

## CONCENTRATION OF CREDIT EXPOSURE AS A SIGNIFICANT SOURCE OF RISK IN BANKING ACTIVITIES: THE IDEA AND METHODS OF ESTIMATION

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### Abstract

The simultaneous activation of many sources of risk can slow bank operations and even lead to bankruptcy. Credit risk is the greatest threat to the orderly functioning of a bank. To protect against its materialization banks spend nearly 90% of their total capital requirement. Concentration of credit exposure to single entities, as well as to single economic sectors, can be a source of additional risks. Estimation of the additional portion of the capital requirement in selected banks in Poland in 2008-2013 indicates that banks should assign additional 4% and 2% of the capital requirement to cover the risk of exposure concentrations in: respectively, individual entities and individual economic sectors. For banks with a retail profile more important was the risk of large exposures in individual economic sectors, and for banks with a corporate profile in individual entities. Estimates were carried out according to the procedure used by the Bank of Spain and the Bank of Slovenia, and the data derived from the annual financial reports of selected banks listed on the WSE.

JEL classification: G22, G32 Keywords: Poland, banks, credit risk

DOI: <https://dx.doi.org/10.1515/fiqf-2016-0122>

Received: 17.02.2015

Accepted: 10.11.2015

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## INTRODUCTION

Risk is an essential aspect of business activity, and its materialization can have adverse effects on the financial situation of each company. Excessive risk leads to reduction of the security in a company's operation, unsettles its liquidity and solvency, undermines reputation and contributes to the loss of customers. Simultaneous activation of many sources of risk can significantly limit functioning of the company and lead to its bankruptcy.

Risk is particularly important in the banking business. Among the various types of risk the most important is credit risk, which arises from the uncertainty about the solvency of borrowing companies and individuals. To hedge against its materialization banks assign nearly 90% of the total capital requirement. The complexity of banking activities makes their financial situation to a large extent dependent on the efficient methods of identifying and controlling credit risk, as well as other types, including operational risk, liquidity risk and market risk. The structure of risk in each bank results from the bank's product range, level of aggressiveness of credit policy or organizational structure (Laeven & Levine, 2008).

On a national scale the excessive growth of risk in the banking sector can weaken the economic growth rate. Materialization of credit risk generally leads to an increase in risk aversion of banks, tightening credit policy and limiting of loans for investment and consumption<sup>1</sup>. The activation of the liquidity and solvency of any bank can become a source of social unrest and even panic among customers. This leads to a reduction in the public's confidence in the banking sector. Although deposits in the countries of the European Economic Area are insured by the agencies overseen by the State<sup>2</sup>, for example, inaccuracies resulting from the payment of deposits made to customers in Icelandic banks that collapsed in 2008 may justify customers' skepticism about the possibility of recovery of deposits at the time of the bankruptcy of any

bank (Avgouleas, Goodhart & Schoenmaker, 2013)<sup>3</sup>.

Risk in banking can pick up even more when its sources are correlated and have the opportunity for simultaneous activation. Such a situation causes concentration of risk and generates additional threats for banks. Concentration risk is a factor which multiplies effects of individual random events, which could disturb the stability of the bank's operations (Gai, Haldane & Kapadia, 2011). The concentration of the different types of risks can occur during the execution of activities such as:

- 1) lending to businesses and individuals,
- 2) financing activities of the bank,
- 3) liquidity management,
- 4) foreign exchange transactions,
- 5) investing in, usually, debt securities,
- 6) protection of bank debt.

This study analyzes the nature of risk in banks, potential areas for its concentration and methods of its estimation. It characterizes the main types of risk and the most vulnerable areas of its concentration. It presents measures of concentration risk and estimated levels of risk associated with the concentration of credit risk and the corresponding sizes of the capital requirement in the selected stock exchange banks in Poland in the years 2008-2013. The goal of this research is to test hypotheses that the concentration of credit exposures in a single entity or in a single sector of the economy generate a significant additional portion of risk, and that Polish banks for covering such risk should assign an additional amount of capital. The study used information obtained from the analysis of the economic literature and reports of central banks, and in the empirical part the annual financial reports of the banks listed on the Warsaw Stock Exchange (WSE).

The remaining part of the study has the following structure. The first chapter examines different types of risk in the banking business, the second points to the areas where it can be accumulated, and the third presents indicators for assessment of the level of risk concentration. The fourth chapter presents, formulated by the Bank of Spain, the procedure for estimation of the

1 Banks' opinions on directions of changes in lending policies and causal factors can be traced in the quarterly reports of NBP entitled: Senior loan officer opinion survey; <http://www.nbp.pl/homen.aspx?c=/ascx/subgen.ascx&navid=5060> (2015.01.05).

2 Directive 94/19/EC of the European Parliament and of the Council of 30 May 1994 on deposit-guarantee (OJ L 135 , 31.05.1994, p. 0005).

3 Although in the case of bank failure the Directive on Deposit Guarantee Schemes (94/19/EC) requires the home state for the bank to pay deposits of customers of branches located in other EEA countries, in 2008 after the collapse of Landsbanki supervisory authorities in Iceland did not pay back deposits collected in branches in the UK and the Netherlands. Finally deposits were paid by the governments of these two host countries. In addition, after bankruptcy of other major banks in Iceland the supervisory authorities in this country in the first place paid deposits to customers-residents of Iceland, then the citizens of other EU countries.

degree of concentration of credit risk and corresponding to it a required additional capital requirement for selected banks listed on the Warsaw Stock Exchange. The whole is summarized in the conclusions.

## IDEA AND TYPES OF RISK IN THE BANKING ACTIVITY

Risk is a multi-faceted and difficult concept to define. Usually, it means a state of uncertainty and danger resulting from the probable occurrence of an event which is independent of the one affected. Therefore, risk can be defined as a condition or event that could lead to financial loss (Sierpińska & Jachna, 1997, p. 232). Another approach to risk indicates the variability of the main events for the source. This variation creates uncertainty about the correctness of the assessment of future events and lowers the accuracy of prepared projections. This limits the ability to build long-term plans of action and the efficiency of management of the institution. According to this theory, risk is an objective concept and its level can be measured (Williams, Smith & Young, 2002, p. 28-29). In a similar way risk is considered by the Terminology Commission on Insurance in the United States. In 1966 the Commission adopted the concept of risk defined as an eventual uncertainty in terms of two or more options (Ronka-Chmielowiec, 2002, p. 134).

Among definitions of risk based on probabilistic or

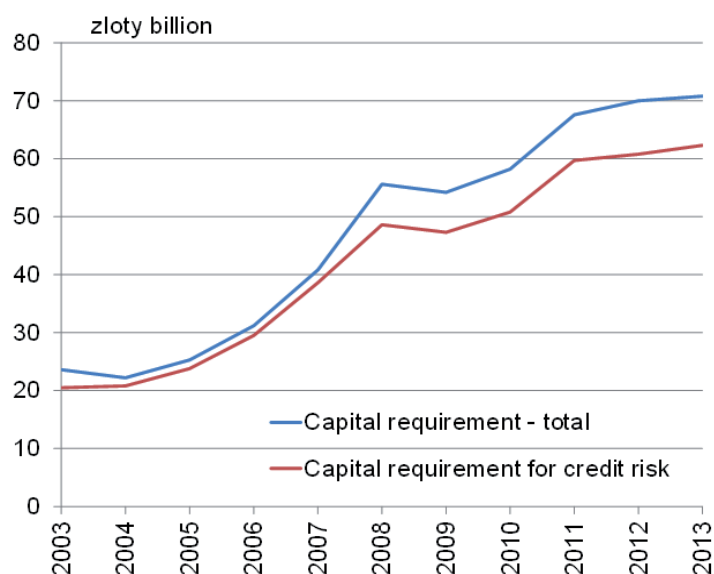
statistical measurement of the phenomenon should be cited the definition of Uyemura and van Deventer (1993) according to which “risk is volatility - standard deviation –of net cash flows, understood as liquid assets less liabilities variables generated by an economic operators”. Markowitz (1952), analyzing the phenomenon of volatility in the capital markets, defines risk as the variance of returns, although this volatility is treated as a negative phenomenon that should be minimized.

In the banking sector risk appears in different areas. Jajuga defines financial risk as a collection of various types of risk resulting in financial consequences for the entity that is exposed (Jajuga, 2007, p. 18). These risks include, inter alia:

- 1) credit risk – related to defaults of counterparties in their commitments,
- 2) operational risk – caused by disturbances in the continuity of business,
- 3) market risk – resulted from the dependence of prices of certain assets and liabilities from changes in interest rates, foreign exchange rate, or the stock market index,
- 4) liquidity risk – arising from the imbalance of maturities of assets and liabilities,
- 5) risk of events – resulted from occurrence of random events, such as natural disasters, terrorist attacks, social conflicts and other torts (e.g. strikes, arson).

The basic function of banks, which is financial intermediation, makes the granting of loans and advances

**Graph 1: Capital requirement in the banking sector in Poland, 2003-2013**



Source: KNF

one of the main areas of its activities. Credit risk is therefore a major source of uncertainty about the future financial situation. To cover eventual losses accounted from risk materialization banks are required to assign the largest proportion of equity (Fig. 1).

## RISK CONCENTRATION IN BANKING ACTIVITY

Concentration of risk significantly contributes to the increase of instability in banking. Although the main focus is made on the credit risk concentration, the accumulation of other types of risk, or a combination of some of them with credit risk can also lead to serious actions, financial losses or bankruptcy. The Basel Committee on Banking Supervision (BCBS, 2006) in the analysis of risk concentration refers to such a situation as a set of exposures arising in the context of a particular type of risk or as a result of the interaction between various types of risk. The BCBS indicates that such processes may result in:

- 1) losses which threaten the solvency or sustainability of the normal functioning of the bank,
- 2) a significant change in its risk profile.

Depending on the location of the risk, the BCBS introduces two areas of concentration:

- 1) intra-risk (in the area of one type of risk) – caused by adding many exposures of the same nature of the risk,
- 2) inter-risk (multi-generic risk) – resulted from interaction of events caused by the materialization of the risk, often correlated. Correlation may come from common risk factors or the interaction of various risk factors<sup>4</sup>

Among the risks significant for the effectiveness of banking activities particularly vulnerable are:

- 1) credit risk,
- 2) operational risk,
- 3) market risk,
- 4) liquidity risk.

*Concentration of credit risk* – results from the uneven distribution of credit relationships with debtors, depending on the size of the commitment, sectors or geographical regions in which debtors operate. A non-diversified loan portfolio could lead to financial losses

threatening the solvency of the bank. Generated in this way the risk can be characterized as:

- 1) single name risk (or idiosyncratic risk) – risk from concentration in individual institutions,
- 2) sectorial risk (or systemic risk) – risk stemming from concentration in individual sectors of the economy.

The first type of concentration stems from considerable involvement of the bank in a small group of large borrowers. The method to reduce such risk is the granularity of the investment portfolio, i.e. its division into a very large group of borrowers. The source of sectorial concentration is the lack of diversification in terms of the industry or geographical area. This risk materializes with the deterioration of the situation in one of the sectors of the economy or administrative regions of the country, in respect of which the bank has adopted an unduly high exposure.

Concentration risk in the banking sector can be considered both, from the macroeconomic and microeconomic perspective (Deutsche Bundesbank, 2006, p. 36)<sup>5</sup>. From the point of view of financial stability (macro perspective), the risk lies not in one, but in many banks that are exposed due to engagement in the same business lines (types of assets) or simultaneous financing debtors operating in the same regions at risk of recession. Such a situation may downgrade the stability of many banks, even organizationally unrelated, as well as hamper the economic growth of the country. This risk may be of particular importance if the lack of sectorial diversification concerns banks systemically important.

The concentration of risk in an individual bank (micro perspective) may derive from three main areas:

- 1) concentration of risk in relation to a single borrower,
- 2) concentration of risk in one sector of the economy,
- 3) concentration of risk arising from a possible contamination of risk (financial contagion).

Particularly important in the analysis of the risk concentration is the contagion effect. Through various transmission channels adverse disturbance in the operation of one or a group of companies can spread over a larger area and pose a threat to one or more banks.

*Concentration of operational risk* – occurs when a

4 For example, the concentration of large exposures (credit risk), due to its materialization, may cause concentration and increased liquidity risk. Concentration „inter-risk” may also arise when exposures to a single client (or a group of interconnected customers) are not recorded in the same systems, e.g. are recorded in the banking and trading books.

5 Deutsche Bundesbank (2006). Concentration Risk in Credit Portfolios. DB Monthly Report, June 2006. Retrieved from [http://www.bundesbank.de/Redaktion/EN/Downloads/Publications/Monthly\\_Report\\_Articles/2006/2006\\_06\\_concentration\\_risk.pdf?\\_\\_blob=publicationFile](http://www.bundesbank.de/Redaktion/EN/Downloads/Publications/Monthly_Report_Articles/2006/2006_06_concentration_risk.pdf?__blob=publicationFile) (2015.01.05).

bank is exposed to one or more sources of operational risk. This can happen when the bank is obliged to implement a large number of high amount payments, to carry out a number of settlements or commercial operations, which are significant in amount. The concentration of operational risk can occur when the bank significantly depends on one supplier of computer hardware, operating software, outsourcing or insurance. Useful for the identification of this type of risk may be to identify operational events (losses), which can be characterized as “high frequency / medium impact” (HFMI) and, particularly dangerous for the continuity of the bank operation, “low frequency / high impact” (LFHI).

*Concentration of market risk* – primarily results from significant open positions in interest rate risk, foreign exchange risk, equity, commodities, the non-linear risk (involvement in derivatives) and the specific risks. Sources of market risk may be irregularities in the specification of the model used by the bank for its measurement, primarily in the VaR model. These errors can stem from an incorrect assessment of diversification and the correlation between risk factors appearing in adverse market conditions. The VaR model may prove to be a source of risk due to the adoption of incorrect valuation of marketable assets, especially in periods of collapse in market prices. Another area of market risk concentrations is the collateral of refinancing transactions. The restriction of the bank to one group of securities may, in the case of a significant reduction in their market value, lead to a restriction on the ability to refinance the banking activity.

*Concentration of liquidity risk* – occurs when an excessive concentration of the bank’s assets and liabilities potentially generate problems in maintaining liquidity. Concentration in assets (market liquidity risk) - e.g. in the market-based instruments – can limit the bank’s ability to generate cash, at a time when a market of particular type of asset becomes illiquid or its liquidity is limited. Concentration of funding (funding liquidity risk) occurs when the financing structure is sensitive to individual risk factors. It can occur for example in the case of a large and unexpected withdrawal of high fixed rate deposits or other funds or limit the possibility of rolling funding.

One of the important aspects of liquidity risk is funding bank activity on the interbank market, which significantly increases the sensitivity to changes in the bank’s asset prices and spreads. This form of financing is becoming an important channel of transmission of

contagion risk, since the problems of one bank – through the market interconnectivity – increase risk aversion in the banking sector. As a result, banks significantly reduce the number and the maturity of transactions they made. High concentration in the financing market raises the level of liquidity risk, as wholesale funding providers are more sensitive to information about the bank’s financial problems, in contrast to other liquidity providers, e.g. individual customers. Liquidity risk concentration also rises from the international profile of banks. Disturbances in liquidity may arise in the case of restrictions on the movement of assets between different national jurisdictions or lack of refinancing options in foreign currencies

Off-balance sheet transactions, including lines of credit, guarantees, participation in the securitization of assets, security surcharge derivative transactions, withdrawal options, or support for special purpose entities (special purpose vehicle – SPV) are additional sources of liquidity risk concentration. All of these obligations may generate sudden liquidity needs, which in the absence of rapid refinancing can cause serious damage to the bank. A similar situation may occur when the bank will lead to a concentration of maturities by basing the financing of long-term assets (mostly loans) in short-term deposits. Materialization of this risk occurs when a bank is unable to renew maturing funding sources at reasonable prices.

## **METHODS OF ASSESSMENT AND MITIGATION OF RISK CONCENTRATION**

The central banks of the EU countries show that credit risk is the most important in monitoring and risk management. This rule is particularly noticeable in countries with banking-oriented financial systems, including in Germany, Ireland, Italy, Spain, and the countries of Central and Eastern Europe (NBP, 2004, p. 14-15)<sup>6</sup>. To a lesser extent, such rule refers to the countries where financial markets play a greater role in the financial system, including the United Kingdom, the Netherlands and Sweden.

Consistent with the approach to risk based on internal capital, quantifiable risks can be expressed using

6 Depending on the dominant source of funding for companies, i.e. using a credit or issue of securities, there are two types of financial systems, i.e., market or banking oriented; National Bank of Poland (2004). Financial System Development in Poland 2002-2003. NBP, Warsaw, p. 14-15. Retrieved from [http://www.nbp.pl/systemfinansowy/rozwoj2002\\_2003.pdf](http://www.nbp.pl/systemfinansowy/rozwoj2002_2003.pdf).

**Table 1: The capital requirement for credit risk as % of total capital requirement for the banking sectors of the EU countries, 2008-2013**

	2008	2009	2010	2011	2012	2013
AT	89	88,1	88,4	87,7	88,6	88
BE	85,2	86,5	86,7	83,7	85,3	84,8
BG	60,8	59,7	58,2	58,2	58,1	57,9
CY	90,1	89,4	91,4	91,1	90,1	89,8
CZ	85,8	86,4	85,9	85,2	83,8	85,6
EU	80,5	82,4	81,4	79,4	79,5	79,7
DE	87,5	87,8	88,1	84,5	85,5	85,1
DK	-	85,3	84,1	83,4	82,9	83,4
EE	87	86,1	83,5	80,1	75,4	71,4
ES	88	88,5	87,3	87,9	86,6	87,1
FI	84,9	89,2	89,2	86,5	83,9	76,1
FR	76,7	83,1	82	80	84,3	84,6
UK	60,8	60,1	59,6	66,2	66,8	69,2
GR	87,7	88,4	88,7	88,4	88,3	90,5
CR	-	-	-	-	-	87,3
HU	87,1	85,8	83	81,7	81,9	81,4
IE	84,9	81	77,7	81,6	82	86,9
IT	98,1	97,5	96,4	86,1	86,2	81,9
LT	84,3	86,2	85,2	79,3	77,6	79,9
LX	83,6	86,6	88,8	86	90	90,2
LA	88,4	88,9	88,7	87,2	87,9	87,6
MT	93,9	90,6	90,4	90,7	85,9	88,2
NL	74,5	81	78,2	74,5	69,2	70,1
PL	87,2	87	86,9	88,1	86,8	87,2
PT	90,3	90	89,7	91,1	90,9	90,3
RO	90,2	87,1	85,5	84	83,6	82,4
SE	68,3	72,1	67,6	62,8	57,2	53,2
SI	92	91,5	91,2	91,5	91	88,3
SK	84,2	88,4	89,3	89,2	87,9	88,2

Source: European Central Bank – Statistical Data Warehouse

the capital requirement, i.e. the amount of equity needed to cover losses arising in the case of its materialization. In the interest of maintaining by banks appropriate size of the capital requirements the new regulations of Basel

III have been introduced.<sup>7</sup> Bonti et al. (2005) indicate that the concentration of credit risk is one of the key factors determining the level of capital requirements for credit risk. For this reason, the following part of the

7 Descriptions of new regulations and their effects on banking system can be found for example in publications: Basel Committee on Banking Supervision (2011). Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems. Bank for International Settlements, Basel, June 2011; Gafrikova, V., Milic-Czerniak, R. (2011). Bazylea III – zmiany kapitałowe i ich konsekwencje. Bezpieczny Bank, Nr 2; Gemzik-Salwach, A. (2012). Skutki regulacji Bazylei III dla sektora bankowego i gospodarki. Annales Universitatis Mariae Curie-Skłodowska Lublin-Polonia, Sectio H Oeconomia, VOL. XLVI, 4; Gołędzinowski, P. (2009). Wpływ regulacji systemu bankowego na jego efektywność. Materiały i Studia NBP, z. 235.

analysis of the concentration of banking risk is limited to concentration of credit risk (Graph 1 and Table 1).

Concentration of credit risk is associated with non-uniform distribution of exposures in the loan portfolio of banks. For its estimation concentration ratios are used, which commonly are applied in assessing the degree of market concentration (Hoffman, 1984).

The frequently used measures of credit risk concentration may include (Avila et al., 2012):

- 1) concentration ratio ( $CR_k$ ),
- 2) Herfindhal-Hischman Index (HHI),
- 3) weighted concentration ratios.

Concentration ratio  $CR_k$  is a sum of shares of  $k$  largest commitments<sup>8</sup> in the entire loan portfolio (equation 1).

$$CR_k = \sum_{i=1}^k \xi_i \quad (1)$$

where:  $\xi_i$  – means the shares in the bank’s total loan portfolio ordered from largest to smallest. This measure can take values from 0 to 1 (or in percentages from 0 to 100%), while values close to 1 indicate a strong concentration of the loan portfolio. The ratio is charged with several drawbacks. The number  $k$  is chosen arbitrarily (e.g. 5, 10, 20, or 1000), which means that only a limited number of exposures is analyzed. The ratio does not account for the distribution of analyzed loans, what means that their values can be highly concentrated in a small group of loans. These imperfections can be reduced by calculating several concentration ratios for different values of  $k$ , e.g. for 10 and 20, which allows comparing the share in the portfolio of 10 largest and 10 consecutive exposures, it means between 11 and 20.

Herfindahl-Hirschman Index (HHI) is a measure commonly used in empirical market research. In the risk analysis it is equal to the sum of the squares of the shares of exposures to each borrower in the entire loan portfolio (equation 2).

$$HHI = \sum_{i=1}^n \xi_i^2 \quad (2)$$

where:  $\xi_i$  – means the share of  $i^{th}$  exposure in the portfolio

composed from  $n$  largest exposures. The advantage of this indicator is that it takes into account the bank’s exposure to a high number of borrowers, which makes it sensitive to changes in the share of the involvement of both, large and small entities. The indicator takes values from 0 to 1. Values close to zero mean that the portfolio is made up of an infinite number of nearly identical small loans. Such a situation can be described as excellent granularity of the loan portfolio. HHI has a value of 1 when the portfolio consists of a commitment only to a single borrower.

In a study on concentration of credit risk there are also used weighted concentration ratios of the bank’s involvement in the various economic sectors (Michelini & Pickford, 1985). Such complex measures of concentration use the primary concentration measures as:  $CR_k$  (equation 3) and the HHI (equation 4). They are described, respectively, as  $CR_k^{total}$  and  $HHI^{total}$ , and are defined by formulas:

$$CR_k^{total} = \sum_{i=1}^m F_i \times CR_k^i \quad (3)$$

where:  $CR_k^i$  – is a concentration ratio of the loan portfolio of exposures to the  $i$ th sector of economic activity,  $F_i$  – a share of exposures to the  $i^{th}$  sector in the total portfolio of the bank,  $m$  - number of sectors included in the analysis of the concentration of the loan portfolio.

$$HHI^{total} = \sum_{i=1}^m F_i^2 \times HHI_i \quad (4)$$

where:  $HHI_i$  – is the HHI for the  $i$ th sector,  $F_i$  – a share of exposures to the  $i$ th sector in the total portfolio of the bank,  $m$  - number of sectors included in the analysis of the concentration of the loan portfolio. The advantage of these complex measures is that they take into account both, the size distribution of exposures to individual borrowers, as well as the distribution within the sectors in which they operate. The disadvantage is its complexity and the need to have detailed data on exposures. The process of selecting exposure can face some difficulties in the proper classification of certain commitments to particular economic sectors. These obstacles make such indicators less popular.

<sup>8</sup> As the commitment it is understood the total amount of loans granted to one company, the credit facilities, warranties, guarantees, bonds purchased admitted to discount bills of exchange and other exposures.

## ASSESSMENT OF THE CREDIT RISK CONCENTRATION AND METHODS OF ITS MITIGATION BASED ON THE CASE OF SELECTED POLISH BANKS

The problem of the credit risk concentration in Poland is regulated by the provisions of Art. 71 of the Banking Act<sup>9</sup> limiting the value of the bank's exposure to a single entity or entities linked by capital or management to 25% of its own capital. In the management of concentration risk in the first place, banks are focused on maintaining the statutory limit exposure concentration.<sup>10</sup> Data from the annual financial statements of banks listed on their home websites show that in 2008-2013 the analyzed banks fully complied with the requirements of this regulation.<sup>11</sup> For a more detailed assessment of the degree of concentration of credit risk to individual borrowers, banks recognize a group of 5, 10 or 20 entities to which they have the greatest commitments (*single name concentration*) (Table 2). The structures of these groups are periodically analyzed by the risk committees. In the case of noticed excessive increase in the risk concentration banks take action to improve portfolio diversification.

Furthermore, in accordance with the rules of the Banking Act and recommendations of the Polish Financial Supervision Authority (KNF), the banks establish internal

limits on the concentration of entities belonging to the same industry, or operating in the same unit of administrative division or economic and geographic area, known as the region. To reduce the level of risk banks analyze their involvement in terms of concentrations of types of assets used as collateral.

In order to reduce the degree of concentration of the loan portfolio, banks establish permitted levels of sector concentration ratios, and the exposures to individual business areas classified according to the Polish Classification of Activities (PKD) (Table 3). A monitoring procedure includes the calculation of concentration ratios in the current period, and comparison of these results with ratios created with historical data on the sectorial structure of the bank's portfolio. This allows them to identify the sectors with the trend in increasing, or excessive risk concentration.

An additional element of credit risk management is the analysis of the current and forecasting condition of the various economic sectors and the quality of exposures to entities operating in them. This analysis allows customization of the sectoral structure of the current distribution of concentrations of credit risk to the currently prevailing and forecasted macroeconomic conditions. Some of the banks, to avoid excessive complexity of the models used in econometric analysis, include only sectors

**Table 2: Concentration of credit risk of individual entities<sup>1</sup> in selected banks in Poland at the end of 2013 (in %)**

Customers	Bank Pekao	BOŚ	BZ WBK	ING Bank Śląski	PKO BP
Customer 1	2	2,6	1,7	2,7	1,5
Customer 2	1,4	2,3	1,6	2,1	0,6
Customer 3	1,1	1,6	1,5	1,4	0,4
Customer 4	1,1	1,4	1,5	1,2	0,4
Customer 5	1	1,3	1,2	1,2	0,3
Customer 6	0,9	---	1,1	1,2	0,3
Customer 7	0,8	---	1	1	0,2
Customer 8	0,8	---	0,9	1,1	0,2
Customer 9	0,7	---	0,9	1	0,2
Customer 10	0,7	---	0,8	0,9	0,2

Note: concentration is defined as the percentage of exposures to a single entity in the bank's total loan portfolio.

Source: Own calculations based on the annual reports of banks

<sup>9</sup> The Act of 29 August 1997 Banking Law (Dz.U.2012. No. 1, pos. 1376).

<sup>10</sup> The involvement of an entity consists of gross credit exposures, liabilities i.e. open lines of credit and guarantees, debt securities issued by the entity and included foreign exchange transactions FX spot, FX forwards, FX swaps.

<sup>11</sup> Banks: Bank Pekao, BOŚ, BZ WBK, ING Bank Śląski, mBank, PKO BP were analyzed.

**Table 3: Concentration of credit risk to sectors of the economic activity<sup>1</sup> in selected banks in Poland at the end of 2013 (in%)**

Item	Bank Pekao	BOŚ	BZ WBK	ING Bank Śląski	PKO BP
Sector 1	14,3	7,3	13,4	14,2	17,9
Sector 2	14,1	6,6	10,9	12,5	17,1
Sector 3	13,6	4,6	9,5	8,7	15,1
Sector 4	12,2	3,9	8,4	7,7	10,8
Sector 5	9,5	2,4	2	6,1	9,8
Sector 6	6,3	1,5	1,5	5,7	2,2
Sector 7	5,5	1,3	1,3	5	---
Sector 8	5,4	1	1,3	4,9	---
Sector 9	5,1	0,9	---	3	---
Sector 10	3,3	0,9	---	2,6	---

Note: concentration is defined as the share of exposures to companies operating in one economic sector in the total loan portfolio.

Source: Own calculations based on the annual reports of banks

with the participation of more than a certain level. Among others, Bank Pekao has set a limit of 2%.<sup>12</sup>

Financial authorities and the central banks of some EU countries have introduced additional measures to limit the risk arising from the concentration of credit risk. Among others, Bank of Spain [2008] and the Bank of Slovenia [2010]<sup>13</sup> in the guidelines directed to the supervised banks defined indicators of individual and sectorial credit risk concentration, which are supposed to help their risk management. Formulas of these indicators are similar to the HHI formula, and are calculated separately for individual and sectorial structure of the loan portfolio. Based on the levels of these indicators central banks assign appropriate multipliers, it means the percentage values of which banks are required to increase the capital requirement for credit risk coverage. Guidelines of Bank of Spain are used as a basis of concentration risk management systems in private banks operating in other countries, including RBC Bank in Georgia<sup>14</sup> and Robinsons Bank of the Philippines<sup>15</sup>.

This procedure introduces two indicators, which represent two types of risk concentration, it means:

- 1) ICI (*individual concentration index*) – defining the concentration of individual commitment to the institution (*single name concentration*),
- 2) SCI (*sectorial concentration index*) – defining the concentration of involvement in the economic sector (*sectorial concentration*).

The ICI index is calculated for a thousand largest borrowers according to the equation:

$$ICI = 100 * \sum_{i=1}^{1000} x_i^2 / (\sum y)^2 \quad (5)$$

where:  $x_i$  equals the value of the bank's commitment<sup>16</sup> to the  $i^{th}$  borrower and  $\sum y$  is equal to the total value of its loan portfolio. For the ICI index threshold levels are assigned (Table 4), above which banks are required to increase the value of the capital requirement for credit risk based on a specific multiplier expressed as a percentage.

12 Bank Pekao analyzes the structure of the involvement in sectors with minimal participation in the loan portfolio of 2%; see: The Financial Statements of Bank Pekao for the Year Ended 31.12.2011. Retrieved from [http://www.pekao.com.pl/informacje\\_dla\\_inwestorow/informacje\\_finansowe/sprawozdania\\_finansowe/#tab4](http://www.pekao.com.pl/informacje_dla_inwestorow/informacje_finansowe/sprawozdania_finansowe/#tab4) (2015.01.08).

13 The guidelines were updated by decisions of the Management Board of the Bank of Slovenia of 18.03.2009, 26.01.2011 and 26.10.2012.

14 See: National Bank of Georgia. Credit Risk – Overview; presentation on the web page of the National Bank of Georgia: Sharing TBC Bank Experience on Credit Risk under ICAAP. Retrieved from [https://www.nbg.gov.ge/uploads/prezentacia/lending\\_standards/sharing\\_tbc\\_experience\\_on\\_credit\\_risk\\_under\\_icaap.ppt](https://www.nbg.gov.ge/uploads/prezentacia/lending_standards/sharing_tbc_experience_on_credit_risk_under_icaap.ppt) (2015.01.08).

15 See: Robinsons Bank, Annual Report for 2013, Philippines, p. 27-28. Retrieved from <http://www.robinsonsbank.com.ph/uploads/2013%20Annual%20Report.pdf> (2015.01.08).

16 In accordance with Annex 2, in determining indicators SCI and ICI bank it is taken into account direct exposures to entities established in the EU due to: debt securities, loans, liquid assets, off-balance sheet exposures, guarantees and other recorded in the trading book assets available for sale, or held-to-maturity. Exposure amounts should be reported in the gross value created without deducting for reserves or other insolvency risk mitigation instruments. The calculations do not take into account exposures to government and monetary institutions.

**Table 4: The threshold values of the ICI index and the corresponding multipliers of the capital requirement for the credit risk**

ICI Index	Multiplier
0.10%	0%
0.15%	2%
0.30%	7%
0.60%	15%
1.20%	27%
2.40%	60%
4.80%	129%
9.60%	248%
42.80%	1071%

Source: Bank of Spain

SCI index is calculated using the shares of all loans granted to enterprises classified by the national classification of economic activities (equivalent of the Polish classification PKD) according to the following formula:

$$SCI = 100 * \sum_{i=1}^n x_i^2 / (\sum x)^2 \quad (6)$$

where:  $x_i$  equals to the exposure to the  $i$ th economic sector,  $n$  – the number of sectors analyzed in the portfolio, and  $\sum x$  total exposures to all sectors included in the analysis of the bank’s loan portfolio. For both indicators there are threshold values (see Tables 4 and 5), above which banks are required to increase the value of the capital requirement for credit risk based on a specific multiplier expressed as a percentage.

According to the Bank of Spain’s procedure for analyzing the level of concentration of the loan portfolio and the amount of additional capital requirements, formulas 5 and 6 were applied to the financial data of the Polish listed banks. The data provide information

**Table 5: The threshold values of the SCI index and the corresponding multipliers of the capital requirement for the credit risk**

SCI index	Multiplier
0% < ICS < 12%	0%
12% < ICS < 15%	2%
15% < ICS < 20%	4%
20% < ICS < 25%	6%
25% < ICS < 100%	8%

Source: Bank of Spain

on the structure of the largest exposures to individual companies and towards sectors of economic activity in the years 2008-2013. A limited range of data presented in the financial statements of banks makes it impossible to carry out a full scope analysis of the loan portfolio concentration.

The concentration ratios of ICI and SCI were calculated based on values of the 20 or 10 largest borrowers, and in the case of BOŚ the number was limited to 5 borrowers. Also in the case of the analysis of sectoral concentration, the listed banks restrict information on the sectors with the largest share in the loan portfolio to 5 or 10 sectors.

Procedures for assessing the degree of concentration of credit risk applied to Polish banks yielded the following values of the ICI and SCI indices for the analyzed banks in 2008-2013 (Tables 6 and 7).

The results of calculation show that the growth in the loan portfolio concentration risk is significantly affected by both the concentration within the individual entities (single name risk), and within individual economic sectors (sectoral concentration risk). The predominance of one of these types of risk depends on the structure of the loan portfolio of individual banks. PKO BP, a bank with a dominant retail profile, has a much more strongly diversified loan portfolio than other banks. It can be expected that it is one of the reason, why it has not the pressure to allocate additional capital to cover the “single name risk”. Increased value of the requirement to cover the sectorial concentration risk may be due to the fact that even if the bank granted lower value loans, it can provide funds to enterprises operating in a few dominant economic sectors.

On the other hand, banks with relatively greater involvement in corporate banking, including ING Bank Śląski and BZ WBK, are exposed to a greater risk coming from large commitments to a few or several large companies. As a result during some years to cover risk of such large exposures comparing to the value of entire portfolio, these two banks should designate additional capital exceeding 3% of the capital requirement for credit risk. Also in these banks loan portfolio concentration in companies operating mainly in four or five economic sectors means that they should allocate an additional capital requirement of about 2% of the capital requirement for credit risk. The superiority of the risk associated with insolvency of an enterprise for which banks have large exposures have a much greater impact on the banks’

**Table 6: ICI index and the corresponding values of the multiplier of the capital requirement for credit risk in selected banks in Poland, 2008-2013 (in %)**

Bank name	Index	2008	2009	2010	2011	2012	2013
Bank Pekao	ICI	0,11	0,12	0,12	0,12	0,12	0,12
	Multiplier	1,28	1,34	1,39	1,34	1,36	1,4
BOŚ	ICI	0,15	0,11	0,07	0,05	0,05	0,18
	Multiplier	1,73	1,21	0	0	0	1,88
BZ WBK	ICI	0,14	0,23	0,17	0,23	0,27	0,16
	Multiplier	1,51	2,62	1,79	2,65	3,1	1,75
ING Bank Śląski	ICI	0,29	0,28	0,23	0,27	0,22	0,12
	Multiplier	3,87	3,67	2,66	3,1	2,45	1,35
PKO BP	ICI	0,02	0,03	0,01	0,02	0,03	0,03
	Multiplier	0	0	0	0	0	0

Source: Own calculations based on the annual reports of banks

**Table 7: SCI index and the corresponding values of the multiplier of the capital requirement for credit risk in selected banks in Poland, 2008-2013 (in %)**

Bank name	Index	2008	2009	2010	2011	2012	2013
Bank Pekao	SCI	12,8	13,5	13,55	13,66	13,65	14,59
	Multiplier	1,71	1,8	1,81	1,82	1,82	1,95
BOŚ	SCI	12,65	12,45	13,51	12,96	13,32	12,59
	Multiplier	1,69	1,66	1,8	1,73	1,78	1,68
BZ WBK	SCI	12,56	13,87	12,42	12,66	12,55	12,72
	Multiplier	1,68	1,85	1,66	1,69	1,67	1,7
ING Bank Śląski	SCI	13,48	13,49	13,8	13,78	13,63	13,02
	Multiplier	1,8	1,8	1,84	1,84	1,82	1,74
PKO BP	SCI	13,39	12,39	12,53	12,19	12,68	12,19
	Multiplier	1,78	1,65	1,67	1,62	1,69	1,63

Source: Own calculations based on the annual reports of banks

soundness than the concentration in the sector, which can be distributed among a larger number of companies.

The test results can confirm the rule that the greater risk for the bank can come from a collapse of the company for which the bank has a large exposure, rather than sectoral concentration of credit risk dispersed among more entities. Indeed, it can be expected that each of these entities in the sector affected by the crisis conducts many uncorrelated with each other activities. In such a situation it can be expected that the crisis could lead to bankruptcy and failure in credit servicing only a part of the entities operating in the crisis affected sector.

Hence, the value of additional capital to cover the credit risk of individual concentration is up to about 4% of the capital requirement for credit risk. To cover the

additional risks due to the exposure concentration within one economic sector banks need to assign additional capital of the value of about 2% of the credit risk capital requirement.

## CONCLUSIONS

Excessive risk leads to a reduction in the bank's financial stability. It can shake its liquidity and solvency, undermine its reputation and contribute to the loss of customers. Simultaneous activation of many sources of risk can completely stop operations and lead to bankruptcy.

Credit risk is the greatest threat to the orderly functioning of the bank, as it results from the uncertainty

as to the solvency of companies and individuals to which the bank is exposed. To hedge against its materialization banks spend nearly 90% of the total capital requirement.

Credit risk may be increased due to the concentration of the bank's exposure to single entities, as well as to a group of entities operating in one economic sector.

Simultaneous materialization of credit risk justifies introduction, inter alia, by the Bank of Spain and the Bank of Slovenia, an obligation to allocate additional capital to absorb the risks associated with the concentration of exposures in a single entity and in a single sector of the economy.

Results of the research confirmed hypotheses that Polish banks should reserve additional portions of capital, both in respect of credit risk concentration within a single entity, as well as the concentration in a single economic sector. The values of these two additional requirements

are, respectively, 4% and 2% of the capital requirement for credit risk.

Banks with a retail profile had more fragmented loan portfolios, which reduces their single name concentration of credit risk. Despite such diversification of entities, a substantial portion of borrowers was active in a few economic sectors, which generated a sectoral concentration of credit risk.

Banks with a stronger corporate profile had significant exposures to a small group of large companies, which shifts their risk profile towards the credit risk concentration within individual sectors. Such a relationship could stem from the fact that large companies are active in various economic sectors and naturally diversify their sectorial risks to which the bank is exposed.

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