OWNERSHIP STRUCTURE AND RISK PROFILE OF BANKS IN EMERGING ECONOMIES

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Abstract

This article analyzes the relationship between ownership structure and risk profile based on the data from the emerging banking market. Using Kohonen self-organizing maps, we divide banks into clusters according to the type of risk profile. This mapping technique is based on panel data dimensionality reduction, as risk profile is changeable over time. We adopted the Basel Committee on Banking Supervision recommendations regarding the types of concentration of funding serving also as a basis for determining the risk exposure of banks and used them as an input for Kohonen maps. We conclude that business models and, consequently, risk exposures of banks significantly depend on sources of capital (domestic private, foreign, state). Our empirical results show that ownership type is a major, but not the only factor influencing bank risk profiles. These findings call for a change of the regulatory paradigm in emerging (banking) markets.

Keywords: Bank Ownership Structure, Risk Profile, Banking Regulation, Kohonen Self-Organizing Maps, Emerging Banking Market

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1. INTRODUCTION

In many developed economies, banks play a crucial role: while they transform volumes, values, terms, and risk in ways that allow handling the problems of transaction cost and information asymmetry efficiently (originally, Benston and Smith 1976; Leland and Pyle 1977; as an overview, Greenbaum, Thakor, and Boot 2015). Thereby they are selecting their borrowers individually, depending on their risk portfolio.

The financial crises have shown that overindebtedness or illiquidity of banks leads to massive distortions in local as well as in global financial markets and may affect the development of economic key figures for a long-term, and in contagious ways. The last crises started with American banks granting real estate loans to subprime debtors, and (via the MBS-market) resulted in worldwide liquidity problems of banks, spillovers to the real economy, decreasing GDP and a global recession for several years. Furthermore, it prepared the ground for the crisis of several EU member states, and, finally, the Euro and the EU themselves.

Numerous financial crises in history continuously draw the attention of researchers and regulators to the activity of banks, their performance, and factors of their success and failures. In particular, such issues as banking ownership structure and risk profile are crucial parts of the research agenda in many countries (Chun, et al., 2011; Dong et al., 2014).

This paper approaches the problem of bank risk profiles in conjunction with the bank ownership structure. Compared to other studies, current research accumulates data on the ownership structure in several directions: state/private and foreign/domestic. We choose Ukraine with its developing banking system as a very suitable case

for such empirical research due to the presence of banks of all kinds of ownership.

We use Kohonen self-organizing maps that allow dividing banks into clusters according to the type of risk profile, making in-depth analysis possible. The majority of previous papers that divide banks into clusters use k-means or hierarchical clustering methods (Rashkovan & Pokidin 2016). Our paper proposes Kohonen self-organizing maps as a less widely used, but still valid alternative to conventional methods. This approach is particularly strong in terms of dividing data into homogeneous groups, but it also provides researchers with extensive data visualization, which helped us distinguishing the banking groups selected for this research.

Ukrainian data is unique since the banking system in Ukraine includes viable banks of each ownership group: banks with foreign capital (Russian capital, in particular, taking into account the complex relationship between the two countries), domestic banks with private capital and domestic banks with the state capital. There are few examples of other countries providing a comparable banking system in terms of ownership characteristics, making Ukraine a perfect research object for exploring the relation between bank ownership structure and risk profile, which is the aim of this paper. In addition, the Ukrainian financial industry experienced the same trends of capital inflows (and subsequent outflows) from Western Europe as banks operating in CIS markets.

To our knowledge, this is the first study that analyses the relationship between bank risk profile and ownership structure of the banks in Ukraine in terms of several ownership groups including domestic state/private owned, and foreign banks.

The structure of the work is as follows: Section 2 provides a brief overview of the relevant literature to present a theoretical background and to identify the research gap to be filled in by this paper. Section 3 moves to the ownership structure of Ukrainian banks in order to illustrate the practical background of the problem and the conditions under which the empirical analysis takes place. It also focuses on recent trends in the Ukrainian banking system and provides important information on the regulations that influence the methodology and calculations provided in Section 4. Section 5 shows the empirical results of the analysis based on the Kohonen maps approach and provides their explanation. Section 6 contains a short overview of the paper's main findings and key concluding statements.

2. LITERATURE REVIEW

2.1. Bank ownership types and structure

Previous studies contain extensive analyses of various bank ownership structures and their correlation with performance indicators of the respective financial institutions. Traditionally, researchers distinguish several parameters of ownership: first of all, attention is paid to the issue of state ownership. Some authors (Barry et al., 2009; Dong et al., 2014; Zhu & Yang 2016) argue that due to the specificities of state ownership (in particular political considerations influencing a bank's goals,

risk attitude, structures, and processes, and the existence of a governmental safety net), it may influence a bank's performance in a particular way, as managerial, regulatory and funding procedures in state-owned banks differ from those in privately owned banks.

Apart from ownership, researchers also take into account, actors of which level of the political system exercise ownership or control rights (Iannotta & Nocera, 2013; Schmielewski & Wein, 2013; Tandelilin et al., 2007). A federal or central government usually has more power and funds to support and direct institutions under its ownership. On the other hand, banks that are owned by local administrations may experience higher control and tighter monitoring levels due to the physical proximity of the owner and the fact that local governments usually have a good knowledge of regionally based banks that conduct business under their jurisdictions. Consequently, the situation is different for local governments that own banks located in different regions, but such cases appear to be a rare exception.

As for privately owned banks, previous research divided them into foreign banks and domestic banks. This distinction is important for cross-country studies (Laeven & Giovanni, 2008; Nicolò & Loukoianova, 2007) or studies that focus emerging economies, where foreign banks can play a particularly significant role, as the institutional framework of rules and organizations is still under construction (Rahman & Rejab 2013). This approach can be explained by the strong support and experience that foreign banks can obtain from parent companies. Especially if the bank is a representative of a strong international financial group, it can rely on substantial financial backup while developing its structures and operations in the domestic market. Local banks, as a rule, have superior knowledge of market peculiarities, of how to find approaches to clients and possibly better informal connections to decision-makers in political and regulating institutions.

Some studies (Cooper & Uzun, 2009; Lee, 2008), pay special attention to insider or institutional ownership, as institutional and owners, represented by insiders have more influence on the operations of a bank.

Another approach is to analyze the ownership structure of banks according to its concentration. As a rule, organizations that are owned by numerous small (minority) shareholders behave differently compared to those that are owned by a few large stockholders, because they have to deal with different agency problems and costs. This analysis shows that there is no single approach to ownership structure in previous research.

Table 1 (see Appendix) summarizes the period of study, the covered markets, and the different ownership types compared in previous studies.

A larger number of bank's failures highlights the fact that banking in Ukraine is still riskier than in most developed countries. Therefore, examining the determinants of banks' risk-taking seems crucial for the understanding of the prospects of the stability and profitability of the banking system in particular and for future economic development and growth in general (see, for example, Fungáčová & Solanko 2009).

2.2. Risk profiles in banking

Bank managers are obliged to increase shareholders' value by enhancing bank performance. To achieve this goal, they have to take risks and thus must deal with the issue of risk management. While the risk environment of banks usually is divided into market (price) risk (such as interest rate risk, securities price risk, currency risk, commodity price risk), credit risk (including country risk), liquidity risk, operational risk, and other risk categories (Crouhy et al., 2014; Hull, 2015), their management attempts to avoid losses and liquidity shortages, and to stabilize cash flows and thus shareholder value instead (Tandelilin et al., 2007).

Lamy (2012) provides a different system of bank risk categories, taking into account their connection to a bank's ownership structure, which is also particularly interesting for this research. The author develops a theory that insolvency risk, systemic risk, and idiosyncratic risk may be present in banks – and be connected to their ownership structure, as the risk-taking the behavior of banks is the result of two main agency problems. The first agency problem affecting bank risk (taking) is the owner/manager agency problem, which may incentivize managers to act in general and to take a risk in particular in a self-interested way instead of acting in the best interest of the shareholders (Jensen & Meckling, 1976). The second agency problem affecting bank risk arises from conflicts between controlling and non-controlling shareholders. Controlling shareholders may seek private benefits at the expense of non-controlling shareholders which may lead to higher bank risk (Shleifer & Vishny, 1997).

Previous studies approached the issue of measuring bank risk differently. One of the most widespread variables used to estimate a bank's risk exposure is the nonperforming loan (NPL) ratio, which is usually used to demonstrate a bank's credit risk exposure (Cheng, Zhao, & Zhang, 2013; Zhu & Yang, 2016; Dong et al., 2014; Tandelilin et al., 2007; Rahman and Rejab 2013). NPL is the total amount of issued loans that were not repaid by the debtor in due time. Once a loan is nonperforming, the probability that it will be debt serviced and (at least partly) repaid is considered lower. The NPL ratio itself is calculated as a ratio of nonperforming loans to total loans issued by the bank.

Alternatively or in addition to NPL ratios, the so-called Z-score is used in a number of studies to demonstrate insolvency risk of banks (Zhu & Yang, 2016; Nicolò & Loukoianova, 2007; Riewsathirathorn et al., 2011; Schmielewski & Wein, 2013). The Z-Score attempts a quantitative measurement of a bank's financial health. It highlights factors contributing to a company's financial health and uncovers emerging trends that indicate improvements or deterioration in financial conditions. Bouwens and Verriest (2014) propose to calculate Z-Scores defined as the bank's capital assets ratio (ratio of equity over assets) plus the return on assets (ROA), the sum of both divided by the standard deviation in ROA.

Another variable to determine bank risk is return volatility (Zhu & Yang 2016). This variable shows the ability of bank managers to make sustainable, less uncertain profits on the bank's assets. Especially in countries with highly developed stock markets, bank's stock prices depend on the earnings, and respective announcements. If managers fail to provide competitive earnings, the market will react negatively. Barry et al. (2009), Lassoued et al. (2010) use as a variable for return volatility the standard deviation of the return on average assets (SDROA). On the contrary, Iannotta and Nocera (2013) use a market measure instead of an accounting measure, employing the volatility of bank stocks returns, or their stocks' beta. While market measures work fine in countries with developed stock markets, emerging economies like Ukraine require a different approach, taking into account the amount of reliable information. We use accounting measures in this study due to the level of information disclosed the structure of reporting and the weak development of the stock market in Ukraine.

Several authors take capital adequacy ratios (CAR) as an indicator of a bank's risk position (see, for example Lassoued et al., 2010; Dong et al., 2014; Tandelilin et al., 2007; Cheng et al., 2013), thus focusing their loss cushion shielding them – and their depositors – from insolvency. The capital adequacy ratio is defined as tier 1 or/and tier 2 capital divided by risk-weighted assets. This ratio differs from others because of its regulatory roots and attention. National and international regulators of banking markets worldwide set standards including CAR and monitor CAR to protect depositors and maintain trust in the banking system.

Similar to previous indicators, some authors (see, for example, Cheng et al. 2013; Barry et al., 2011) use loan loss provisions to approach bank risk. The ratio of loan loss provisions to total assets (LLP) shows, which percentage of a bank's assets is devoted to reserves against potentially defaulting loans. Similar to CAR, LLP represents cushions against losses, helping a bank to withstand losses and to ensure depositors' property rights. Accordingly, several national regulators have adopted requirements for loan loss provisions (see, for example, Laeven & Majnoni 2003). One of the more complex indicators of bank risk profile is the value at risk (VaR), which measures and quantifies the level of financial risk within a firm or investment portfolio over a specific period. Value at risk is used by bank risk managers in order to measure and control the level of risk the firm undertakes. The risk manager's job is to ensure that risks are not taken beyond the level at which the firm can absorb the losses of a probable worst outcome. Due to the complexity of this indicator, it was used only by Tandelilin et al. (2007) among the studies investigated in the literature review.

According to current risk measurement practices, bank risk is measured in various ways and should be gauged using and comparing more than one approach to produce reliable results.

Aforementioned approaches and indicators suit different research aims for particular markets and conditions. Due to the specifics of the Ukrainian banking sector, which are described in Section 3, we stick to the metrics proposed by the Basel Committee on Banking Supervision which, based on main types of the concentration of funding, allow to determine the risk exposure of Ukrainian Banks. The respective indicators are provided in Section 4.

2.3. Correlation between ownership structure and risk profile of a bank

Previous research has approached the issue of the connection between the ownership of the banks and their risk profile in several dimensions (see Figure 1 in Appendix).

First, various authors have analysed how banks with a more concentrated ownership structure perform compared to the banks with dispersed ownership structure in terms of risky activity. Laeven and Giovanni (2008) conclude that banks with more powerful owners tend to take greater risks. These findings are supported by Martinez & Ramírez (2011), who argue that risk is higher in large banks with concentrated ownership; but decreases with the degree of market competition. In essence, bank risk depends on the party that predominantly controls the financial institution's assets (manager or owners), but the operating scale and the actions taken by other market competitors have also relevant effects. Nicolò and Loukoianova (2007) go beyond analyzing the concentration of bank ownership by adding factors of market share and detecting that the connection between concentrated ownership and risk is strongest when state-owned banks have sizeable market shares. On the contrary, Riewsathirathorn et al. (2011) found that more concentrated ownership is associated with poorer bank performance and lower risk-taking. In particular, a rise in ownership concentration by one standard deviation lowers the degree of risk-taking by about 10 percent. Lamy (2012) supports these results by adding that large shareholders have preferences toward lower risk levels. Bouwens and Verriest (2014) reinforce the aforementioned reasoning by supporting the hypothesis of a concentration-risk connection, however admitting that higher managerial equity incentives decrease a bank's risk-taking. Chun et al. (2010) partially confirm these findings based on the Japanese banking system. However, at the same time, the authors admit that managerial ownership alone does not affect either the risk or the profit levels of banks. At the same time, Chou and Lin (2011) argue that banks in Taiwan with higher insider ownership and higher government ownership have higher overdue/nonperforming loan and lower capital adequacy ratios.

Secondly, the authors tried to learn whether banks controlled by the state outperform privately owned banks in terms of risk-taking and risk profile. Dong et al. (2014) find that banks controlled by the government tend to take more risks than those controlled by private investors. Concentrated ownership even increases this difference. At the same time, Iannotta and Nocera (2013) argue that government-owned banks have lower default risk, but higher operating risk than private banks, indicating the presence of governmental protection that induces higher risk-taking.

The third dimension of research on the topic addresses issues of ownership controlled by families, individuals, or institutional investors. Barry et al. (2009) state that risk exposure is lower in banks where a higher proportion of total stocks is held by families and individuals, and that the probability of default of banks is higher when non-financial companies and institutional investors hold a higher proportion of total equity. This can be explained by the more risk-averse decision making of individual and direct investors who invest their own money compared to managers who re-invest money that others invested in the company they manage. Schmielewski and Wein (2013) neither confirm nor contradict this insight, finding that private banks seem to be more risk-averse than banks with alternative ownership structures such as those with dispersed minority shareholders or affiliates of commercial banks.

The fourth approach tends to take into account the origin of controlling shareholders, by dividing them into resident and foreign owners. Lassoued et al. (2010) conclude that foreign ownership of banks in the Middle East and North Africa reduced risk-taking. Chou and Lin (2011) support this insight, declaring that Taiwan banks with higher foreign institutions' ownership and relatively stricter governance are associated with lower volumes of overdue loans and higher regulatory capital. However, their results seem to be significantly influenced by the market that is researched, as Fungáčová and Solanko (2009) contradict the aforementioned observations by proving that Russian foreign-owned banks exhibit higher insolvency risk than domestic banks.

A couple of studies considered the problem of bank ownership and risk-taking based on Ukrainian data. Rashkovan and Pokidin (2016) also employed the methodology of Kohonen Self-Organising Maps (SOM) in order to cluster and identify six distinct bank business models. The authors also analyzed the risk profiles of the banks' business models and differentiated between safest and riskiest ones. Thus, their study clearly showed that Kohonen maps can be used in order to analyse banking activity in Ukraine. However, the authors used data limited to the 4-year-period from 2013 to 2016. In addition, they did not regard bank ownership structure as an important variable, but divided banks in terms of their business models. Consequently, our study offers further insights by encompassing a longer research period as well as important criteria neglected so far.

Another study by Love and Rachinsky (2015) presented evidence on the relationship between ownership, corporate governance and operating performance in banks. However, the authors used the financial data from the period of 2003-2006 and corporate governance data based on a survey performed by the IMF. It is important to note that the first recommendations on corporate governance in Ukraine were issued by the NBU only in 2007 and before that, there were no unified documents to regulated issues of corporate governance for the banks in Ukraine. In addition, the authors did not consider the issue of risk in their study.

Kyj and Isik (2008) analyzed the operational efficiency of commercial banks in Ukraine from 1998 to 2003 based on several factors, including the origin of capital (foreign/domestic). The authors concluded that banks with foreign capital tend to outperform their domestic peers. However, the authors did not take into account the risk profiles of the banks in their study.

Tsapin (2010) analyzed the role of ownership impact on the link between bank risk and lending in Ukraine. The author concludes that there is a

negative impact of ownership concentration on interbank loans, which may lead to higher liquidity risk. However, this study is limited to the period from 2003 to 2006, too. The author does not analyse ownership structure in terms of its type but in terms of its concentration and approaches only liquidity risk.

Altogether, previous literature provides various approaches toward the relation between bank ownership structure and risk profile. However, existing studies that employ banking data from Ukraine mostly overlook the issue of bank risk profile and ownership structure, analyzing the operational efficiency and business models instead. The results of previous studies that do take into account bank risk profile and ownership structure cannot be transferred to emerging banking systems like the Ukrainian one without alterations. In addition, these studies present contradictory results that are not homogenous and depend on many factors. Consequently, there is a necessity to perform an empirical study based on the Ukrainian banking system, as it shows important peculiarities: the presence of state-owned, privately owned, different in size banks, as well as banks in ownership of non-residents (who in their turn have to be divided into groups due to their specifics). All this provides a unique opportunity to draw valuable results for the emerging economy.

3. THE OWNERSHIP STRUCTURE OF UKRAINIAN BANKS: EVOLUTIONARY ASPECTS AND PERSPECTIVES

The Ukrainian banking system played an important role in economic development and overcoming the crisis of public finance in neighbouring Russia in 1998 through the development of suitable mechanisms for resolving the crisis both for banks and for the state. Therefore, Ukraine was able to avoid defaulting on domestic public borrowing in 1998-1999. Until 2005, the ownership structure of the Ukrainian banks was rather homogeneous, as a vast majority of banks were owned by private domestic investors. While there has been a rapid growth of foreign ownership since 2005, USD became a primary currency in private banking, leaving about 80 percent of mortgages denominated in foreign currency and creating serious currency exchange risks.

Before Ukraine joined the World Trade Organization, the activity of foreign banks in Ukraine was heavily regulated in order to protect domestic financial institutions from European and North-American competitors. This protective regulation happened simultaneously with the rapid development of the Baltic countries' banking systems, which quickly showed high levels of ownership concentration and large foreign ownership (Koivu, 2002). In 2008, Ukraine joined WTO and accepted GATS standards (including Article XVI, which obliges member countries to reduce barriers to entry and operations so that firms of any other member-state are treated as local firms regarding the terms, limitations, and conditions of business). Ukraine introduced the necessary amendments to the institutional framework with the Law of Ukraine 'On Banks and Banking' in May 2008.

According to Figure 2 (see Appendix), this led to increasing volumes of foreign capital invested in Ukrainian banks until 2009, with the first wave of foreign investment occurring within the subsequent years because of the consequences of the financial crisis. Although the invested volumes increased, the adoption of GATS standards did not attract new players, because those foreign intermediaries who wanted to be present in Ukraine, had already operated in this country by 2008 via buying stakes in local banks.

The presence of foreign (first of all European) players in the domestic financial market was among the most powerful drivers for its ownership structure transformation. Two other groups of investors (Russian investors and Ukrainian state) increased their presence later (see Figure 2 in Appendix).

The crisis has shown the presence of four clusters of Ukrainian banks according to their ownership (see Table 2 in Appendix):
1. banks with predominant private Ukrainian owners;
2. banks with predominant public Ukrainian owners;
3. banks with predominant foreign (non-Russian) owners;
4. banks with predominant Russian owners.

On 1: The market behavior of the private banks with Ukrainian capital was to supply financial resources to all solvent clients of different origins, primarily enterprises of the real economy. The level of transparency before the crisis was very low due to the weak regulation. Thus, many banks with private domestic capital in Ukraine performed as treasury units of big corporate groups (Kirchner et al., 2011).

On 2: The state banking sector was initially assigned the task to promote economic development, including the support of export-import activities and guaranteeing deposits of the population. During the 2008-2009 crisis, shares in certain commercial banks were purchased by the state through direct recapitalization. In order to fulfill special tasks, functional banks were established. Oschadbank, Ukreximbank, and Ukrgazbank have gradually developed as universal banking institutions operating in all sectors of the Ukrainian economy, issuing large-sized loans to legal entities. In 2014 and 2015, operations of the banks were loss-generating. Non-performing loans constituted a considerable portion in the portfolio of these banks (as well as in the whole banking system). The Strategy for State Banking Sector Development (2018) is based on the assumption that state-owned banks will be fully or partially sold to private investors.

On 3: The strategic goal of banks with foreign (European) capital was lending to households to allow them for the purchase of imported goods. This stimulated public consumption by Ukrainians of goods manufactured outside Ukraine. Thus, the entry of these banks into the domestic market of Ukraine was driven by expected future incomes due to high-interest margins compared with the entrants' home country, as well as initiatives of parent companies on geographic expansion to strengthen their global market position.

On 4: Banks with Russian capital attempted lending to companies of the highest

creditworthiness, facilitating their transition under the control of Russian capital and strengthening the position of the latter in the Ukrainian market. Terms of the banking business in Ukraine are similar to Russian ones, so the adaptation of the Russian investors to the Ukrainian business environment was comparably rapid.

Unlike most private foreign banks that used their parents' equity for retail loans, domestic-owned banks used deposits from individuals for that purpose. The support from parent companies was a real advantage of banks with foreign capital. There were 17 banks in Ukraine that demonstrated more than 25 percent in annual loan portfolio growth for two subsequent years. Twelve of them were banks with foreign capital, which received significant financial support from parent companies. Five banks were represented by Ukrainian investors. Subsequently, all of them experienced serious liquidity problems.

In 2015, Fitch Ratings downgraded the largest state-owned banks Oschadbank and Ukreximbank significantly. Partially, this downgrade was caused by a significant accumulation of government bonds in the asset portfolios of the aforementioned banks. Thus, there was a considerable conflict of interest, as the government acts as the issuer of bonds, and buys these bonds through its own banks to cover budgetary gaps.

The conflict between Russia and Ukraine additionally impacted the behaviour of depositors, who withdrew their deposits in particular from banks with Russian capital, leading them to reduce their activity in the Ukrainian market and to adjust their expansion plans. At the same time, in spite of the European and US sanctions intended to block access of Russian parent companies to the international capital markets, their subsidiary banks in Ukraine were supported by additional funds through providing their subsidiaries with long-term loans and capital injections.

Due to the financial crisis, most banks with foreign capital operating in the market in 2008 built up the necessary reserves against losses connected to their toxic assets. At the beginning of 2011, the number of banks with foreign capital began to decrease due to the gradual decline of the Ukrainian economy.

The political and economic crisis in Ukraine, which is intertwined with the military operations in Eastern parts of the country, had a severe negative impact on the economy in general, and on economic expectations of foreign owners of Ukrainian banks in particular. Recalculations of loans issued in foreign currency at new exchange rates led to a significant increase of the share of non-performing loans in the total loan portfolio during 2014. At the same time, the suspension of banking operations in annexed and occupied territories, and the lack of mechanisms for a collection of outstanding loans issued in the Crimea, Donetsk and Lugansk regions caused an increase of bad debts, putting bank performance under even more stress.

Additionally, the decrease of the country's credit rating has led to an analogous decrease of credit ratings of resident Ukrainian banks, turning Ukrainian subsidiaries of international financial groups into possibly toxic assets. This led to lower credit ratings of affected international parent

companies (namely Barclays Plc, Credit Suisse Group AG, HSBC Holdings Plc, Lloyds Banking Group, Royal Bank of Scotland Group Plc and Standard Chartered Plc) of Ukrainian banks. During the processes of crisis-driven re-regulation, the probability of emergency state support for banks was explicitly reduced, while it was emphasized that the owners have to bear losses of their financial institution with little or no governmental support (IMF, 2012). Thus, European banks were increasingly interested in cleansing their balance sheets from potentially troubled assets. Whereas, their subsidiaries in Ukraine offered no attractive risk-return-positions to potential buyers.

Currently, the banking market in Ukraine is influenced by several factors:

- devaluation of the national currency;
- the loss of assets in the Crimea and the area of anti-terrorist operations (territories occupied by Russian troops) which encounters a loss of more than 15 percent of total assets of banks;
- deteriorating solvency of borrowers, mass layoffs and the continuation of a series of bank defaults (for example, during 2014, 33 banks that controlled 13.5 percent of the market deposits of the population and 13.9 percent of banking system assets were officially declared insolvent);
- massive withdrawals (outflow of deposit funds of the population amounted to USD 10 billion of deposits denominated in foreign currency and more than 40 billion in UAH) putting banks' liquidity and profitability under stress.

At the same time, as shown in Figure 3 (see Appendix), insolvency was not the only reason for the liquidation of banks (Deposit Guarantee Fund of Ukraine, 2015). Another was governmental intervention: Eight banks were withdrawn from the market for money laundering, six banks had significant amounts of transactions with related parties, and two banks were owned by the persons against whom sanctions were imposed by the EU. To meet the requirements of international lenders for the next tranche from the IMF, in 2015 the Law of Ukraine 'On Amendments to Certain Legislative Acts of Ukraine Regarding Responsibility of Persons Related to a Bank' was adopted. However, no criminal proceedings against members of top management or owners of failed banks were initiated, so that the effectiveness of the regulatory act remained low at first. Figure 3 illustrates the timeline of governmental sanctioning of bank behavior during the peak year of 2014. Recently, the NBU launched the project 'Reasons and Results of the Big Banking Cleaning' (available in Ukrainian only via badbanks.bank.gov.ua) that represents the structure and business models of liquidated banks, recent timelines for the liquidation/temporary administration process, results of banking cleaning and punishment of top managers. We did not include the subsequent events related to the period of research as this information is irrelevant to the objectives of this paper.

Using the new supervisory standards (NBU, 2015d) in the banking system is based on a proactive approach to management, so permanent identification and monitoring of risks must take into account the variability of banks' business models. Activities of the National Bank of Ukraine in this

direction is aimed at introducing the cluster model, according to which supervisory regimes and procedures may differ depending on the group to which the bank belongs. While the main criterion for the mode of supervision still is the size of bank assets, this criterion seems not informative enough with regard to a bank's business portfolio and risk exposure.

With the use of cluster analysis (Figure 4 of the Appendix), the central bank groups banks of comparable business models and risk profiles. As one of the clustering criteria, the NBU chose ownership structure (see Figure 3 of the Appendix).

Differentiation of banks of the 3rd and 4th groups for the purposes of supervision will be based on an assessment of business models and the nature of operations. The subsequent three-dimensional scale is used to assess the condition of individual banks:

- transparency of the ownership structure – the resource potential of shareholder determines the ability of additional capitalization and liquidity support to financial institutions and allows to identify the bank's dependence on related parties;
- the presence of a business model – a way to generate profit in the banking business by implementing certain strategies and tactics of behavior in the market;
- the riskiness of the business model – concentration on certain industries or enterprises increase credit and investment risks and may also indicate money laundering through lending to the related parties.

Table 3 (see Appendix) shows the characteristics of clusters formed by the method of the regulator.

Banks that received their equity investments from and conduct business with unrelated parties at market conditions belong to the 'market' cluster. 'Inactive' banks do not have a clearly defined business strategy since the vast majority of them were established before the crisis to be subsequently sold to foreign investors and did not have sufficient capital to cover unexpected withdrawals of customers. This cluster also includes active banks that conducted a large-scale reduction of units and activities in times of volatility in financial markets, but today a significant change in the structure of their balance sheets is not observed so that the future behavior of these financial intermediaries is particularly uncertain.

The structure of assets and liabilities of 'captive' banks is determined only by transactions with their shareholders. These institutions do not perform widespread financial intermediation but were established exclusively to manage the financial flows of certain companies. If this model of the concentration of transactions with related parties has not changed for three years, it is likely that the bank will be sold or liquidated. 'Risky' banks show significant imbalances of the relation of the equity to their (often heavily concentrated, in other words non-diversified) total assets (NBU, 2013). The last cluster is formed by 'criminal' banks that performed money laundering. The only scenario the NBU sees for such banks is liquidation by law enforcement agencies, combined with identification and sanctioning of responsibilities of owners and senior managers for proven violations of laws.

The use of the cluster approach for supervisory purposes is designed to help optimize the workload of supervisors; determine the most urgent areas for the analysis of bank operations; coordinate of supervisory activities of the central bank's departments, financial monitoring, and currency control.

4. DATA AND METHODOLOGY

To determine the risk profile of banks in Ukraine, their public statements from 2008 to 2013 were taken as the input data set. This period was chosen because in crisis and post-crisis years the behavior of domestic banks has undergone significant changes highlighted above. Statistical data do not include 2014, as, since this period, the activities of financial institutions were influenced by unpredictable factors (occupation of the Crimean Peninsula by Russia, war and subsequent occupation of further territories of Ukraine by Russia). Additionally, since 2016 Ukrainian banks are obliged to prepare their financial statement in accordance with IFRS standards. Before this requirement became legally active, banks in Ukraine could voluntarily use IFRS as a basis for accounting/reporting, but very few banks did so, thus the official data starting at Jan 1, 2016, is not comparable with the financial data of previous years (NBU, 2015e). The sample included banks that were in the 1st and 2nd group according to the NBU classification by Jan 1, 2014. As it can be seen in Figure 5 (see Appendix), during the entire sample period, banks of these groups owned more than 80 percent of total assets of the banking system, so the sample can be considered representative. The inclusion of the additional banks (namely groups 3 and 4) in the sample, most of which are 'pocket' and have no clearly defined strategy or power to influence the market, would distort the results of our analysis.

The Basel Committee on Banking Supervision (2013) defines three main types of concentration of funding serving also as a basis for determining the risk exposure of Ukrainian Banks:

- by currency (foreign currency assets/total assets (A_{fc}/A); liabilities in foreign currency/total liabilities (L_{fc}/L)),
- by the instruments (securities/total assets (S/A)),
- by contractors (loans to banks/total assets (C_b/A); loans to individuals/total assets (C_i/A); loans to companies/total assets (C_e/A); bank debt/total liabilities (L_b/L); individuals' deposits/total liabilities (L_i/L); deposits of the companies/total liabilities (L_e/L)).

Using Viscovery SOMine software, we develop a neural network model. Kohonen maps for each of the input parameters for all objects throughout the study period were built to facilitate interpretation of the test. Grytsenko (2012) proposed this method for the analysis of insurance companies. This approach allows maximizing the comparability of data. As an output of Viscovery SOMine, we get Kohonen map images, which in this case consist of 10 clusters (patterns) characterized by certain features, which have to be studied by detailed maps for each indicator. According to the methodology proposed

by (Zarutska, 2009), the formation of cards was made on every date of the sample. However, with this approach, the cluster limits do not match, so the process of determining the risk profile of the bank or group of banks is complicated and increases the likelihood of a false interpretation of the data. But this does not diminish the results received in the study, because the usage of Kohonen maps in the aforementioned research was justified by the needs of the banking supervision system, where the use of reactive approaches is justified by the use of additional tools.

The next stage is the construction of a neural network and its training by sorting items and transfers them to the card (the output layer). One of the neurons is called 'winner' if the weight of its relations is the closest to the input image from the perspective of Euclidean distance. It should be noted that with the construction of typological mapping (Kohonen maps) during the algorithm of patterning not only the weight of neuron-'winner' (the center of the pattern) is governed but the weight of neighboring output neurons that are close to the input image is regulated also (Gorbunov, 1999). The learning process starts with random values and supposes a gradual reduction in the number of neurons by reducing their sensitivity to changes in the input signal. As a result, in the last stage of correction, only the weight of the neuron-'winner' is needed. Hereafter, the weight of relationships between input vectors and output neurons is determined. Each of them corresponds to the input image, which is typical for some subset of the input data. The initial high dimensional space rolls in a two-dimensional map.

In a formalized view, this process can be represented using the data set consisting of *n*-dimensional real vector:

$$x_j(t) = \left[x_{j1}(t), x_{j2}(t), \dots, x_{jn}(t) \right] \quad (1)$$

Matching the model vector to the node is the results of feedback on data $x_j(t)$ $(t = 1,2,3, \dots)$, which are used consistently in the algorithm:

$$m_i(t) = [\mu_{i1}(t), \mu_{i2}(t), \dots, \mu_{in}(t)] \quad (2)$$

Since in the result of the analysis the space of observations is transformed into a two-dimensional map, the relationships between model vectors are based on the assumption that they are aligned along some two-dimensional flexible network, and the index of neuron-'winner' is determined separately for each stage:

$$\|x - m_w\| = \frac{min}{i}\{\|x - m_i\|\} \quad (3)$$

where m_w – is a characteristic of neuron-'winner' on the map (model vector).

Modification of weight coefficients after identification of neuron-'winner' is performed with the formula:

$$m_i(t + 1) = m_i(t) + a(t) * h_{wi}(t) * [x(t) - m_i(t)] \quad (4)$$

where $a(t)$ - speed training $(0 < a(t) < 1)$;
$h_{wi}(t)$ - a function of neighborhood centered at neuron- 'winners';

$x(t)$ - the entrance to the t-th iteration.

Vector $x(t)$ is chosen from the sample on the *t*-th iteration randomly. The radius of training $h_{wi}(t)$ is a non-growing function of time (iteration) and describes the distance between neuron- 'winner' and neighboring neurons in the network. On the initial stage of mapping, the radius of training is big enough and decreases proportionally to the reduction of the response of neurons belonging to it on the input signal.

At the same time, the function of speed training can be described as:

$$a(t) = \frac{A}{(t + B)} \quad (5)$$

where A, B – are constants satisfying the condition $(0 < a(t) < 1)$.

The use of this function allows equalizing the contribution of all vectors included in the sample during the training. The main drawback of this method is its high sensitivity to the number and weight coefficients of the input parameters. To determine the concentration of funding we hypothesize that in the face of uncertainty about the role of a stakeholder for implementing the strategy of a separate bank it is not practical to artificially set the priorities on the initial stage of analysis (Kohonen, 1982). In addition, to improve the accuracy of the results, a certain proportion of assets and liabilities in their total volume can be used as input parameters to improve the accuracy of the research results. But in this case the neural network input layer is formed solely of those indicators that reflect the concentration of funding by the groups of stakeholders and currencies and tools (according to the recommendations of the Basel Committee), because while expanding the input data the sensitivity of the model to the change of primary indicators will decrease.

5. EMPIRICAL RESULTS

The result of the described operations is graphic Kohonen maps, which in this case consist of 10 clusters. One of the features of our approach is the inclusion of input for all periods of the study, so the results allow tracking the intensity of changes in the business models of banks based on the risk profile monitoring. At the same time, it must be stated that this approach identifies clusters as they existed during the research period. Due to ongoing market processes, however, banks since then may have switched market approaches or investment and funding strategies, or even left the market (see Table 4 of the Appendix).

The analysis allowed us to determine individual clusters, as well as to find a stable relationship between the business model and ownership structure. Moreover, this distinction is based not upon the formal, but the actual criterion of ownership. There were significant transparency issues for ownership structures of Ukrainian banks during the period of research as some banks disclosed only information about the formal beneficiary to avoid the dissemination of the information about the real owner (last beneficiary). To eliminate the influence of this factor, we used both official information represented on the central

bank website and own data search. For example, the owners of many Ukrainian banks are offshore companies owned by Ukrainian citizens. Regarding ownership, the risk profile of the bank will be similar to the risk profile of banks with Ukrainian capital and not similar to that of a foreign bank, because the primary owner who could influence the bank's decision-making is Ukrainian, and just acting via a vehicle that is located outside the country.

It should be noted that one group includes banks in which the state is the majority shareholder with shared ownership of less than 100 percent. Under Ukrainian law, a bank cannot be considered state-owned because of the presence of individuals and/or legal entities among shareholders. But their impact on a strategic solution, the formation of business models and, consequently, establishing of the risk profile is not essential because in fact, the behavior of these banks is similar to the behavior of state banks of the 2nd level.

Seen geographically, Russian is a form of foreign capital, but as the Russian players entered the Ukrainian banking market later than other foreign banks, and as the main shareholder of most Russian banks is their state or other state-owned companies, the goals they pursue will be different from those of private owners, who are predominant in other foreign banks. We will proceed with the analysis of the concentration of funding on certain indicators (see Figures 6-8 of theAppendix).

Most commonly, component planes and the U-Matrix, which both take only the prototype vectors and not the data vectors into account, are applied to visualize the map. Component planes show projections of individual dimensions of the codebook vectors. If performed for each component, they are the most precise and complete representation available. However, cluster borders cannot be easily perceived, and high feature space dimensions result in lots of plots, a problem that many visualization methods in multivariate statistics, like scatterplots, suffer from. The U-Matrix technique is a single plot that shows cluster borders according to dissimilarities between neighboring units. The distance between each map unit and its neighbors is computed and visualized on the map lattice, usually through color coding (Pölzlbauer, Dittenbach, & Rauber, 2006). The blue cells represent the vectors with a weak relation. The intensity of relation changes up to the red cells (see the scale at the bottom of each figure). Coloured figures can be obtained from the authors, but in the analysis below, we will indicate relevant clusters and explain their meaning. The borders of each cluster are built automatically, so it is clearly visible for each ratio. The intensity scales have various thresholds for different ratios. We did not aim to unify these borders for all input parameters as they might have a different contribution to the final characteristics of the particular cluster.

As shown by Figure 6 (see Appendix), the impact of political factors and growing uncertainty in the market led to excessive demand for cash among creditors. Only selected banks (PJSC 'Ukrinbank', PJSC 'Credit Dnipro Bank') concentrated funding for depositing in other banks. A high concentration of funds attracted from other banks is the feature of clusters 1, 5 and 8. These clusters include banks controlled by foreign companies

(mainly Russian). The further growth of the share of funds outsourced from Russia can lead to liquidity problems in the case unavailability of this source of funding.

As shown in Figure 7 (see Appendix), banks representing clusters 8 and 9 focus on active lending to individuals. This group includes almost all banks with foreign capital, but in the post-crisis period, their risk profile began to shift towards diversification of funding in order to reduce risk and expand presence in other segments of the market. This statement is supported by the transformation from the 8th to the 9th cluster.

It should be noted that particular conflicts of interest can arise in banks with a highly concentrated ownership structure, be it banks with private capital or those whose main shareholder is the state. Thus, according to Figure 7, all banks with state capital show a high concentration of risk in terms of investments in securities (clusters 6 and 7). This can be explained by the urgency to finance the Ukrainian budget deficit, so the state banks have to purchase government bonds. This data also gives reason to believe that the business model of state-owned and quasi-state banks vary in the same way. As already noted, there are several features associated with the PJSC 'Rodovid Bank' due to the specific status of the bank: the growth of investments in securities took place almost immediately after the recapitalization by the state, but after the bank received the status of remedial bank, the degree of concentration on this indicator decreased significantly. The domestic government bodies as the owners of PJSC 'Rodovid Bank' failed to develop the functions of a remedial bank effectively, so at the end of 2017, the liquidation procedure was initiated (DIF, 2017). This clearly confirms that banks that form unique clusters due to the specific structure of balance sheet structure are either special-purpose banks supported by the government or bound to be liquidated based on risky, non-market business models.

From the standpoint of attracting deposits from individuals almost all banks showed high or moderate concentration ratios during the observation period, except for banks of the 1st, 4th and 5th clusters, which are banks with Russian capital and banks with foreign capital. Under the pressure of their parent companies, they announced their withdrawal from the retail market or have lost a significant proportion of the portfolio of assets located in retail loans (PJSC 'ING Bank Ukraine', PJSC 'Credit Agricole Bank') while increasing their presence in the corporate banking segment. In addition, based on the results of the analysis, this group includes PJSC 'Vseukrainskiy Bank Rozvytku'. Due to the specific ownership structure (sole ownership) and political engagement of the shareholders this bank was focused on working with a limited number of entities, which determined its development strategy for the whole period of analysis.

As shown by Figure 8, the high level of concentration of loans to legal entities (cluster 7) is characteristic for banks with domestic capital, where a small number of shareholders are the majority (PJSC 'Brokbiznesbank', PJSC 'Finansova Initsiatyva Bank', PJSC 'Imexbank'). This increases the pressure on equity and liquidity due to increased credit risk,

because of the aggressive lending strategies, particularly when funds are granted in temporary use to the related parties of the bank. In this case, the proper balancing between the options of bank's financial independence and credit risk level of the bank owned by one person or group of persons, preference is usually given to the first option, endangering the existence of a bank as a whole (for example PJSC 'Brokbiznesbank').

Figure 10 (see Appendix) finally shows the results of the analysis of the risks connected to foreign currency.

It gives reason to believe that banks with Russian (cluster 5) and foreign (clusters 8, 9) capital are exposed to high-risk levels. At the same time, there is a transition of banks with foreign capital to the category of moderate risk, while the banks with Russian capital depend more heavily on foreign currency during the period of operation in the Ukrainian market. Extremely low shares of foreign currency assets and liabilities of banks with a high degree of concentration of ownership (clusters 4, 7) is very indicative. The observations support the existence of close ties with Ukrainian companies in a situation where one owner controls the bank's activities and the activities of these companies alike. In such circumstances, the bank can be classified as captive.

Taking into account the insights stated above, we have formed a matrix of funding concentration within the clusters (see Table 5 of the Appendix).

Thus, based on the construction of Kohonen maps, we determined risk profiles for each of the clusters, reflecting the banks' orientation to working with different groups of stakeholders, and determined that their business models are largely influenced by the owner's vision of achieving the strategic objectives of the bank.

6. CONCLUSIONS

Based on the analysis of public financial statements of Ukrainian banks with the help of Kohonen self-organizing maps, the paper empirically proves the existence of a close relationship between the structure of bank ownership (origin of the capital) and bank risk profile.

We analysed the public statements of banks from 2008 to 2013. This period was chosen because

in crisis and post-crisis years the behavior of domestic banks has undergone significant changes. Statistical data do not include the period starting with 2014, because during this period the activities of financial institutions were influenced by several unpredictable factors beyond economic consideration (such as political and military crises). We adopted the Basel Committee on Banking Supervision recommendations regarding the types of concentration of funding serving also as a basis for determining the risk exposure of banks: by currency (foreign currency assets/total assets; liabilities in foreign currency/total liabilities); by the instruments (securities/total assets); and by contractors (loans to banks/total assets; loans to individuals/total assets; loans to companies/total assets; bank debt/total liabilities; individuals' deposits/total liabilities; deposits of companies/total liabilities). These data were used as an input for the Kohonen maps in order to look into the relationship between bank ownership structure and risk profile.

It is shown that the ownership structure is not the only factor affecting the business model of the bank. Thus, the use of this criterion as an exclusive guide to clustering is impractical. So we confirm the necessity of further stages of qualitative transformation of banking supervision in Ukraine and countries with similar banking sectors should be directed to a more thorough specification of control regimes of the activities of financial intermediaries based on their risk profile, preferably with the help of the methodology that was developed in this paper. We believe that using Kohonen self-organizing maps is one particular achievement of this study. Although this approach has been rarely used in analyzing financial data so far, a couple of previous and current paper proves that SOM provides researchers with the effective visualization tool that, together with the knowledge of the market under analysis helps to systematize data in a simple and precise way. In order to have the possibility to replicate results of this study on the Ukrainian market or other markets, other researchers should possess knowledge on the specifics of the banking market so to interpret the SOM results correctly, so this might be also regarded as a limitation of the current study. Future research might be directed at analyzing data from various emerging markets, representing different geographical regions.

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APPENDIX

Table 1. Previous research

Author	Region/markets	Period of study	Ownership types			
			private owned banks		*state-owned banks*	
			Foreign	*Private (private domestic banks)*	*City and rural commercial banks (local Government controlled)*	*Central government-controlled banks*
Aymen (2014)	Tunisia	2000-2010	x	x	x	
Barry et al. (2009)	Europe	1999-2005		x	x	
Barry et al. (2011)	Europe	1999-2005		x	x	
Bouwens & Verriest (2014)	cross country	2000-2007	differentiated by the largest shareholder			
Cheng et al. (2013)	China	2001-2009	x		x	x
Chou & Lin (2011)	Taiwan	2001-2006	x		x	
Chun et al. (2010)	Korea and Japan	1997-2006	differentiated by managerial ownership			
Cooper & Uzun (2009)	banks within SNL bank Index	as of year end 2006	insider/ institutional ownership			
Dong et al. (2014)	China	2003-2011		x	x	x
Fungáčová & Solanko (2009)	Russia	1999-2007	x	x	x	
Iannotta & Nocera (2013)	Europe	2000-2009		x	x	
Laeven & Giovanni (2008)	cross country	1996-2001	x	x		
Lamy (2012)	USA	1997-2007	differentiated by the largest shareholder			
Lassoued et al. (2010)	Middle East & North Africa	2006-2012	x		x	
Lee (2008)	Korea	1999-2006	differentiated by insider ownership			
Marco & Fernandez (2007)	Spain	1993-2000			x	
Martínez & Ramírez (2011)	Colombia	1989-2009	x		x	x
Nicolò & Loukoianova (2007)	cross country	1993-2004	x	x	x	
Paligorova (2010)	cross country	2003-2006	differentiated by the largest shareholder			
Rahman & Rejab (2013)	Malaysia	2000-2011	x	x	x	
Riewsathirathorn et al. (2011)	East Asia	2004-2008	differentiated by ownership concentration			
Schmielewski & Wein (2013)	Germany	2000-2010	x	x	x	x
Tandelilin et al. (2007)	Indonesia	1999-2004	x	x	x	x
Tsapin (2010)	Ukraine	2003-2006	x		x	
Zhu & Yang (2016)	China	2004-2012	x		x	x

Table 2. Problems of banks with different predominant owners

Ownership structure	Problem areas
Banks with private Ukrainian capital	high level of loans issued to the related parties; dependence on the political conditions because PEPs (politically exposed persons) are the real owners of many banks; engagement of some banks in illegal activities (for instance money laundering);
Banks with state Ukrainian capital	interference of authorities with credit policy of the banks in order to solve current financial problems of the state budget; unclear role of the state banks in the economic processes; high level of government bonds in the structure of assets;
Banks with foreign capital	activity with losses due to high-risk appetite (fast credit expansion) and direct goals to take the market; loss of support of parent companies; possible exit from the market.
Banks with Russian capital	the high concentration of the assets connected to the services provided to the companies; the pressure of Russian politics on the credit policy of Russia banks in Ukraine and subordination of the banking business to the political aims;

Table 3. NBU recommendations on banks in groups 3 and 4

Cluster	Characteristics	Recommendations of the NBU
Market	Conduct classic banking business, do not perform questionable deals.	Continue business.
Inactive	Were established to be sold and in fact did not perform banking activity.	Should be sold or liquidated.
Captive	Serve only to their owners and are completely dependent on them.	Merge with 'market banks' or call for additional capitalisation by the related parties.
Risky	Perform a very risky activity.	Liquidation or change in the structure of the assets.
Criminal	Were established for the purpose of money laundering.	Should be liquidated by proper bodies.

Source: authors' construct based on the data of NBU

Table 4. Dynamic distribution of the banks of the 1st and 2nd groups according to the Kohonen maps based on the ownership structure

Name of the bank	01.01.2008	01.01.2009	01.01.2010	01.01.2011	01.01.2012	01.01.2013	01.01.2014
Privatbank	6	6	6	6	6	6	6
Oschadbank	3	3	10	10	10	10	10
Ukreximbank	5	5	5	10	10	10	10
Delta Bank	8	3	9	9	9	9	9
Prominvestbank	7	7	6	6	5	5	5
Ukrsotsbank	9	8	8	8	9	9	9
Raiffeisen Bank Aval	9	8	9	9	9	9	9
Sberbank of Russia	X	X	5	5	5	5	5
PUMB	3	2	9	9	2	6	6
Alfa Bank	2	2	5	5	5	6	6
Nadra Bank	8	8	8	8	8	9	9
VTB Bank	5	1	5	5	5	5	5
Finansy i Kredit Bank	9	9	9	9	9	6	6
Ukrsibbank	8	8	8	9	9	9	9
Ukrgasbank	3	3	10	10	10	10	10
VAB Bank	2	2	9	6	2	6	6
OTP Bank	8	4	9	9	9	9	9
Credit Agricole Bank (Index Bank)	3	7	7	4	9	4	4
Brokbiznesbank	3	2	2	6	6	6	7
Finansova Initsiatyva Bank	5	5	1	1	7	7	7
Pivdennyi Bank	7	7	6	6	6	6	6
Fidobank (SEB Bank)	2	2	8	8	8	10	10
Imexbank	2	3	1	7	7	7	7
ING Bank Ukraine	1	1	5	5	5	5	5
Forum Bank	3	2	5	6	6	6	6
Rodovid Bank	3	2	10	10	1	1	1
Hreschatyk Bank	2	2	6	6	6	10	10
Kyivska Rus' Bank	6	2	6	6	6	6	6
Zlatobank	X	4	5	2	2	6	6
Universalbank	8	8	8	8	8	9	9
Ukrinbank	6	6	2	2	6	2	2
Vseukrainskiy Bank Rozvytku	X	X	4	6	6	4	4
Credit Dnipro Bank	2	2	3	3	3	2	2
Pivdenkombank	2	2	2	2	6	6	6
BTA Bank	2	3	3	9	5	5	5

	Banks with private Ukrainian capital
	Banks with foreign capital
	Banks with state Ukrainian capital
	Quasi-state Ukrainian banks
	Banks with private Russian capital
	Banks with mixed capital (Ukrainian + foreign)
	Banks with mixed capital (private Ukrainian + state Ukrainian)
	Banks with mixed capital (Russian + foreign)

Source: Riabichenko (2015)
Note: Numbers in the table above refer to the clusters; amendment of numbers means the migration between various clusters.

Table 5. The matrix of funding concentration for individual indicators within separate clusters

Pattern	Index								
	Cb/A	Ci/A	Ce/A	S/A	Afc/A	Lb/L	Li/L	Le/L	Lfc/L
1			medium			high			
2	medium		medium		medium		medium		medium
3	high				medium		medium		medium
4			medium					high	
5			high		high	medium			high
6			medium		medium		high		medium
7			high				medium		
8		high			high	medium	medium		high
9		medium			high		medium		high
10			medium	high			medium		

Source: Riabichenko (2015)

Figure 1. Connection of Ownership structure and risk profile of a bank
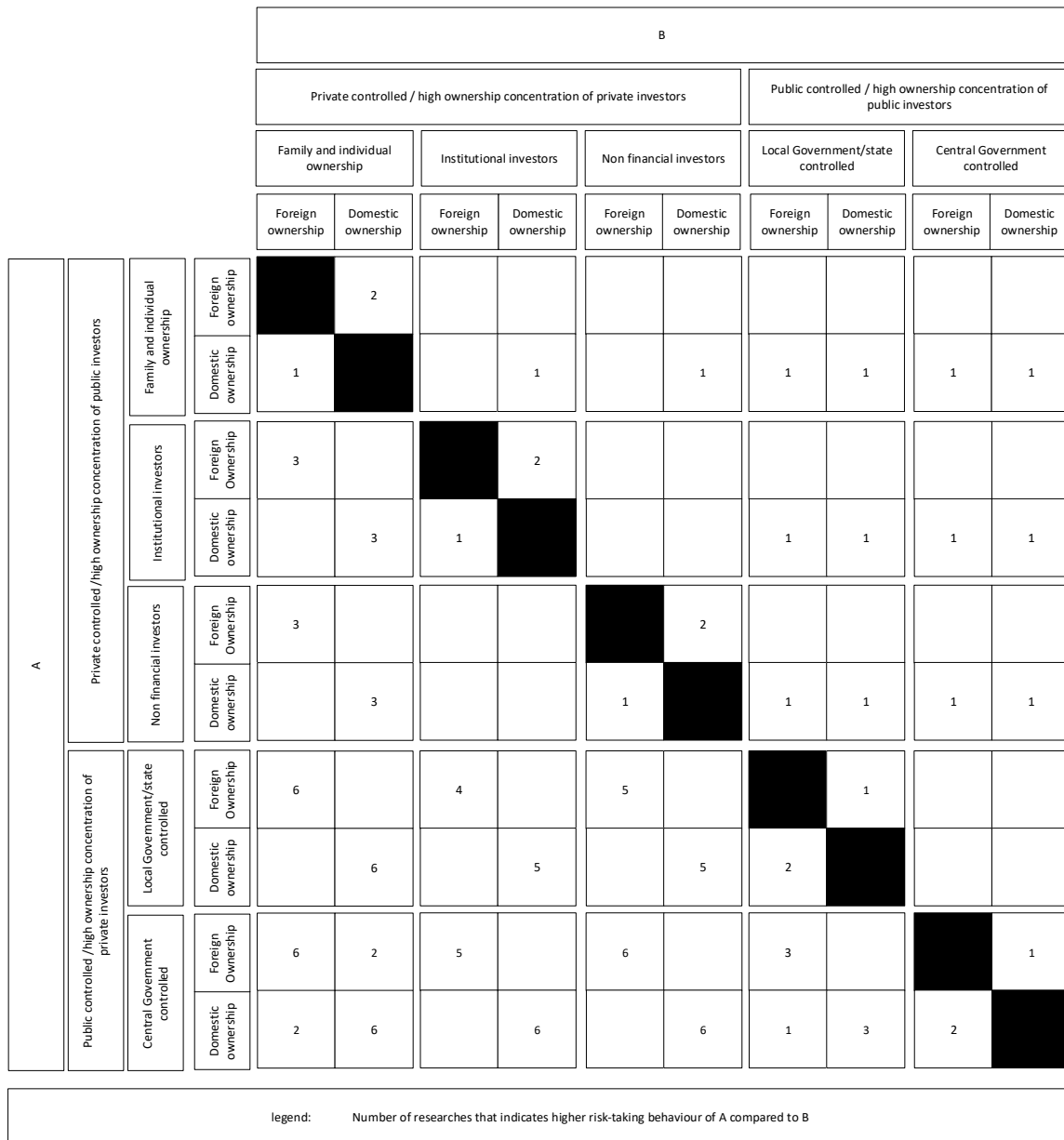
Figure 2. Ownership structure of Ukrainian banks
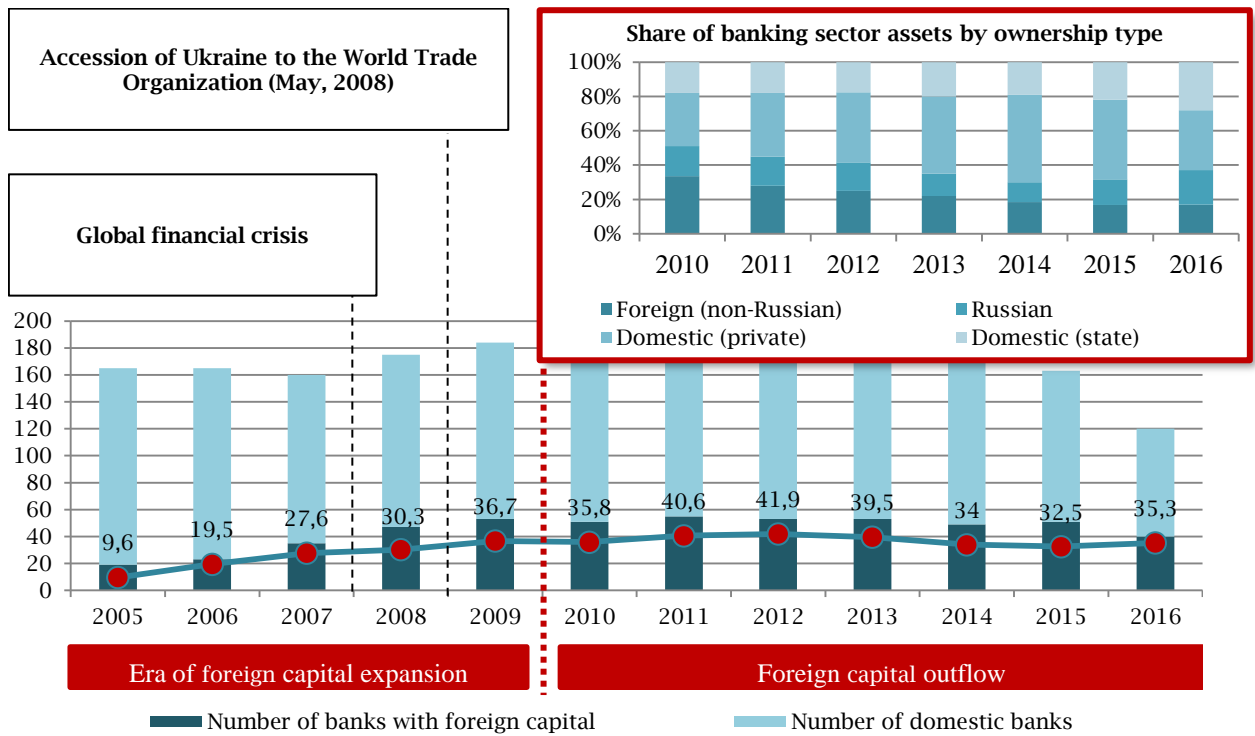
Source: NBU for period 2005-2009; Barisitz et al. (2015) for period 2010-2014; authors' calculations for period 2015-2016

Figure 3. Temporary administration (TA) of Ukrainian banks during 2014
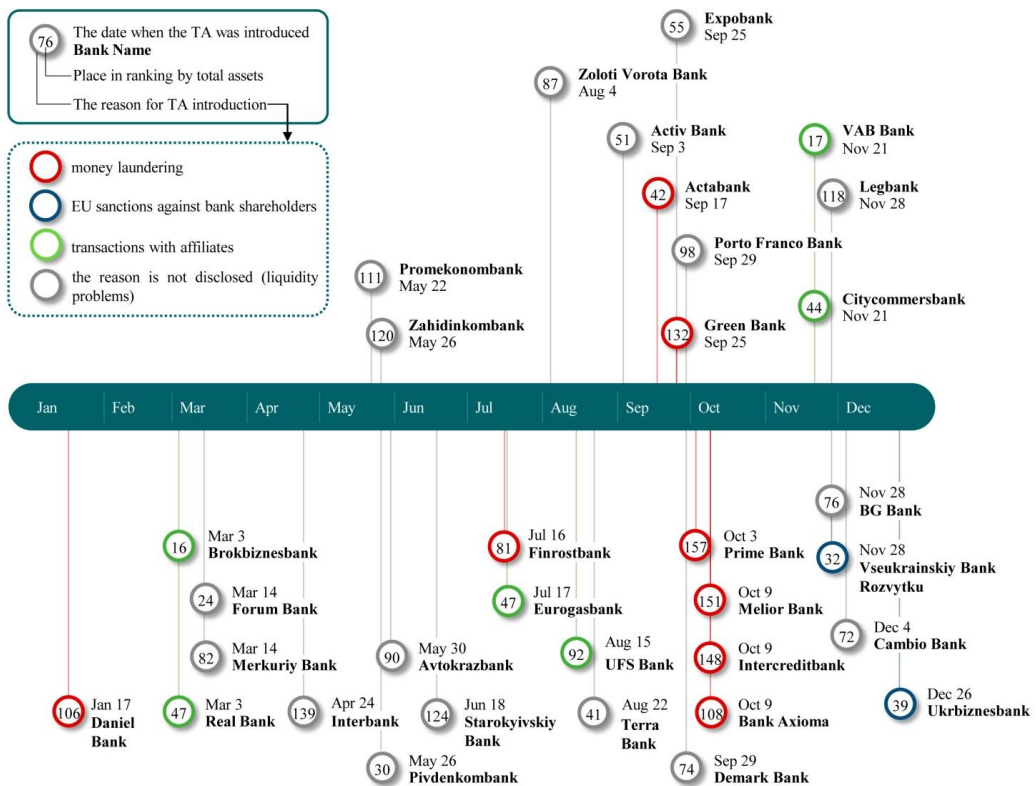
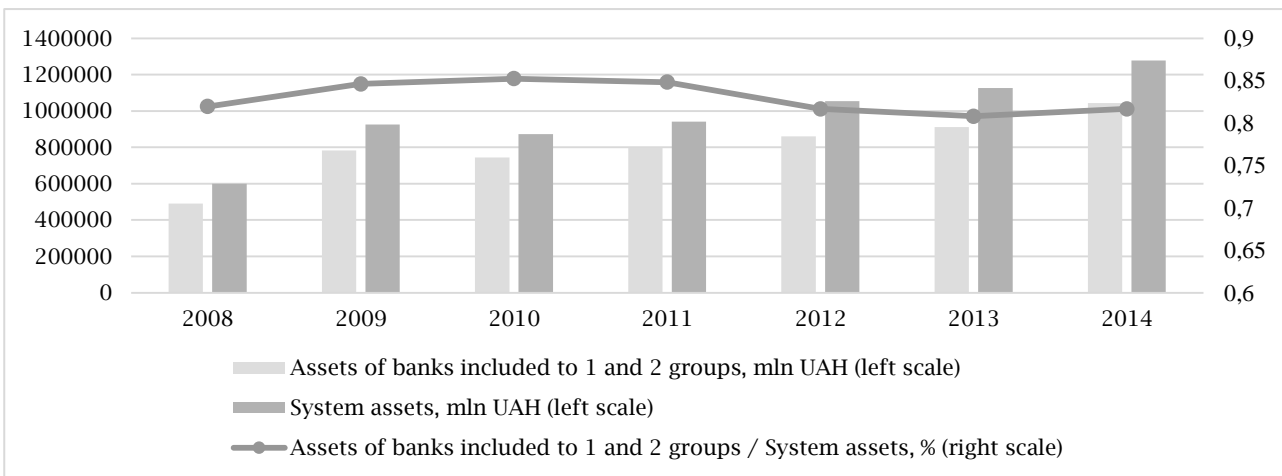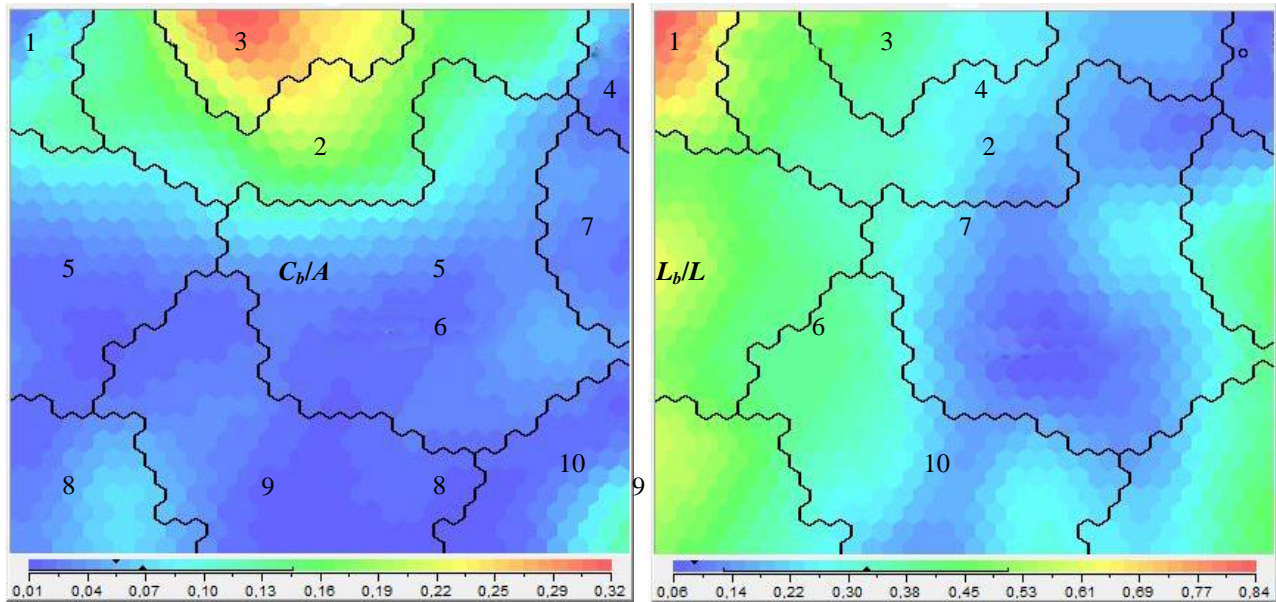**Figure 4.** Approaches to the supervision of the banks by the NBU
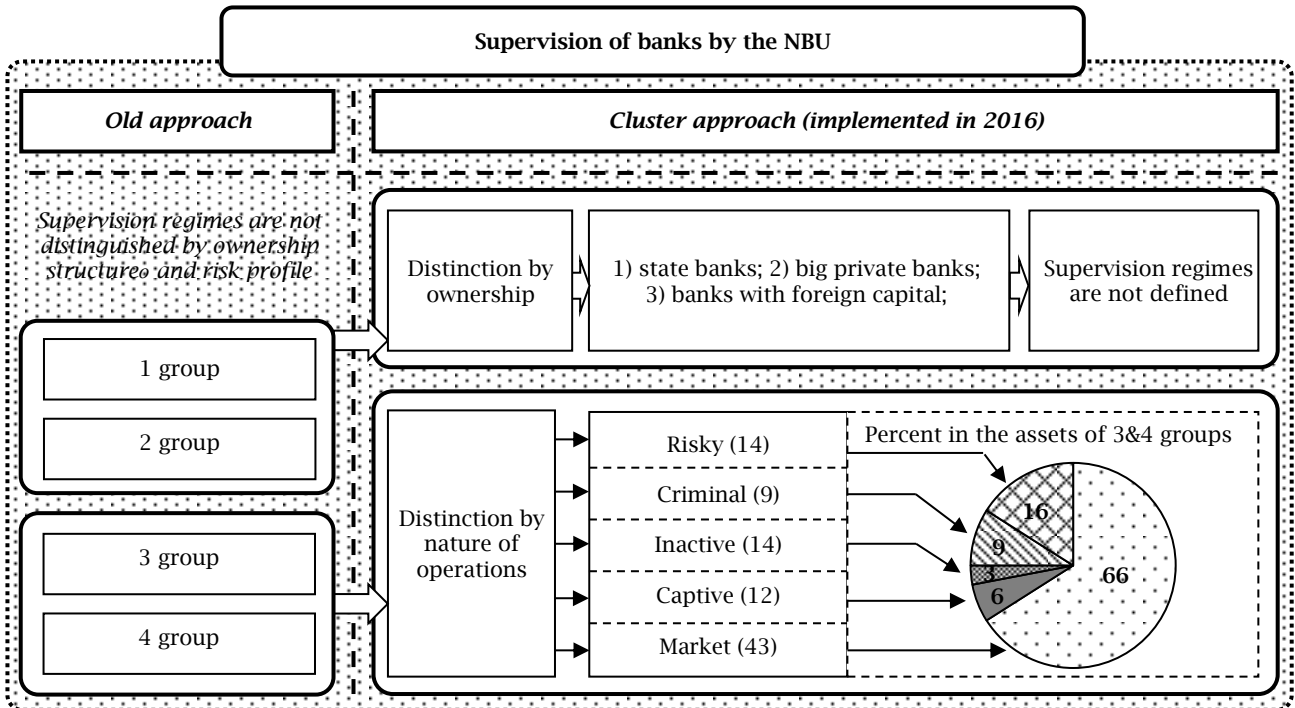
Figure 5. Assets of the banks in the 1st and 2nd groups compared to the total assets of the banking system from 01.01.2008 to 01.01.2014
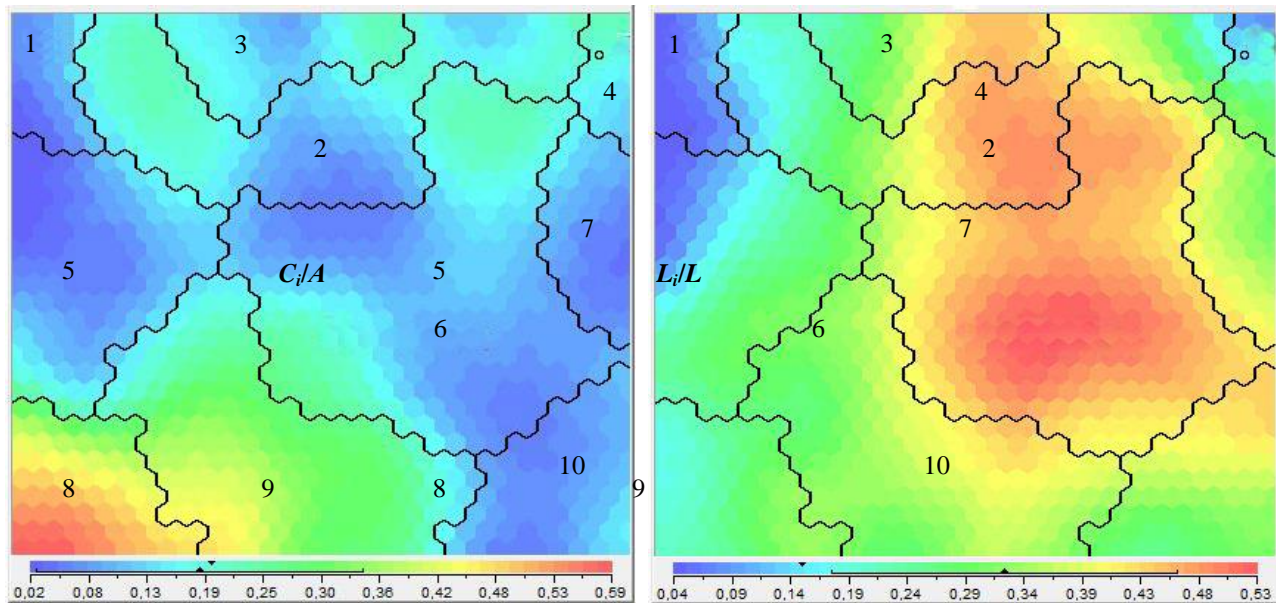

Source: National Bank of Ukraine

Figure 6. The level of concentration according to the indicators Cb/A, Lb/L inside the clusters formed with the help of Kohonen maps
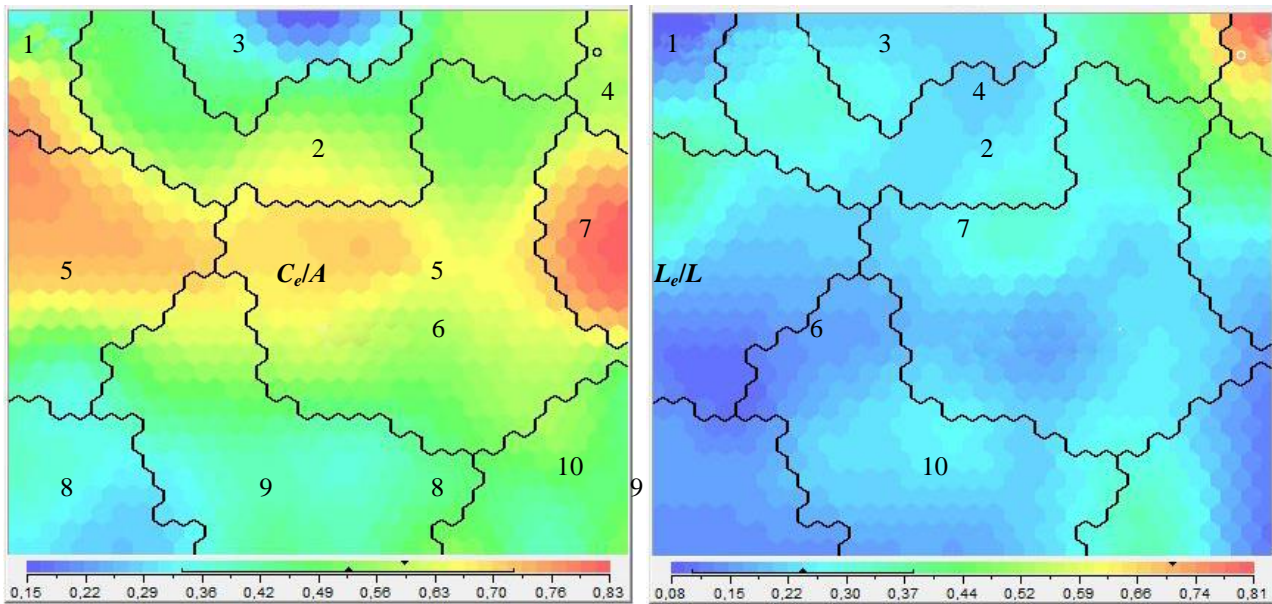

Source: Riabichenko (2015)

Figure 7. The level of concentration according to the indicators Ci/A, Li/L inside the clusters formed with the help of Kohonen maps
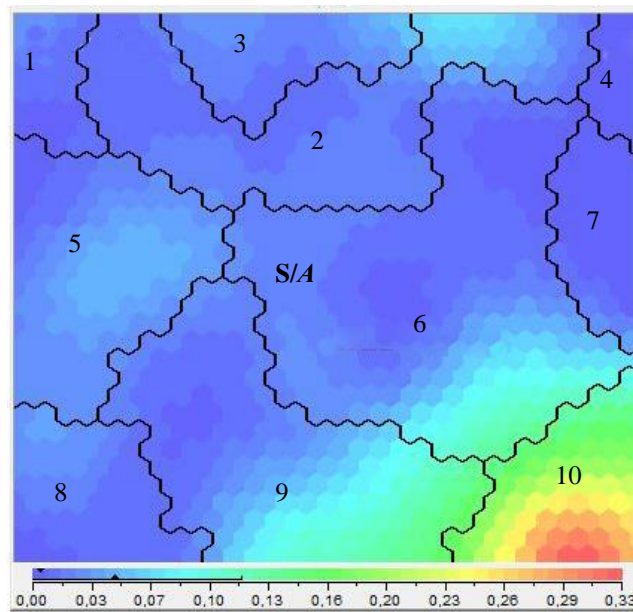

Source: Riabichenko (2015)

Figure 8. The level of concentration according to the indicators Ce/A, Le/L inside the clusters formed with the help of Kohonen maps
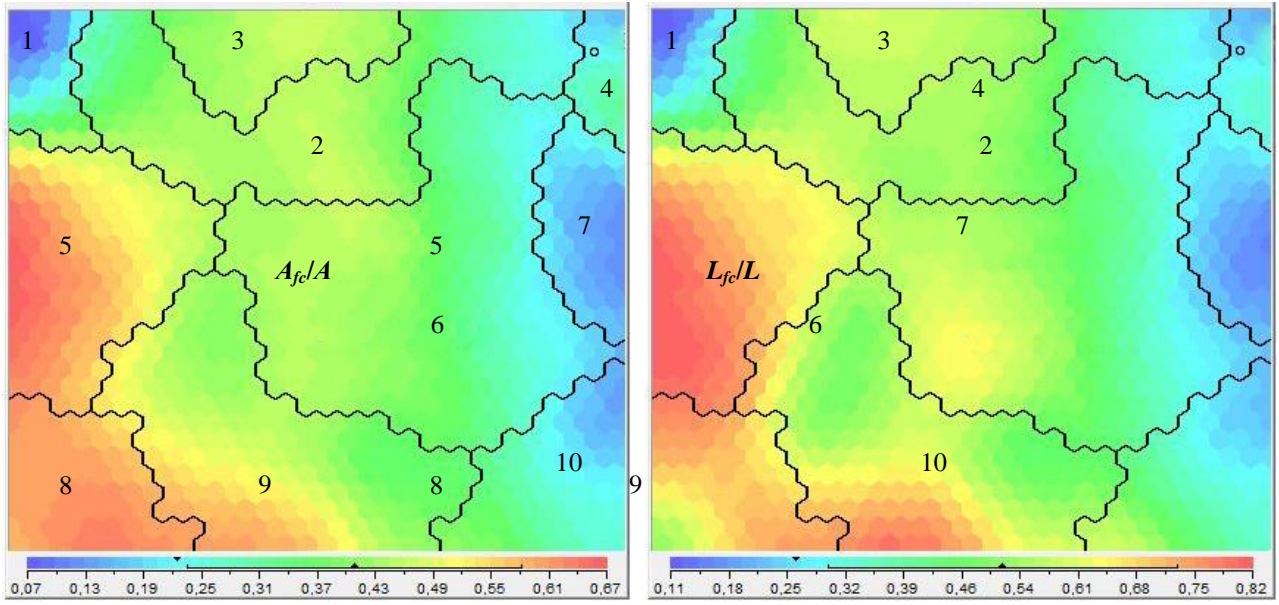
Figure 9. The level of concentration according to the indicator S/A inside the clusters formed with the help of Kohonen maps

Figure 10. The level of concentration according to the indicator Afc/A, Lfc/L inside the clusters formed with the help of Kohonen maps

Source: Riabichenko (2015)