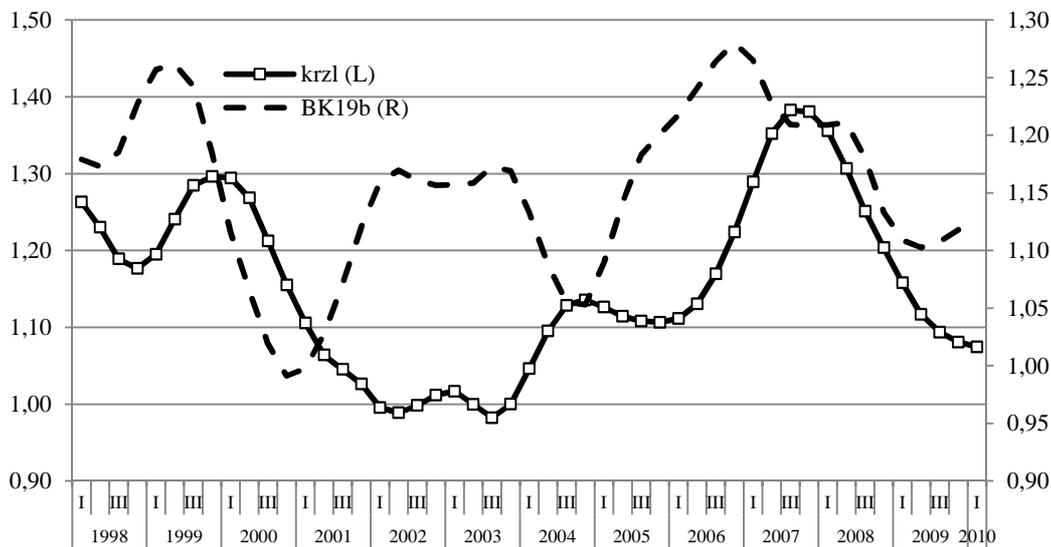
**Figure 4.** PLN loans (krzl) and barometer BK1

Source: Own calculations



**Figure 5.** PLN loans (krzl) and barometer BK24b

Source: Own calculations



**Figure 6.** PLN loans (krzl) and barometer BK19b

Source: Own calculations

The values of barometers obtained for PLN loans indicate that in the coming quarters there should be a dynamic increase in the growth rate of PLN loans extended by the banks. This conclusion is supported by the analysis of differentiation of leads in peaks and troughs of particular barometers. At the same time, one may observe a relatively long lead of the incoming trough in the reference variable, also in the case of barometers which were characterized by short leads in most of the previous turning points.

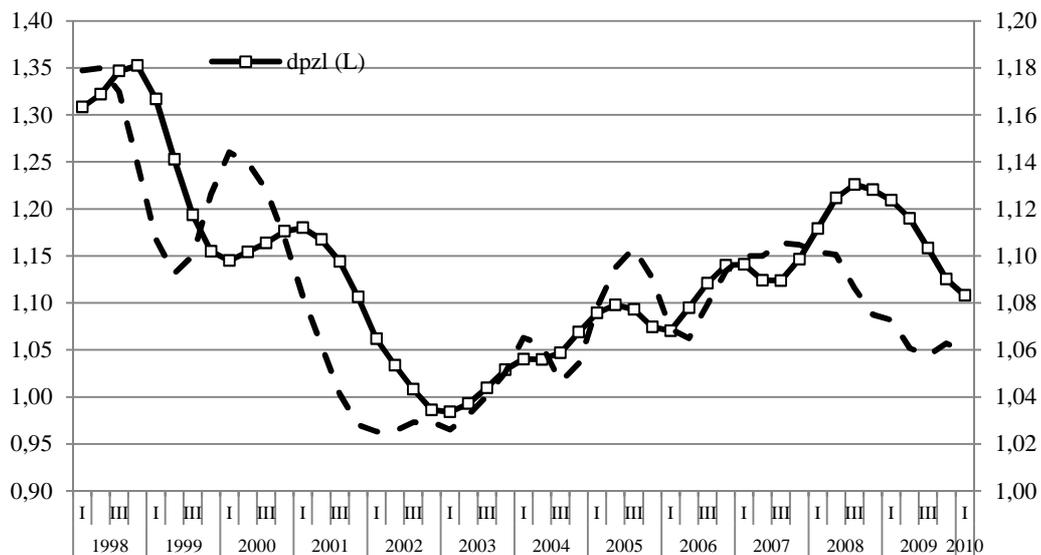
#### 4. Barometers for PLN deposits

##### 4.1. Components of barometers

From the whole set of variables, on the basis of the analysis of diagrams, an initial selection of 128 indicators was carried out. Then, after removing random fluctuations and seasonality, the turning points for cycles were defined and the length of leads in relation to reference variable – PLN deposits – was established. 26 indicators were selected for the construction of barometers. They exhibited leading features and, moreover, their correlation coefficients with the reference variable exceeded 0.7. Because of the substance of the research, an exception was made in the case of three

indicators which are characterized with a slightly lower value of correlation coefficient with the reference variable. The indicators which reflected the development in the PLN deposit cycle in a relatively best way can be found in this reduced set and, because of this, the variables which had lagging turning points or overlooked more than one cycle of the reference value were omitted.

In the selected set of 26 variables, there were, in total, 11 qualitative indicators, among which 4 concerned the banking sector, 4 concerned the industry, 1 concerned trade and 2 – consumer tendency survey. Among the remaining 15 quantitative variables, there were as many as 8 various indicators of receivables and 1 indicators of payables of monetary institutions and, moreover, 2 rates for the inter-banking deposits, 3 GDP components and WIG20 stock exchange index. In total, 16 variables related to the financial market and the remaining 10 – to other sectors or to the economy as a whole.

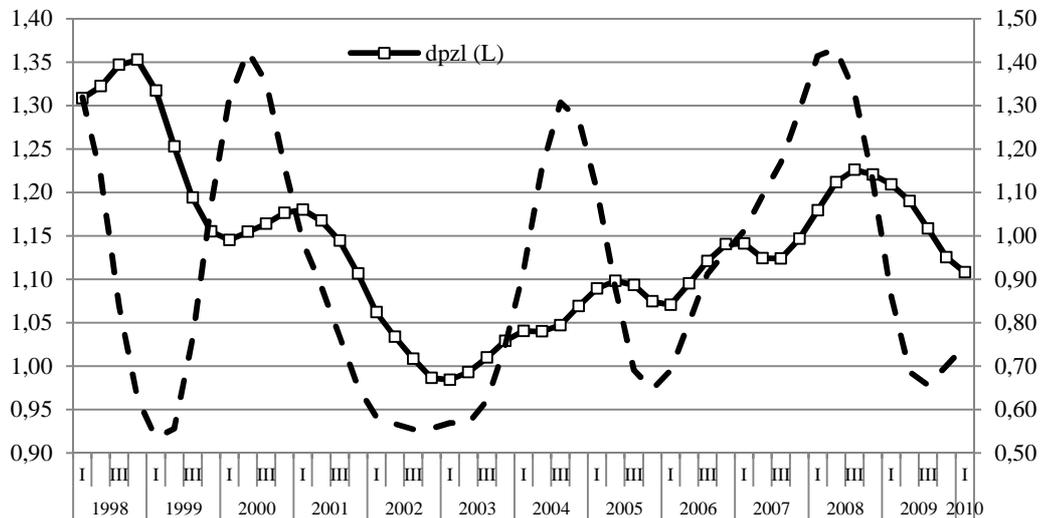


**Figure 7.** PLN deposits (dpzl) and gross value added (gdp11)

Source: Own calculations

**Table 5.** Set of components of PLN deposits barometers

<b>Variable</b>	<b>Code of variable</b>
MFIs loans and other claims on other domestic residents (PLN)	nsk2
MFIs loans and other claims on non-monetary financial institutions (PLN)	nsk228
MFIs loans on non-financial sector (PLN)	nsn5
Other MFIs loans to households for the purchase of real property (PLN)	kgd19
Other MFIs loans to households (PLN)	kgd31
Other MFIs loans and other claims (excluding interest) on individuals (PLN)	n2op25
Other MFIs loans on non-financial corporations (PLN)	np5
Loans to non-financial private corporations (PLN)	kppry31
Overnight deposits of MFIs to other domestic residents (PLN)	zsk9
WIBOR3M rate	wibor3m
WIBOR6M rate	wibor6m
Gross fixed capital formation	gdp6
Domestic demand	gdp10
Gross value added	gdp11
WIG20 stock exchange index	wig20
Total loans value (balance)	bowk
PLN loans value (balance)	bokz
Climate for PLN deposits (balance)	bkdz
Climate for PLN loans (balance)	bkbkz
General economic situation of the retail trade units - motor vehicles (balance)	hm1samoch
Ability to pay current debts - manufacture of fabricated metal products (balance)	przem6wyrmet
Expected ability to pay current debts - manufacture of fabricated metal products (balance)	przem14wyrmet
General business tendency climate in industry (balance)	przem15og
General business tendency climate in industry - manufacture of fabricated metal products (balance)	przem15wyrmet
Expected economic situation of household in the next 12 month (balance)	kgd2
Expected general economic situation of the country in the next 12 month (balance)	kgd4



**Figure 8.** PLN deposits (dpzl) and WIBOR 6M rate (WIBOR 6M)

Source: Own calculations

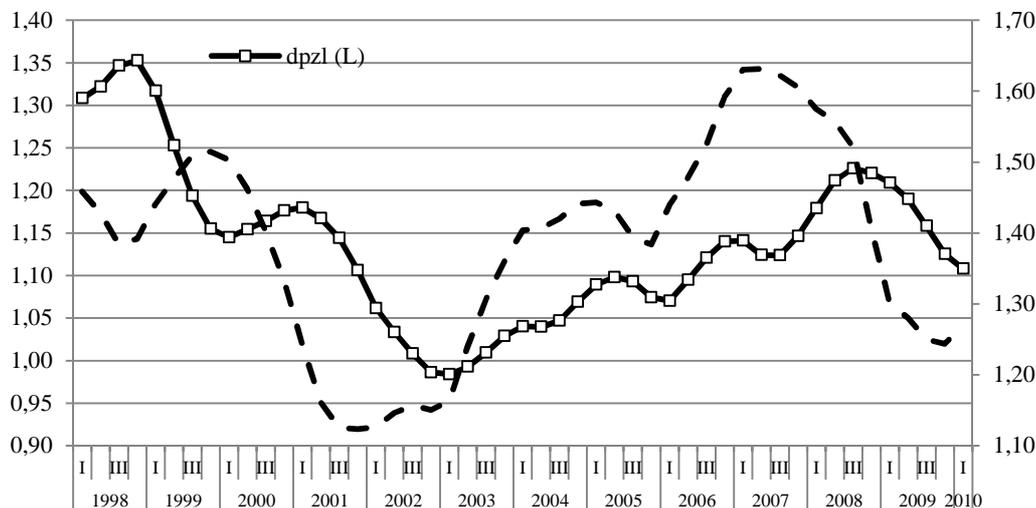
The average leads in turning points of the reference variable usually exhibited, with certain exceptions, a very high convergence with the data obtained on the basis of correlation analysis. At least 8 out of 9 turning points for PLN deposits were signalled with a lead by 8 variables, among which there were 7 qualitative variables: general economic situation of the retail trade units from the motor vehicles sector, the ability to pay current debts by the enterprises from the metal products sector, the expected ability to pay current debts by the enterprises from the metal products sector, general business tendency climate in industry, general business tendency climate in the metal products sector, expected economic situation of households in the next 12 months, expected general economic situation of the country in the best 12 months and one quantitative variable – gross value added.

**Table 6.** Lead of components of a barometer in relation to DPZL referential variable

Indicator code	Peaks and troughs in total			Correlation in relation to referential indicator	
	median	mean	standard deviation	correlation coefficients	lead (-)
nsk2	-3.5	-3.3	1.37	0.87	-3
nsk228	-4.0	-3.2	1.83	0.69	-4
nsn5	-3.5	-3.3	1.63	0.91	-3
kgd19	-4.0	-3.7	0.82	0.83	-4
kgd31	-4.0	-4.0	1.41	0.90	-3
n2op25	-4.0	-3.3	1.51	0.91	-3
np5	-3.5	-3.3	2.07	0.86	-3
kppry31	-3.5	-3.3	1.63	0.87	-3
zsk9	-7.0	-7.2	1.30	0.78	-8
wibor3m	-2.0	-2.3	1.03	0.78	-1
wibor6m	-2.5	-2.5	1.05	0.75	-2
gdp6	-4.0	-3.8	1.50	0.92	-5
gdp10	-5.0	-4.5	1.22	0.86	-4
gdp11	-4.0	-4.4	0.92	0.89	-3
wig20	-4.5	-3.7	1.97	0.62	-4
bowk	-4.5	-3.7	2.58	0.92	-5
bokz	-4.5	-3.7	2.16	0.93	-5
bkdz	-3.0	-2.8	1.72	0.94	0
bkbkz	-5.0	-3.7	2.50	0.90	-5
hm1samoch	-5.0	-4.4	1.81	0.93	-6
przem6wyrmet	-4.0	-4.1	1.62	0.75	-6
przem14wyrmet	-5.0	-5.0	0.76	0.81	-5
przem15og	-5.0	-4.9	0.99	0.73	-6
przem15wyrmet	-5.0	-4.4	0.92	0.82	-5
kgd2	-2.0	-3.4	3.09	0.70	-8
kgd4	-3.0	-3.8	3.07	0.66	-8

Source: Own calculations

Both the median and the average indicated that the typical leads of turning points of particular indicators in relation to PLN deposits amount to 2 to 7 quarters. The average leads in peaks and troughs were very close in the case of almost all variables. In consequence, the standard deviations from the lead length were quite low, as for 5 variables they did not exceed 1 quarter and for another 15 they were within the 1 to 2 quarter range. It is worth emphasising as the average lead in relation to a reference variable amounted to about 4 quarters.



**Figure 9.** PLN deposits (dpzl) and PLN loans value (bokz)

Source: Own calculations

The leads established on the basis of correlation analysis were close to the average leads in turning points. The leads of 2 quarters were indicated by correlation analysis results for 3 variables and in the case of as many as 11 indicators, the highest values of correlation coefficients appeared for the leads amounting to 3 or 4 quarters. In the case of the remaining 12 variables, the leads were from 5 to 8 quarters. Correlation coefficients were on a relatively high level and only in the case of 9 variables they were lower than 0.8 while for 10 variables they amounted to 0.8 to 0.9 and for the remaining 7 they were higher than 0.9.

#### 4.2. Constructed barometers

As among the selected 26 indicators there are numerous categories of payables of monetary institutions, which are partly overlapping, various possible barometers were created, including one general category of payables or several separate categories of payables from different groups of entities. In total, 27 barometers for PLN deposits were created. The barometers were usually constructed on the basis of varied sets of variables; however, also their versions based solely on qualitative data, as well as only on different categories of payables were created. When selecting the components, one was aiming also at combining indicators with similar leads in relation to the reference variable. As a result of a significant differentiation of components' leads, barometers

with both short-term, medium-term and long-term leads were constructed. Most frequently, the barometers were constructed on the basis of three or four components and, therefore, 22 composite leading indicators for PLN deposits were created on the basis of no more than 5 variables. The remaining barometers included from 6 to 10 components.

**Table 7.** PLN deposits barometers and their components

<b>Barometer</b>	<b>Components</b>
BD1b	nsn5, wibor6m, gdp10, wig20, bkdz
BD2b	nsn5, wibor6m, gdp10, wig20
BD3b	nsn5, gdp10, wig20
BD4	kgd31, np5
BD5	kgd19, n2op25, np5
BD6	bowk, bokz, bkdz, bkbkz
BD7	bowk, bokz, bkbkz,
BD8	nsn5, wibor6m, gdp10, wig20
BD9	nsk2, wibor6m, gdp10, wig20
BD10	nsn5, wibor6m, gdp10
BD11	nsk2, wibor6m, gdp10
BD12	kgd31, np5, wibor6m, gdp10
BD13	kgd31, kppry31, wibor6m, gdp6
BD14b	kgd31, kppry31, wibor6m
BD15b	nsn5, wibor6m
BD16b	nsk2, wibor6m
BD17b	bokz, gdp11, nsk228
BD18b	bkbkz, gdp10, kgd19
BD19b	bowk, gdp6, kgd31
BD20b	bokz, gdp10, n2op25, nsn5, wibor6m, np5
BD21b	bkbkz, gdp10, kgd19, wibor6m, np5
BD22b	bowk, gdp6, kgd31, wibor6m, np5
BD23b	bokz, gdp11, nsk228, zsk9, hm1samoch, przem6wyrmet, przem14wyrmet, przem15wyrmet, kgd2, kgd4
BD24b	bkbkz, gdp10, kgd19, hm1samoch, przem6wyrmet, przem14wyrmet, przem15wyrmet, kgd2, kgd4
BD25b	bowk, gdp6, kgd31, hm1samoch, przem6wyrmet, przem14wyrmet, przem15wyrmet, kgd2, kgd4
BD26	hm1samoch, przem15og, kgd2, kgd4
BD27	hm1samoch, przem6wyrmet, przem14wyrmet, przem15wyrmet, kgd2, kgd4

When it comes to the barometers constructed during the study, at least eight out of nine turning points of the reference variable are signalled only by one of them – by BD3b. The remaining composite leading indicators usually overlook one of the short cycles of PLN deposits. In the case of 19 of all constructed barometers, despite the relatively large number of turning points, the standard deviation of leads is not very high and does not exceed 1.5 quarters, while for the others barometers it amounts to 1.51 to 2.8.

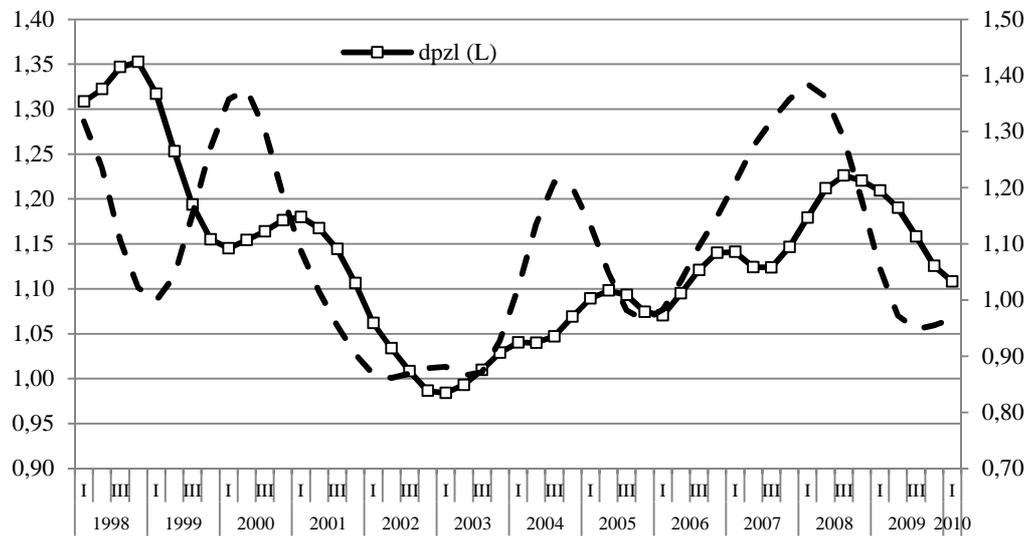
Composite leading indicators for PLN deposits are characterized, similarly to the case of their components, by a similar length of average leads in the turning points of the reference variable and the leads established on the basis of correlation analysis. Both the medians and the averages for peaks and troughs assume similar values in majority of cases. The barometers thus constructed are characterized by a relatively high correlation with the reference variable – in the case of 12 indicators the correlation coefficient amounts to at least 0.9 (including 2 indicators for which it stays in the range of 0.95 to 0.97) while for the remaining 15 it assumes the values from the range of 0.81 to 0.89.

Among the barometers with shortest leads in relation to PLN deposits, BD12 and BD14b deserve special attention. These indicators, as the correlation analysis proves, define the future directions of development of the reference value with a lead amounting to 2 quarters and quite a high value of the correlation coefficient (0.87). Both indicators overlook only one short cycle of the reference variable with small amplitude and, moreover, they are characterized by a relatively low value of the standard deviation of leads in turning points. One should also note that BD12 is composed of 4 elements, among which there are PLN loans to households and non-financial corporations, domestic demand and WIBOR 6M rate. In turn, barometer BD14b was created on the basis of 3 components, including PLN loans to households and non-financial private corporations and WIBOR 6M rate.

**Table 8.** Barometer lead in relation to DPZL referential variable

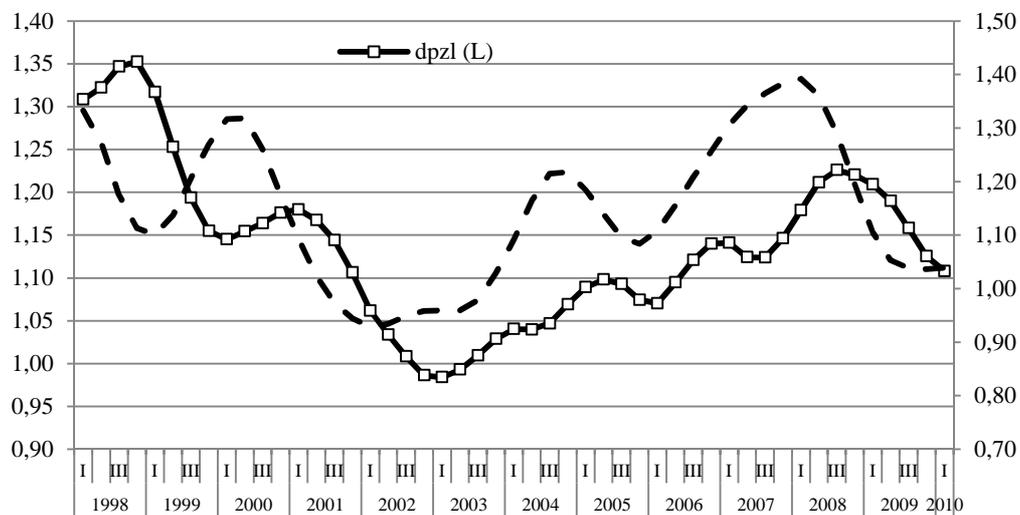
Barometer	Peaks and troughs in total			Correlation in relation to referential indicator	
	median	mean	standard deviation	correlation coefficients	lead (-)
BD1b	-3.0	-2.7	1.51	0.87	-3
BD2b	-3.0	-3.3	1.03	0.83	-3
BD3b	-4.0	-3.9	1.36	0.86	-4
BD4	-3.5	-3.2	1.47	0.91	-3
BD5	-4.0	-3.5	1.38	0.88	-4
BD6	-3.0	-2.7	2.58	0.92	-4
BD7	-5.0	-3.8	2.64	0.93	-5
BD8	-3.0	-3.3	1.03	0.83	-3
BD9	-3.5	-3.5	1.05	0.81	-3
BD10	-2.5	-2.5	1.05	0.85	-2
BD11	-2.5	-2.5	1.05	0.83	-2
BD12	-3.0	-2.7	1.03	0.87	-2
BD13	-3.0	-2.8	1.17	0.89	-3
BD14b	-3.0	-2.7	1.03	0.87	-2
BD15b	-2.5	-2.5	1.05	0.84	-2
BD16b	-2.5	-2.5	1.05	0.82	-2
BD17b	-4.0	-3.5	1.64	0.86	-4
BD18	-4.0	-4.0	1.10	0.90	-4
BD19b	-4.0	-3.7	1.86	0.94	-4
BD20b	-3.5	-3.2	1.47	0.91	-3
BD21b	-3.5	-3.2	1.17	0.87	-3
BD22b	-2.0	-1.3	2.80	0.91	-3
BD23b	-4.5	-4.5	1.05	0.97	-5
BD24b	-4.0	-4.0	0.63	0.95	-5
BD25b	-4.5	-4.8	0.96	0.93	-5
BD26	-2.0	-2.7	2.08	0.90	-7
BD27	-5.0	-4.4	1.72	0.90	-6

Source: Own calculations



**Figure 10.** PLN deposits (dpzl) and barometer BD14b

Source: Own calculations



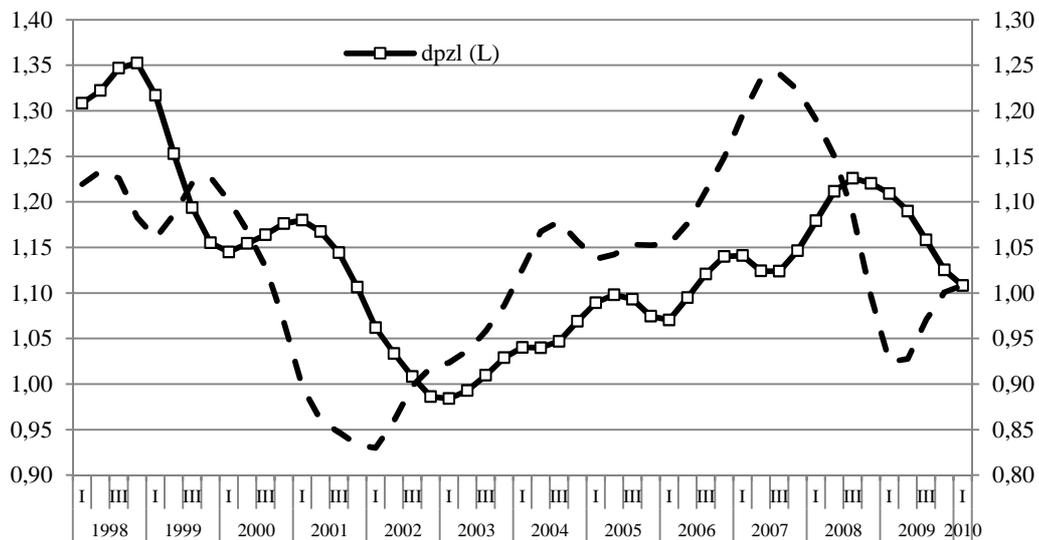
**Figure 11.** PLN deposits (dpzl) and barometer BD22b

Source: Own calculations

Among the barometers with medium leads, BD22b deserves special attention. This barometer as the correlation analysis proves, signals the future directions of

development of the reference variable with a lead amounting to 3 quarters ( $r=0.91$ ). BD22b barometer is composed of 5 elements, among which there are PLN loans to households and non-financial corporations, gross fixed capital formation, balance of total loans value and WIBOR 6M rate.

Among the barometers with medium leads, BD22b deserves special attention. This barometer as the correlation analysis proves, signals the future directions of development of the reference variable with a lead amounting to 3 quarters ( $r=0.91$ ). BD22b barometer is composed of 5 elements, among which there are PLN loans to households and non-financial corporations, gross fixed capital formation, balance of total loans value and WIBOR 6M rate.



**Figure 12.** PLN deposits (dpzl) and barometer BD24b

Source: Own calculations

Among the barometers which exhibit long leads, two deserve special attention: BD24b and BD27. BD24b barometer was created on the basis of 9 variables, including 7 qualitative variables from business tendency surveys and 2 quantitative variables. The leads of this barometer, as the results of correlation analysis show, amount to 5 quarters with a relatively high value of correlation coefficient (0.95). When it comes to BD27 composite leading indicator, it was built on the basis of 6 variables resulting exclusively from business tendency surveys, including 3 indicators from the sector of

metal products, 2 indicators of consumer tendency surveys and 1 indicator for the retail trade. The lead in the case of this barometer, established on the basis of correlation analysis, amounts to 6 quarters, with quite a high value of correlation coefficient (0.90).

The values of barometers for PLN deposits calculated up to the first quarter of 2010 indicate that in the 2nd or 3rd quarter of 2010 one may expect the appearance of the through also in the reference value and an increasing dynamism of PLN deposit growth rate in Polish banks. What supports this thesis is the existence of similar troughs 4 quarters before (in the case of barometers with longer leads) or 1-2 quarters before in the case of barometers with short leads.

## 5. Conclusions

The barometer method may be successfully used for correct forecasting of the future direction of changes and anticipation the appearance of turning points of two most important categories in the banking market – PLN loans and PLN deposits. The majority of barometers were characterized by a high correlation with the reference value. However, it is also worth noting that there are significant differences between composite leading indicators for both reference variables in the scope of lead lengths. In the case of PLN loans, short-term and medium-term barometers were obtained, allowing for the forecasting of the appearance of a turning point in the reference variable with a lead of up to four quarters. In turn, for PLN deposits, short-term, medium-term and long-term barometers were constructed, which, in effect, exhibited a longer forecasting horizon and their leads amounted to two to seven quarters.

Moreover, barometers for PLN loans usually better reflect the development of a cyclical element of a reference variable, as in majority of cases they signal all turning points without lags. Barometers for PLN deposits, in turn, relatively often omit one short cycle which appears in the reference variable. The above situation is influenced by the fact that usually slightly longer cycles with higher amplitudes are exhibited in the case of PLN loans. In turn, reflecting shorter cycles which appear in the case of PLN deposits remains more difficult.

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