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UDK: 336.76

Original scientific article

Received: March 13, 2019

Accepted for publishing: May 22, 2019

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COEVOLUTION OF BANKS AND CAPITAL MARKETS IN THE MODERN VIEW OF EFFECTIVE PARTS OF THE FINANCIAL SYSTEM ARCHITECTURE

ABSTRACT

Due to the onset of the last economic crisis, the recent focus of policy makers has been shifted from economic development to the possibility of fast identification of the sources of financial shocks and imbalances in order to quickly solve the extreme stresses that can emerge in the financial system. Therefore, the interdependences of financial institutions and financial leverages as well as the causes of endogenous changes of real interest rates and the differences emerging between interest rates and the rates affecting expenditure are observed more often in this context.

The paper emphasizes this problem as well as the problem of the need for a different structure of the financial system and its participants that would contribute to a higher level of economic development. In this context, on the example of data on the Croatian capital market shareholders' structure and data on the amount of loans to companies in the period from 2006 to 2018, a model was developed via ANFIS. The model indicated the positive and negative impacts of banks and shareholders' structure on the capital market.

Keywords: Financial institutions, financial leverage, capital market shareholders' structure, co-evolution of banks and capital market, ANFIS

1. Introduction

In recent times, the scientific community has been discussing the effects of financial friction and the importance of studying it when observing factors of economic stability and factors that could cause new economic imbalances and crises. Thus, the focus of policy makers has been shifted from economic development to the possibility of fast identification of sources of financial shocks within the context of a successful resolution of extreme stresses that can occur in the financial system (Pang, Siklos, 2010).

In addition, a lot of institutions and mechanisms supporting the global financial architecture were created several decades ago and their structure does not reflect the global economic circumstances (Drysedale et al., 2017). In this sense, the effects of the interdependence between financial institutions and financial leverages are observed, as well as the causes of endogenous changes in real interest rates and the differences emerging between interest rates and the rates affecting decisions on expenditure (Vines, Wills, 2018). Following the definition

of “financial friction” (Hall, 2012), there has been more and more discussion within the scientific community on the gap that increases when financial institutions earn in larger ranges than those created between their costs of financing and interest costs, as well as the adverse effects of the gap on the macroeconomic balance. At lower levels of financial development there is a predominance of the redistribution effect, and the fall in financial friction increases productivity shocks (Pinheiro et al., 2017). Today, the international financial architecture enables the continuation of international imbalances causing financial imbalances and subsequent crisis phenomena, as well as the spillover of negative effects on the global economy (Sau, 2016). However, the areas of Eastern and Central Europe are also marked by the effects of political volatility that surely impose a great impact on their economic development. There were attempts to solve some of the effects of the volatility by numerous initiatives for EU integration, which may have had positive outcomes in some international effects; nevertheless, the effects on national levels remained unresolved (Hartwell, 2018). The effects of political instability damage economic development, and, within financial markets, they are negatively transferred to capital markets, mostly due to political news and the total volatility of the financial sector (Engle, Ng, 1993). Therefore, within the European Union, there have been more and more discussions on the Capital Market Union and the advantages and disadvantages of these ideas (Braun, Hubner, 2017). The financial vortex that emerged because of the prevalence of bank-centrism, not only in these regions, but in the entire EU area, created surplus liquidity for banks and deficit for companies. Namely, a situation occurred in which mostly large and stable companies with high credibility borrow money from banks to insure their liquidity, even though they do not need to, while small and medium enterprises that are not on the capital market and have lower credibility cannot use credit lines to finance liquidity (Acharya et al., n.d.).

Therefore, there is an immediate necessity of a co-evolution of banks and the capital markets that would result in positive effects on economic development. One of the recommendations for such a co-evolution suggests that banks engage in securitisation of loans of higher quality, which could encourage greater participation of investors and capital market development (Song, Thakor, 2010).

This paper uses an ANFIS-constructed model to study the effects of co-evolution of banks and capital markets in this country, i.e. the way in which the available market value on the shareholders' accounts affects lending to the private sector (companies). The shareholders' structure, made up of categories of domestic natural persons, domestic legal entities, foreign persons and others, has been indicated as key in studying the co-evolution and its effects on the potential for economic development. This especially relates to domestic legal entities.

2. Theoretical background

The financial sector is an essential component of any economic system as it provides key qualitative services of transforming assets in the sense of liquidity, maturity and volume. Therefore, the functional perspective of financial intermediation can also be used to study financial network effects (Gaffeo, Molinari, 2018). This is especially related to studying effects that impact good or bad economic circumstances with consideration to good or bad functioning of the markets. The recent research studies almost unanimously conclude that the crisis increases the return spillover among different financial markets (Huang, Wang, 2018). The crisis resulted in not only a decrease in the number of securities on the market, but it also indicated changes in the topology of the network infrastructure and the evolution of statistical changes of time after it, not having a regular effect at the same time on the structure of the international financial network architecture (Chinazzi et al., 2013).

The strengthening of capital markets, especially at the EU level, is considered mainly due to domestic and intra-country macroeconomic effects of financial shocks that can be caused by excessive bank-centrism. Namely, the research studies show that the business cycles within the EU depend not only on real shocks, but also on financial shocks, that the financial sector enhances the transfer of (real) shocks and that the banking sector can cause asymmetry between the business cycle and spillover among countries in the monetary union (Bokan et al., 2018). Banks face financial friction in the shape of time-variable limitations of endogenous balance due to an agency problem with foreign investors, whereby the control over capital can become an effective tool in resolving the problem (Kitano, Takaku, 2017). Likewise, a higher level of financial

openness contributes to development only if a certain development level of general legal systems and institutions is achieved (Chinn, Hiro, 2006). This is the reason behind the EU's dedicated intention to the alignment of these systems at the Union level.

In addition to this, traditional opinions on the effectiveness of economic policies focusing on monetary, fiscal and value aspects of monitoring and managing capital are being abandoned, i.e. their effectiveness in the short term is emphasised, while a long-term economic development requires stimulation of innovations in the financial system (Merton, Bodie, 2005). Consequently, there is a demand for reforms of the monetary and financial systems at the global level that are not only short-term, "cosmetic reforms" (Sau, 2016), based on numerous new research studies and their conclusions on balance models (Jesús Fernández-Villaverde, 2010). These reforms require more research into the interdependence among various types of institutions and an orientation toward intra-country spillovers, which are systematically neglected (Ghulam, Doering, 2018).

A financial structure is appropriate for an economy at a specific level of economic development only when the characteristics of the financial structure correspond to the characteristics of the industrial structure, i.e. needs of the economy. In other words, an appropriate financial structure varies among countries at different levels of economic development and needs to be dynamic in time (Lin et al., 2013). Furthermore, financial development and institutional quality will have a larger direct impact on the total economic development than foreign direct investment, the impact of which is more significant at the level of the enterprise itself (Bruno et al., 2018).

The crisis created the need for a new economic paradigm, followed by a choice between a free deregulated or a regulated financial market structure, which obviously leaned toward the regulation area. Besides regulatory mechanisms, the years following the crisis saw the development of mechanisms that should have had a desired preventative role and somewhat serve as a counterbalance to the increase in volatility; however, they led to a decrease in trading volumes (Tanasie et al., 2015). Nevertheless, the research studies show that the disturbances in financial intermediation cause negative effects on the real economy and turn out to be the primary source of business cycle fluctuations, only in periods of

financial difficulties (Lhuissier, 2017). Namely, the new regulation has still not recognised sufficiently the different dimensions of systemic risk and the paradigm "too big to fail" is still widely accepted. The new one has only just been emerging that states "too connected to fail" (Ghulam, Doering, 2018), which likely has more far-reaching implications for risk transfer.

Considering all the above-mentioned, we can definitely conclude that the economic development in the new era requires an evolution of the financial system architecture, which is evident in three forms: competition, complementarity and co-evolution (Song, Thakor, 2010). Co-evolution requires new financing techniques such as securitisation for example, which also demands a new approach to financial infrastructure development. Only a financial infrastructure developed in such a way can revive the sluggish capital markets as the European one.

In connection to this, starting from the end of 2009, the EU has regulated the business of Credit Rating Agencies, and the regulation has been directed towards: a) registration – each CRA needs to be registered with the supervision of ESMA; b) CRA operations management (employee conflict of interest was regulated, CRA needs to establish a continued monitoring of the issuer's rating, CRA needs to draft a "Transparency Report" each year); c) supervision – ESMA has extensive authority in supervising CRA in the form of on-site supervision and imposing sanctions.

Furthermore, the new rules on "capital requirements for banks", in effect since 2014, require banks to avoid excessive leaning on CRA ratings and to have an obligation to make their own solvency assessments of loan users. ESMA established the "European Rating Platform" aimed at easier comparison of all solvency assessments of the issuer by the registered credit rating agencies (CRA).

Besides, since Croatia is a member of the EU, it is noteworthy to emphasise the conclusions of some research studies related to the impacts of political volatility on the financial infrastructure and capital markets in that EU membership decreases yield, but functions as a stability anchor in order to prevent informal volatility that turns into financial instability (Hartwell, 2018).

By strengthening the financial stability Croatia also contributes to the macroprudential diagnostic pro-

cess under the authority of the CNB that consists of assessing macroeconomic and financial relationships and trends that can result in distortion of financial stability. Hence, macroprudential diagnostics serves as a channel of regular public informing on the undertaken macroprudential activities and measures in Croatia and comparable countries, and the activities related to the European Systemic Risk Board (ESRB).

Although the total assets of the financial system are 60% larger than the GDP, the assets structure of the Croatian financial sector is dominated by banks with a share of 75%. Furthermore, the system is dominated by large banks in foreign ownership, comprising a share of 90.1% in total assets. Most banks in foreign ownership are held by EU shareholders, and the share of their assets in the total assets of all banks was 89.2% in 2017. With regard to total loans (2017), the negative decreasing trend continued, which afterwards resulted in a contin-

ued decrease in the share of loans in assets to 57.9%, marking the lowest value of the indicator since March 2005. At the same time, the ratio of loans and deposits fell to 76.1%, with the last values lower than those recorded in 2002 (Croatian National Bank (2018), "Banks Bulletin No. 31").

Within such a financial infrastructure, the key meeting point of the bank's ownership structure as the dominant financial institution and the ownership structure of non-financial companies is the loan as an expression of mutual trust and expectations within the established regulatory framework under the authority of the central bank.

3. Data set and methodology

The impact of the available market value of shareholders' accounts on lending to the private sector (companies) was studied on the basis of the set of data shown in Table 1.

Table 1 Trends of loans to the private sector and values of investment on the capital market in the period from 2006 to 2018

Date	Loans to companies (in m HRK)	Domestic natural persons (in m HRK)	Domestic legal entities (in m HRK)	Foreign persons (in m HRK)	Others (in m HRK)
31 March 2006	67,018	22,981	90,735	60,482	22,818
30 June 2006	71,420	22,946	92,204	69,198	24,335
30 September 2006	74,707	26,105	101,126	82,186	28,295
31 December 2006	76,797	27,980	107,235	97,249	25,356
31 March 2007	83,387	36,171	128,349	127,121	39,972
30 June 2007	87,190	43,439	141,365	144,132	45,654
30 September 2007	90,980	45,484	142,935	111,747	79,403
31 December 2007	88,678	56,105	145,213	122,653	83,734
31 March 2008	92,265	46,268	120,930	107,371	64,558
30 June 2008	94,325	43,834	109,828	99,530	58,528
30 September 2008	96,312	38,455	98,490	93,924	50,834
31 December 2008	98,914	26,793	77,933	76,541	30016
31 March 2009	102,780	24,803	70,668	74,738	25,233
30 June 2009	104,546	26,990	76,411	75,508	32,595
30 September 2009	103,336	29,388	89,075	82,304	28,085
31 December 2009	102,550	28,456	98,351	92,971	4,440

Date	Loans to companies (in m HRK)	Domestic natural persons (in m HRK)	Domestic legal entities (in m HRK)	Foreign persons (in m HRK)	Others (in m HRK)
31 March 2010	107,130	32,186	99,738	94,689	4,848
30 June 2010	109,605	28,076	94,695	89,441	4,422
30 September 2010	110,973	29,218	95,816	92,194	4,675
31 December 2010	107,687	29,299	108,641	95,275	6,759
31 March 2011	109,356	29,436	119,549	90,534	7,527
30 June 2011	111,265	28,296	119,479	88,297	7,437
30 September 2011	113,209	25,713	114,202	81,962	7,093
31 December 2011	116,840	24,659	108,490	79,621	6,741
31 March 2012	117,851	24,551	108,858	81,190	6,637
30 June 2012	111,830	23,416	107,999	77,266	6,524
30 September 2012	109,467	23,452	115,367	76,033	7,184
31 December 2012	103,157	23,649	111,545	92,249	7,207
31 March 2013	104,766	25,490	118,421	94,579	7,976
30 June 2013	105,541	24,001	118,102	89,052	7,702
30 September 2013	105,596	23,256	117,927	86,529	7,709
31 December 2013	102,459	22,730	112,871	87,662	7,288
31 March 2014	102,360	22,585	111,204	86,844	7,131
30 June 2014	100,609	22,957	118,263	88,837	7,205
30 September 2014	99,486	39,455	124,269	86,416	7,791
31 December 2014	98,406	56,844	116,806	89,953	7,415
31 March 2015	99,262	57,310	117,999	92,125	7,566
30 June 2015	97,525	57,868	118,872	94,319	7,687
30 September 2015	95,708	57,468	117,649	91,936	8,054
31 December 2015	93,529	58,580	114,582	92,680	8,706
31 March 2016	94,626	58,198	109,780	93,159	8,717
30 June 2016	93,483	57,591	111,500	93,298	9,402
30 September 2016	92,916	60,195	118,172	100,322	10,853
30 December 2016	92,987	61,113	116,976	102,984	11,628
31 March 2017	92,271	61,275	113,570	106,534	11,198
30 June 2017	92,210	60,259	132,662	99,215	11,619
30 September 2017	92,371	59,483	131,655	100,184	11,365
31 December 2017	89,901	58,961	128,245	100,745	11,176
30 March 2018	89,515	58,610	127,643	101,045	11,015

Source: Croatian National Bank (CNB) Bulletin, Central depository & clearing company Inc (CDCC) Bulletin

Domestic legal entities comprise joint-stock and limited liability companies, financial institutions (banks), as well as the public sector (state, local government/self-government units, agencies, etc.). Foreign persons consist of foreign natural persons (foreign passport) and foreign (non)legal entities registered in another country. Others are mostly portfolio investors, not to say exclusively, but in the majority. This category also comprises investors who could not be classified into any of the other categories for various reasons.

Using an input-output dataset, ANFIS delivers a Fuzzy Inference System (FIS), whereby the membership functions parameters are adapted by a backpropagation learning algorithm or combined with the method of least squares (hybrid learning method). Such a setup allows the FIS system to learn from training data (Sugeno, 1985).

All nodes are adaptive in the first layer. Outputs of the first layer are inputs connected with membership functions (usually two per input). In the second layer, the nodes are fixed and labelled with Π since it is a simple multiplication. In the third layer, the nodes are also fixed and marked with N . The outputs of this layer represent input normalization. In the fourth layer, the nodes are adaptive again. The outputs from this layer are obtained as the products of the normalized inputs and first-degree polynomials (for the first-order Sugeno model). In the fifth layer there is only one fixed node marked with Σ in which the final output is calculated as the sum of all input signals. The aim of the training is to reduce as much as possible the difference between real and predicted values by adjusting the assumed (Layer 1) and consequent (Layer 2) parameters.

The learning algorithm adjusts the parameters $\{a_i, b_i, c_i\}$ and $\{p_i, q_i, r_i\}$ to determine the optimum between the ANFIS output and the output of the training data set. After this phase, the optimal values of these parameters are determined by the least squares method. In order to avoid problems related to an oversized area of searching for results or slow convergence when the assumed parameters are not fixed, a hybrid learning algorithm is used that combines the method of least squares with the back-propagation learning algorithm. When the optimal values of the resulting parameters are determined by the method of least squares, the setting of the assumed parameters is achieved by the gradient descent method. Finally, ANFIS output is calculated using the resulting parameters. The residuals between the calculated ANFIS output values and the actual outputs are used to adjust the assumed parameters for the next epoch on the basis of the standard learning algorithm with error backpropagation (Valčić et al., 2011) and (Samodol, Brlečić Valčić, 2018).

The reason for using the Adaptive Neuro-Fuzzy Inference System (ANFIS) in this analysis was its characteristic of a universal approximator of such tools in modelling nonlinear functions of multiple variables, but also for the prediction of chaotic time series (Jang, 1993b).

More on the formal code and characteristics of ANFIS can be found in Jang (1993a), Sugeno (1985), Valčić et al. (2011) and Samodol, Brlečić Valčić (2018).

4. Results

The ANFIS based model was created using empirical data shown in Table 1 and explained in Table 2.

Table 2 The input and output variables for the model

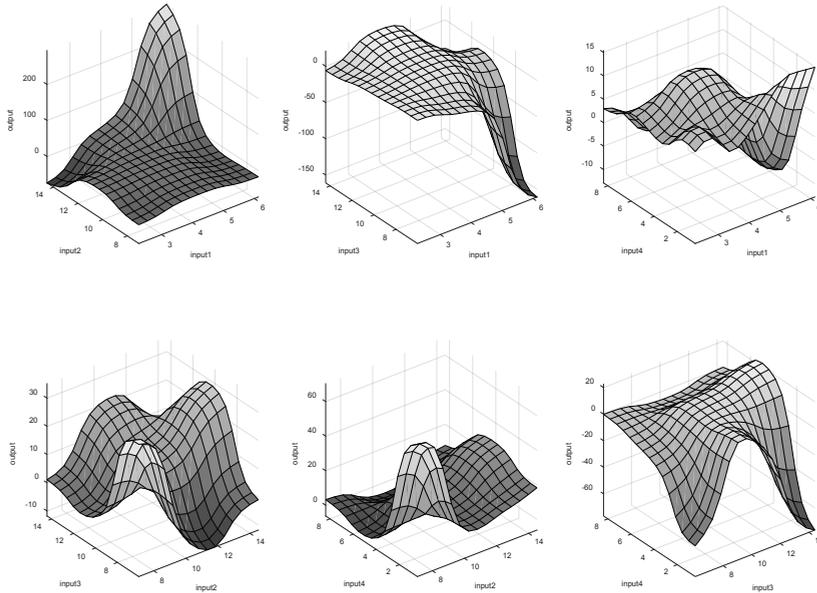
Input 1	Investment in the capital market by domestic natural persons
Input 2	Investment in the capital market by domestic legal entities
Input 3	Investment in the capital market by foreign persons
Input 4	Investment in the capital market by others
Output	Loans to companies

Source: Authors

The input-output mapping of the created ANFIS, as the multivariate nonlinear model is visually pre-

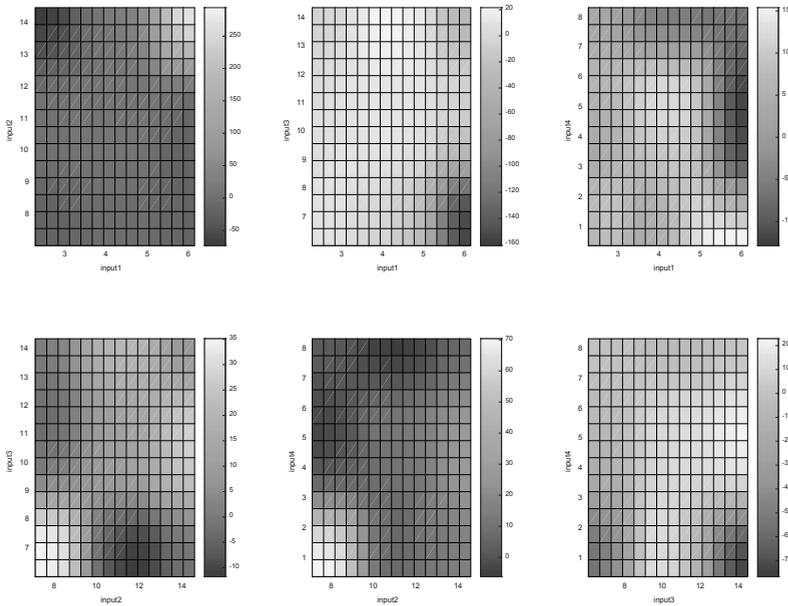
sented in Figure 1 and Figure 2.

Figure 1 3D overview of the analysis of the interdependence between loans to the private sector and the values of investments on the capital market



Source: Authors

Figure 2 2D overview of the analysis of the interdependence between loans to the private sector and the values of investments on the capital market



Source: Authors

The analysis results shown in Figure 1 and Figure 2 can be observed through several relationships, the first of which being the relationship among domestic natural persons and domestic legal entities as input variables to loans to companies as the output variable (scale, Figure 2). By observing the analysis results of this relationship, we can conclude that the model predicts high values of loans to companies only for a small number of combinations within the relationship. It is a combination of very high values of investments by domestic natural persons and very high values of investments by domestic legal entities. All other combinations of these two variables cause a small or mild impact on the size of loan amounts to companies, whereas the worst combination of the relationship is the one with a very low value of investment by domestic natural persons and a very high value of investment by domestic legal entities.

The relationship among domestic natural persons and foreign persons as input variables to loans to companies as the output variable is characterised by combinations of low and medium values of investment by domestic natural persons and medium and high values of investment by foreign persons, which have a mild, but positive impact on the amount of loans to companies. The possibility of a high negative impact on the value of loans to companies occurs with a combination of very high values of investment by domestic natural persons and low values of investment by foreign persons.

The characteristics of the relationship among domestic natural persons and others as input variables to loans to companies as the output variable can be described through a positive, but mild impact on the amount of loans to companies effected by high investment values by domestic natural persons combined with very low investment values by others, while a negative impact on the amount of loans to companies indicated by the model is the combination of very high investment values by domestic natural persons and medium to high investment values of others.

If we observe the relationship among domestic legal entities and foreign persons as input variables to loans to companies as the output variable, the model suggests that a mild positive impact on the amount of loans to companies could be caused by a combination of low values of investment by domestic legal entities and low values of investment by foreign persons, as well as the combination of

high values of investment by domestic legal entities and medium values of investment by foreign persons. All other combinations have an insignificant impact on the amount of loans to companies in a positive sense. The model also suggests the possibility of negative impacts on the values of loans to companies in the case of medium to high investment values by domestic legal entities with medium investment values by foreign persons, as well as with the combination of low investment values by domestic legal entities and medium to high investment values of foreign persons.

The relationship among domestic legal entities and others as input variables to loans to companies as the output variable indicates the possibility of a more significant impact on the value of loans to companies with the combination of low values of investment by domestic legal entities and low values of investment by others. All other combinations do not cause significant changes in values of loans to companies and it is noteworthy that this relationship does not indicate the emergence of negative effects on the amounts of loans to companies.

The analysis of the relationship among foreign persons and others as input variables to loans to companies as the output variable suggested by the established model indicates that a mild positive impact on the values of loans to companies can be caused by medium values of investment by foreign persons in the combination with all values of investment by investors pertaining to the category of others. A negative impact on the value of loans to companies can be expected in the cases of high values of investment by foreign persons combined with low values of investment by others or (with a more moderate intensity) the combination of low values of investment of foreign persons and low values of investment by others.

5. Conclusion

Using data on the Croatian capital market shareholders' structure and data on the amount of loans to companies in the period from 2006 to 2018, based on the conducted analysis the authors indicate the need for a different structure of the financial system and its participants that would contribute to a higher level of economic development.

More precisely, the conducted analysis indicates that a possibility of the emergence of higher posi-

tive impacts on the amounts of loans to companies can occur with:

- a) a very high value of investment on the capital market by domestic natural persons and domestic legal entities, and
- b) low values of investment on the capital market by domestic legal entities combined with low values of investment by others.

On the other hand, the possibility of a negative impact on the values of loan amounts to companies are caused by the following relationships:

- c) low and medium values of investment by domestic natural persons and medium and high values of investment by foreign persons,
- d) high values of investment by domestic legal entities and low values of investment by others,
- e) low values of investment by domestic legal entities combined with low values of investment by foreign persons,
- f) high values of investment by foreign persons combined with medium values of investment by others and
- g) a combination of medium values of investment by foreign persons and all types of values of investment by others.

In other words, the most significant type of investment on the Croatian capital market is the investment by domestic natural persons and domestic legal entities, which at the same time implies high values of loans to companies.

The fact that domestic legal entities comprise joint-stock and limited liability companies, financial in-

stitutions (banks), as well as the public sector (state, local government/self-government units, agencies, etc.) is also a limitation of the research.

However, further research may take additional facts into account. A general decrease in interest rates has not resulted in a higher investment activity of companies. At the same time, the share of loans to companies for long-term investment and financing in the total loans to companies is only 54%, while the share of long-term loans to citizens in the total loans to citizens is as much as 84%. In sources of financing banks there is a continued trend of substituting foreign funds with domestic ones as well as an increase in demand deposits and deposits in HRK. Thus, in the deposit structure, there is a continued increase in the share of demand deposits, which has reached almost a half of total deposits. Lending activity of foreign banks is mostly affected by real economic trends, while the share of two largest banks in the total assets of banks is 46.4%, and of the four largest banks as much as 69% (Q2/2018). The rate of total bank capital increased and reached as much as 22.6% (Q2/2018).

One of the biggest obstacles to a change of direction in lending to companies is the dominance and concentration of foreign ownership structure of banks with their focus on providing loans to citizens. This business is actually the largest source of finance for banks, and is carried out within a firm regulatory framework of the central bank.

On the basis of mapping out risks in macroprudential diagnostics, the balance of the coexistence of companies and citizens needs to be taken into account. This should occur not only in the deposit and lending business, but also in using ownership effects of wealth of both groups in the transmission mechanism of the monetary policy toward greater rates of economic growth.

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KOEVOLUCIJA BANAKA I TRŽIŠTA KAPITALA U MODERNOM POGLEDU UČINKOVITE ARHITEKTURE FINANCIJSKOG SUSTAVA

SAŽETAK

Zbog nastanka posljednje ekonomske krize fokus je tvorca politika u novije vrijeme prebačen s razvoja gospodarstva na mogućnost brze identifikacije izvora financijskih šokova i neravnoteža kako bi se brzo mogli riješiti ekstremni stresovi koji mogu nastati u financijskom sustavu. Stoga se i međuovisnosti financijskih institucija i financijskih poluga, kao i uzroci endogenih promjena realnih kamatnih stopa te razlika koje nastaju između kamatnih stopa i stopa koje utječu na odluke o izdacima promatraju više u tom kontekstu.

U ovom se radu naglašava taj problem kao i problem potrebe drugačije strukture financijskog sustava i njihovih sudionika koji bi mogao pridonijeti većem stupnju razvoja gospodarstva.

Stoga je u tom kontekstu, na primjeru podataka o strukturi ulagača na hrvatskom tržištu kapitala i podataka o visini iznosa kredita trgovačkim društvima u razdoblju od 2006. do 2018. godine, konstruiran model pomoću ANFIS-a. Model je ukazao na pozitivne i negativne učinke banaka i strukture ulagača na tržištu kapitala.

Ključne riječi: financijske institucije, financijska poluga, struktura ulagača na tržištu kapitala, koevolucija banaka i tržišta kapitala, ANFIS