

EFZG WORKING PAPER SERIES  
EFZG SERIJA ČLANAKA U NASTAJANJU  
ISSN 1849-6857  
UDC 33:65

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No. 15-02

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The article is published in *Financial Theory and Practice* (2015), Vol. 39, No. 1, pp. 57-82.  
doi: 10.3326/fintp.39.1.3

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### **Abstract**

Research on bank financial intermediation in a country's narrower territorial units is scarce, in both domestic and international literature. Banks are almost the only financial intermediaries in narrower territorial units and their role is substantial, ranging from participating in regional development to the successful running of their own business. Hence, the main objective of this paper is to examine the characteristics of the financial intermediation of banks in the counties of the Republic of Croatia, both through a comparison between their economic development levels and the general presence of financial intermediation, and a more specific analysis of their deposit and credit policies. The article uses hierarchical and non-hierarchical (k-means) cluster analyses to identify relatively homogeneous groups of counties based on sets of indicators of: economic environment, financial development and infrastructure and, at a more detailed level, the deposit and credit policies of banks. The research results suggest heterogeneity and diversity of bank policies across the counties and sets of indicators. Differences have been observed between developed and developing counties, as well as in approaches to banks' deposit and credit policies. The paper's findings encourage further research into these issues.

### **Key words**

bank financial intermediation and banks' business policies, counties, Republic of Croatia, cluster analysis

### **JEL classification**

G21, O16, O18

## 1 INTRODUCTORY NOTES

The importance of bank financial intermediation, as well as its contribution to and influence on economic growth and development have been the subjects of numerous studies. Theories about this matter range from there being no direct link between bank financial intermediation and economic growth to „the role of bank financial intermediation is neutral“, to „it has a significant influence on economic growth“. Bank financial intermediation at the regional level has been underrepresented in the research on contributions to regional economic growth and development. Commercial banks, as well financial institutions in private or state ownership, justifiably take as the purpose of their business the maximisation of shareholders' wealth, whereas regional development and balancing the levels of development of regions are left to the government's targeted regional policy. In the traditional European and underdeveloped bank-based financial sectors, banks are dominant financial intermediaries and, observed at the level of narrower territorial units, banks are the most important financial intermediaries. This is also due to a high concentration of financial flows around major financial centres and markets. The regional dimension of bank financial intermediation is primarily reflected in an efficient credit policy, deposit collection, performance of other financial transactions and provision of financial services. A bank's regional business policy is associated with the bank's overall business strategy, expansion of branches, investment in bank infrastructure, use of information technology, financial exclusion, profitability of certain smaller territorial units, regulatory framework and other business determinants, as well as the determinants of a relevant narrower territorial unit. The overall characteristics and importance of the banking business call for a revision of banking policies in the narrower territorial units of a country.

The main goal of this paper is to examine bank financial intermediation in the counties of the Republic of Croatia with respect to the economic development level, degree of financial intermediation and characteristics of the deposit and credit policies of banks. The objective of the statistical analysis is to identify relatively homogeneous groups of countries on the basis of four sets of indicators, in order to gain a picture of the territorial distribution and (inter)dependence of various characteristics of bank financial intermediation and economic environment. The paper uses descriptive statistics to analyse the created indicators, employing the hierarchical and non-hierarchical (k-means) cluster analysis method. According to the authors' knowledge, this is the first research paper in the Republic of Croatia to analyse the sectoral financial intermediation of banks and general operations of some of Croatian financial institutions at the county level. The results of such an approach and more extensive research may be used for the formulation of a regional economic policy, but they also reveal market potential and possibilities for creating better targeted banking policies at the county level in Croatia.

The paper consists of five parts. Part two, following the introductory notes, provides a broad overview of the domestic and international literature dealing with the issues of bank financial intermediation in narrower regional areas. Part three presents data and the research methodology, and part four sets out the research results, their interpretation and discussion. The conclusion summarizes key findings of the paper and recommendations for further research.

## 2 LITERATURE REVIEW

The subject of this paper is multidisciplinary and it includes a wide range of areas, from banks' business policies to financial intermediation and its connection with regional growth. International literature points to a lack of research on the impact of financial intermediation on regional development (Rodriguez-Fuentes, 1996; Dow, 1987; Crocco et al., 2010; and Burgstaller, 2013). This is due to limited access to data, but also due to the theoretical perception of a neutral role of money and financial intermediation in achieving economic growth. Relevant international and domestic studies can be divided into the groups of studies on:

- 1) the importance of bank financial intermediation for economic growth and, in narrower terms, the impact of bank financial intermediation on regional development;

- 2) banks' territorial business policies by banking activity;
- 3) the performance of economic policies in achieving regional development and reducing regional disparities, as well as in ensuring an optimal division of regions into narrower territorial units.

The first group of studies, dealing with the importance of bank financial intermediation for economic growth, were mainly conducted at the levels of different countries and financial systems. Among the most prominent works on this subject are those by Allen and Gale (1999), Levine (2002), Demirgüç-Kunt and Levine (2001) and Arestis et al. (2005). Levine provides one of the proofs that the structure and type of the financial sector are irrelevant and have no influence on economic growth. Neither the bank-based financial systems, predominantly oriented to financial intermediation through banks, nor the market-based ones, oriented to financial intermediation through the financial market, are directly correlated with economic growth. Instead of, importance of financial services and markets in whole is relevant for economic growth. He forms his conclusions using econometric testing on the regression models of growth (Levine, 2002).

Bađun (2009) made a thorough presentation and analysis of research on the influence of bank financial intermediation on economic growth. In her study, she indicates the conclusions of both research works demonstrating a positive impact of the degree of financial intermediation on economic growth and those showing no significant correlation in this respect. She concludes that, given the prevailing opinion that financial intermediation has a positive influence on economic growth, further research is necessary, with efforts focused on the study of the relationship between banks and the state (Bađun, 2009).

Valverde et al. (2007) examine the impact of financial intermediation on economic growth in the territorial units - the regions of Spain. They underline that such an analysis by regions of a country is more relevant, since regional data are more homogeneous, the regulatory and legal frameworks are the same and the financial systems are clearly defined and implemented. The research results obtained using the dynamic panel model on the example of the regions of Spain confirm a positive and significant correlation between the depth of bank intermediation and regional growth (Valverde et al., 2007). Rodriguez-Fuentes (1998) shows different perceptions of the impact of banking business on regional development. He argues that monetary and financial variables and their effects on regional economic growth are often excluded from studies dealing with regional policy, due to the acceptance of the perception that monetary policy is neutral to economic growth and a lack of monetary policy instrument at the regional level, as well as due to the assumption of a perfectly open market and capital mobility. He concludes, using the simple linear regression model, that banks can nevertheless influence regional development through credit availability.

Dow made a significant contribution to the study of financial intermediation and regional development, exploring the influence of monetary variables and financial intermediation on regional development. Based on a comprehensive presentation and analysis of different theoretical approaches and orientations, Dow (1987a) concludes that monetary policy and financial institutions have an active role in uneven regional development. She emphasizes that uneven regional development is the consequence of a series of economic policies and influences, including money and bank intermediation. Headquarters of banks located in financial centres create difficulties in borrowing funds for business entities in other regions, while households and enterprises in underdeveloped regions express a stronger preference for liquidity. She indicates that underdeveloped regions also prefer saving and liquidity maintenance in financial centres, thus further weakening their financial positions, given the lower availability of loans. She points to differences among regionally-specific banks and bank branches in financial centres with respect to liquidity management, credit policy and investment in securities (Dow, 1987a).

Crocco et al. (2010) analyse differences in the regional strategy of banks in Brazil. By means of an analysis of own indicators based on the accounting data on banking operations, they prove that the strategies of banks within the Brazilian banking system are heterogeneous by region, which increases

disparities in regional development. Fernandez de Guevara and Maudos (2009) analysed and mathematically modelled the influence of regional financial development and bank competition on company growth, using the example of Spanish counties (NUTS<sup>1</sup> 3). They concluded that companies in financially more developed counties with relatively considerable foreign funding grow faster. Burgstaller (2013) uses spatial regression analysis to explore bank penetration, market structure and bank operations in Austrian counties. He argues that less developed counties show higher borrowing rates and lower saving rates, whereas bank concentration has no effect on differences in interest rates among counties, profitability or bank efficiency. He emphasizes the importance of promoting uniform and equitable banking coverage in the counties. Colombo and Turati (2014) provide evidence of a strong and direct effect of economic and social characteristics of the NUTS 2 regions on bank industry concentration in Italy, as well as the agglomeration of acquiring banks in well-developed regions. Their methodology includes the probit and count data models.

The second group of papers is focused on the geographic aspect of the banking policy and the financial exclusion problem. Literature dealing with banking business does not attach too much importance to regional specificities of banks' business policies. There are studies on the geography of banking, information technologies, spatial price discrimination, asymmetric information problem, etc. (see Allesandrini et al., 2005 and Allesandrini et al. (ed.), 2009).

Using data from credit agreements of a major Belgian bank and a series of multiple regression analyses with and without dummy variables, Degryse and Ongena (2005) explore the impact of geographic distance on credit, taking into account the distance between a commercial borrower and its bank and between a commercial borrower and another (competitive) bank. Using a sample of over 15 thousand loans, mainly to small businesses, they notice a marked increase in interest rates on loans as the distance between borrowers and competitive banks grew, whereas an inverse relationship is observed between the costs of borrowing and the distance of the business entity from the crediting bank. They conclude that transportation costs, rather than asymmetric information, are likely to be the main source of the spatial price discrimination.

Leko (2011) points to the problems of regional development funding, as one of the issues of public interest. He demonstrates systematic approaches to funding for all purposes of public interest, employing different models, techniques and instruments including the state, specialized government financial institutions, as well as privately-owned financial institutions and financial markets. Egalitarian regional policy of banks is directly connected with the problems of financial exclusion and the conscious neglect of certain less profitable or riskier territories or population groups by private commercial banks (for more information, see Leko and Stojanović, 2011).

The third group of studies includes domestic papers on regional policy, most of them dealing with an optimal regional division into counties, as well as with a statistical division into NUTS 2 regions or criticism of the regional division of the Republic of Croatia (Lovrinčević et al., 2005; Kurnoga Živadinović, 2007; Žuljić, 2011; and Rašić Bakarić, 2005 and 2012). Most of the works rely on the methodology of multivariate statistical analysis, typically cluster analysis. There are also studies in the field of local finances, i.e. on fiscal equalisation and reducing disparities between municipalities and cities, city financing systems and decentralisation issues in cities, local budgets, fiscal relations between different levels of government and fiscal decentralisation (for more information, see Rašić Bakarić et al., 2014). Regional development in the Republic of Croatia has been the subject of numerous research works, e.g. Baletić et al. (1999), Čavrak (2002, 2003 and 2012), Puljiz (2009), etc. The aforementioned domestic papers do not use variables and data on financial intermediation at the county level, and the financial institutions and market segments are excluded from the analyses. One of the reasons for this is limited access to the data disclosed in statistical publications which still do not cover the financial institutions' operations at the level of narrower territorial units of the Republic of Croatia.

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<sup>1</sup> 'Nomenclature of territorial units for statistics (NUTS)' relates to a statistical classification system used for the collection, processing, analysis and publication of territorial statistical data at the European Union level.

### 3 DATA AND RESEARCH METHODOLOGY

The objective of the statistical analysis is to identify relatively homogeneous groups of counties on the basis of four sets of indicators, in order to gain a picture of the territorial distribution and (inter)dependence of the economic environment characteristics, the level of financial intermediation development and banks' credit and deposit policies. The following methodological approach is used:

- 1) 17 out of 23 indicators were selected and classified into four sets of indicators;
- 2) a descriptive statistical analysis of data was carried out;
- 3) standardisation of data was applied for the purpose of a cluster analysis using a standardised value  $z$ ;
- 4) hierarchical cluster analyses were carried out for the sets of indicators, including and excluding the City of Zagreb;
- 5) the robustness of the results was tested by using another measure of distance;
- 6) based on the number of clusters obtained through the hierarchical analysis and identified outliers, a non-hierarchical k-means cluster analysis was carried out; and
- 7) the results were statistically and economically processed, research limitations were highlighted and recommendations for further research were made.

Twenty Croatian counties including the City of Zagreb (hereinafter: counties) are analysed on the basis of 17 indicators classified into four groups standing for: 1) economic environment; 2) financial development level and infrastructure; 3) banks' deposit policies; and 4) banks' credit policies. Individual indicators in the aforementioned groups of indicators are usually used for measuring economic development, the degree of financial intermediation and banks' business policies, or have been created in order to take account of the specific characteristics of data and financial intermediation in the Republic of Croatia. All the indicators relate to 2011, because, given the limited access to data, this is the only year and the most recent period in which all the data overlap.<sup>2</sup> Selected studies, conducted in narrower territorial units in Croatia applying multivariate statistical analysis, also use data for a single year (Lovrinčević, Ž. et al., 2005; Rašić Bakarić 2005; Kurnoga Živadinović, 2007; and Rašić Bakarić, 2012).

Banking business indicators were obtained on a written request from the Croatian National Bank.<sup>3</sup> In addition to the banking business indicators, obtained from the Croatian National Bank, which make the bulk of data for the analysis, part of the data come from the publications and Internet sites of the Croatian Bureau of Statistics and Croatian Employment Service. While some of the indicators used in the analysis are presented in an explicit form, others have been created by putting the collected data into a relationship. The selection of indicators within the sets of indicators was theory-based, but the intention was also to select indicators with lower mutual correlation coefficients. The correlation coefficients of the selected indicators were lower than 0.7, whereas a correlation coefficient higher than that specified, but lower than 0.8, was recorded in only two cases.

A descriptive statistical analysis of the applied indicators has been carried out using the MS Office Excel program and the results are presented in Table 1. The descriptive analysis showed a great variety of counties observed on the basis of four sets of indicators. The variation coefficient of the population is as high as over 80%. The net salary data dispersion is small, but the mean GDP values

<sup>2</sup> On 14 February 2014, the Croatian Bureau of Statistics published on its Internet site the GDP data for 2011 by county.

<sup>3</sup>The data on assets and gross loans relate to counterparties from the Republic of Croatia, established or resident in a relevant county. In certain counties, net assets of banks are lower than the amount of gross loans. This discrepancy is due to the fact that banks' assets are expressed in net book amounts (reduced by value adjustments), while loans are expressed in gross book amounts in order to be used in the calculation of loan quality indicators. (Net) loans granted account for an average (arithmetic mean) of 94% of a county's assets. The assignment of counterparties (i.e. their seats or places of residence) to counties is based on a list published by Hrvatska pošta d.d. (Croatian Post) on its Internet site. However, there are certain instruments (e.g. cash, goodwill, general reserves for risk category A placements, etc.), where the bank is obliged to indicate itself as the counterparty. Therefore, these instruments are allocated to the county where the relevant bank has its seat). Furthermore, some instruments (such as deposits with the Croatian National Bank) are fully allocated to a single county, in our case the City of Zagreb (CNB, 2014).

per capita and unemployment rates are not representative. The indicator of the share of investments in long-term assets intended for financial and insurance activities in GDP reveals extremely large differences among counties with respect to the financial development level and infrastructure. The minimum value is 0.01 and the maximum is as high as 3.2%.

*Table 1. Descriptive statistical analysis results by set of indicators, by county*

<b>Set of indicators</b>	<b>Indicator</b>	<b>Average</b>	<b>Median</b>	<b>Standard deviation</b>	<b>Min.</b>	<b>Max.</b>	<b>Variation coefficient %</b>
<i>Economic environment</i>	Gross domestic product per capita, in thousands of HRK (the 2011 census)	76.8	60.1	24.5	43.7	137.6	32.0
	Net salary, in HRK	5,014	4,985	440	4,380	6,359	8.8
	Population, in thousands	204.0	158.3	165.5	50.7	790.9	81.2
	Unemployment rate, %	22.4	22.3	7.0	9.4	33.8	31.4
<i>Financial development level and infrastructure</i>	Net assets/GDP, %	112.1	69.6	0.4535	52.0	187.3	40.5
	Number of inhabitants per branch, in thousands	3.4	3.3	1.1	1.1	6.0	33.8
	Number of inhabitants per ATM, in thousands	1.1	1.4	0.6	0.3	2.2	52.8
	Banks' assets per capita, in thousands of HRK	86.0	41.3	57.7	29.8	257.6	67.1
	Investments in new long-term assets intended for financial and insurance activities/GDP, %	1.2	0.1	0.0111	0.01	3.2	94.0
<i>Deposit policies</i>	Loans/deposits	1.28	1.36	0.3730	0.79	2.07	29.1
	Deposits per capita, in thousands of HRK	52.8	31.3	26.2	17.4	110.4	49.6
	Foreign exchange deposits in total deposits, %	66.6	68.7	0.0629	59.2	78.7	9.4
<i>Credit policies</i>	Share of loans to households in total loans, %	44.0	60.3	0.1543	27.1	72.1	35.1
	Share of CHF-denominated loans in total loans, %	10.9	13.2	0.0431	7.3	22.7	39.5
	Share of EUR-denominated loans in total loans, %	63.6	58.5	0.0562	54.3	69.3	8.8
	Share of non-performing loans in total loans, %	12.4	13.4	0.0219	10.9	17.8	17.7
	Share of mortgage loans in total loans to households, %	49.3	43.2	0.0981	32.3	59.0	19.9

*Source: Authors' compilation.*



All the other indicators from this group confirm regional disparities. The range of variation in deposits per capita stands at 93 thousand, suggesting a relatively large territorial disparity in the deposit policy characteristics. However, deposit transactions of banks in terms of currency features are not characterised by spatial disparity. The indicators of the share of non-performing loans in total loans, the share of euro-denominated loans in total loans and the share of mortgage loans in total loans to households suggest relative territorial consistency of the credit policy. By contrast, as shown by indicators of the share of loans to households in total loans and the share of Swiss Franc-denominated loans in total loans, data dispersion around the mean value is significant. The territorial consistency of the currency features of deposit and credit policies, measured by a lower amount of the variation coefficient, confirms a high share in and the relatively uniform distribution of dollarization (euroisation) across the Croatian banking system.

While carrying out a cluster analysis account should be taken of the units of variable measurement. If they are different, any measure of distance will affect the contribution of variables measured by larger units of measurement. Therefore, the standardisation of data for the analysis was carried out using the standardised value  $z$ , which is why the deviations of the variable values from its mean value are expressed in terms of units of standard deviation.

In order to classify Croatian counties as the observed units into larger and more homogeneous (as concerns the observed characteristics) spatial units, the hierarchical cluster analysis method was initially applied. Hierarchical cluster analysis methods are characterised by hierarchy development; it should be differentiated between agglomerative and divisive methods. This paper uses the agglomerative method which consists of four basic steps (Rašić Bakarić, 2010):

- 1) The algorithm starts with  $n$  clusters, each containing one object and a symmetric distance matrix with a row  $n \times n$ ,  $D = [d_{ik}]$ ;
- 2) Within the distance matrix the closest (most similar) pair of clusters is looked for. Let the distance between the „most similar“ clusters U and V be marked with  $d_{UV}$ ;
- 3) The U and V clusters merge and the elements of the distance matrix are calculated again in the way that rows and columns corresponding to clusters U and V are deleted, and rows and columns containing the elements of the value of distance between the U and V clusters and the remaining clusters are added.
- 4) Steps 2 and 3 are repeated  $n-1$  times. After the algorithm terminates, all objects will be in a single cluster.

Ward's variance method was used, with clusters defined by minimising the variance within a cluster. This method involves computing the information loss incurred when objects are grouped into clusters, and is based on the application of squared Euclidean distance where the distance between objects is expressed as a sum of squared differences between the values of objects:

$$u_{AB} = \sum_{i=1}^p (A_i - B_i)^2 .$$

Ward's method of the distance between two clusters is expressed as follows:

$$u_{AB} = \frac{|\bar{x}_A - \bar{x}_B|^2}{\frac{1}{N_A} + \frac{1}{N_B}}$$

where  $\bar{x}_A$  is the mean of cluster A,  $\bar{x}_B$  is the mean of cluster B,  $N_A$  is the number of objects in cluster A, and  $N_B$  the number of objects in cluster B. Ward's method involves the calculation of the mean of all variables for each cluster. Then, the squared Euclidean distance between the cluster centres is calculated for each cluster and the obtained distances for all objects are summed up. As the number of defined clusters grows the total sum of squares of deviations increases. In each step, two clusters are merged into a new cluster whose merging contributes the least to an increase in the total sum of squared Euclidean distances within the new cluster (Kurnoga Živadinović, 2007).

The results of the hierarchical cluster analysis are shown in a dendrogram. Despite the lack of strict rules on determining the number of clusters, which has often been subject to review, the number of clusters in a hierarchical analysis can be determined using a cut-off value, either by means of an inconsistency ratio or a distance-based criterion (Halaj and Zochowski, 2009). Kurnoga Živadinović (2007) offers some guidance on determining the number of clusters, given that a hierarchical analysis results in multiple solutions. She first specifies theoretical and practical knowledge that can help in deciding on the number of clusters. Then she suggests the use of a dendrogram to identify a great change in the distance at which clusters are merged, noting that the relative size of clusters may also be relevant. She emphasizes that the final choice of the number of clusters is subject to the subjectivity of the researcher and that it is therefore necessary to supplement the empirical opinion by theoretical knowledge that may suggest a natural number of clusters. The number of clusters is identified on the dendrogram based on the distance criterion, i.e. a great change of distance during the cluster merger. In this respect, the second greatest change of distance on the dendrogram was identified and taken as a critical change. The second greatest change of distance determines the number of clusters in the way that the clustering that it generates is not considered satisfactory, i.e. the number of clusters is determined by moving a step backwards.

The robustness of the hierarchical cluster analysis using Ward's method with squared Euclidean distances can be tested by applying another measure of distance (Halaj and Zochowski, 2009). In our case, the testing was done by means of a hierarchical cluster analysis based on Ward's method using Chebyshev's distance, and the obtained results were compared. Chebyshev's distance is the maximum absolute difference between the values of two objects (Kurnoga Živadinović, 2007):

$$u_{ab} = \text{MAX}_t |A_t - B_t|.$$

A non-hierarchical (k-means) cluster analysis was conducted in accordance with the results of the hierarchical cluster analyses. A k-means analysis requires a predefined number of clusters, and its main characteristic is the possibility for objects to move from one cluster to another.

The clustering process using the k-means method consists of several steps. First, objects are partitioned into  $k$  initial clusters, and then each object is assigned to a cluster with the closest centre. Once an object joins or leaves the cluster, a new centre of the cluster and new distances are calculated, and the assigning is performed. This operation is repeated until the goal of minimising variability within clusters and maximising variability between clusters is accomplished (Rašić Bakarić, 2010). The described procedure is repeated until the selection of the centres of clusters enabling the grouping of all objects into  $k$  clusters, which results in the highest significance of ANOVA results (Lovrinčević et al., 2005). To calculate inter-cluster distances using the k-means method, the Euclidean distance is calculated on the basis of the centres the clusters have in distance dimensions.

The distance between two objects or cluster centres is the following:

$$D_{ij} = \sqrt{\frac{\sum(x_i - x_j)^2}{BD}}$$

where  $x_i$  is the value of an object variable  $i$ ,  $x_j$  the value of an object variable  $j$ , and  $BD$  is the number of dimensions (Rašić Bakarić 2010).

Unlike the hierarchical method, the non-hierarchical method allows an object to leave a cluster and join another one, if this contributes to meeting the clustering criteria. Consequently, the stability and reliability of results appear to be the main advantages of the hierarchical approach (Rašić Bakarić, 2010). Moreover, this method allows the analysis of more data and ensures more accuracy, since the starting point is given. A disadvantage is lower flexibility, i.e. a limited possibility to apply different distance measures, so that it is sometimes difficult to determine *a priori* the number of clusters (Kurnoga Živadinović, 2007). However, a combination of the two methods yields the best results, i.e. first the hierarchical method is used to determine the number of clusters and outliers and then, after

removing the outliers, a k-means analysis is carried out (Rašić Bakarić, 2010). This approach has been applied in our research work.

#### 4 RESEARCH RESULTS AND DISCUSSION

Hierarchical and non-hierarchical cluster analyses were conducted using SPSS software tools. The hierarchical cluster analyses was carried out by means of two groups of data, where one group was obtained by leaving out one observed unit from the other group, i.e. one group of data included all the 21 counties, whereas the City of Zagreb was excluded from the other group. In the first testing (including the City of Zagreb), using the hierarchical cluster analysis based on Ward's method with squared Euclidean distances, the City of Zagreb was singled out into a separate cluster and an outlier in all sets of indicators, except the set 'deposit policies', where the City of Zagreb shared the same cluster with the Istria County. Consequently, Table 2 shows the results of the second cluster analysis testing excluding the City of Zagreb for all sets of indicators, except that of 'deposit policies' which included the City of Zagreb. According to a cut-off value based on the second greatest change of distance, a three-cluster solution has been acceptable for all the sets of indicators.

Table 2. Cluster assignment of counties in a hierarchical cluster analysis

Cluster	County			
	Economic environment	Financial development level and infrastructure	Deposit policies	Credit policies
I	Bjelovar-Bilogora	Bjelovar-Bilogora	Dubrovnik-Neretva	Karlovac
	Brod-Posavina	Karlovac	Karlovac	Koprivnica-Križevci
	Osijek-Baranja	Krapina-Zagorje	Lika-Senj	Lika-Senj
	Požega-Slavonia	Koprivnica-Križevci	Međimurje	Sisak-Moslavina
	Sisak-Moslavina	Međimurje	Primorje-Gorski Kotar	Split-Dalmatia
	Virovitica-Podravina	Osijek-Baranja	Split-Dalmatia	
	Vukovar-Srijem	Požega-Slavonia	Šibenik-Knin	
		Sisak-Moslavina	Zadar	
		Varaždin		
	Virovitica-Podravina			
II	Krapina-Zagorje	Brod-Posavina	City of Zagreb	Brod-Posavina
	Međimurje	Vukovar-Srijem	Istria	Krapina-Zagorje
	Varaždin			Međimurje
				Šibenik-Knin
				Varaždin
				Vukovar-Srijem
			Virovitica-Podravina	
III	Dubrovnik-Neretva	Dubrovnik-Neretva	Bjelovar-Bilogora	Bjelovar-Bilogora
	Istria	Istria	Brod-Posavina	Dubrovnik-Neretva
	Karlovac	Lika-Senj	Koprivnica-Križevci	Istria
	Koprivnica-Križevci	Primorje-Gorski Kotar	Krapina-Zagorje	Osijek-Baranja
	Lika-Senj	Split-Dalmatia	Osijek-Baranja	Požega-Slavonia

	Primorje-Gorski Kotar	Šibenik-Knin	Požega-Slavonia	Primorje-Gorski Kotar
	Split-Dalmatia	Zadar	Sisak-Moslavina	Zadar
	Šibenik-Knin	Zagreb	Varaždin	Zagreb
	Zadar		Virovitica-Podravina	
	Zagreb		Vukovar-Srijem	
			Zagreb	

*Note: The results for the set of indicators 'deposit policies' include the City of Zagreb; the results for all the other sets of indicators exclude the City of Zagreb.*

*Source: Authors' compilation.*

Robustness testing of the hierarchical cluster analysis using Ward's method with squared Euclidean distances produced satisfactory results. The three-cluster solution was partially called into question for the set of indicators 'economic environment', because the application of Ward's method using Chebyshev's distance based on the criterion of the second greatest change of distance on the dendrogram resulted in identifying four clusters. The tests fully confirmed the first cluster; only one new member was added to the second cluster, and the third cluster was divided into two smaller ones. Clusters formed in the set of indicators 'financial development level and infrastructure' were fully confirmed by the tests. Clustering based on Chebyshev's distance fully confirmed the obtained number of clusters and 75% of the cluster assignment of counties according to the deposit policy characteristics. The robustness tests of grouping of the set of indicators 'credit policies' confirmed three clusters, with deviations in cluster assignments for only two counties (10%).

The findings of the hierarchical cluster analysis relating to the number of clusters and outliers were used for the development of a non-hierarchical k-means cluster analysis. The non-hierarchical k-means analysis of all sets of indicators was carried out for three clusters; the City of Zagreb, as an outlier, was excluded from the analyses with respect to all sets of indicators except the set 'deposit policies'. The clustering process using the k-means method was carried out in two iterations for the sets of indicators 'economic environment' and 'deposit policy characteristics', whereas the grouping in the set of indicators 'credit policies' was done in three, and in the set of indicators 'financial development level and infrastructure' in five iterations. The analysis of the classification of Croatian counties in three clusters using the non-hierarchical k-means method provided the results of the cluster assignment of counties shown in Table 3; a more detailed presentation is given in an ANOVA table in the Appendix.

*Table 3. Cluster assignment of counties in a non-hierarchical k-means cluster analysis*

Cluster	County			
	Economic environment	Financial development level and infrastructure	Deposit policies	Credit policies
I	Dubrovnik-Neretva	Koprivnica-Križevci	City of Zagreb	Bjelovar-Bilogora
	Istria	Međimurje	Istria	Karlovac
	Primorje-Gorski Kotar	Osijek-Baranja		Koprivnica-Križevci
	Split-Dalmatia	Požega-Slavonia		Lika-Senj
	Zadar	Varaždin		Osijek-Baranja
		Virovitica-Podravina		Primorje-Gorski Kotar
				Sisak-Moslavina
				Split-Dalmatia
			Varaždin	

				Zadar
				Zagreb
<b>II</b>	Bjelovar-Bilogora	Bjelovar-Bilogora	Bjelovar-Bilogora	Brod-Posavina
	Brod-Posavina	Brod-Posavina	Koprivnica-Križevci	Krapina-Zagorje
	Karlovac	Karlovac	Krapina-Zagorje	Međimurje
	Osijek-Baranja	Krapina-Zagorje	Osijek-Baranja	Šibenik-Knin
	Požega-Slavonia	Sisak-Moslavina	Sisak-Moslavina	Virovitica-Podravina
	Sisak-Moslavina	Vukovar-Srijem	Varaždin	Vukovar-Srijem
	Šibenik-Knin		Virovitica-Podravina	
	Virovitica-Podravina		Vukovar-Srijem	
	Vukovar-Srijem			
<b>III</b>	Koprivnica-Križevci	Dubrovnik-Neretva	Brod-Posavina	Dubrovnik-Neretva
	Krapina-Zagorje	Istria	Dubrovnik-Neretva	Istria
	Lika-Senj	Lika-Senj	Karlovac	Požega-Slavonia
	Međimurje	Primorje-Gorski Kotar	Lika-Senj	
	Varaždin	Split-Dalmatia	Međimurje	
	Zagreb	Šibenik-Knin	Požega-Slavonia	
		Zadar	Primorje-Gorski Kotar	
		Zagreb	Split-Dalmatia	
			Šibenik-Knin	
			Zadar	
		Zagreb		

*Note: The results for the set of indicators 'deposit policies' include the City of Zagreb; the results for all the other sets of indicators exclude the City of Zagreb.*

*Source: Authors' compilation.*

In the set of indicators 'economic environment', unemployment rate (with the highest F-ratio) contributes the most to the clustering solution. All the indicators are significant at a significance level of 5%, except for the indicator of population. In the set of indicators 'financial development level and infrastructure', the largest contributors to the clustering solution are 'number of inhabitants per branch' and 'number of ATMs per branch'; the variables 'net assets/GDP' and 'investments in new long-term assets intended for financial activity' are not significant at the significance levels of 5% and 10% respectively. The set of indicators 'deposit policies' is greatly determined by the indicator 'deposits per capita', although all the indicators have high F ratios. Therefore, differences among clusters are significant. In the group of indicators 'credit policies', the largest contributors to the clustering solution are the 'share of non-performing loans in total loans' and the 'share of CHF-denominated loans in total loans'. The variables 'share of EUR-denominated loans in total loans' and 'share of loans to households in total loans' are not significant at the significance level of 5%, and the latter variable is additionally insignificant at the significance level of 10%. A possible explanation for this is greater diversity of counties, which is also shown by the hierarchical cluster analysis dendrogram where the third, and even fourth and fifth greatest distance changes are still relatively great.

A comparison of the results, obtained through the hierarchical and non-hierarchical k-means cluster analyses, shown in Tables 2 and 3, suggests partial correspondence between the results. Full correspondence exists with respect to the set of indicators 'financial development level and infrastructure' in the third cluster and the set of indicators 'deposit policies' in the part of the cluster

relating to the City of Zagreb and Istria County. Overlapping can be observed in all sets of indicators and the created indicators. However, clusters differ in the number of counties assigned to them and in structure. Since the hierarchical cluster analysis, as part of the methodology employed in this research, was primarily used to select the number of clusters for a non-hierarchical k-means method and to identify outliers (according to Rašić Bakarić, 2010), the results and clustering solutions based on the k-means method will have the overriding importance in the economic interpretation of results.

Based on the analysis carried out, the following economic and financial interpretations of the results can be discussed:

- The City of Zagreb stands out as an outlier and the most developed narrower territorial unit in the Republic of Croatia according to all indicators. Only in the set of indicators 'deposit policies' it formulates a clustering solution together with the Istria County. This is due to the economic power of the City of Zagreb, and, primarily, to the structure of the banking sector and the headquarters of banks that are predominantly located in the City of Zagreb, and are only rarely located regionally. Consequently, as concerns banking operations, the City of Zagreb provides a great number of additional financial services, whereas the business of banks in other territorial units has generally been reduced to deposit and credit transactions.
- The Dubrovnik-Neretva, Istria, Primorje-Gorski Kotar, Split-Dalmatia, and Zadar Counties can be generally characterised as developed counties, according to both the set of indicators of economic environment and other sets of financial indicators. With respect to financial intermediation, these counties are characterised by well-developed financial infrastructures, loan-to-deposit ratio lower than 1, larger shares of foreign exchange deposits in total deposits and larger shares of CHF-denominated loans in total loans than other counties. However, no major differences compared with other counties have been observed in the quality of the loan portfolio and the sectoral structure of loans. The increase in the share of CHF-denominated loans can be accounted for by the economic cycle in the Republic of Croatia and growth in residential construction during the pre-crisis years, and, after the outbreak of the financial and economic crisis and its escalation, by high non-performing loan ratios in these counties.
- Counties that are underdeveloped in terms of economic characteristics and financial development level and infrastructure generally record higher loan-to-deposit ratio, larger shares of non-performing loans in total loans, lower deposit amounts per capita, poorer financial infrastructure and lower levels of development. These findings correspond to the findings of international studies (Burgstaller, 2013), and they necessitate further review of the impact of banks' credit policies and inflows of funds into underdeveloped counties and the ensuing potential influence on economic growth. Moreover, they highlight an interesting aspect of banks' operations in the Republic of Croatia, i.e. that banks do not avoid underdeveloped counties, but rather invest in them and feed additional funds to them in excess of these counties' collected deposit bases. The above said is contrary to some studies (Dow, 1987a) on the outflows of funds from periphery areas to the cities where banks' headquarters are, as well as to the prevailing public opinion in the Republic of Croatia; hence, it should be further reviewed, including additional variables and indicators.
- Common characteristics of the banking system as concerns high dollarization (euroisation) of banks' deposit and credit policies are consistent at the county level.
- According to the k-means analysis results for individual sets of indicators, clusters can be assigned characteristics, depending on the counties they represent (developed, medium-developed and underdeveloped counties). However, in all sets of indicators counties are not always included in clusters representing the same level of development. This confirms that counties are specific in respect of the observed sets of indicators, which is the consequence of the counties' economic development, their demographic characteristics and economic structures, as well as of the banking policy targeting and differences in the market potential, expressed in the set of indicators 'financial development level and infrastructure'. This finding emphasizes the importance of undertaking further more specific and targeted research.
- There are pronounced disparities and discrepancies in clustering solutions and cluster assignments of counties for the sets of indicators 'deposit policies' and 'credit policies';

- Heterogeneity of counties according to different sets of indicators has been observed, which also highlights the importance of further research.
- The results point to a need to include the data on the financial intermediation of financial institutions in regular statistics and to publish it, as well as to stress the importance of financial intermediation of banks and other financial institutions for regional development.

Notice should be taken of the limitations and drawbacks of this research. They arise from the comprehensiveness of the analysis and necessity of further specialised studies, the need to conduct multi-year analyses, subject to data availability, in order to test the reliability of results, and the need to select additional indicators to enable a complete analysis of all relevant factors of banking operations across counties.

## 5 CONCLUSIONS

This study provides a comprehensive review of the characteristics of bank financial intermediation in the counties of the Republic of Croatia, using hierarchical and non-hierarchical k-means cluster analyses. The study results show pronounced heterogeneity of the counties with respect to various sets of indicators from 'economic environment' and 'financial development level and infrastructure' to 'banks' deposit and credit policy characteristics'. Differences between developed and underdeveloped counties in Croatia primarily exist in the characteristics of the financial development level and infrastructure and deposit policies. The City of Zagreb stands out as an outlier and it is the most developed narrower territorial unit according to all the sets of indicators. The Dubrovnik-Neretva, Istria, Primorje-Gorski Kotar, Split-Dalmatia and Zadar counties, as relatively advanced counties with respect to financial intermediation, have sound and substantial deposit sources of funds. The results further show that Croatian banks do not avoid underdeveloped counties, but rather invest in them and feed additional funds to them in excess of these counties' collected deposit bases, notwithstanding lower levels of financial intermediation development, suggested by other indicators. A contribution of this study consists in starting to evaluate banking operations and financial intermediation at the level of narrower territorial units, which provides a basis for conclusions on the impact of banking operations on economic growth, specific business policies of banks and the potential to provide banking services at the county level. All this also contributes to a debate on the regional division and well-designed regional policy of the Republic of Croatia which must be based, among other things, on effective financial intermediation of banks.

In addition, the presented results and discussion underline the importance of undertaking further more specific and targeted research in the following areas: (a) examining the specificities of banks' credit policies and their impact on the counties' economies and their growth, (b) a detailed analysis of banks' deposit policies and interdependence on demographic and economic characteristics of counties; (c) reviewing the problem of financial exclusion by county; and (d) finding a link between the regional headquarters of banks and the efficiency of county economies. The research conducted in this paper is one of the first attempts to describe and examine financial intermediation of banks across the counties using a cluster analysis.

Moreover, the research conclusions and methodology may be of use to banks in the Republic of Croatia in the formulation of targeted regional business policies and evaluation of different market approaches to the counties in the Republic of Croatia. Finally, banks as institutions with characteristic of public good are among the main catalysts of economic growth in all territorial units. Therefore, it is necessary to include both the financial and banking sectors in the analyses and formulation of the counties' strategic frameworks.

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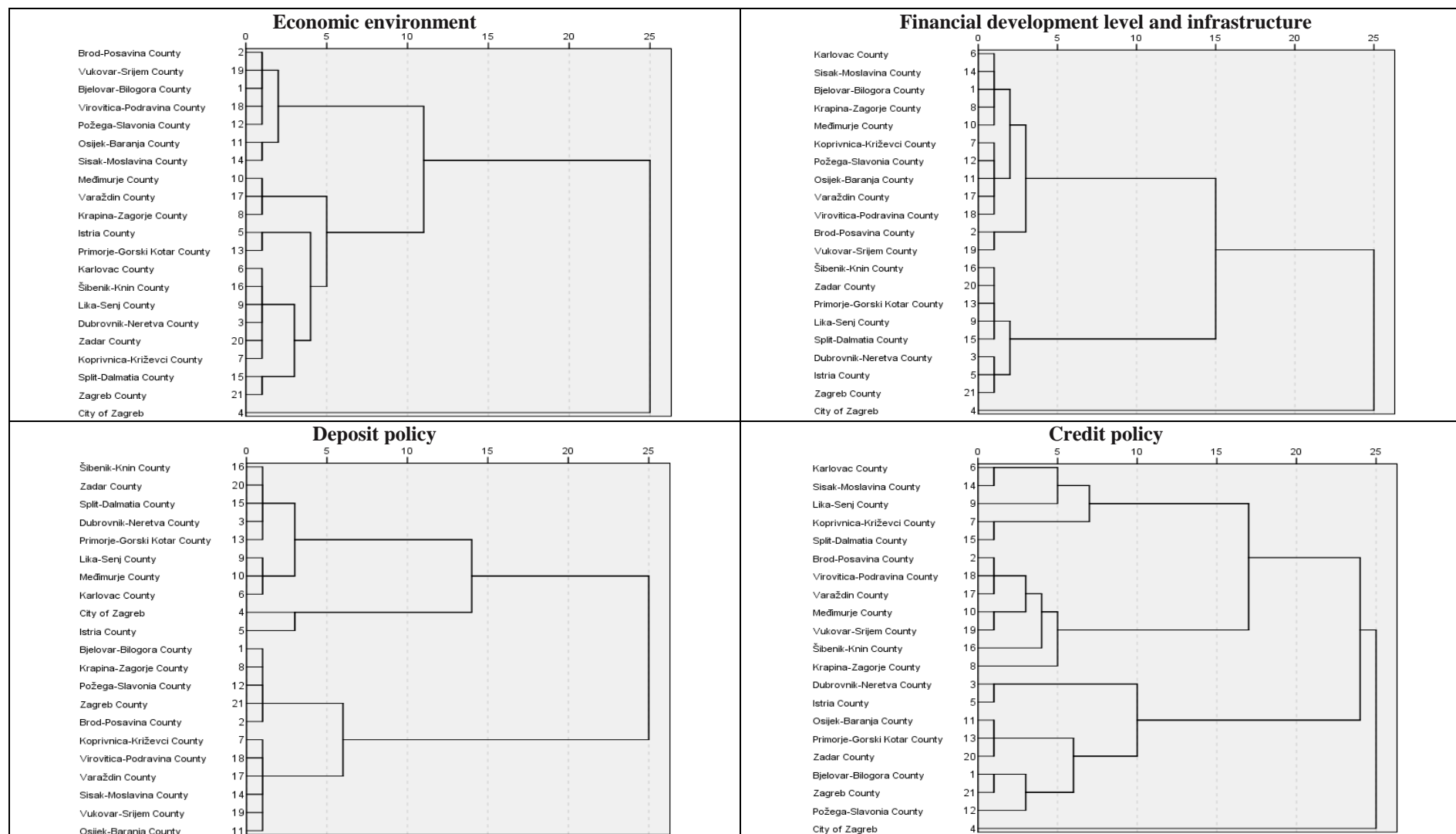
## Appendix

Table A1. ANOVA table results for a k-means cluster analysis

Set of indicators	Indicator	Cluster		Error		F	Sig.
		Mean Square	df	Mean Square	df		
Economic environment	Gross domestic product per capita, in thousands of HRK (the 2011 census)	1.614	2	0.178	17	9.065	0.002
	Net salary in HRK	2.432	2	0.313	17	7.758	0.004
	Population, in thousands	0.700	2	0.317	17	2.206	0.141
	Unemployment rate, %	5.891	2	0.272	17	21.683	0.000
Financial development level and infrastructure	Net assets/GDP, %	0.119	2	0.059	17	2.025	0.163
	Number of inhabitants per branch, in thousands	7.957	2	0.288	17	27.669	0.000
	Number of inhabitants per ATM, in thousands	5.808	2	0.203	17	28.579	0.000
	Banks' assets per capita, in thousands of HRK	0.225	2	0.026	17	8.587	0.003
	Investments in new long-term assets intended for financial and insurance activities, in thousands of HRK	0.012	2	0.012	17	0.956	0.404
Deposit policy	Loans/deposits	6.483	2	0.432	18	15.019	0.000
	Deposits per capita, in thousands of HRK	6.075	2	0.214	18	28.358	0.000
	Foreign exchange deposits in total deposits, %	6.400	2	0.255	18	25.076	0.000
Credit policy	Share of non-performing loans in total loans, %	4.217	2	0.187	17	22.517	0.000
	Share of loans to households in total loans, %	0.030	2	0.300	17	0.101	0.904
	Share of EUR-denominated loans in total loans, %	0.792	2	0.294	17	2.695	0.096
	Share of mortgage loans in total loans to households, %	1.857	2	0.491	17	3.780	0.044
	Share of CHF-denominated loans in total loans, %	4.464	2	0.228	17	19.581	0.000

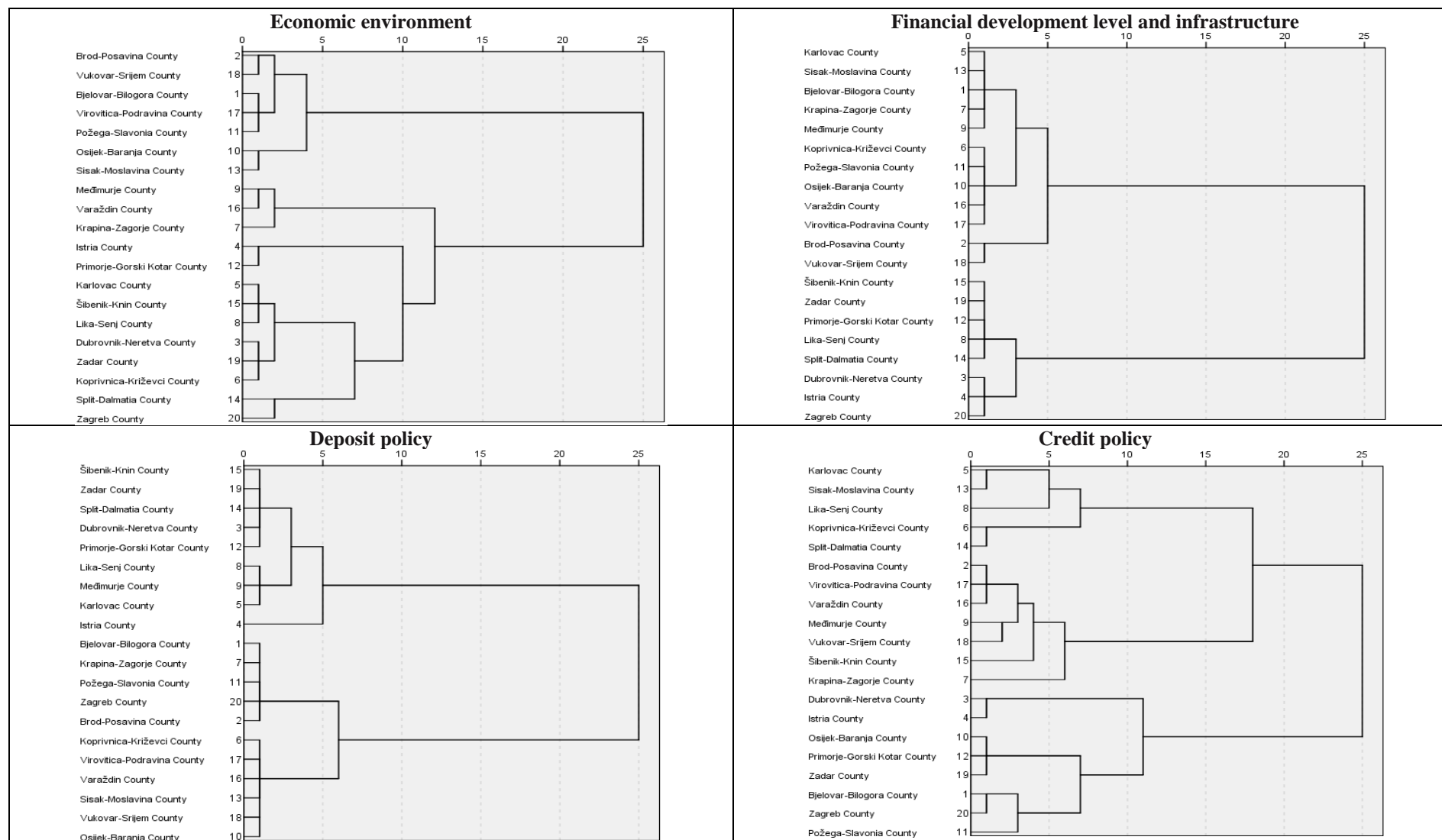
Source: Authors' compilation.

Graph A1. Dendrograms for the hierarchical analysis carried out, by set of indicators, the City of Zagreb included



Source: Authors' compilation.

Graph A2. Dendrograms for the hierarchical analysis carried out, by set of indicators, the City of Zagreb excluded



Source: Authors' compilation.