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VISUAL CORRELATION ANALYSIS OF FINANCIAL TIME SERIES

UDC 519.246.8:336

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Abstract. *The massive amount of financial time series data that originates from the stock markets generates huge quantity of complex data that is of interest to a large number of market participants. In order to gain a comprehensive understanding of the market mechanism investors require adequate solutions that can effectively handle the information. In this paper the concept of a minimum spanning tree (MST) is used to study patterns of comovements for a set of stocks from the South-East European emerging markets. It is presented how the MST and its related hierarchical tree evolve over time and describe the development of securities linkages. Over the sample period, 2007–2014, linkages between securities have changed, especially during the period of global financial crisis, what can have significant implications for investment decision-making.*

Key words: *correlation, minimum spanning tree, financial time series, emerging markets*

INTRODUCTION

Financial markets can be considered as complex systems characterized by a large number of elements correlated in a way that is difficult to identify and quantify. However, it is this correlation between the system elements that has a central role in investment theory and risk management, as it stands for a key factor in financial asset pricing and optimization of investment decisions. Efficient market hypothesis, as the most important paradigm of mathematical finance, rejects the possibility of predicting the price of securities. Specifically, financial time series, according to this theory, can be described by random process, so that it is impossible to predict their future values, because information from the financial market is instantly, fully, and continually reflected in the current prices of securities. In such conditions, prices and returns on financial assets can be considered uncorrelated. If, however, there are certain economic factors that can affect these values, then they exert impact on several financial instruments at the same time. The fact is,

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however, that financial markets are not perfectly efficient and that they exhibit numerous anomalies. Therefore, it can be concluded that the time series of financial asset prices carry a large amount of non-redundant information from which it is necessary to single out just that, which, through its specific impact, makes the market inefficient. The modeling of complex features of financial markets and various types of non-linear relations within it has recently used tools and procedures developed for the modeling of physical systems. Graphic presentation and analysis of financial markets is considered to be extremely useful, because of an intuitive way of showing the correlation structure of different securities and the possibility of identification of key factors, i.e. market segments.

Standard analysis of financial issues in econophysics is largely based on the minimum spanning tree. Minimum spanning trees are networks of nodes, which are connected with at least one edge, without a loop, in such a way that the sum of all edges is minimal. The application of this method in the graphic presentation of complex networks, such as financial markets, and the filtering of information about correlation between nodes was initiated by Mantegna [15]. Due to their simplicity, minimum spanning trees are today used in the study and presentation of the financial structure, such as the structure of financial markets [2, 17], currency markets [7], and the correlation of financial markets themselves [22, 3, 16].

Taking into account the possibility of portfolio diversification by investing in emerging capital markets [12, 8], as well as the participation of foreign investors in trading on markets in the region, this paper analyzes the correlation of securities traded on Belgrade, Zagreb, Ljubljana, and Skopje stock exchanges. The aim of the paper is to use methods of visualization to discover complex correlation between securities on these stock exchanges and point to their hierarchical clustering, as well as to analyze the impact of crisis on correlation of returns on securities analyzed. Therefore, this paper will first point to the complexity of financial time series, as an important characteristic that conditions the implementation of multidimensional models, and the second part of the paper will present the minimum spanning tree, as one of the network techniques for the analysis of financial data and extracting of information necessary for decision-making. In the third part of the paper, this specific technique will be applied to the selected sample of stocks, followed by the presentation of the correlation structure, on the basis of which the final part of the paper will provide appropriate conclusion and guidelines for the formation of investment strategies on markets in the region.

1. Multidimensional Analysis and Data Mining Framework for Financial Time Series Analysis

Huge quantity of complex data that is generated on the financial markets is of interest to a large number of market participants. Analysis of financial market information attracted particular public attention in the years of the global financial crisis of 2007-2008, as well as during the European debt crisis of 2010, when a large number of financial instruments lost significant value [14]. Given that the effects of the shocks on the stock exchange are transmitted through international financial markets [6] and increasingly affect the global economy [10], the methods for managing information in the monitoring and analysis of financial markets are becoming essential for a large number of stakeholders, especially investors. However, the analysis and understanding of the relations on the financial

market requires the processing of huge amounts of data, which is becoming increasingly challenging, taking into account that in periods of intense trading on financial markets every second generates 50,000 new pieces of data on changes in financial asset prices [29]. One can, therefore, conclude that the processing of data collected over longer time intervals goes beyond the analysts' capabilities, while the mathematical and statistical models are less and less reliable basis for timely investment decision-making. Visualization methods commonly used as an analysis tool, such as a line graph with a time axis and a price axis, cannot be used to display a large number of time series because they are not transparent [24]. The complexity of financial data, accompanied by investors' aspiration to receive information constantly, timely, and in easily accessible and visually acceptable manner caused the emergence of multi-dimensional data models and sophisticated visualization techniques. Business intelligence systems, with OLAP (Online Analytic Processing) tools, analytical techniques, data warehouses and data visualization, are good source of information in modern business, including investment decision-making. Business Analytics covers a range of applications and techniques for collecting, storing, analyzing data and providing access to data, to help users bring adequate and timely decisions. All the tools and techniques can be classified into several categories: information and knowledge discovering, decision support and intelligent systems and visualization. Business analytics tools and techniques include reporting (formatted reports to a wide range of users), *ad hoc* query and analysis, statistical analysis and data mining [27]. OLAP is a set of activities performed by users of business intelligence systems. These activities include generating queries and their results, graphics, statistical analysis, multidimensional analysis and data visualization. OLAP tools enable discovering of knowledge hidden in existing data, discovering patterns and trends in the historical data, predicting future events and values based on current trends, discovering deviations from the trends and their relation to sudden turbulent movements and so on [23].

Several technologies are used for analyzing financial and accounting data stored in a data warehouse, among which the most frequent is OLAP technology. OLAP multidimensional model, along with specific aggregation techniques, ensures the organization of large data series, which allows an easy and prompt interpretation [26]. It uses data structures, called cubes, which are organized in multidimensional databases. The process of defining the structure of cubes is called multidimensional modeling.

Data cube is a multidimensional model that provides a new approach to the organization of data. The number of dimensions may be 3 as in the regular cube as shown in Figure 1, or greater depending on the particular problem and data [28]. Financial time series data can be presented by data cube whose edges are defined as dimensions of the data, and each cell in the cube is identified by specific values of each dimension. The basic architecture of the dimensional model is the star schema (see Fig. 1). Star schema contains two types of tables – fact table and dimension tables.

Data cube Stocks is formed, with each cell representing a combination of values from dimensions. The contents of each cell are measures: stock prices and continuously compounded returns. Data in dimensions are organized in hierarchies with different levels of aggregation. Stock dimension has levels: All sectors, Sector and Stock. Regions dimension has levels: All regions, Region and Country. Time dimension has levels: year, quarter, month and day. Data cube was created using Oracle Analytic Work Space Manager over Oracle 12c database [30].

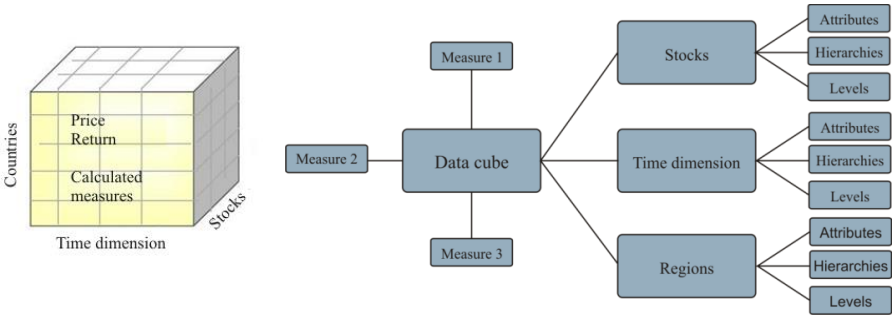

Fig. 1 Data Cube and Multidimensional Data Model

Data cube Stocks consists of data on the securities of the South-East European emerging stock markets. Stocks stand for the most liquid securities on the analyzed markets, and most of them are components of the Stoxx Balkan 50 Equity Weight index basket. In this paper the following stocks are analyzed:

- From the Belgrade Stock Exchange AIKB (AIK banka a.d. Beograd), ALFA (Alfa plam a.d. Vranje), ENHL (Energoprojekt holding a.d. Beograd), KMBN (Komercijalna banka a.d. Beograd) from the financial sector, and AERO (Aerdorom Nikola Tesla a.d. Beograd), FITO (Galenika Fitoframacija a.d. Zemun), GMON (Goša montaža a.d. Velika Plana), IMLK (Imlek a.d. Beograd), JESV (Jedinstvo a.d. Sevojno), MTLC (Metalac a.d. Gornji Milanovac), SJPT (Sojaprotein a.d. Bečej) from the non-financial sector,
- From the Zagreb Stock Exchange ADRIS (Adris grupa d.d.), HRTELEKOM (Hrvatski telekom d.d.), INA (INA-industrija nafte d.d.), LEDO (Ledo d.d.), PODRAVKA (Podravka prehrambena industrija d.d.) from the non-financial sector,
- From the Ljubljana Stock Exchange GORENJE (Gorenje d.d. Velenje), KRKA (Krka d.d. Novo Mesto), MERCATOR (Mercator d.d. Ljubljana), PETROL (Petrol d.d. Ljubljana), TELEKOMSI (Telekom Slovenije d.d. Ljubljana) from the non-financial sector, and
- From the Skopje Stock Exchange KMBMK (Komercijalna banka a.d. Skopje) from the financial sector, and ALKALOID (Alkaloid a.d. Skopje), GRANIT (Granit a.d. Skopje), PETROLMK (Makpetrol a.d. Skopje), TELMK (Makednosnki Telekom a.d. Skopje) from the non-financial sector.

The data period is 8 years long – from January 2007 until the end of December 2014.

2. CAPITAL MARKET VISUALIZATION USING MINIMUM SPANNING TREE NETWORK

The widely used approach to analyses is describing the structure of a market by constructing Minimum Spanning Tree. This graph shows the interconnection among the securities, detecting clusters and mutual relationships in a financial market. The process starts with finding a matrix based on the Pearson correlation coefficient between each pair of time series of stock returns. The correlation matrix is than transformed into the distance matrix using the following formula [15]

$$d_{i,j} = \sqrt{2(1-\rho_{i,j})} \tag{1}$$

where $\rho_{i,j}$ is correlation coefficient between returns on stocks i and j respectively.

These distances are then used for constructing a network that connects the individual stocks based on the levels of correlation.

Let G = (V, E) be a connected, undirected graph with a set of nodes V (stocks) and a set of edges E (distances between nodes). Each edge e ∈ E has non-negative length ℓ(e), i.e. the function set is ℓ : E → R+ for the length or weight of the edges.

What needs to be found is a subset T of edges of graph G so that all nodes from V remain connected when edges of T are used and the sum of the lengths of the edges in T is minimum in all such sets T. It is easy to see that the subgraph (V, T) of graph G is the tree, i.e. the connected non-cyclic graph. This graph is called the minimum spanning tree (MST) of the graph G. For the solution to this problem, two greedy algorithms can be used – Prim's and Kruskal's algorithms.

Greedy algorithms usually have a simple form and are used to solve optimization problems, such as discovering MST, discovering the shortest path in a graph, or discovering the sequence of some operations. The abstract formulation of optimization problems contains standard characteristic elements, with the following meaning:

- Set C of all possible (available or allowable) candidates – e.g. edges of the graph.
- Function that checks whether a particular set S of the selected candidates is a solution to the problem, i.e. whether a set of edges is a link between two selected nodes of the graph.
- Objective function that gives the value to any solution to the problem. This is the function to be optimized (minimized or maximized) – e.g. total length of the spanning tree or the length of path between two nodes.

Solving the optimization problem is the search for a set of candidates that represents the solution to the problem and optimizes the value of the objective function. The initial assumption is that the underlying problem has at least one solution, i.e. that there is a subset S ⊆ C, which is the solution to the problem.

In the case of MST, candidates are edges of the graph, i.e. C = E. S set of the selected edges is the solution to the problem if the edges of S make the spanning tree of G, i.e. connect all the nodes of V. The S set of edges is allowed if it does not have cyclic connection. Depending on the algorithm used, there is or there is no limitation that the set will give the tree for V, i.e. that (V, S) is a connected graph. The problem solution might be a tree, or an unconnected graph – spanning forest with several connected components (trees), which are not interconnected.

The main difference between the various greedy algorithms for solving problems in MST is in the method of choice of edges to be added. Prim's algorithm builds a tree that grows, while Kruskal's algorithm greedily makes a forest that gradually merges into a tree. Both algorithms are careful not to make a cyclic graph by adding nodes.

Prim's algorithm - The authors of this algorithm are Prim in 1957 [19] and Dijkstra in 1959 [4], although it was later discovered that Jarnik in 1930 formulated a similar procedure.

The algorithm starts from any node – the root of the tree. At the beginning, the set W has a single edge, with any node as an element, and the set T is empty. At each step, the existing tree (W, T) increases, adding to a set T a new edge that touches W, and adding to a set W another node of that edge, which was not in W. In this way, there is a tree that grows until it connects all the nodes in V.

Function of choice in Prim's algorithm has the following form – at each step, for the current tree (W, T), function of choice selects the shortest edge e = {u, v}, such that u ∈

V \ W and v ∈ W, i.e. node u belongs to the current tree, and node v is the unclassified node from the set of all nodes W. Algorithm adds node into a set W, and edge {u, v} into a set T. At any time, edges in set T make a minimum spanning tree of a graph. The algorithm continues until all nodes are connected, or until the sets W and V are equalized.

Prim's algorithm performs well, i.e. for the connected, undirected graph G with the cost function ℓ, the algorithm returns a set of edges T, so that (V, T) is the minimum spanning tree of graph G. The algorithm in the loop runs exactly |V| - 1 times, because, at each iteration, one node is added to set W.

For a graph G, there can be several minimum spanning trees. This is due to the possibility that, at some point, there may be more edges e of minimum length ℓ(e), attached to the current set of nodes W.

Kruskal's algorithm - This algorithm was formulated by Kruskal in 1956 [13]. As with Prim's algorithm, in the set of edges T, MST of graph G is created. The difference is that every iteration uses the whole set of graph nodes. At the beginning, the set of edges is empty and all nodes are unconnected, and then, at each step, an edge with the smallest length is added. Prior to the algorithm, all the edges are sorted by weight (cost) in ascending order, and at each next step, the shortest remaining edge is chosen, taking care not to make a cyclic edge. In this way, the subgraph is formed, comprising a number of nodes, and may not be connected.

The difference in relation to Prim's algorithm is that here the next edge is added without checking whether nodes of this edge touch some of the already connected nodes. So, the basic difference is in the choice of the edge to be added at each step. Prim's algorithm always starts from the already connected nodes (at the beginning from the arbitrary node). All the edges that touch the already connected nodes are checked, and the edge with the lowest weight added. When the edge is selected, the node belonging to that edge is added.

In Kruskal's algorithm, at each step, edge with the lowest weight is added, regardless of whether its nodes are already connected, thus forming a forest – of mutually unconnected trees. It can be concluded that Prim's algorithm starts from nodes, while Kruskal's algorithm is based on the edges of a minimum weight (cost). The condition for the implementation of Prim's algorithm is that the graph is connected.

The choice of the algorithm depends on the characteristics of the graph, number of vertices and edges. Prim's algorithm is significantly faster in the case of a really dense graph with many more edges than vertices. Kruskal performs better in typical situations (sparse graphs) because it uses simpler data structures.

In this paper Prim's algorithm is used, where the creation of the tree relied on the use of *spantree* function from R package "vegan" [18]. After creating MST, dendrograms were created based on the calculation of the distance between all nodes using *cophenetic* function from the same package and clustering.

Since data for the analysis is in the data cube Oracle R Enterprise was used for creating MST and dendrograms. Oracle R Enterprise integrates R with Oracle Database, enabling execution of R commands and scripts for statistical and graphical analyses on data stored in Oracle Database. Using Oracle R Enterprise to prepare and analyze data in an Oracle Database instance has many advantages for an R user. Some of the advantages are: eliminating data movement, operating on database-resident data, keeping data secure, using the memory and processing power of the database, using current data, preparing data in the database and execution of R Scripts in the database.

3. Results of Correlation Analysis of Emerging Financial Markets

Effects of diversification of portfolio investment generated on emerging markets have been pointed out as the most important feature of financial globalization during the nineteen-nineties [1]. Emerging markets, as a special group of capital markets, were for the first time defined in 1981 by the World Bank, in order to form the Third World Equity Fund. Given the fact that there was no single definition of these markets, the basic criterion for classification was GDP per capita. Today, however, classification of capital markets based on the development level cannot be linked to economic indicators. Emerging markets and frontier markets, which have since emerged as a subgroup of emerging markets, are usually considered separately from the developed markets due to the political environment and their specifics – depth and width, regulatory and institutional infrastructure. These new capital markets in transition countries in Europe, South America, Asia, Middle East, and Africa offered investors unusually high returns, compared to developed markets, and a lower level of volatility [9]. The main differences between the developed and frontier markets, which can be characteristic of the analyzed capital markets, are reflected in: level of information efficiency, investor basis, homogeneity of assets, liquidity of stocks, and type of investors interested in these markets. Specific functioning of these markets prevented the establishment of relationships with other world markets, protecting them from the impact of global developments. However, connections between the financial markets caused the spillover of crisis to emerging markets and to different types of financial assets [5]. In this way, the emerging markets during the financial crisis 2007-2008 lost 50% of market capitalization, while frontier markets lost 60% [21]. In Europe, this financial crisis turned into a sovereign debt crisis in several countries, which did not pass unnoticed on emerging markets, although debt crisis spillover can use various channels, so that the research results are different [11, 25]. Therefore, in this paper, the time series of returns on stocks from emerging financial markets were divided into three periods: pre-crisis period, which includes trading in 2007, period during the crisis – from 2008 to the end of 2010, and period after the crisis – from 2011 until the end of 2014.

Based on the statistical characteristics (Table 1), it can be concluded that the probability distribution of correlation coefficients in all the observed periods deviates from normal distribution. The mean value of the correlation coefficient in all three periods under consideration does not change significantly and retains a relatively low value. Standard deviation also has similar values in the entire observation period. However, the maximum values of the correlation coefficient in the period before, during, and after the crisis amounted to 0.38, 0.65, and 0.33, respectively. The values of skewness and kurtosis are lower in the crisis period, indicating that the probability distribution curve is wider during the crisis, but it can be concluded that, among the stocks analyzed, negative correlation prevails.

Table 1 Statistical properties of the distribution of cross-correlation coefficients before, during, and after the crisis.

Period	Mean cross-correlation	Standard deviation	Skewness	Kurtosis
Before	0.10619	0.26774	2.84353	6.77291
During	0.18690	0.27178	1.96439	3.32018
After	0.10151	0.26048	3.02269	7.69843

Source: authors' calculation

Looking at the minimum spanning tree graph in the period before the crisis (Fig. 2), regardless of the fact that this period covers only one year, it can be concluded that there are several centers – stocks, around which returns on other stocks gravitate. The largest number of stocks (6) is related to the ALKALOID and PETROLMK, as well as to SJPT and MERCATOR (5). All hubs belong to the non-financial sector, as well as the largest number of stocks that gravitate towards them. Distance values between returns on the stocks analyzed are in the range from 1.11 to 1.48, and stocks can be grouped into several clusters.

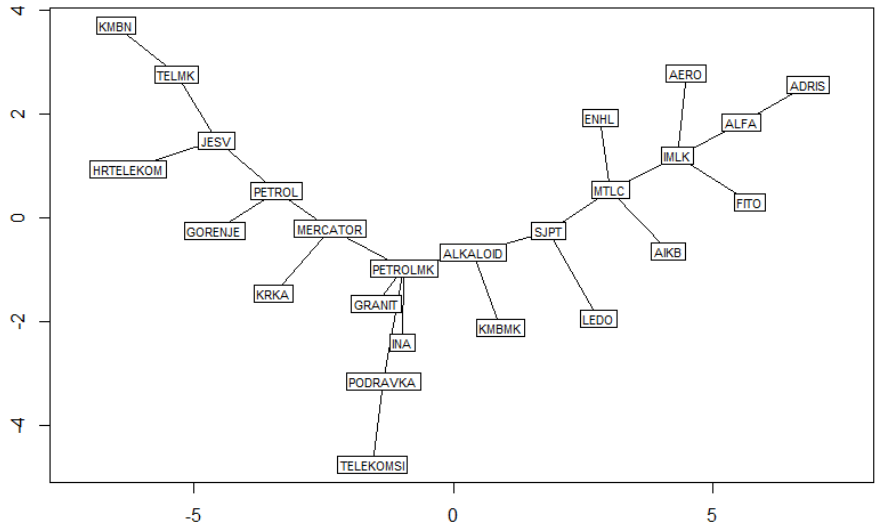

Fig. 2 Minimum spanning tree before the crisis for 25 stocks from emerging markets

At the level of distance between 1.3 and 1.35 it is possible to divide the tree into 11 clusters, but two large groups of stocks are being observed (Fig. 3). The remaining stocks do not form clear clusters. The first cluster consists mainly of the stocks from the Serbian capital market, while the second cluster contains the Slovenian and Macedonian stocks. The stocks from the Croatian capital market do not form a clearly visible cluster.

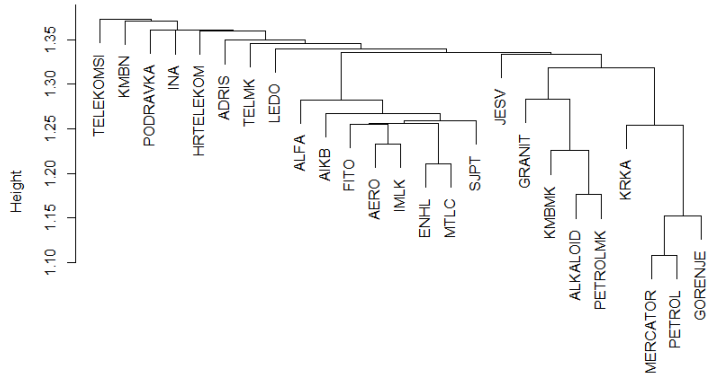

Fig. 3 Hierarchical tree of 25 stocks from emerging markets before the crisis

The crisis period is characterized by concentration of stocks around three hubs, as follows: AIKB (5), SJPT (4), and FITO (4) (Fig. 4). These stocks are traded on the Belgrade Stock Exchange and belong to different sectors: issuer of stocks AIKB belongs to the financial sector, while issuers of stocks SJPT and FITO belong to the non-financial sector (manufacturing industry sector). To AIKB, as a central hub, SJPT and FITO gravitate, as well as stocks from the financial sector of other stock exchanges, so it cannot be argued that the hierarchical structure is determined by sector. During the crisis, there is a more pronounced positive correlation between returns on the observed stocks, with regard to the fact that the distance value ranges from 0.84 to 1.50.

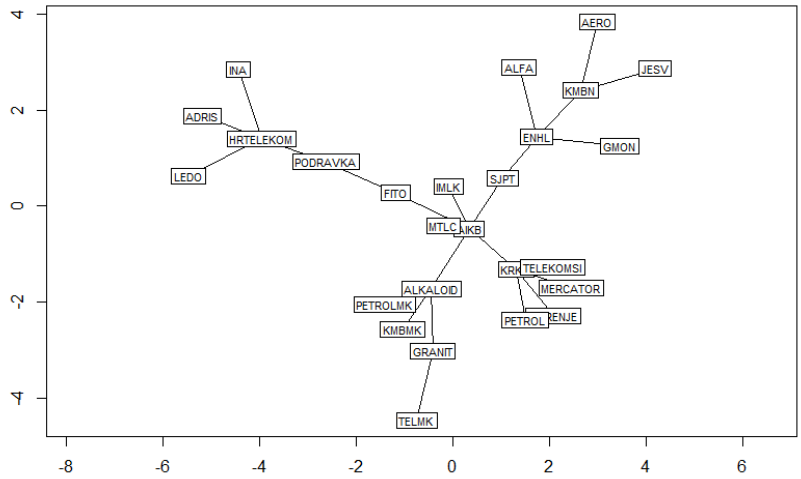

Fig. 4 Minimum spanning tree during the crisis for 26 stocks from emerging markets

The height of dendrogram indicates that the distances between the clusters are lower comparing to the pre-crisis period, as in the period after the crisis (Fig. 5 and 7), but also that there is a greater range of distances between the clusters (around 0.7) during the crisis period in contrast to the period before and after the crisis (about 0.3). During the crisis the most similar group is the group of Slovenian stocks (TELEKOM, KRKA, MERKATOR, PETROL, GORENJE), which is followed by a cluster of Serbian stocks (ENHL, SJPT, AIKB, KMBN) and a cluster of Macedonian stocks (ALKALOID, PETROLMK, GRANIT and KMBMK). A cluster of the Croatian stocks (INA, HRTELEKOM, ADRIS, LEDO, PODRAVKA) can be observed, but the distance within the cluster significantly differs from the previous clusters of stocks. At the level of just over 1.3 it is possible to divide the tree and get the three clusters, and, if GMON is excluded from analysis, two clusters. In the hierarchical structure under this term, one cluster consists of the stocks from Zagreb stock exchange and a second cluster of the remaining stocks.

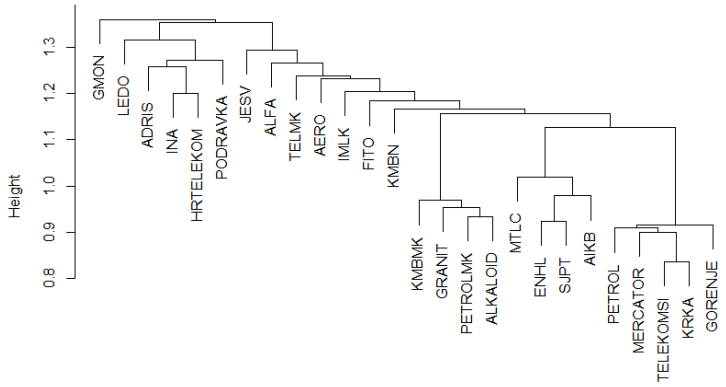

Fig. 5 Hierarchical tree of 26 stocks from emerging markets during the crisis

In post-crisis period, financial institutions retain the role of central hubs (Fig. 6). The biggest hubs are AIKB and KMBN (5), followed by NTLC, ENHL, and KRKA (4). Both stocks whose issuers belong to financial sector and stocks whose issuers belong to non-financial sector gravitate to these centers. The hierarchical structure is less dispersed, and distance values are in the range from 1.16 to 1.48, based on which one can conclude that the correlation of returns in the period after the crisis is largely negative.

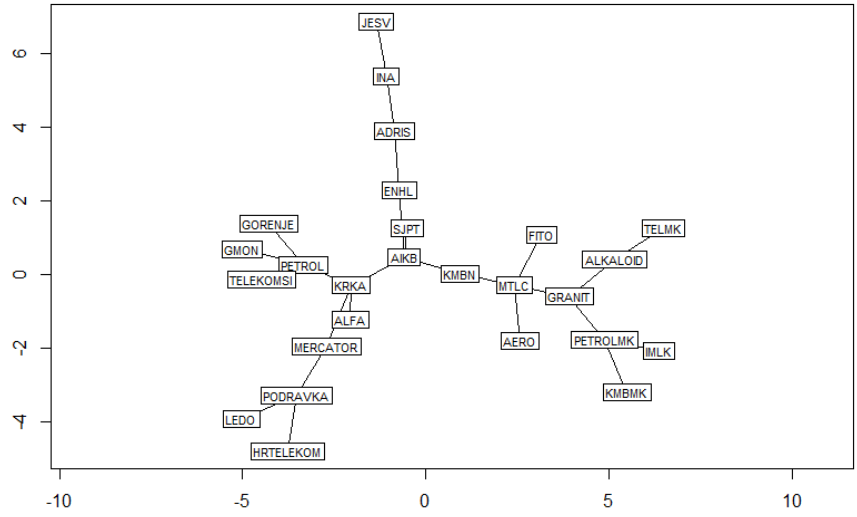

Fig. 6 Minimum spanning tree after the crisis for 26 stocks from emerging markets

The height of the hierarchical tree is similar to the dendrogram before the crisis (Fig. 7). In the period after the crisis, with the exception of the cluster consisting of the Slovenian stocks (TELEKOM, KRKA, MERKATOR, PETROL, GORENJE), there are no clearly visible clusters.

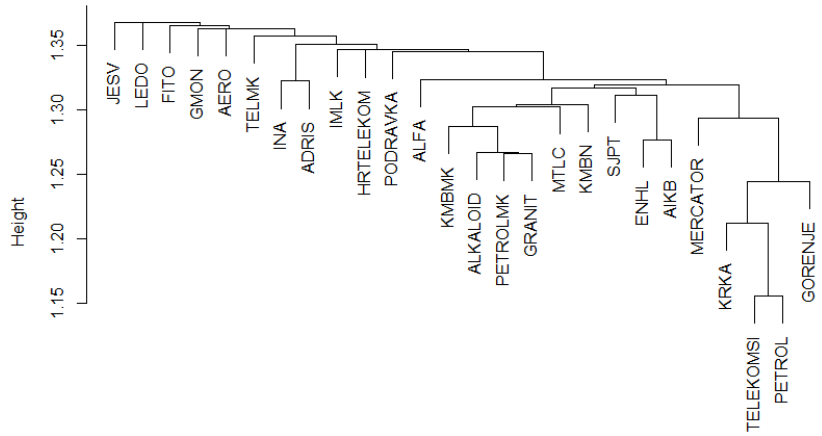

Fig. 7 Hierarchical tree of 26 stocks from emerging markets after the crisis

CONCLUSION

The massive amount of financial time series data that originates from the stock markets is of interest to a large number of market participants. The complexity of financial data, accompanied by investors' aspiration to receive information constantly, timely, and in easily accessible and visually acceptable manner caused the emergence of multi-dimensional data models and sophisticated visualization techniques. Business intelligence systems, with OLAP tools, analytical techniques, data warehouses and data visualization, are good sources of information in modern business, including investment decision-making. The widely used approach to analyses is describing the structure of a market by constructing MST, which represents the interconnection among the securities, enables detecting clusters and mutual relationships in a financial market.

Considering possible diversification effects of investing in emerging markets, correlation structure of the stocks from the four South-East European emerging markets using MST method is presented in this paper. Although the observed markets are located in the same geographic region, during the periods without shocks on the capital markets, selected stocks do not reflect significant correlation. However, in the period of the global financial crisis markets show certain interdependence, especially on the movement of the returns in financial sector. In terms of investment decision-making these results can provide useful insights as to which stocks could be included in a portfolio to improve its performance. Since the main objective of investors is to diversify the portfolio, selecting stocks that are in different clusters (far away from each other) would be beneficial. This analysis is especially relevant in crisis periods, when investors prefer to have a well-diversified portfolio.

Since the characteristics of emerging markets are reflected in numerous anomalies, such as information inefficiency, homogeneity of assets and illiquidity of stocks, several directions for the future research can be observed. The analyzed technique should be modified in order to adjust to the distribution of the continuously compounded returns, which is usually not Gaussian. On the other hand, the non-linear correlations between

financial time series can be observed using different correlation measures, such as the Spearman's rank correlation and the Kendall tau correlation. Observing the correlation with developed stock market and causal relationship will enable investors to discover key markets that drive trading and spillovers.

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Obiman broj podataka u finansijskim vremenskim serijama sa tržišta kapitala generiše ogromnu količinu kompleksnih podataka koji su od interesa za veliki broj učesnika na tržištu. Da bi na sveobuhvatan način razumeli tržišni mehanizam, investitori zahtevaju adekvatna rešenja kojima mogu efikasno manipulisati podacima. U ovom radu korišćen je koncept minimalnog obuhvatnog stabla (MOS) u cilju otkrivanja obrazaca promene korelacija u skupu akcija sa novonastalih tržišta jugoistočne Evrope. Pokazan je način na koji MOS i odgovarajuće hijerarjisko stablo evoluiraju tokom vremena i opisuju razvoj međuzavisnosti između akcija sa posmatranih tržišta. Tokom perioda posmatranja, 2007-2014, veze između akcija su se menjale, posebno u periodu globalne finansijske krize, što može imati značajne implikacije na donošenje investicionih odluka.

Ključne reči: *korelacija, minimalno obuhvatno stablo, finansijske vremenske serije, novonastala tržišta*

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THE ROLE OF MONETARY AND MACROPRUDENTIAL POLICIES IN PURSUIT OF FINANCIAL STABILITY

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Abstract. *During the recent financial crisis, there have been significant real and fiscal implications that have renewed concerns of the regulatory agencies for financial stability. The stability of the financial system implies its resistance, which must be set up in advance and installed along the entire lifetime of financial institutions. The authors of this study have firstly presented the concept and conceptual questions of financial stability, and secondly, they have perceived the role of relevant policies in preserving financial stability. Special emphasis is given to the role of monetary and macroprudential policies and their conditionality in the realization of the same objective. Since the policy of preserving financial stability is a particularly sensitive area within the European Union (EU), this paper has summed up the current framework for financial stability, as well as the efforts towards the creation of the banking union.*

Key words: *crisis, financial stability, macroprudential policy, monetary policy, banking union*

INTRODUCTION

Due to the frequent banking crisis in the last decades of the past century, the issue of financial stability has become more than a popular topic. Bearing in mind that the stability of the financial system is seen as a precondition for the stability of the economic system, achieving and maintaining the stability of the financial system is set as an explicit goal of a growing number of central banks (CB). In order to be realized, this kind of objective requires to be clearly defined, and its significance and position in relation to the primary objective of the central bank, which is price stability, should be pointed out. In this respect, the first part of the paper deals with the concept and the basic conceptual issues

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related to financial stability. Along with the actualization of the issues of pursuing financial stability, in a growing number of countries, special bodies for macroprudential issues are being formed, in all of which, the role of the CB is crucial. The extent to which the field of monetary and macroprudential policies will overlap, largely depends on the achieved level of development of the macroprudential framework in a particular country. In this regard, the second part of the paper suggests possible approaches to the role of the monetary policy in maintaining financial stability. In the last part of the paper, the policy of maintaining financial stability is narrowed down to the EU, where special attention is paid to the analysis of the role of the European Central Bank (ECB) in preserving monetary and financial stability.

1. FINANCIAL STABILITY – THE TERM AND CONCEPTUAL ISSUES

Along with the financial deregulation that marked the last decades of the past century, the incidence of financial crisis has suddenly increased. Among them, the banking crisis emerged as the dominant form of financial crisis. In 1995, there were even 13 systemic banking crisis. The real and fiscal implications of the crisis were the reason for setting financial stability as an increasingly important objective for the economic policy formulation. This can be confirmed by the fact that almost all central banks and several international financial institutions have begun to publish reports on financial stability and financial stability has become the responsibility of many institutions. Actualization of issues of preserving financial stability has been related to several trends and changes in financial systems over the last few decades.

Due to the deregulation of the financial regulations, the environment for intensive development of the financial sector was created, which was why the volume of financial transactions exceeded the volume of transactions in the real sector several times. The enormous growth in the financial services sector is evident on several grounds: its dominant share in the gross domestic product (GDP), the size of financial assets, the number of employees and average wages in this sector (Scharfstein & Greenwood, 2013). These changes are indicated by the term *financialization*, which basically means the separation of the real and the financial sector, whereas the financial sector becomes an end in itself. The consequences of financialization are the growing transfer of income from the real to financial sector, an increasing income inequality and the growing influence of financial incentive used to manage companies. In such circumstances, the prices of certain financial assets are determined on the basis of monitoring the prices of other financial assets, without any connection to the current situation and trends in the real sector of the economy. This kind of the financial sector growth is encouraged by a number of financial innovations, and above all, by the rapid development of financial institutions in the shadow banking. This sector includes financial institutions that, similarly to banks, perform maturity transformation of the banking resources, but they cannot mobilize the insured deposits and do not have the same system of protection that applies to banks. Structured investment vehicles, money market funds and the Government-sponsored entities like Fannie Mae and Freddie Mac can be included here. These institutions, during the recent financial crisis allowed loans to a wide circle of beneficiaries at much more favorable terms than those offered by the banks (Palley, 2007). Although it was designed to improve the standard of living, this kind of model that offered mortgage loans led to the over-indebtedness of households, bearing in mind the

fact that the most common users of housing loans were entities with low and middle income (low and average salaries). In addition, the participation of the shadow banking sector in the credit intermediation burdened this procedure with a larger number of stages and made it impossible for participants to adequately assess the counterparty risk. As this sector did not enjoy the benefits of the Safety net, during the recent financial crisis, it became the subject of assault and it generated a significant risk to financial stability.

The development of the new financial activities and institutions, internationalization and homogenization of financial activities led to the formation of financial conglomerates, which united banks and non-banking institutions (Jovanić, 2006). The more important relationship of institutions within and between financial systems, as well as a significant number of mergers and acquisitions in the financial sector, left the creators of the economic and financial policies without adequate instruments and tools to preserve global financial stability.

In finance, not every efficiency drop needs to be followed by an immediate intervention. On the other hand, it is most certainly desirable in situations when the inefficiency of the market represents a threat to financial stability. However, the concept of an adequate framework for financial stability does not aim to prevent all possible risks in business, and there are several reasons why this is so. First, it is unrealistic to expect that all financial institutions will be able to manage the risks they face in their operations. Second, it is not desirable to create and enforce mechanisms that are too protective, considering that those mechanisms suppress innovation of institutions. In this sense, achieving and maintaining financial stability needs to be harmonized with other, perhaps even more important goals, such as economic efficiency. This means that finance should not be an end in itself-, but also should support the efficient allocation of resources in the real sector of the economy. For this reason, policymakers need to establish a balance between stability and efficiency of the financial system. Looking at the characteristics of the US financial system which is a market-oriented, it is pointed out that the efficiency of the financial system is achieved at the expense of financial stability, which was confirmed during the latest financial crisis. In this sense, it is important to identify potential threats to financial stability at an early stage.

Setting up the concept of an adequate framework for maintaining and strengthening financial stability requires defining relevant concepts, such as financial systems, financial stability and systemic risk. In the broadest sense, the financial system is composed of three separate, but closely related components: financial institutions, financial markets and financial infrastructure. The financial system is considered stable if it enhances (rather than worsens) economic performance and is resistant to internal and external shocks (Schinasi, 2004). There are several important implications of defining financial stability in this way. Firstly, the assessment of the performance of the financial system shows the extent to which the financial system facilitates the allocation of economic resources, savings and investment processes, and ultimately economic growth. However, this is a two-way relationship, meaning that the real sector of the economy can have a positive or negative impact on the financial system, which has to be taken into consideration when designing a framework for evaluating and improving financial stability. Secondly, it should be noted that the disorder and instability in any of the components of the financial system do not pose a threat to financial stability, unless it leads to negative implications for the real sector of the economy. From the point of view of financial stability, shutting down less efficient markets and financial institutions is even desirable. As in Schumpeter (1934) business cycles, where the adoption of new technologies has both its constructive and destructive implications, the

specific situation of instability can be occasionally tolerated if that will contribute to the long-term efficiency of the financial system. Third, not only does financial stability exist when the financial system adequately performs its role in mobilizing and allocating financial surpluses, transforming and managing risks, but also when the payment system functions efficiently. This means that the money, both the central bank money, and its close substitutes, properly serves its purposes as a means of payment, billing unit and a value keeper. Since this part represents a vital part of monetary stability, the financial and monetary stability overlap to a large extent. Fourth, financial stability means the absence of the financial crisis and the ability of the financial system to manage the imbalances before they become a threat to financial stability. And last but not least, financial stability can be seen as a phenomenon in time - reflecting different status combinations of the constituent parts of the financial system. One of the implications of observing financial stability in this way is that maintaining financial stability does not necessarily require that every part of the financial system operates continuously with maximum performance. The Continuum Concept becomes relevant in the analysis of the financial system, because the uncertainty and risk are constantly present, dynamic (intertemporal and innovative) and they consist of many interconnected elements (infrastructure, institutions and markets).

Financial stability is a fundamental precondition for the development of any economy, and that is why regulatory agencies continuously monitor the risks that threaten financial stability. This includes a two-dimensional approach where risks are monitored both at the level of individual financial institutions and at the level of the overall financial system. This kind of approach is used so that the problems that individual institutions are facing can be avoided before they become problems for the whole system. Systemic risk is often defined as a risk of disruption in providing financial services that can seriously harm the real economy. In this sense, it is very important to define policies for its management on time. The policies for managing systemic risk must include both of its dimensions, structural and cyclical. The structural dimension of the systemic risk results from the external effects produced by the components of the financial system affecting financial stability. In this respect, the policies for managing this dimension of systemic risk include establishing higher capital requirements for systemically important financial institutions, introducing a stable margin system (*hair-cuts*) as well as mechanisms for strengthening the resilience of the market infrastructures (Caruana, 2010). The cyclical dimension of the systemic risk indicates the progressive accumulation of risk over time, whereby the stakeholders tend to over-invest in the beginning, whereas the down phase leads to strengthening of the uncertainty in the market, price drop of financial assets, the reduction of financial leverage, a sharp decrease in liquidity, and to financial crisis after all (Cardarelli, Elekdag, & Lall, 2009). Measures to manage the cyclical dimension of systemic risk are prudential in their nature, and involve the introduction of countercyclical and sectoral protective layers of capital, limitation of the leverage level, as well as the introduction of standards for liquidity risk management (Bank for International Settlements, 2010).

The recent financial crisis pointed out to the importance of having an adequate regulatory framework for preserving and strengthening the stability of financial institutions. Its basic goals are to prevent and resolve systemic problems, in a situation when prevention fails to yield results. This is the concept of financial safety net, which includes a number of institutions, rules and procedures that are activated to protect stability of the system of financial intermediation (Marinkovic, 2004, p. 14). Since the banks are the dominant financial institutions in most of the financial systems, this framework is largely adapted to them. The

regulatory framework is set along the entire lifetime of financial institutions and includes both *ex ante* components - regulation and supervision, and *ex post* components - the lender of last resort, deposit insurance and the policy of restructuring and exiting of banks from the market. Though important in the different stages of the bank's operations, the stability of the banking sector can only be achieved by the synergetic effect of all components.

Ex ante components of the security infrastructure define policies for the efficient and stable functioning of the banking and overall financial system, whereas *ex post* components' role is to stop further expansion of the crisis and to intervene with the institutions threatened with bankruptcy. The deposit insurance system aims to maintain the confidence of depositors in times of crisis, while in the stable conditions generally takes over the duties of restructuring banking institutions. Deposit insurance becomes important once a bank is declared insolvent and its primary task is to protect the depositors first, while the lender of last resort becomes important at the moment when the bank has already exhausted all the previous sources of liquidity, and then its focus is primarily on the protection of banks. The abovementioned components are directed, as we can see, towards the realization of different, not entirely consistent objectives, and that is why there is an institutional division of responsibilities and the presence of numerous institutions: prudential authorities (regulators and supervisors), Deposit Insurance Agencies, the Agency for Restructuring, monetary and fiscal authorities. The Central Bank has a significant role in pursuing financial stability, which is perfectly consistent with its role in implementing the monetary policy. In this regard, in the following part of the paper, we will try to look at what is the role of monetary policy in maintaining financial stability, in terms of coordination, and not mutual exclusion of monetary and macroprudential policy.

2. Different Approaches to the Role of Monetary Policy in Maintaining Financial Stability

There are several reasons why we can claim that CB has a natural and not assigned role in preserving financial stability. First, the emergence and development of central banks was mainly related to their role in preserving financial stability. The Federal Reserve System was the first one responsible for preserving financial stability, and it was only later when it became responsible for monetary stability as well. Being a supreme monetary financial authority, a regulator and a supervisor in most of the financial systems, the central bank has all the necessary competence and experience to have the lead role in achieving and maintaining financial stability. The central bank issues legal tender and supplies the banking sector with the necessary amount of liquid assets. In addition, it is responsible for the payment system and its efficient functioning. The introduction of a real-time gross payment helped preventing the spreading of bankruptcy from one institution to another through the payment system. Given that banks are the main channel for the transmission of monetary policy, stable and sound operation of banks is a necessary precondition for the effective implementation of monetary policy (Bank for International Settlements, 2003). Once financial instability occurs, monetary instability is likely to follow, which is another thing that goes in favor for the central bank to be responsible for both aspects of stability.

Monetary policy, although primarily aimed at the preservation of price stability, must consider the impact of its measures on financial stability. During the recent financial crisis, it was monetary policy that was used as the first anti-crisis instrument that used its expansionary course of action to increase the liquidity in the system. The policy of low

interest rates and the implementation of a number of unconventional monetary policy measures had had assets of central banks increased many times, due to which, further financial stability had become directly conditioned by fiscal policy. However, a significant state support for the banking sector arranged during the recent financial crisis, raised the question of fiscal sustainability of many national economies, thus illuminating the relationship between financial sector stability and the level of public debt and budget deficit. Due to the lack of adequate macroprudential regime in a number of countries, both monetary and fiscal policy played a significant role in calming the financial crisis. Of course, monetary and fiscal policy should primarily be responsible for the basic objectives of their policies, which is the reason why macroprudential policy should be further improved.

Monetary and macroprudential policies are singled out as a countercyclical policies - the former is concerned with price stability, and the latter with the stability of the financial system. Microprudential policy is concerned with the stability of individual banks. It is necessary to bear in mind that sometimes it is very difficult to separate microprudential policy from macroprudential one, given that macroprudential policy is largely implemented by means of instruments of microprudential policy. The connection of those policies have caused the European Central Bank (ECB) to expand the field and deadline for monetary analysis, in order to adequately comprehend the implications of the financial system stability on price stability, which is set aside as a complementary measure to the use of macroprudential instruments aimed at limiting ups and downs on the credit market in recent decades. In this sense, the following question arises: "Is it necessary to expand the jurisdiction of the functions of monetary regulation, so that it can be responsible for pursuing and strengthening financial stability?". Three views have risen from this question: a) Modified Jackson Hole Consensus, b) Leaning against the wind vindicated c) Financial stability is price stability (Smets, 2013, p. 125).

Table 1. Potential views to the role of monetary policy in maintaining financial stability

	Modified Jackson Hole Consensus	Leaning against the wind windicated	Financial stability is price stability
Monetary policy	Framework largerly unchanged. Limited effects on credit and risk taking. Blunt instrument to deal with imbalances.	Financial stability as secondary objective: lengthening of horizon. Affects risk-taking. „Gets in all of the cracks“	Twin objectives on equal footing. Unblocks balance sheet impairments; avoids financial imbalances in upturns
Macro prudential policy	Granular and effective	Cannot fully address financial cycle; arbitrage	Indistinguishable from monetary policy
Interaction	Limited interaction and easy separation of objectives and instruments.	Financial fragility affects monetary transmission and price stability	Financial stability and price stability are intimately interlinked
Issues	Coordination? Lender of last resort?	Coordination? Overburden money policy?	Time inconsistency problems?
Models	Svensson; Collard, Dellas, Diba and Loisel (2012)	Borio; Woodford (2012)	Brunnermeier and Sannikov (2012)

Source: (Smets, 2013, p. 134)

The first view advocates the responsibility of monetary policy solely to price stability, while financial stability is the sole responsibility of macroprudential policy. The course of leading monetary policy will not lead to the formation of the boom and bust cycle, and a short-term interest rate is not a suitable instrument for managing these imbalances. The application of higher prudential requirements conditions banks to internalize the risk, and these effects cannot be achieved by the measures of monetary policy, that are focused on the loan volume, rather than on the loan structure. This approach does not assume a connection between interest rates and macroprudential policy instruments, and it is not rare for these policies to move in completely opposite directions during the business cycle: on the one hand, the introduction of additional prudential requirements, and on the other, the reduction of interest rates in order to avoid the effects of prudential policy on the loan volume.

The second view does not support a narrow focus of monetary policy, noting that it is the focus of a number of central banks to preserve price stability in the short term the one that has prevented their aggressive engagement in preserving financial stability. Given that the banking sector is the main channel for the transmission of monetary policy, its stability has important implications for price stability. In order to comprehend the impact of financial imbalances in the implementation of monetary policy, the CB must expand its scope of action. Representatives of this approach point out that monetary policy can significantly contribute to the maintenance of financial stability with its tools and instruments, without compromising the price stability. The coordination of monetary and macroprudential policies in the field of preserving financial stability is quite justified, given that both have an impact on real economic variables. In addition, the fact that monetary policy can take over the macroprudential role at a certain point is justified by the fact that the monetary policy decisions are more frequent than those of macroprudential policy (Galati & Moessner, 2011).

The third view advocates equal treatment of price and financial stability, emphasizing that they are so closely connected that it is practically impossible to distinguish between them. The task of the monetary policy is to support the sector in crisis with its standard and non-standard tools and instruments, as it did in the case of the price of mortgage instruments during the recent crisis, by buying mortgage securities, and thus helped overindebted household sector. This approach, therefore, advocates the important role of monetary policy in the field of preserving financial stability, especially in the case when the fiscal policy measures do not achieve the desired effects.

The abovementioned views clearly have different implications for the institutional set-up for the monetary and financial stability policy, although each of them highlights the interrelatedness of monetary and financial stability. To what extent monetary policy should take an active role in the field of preserving financial stability largely depends on the extent to which it can manage the growing instability in the system by using its standard tools and instruments, as well as to what extent it can channel the risk that financial institutions take by using short-term interest rates. It should be borne in mind that the impact of monetary policy is not sector-oriented but it affects all financial institutions, even those that operate in the shadow banking, and that are difficult to comprehend with measures of supervision and regulatory activities. However, in a situation where an excessive growth of credit activity is linked to a specific market or institution, regulatory and supervisory measures are considered adequate. In such conditions, the standard instrumentation of monetary policy does not work, causing the central bank to introduce a number of non-standard monetary policy instruments. In fact, numerous non-standard monetary policy measures (changes in the policy of mandatory

reserves or adjusting the value of the collateral in the system in operations conducted by the central bank) can be characterized as macroprudential policy instruments. In this case, the question is whether CB should use non-standard measures to lean against boom periods (Smets, 2013, p. 140)

Assigning macroprudential mandate to the central bank, in addition to its primary responsibility for price stability, is justifiable. This ensures better coordination and exchange of information necessary for the preservation of price and financial stability. Then, the central bank has the expertise in macroeconomic affairs and supervision of financial institutions and other segments of the financial system. Finally, as a lender of last resort, it grants loans for liquidity to banks, thus reducing the likelihood of the outbreak of the crisis. However, this kind of engagement of the central bank may quite distance it from its primary objective, which is the pursuit of price stability, because it has to take the role of a distributor and the role of a quasi-fiscal actor. This draws its political responsibility and ultimately it may compromise its independence. As an additional problem, dynamic (time) inconsistency is highlighted, given that the central bank can be easily found in the position to put a larger quantum resources into the system than necessary to preserve the long-term price stability. Such risks can be controlled by the division of goals, instruments and responsibilities of macroprudential and monetary policy, which is especially important if both of these roles are performed by the same institution, i.e.the central bank. In order to solve the problem of time inconsistency, the central bank, being a part of monetary regulation must take care primarily of price stability, while pursuing financial stability remains the primary responsibility of macroprudential, and not monetary policy.

There are numerous ways in which the central bank fulfills its macroprudential role. In some countries (e.g. The United Kingdom), the central bank has a clear mandate for macroprudential and microprudential policies. In other countries, the central bank has a significant share in the structure of the committee vote on macroprudential issues (as in the case of the European Systemic Risk Board, ESRB). In the US, the Federal Reserve System is one of the 10 authorities that have the right to vote in the Financial Stability Oversight Council (FSOC), and are responsible for the regulation of systemic banking and nonbanking financial institutions. The role of macroprudential policy in preserving and strengthening financial stability largely depends on the effectiveness of its instruments, and it should be taken into consideration that there is no widely accepted list of macroprudential instruments. On the contrary, they are adapted to the specific intermediate target, which may be stopping excessive credit growth and leverage, maturity mismatches, direct and indirect exposures, etc. These instruments proved to be very useful in combating the cyclicality of the financial system during the recent financial crisis. However, the lack of international coordination of these measures can be the basis for regulatory arbitrage, thus reducing their effectiveness in combating systemic risk significantly. This problem is particularly acute in the area of European Monetary Union (EMU), given the supranational monetary policy and national policy of financial stability.

3. The Role of Monetary and Macroprudential Policies in Preserving Financial Stability in the European Union

On the territory of the European Union, the division of responsibilities over the basic functions of CB was carried out so that ECB took over responsibility for the implementation of monetary policy in the Eurozone countries, while the functions of supervision and the lender of last resort remained under the jurisdiction of the national central banks and supervisory authority. The ECB is in total control of the function of monetary regulation within which it defines and implements monetary policy, taking care of price stability within the EMU. However, the ECB does not have official jurisdiction in matters of regulation and supervision, and it is included here only indirectly, through the European System of Central Banks, as much as the central bank of a particular national economy is at the same time a regulator as well. Despite possible limitations and the lack of direct involvement of the ECB in the field of regulation and supervision of credit institutions, its role in this segment cannot be ignored, especially when it comes to its macroprudential role. Macroprudential role of the ECB is even more relevant in the context of monetary union, where its duty is to express the differences between the financial systems of comparable countries which have the same level of economic development (Božina & Štajfer, 2009). Within a monetary union, macroprudential policy is defined at the national level and the national central banks have the ability to define macroprudential policy instruments tailored to the specific sources of instability in the financial system. That is how they act countercyclically by using macroprudential policies, given that the monetary policy is within the competence of the ECB and that they have no ability to influence interest rates (Galati & Moessner, 2011).

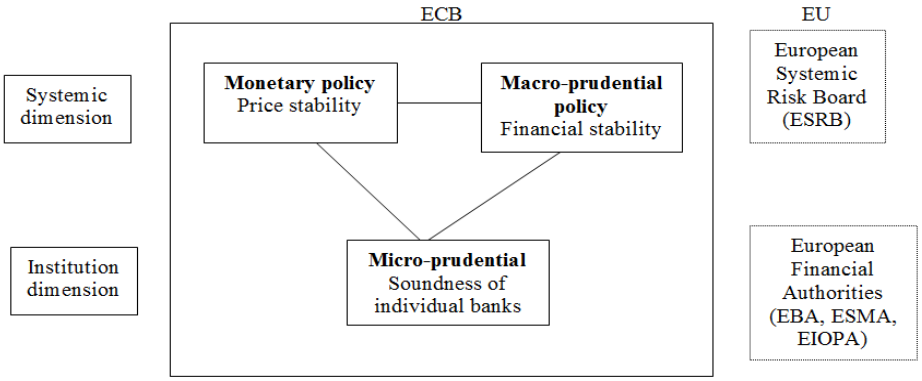

Fig. 1 The new institutional framework of the European Monetary Union
Source: (Smets, 2013, p. 122)

As we can see in the figure, monetary and macroprudential policies are used as countercyclical policies, whereby monetary policy is focused on price stability and macroprudential policy on financial stability. On the other hand, microprudential policy takes care of the stability of the individual financial institutions, i.e.banks. It is necessary to examine how monetary and macroprudential policy co-operate since they have different objectives and use different instruments. In the previous section, we have pointed out to a significant

relationship these objectives have, which is the reason why the ECB in its monetary strategy opted out for a broader approach and perceiving the impact of financial stability on price stability. In this way, it has made a balance between its business area and macro and micro prudential policies.

The ECB has a limited capacity in the field of preserving financial stability given the limited fiscal mandate, which prevents it from stepping forward as the lender of last resort for credit institutions. This is a significant difference compared to the Fed and the Central Bank of England, which have the capacity to come forward in the role of the lender of last resort. Moreover, the Fed has the final say in the supervision over the other regulatory bodies, which is not the case in the Eurosystem, where the national central banks decide in case of bankruptcy of an institution. The lack of uniform measures, and procedures that supervisors in the EU apply, caused the convergence of supervisory practices. In order to achieve a higher level of integration and coordination between national supervisory authorities, the European Commission in late 2008 organized a group of experts (de Larosière group) under the direction of Jacques Larosière, whose task was to build new infrastructure functions of supervision of the financial services sector (The de Larosière Group , 2009).

The reform divided supervision in two levels: supervision at the macro level, assigned to the European Systemic Risk Board (*European Systemic Risk Board, ESRB*) and supervision at the micro level, assigned to the European System of Financial Supervisors (*European System of Financial Supervision, ESFS*), consisting of national supervisors and three new European supervisory authorities: (*European supervisory Authorities, ESAs*) banking (*the European Banking Authority, EBA*); securities and markets (*the European Securities and Markets Authority, ESMA*) and insurance companies and pension funds (*the European Insurance and Occupational Pensions Authority, EIOPA*).

European Systemic Risk Board has been established in order to coordinate macroprudential policies, as a supranational consultative body whose main task is to send ESFS early signals about the possible existence of systemic risk and the need for the intensive supervision. The way micro-supervision is organized is that every financial services sector is regulated by a separate body. There are national regulators for all three sectors separately at the bottom of the European supervisory infrastructure. As it can be noted, here we have a vertical model of supervision where each sector is regulated by a separate body.

With the new institutional framework, the ECB has taken a key role in the European Systemic Risk board - as a macro-supervisor, whereas micro-supervision has remained within the competence of national supervisors of the Member States. In addition, an authority for macroprudential issues at the national level has been formed at the central bank or at the supervisory authority. In this way, a jurisdiction in macroprudential policies has been divided between those newly formed authorities and ECB. In such macroprudential framework, the ECB has the right to define more severe requirements for macroprudential instruments in comparison to those already defined by national supervisors (Freystatter, 2015). This role of the ECB in the macroprudential sphere is partly limited. Namely, it only refers to macroprudential instruments that have been already defined at the national level, and which are at the same time part of the ECB; its power is asymmetrical, given that there is no possibility to prescribe more lenient requirements, and a problem of coordination can occur, considering that ECB shares its responsibility with national authorities.

The new institutional framework of the macroprudential policy in the Eurozone cannot be fully identified with leaning-against-the-wind approach. National macroprudential

authorities are the first ones responsible for maintaining financial stability, and they are trying to use monetary policy as little as possible for the purposes of preserving financial stability. However, underdevelopment and lack of experience in using macroprudential instruments have caused that monetary policy does take its stake in preserving financial stability. The financial crisis in the Eurozone has clearly shown that in countries that share single currency, there is a need to centralize the rules governing banks, especially due to the extreme relationship of countries and their banking systems. Banking Union emerged as a possible solution to this problem. In June 2012 there was an initiative for the establishment of a banking union, which would centralize supervision (*the Single Supervisory Mechanism, SSM*), restructuring policy (*the Single Resolution Mechanism, SRM*) and deposit insurance (*the European Deposit Insurance Scheme, EDIS*). The first two pillars of the banking union, SSM and the SRM have already been established, and the proposal for the third pillar was accepted for consideration in November 2015.

Banking Union is based on the Single Rule Book to ensure equal conditions for business institutions and the functioning of the regulatory authorities, avoid national regulatory authorities being bias, as well as problems of coordination and cooperation, and at the same time, preventing the spillover of problems from one country to another (Gaspar & Schinas, 2010). Also, this helps preventing the problems that occur in the banking sector to affect the public finances of the national economy, given that with the new approaches, socialization of bank losses is forbidden. Banking Union is required for the EMU member countries, (19 countries currently), while other non-EMU countries can join the banking union if they wish. Of course, this implies that all three pillars of the Banking Union must be fully accepted.

CONCLUSION

Financial stability is a precondition for the development of any economy, causing regulatory authorities to monitor the risks that threaten financial stability on an ongoing basis. This includes a two-dimensional approach in which risks are monitored, both at the level of individual financial institutions and at the level of the overall financial system. The Central Bank has a significant role in preserving financial stability, which is perfectly consistent with its role in implementing the monetary policy. In this sense, the question is: what is the role of the monetary policy in maintaining financial stability? During the recent financial crisis, due to the absence or insufficient development of macroprudential frameworks in many countries, monetary and fiscal policies took an important role in mitigating the financial crisis. However, this kind of engagement of the central bank may quite distance it from its primary objective, which is the pursuit of price stability, because it has to take the role of a distributor and the role of a quasi-fiscal actor. This affects its political responsibility and ultimately may compromise its independence. As an additional problem, time inconsistency can be highlighted, given that the central bank may get itself in a position to put a larger quantum of resources into the system than it is necessary in order to preserve the long-term price stability. Such risks can be controlled by the division of goals, instruments and responsibilities of macroprudential and monetary policies, which is especially important if both of these roles are performed by the same institution, the central bank in this case. In order to solve the problem of time inconsistency, being a part of monetary regulation, Central Bank must take care of price stability first, whereas, maintaining the financial stability is a primary responsibility of macroprudential, and not monetary policy.

Defining the relationship between monetary and macroprudential policy is particularly specific to the area of EMU, given that monetary policy is defined at supranational level, whereas macroprudential policy is defined at both supranational and national levels. With the new institutional framework, the ECB has taken a key role in the European Systemic Risk board - as a macro-supervisor, while national supervisors of the Member States have jurisdiction over micro-supervision. In addition, there is a formation of the body for macroprudential issues at the national level, either at the central bank or at the supervisory authority. In this way, the jurisdiction of macroprudential policy is divided between the established bodies and ECB. The primary responsibility for maintaining financial stability belongs to the national macroprudential authorities that are trying to use monetary policy as little as possible as a means of preserving financial stability. However, insufficient development and lack of experience in using macroprudential instruments have caused monetary policy to take its stake in preserving financial stability. The financial and debt crisis in the Eurozone has clearly shown that in countries that share the single currency, it is necessary to centralize the rules governing the operations of banks, especially due to the exceptional relationship among countries and their banking systems. For these reasons, in June 2012, an initiative for the establishment of a banking union was launched, within which two pillars have been formed so far - Single Supervisory Mechanism and Single Resolution Mechanism, while the third pillar - the European Deposit Insurance Scheme was accepted for consideration in November 2015.

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ULOGA MONETARNE I MAKROPRUDENCIJALNE POLITIKE U OČUVANJU FINANSIJSKE STABILNOSTI

Značajne realne i fiskalne implikacije nedavne finansijske krize obnovile su zabrinutost regulatornih organa za finansijsku stabilnost. Stabilnost finansijskog sistema podrazumeva njegovu otpornost koja mora biti unapred osmišljena i postavljena duž celog životnog veka finansijskih institucija. Autori su u radu najpre izložili pojam i konceptualna pitanja finansijske stabilnosti, a potom sagledali ulogu relevantnih politika za očuvanje finansijske stabilnosti. Poseban akcenat dat je ulozi monetarne i makroprudencijalne politike i njihovoj uslovljenosti u realizaciji istog cilja. S obzirom da je politika očuvanja finansijske stabilnosti posebno osetljivo područje unutar Evropske unije (EU), u radu je ukratko izložen trenutni okvir za očuvanje finansijske stabilnosti, kao i napori ka stvaranju bankarske unije.

Ključne reči: *kriza, finansijska stabilnost, makroprudencijalna politika, monetarna politika, bankarska unija*

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MODELING MONTHLY INFLATION IN THE REPUBLIC OF SERBIA, MEASURED BY CONSUMER PRICE INDEX

UDC 336.748.12(497.11)

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Abstract. *This paper presents a framework for the practical modeling of inflation, as one of the key economic indicators. Empirical research of monthly inflation trends in the Republic of Serbia was done covering the period from January 2007 to December 2015. The seasonally adjusted ARIMA model and Holt-Winters smoothing were used for determining the future values of the consumer price index, which has been a measure of inflation in the Republic of Serbia since January 2009. The main objective of the study is to create a model that will be used for analytical and forecasting purposes. The specific objective is the comparative analysis of accuracy of these two methods (Holt-Winters and ARIMA) in determining the future value of the consumer price index. The work relies on the theoretical results of dual relationship between AR (p) and MA (q) processes in determining the future values of consumer price index.*

Key words: *consumer price index, inflation, forecasting, Holt-Winters smoothing method, ARIMA*

INTRODUCTION

Price stability, i.e. stabilization of inflation within the target boundaries, as the first priority of monetary policy, is the basis for sustainable economic growth and rising employment. The paper will, through interpenetration of econometrics and time series analysis, present a framework for the practical modeling of inflation, as one of the key economic phenomena. Economic analyses attach great importance to the monitoring and forecasting of movements in the value of consumer price index (CPI), which has been used as a measure of inflation in the Republic of Serbia since January 2009. However, its calculation and publishing has been done since January 2007. Considering the fact that forecasting time series should be performed for a short period with the purpose of higher reliability, the paper determines the future values of the monthly inflation rate for the second half of 2015.

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The main objective of forecasting the monthly inflation rate is to determine its future value. The paper uses two seasonally adjusted methods: Holt-Winters smoothing and ARIMA. Special attention is given to Box-Jenkins ARIMA modeling methodology. This is because a number of empirical studies conducted in the late 20th and early 21st century show that, in the short term, ARIMA models have extremely high inflation forecasting ability. Forming an effective seasonally adjusted model of great forecasting power relies on interdependence of observations, aimed at determining the future values of consumer price index based on its past values.

In addition to introduction and conclusion, the structure of the work consists of four parts. The first part presents inflation targeting by the National Bank of Serbia. The second part of the paper presents the methodology used for the empirical research of the movements of consumer price index in the Republic of Serbia during the period from January 2007 to December 2015. Research results and discussion form the basis of the third part of the work. This part particularly presents the results of Holt-Winters method and the obtained ARIMA model.

1. THE TARGET INFLATION RATE OF THE NATIONAL BANK OF SERBIA

The transition to inflation targeting in January 2009 marked the inflation targeting as the primary objective of Serbian monetary policy. In August 2015, the National Bank of Serbia determined the headline inflation target, as measured by the annual percentage change in the consumer price index for the period from January 2017 to December 2018 in the amount of 4.0%, with permitted fluctuations around that level in the range of ± 1.5 p.p. This decision indicates that the process of price convergence has not been completed and that the exit of the national economy from recession could accelerate it.

Table 1 Inflation target

2009.	8.0% ± 2.0 pp
2010.	6.0% ± 2.0 pp
2011.	4.5% ± 1.5 pp
2012-2018.	4.0% ± 1.5 pp

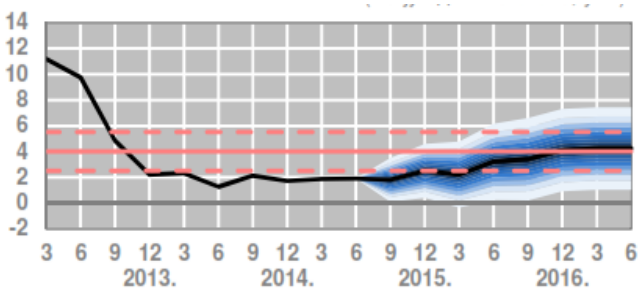
Source: National Bank of Serbia

The main reason why inflation target in developing countries is higher than in developed countries (where price stability is usually quantified as the inflation rate from 2.0% to 2.5%) lies in the process of price convergence. The convergence of price levels in Serbia to the level of prices in the European Union is not finished. The crisis and the fall in domestic demand are the main reasons why the price level in Serbia is lower compared to the price level in the European Union, in relation to the situation five years ago. In fact, domestic prices in 2014 accounted for 52.8% of the average price level in the European Union, and in 2009, for 55.8%.

Inflation in previous years ranged more broadly than it was defined by the limits of the target tolerance band. Such inflation trend was primarily influenced by the lack of a medium-term framework for the adjustment of regulated prices, with clearly defined rules and dynamics of adjustment, as well as the instability on the market of agricultural products, due to structural problems and lack of adequate systemic measures in agricultural

policy. The market of agricultural products has become more liberal in the meantime (customs duties and levies on imports of most agricultural products were abolished), so that the price oscillations on this market decreased. However, the medium-term plan of adjustment of regulated prices is still not defined, which could affect the increased fluctuation of inflation in the coming years. The priority of monetary policy in the coming period is to reduce inflation fluctuations in order to stabilize it within the limits of the target tolerance band. Stabilizing inflation within the target boundaries would bring price stability, which is the basis for sustainable economic growth and rising employment.

The aim of medium-term inflation projections is to show the projected inflation trends in the coming period, the main determinants of those trends, and the risks of its realization. The inflation projection is shown in the form of ranges and central tendencies. The projection assumption is that the monetary policy measures actively keep medium-term inflation within the target tolerance band, which is, in the present context of monetary policy, its main role (The National Bank of Serbia, 2015). According to the projections of the National Bank of Serbia, year-on-year inflation will in 2016 move around the lower limit of the target tolerance, with the possible entry into the target band at the end of this year or early next year. In the second half of 2016, its gradual approximation to 4.0% target can be expected. The most important inflation factors will be regulated prices (higher prices of electricity and low price of cigarettes). In contrast, global prices of primary products (oil and agricultural products), low aggregate demand, low inflation on a global scale, as well as restrictive fiscal policy will continue to have disinflation effect. Risks to the realization of inflation projections relate to developments on a global scale, the movement in prices of primary products, and the deviation from the assumed growth of regulated prices (The National Bank of Serbia, 2015).



Graph 1 Projected inflation (year-on-year rates, in %)
Source: National Bank of Serbia

Short- and medium-term inflation expectations have stabilized within the target band, i.e. economic entities expect that year-on-year inflation in July 2016 and July 2017 will be within the target tolerance band. The stability of inflation expectations is a key prerequisite for the stabilization of inflation and increased efficiency of monetary policy.

2. RESEARCH METHODOLOGY

The forecasting of monthly inflation rate in the Republic of Serbia relies on the official data of the Ministry of Finance on a monthly growth of consumer price index for the period January 2007 – June 2015. The analysis focuses on the price changes in the current month compared to the previous month, based on a total of 102 periods. Bearing in mind the complexity of the forecasting process, the paper will test two methods that are most commonly used in the economic analyses of time series. Integrated approach that includes several methods can be used for determining the future values of consumer price index. The modeling relies on the use of EViews7 software.

The paper will first rely on descriptive statistics to obtain information on the key features of the time series and frequency distribution of consumer price index monthly growth in the period from January 2007 to June 2015. What follows is the Holt-Winters method of forecasting. Seasonally adjusted models that use different parameter values are created, and their comparison performed. To determine the accuracy of forecasts obtained by this method, mean absolute error and root mean squared error are used. Taking into account the data specifics, the additive model is presented, which, together with the multiplicative model, presents two main models of Holt-Winters forecasting method. The additive model is the type of forecast where the expected seasonal increase in the amount of the observed phenomenon for a certain period of time is added to the annual mean. In addition, considerable attention is paid to Box-Jenkins methodology, for the purpose of forecasting the movement of the monthly inflation rate in the Republic of Serbia for the next six months. Box-Jenkins methodology is the three-stage process of constructing a model that includes: identification, estimation, and checking the adequacy of the model. Construction of the model can be considered an iterative process which ends when a satisfactory model is found, consistent with the statistical criteria of model adequacy. After examining 25 different models, one linear, seasonally adjusted ARIMA model will be proposed, which is supposed to be able to provide good results in forecasting future trends in consumer price index in Serbia. The obtained models can be used for analytical and forecasting purposes.

3. RESEARCH RESULTS AND DISCUSSION

Forecasting the inflation rate in the Republic of Serbia relies on the data on a monthly growth of consumer price index in the period from January 2007 to June 2015. The analysis focuses on changes in prices in the current month compared to the previous month, based on a total of 102 periods (observations). Graphical presentation of time series can point to the key characteristics of time series and frequency distribution. The observed series does not exhibit a pronounced trend, but fluctuations around a constant level. In respect of this time series, there is a greater intensity and degree of fluctuation and slow decline in the monthly consumer price index.

Base series flow represents a pattern of its behavior over time. The existence of a large variability in the time series, i.e. the expressed local fluctuations around the base flow, imposes the need for time series smoothing.

3.1. The seasonally adjusted Holt-Winters forecasting method

Holt-Winters method is used for the forecasting of future values in situations when the time series data has trend and seasonal character. Considering the fact that the trend points to a development tendency, one must distinguish between linear, exponential, and damped trend. The linear trend means that the time series increases (decreases) in equal absolute amounts from period to period, i.e. that the phenomenon exhibits approximately the same absolute change in the same time periods. At the same time, exponential trend means that the time series increases (decreases) in the same relative amounts from period to period. The damped trend is a combination of linear and exponential trend, where, in the first period, there is an increase (decrease) in absolute amount, and in each subsequent period relative changes occur by the exponential trend principle.

Monthly seasonal variation of time series means that the data varies around the monthly average by a certain rule. In this regard, seasonality can be defined as a time series tendency to exhibit behavior that repeats every *s* periods. Seasonal index for a period shows how much the period deviates from the annual average. To calculate this amount, at least one full data season is needed.

Two main models within Holt-Winters method are additive and multiplicative model. Additive forecasting model is the type of forecast where the expected seasonal increase in the amount of the observed phenomenon for a certain period of time is added to the annual mean. Multiplicative model involves the relative change of the observed variable which is higher if the absolute amount of the observed variable is higher, and vice versa. In parts of the time series which exhibit an additive character, the series shows stable seasonal fluctuations regardless of the overall trend level of a time series. In the case of multiplicative model, the level of seasonal fluctuations varies depending on the overall level of the series.

Additive seasonal model is used when the time series data exhibits additive sensitivity. This model is applicable in time series where the amplitude with the seasonal character is independent of the average series level. Additive version of this method may be described by the following formula:

$$L_j = \alpha(y_j - S_{j-s}) + (1-\alpha)(L_{j-1} + b_{j-1})$$
$$b_j = \beta(L_j - L_{j-1}) + (1-\beta)b_{j-1}$$
$$S_j = \gamma(y_j - L_j) + (1-\gamma)S_{j-s}$$
$$F_{j+1} = L_j + b_j + S_{j+1-s}$$

$$j = s+1, s+2, \ldots,$$

where α, β, and $\gamma \in [0,1]$ are smoothing parameters, L_j is the smoothing level in time j, b_j is the change in time j; S_j is the seasonal smoothing in time j; s is the number of periods in the season; F_{j+1} is one step ahead of the forecasted value. Initial values are calculated using the following formula:

$$L_s = \frac{1}{S}$$
$$b_s = \frac{1}{s}\left[\frac{y_{s+1} - y_1}{s} + \frac{y_{s+2} - y_2}{s} + \cdots + \frac{y_{s+s} - y_s}{s}\right]$$
$$S_j = y_j - L_s,\ j = 1,2,\ldots,s.$$

Multiplicative seasonal model is used when data has multiplicative seasonality. This model can be represented by the following formulas:

$$L_j = \alpha\left(\frac{y_j}{S_{j-s}}\right) + (1-\alpha)(L_{j-1} + b_{j-1})$$
$$b_j = \beta(L_j - L_{j-1}) + (1-\beta)b_{j-1}$$
$$S_j = \gamma\frac{y_j}{L_j} + (1-\gamma)S_{j-s}$$
$$F_{j+1} = (L_j + b_j)S_{j+1-s}$$
$$j = s+1, s+2, ...$$

The initial values of the model are calculated using the same formula as in the additive version of the model, except for the seasonal variable:

$$S_j = \frac{y_j}{L_s}, \text{ j} = 1, 2, ..., s$$

To calculate the initial value of *b*, data for the first two seasons was needed. Due to the complexity of the basic versions of the two above-mentioned models of Holt-Winters method, their simplified versions are used in practice. Simplified versions can also be used in the analysis of the volatility of the monthly consumer price index. If data in the time series has no clear trend, one can use a simplified version of Holt-Winters method (without variable *b*).

Simplified additive model can be described as follows:

$$L_j = \alpha(y_j - S_{j-s}) + (1-\alpha)L_{j-1}$$
$$S_j = \gamma(y_j - L_j) + (1-\gamma)S_{j-s}$$
$$F_{j+1} = L_j + S_{j+1-s}$$
$$j = s+1, s+2, ...,$$

The initial values of L_s and S_j in the simplified model are calculated using the above-mentioned formulas.

Simplified multiplicative model can be defined as follows:

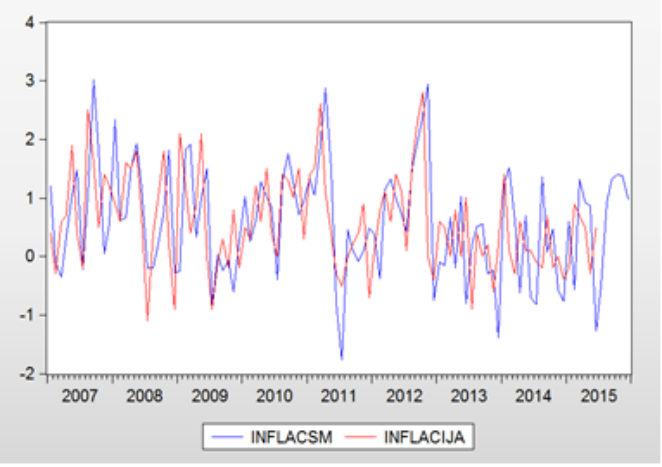
$$L_j = \alpha\left(\frac{y_j}{S_{j-s}}\right) + (1-\alpha)L_{j-1}$$
$$S_j = \gamma\left(\frac{y_j}{L_j}\right) + (1-\gamma)S_{j-s}$$
$$F_{j+1} = L_j S_{j+1-s}$$
$$\text{j} = \text{s} + 1, \text{s} + 2, ...$$

The initial values of L_s and S_j are calculated in the same way as in the original multiplicative model. For the prediction of accuracy of each model, mean absolute error (MAE) and root mean squared error (RMSE) will be used.

Table 2 Additive model of seasonally adjusted Holt Winters method

Parametars:	Alpha		0.8000
	Beta		0.5000
	Gamma		0.0000
Sum of Squared Residuals			87.65239
Root Mean Squared Error			0.927004
End of Period Levels	Mean		0.329324
	Trend		0.216787
	Seasonals:	2014M07	-1.050794
		2014M08	0.158036
		2014M09	0.341865
		2014M10	0.213194
		2014M11	-0.040476
		2014M12	-0.669147
		2015M01	0.271230
		2015M02	-0.057440
		2015M03	0.263889
		2015M04	0.222718
		2015M05	0.531548
		2015M06	-0.184623

In this paper, special focus is on calculating the seasonally adjusted Holt smoothing. In the course of analysis, additive model is created, with the following parameters: $\alpha = 0.8$ $\beta = 0.5$ $\gamma = 0.0$, proven as the best for the needs of forecasting. The forecasted value is calculated as the sum of the mean value of time series, trend component, and seasonal component for the corresponding period.



Graph 2 The monthly inflation rate in the period January 2007 – December 2015, with smoothed and seasonally adjusted values for six months in advance

Applying the Holt-Winters smoothing to the time series with 102 observations (January 2007 – June 2015) results in the forecasted values of the monthly inflation rate for six periods in advance (second half of 2015). According to this model, the projected values are -0.504682, 2.873196, -0.945262, -0.554167, -0.338253, -0.391247, respectively (Graph 3).

Bearing in mind the empirical indicators and high volatility of political and economic cycles in Serbia, which reduces the forecasting power of the model, the results obtained can be considered efficient.

3.2. Forecasting using ARIMA model

Numerous empirical studies conducted in the late 20th and early 21st century show that, in the long run, aggregate structural models provide efficient forecasts, but that, in the short term, ARIMA models have an extremely high ability to forecast inflation. So, Meyera Aidan, Kenny Geoff & Terry Quinn (1998) use ARIMA models for forecasting inflation in Ireland, and the same are used by Toshitaka Sekine (2001) in Japan, Salam, A. Muhammad, Shazia Salam and Mete Feridun (2006) in Pakistan, Kalezić, Cerović, and Božović (2007) in Montenegro, Nastić (2011) in Bosnia and Herzegovina. By analyzing stochastic characteristics of time series, ARIMA models explain the movement of the variables in time, based on historical data and stochastic errors from the previous period.

This part of the work presents linear, seasonally adjusted ARIMA model, which is supposed to be able to provide good results in forecasting future trends in the consumer price index in Serbia. Analysis relies on monthly data on the movement of the consumer price index in the period from January 2007 to June 2015, so that the series includes 102 observations. Box-Jenkins methodology is applied for forecasting trends in monthly inflation rate in the Republic of Serbia for the second half of 2015 (next six months). Box-Jenkins is a powerful method for mathematical modeling of stochastic processes. It is a methodology for identifying and estimating models that include autoregressive models (AR) and moving average models (MA) for the purpose of forecasting. The main advantage of Box-Jenkins methodology lies in obtaining large data on the analyzed empirical time series using a small number of parameters. It is suitable for modeling of both stationary and non-stationary time series with or without seasonal component. Through the application of theoretical results, the dual relationship between the AR (p) and MA (q) processes in inflation modeling is examined. Basically, Box-Jenkins methodology is the three-stage process of constructing a model that includes: identification, estimation, and checking the adequacy of the model. Construction of the model can be considered an iterative process which ends when a satisfactory model that is consistent with the statistical model adequacy criteria is found. The resulting model can be used for analytical or forecasting purposes.

Seasonal character of the time series is a common phenomenon in economic research, where the number of time periods, *s*, repeats over time. In the specific case, *s* is 12 and represents the number of months. In order to solve the problem of the seasonal character of inflation, ARIMA process is generalized and seasonally adjusted. Seasonal autoregressive integrated moving average (SARIMA) model is created as well, which includes trend, seasonal component, and short-time adjustment. It is derived from the standard Box-Jenkins model. Seasonal ARIMA models include seasonal and non-seasonal factors in the multiplicative model according to the following formula:

ARIMA (p,d,q)*(P,D,Q)s

where:

p – Non-seasonal component of autoregressive model (AR)
d – Non-seasonal differentiation
q – Non-seasonal component of moving average model (MA)
P – Seasonal component of autoregressive model (AR)
D – Seasonal differentiation
Q – Seasonal component of moving average model (MA)
S – Number of periods during the year

Box-Jenkins methodology comprises three sequential phases:

1. Model identification;
2. Estimation of model parameters;
3. Diagnostics and projection of the selected models.

The next part of the paper will present the results obtained during the research within each phase of the applied methodology.

3.2.1. Model identification

The first stage involves establishing the necessity of transformation for the purpose of stabilizing the variance and determining the differentiation order, then the inclusion of a determinant into the model when d is greater than 1, and the selection of the appropriate order of ARIMA model, i.e. values p and q. The model is marked as ARIMA (p, d, q) where p and q represent the number of AR and MA model lags, respectively, while d indicates the level of stationarity of the time series. Based on the graphic presentation of the series, the appropriate transformation is selected. The values of autocorrelation and partial autocorrelation are used to determine the order of differentiation, required in order to achieve a stationary time series. Slow and almost linear decrease of autocorrelation function is an indicator of non-stationarity. In addition to this visual determination, the need for differentiation can be determined on the basis of the statistical testing of the presence of one or more unit roots. Accepting the null hypothesis of the existence of unit root indicates non-stationarity of the time series. Basic characteristics of stationary stochastic processes are: constancy of the mean (series level), constancy of variance, and covariance dependence only on the time interval. After prospective transformation and determining the order of differentiation, p and q values are identified on the basis of autocorrelation and partial autocorrelation functions, and/or on the basis of information estimation criteria (Akaike AIC, Schwarz-Bayesian SBC, Hannan-Quinn). These tests measure how well the model describes the data. Relatively the best model is the one with the lowest value of those indicators. Thus, one can conclude that the model identification is based on observing the autocorrelation and partial autocorrelation functions of the time series at the level of differentiation at which the stationarity condition is fulfilled.

We used a graphic illustration of autocorrelation and partial autocorrelation to figure out if the data is stationary or not. With regard to the value of the original data, it can be concluded that series transformation and differentiation is not necessary. This is because stationarity is achieved, as the basic precondition for the creation of ARIMA model. Stationarity is reflected in the fact that the series has a constant variance and the mean value in time.

Testing the stationarity is done through Augmented Dickey-Fuller Unit Root Test (ADF) and Phillips-Perron Unit Root Test (PP). The obtained values of ADF and PP tests are 7.623649 and 7.686779, respectively, and they are greater than the critical values at the error level of 5%. This points to the rejection of the null hypothesis and the existence of the necessary stationarity.

Table 3 Augmented Dickey-Fuller Unit Root Test and Phillips-Perron Unit Root Test

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.623649	0.0000
Test critical values:	1% level	-3.496346	
	5% level	-2.890327	
	10% level	-2.582196	
*MacKinnon (1996) one-sided p-values.			
		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-7.686779	0.0000
Test critical values:	1% level	-3.496346	
	5% level	-2.890327	
	10% level	-2.582196	
*MacKinnon (1996) one-sided p-values.			

Based on these tests, it can be concluded that it is a stationary time series (which has a constant variance and the mean value in time), which fulfills the basic prerequisite for the creation of ARIMA model. Thus, the series does not need additional transformation, because it is stationary, so that the alternative hypothesis on the absence of unit root is ultimately accepted.

During the analysis, 25 models with different combinations of AR and MA variables are tested. Akaike Info Criterion (AIC) and Schwarz criterion are used for choosing one model, characterized as the best for forecasting.

The minimum values of the selected criteria suggest the selection of ARIMA model (1,0,3) for forecasting the future movement of the monthly inflation rate in the Republic of Serbia. This points to the next stage of the iterative process of time series model construction.

Table 4 Akaike info criterion and Schwarz criterion

	p/q	1	2	3	4	5
Akaike	1	1,906045	1,949938	1,859961	2,050456	2,019729
Schwarz		2,044856	2,089749	1,999772	2,190267	2,159540
Akaike	2	2,161159	2,241530	2,035048	2,176829	2,099177
Schwarz		2,301916	2,382288	2,175805	2,317587	2,239935
Akaike	3	1,915258	1,967084	2,126526	1,4266659	2,041952
Schwarz		2,056977	2,108802	2,268245	2,008377	2,183691
Akaike	4	2,000221	2,078368	2,041140	2,037075	1,994555
Schwarz		2,142916	2,221062	2,183834	2,179710	2,137350
Akaike	5	1,943178	2,019091	2,008594	2,061410	2,040090
Schwarz		2,086863	2,162777	2,152279	2,205095	2,181378

3.2.2. Model parameter estimation

The task of time series analysis is to find a model which describes the stationary time series of the consumer price index. Estimation phase, i.e. model parameter estimation, is the second, most extensive phase. The analyzed model is, after diagnostics, reduced to one model, which will be used to forecast future values of the monthly inflation rate in the Republic of Serbia. Model parameter estimation is performed by Ordinary Least Squares method (OLS). The quality of diagnostics and behavior of residuals are crucial in choosing the most efficient models for forecasting. In order to obtain a more efficient ARIMA model, special attention is paid to the selection of autoregressive variables (lags of dependent variable) and moving average (lags of residual value). The models are estimated in terms of: the coefficient of determination (R2), the value of Durbin-Watson statistic, and F statistical significance.

During the study, 25 models with different combinations of AR and MA variables are tested. The most acceptable model is AR(1) SAR(12) MA(3) SMA(12), i.e. (1,0,3)*(12,0,12)12 with the following parameters:

MODEL: AR(1) SAR(12) MA(3) SMA(12)

Model residuals have white noise characteristics, i.e. are not correlated and move randomly, thereby creating the conditions for obtaining high-quality forecasts outside the sample.

Table 5 Statistics of the chosen model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.377193	0.154000	2.449300	0.0164
AR(1)	0.255164	0.105091	2.428034	0.0173
SAR(12)	0.694280	0.064620	10.74410	0.0000
MA(1)	0.145197	0.070204	2.068198	0.0417
SMA(12)	-0.884930	0.034824	-25.41169	0.0000
R-squared	0.479024	Mean dependent var		0.546067
Adjusted R-squared	0.454216	S.D. dependent var		0.807783
S.E. of regression	0.596767	Akaike info criterion		1.859961
Sum squared resid	29.91503	Schwarz criterion		1.999772
Log likelihood	-77.76828	Hannan-Quinn criter.		1.916315
F-statistic	19.30896	Durbin-Watson stat		1.960864
Prob(F-statistic)	0.000000			

3.2.3. Diagnostics and projection of the selected model

There are several criteria to be fulfilled by a good model. These are: cost-effectiveness, identifiability, consistency with data, consistency with theory, eligibility of data, forecasting efficiency, and comprehensiveness (Kovačić, 1995, pp. 158-159). The model diagnostics stage assesses the validity of the chosen model, based on its compatibility with the real data and the quality of its forecasting power.

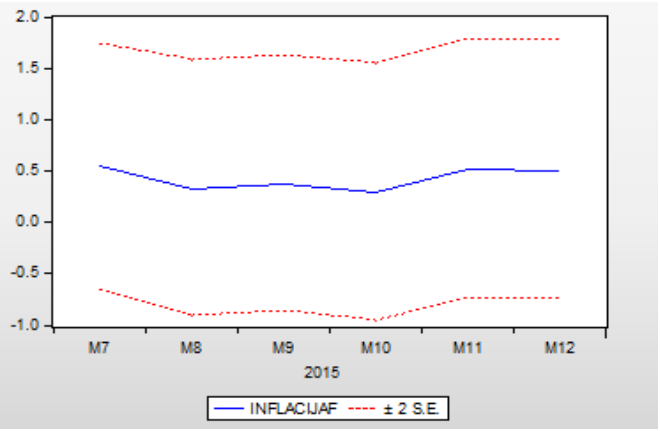
Using a histogram of probability and correlogram (Q-statistics correlogram and residual root correlogram), we found that the selected model has a normal distribution of residuals, whose value of autocorrelation and partial autocorrelation points to random movement of residuals. Justification of the accepted model is also proven by key parameters obtained during the model diagnostics phase – the coefficient of determination (R2), the value of Durbin-Watson statistic, and F statistical significance.

Table 6 Heteroskedasticity test – White test

F-statistic	1.426302	Prob. F(20,68)	0.1408
Obs*R-squared	26.30189	Prob. Chi-Square (20)	0.1561
Scaled explained	27.40062	Prob. Chi-Square (20)	0.1244

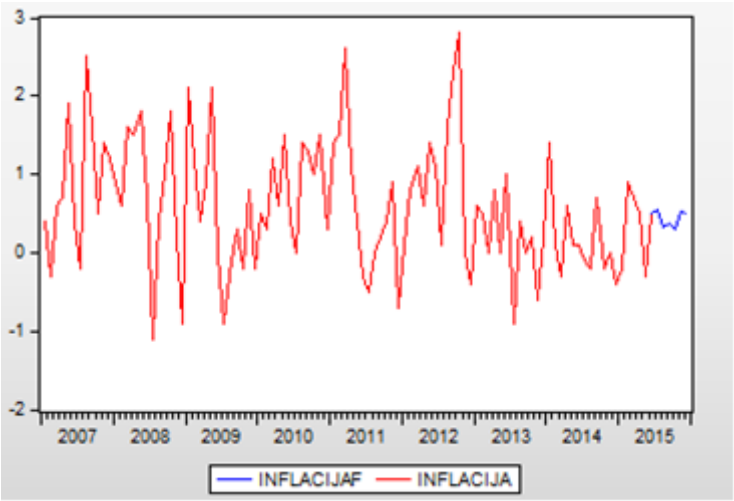
Another indicator supporting the model is the heteroskedasticity test (White test), whose value (26.301) is less than the critical value of $\chi 2$ (0.05, 20), which amounts to 31,410 (Table 6). On the basis of this, the claim on homoscedasticity of model variance is accepted.

For the purpose of forecasting the future values, the original number of observations is modified by the length of the forecasting horizon. In view of the tendency for forecasting the movement of the monthly inflation rate for six months in advance (July-December 2015), the following graph is obtained, which incorporates three scenarios of future trends of the monthly inflation rate.



Graph 3 Projected values of the monthly inflation rate until the end of 2015

Optimistic and pessimistic scenarios are defined as ± two standard errors of the real movement of the consumer price index. Graph 4 shows the movements of monthly inflation rate from January 2007 to December 2015. It shows both actual and projected values of the monthly inflation rate for the period July-December 2015.



Graph 4 Actual and projected values of the monthly inflation rate

Part of the graph showing the projected values shows that the monthly rate of inflation will have cyclical character. First, one can see a downward trend, with quick upward trend towards the end of the year.

Table 7 Projected values according to the chosen model

July 2015	0.543769
August 2015	0.328622
September 2015	0.377211
October 2015	0.288579
November 2015	0.522074
December 2015	0.507158

The selected model has been used to forecast the movement of the monthly inflation rate for the period July-December 2015. Based on actual and projected data, the average annual inflation rate in 2015 has been calculated, which amounts to 0.58%. Finally, the analysis has resulted in the projected values of monthly inflation developments by the end of 2015, which can be seen in Table 7.

CONCLUSION

Application of theoretical results has given practical framework for modeling inflation, as one of the key economic indicators of a country. Empirical research into the developments of consumer price index, which measures inflation in the Republic of Serbia, has been done for the period January 2007 – December 2015. Using seasonally adjusted ARIMA models and Holt smoothing method has resulted in the future values of the consumer price index. The comparative analysis of accuracy of the two methods (Holt-Winters method and ARIMA) in determining future values of the observed indicator has been performed. In

the course of the research, a total of 30 models have been tested in respect of both methods. A comparative analysis of the model has been reduced to the calculation of mean absolute error and root mean squared error.

The results of seasonally adjusted Holt smoothing have been presented, and the additive model chosen, with parameters $\alpha = 0.8$ $\beta = 0.5$ $\gamma = 0.0$, estimated as the best for forecasting future levels of consumer price index. Based on Akaike Info Criterion (AIC) and Schwarz Criterion, a single ARIMA model has been selected, proven as the best for the needs of forecasting. ARIMA model has been estimated in terms of the following diagnostics parameters: coefficient of determination (R2), the value of Durbin-Watson statistic, F statistical significance, and residuals. The most acceptable model turned out to be AR(1) SAR(12) MA(3) SMA(12), i.e. (1,0,3)*(12,0,12)12. Residuals of the selected model have characteristics of white noise, i.e. are not correlated and move randomly, thereby creating the conditions for obtaining high-quality forecasts outside the sample as well. Therefore, one can conclude that the selected model can be used for further analytical and forecasting purposes.

Based on the above, it can be concluded that the selected models have a sufficient level of reliability and that the results obtained are a fairly reliable indicator of the monthly inflation rate movements in Serbia. It is undisputed that the efficiency and predictive power of the obtained models will be tested in the future. At the same time, one should not ignore that the great volatility of the political and economic cycles in developing countries, such as Serbia, reduces the predictive power and ability to construct an efficient model.

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MODELIRANJE MESEČNE STOPE INFLACIJE U REPUBLICI SRBIJI MERENE INDEKSOM POTROŠAČKIH CENA

U radu je predstavljen okvir za praktično modeliranje inflacije kao jednog od ključnih ekonomskih pokazatelja. Empirijsko istraživanje kretanja mesečne stope inflacije u Republici Srbiji urađeno je za period januar 2007- decembar 2015. godine. Korišćenjem sezonski prilagođenog ARIMA modela, i metoda Holtovog izravnanja utvrđene su buduće vrednosti indeksa potrošačkih cena koji je mera inflacije u Republici Srbiji od januara 2009.godine. Osnovni cilj rada je kreiranje modela koji će se koristiti u analitičke i prognostičke svrhe. Uz to, sprecifični cilj je uporedna analiza preciznosti dva metoda (Holt-Winters metod i ARIMA) u određivanju buduće vrednosti indeksa portošačkih cena. U radu su primenjeni teorijski rezultati dualne veze između AR (p) i MA(q) procesa u određivanju buduće vrednosti indeksa potrošačkih cena.

Ključne reči: *indeks potrošačkih cena, inflacija, prognoziranje, Holt-Winters-ov metod izravnaanja, ARIMA*

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CORPORATE GOVERNANCE MECHANISMS EFFECTIVENESS: THE CASE OF TRANSITION COUNTRIES

UDC 334.725:005

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Abstract. *Ever since ownership and management were separated, corporate governance emerged as an essential institution of market economy. Based on this statement, several corporate governance mechanisms have been extensively researched. Developed and transition countries, according to the differences that determine the corporate governance model, which refer to the historical and cultural heritage of countries, socio-economic conditions, legal/institutional framework and ownership structure, apply various corporate control mechanisms. Since market institutions are missing in transition countries, and institutional framework is insufficiently developed, these countries must develop appropriate corporate governance model, as well as corporate governance mechanisms. Due to these mentioned features, the research topic is to analyze effectiveness of corporate governance mechanisms in selected transition countries with common socio-economic environment. Special attention is given to the problems of corporate governance mechanisms improvement and possibilities of overcoming them.*

Key words: *transition countries, privatization, corporate governance mechanisms, ownership concentration, board of directors*

INTRODUCTION

The main problem of corporate governance is how to ensure that managers run firms for the benefit of shareholders and therefore prevent the appearance of agency conflicts between owners (principal) and managers (agents). In above mentioned, corporations in developed, market countries are constantly devoted to improving corporate governance mechanisms. The role of corporate governance mechanisms is related to the process of harmonization of interests between owners and managers, as well as the process of effective strategic decision-making. Accordingly, development of appropriate corporate governance mechanisms is a relevant question, both for developed and transition countries, which are facing specific problems of corporate governance that occur as

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consequence of ownership and managerial transformation. Developed and transition countries, according to the differences that determine the corporate governance model, and those are referred to the historical and cultural heritage of countries, socio-economic conditions, legal/institutional framework and ownership structure implement various control mechanisms of managers. Transition countries are faced with numerous problems, disabling the application of corporate governance mechanisms of developed economies: undefined property rights, expropriation of the rights of minority shareholders, violation of contracts, underdeveloped stock markets, inconsistent and/or inefficient application of the legislation.

These problems arise from the process of transition towards market economy, especially as a result of the privatization and changes in ownership structure. However, it is not supported by an effective change in the formal institutional framework and the adoption of a set of laws concerning the following: governance of the companies, property rights, economic transactions, bankruptcy of the firms. Also, the development of the stock markets is related to the privatization and represents the means of property redistribution. Therefore, a common characteristic of transition countries is undeveloped market, with low level of liquidity, which results in inability of applying the external corporate governance mechanisms through market for corporate control. Since market institutions are missing in transition countries, and institutional framework is insufficiently developed, these countries must develop appropriate corporate governance model, as well as corporate governance mechanisms.

Due to these mentioned differences, the research topic is to analyze effectiveness of corporate governance mechanisms in transition countries, in accordance with the implemented corporate governance model. The research aim is to determine the similarities and differences between corporate governance mechanisms in transition countries of Central and Eastern Europe, as well as to point out the possible ways of improvement of their effectiveness. According to research topic, the hypothesis is as follows: ownership concentration is the key corporate governance mechanism in transition countries due to undeveloped institutional framework and undeveloped market for corporate control.

The qualitative research methodology is applied in this research and the comparative method of scientific analysis. The methods of analysis and synthesis are used to make conclusions by the process of generalization, i.e. to theoretically verify the research hypothesis. At the first section, the key characteristics and significance of corporate governance in transition countries are described. The second section analyses the corporate governance mechanisms that are applied in selected transition countries with common socio-economic environment: Czech Republic, Slovakia, Poland, Hungary, Slovenia, Croatia and Serbia. Special attention is given to the problems of corporate governance mechanisms improvement and possibilities of overcoming them at the third section.

1. ROLE OF CORPORATE GOVERNANCE IN TRANSITION COUNTRIES

Corporate governance could be defined as a set of relationships between a board of directors, shareholders and other stakeholders. It also provides "the structure through which the objectives of the company are set, and the means of attaining those objectives, and monitoring performance, are determined" [33]. On the other hand, it has also been interpreted as "the manner in which suppliers of corporate funds ensure appropriate returns to their investment"[38], but it has also been emphasized that a country's

political/institutional as well as regulatory framework determines the quality of its corporate governance practices [36]. Based on the understanding of the concept of corporate governance and the view that corporate governance development in market and transition countries is characterized by a completely different context, analysis of corporate governance significance in post-communist countries should be adapted to the specifics of the process of transition to a market economy [34].

In fact, research in the area of corporate governance system of transition economies is based on identifying the common characteristics of post-communist countries. It is the consequence of the effort to promote the idea that the monetary model of reforms can be applied in all transition countries. Therefore, all countries can apply the same "recipes for healing", and inability of government to implement this policy caused the failure of the reforms [26]. However, experience of transition countries indicates that transition to the new market system is much more complicated. The process of building the market economy cannot be conducted according to corporate governance model of developed countries, since available time, resources and initial assumptions fundamentally differ. Also, modifications of the current system cannot be applied, since transition countries have specific economic system in which the residuals of old communist system and the beginnings of new market system exist in parallel. In addition, transition processes occur in the whole spectrum of economic, cultural and social diversity determining the potentials of changes in some countries.

Within the transition to market economy, privatization as the most important aspect of post-communist reforms resulted in the need for development of corporate governance system. At the beginning of the transition process, privatization of state-owned firms was regarded as the crucial element of reform at a microeconomic level [18]. In the transition countries, privatization involved selling the bulk of firms in the previously state-owned industrial sector. Privatization is considered to be a mechanism which may eradicate inefficiency of state property and influence the change in industrial structure in national and regional economy.

This viewpoint arises from the fact that privatization led to significant changes in ownership structure, as well as to the creation of the new corporate sector. The new corporate sector consists of “instant corporations” formed as the result of mass privatization, without the simultaneous development of legal and institutional structures necessary to operate in a competitive market economy [6]. Privatization has become a world-wide economic phenomenon where governments usually adopted the path in order to raise revenue, improve economic efficiency and develop their national stock market. Privatization has been viewed by most of economic actors as an inevitable step of the reforms required for economic development [31]. All transition countries have implemented the privatization as the process of transfer of control from the state to the private sector, using the specific models and methods. Privatization could be done in different ways: privatization by sale, voucher privatization and insider privatization [32]. Privatization by sale results in concentrated ownership, because it means sale of majority share block of the company to domestic or foreign investors (strategic partners). Voucher privatization means distribution of shares which leads to highly dispersed ownership. Insider privatization means that managers or employees are purchasing the shares.

However, privatization in the transition countries has posed a number of practical problems. Implemented privatization resulted in very different ownership structures and caused the development of different corporate governance mechanisms. It can be

concluded that implemented privatization in transition countries resulted in separation of ownership and control, led to ownership concentration, as well as to very different ownership structures. The majority shareholder (i.e., controlling owner) is often associated with a business group [44]. Nevertheless, within the process of privatization in some transition countries, business groups have been created, instead of forming the autonomous companies. Transactions between privatized companies are carried out not by the market, but through direct business arrangements, the relations with the banks as well as the complex structure of mutual ownership and interdependence. This business group (i.e., business network) emerged as a natural consequence of socialism, and it is stimulated by the interests of the existing management structure. Also, undeveloped financial market favors the creation of business networks. In such circumstances, the role and the significance of corporate governance were marginalized. Hence, the problems of separated ownership and control are increasing, which negatively influences the performance of companies.

We can conclude that the above-mentioned corporate governance problem represents one of the most relevant components of corporate long term success, and caused the development of different corporate governance mechanisms. Since management is separated from those who provide capital, it is responsible for using the resources effectively in order to achieve strategic goals. Assurance that management will act in that way is important for successful achievement of economic performance of the organization as well as for its ability to attract long-term, stable and inexpensive source of funding. Fundamental task of corporate governance is to provide mechanisms which will ensure managerial responsibility towards shareholders for appropriate use of their resources. Shareholders have available governance mechanisms to help bring the interests of managers in line with their own.

These mechanisms can be classified as internal and external mechanisms: ownership concentration and board of directors are internal, and market for corporate control and legal protection are external mechanisms [5]. Consistent with that classification, in transition countries ownership concentration and board of directors should be the most important corporate governance mechanisms. Ownership concentration has the advantages due to better control of management actions, since major owners have the power and initiative to supervise managers. Owners with higher share of stocks are motivated to perform monitoring and dismiss unsuccessful managers, therefore reducing conflicts between owners as principals and managers as agents [32]. This attitude is based on the fact that corporate sector consists of corporations which were created as a consequence of mass privatization, which was not followed by simultaneous development of legal and institutional infrastructure necessary for market economy functioning.

Also, the board as internal mechanism of corporate governance represents the link between individuals that provide the capital (owners) and individuals exploiting that capital in order to create value (managers). The board has a role to monitor and control managers, in order to protect the owners' best interests. Composition, size and board roles are different depending on the board models. Generally, there are two board models: one-tier and two-tier boards. In contemporary studies, two-tier boards were generally recommended. This statement is based on separation of management and supervisory board. The central feature of internal corporate governance lies in the division of management and control by a two-tier structure. While the role of the management board is the running of the business, the role of the supervisory board is primarily the appointment, supervision, and removal of members of the management board [22]. The one-tier board model entrusts both management and control to the unitary board, who are vested with universal powers.

In addition to internal mechanisms of corporate governance, market for corporate control serves as an external mechanism that is typically activated when internal mechanisms for controlling managerial opportunism have failed [15]. In line with these arguments, studies of corporate governance mechanisms in transition countries require to identify some additional specified criteria, as well as some of common denominators in order to set universal assumptions and conclusions, as well as to conduct comparative research.

2. CORPORATE GOVERNANCE MECHANISMS: THE EVIDENCE OF TRANSITION COUNTRIES

Consistent with above classification of corporate governance mechanisms and specific characteristics of transition countries, the experiences of selected transition countries - Czech Republic, Slovakia, Poland, Hungary, Slovenia and Croatia (as members of EU), and Serbia (as candidate for membership), are analyzed. One of the key features of transition from former planned economies to market economies was the privatization process, which was influenced by integration with the European Union and pressured by international financial institutions. The privatization was conducted in different ways, which resulted in differences in corporate governance, ownership structures and other corporate governance mechanisms.

Czech Republic

In Czech Republic voucher privatization was carried out, where 40-80% of firm's equity was available for auction through vouchers, while remaining shares were distributed to employees (a small percentage) and state [1]. Privatization through vouchers resulted in the creation of Investment Privatization Funds, which led to ownership concentration, because IPFs obtained 70% of all available vouchers. In order to overcome legal obstacles, IPFs transformed themselves into holding companies, which finally led to ownership concentration. Institutional investors and industrial firms with foreign ownership are the most common owners, but the state still has a meaningful share with 12,7% shareholding [1]. Foreign investors have on average 58,6% of shares [1, 34]. The biggest owner has on average 60,6% of shares, while three biggest shareowners have around 76% of shares [1]. Although ownership concentration is a strong control mechanism of manager's opportunistic behavior, it has negative effect in sense of expropriation of minority owners' rights. That is confirmed with the rank of the Czech Republic, which was at 50th position by protection of minority shareowners' rights by the Global competitiveness report of the World Economic Forum in 2015 [42].

Regarding the board of directors as internal control mechanism, two-tier board is applied [27], which consists of managerial and supervisory board. Managerial board and supervisory board have at least three members, but employees have a representative at the supervisory board (one third of the members is elected by the employees). Candidates for employee representative are nominated by works council or trade unions, or in case of state-owned companies by electoral regulations established by employer in agreement with trade unions [14]. Czech Republic was at 34th position by board effectiveness in 2015 [42].

Market for corporate control as external mechanism is not fully developed and it is not often used as control mechanism. Still, Czech Republic was at 3rd place among the countries of Central and Southeastern Europe by the number of mergers and acquisitions in 2015 (185 completed transactions), where strategic investors participated in almost 83% in these transactions [17], which shows that there are efforts and tendencies towards

more efficient development of market for corporate control. Comparing the number of transactions in 2011 to 2015, there is an increase in the number of transactions by 20,9% [39]. Even though the market for corporate control remains undeveloped, there is another limitation for improvement of corporate governance. The legal system is not efficient, which is confirmed with the results from the Global competitiveness report which show that Czech Republic is at 90th position by the efficiency of legal framework [42]. The efficiency of legal framework needs to be at much higher level in order to insure adequately protected property, minority rights and prevent managerial opportunism.

Slovakia

In Slovakia privatization was carried out through small-scale privatization, which was almost finished in late 1992, and large-scale privatization, which had two different stages. Firstly, there were two waves of voucher privatization, and then direct sales which was used in privatization of nearly 80% of companies [41], which resulted in ownership concentration. Dominant owners became individual investors, insiders and foreign investors [4]. The state holds on average 18% of shares [23]. The share of biggest shareowner is on average 39,4% [10]. Slovakia was at 92nd position by protection of minority shareowners rights by the Global competitiveness report of the World Economic Forum in 2015 [42], which is worse than Czech Republic and should be improved.

The two-tier board is dominant in Slovakia. The managerial board consists only of executive directors, while the supervisory board consists only of non-executive directors. The supervisory board consists of at least three members. If the company has more than 50 employees, one third of the supervisory board members is elected by the employees [30], whilst in state-owned companies, employee representatives have one half in the supervisory board [14]. The employee representatives are nominated by the trade unions and employees. Slovakia was at 73rd position by board effectiveness in 2015 [42].

The market for corporate control is undeveloped, and cannot be used as an effective control mechanism for managers. Slovakia is at 6th place among countries in Central and Southeastern Europe by the number of mergers and acquisitions. The number of mergers and acquisitions in 2015 was 65, where strategic partners participated with almost 86% in these transactions [17]. Comparing the number of transactions in 2011 to 2015, there is an increase in the number of transactions by 41,3% [39]. The increase in number of mergers and transaction shows the growing importance of this control mechanism. Slovakia was ranked as 138th by the efficiency of legal framework in 2015 [42]. Very low rank by the efficiency of legal framework suggests that implementation of legal framework is still a significant problem for improving corporate governance.

Poland

In Poland, mass privatization was carried out by transferring majority share blocks to National Investment Funds (NIF) (60% of shares), while the rest of shares was transferred to employees (15%) and treasury (25%) [28]. Vouchers, which represented one share of NIF each, were distributed to citizens, who became indirect companies' owners. With withdrawal of NIF, their shares were being sold to domestic and foreign investors. Privatization resulted in concentrated ownership [9]. The state has in average 4% of share ownership [1]. Meaningful stake in ownership have individual investors and industrial firms [1]. Foreign investors have on average 21,9% of shares [1, 34]. The

majority shareowner has on average 43% of shares [2], while three biggest shareowners have 50% of shares [1]. Poland was at 63rd position by protection of minority shareowners rights by the Global competitiveness report of the World Economic Forum in 2015 [42]. The ownership concentration is very high, which implies that the minority owners' rights could be threatened, which is confirmed by low rank of protection of their rights.

The second internal mechanism of corporate control is managerial board. Management is conducted by two-tier board [9], which consists of managerial and supervisory board. The employees elect around one third of the of supervisory board members, depending on the size of supervisory board [21], two members on a board of six, three where the board has seven to 10 members, and four where the board has more than 10 members. In state-owned companies employees have 2/5 representatives in supervisory board, and employees have one representative in managerial board when the company have more than 500 employees [14]. Poland was at 66th position by board effectiveness in 2015 [42]. Still, Czech Republic has better position by board effectiveness.

The importance of the market for corporate control is reduced, even though the activity at this market is high in this part of Europe. The number of mergers and acquisitions in 2015 in Poland was 278, which was the second highest number in Central and Southeastern Europe. Strategic partners participated with almost 74% in these transactions [17]. Comparing the number of transactions in 2011 to 2015, there is a decline in the number of transactions by 46% [39]. Poland was ranked as 70th by the efficiency of legal framework in 2015 [42]. The position of Poland is better than previously analyzed countries, but still needs to be improved in order to improve corporate governance.

Hungary

In Hungary, privatization was conducted through direct sale to strategic partners or financial institutions [27]. Privatization resulted in very little employees' ownership, very little dispersed ownership and high concentrated ownership, where majority of shares were held by foreign investors [11]. One majority owner has on average 54,2% of shares, while three biggest shareholders have on average 71,5% of shares, where foreign investors participated in ownership with 70,6% [1, 34]. The state owns on average 2,4% shares [1]. Hungary was at 90th position by protection of minority shareowners rights by the Global competitiveness report of the World Economic Forum in 2015 [42]. Czech Republic and Poland have better protection of minority owners' rights, but the ownership concentration in Hungary is higher. Regulatory reforms have been introduced, but the enforcement is still lagging behind.

Regarding other internal mechanism of corporate control, by Company Act IV (2006), companies may apply one-tier or two-tier board. In case of one-tier board, the board has 5 to 11 members, whilst independent members have the majority. In case of two-tier board, there is managerial and supervisory board. Minority shareholders have the right to appoint one member of supervisory board. Employees choose one third of the members of supervisory board. The representatives are nominated by works council who has a duty to ask trade union for opinion [14]. Hungary was at 112th position by board effectiveness in 2015 [42]. Very low board effectiveness and low protection of minority rights are significant problems for improvement of corporate governance.

Market for corporate control is not significantly used as a mechanism for disciplining managers, as the activity on this market is reduced. Hungary takes 4th position in Central and Southeastern Europe by the number of mergers and acquisitions in 2015 (130

transactions), where strategic partners participated with almost 62% in these transactions [17]. Comparing the number of transactions in 2011 to 2015, there is a decline in the number of transactions by 5,2% [38]. Hungary was ranked as 96th by the efficiency of legal framework in 2015 [42]. Efficiency of legal framework needs to be improved in order to insure better protection of minority owners' rights and investors' property, as the foreign investors are the biggest shareowners and concentration of ownership is very high.

Slovenia

Slovenian privatization was conducted through transfer of 40% of shares to state funds' ownership, and the rest of shares were privatized through selling shares to insiders (employees and managers) and private investors [25]. Insider privatization was conducted in 90% of companies. State and investment funds were the primary share owners, who would sell the shares to private investors. Privatization resulted in relatively concentrated ownership. The biggest shareowner has 35% of shares, and the five biggest shareowners control on average 66,2 % of shares [24]. The most important shareowners are domestic companies, insiders (employees) and investment funds [25]. The state controls on average 12,4% of shares [24]. Slovenia was at 121st position by protection of minority shareowners rights by the Global competitiveness report of the World Economic Forum in 2015 [42]. Comparing to previously analyzed countries, Slovenia has the lowest rank by this indicator.

Companies have the choice to apply one-tier or two-tier board [16]. Public companies apply two-tier board of directors. In those companies employees appoint one third to one half of the members of supervisory board. If company has more than 500 employees, employees have the possibility to appoint one member of managerial board. The representatives are appointed by works council [14]. Slovenia was at 110th position by board effectiveness in 2015 [42].

The market for corporate control is not active, and the Slovenia was at 9th position in Central and Southeastern Europe in 2015 by the number of mergers and acquisitions. In 2015 in Slovenia 38 mergers and acquisition were conducted and the participation of strategic investors was 79% [17]. Comparing the number of transactions in 2011 to 2015, there is a decline in the number of transactions by 9,6% [39]. Slovenia was ranked as 115th by the efficiency of legal framework in 2015 [42]. Companies often follow the regulatory obligations and recommendations but implementation in practice is absent, so there is a very low result on efficiency of legal framework.

Croatia

Privatization in Croatia was conducted through two phases. Firstly, the goal was to terminate social ownership and to transfer it to private or state ownership, primarily through insider privatization. In the second phase, voucher privatization was conducted [40], which finally resulted in highly concentrated ownership. The majority owner has on average 51% of shares [37]. Three biggest owners have on average 80% of shares in listed companies [29]. Among owners with the largest share were nonfinancial companies, state and its institutions. The average ownership of the state among public listed companies is 10,8% [29]. Croatia was at 111th position by protection of minority shareowners rights by the Global competitiveness report of the World Economic Forum in 2015 [42]. Low protection of minority owners' rights is common problem when ownership is concentrated, like in case of Croatia.

Since 2007 two systems are being applied: one-tier and two-tier board. Two-tier board was applied by 98,9% listed companies in 2010 [37]. The average number of managerial board members is 2, but in 47% of companies there is only one member. The average number of supervisory board members is five. Employees have one representative in the board, and he/she is appointed by works council or by trade union [14]. Croatia was at 95th position by board effectiveness in 2015 [42].

Market for corporate control is not developed and is inefficient for corporate control. Croatia was at 11th position by the number of mergers and acquisitions in Central and Southeastern Europe in 2015 with 27 conducted transactions, which is much less than previous year, even though the strategic investors participated with 96% in these transactions [17]. Comparing the number of transactions in 2011 to 2015, there is a decline in the number of transactions by 59,7% [39]. Numerous changes have been conducted in the Company law and corporate governance in Croatia during two last decades, mostly as a result of the need of harmonization with the EU practice. Still, Croatia was ranked as 137th by the efficiency of legal framework in 2015 [42]. As Croatia has very low position by the efficiency of legal framework it is necessary to improve legal system and its efficiency, in order to improve corporate governance and its mechanisms.

Serbia

Privatization in Serbia was conducted through three models [7]. Firstly, insider privatization resulted in relatively dispersed ownership. Then, free distribution of shares in line with selling shares with discount was done, which resulted in ownership concentration. And finally, the privatization was conducted through sale to strategic partners, which led to ownership concentration in the hands of one or small group of shareowners [32]. Ownership is highly concentrated in Serbia, because one biggest shareowner owns on average 65,26% of shares. This conclusion is based on the analysis of the ownership structure of 2037 companies listed in database of the Central Securities Depository and Clearing House. The state and its institutions own on average 37,04% of shares. Other companies own on average 66,24% of shares, while individual investors own on average 44,31% of shares. High ownership concentration increases likelihood of the expropriation of minority shareowners, so the legal and regulatory reforms are essential. In line with this argument, Serbia was at 138th position by protection of minority shareowners rights in 2015 [42]. This result is the lowest of all analyzed countries.

According to Company Law from 2011, a company may apply one-tier or two-tier board. In practice, two-tier boards are more applied. At one-tier board, assembly and managerial board are the managing bodies. At two-tier board, assembly, the managing bodies are supervisory and managerial board. Managerial board has majority of independent members, while supervisory board has at least three members and they have to be independent. Employees usually do not have a representative in the boards. Serbia was at 111th position by board effectiveness in 2015 [42].

Market for corporate control is not developed. Serbia was at 8th place among Central and Southeastern Europe countries by the number of mergers and acquisitions in 2015, with 45 mergers and acquisition conducted, which is less than previous year. The participation of strategic investors was 93% [17]. Comparing the number of transactions in 2011 (67 transactions) to 2015 (45 transactions), there is a decline in the number of transactions by 32,8% [39]. Inactive market for corporate control cannot be used for disciplining managers. Therefore, Serbia was ranked as 125th by the efficiency of legal

framework in 2015 [42]. Poor law enforcement is one of the main obstacles for protection of minority owners' rights, investors' property protection, for prevention of managerial opportunism and improvement of corporate governance. Numerous changes are conducted, mainly in accordance with the directions of EU and OECD recommendations, codes are defined, but implementation is lacking. Comparison of corporate governance mechanisms analyzed in transition countries is given in Table 1.

Table 1 Comparison of corporate governance mechanisms in transition countries

Indicators	Czech Republic	Slovakia	Poland	Hungary	Slovenia	Croatia	Serbia
Ownership structure as corporate governance mechanism							
Ownership dispersion vs. concentration	OC[2]	OC	OC	OC	OC	OC	OC
Dominant owner's identity	Institutional investors and industrial firms	Individual investors, insiders and foreign investors	Individual investors and industrial firms	Foreign investors	Domestic companies, insiders and investment funds	Nonfinanc. companies, state and its institutions	Domestic and foreign companies and state
Share of the biggest owner	60,6%	39,4%	43%	54,2%	35%	51%	65,26%
Share of state ownership	12,7%	18%	4%	2,4%	12,4%	10,8%	37,04%
Board as corporate governance mechanism							
Board model	Two-tier	Two-tier	Two-tier	One-tier and two-tier	One-tier and two-tier	One-tier and two-tier	One-tier and two-tier
Proportion/ number of employee representatives in the board	1/3 of board members	1/3 – 1/2 of board members	1/3 – 2/5 of board members	1/3 of board members	1/3 - 1/2 of board members	1 board member	/
Board effectiveness[3]	34	73	66	112	110	95	111
Market for corporate control as corporate governance mechanism							
Ranking by the number of M&A in CSE in 2015	3	6	2	4	9	11	8
Number of M&A in 2015 comparing to 2011	153 - 185 Higher by 20,9%	46 - 65 Higher by 41,3%	516 - 278 Lower by 46%	137 - 130 Lower by 5,2%	42 - 38 Lower by 9,6%	67 - 27 Lower by 59,7%	67 - 45 Lower by 32,8%
Legal framework as corporate governance mechanism							
Ranking by protection of minority shareowners rights[4]	50	92	63	90	121	111	138
Ranking of efficiency of legal framework[5]	90	138	70	96	115	137	125

Source: Authors

[2] OC – ownership concentration
[3] Ranking by Global Competitiveness Index
[4] Ranking by Global Competitiveness Index
[5] Ranking by Global Competitiveness Index

3. Improvement of the Corporate Governance Mechanisms Effectiveness in Transition Countries

Starting with the corporate governance mechanisms analysis in transition countries, it can be concluded that the processes of property and managerial transformation created a specific environment for development of corporate governance mechanisms. There are four key features. The first feature is slow process of property and managerial transformation and absence of market of corporate control. Therefore, the process of privatization and restructuring, and developing a suitable system of corporate governance model for transition countries are the key elements to replace the missing market institutions. Achieving the ownership transformation and strengthening the role of the owners are essential conditions for improving corporate governance. Possibility for policy intervention is related to control and ownership disclosure and transparency.

The second feature refers to the problem of insufficient effectiveness of boards of directors as an important internal control mechanism of managers. Boards of directors have been used as an instrument of political control over the CEO's work. Hence, the different modalities of CEO's domination over board appeared in practice. The use of power varied depending on the political forces, managerial and leadership skills of directors, but still the boards of directors had a role of executive political power. Thus, boards of directors are not effective because the owner controls the board and can fire or hire its members. The possibility for boards of directors as corporate governance mechanisms enforcement is: voting transparency; introduce cumulative voting as well as train the board of directors [12].

The third feature is related to ownership concentration as the primary corporate control mechanism. Concentrated ownership is dominant in transition countries for two reasons [44]. Firstly, ownership dispersion means that the majority owner has to share relevant information with external investors, and they may have risk aversion, because they want to protect strategic information from the outsiders, especially when it relates to company's competencies. Sharing information requires trust between different parties, which is rare in transition countries because of the inadequate institutional framework. Secondly, concentrated ownership exists because that is the only possible way to prevent managerial opportunistic behavior in the conditions of undeveloped market institutions. This stand is based on the hypothesis of preference of control and on the results of numerous empirical studies which confirm that higher ownership concentration enables better monitoring and restricts opportunistic managerial behavior [32]. Active monitoring by majority owners can increase the quality of managerial decisions, prevent exaggerated diversification, as well as prevent exceeding compensations. Therefore, when ownership is concentrated in the hands of the majority owners, the control of managerial behavior is increased and principal-agent conflict is mitigated. Ownership concentration improves corporate performance, lowering the agency costs of dispersed ownership.

However, ownership concentration may lead to principal-principal conflict between majority and minority owners [20], which occurs when majority owners gain private benefits at the expense of minority owners [13]. Principal-principal conflict represents the fourth, most important feature. The dominant shareholder may tend to abuse minority investors particularly under conditions of poor institutional order [35]. In transition countries there is no adequate legal protection of minority shareowners' rights, because this problem has additional weight. Possibility for policy intervention is related to reinforcing laws that protect minority shareholders whilst maintaining the incentive to hold controlling blocks [8].

Accordingly, codes of best corporate governance practice developed in many countries play an important role in the process of setting standards for corporate behavior and boosting activism of minority investors. Despite different national legal regimes, the set of guidelines proposed in the codes of best practice remains similar. Principles of corporate governance usually refer to the equal treatment of shareholders with emphasis on the protection of minority shareholders, corporate transparency, board functioning, procedures of voting, and electing shareholders representatives. As a result, codes and the formulated rules of corporate governance build public pressure on dominant shareholders as well as provide rating of companies according to their compliance with corporate governance [3].

Starting from listed futures, the required assumption of improvement of corporate governance mechanisms effectiveness is finalization of the process of ownership transformation, development of institutional framework and creating market economy institutions necessary for economic growth. Implementation of appropriate institutional rules and establishment of market institutions increase the responsibility of managers for company performance. In order to effectively allocate resources, investors must have the ability to control those who use these resources. Effectiveness of corporate governance mechanisms is increased when the owners have clearly defined power which will allow them to control and when they have good access to information which prevents information asymmetry. In addition, minority owners should be protected from expropriation of majority owners through effective legal system.

CONCLUSIONS

Privatization and restructuring, as the two main aspects of post-communist reforms, led to growing interest for corporate governance research in transition countries. These processes present the key factors for transition success as well. Privatization is crucial, since it creates effective owners, enables more effective use of resources, and confirms dominance of market mechanisms. In addition, privatization was designed to eliminate the constraints on the independent managerial decision-making process imposed by state ownership. Nevertheless, real privatization effects were not in accordance with expectations. This was caused by unbalanced development of macroeconomic and microeconomic instruments in the first stages of transition process. In fact, in transition countries the focus was on achievement of macroeconomic stability in order to create an appropriate environment for privatization process. Then, it is necessary to implement microeconomic changes that correspond to macroeconomic policy of transition countries. Accordingly, corporate governance is a powerful instrument of microeconomic policy and effective way of transition to market economy.

Corporate governance system has the key role in the process of economic regeneration in transition countries. Therefore, it improves the performance of enterprises by aligning conflicts of interest, and by reducing opportunistic behavior. The above-mentioned is achieved by improving effectiveness of corporate governance mechanisms, because all transition countries faced specific problems that result from the process of the ownership and management transformation. Primarily, the inefficiency of corporate governance mechanisms in the selected countries might be due to: weak minority investor protection, along with entrenched positions of managers, who remain in control despite that privatization had transferred ownership to outsiders, undeveloped capital markets as well as ineffective boards

of directors. The inefficient corporate governance in the selected countries can also be explained with the weaker legal systems. Consistent with above arguments, the key corporate governance mechanism is ownership concentration, which confirmed initial research hypothesis. Our analysis showed that selected countries are characterized by similar majority owner's identity and weak protection of minority shareholders' rights, too.

Therefore the enforcement of corporate governance mechanisms is needed. All transition countries have made significant progress in developing corporate governance mechanisms and are moving towards adopting the OECD Principles on voluntary or statutory basis. Also, the necessary assumption of improving the effectiveness of corporate governance mechanisms is development of institutional framework suitable for market economies. We emphasize the necessity of higher legal protection of minority owners' interests in order to prevent expropriation of their interests. In contrast, ownership concentration results in negative effects that can jeopardize the corporate control benefits. Therefore, large shareholders have both the incentives and the means to restrain the strategic independence of managers. In the transition environment, managerial strategic independence, or their ability to make good decisions without restrictions imposed by new owners of privatized firms, may become particularly important.

In addition, board of directors is another governance instrument that can affect the decision-making process, shaping the extent of managers' strategic independence. Strategy research particularly emphasizes the importance of the strategic board role when the firm faces a highly uncertain environment of economic transition. Board members associated with foreign investors also improve monitoring role of the board, and mitigate moral hazard costs related to managerial decision-making autonomy [19]. Accordingly, the enhancement of board effectiveness is one of the main conditions to improve corporate governance in transition countries. On the way to joining the European Union, these conclusions are especially significant for Serbia, which needs to establish a strong institutional and legal framework, enabling the effective implementation of corporate governance mechanisms.

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EFEKTIVNOST MEHANIZAMA KORPORATIVNOG UPRAVLJANJA – ANALIZA ZEMALJA U TRANZICIJI

U uslovima razdvojenosti vlasništva i upravljanja, korporativno upravljanje predstavlja važnu instituciju tržišne ekonomije. Shodno navedenom, istraživanja u oblasti mehanizama korporativnog upravljanja su sve intenzivnija. U skladu sa razlikama koje se odnose na istorijsko i kulturno nasleđe zemalja, socio-ekonomske uslove, pravni/institucionalni okvir i vlasničku strukturu, razvijene i tranzicione zemlje primenjuju različite mehanizme korporativne kontrole. Pošto u tranzicionim zemljama nedostaju tržišne institucije, a institucionalni okvir je nedovoljno razvijen, potrebno je razviti odgovarajući model, kao i mehanizme korporativnog upravljanja. U skladu sa navedenim karakteristikama, predmet istraživanja je analiza efektivnosti mehanizama korporativnog upravljanja u tranzicionim zemljama koje odlikuju slični socio-ekonomski uslovi. Posebna pažnja je posvećena problemima unapređenja efektivnosti mehanizama korporativnog upravljanja i mogućnostima za njihovo prevazilaženje.

Ključne reči: *tranzicione zemlje, privatizacija, mehanizmi korporativnog upravljanja, koncentracija vlasništva, upravni odbor*

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HIGHER EDUCATION AND ECONOMIC GROWTH: SWEDISH EVIDENCE FROM MULTIVARIATE FRAMEWORK

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Abstract. *In this article, we investigate the long and short term relationship between higher education and economic growth in multivariate framework for Sweden, for the period from 1971 to 2013, by using ARDL approach. Toda-Yamamoto procedures of Granger non-causality test were applied to detect the direction of causality in the relationship between economic growth and higher education. We found that unidirectional causality between higher education and real GDP per capita exists. This relationship is positive, but not mutually reinforcing.*

Key words: *education, economic growth, ARDL, Toda-Yamamoto, Sweden*

INTRODUCTION

In this research, the long term and causal relationships between higher education and economic growth in Sweden were investigated using ARDL co-integration and Toda Yamamoto causality test. The mutual interaction between higher education and economic growth was investigated in the presence of different variables, in the case of developed and developing countries, considering previous researches. Theory of endogenous growth suggests importance of the human capital as one of the main sources of the economic growth. Apart from theoretical aspects, numerous empirical studies have focused on the issue of education and economic growth. In that sense, great number of empirical researches used education level to measure the level of human capital. The positive impact of education on the economic growth is confirmed in a lot of studies (Barro 1991; Mankiw et al. 1992; Barro i Sala - Martin 1995; Hanushek i Kimko 2000, Zivengwa 2012, Hussin, et al 2012, Pegkas, 2014). Furthermore, De Meulemeester and Rochat (1995), analyzed the relationships between higher education and economic development for various developed countries using the Johansen co-integration and the Granger causality approach,. Their results show that there

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is unidirectional causality running from higher education to economic development for four countries: Sweden (1910-1986), UK (1919-1987), and France (1899-1986). Khorasgani (2009) demonstrates by using ARDL model that long and short-term relationship exists between higher education variable and economic growth of Iran. His results suggest that higher education had positive influence on the economic growth.

Katircioğlu et al. (2014) investigate the higher education-led growth hypothesis in the case of Northern Cyprus. They found that unidirectional causality from higher education to real income growth exists. There is also long-term equilibrium relationship between economic growth and higher education sector in Northern Cyprus. Narayan and Smyth (2006) analyzed the causality between real income, real investment and higher education for the Republic of China in the period of 1952-1999. The obtained results show evidence of co-integration when real investment is the dependent variable. Their findings suggest that tertiary education and economic growth have major role in propelling real investment. The interrelationship between higher education and economic growth has been subject of Danacica et al. (2010) research. The authors examined this relationship in Romania for the period 1980-2008 using the bivariate causality analysis,. Their results showed unidirectional causality running from GDP to higher education.

Huang et al. (2009) discovered that co-integration relationship exists between enrollment of higher education and actual GDP per capita in China for the period 1972-2007. Empirical result from this study reveals the long-term positive interaction. Lin (2004) investigates the effects of higher education on economic growth in Taiwan over the time period 1965–2000. Results reveal that higher education provided a positive and significant effect on Taiwan's economic growth. On the otherhand , increasing education at all levels, except tertiary has a significant effect on growth, according to Pereira and Aubyn (2009). Considering the higher education and growth performance of Pakistan, for the period 1980-2011, Wasim et al. (2014) discovered bidirectional causal relationship between these two variables. This result is in accordance with Asteriou and Agiomirgianakis (2001), Omojimite (2010) and Yakubu and Akanegbu (2015). The conducted empirical research in a number of countries around the world showed that the causal link between higher education and economic growth as a rule, should exist.

The rest of the paper is as follows: after the introduction, we present the methodology used, followed by the empirical results and causality test. Finally, the concluding observations include a brief discussion of the results.

1. METHODOLOGY

To test the relationship between economic growth and the observed variables, ARDL bounds testing approach was used (Pesaran et al., 2001). The advantages of this approach are reflected in the fact that it is not necessary to accurately identify the order of the underline series (Hsiao, 1997). This is an advantage, if we consider a standard co-integration analysis that requires classification variables of the same order of integration. In tests by ARDL model, the relation between the variables is possible regardless of whether the variables are I (1), I(0) or mixed order of integration. This approach is particularly suitable for a given sample, because it can be applied to the variables that have a different order of integration. The only previous requirement for applying ARDL testing approach is that no

variable is of the order of integration I (2). This approach is extremely suitable for small sample data, because it can get reliable results. The following empirical model describes the relationship between economic growth (GDP), life expectancy (LEX), higher education (EDU) and health expenditure (HEC):

$$GDP_t = f(edu_t, lex_t, hec_t) \quad (1)$$

Table 1 Clemente–Montanes-Reyes structural breaks trended unit root test

Variable	At level			At first difference		
	T-statistic	TB1	TB2	T-statistic	TB1	TB2
LEX	-1.891 (3)	1979	1992	-7.567* (4)	1975	1993
EDU	-4.503 (2)	1991	1997	-5.212*** (4)	1994	2003
LHEC	-5.829 (1)	1997	2004	-5.734** (3)	1981	1993
LGDP	-3.956 (1)	1982	1996	-6.332* (4)	1992	2006

Note: The *, ** and *** indicates significant at 5 and 10 % level respectively.
Lag length of variables are shown in small parenthesis.
Source: Author's calculation

In general, structural breaks test suggests that all variables have maximum order of integration of 1. Formatting Unrestricted Error Correction Modela (UECM) involves short run dynamics and the long run information based on ARDL testing approach. It can be expressed like this:

$$\Delta LnGDP_t = \alpha_0 + \alpha_{GDP} LnGDP_{t-1} + \alpha_{LEX} LEX_{t-1} + \alpha_{EDU} EDU_{t-1} + \alpha_{LHEC} LnHEC_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta LnGDP_{t-i} + \sum_{j=1}^{q} \alpha_j \Delta LEX_{t-j} + \sum_{l=1}^{m} \alpha_l \Delta EDU_{t-l} + \sum_{z=1}^{n} \alpha_z \Delta LnHEC_{t-z} + \mu_1 \quad (2)$$

Co-integrating relationship among the variables in the equation is tested using the Wald Coefficient test. F-test for joint significance of the coefficients is performed to test the null hypothesis of no long term relationship between the variables against the alternative hypothesis of co-integration. It is as follows:

H_o: $\alpha_{lngdp} = \alpha_{lex} = \alpha_{lnhec} = \alpha_{edu} = 0$ (no co-integration);

H_a: $\alpha_{lngdp} \neq \alpha_{lex} \neq \alpha_{lnhec} \neq \alpha_{edu} \neq 0$ (co-integration);

In the case that the computed value of F statistics exceeds the upper critical bound, we need to establish long and short run models. There is also need to check the robustness of ARDL model through the diagnostic tests. It includes checking of normality (J-B test), serial correlation (LM test), heteroscedasticity (ARCH test) and the functional form of the model (Ramsey RESET test). It is also necessary to test the stability of the ARDL approach by applying the CUSUM and CUSUMsq tests.

For further verification of connection between observed variables, we employed Granger non-causality test. This is based on the alternative method proposed by Toda-Yamamoto (1995). In this procedure, the augmented VAR $_{(k+dmax)}$ system is based on Seemingly Unrelated Regression (SUR) at the level which improves the power of the Wald test (Rambaldi and Doran, 1996). The model is valid only if $k > d_{max}$ where k is the number of lags and d_{max} is the maximum order of integration among all time series. The advantage of this model is suitability of performance even when the order of the

integration is mixed. There is no need for pre-testing of co-integration of the time series in order to obtain reliable results, which is another advantage of this model. The model can be specified as follows:

$$LnGDP_t = a_0 + \sum_{i=1}^{k+d\max} a_{1i}\, LnGDP_{t-i} + \sum_{i=1}^{k+d\max} b_{1i} EDU_{t-i} + e_{\ln gdp_t} \quad (3)$$

$$EDU_t = c_0 + \sum_{i=1}^{k+d\max} c_{1i}\, EDU_{t-i} + \sum_{i=1}^{k+d\max} d_{1i} LnGDP_{t-i} + e_{edu_t} \quad (4)$$

Where LnGDP and EDU are the variables, a_0 and c_0 are the constants a_{1i}, b_{1i}, c_{1i} and d_{1i} are parameters of the model and e_{lngdpt} and e_{edut} are the error terms with the distinction of white noise.

2. DATA AND EMPIRICAL RESULTS

In this study, we employed annual data from two different sources. Data covers 1971-2013 period. The value of real GDP per capita was taken for the economic growth. Higher education is proxied by Gross enrollment rate, tertiary, both sexes (%). These two variables were taken from the World Development Indicators available online (World Bank). We used health expenditure per capita and life expectancy from OECD Health Statistics.

Table 2 The Results of ARDL Co-integration Test

Panel I: Bounds testing to co-integration		
Estimated models	F_{gdp}(LnGDP/LnHEC,LEX, EDU)	
Optimal lag structure	(4,4,5,3)	
F statistics	4.833**	
Significant level - Critical values (T=43)		
	Lower bounds	Upper bounds
1% level	4.983	6.423
5% level	3.535	4.733
10% level	2.893	3.983
Panel II: Diagnostic tests		
R^2	0.750	
Adjusted-R^2	0.439	
Breusch-Godfrey LM test	3.170(0.073)	
Jarque-Bera normality test	0.691(0.707)	
ARCH test for heteroscedasticity	3.466(0.071)	
RAMSEY reset test	0.953(0.344)	

Note: Asymptotic critical values are obtained from Narayan (2005); the bounds test: case III: unrestricted intercept and no trend.
The ** indicates significant at 5 % level, respectively.
Source: Author's calculation

ARDL procedure requires appropriate lag to calculate F statistics. The lag length is selected by using Akaike information criteria. In the next step, the calculation of F statistics should reveal whether there is co-integration among economic growth, education, healthcare

expenditures and life expectancy. We have used critical bounds provided by Narayan (2005) which are more suitable for small sample data (between 30 and 80 observations). Our empirical evidence reveals that upper critical bound is less than calculating F statistics at 5% level. This implies co-integration confirming long run relationship between the observed variables. Post-estimation diagnostics confirms the robustness of the model. Jarque-Bera normality test reports that the estimated residuals are normally distributed. Also, there is no heteroscedasticity problem and residuals are not serially correlated. The functional form of the model is well specified.

Table 3 Long and short run results

Long run analysis - Dependent variable LnGDP		
Variable	Coefficient	t-statistic
C	5.22	4.91
LnHEC	-0.011	-0.204
LEX	0.066	3.806
EDU	0.002	3.012
Short run analysis - Dependent variable ΔLnGDP		
C	0.015	0.744
ΔLnHEC	0.054	0.429
ΔLEX	0.074	0.839
ΔEDU	0.002	1.656
ECM(-1)	-0.987	-2.841
Short run diagnostic test		
R^2	0,606	
Adjusted- R^2	0.235	
F-statistics	1.632	
	Statistic	Prob. value
Breusch-Godfrey LM test	1.884	0.184
Jarque-Bera normality test	1.796	0.202
ARCH test for heteroscedasticity	2.880	0.099
RAMSEY reset test	2.756	0.093

Source: Author's calculation

Based on the results, it can be noted that a 1% increase in higher education is linked with an increase in GDP by 0.002%, considering the long run elasticity and keeping all other things constant. The coefficient of the error correction term, $ECM_{(-1)}$ shows the speed of equilibrium adjustment from short to long run. This is confirmation of the integrity of the long termrelationship (Bannerjee et al., 1998). It is statistically significant and negative. The value of $ECM_{(-1)}$ implies that the economic growth is corrected from the short to long run equilibrium almost perfectly by 98%. Sensitivity analysis shows satisfactory results which are shown in lower segment of Table 3.

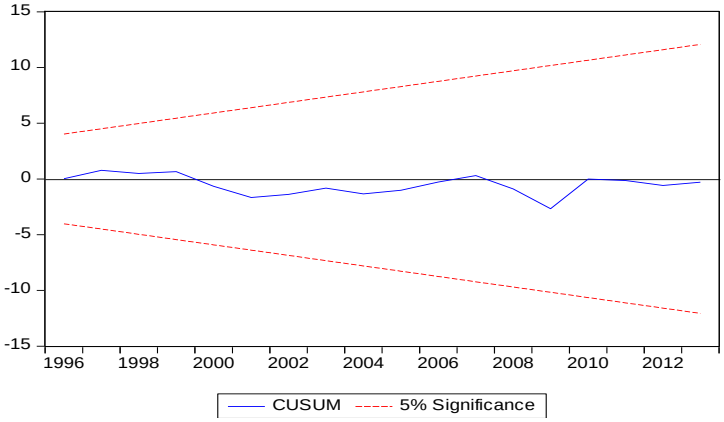

Fig. 1 CUSUM test

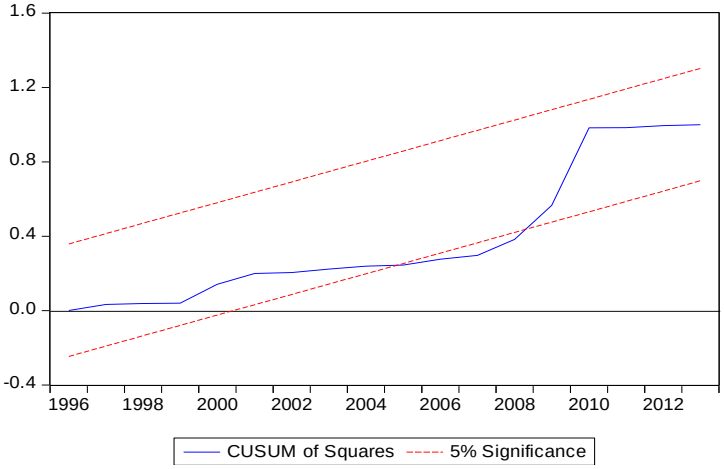

Fig. 2 CUSUM of Squares
Source: Author's calculation

Short term stability is investigated by CUSUM and CUSUMsq tests. According to the CUSUMsq test, the plots fall outside the critical bands at the 5 % level. This means possible instability of the parameters and it happens around the year 2004. We also examine significance and check for structural break in the data using Chow test which is more reliable than graphs. Plots of graphs often tend to present dissimilar and misleading results (Leow, 2004). Chow test does not indicate any significant structural break, because the p-value of the F-statistics is more than 0.05, so the null hypothesis is not rejected. In other words, ARDL estimates are efficient.

Table 4 Chow forecast test

Forecast period	F-statistics	Probability of F-statistics
2004 - 2013	2.790	0.079

Source: Author's calculation

3. CAUSALITY TEST

Since the focus of our attention is the relationship of the higher education and GDP, for further testing and verification of the relation between these two variables the causality test procedure is used. Before the access to testing by Toda Yamamoto procedure, it is necessary to make a minimum diagnostics of the model. According to the test results, The VAR model is stable (stationary) because all the roots are within the unit circle. VAR Residual Normality tests satisfies the null hypothesis that residuals are multivariate normal with p-value (0.3497). The test of serial correlation is also with adequate p-value (0.8525). Finally, we conduct the test of causality. Test results of the Toda-Yamamoto model are shown in the Table 5. The null hypothesis that the higher education does not cause GDP is rejected, which means that there is a causal relation in Granger terms from the direction of higher education to the economic growth, at the 10 % level, respectively. Otherwise, the results indicate that there is no unidirectional causal relation that goes from the direction of economic growth to higher education based on the results of the testing. Results of the analysis indicate the existence of the unidirectional causality.

Table 5 Results of the Granger Non-Causality Test

Null Hypothesis	Chi-square	df	Probability
EDU does not Granger cause GDP	9.49	5	0.09
GDP does not Granger cause EDU	5.72	5	0.33

Source: Author's calculation

CONCLUSION

This paper examines the co-integration and causal relationship between higher education and real GDP in Sweden within a multivariate framework that includes healthcare expenditure and life expectancy during the time period 1971-2013. The specified speed of adjustment to long-term equilibrium is very high and unidirectional relationship has been determined. Multivariate co-integration analysis provided in the paper shows that co-integration exists in the relations which include real GDP, healthcare expenditure, life expectancy and higher education. A unidirectional causality is found that runs from higher education to real GDP per capita. Considering the future research, it may be interesting to explore the multivariate causality between the observed variables and economic growth in comparison with other EU member states.

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VISOKO OBRAZOVANJE I EKONOMSKI RAST: MULTIVARIJANTNI OKVIR NA PRIMERU ŠVEDSKE

U ovom radu, ispitujemo kratkoročnu i dugoročnu povezanost visokog obrazovanja i ekonomskog rasta na primeru ekonomije Švedske koristeći multivarijantni pristup u periodu 1971-2013, primenom ARDL metoda. Toda-Yamamoto procedura Grendžerove neuzročnosti je primenjena za ispitivanje pravca kauzalnosti varijabli ekonomskog rasta i visokog obrazovanja. Rezultati su potvrdili jednosmernu uzročnost visokog obrazovanja i bruto domaćeg proizvoda po glavi stanovnika. Ova veza je pozitivna, ali se uzajamno ne pojačava.

Ključne reči: *visoko obrazovanje, ekonomski rast, ARDL, Toda-Yamamoto, Švedska*

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IMPACT OF INNOVATION ON EMPLOYMENT AND INCOME OF SMALL AND MEDIUM-SIZED ENTERPRISES IN THE REPUBLIC OF SERBIA

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Abstract. *Small and medium-sized enterprises are the "driving force" of modern economies because of the contribution which is reflected in employment, increased exports, dynamics of competition, etc. New and existing innovative SMEs increase overall productivity and competitiveness of the economy, squeezing out less efficient enterprises with lower productivity. By constructing an appropriate econometric model, this paper shows that the income of SMEs significantly depends only on the number of employees in a particular enterprise, not on innovation and the number of employees in research and development areas. The results obtained prove that innovative SMEs do not create more jobs and do not generate higher income compared to non-innovative SMEs in the Republic of Serbia.*

Key words: *innovation, small and medium-sized enterprises, innovative small and medium-sized enterprises*

INTRODUCTORY REMARKS

In most countries, small and medium-sized sector means small and medium-sized enterprises (SME) of up to 250 or 500 employees, depending on the country and upper limit for individual economic activities. According to the legal status, the SME sector consists of individually-owned enterprises, partner enterprises, as well as small family businesses. These enterprises include owners and workers employed, as well as people engaged in handicraft business or other small business activities.

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Small and medium-sized enterprises are, according to the new definition of the European Commission, enterprises with less than 250 employees, an annual turnover of up to 50 million euros, or a balance sheet total of no more than 43 million euros, where the ownership, i.e. control share by other enterprises or multiple enterprises does not exceed 25% (European Commission, 2005, 14).

In the Republic of Serbia, enterprises are, based on size, classified pursuant to the Law on Accounting, which was adopted in 2013 (Official Gazette of RS, No. 062/2013). Under this law, enterprises (legal entities) are classified into micro, small, medium-sized, and large, depending on the average number of employees, operating income, and average value of business assets determined as of the regular annual financial report for the business year. Newly established legal entities are classified on the basis of data in financial statements for the business year in which they are established and the number of months in business, and this data is used for the current and the next financial year.

Even before the adoption of the Law on Accounting, statistical monitoring of SMEs was adapted to the European Commission's recommendations in terms of definition and statistical monitoring of small and medium-sized enterprises. In an effort to harmonize its work with international recommendations and standards, Statistical Office of the Republic of Serbia in 2005 started monitoring and publishing basic macroeconomic indicators of enterprises (number of enterprises, number of employees, turnover and gross value added, number of enterprises engaged in export and export value, number of enterprises engaged in import and import value, etc.) according to their size. Statistical monitoring of enterprises is adjusted to the methodology of the System of National Accounts (SNA). The monitoring encompasses non-financial sector of the economy, with the data obtained from administrative data sources – annual statements of enterprises (processed by the BRA) and customs records. The results of the processing of individual annual financial statements (account settlement) for enterprises on the territory of the Republic of Serbia (without Kosovo and Metohija) are given from the point of division into micro, small, medium-sized, and large enterprises. The division of enterprises according to the size is done in accordance with international recommendations, based only on the number of employees, in the following way: 0 to 9 employees characterize micro enterprises, 10 to 49 employees characterize small enterprises, 50 to 249 employees characterize medium-sized enterprises, while enterprises with more than 250 employees are large enterprises.

Innovative enterprise can be defined in several ways. According to the basic definition, innovative enterprise is the one that implements at least one innovative activity, whereas the product or process innovator is an enterprise that implements either product innovation or process innovation (http://epp.eurostat. 15 June 2013). Innovative enterprises are those that have introduced innovation during the observed period, where innovation does not have to achieve commercial success. Innovative enterprises can be divided into those that develop innovation mainly independently or in collaboration with other enterprises or public research organizations, as well as enterprises that innovate mainly by taking innovation (for example, new equipment) developed by other enterprises. Innovative enterprises may also vary according to the types of innovation implemented. Accordingly, there are innovative SMEs that implement new products or processes, new marketing methods, or organizational changes (UNESCO, 2009, 28).

Innovation-active enterprises are characterized by taking innovative activities in the reporting period, including current and abandoned innovation activities. In other words,

enterprises taking innovative activities in the reporting period, regardless of whether the activity resulted in the implementation of innovation, are considered innovation-active enterprises. Potentially innovative enterprises are innovation-active enterprises, which made innovation efforts, but did not achieve innovation results (Vanhaverbeke, West, 2006, 47). This is a key element in innovation policies whose aim is to encourage, facilitate, and assist businesses to be innovative.

There are also other ways of defining and classifying innovative enterprises depending on research needs. Differentiating enterprises based on innovation could be used to determine the percentage of enterprises (by size, sector, country, or otherwise) representing each of the four types of innovation, or the percentage of enterprises that have implemented combined innovation, such as product innovation and marketing innovation or process innovation and organizational innovation. Classification by innovative status can also include other information, such as information about the creators of innovation. This can help in determining which enterprises independently develop innovation, which in cooperation with other enterprises and/or research organizations, and which assume almost an innovative solution.

The development of knowledge-based economy, changes in business environment, acceleration of the globalization process, creation of a single world market, and global competition are phenomena that enhance the role and importance of SMEs in the innovation process and the development of modern economy. Small and medium-sized enterprises are the driving force of the knowledge economy given their multiple contribution to growth, technological development, rising employment, competitiveness, and export. Through successful innovation activities, SMEs increase income, create new customer needs (new market niches) and better meet the existing ones, develop new technological and non-technological innovation, connect with each other and work together, thereby reducing the advantage of large enterprises that results from the quantity of available resources and opportunities to achieve economies of scale. The ability of SMEs to innovate is of great importance because innovation provides sustainable competitive advantage. Innovativeness of SMEs enables and encourages growth of both enterprises at the micro level and the industry in which economies at the macro level operate.

A large number of studies show that the size of an enterprise contributes little to the research intensity and innovation effort and that, in certain industries, small and medium-sized enterprises have an advantage in innovative development. This is confirmed by the fact that of the 70 most important inventions in the twentieth century, more than half comes from individual inventors, whose innovative entrepreneurial spirit has created products such as personal computers, jet engine, helicopter, color photography, pen, radar, missiles, cellophane, DDT, streptomycin, biosynthetic insulin, etc. (Group of authors, 2002, 31). Furthermore, 46 of 58 major inventions in America and Western Europe in the twentieth century belong to individuals and small businesses. In the United States, according to the National Science Foundation of the United States, small enterprises are 2.5 times more innovative and 24 times more efficient in their innovation activities than large enterprises (in enterprises with up to 500 employees, each dollar invested in scientific research activities gives 24 times more new inventions than in large enterprises with more than 10,000 employees), while innovation is commercialized one year faster, with 25% lower costs (WIPO, 2008, 7).

A large number of small and medium-sized enterprises are characterized by efficient innovation abilities, which allow them to improve business and acquire better position on

the market. In order to survive and develop, small and medium-sized enterprises need to implement and improve their innovation activities, so that they could be successful in the creation and application of new knowledge and innovation. The capacity of enterprises to successfully innovate determines the scope and type of their competitive advantage. Innovation capacity of enterprises is not the same for all SMEs, as it depends on numerous factors (Nikolic, Despotovic & Cvetanovic, 2015). Capacity of SMEs to innovate largely depends on the area in which they operate, business environment, opportunities for sharing knowledge and information, innovative cooperation, orientation of owners (managers), availability of professional, skilled, and innovation-oriented staff, capacity to manage innovation processes, access to existing technology, availability of financial resources, availability and development of infrastructure (technical facilities, training centers, etc.), regulatory framework for innovation (subsidies, tax system and tax relief, protection of intellectual property rights, standards, etc.), existence of networks, alliances, clusters, and other supporting infrastructure.

In order to monitor the level of innovation in the EU, Eurostat, in cooperation with relevant statistical organizations of the member countries, collects information on innovation in the EU, in order to meet the needs of development policy makers and the scientific community. The obtained data allows decision-making on the need and ways to help and encourage innovation, and helps in taking a variety of initiatives and programs, such as Innovation Union or the European Research Area, in the context of the European development strategy, Europe 2020.

Statistical monitoring of innovation for the needs of Eurostat, i.e. European Commission, is based on Community Innovation Survey (CIS)[2], which is implemented in all EU member states, candidate countries for accession to the EU (Iceland, Serbia, and Turkey), and Norway. This survey statistically monitors activities of enterprises in the field of product/service innovation, process innovation, organizational innovation, and marketing innovation. Legal basis for conducting surveys and collecting data on innovation activities of enterprises is the Directive 1450/2004, issued on August 13th 2004 (1608/2003/EC), which elaborates decisions relating to the implementation and development of statistics to monitor innovation.

Study of innovation activities of enterprises also relies on ad hoc modules, which focus on internal and external skills and methods to stimulate new ideas and creativity. The results highlight the differences between innovative and non-innovative enterprises. In addition, these studies provide information on enterprises that acquire specific knowledge from the environment, as well as information on enterprises that mainly rely on internal capacities (for example, in the fields such as multimedia, web design, market research, mathematics, etc.). The obtained data also shows methods that have proven to be successful for stimulating creativity: brainstorming sessions, multi-disciplinary and/or inter-functional work teams, courses and trainings, job rotation or financial and non-financial incentives for employees, and others.

Since the survey of innovation activities of enterprises, conducted for Eurostat, also contains data related to innovative enterprises in Serbia, the following part will provide a comparative overview of the results of innovation activities of enterprises from EU member states and candidate countries (including Serbia), judged by several innovation aspects, using the latest available data related to the reporting period from 2008 to 2010

[2] Community Innovation Survey

(Nikolic, Cvetanovic & Despotovic, 2015). The greatest attention is paid to the position of Serbia in relation to the average of the EU and neighboring countries (Hungary, Slovenia, Croatia, Romania, and Bulgaria).

The subject of research presented in this paper is the relationship between innovative small and medium-sized enterprises in the Republic of Serbia and their employment and the generated income. The research covers the period from 2004 to 2014. The goal of the research is to gain the answers to the following questions: a) Do innovative SMEs in Serbia create more jobs in comparison to non-innovative enterprises, and b) Do they generate higher income compared to non-innovative SMEs. Answers are obtained through the appropriate econometric model, using specific statistical data on innovation activities of SMEs in Serbia, obtained from the Community Innovation Survey.

The subject and goal of the research determine the paper structure. The first part deals with the development of the SME sector in the Republic of Serbia, with emphasis on technological intensity of the sector. The second part looks at the sources of the data used in the study. The third section presents the research results.

1. The Development and Technological Intensity of Small and Medium-sized Enterprises in Serbia

In the modern economy, SMEs are considered the drivers of economic growth and employment growth. The achieved level of development and the importance of small and medium-sized enterprises are usually measured by three main indicators: number of enterprises, number of employees, and GVA.

A typical enterprise in Serbia employs on average 3.6 workers, which shows that Serbian economy is dominated by small business entities (entrepreneurs and micro enterprises). In terms of employment, as in previous years, SMEs employ over two thirds of workers in the economy.

Due to higher capital intensity, growth of enterprise size increases its share in the creation of added value. Although small and medium-sized enterprises in 2014 accounted for 56% in the creation of total value added, their importance in terms of employment was lower.

The three basic indicators of SME business have different trends, especially during the economic crisis (after 2008). Trend in the number of SMEs in the observed ten-year period (from 2004 to 2014) differs from the trend in employment and gross value added. In times of crisis, out of the three observed indicators, only the number of SMEs had a positive growth trend (though at a significantly slower pace), while the other two indicators (employment and GVA) recorded stagnant or declining trends (Fig. 1).

After three years of constant decline (2004 to 2006), the number of SMEs recorded constant growth (2007 to 2011), with the largest growth achieved in 2007. The next three years recorded a cyclical trend in the number of SMEs. First, 2012 and 2013 recorded a slight fall in the number of SMEs, followed by slightly higher growth in 2014. In 2014, as compared to 2004, the number of SMEs increased by 39,134 enterprises, i.e. by 13.7%. Such trend in the number of SMEs was primarily affected by the number of entrepreneurs, micro, and small enterprises, while the number of medium-sized enterprises after 2008 constantly decreased. The number of small businesses constantly increased in the period

from 2004 to 2008, then, in the next three years, their number decreased, and again recorded an upward trend. A similar trend was also observed in respect of micro enterprises, which, from 2006, recorded constant growth, which slowed down in 2014.

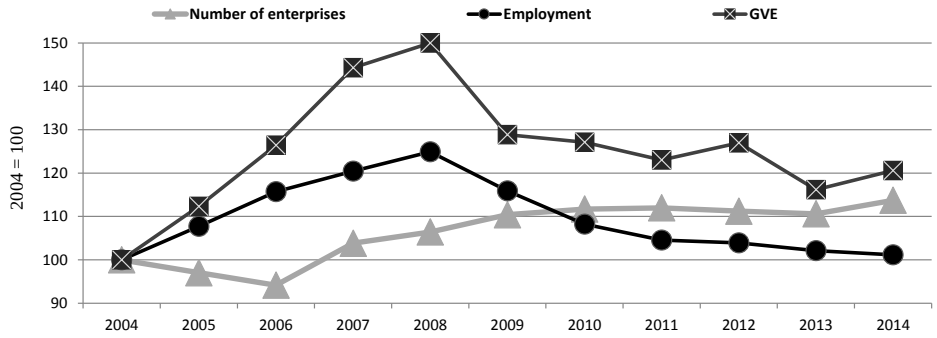

Fig. 1 Trend in the number of enterprises, employment, and gross value added of SMEs in Serbia in the period from 2004 to 2014 (2004 = 100)
Source: Authors, based on the data of the Statistical Office of the Republic of Serbia

In times of crisis, the number of entrepreneurs and micro enterprises constantly increased, contrary to the changes in the number of other enterprises, judging by size. The constant increase in the number of entrepreneurs and micro enterprises was the result of several factors. Specifically, most of these enterprises came from the service sector, where crisis had a lower impact. However, it hit production activities stronger, particularly those fields, i.e. export-oriented production enterprises that export a large part of its products to foreign markets. Due to reduced foreign demand, export-oriented enterprises had to reduce both the volume and value of exports, which had a direct impact on their number and performance. Furthermore, lower dependency of these enterprises on financial market conditions (financing, loans, obtaining guarantees, and the like) affecting mainly larger enterprises proved to be good, because the financial market crisis had a much lower spillover effect on their operations. In addition, closing, i.e. extinguishing of a large number of micro enterprises and entrepreneurial businesses was offset by the opening of new (the so-called start-up) businesses.

The number of newly established enterprises in times of crisis was largely influenced by various government (primarily financial) incentives, through which the state sought to increase the establishment of new enterprises, and thus mitigate the negative effects of the crisis (primarily unemployment growth). Furthermore, it is a well-known fact that economic crisis, i.e. economic downturn, leads to faster growth of newly established enterprises, because economic depression improves conditions for the launch of new, primarily micro enterprises (due to depreciated input prices, lower real estate prices, cheaper labour, etc.), and the growth in the number of potential entrepreneurs, who mostly come from the group of redundant (dismissed) workers in large enterprises or other enterprises closed due to the crisis (the so-called necessity entrepreneurs), or those who are dissatisfied with current conditions in large enterprises and decide to start their own business (the so-called opportunity entrepreneurs).

In the reporting period, the number of large enterprises had a constant declining trend (opposite to SMEs), so that the number of large enterprises in 2014, compared to 2004, decreased by 275 enterprises, i.e. 35.8%. The opposite trend in the number of SMEs and large enterprises resulted in a decrease in the average enterprise size in the economy (in 2004, the average enterprise in Serbia had 4.8 workers, while in 2011, that number decreased to 3.6 workers).

The share of SME employees in total employment in the period from 2004 to 2008 had an increasing trend (from 54.7% in 2004 to 67.2% in 2008), while the period of crisis recorded the opposite trend. In the period from 2008 to 2014, the share of SMEs in total employment gradually decreased, so that, in 2014, it amounted to 64.8%. However, despite the reduction in the time of crisis, the share of SME employees in 2014 was by 10 percentage points higher, compared to 2004.

The largest increase in employment in entrepreneurial businesses was recorded in 2005 and 2006, while in the next two years the number of employees in these businesses stagnated. The onset of crisis in 2008 strongly hit these businesses, so that employment in the next three years recorded a significant decline, while in the period from 2011 to 2014 employment in entrepreneurial businesses stagnated. Despite the fall in the period of crisis and stagnation thereafter, employment in entrepreneurial businesses in 2014 was still higher compared to 2004. Similar trends were recorded in other enterprises (growth of employment in the years before the crisis, decline in conditions of crisis, and stagnation after the crisis). In 2014, as compared to 2013, only entrepreneurial businesses increased employment, while micro, small, medium-sized, and large enterprises decreased employment (Fig. 2).

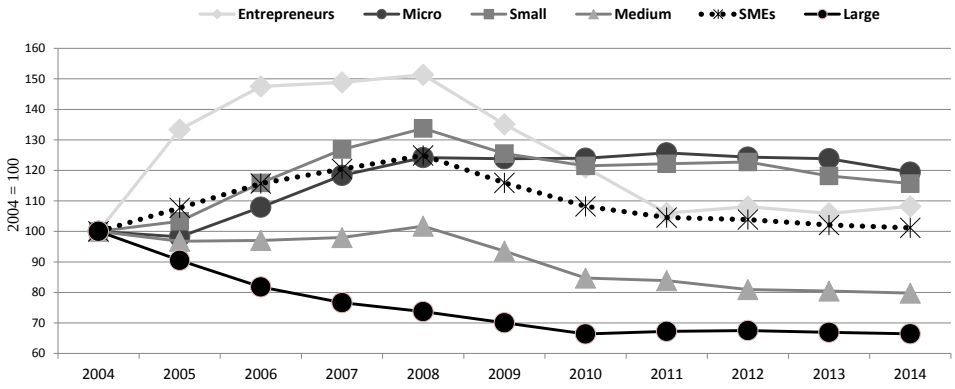

Fig. 2 Change in employment by enterprise size in Serbia in the period from 2004 to 2014 (2004 = 100)
Source: Authors, based on the data of the Statistical Office of the Republic of Serbia

Less pronounced employment trend in relation to other indicators, especially GVA, can be explained by various factors. First, changes in employment are generally less pronounced, compared to other indicators which measure business activity of the company, because due to the existence of collective agreements, high cost of training of new workers, and the like, employment does not completely go in line with economic conditions. At the same time, in the years of crisis, especially in 2010 and 2011, various measures to support the operations of enterprises played an important role in mitigating

the crisis. The key element in the anti-crisis support programs was the maintenance of employment, i.e. keeping of employment at the highest possible level, so that the state approved a variety of subsidies in order for enterprises to maintain the same level of employment, thereby reducing the pressure that enterprises had related to the dismissal of workers because of the sharp drop in demand. Effects of state aid were significantly more pronounced in large enterprises than in SMEs, but were completely absent in entrepreneurial businesses. However, despite state aid, unemployment in Serbia is extremely high and represents a major development, social, and community problem. The current policy of encouraging new employment (for example, by financial incentives to large enterprises to hire new workers – up to 10 thousand euros per employee) has proved to be expensive and insufficiently effective mechanism. Therefore, the solution to high unemployment should be sought in encouraging SMEs, because only they have the capacity to significantly hire new workers and thus mitigate or completely solve the long-term problem of unemployment in the economy.

The research of employment in small and medium-sized enterprises may be supplemented by an analysis of the volume and trends of the gross wages paid to employees by enterprises for the work performed. In most economies, wages of workers in SMEs are on average lower than wages in large enterprises. This rule also applies to Serbia. This can best be seen when comparing the average gross wage per employee in enterprises of various sizes. In 2014, the average wage in SME was 23.2% lower than the average wage in large enterprises, and, within SMEs, the highest average was achieved by those employed in medium-sized enterprises. Observed by sectors, the highest average wages were in the sectors of Information and communication, Professional, scientific, and technical activities, and State administration and compulsory social insurance, which employed only 10% of all employees in SMEs. The lowest average wages were in sectors: Accommodation and food services, Education, Manufacturing industry, and Construction. The difference in wages in SMEs and large enterprises is the result of a greater presence of large enterprises in capital-intensive sectors. It is known that employees in sectors with relatively large capital and more complex manufacturing processes have higher wages. Another reason which, in the present conditions, leads to a nominal difference in the average wages between SMEs and large enterprises is the phenomenon of underreporting of total wages (most often in entrepreneurial businesses and small enterprises), in order to reduce the tax base. In practice, this means that employers pay wages to employees in two ways. The first is the legal way, which involves the payment of the minimum prescribed wage or slightly above it (this portion of the wage is taxed and statistically recorded), and the second portion of the wage is paid outside of legal flows (in cash), which is not subject to taxation and statistical recording. The difference in wages between large enterprises and SMEs also occurs due to uneven protection of employees, i.e. weak unionisation of workers in SMEs and better trade union protection of workers in large enterprises, especially in large state-owned or privatized socially owned enterprises.

Gross value added is a good indicator of business efficiency of enterprises. In the period from 2004 to 2009, real GVA of enterprises in Serbia was constantly growing. As GVA grew faster in SMEs in relation to large enterprises during this period, the share of SMEs in creating GVA of the economy constantly increased. After 2009, the trend was completely opposite, since there was a constant decline in the total GVA, and the decline in the share of SMEs in creating GVA of the non-financial sector of the economy (Fig. 3).

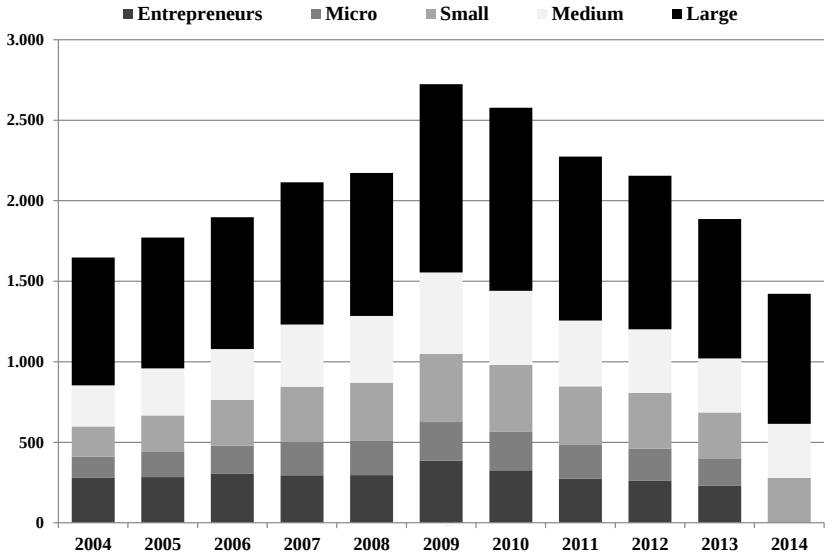

Fig. 3 The value of GVA according to the size of enterprises in Serbia in the period from 2004 to 2014 in millions of dinars (constant prices from 2014)
Source: Authors, based on the data of the Statistical Office of the Republic of Serbia

Analysis of movement of real GVA growth rate indicates that entrepreneurial businesses lag behind other enterprises, and a negative growth of real GVA from 2007. In other enterprises, slowdown in the annual real growth of GVA was observed in 2008, and in 2009, the decline was recorded in all enterprises (the largest fall was in micro and small enterprises). In 2010, the decline continued with entrepreneurial businesses and medium-sized enterprises, whereas micro, small, and large enterprises achieved growth of real GVA. In 2011, the negative trends from 2009 repeated, but at a much lower level. Negative trends were recorded in the next three years as well, except that particularly negative trends were recorded in 2013, when the real annual fall in GVA was the largest in all enterprises.

Innovation, research and development, and knowledge are considered important drivers of productivity, growth, and competitiveness, whereby small and medium-sized enterprises are attached the key role in the creation of knowledge. Accordingly, the focus is on the activity of SMEs in high-tech knowledge-intensive manufacturing and service industries, and their participation in these sectors compared to large enterprises. This is especially important in times of crisis, when it is necessary to restart the development of the economy, because innovative SMEs can play a key role in reviving the economy and achieving significant long-term growth.

In 2014, high technology sectors (HT and HKIS) employed 30,485 workers, which makes 4.0% of total employment in the non-financial sector of the economy (Fig. 4). Although the total number of employees in 2014 in the high-tech sector decreased by 299 employees (1.0%), compared to 2009, its share in total employment increased because employment in the economy decreased at a higher rate (12.7%).

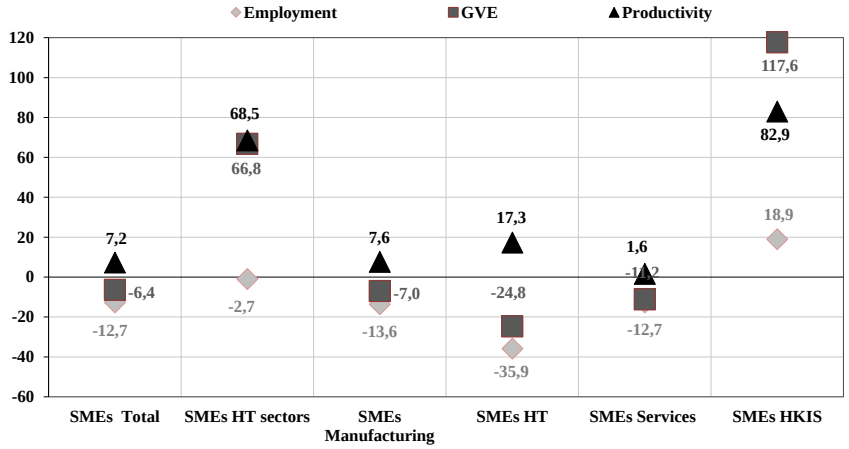

Fig. 4 Real growth in employment, GVA, and productivity in the period 2009-2014
Source: Authors, based on the data of the Statistical Office of the Republic of Serbia

The increase in employment in 2014 (by 496 employees – 1.7%), compared to 2013, which is contrary to the movement of the average of the economy and other sectors, demonstrates the importance of high-tech sectors in terms of employment. The significance is even greater because the level of wages in these sectors is significantly above average than most other sectors in the economy, which increases the purchasing power of employees in these enterprises and, consequently, the market demand.

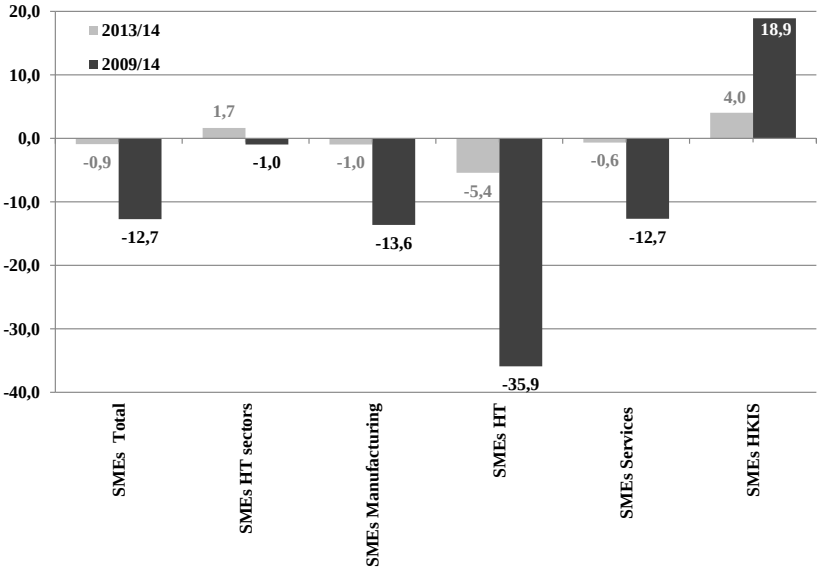

Fig. 5 Change in employment in SMEs in the period 2009-2014
Source: Authors, based on the data of the Statistical Office of the Republic of Serbia

The slower decline in employment in the high technology sector in the period 2009-2014, and growth in 2014, compared to 2013, indicates a lower elasticity of employment in high technology sectors in relation to the rest of the economy (Fig. 6). This can be explained by the higher complexity of jobs and more sophisticated knowledge of employees in high technology sectors, so that each fluctuation (replacement or dismissal) of employees causes higher costs for the enterprise compared to enterprises from other parts of the economy.

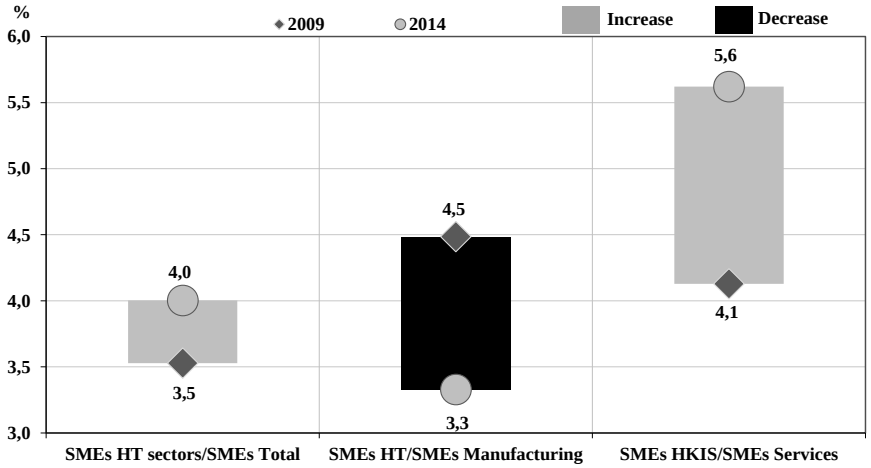

Fig. 6 Change in the structure of employment in the period 2009-2014
Source: Authors, based on the data of the Statistical Office of the Republic of Serbia

Viewed by the structure of high-tech sectors, there is a big difference between employment trends in HT SMEs and HKIS SMEs. Unlike HT SMEs, which constantly decreased employment in the observed period (2009-2014), and where the employment decline was more pronounced than in other sectors of the manufacturing industry (the share of HT SMEs in the manufacturing industry decreased in 2014, compared to 2009, by 1.2 percentage points), employment in HKIS SMEs increased all the time, so that employment growth in 2014, compared to 2009, was 18.9%. Employment growth in HKIS SMEs was contrary to the employment in SMEs in most other service industries, so that employment share of HKIS SMEs in employment in SMEs in the service sector of the economy increased by 1.5 percentage points. Employment growth in HKIS SMEs confirms the greater development and market power of high-tech SMEs in knowledge-intensive service industries in relation to production high-tech SMEs in Serbia.

Small and medium-sized enterprises in the field of high technology in 2014 generated 8.0% (82.7 billion dinars) of the total value added of SMEs, which is by 3.5 percentage points more than in 2009. Unlike GVA trends in all SMEs, which saw a real drop in GVA in 2014, compared to 2009, GVA in the high technology SME sector constantly increased, so that in 2014, compared to 2009, it increased by 66.8% (33.1 billion dinars). The constant growth of GVA of SMEs in the high-tech sector can be explained by the high competitiveness of SMEs that managed to retain the existing customers and expand the market through competitive business.

Products and services that are created in the high-tech sector generally have higher quality, meet the specific needs of customers, are more exclusive, and can be sold at higher prices. Movement of GVA in Serbia is largely in opposition to the movement of GVA in most EU countries, where, in times of crisis, GVA in high technology sectors decreased more than GVA created in the rest of the economy (Edgett, 1993). The reason for the decrease in GVA in these countries is explained by higher income elasticity of demand for high-tech products and services in relation to products and services from other sectors of the economy. In 2010, Berthou and Emlinger showed that the sale of high quality products was more sensitive to changes in income per capita than the sale of low-quality products (Dess et al. 2007, 92). Esposito et al. indicate that the decline in revenue during the crisis, both in the EU and globally, disproportionately affected products and manufacturers from high-tech sectors (Esposito & Vicarelli, 2011, 92). These authors also expect that after the crisis the trend will reverse, which implies faster growth in the sale of high-tech products.

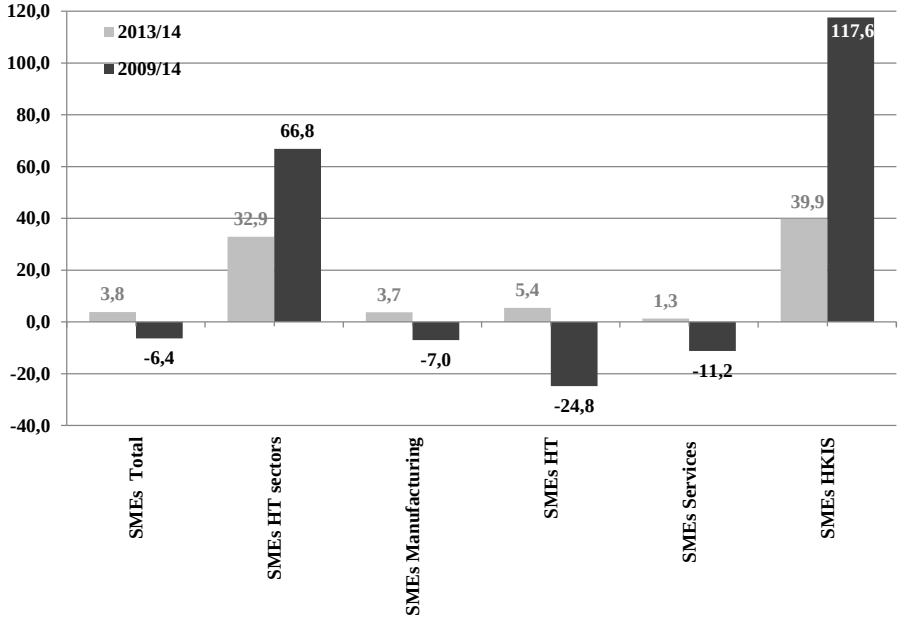

Fig. 7 Trends in GVA in the period 2009-2014, in %
Source: Authors, based on the data of the Statistical Office of the Republic of Serbia

Similar to the employment trends, there is a significant difference in the movement of GVA in the high technology sector between HT SMEs and HKIS SMEs. In the observed three-year period, GVA in HKIS SMEs constantly grew (contrary to trends in other service sectors), so that the share of GVA generated by HKIS SMEs in the total GVA in the service sector increased. In high-tech manufacturing SMEs, situation is the opposite, because the decline in GVA in HT SMEs was higher than the decline in GVA in other manufacturing sectors, so that the share of GVA generated by HT SMEs in the manufacturing industry decreased.

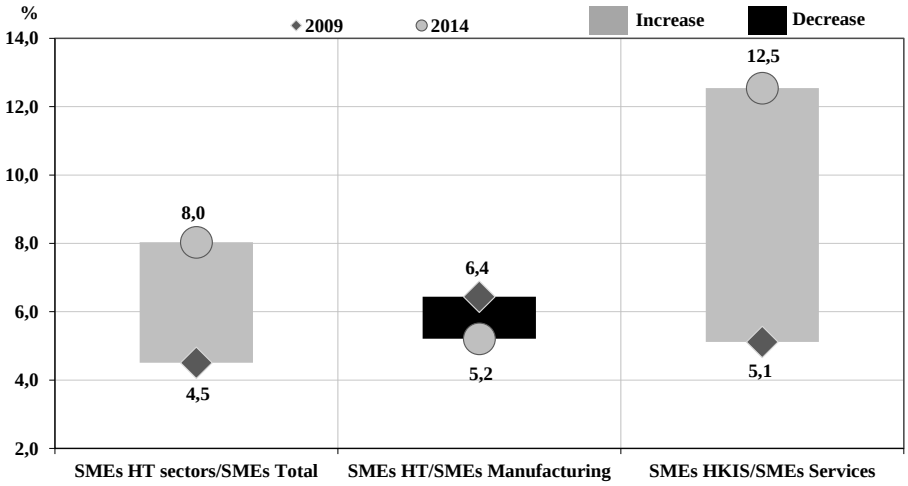

Fig. 8 Change in the structure of GVA in the period 2009-2014
Source: Authors, based on the data of the Statistical Office of the Republic of Serbia

2. DATA USED IN THE STUDY

Most of the world research in this field is based on data obtained from the Community Innovation Survey (CIS), as the method of data collection, coverage of observed units, and the data obtained allow various econometric and statistical studies (Mairesse & Mohnen, 2010). In this way, researchers have the opportunity to explore the starting hypotheses and establish various aspects of SME innovation in the modern economy. Accordingly, the basis for econometric research in this paper is the specifically collected statistical data on innovation activities of SMEs in Serbia, obtained from the Community Innovation Survey.

Econometric analysis was conducted using the Eviews 7 software package, based on data from Community Innovation Survey (CIS), which the Statistical Office of the Republic of Serbia conducted in 2008 and 2010 (the reference year is 2010). The survey included a sample of 3,500 small and medium-sized enterprises from Serbia, reaching to the level of regions, in proportion to the number of SMEs, selected from a set of 12,141 active enterprises with 10 and more employees registered in the Statistical Business Register. The survey of small and medium-sized enterprises focused on a sample stratified by the size of a business entity (small: from 10 to 49 employees; medium-sized: from 50 to 249 employees) and by activity (groups of activities under KD08 – groups of activities were selected according to the Eurostat recommendations). Realization of the sample was 71.37% (about 15% of the selected business entities were blocked or bankrupt, and about 14% of businesses did not respond to the survey). The obtained results were weighted and calculated at the population level of the enterprise. Data collection was based on web questionnaire (51%), survey via e-mail (12%), and printed questionnaire, which was distributed and collected by mail (37%).

The survey on innovation activities of enterprises is the main source of data for measuring innovation, designed to collect information on innovation activities, various aspects of organizational and marketing innovation within the enterprise, as well as on various aspects of the innovation process. The survey recorded the activities of enterprises in terms of product/service innovation, process innovation, organizational innovation, and marketing innovation. The aim of the research was to gain a comprehensive understanding of the real attitude of business policy of enterprises towards innovative activities, in terms of awareness of the needs and effects of innovation in an enterprise, the existing capacities in the enterprise, as well as of factors that hinder or slow down this type of activity. The data obtained shows the type, volume, and quality of innovation activities in enterprises: new or significantly improved products and services, implementation of new or significantly improved processes, logistics, and ways of distribution and promotion (Statistical Office of the Republic of Serbia, 2009, 2).

The data obtained allows users to understand the process of innovation, sources of information, organization of work, cooperation among enterprises, relationships with the environment, the objectives pursued by enterprises, and other aspects related to innovation activities of enterprises. The enterprise can simultaneously have more than one type of innovative activity over the observed period. In the survey, the enterprise is viewed as a unit, whereas an innovative activity is seen as a phenomenon (multiplied number).

The survey saw innovation as based on the application of a new or significantly improved product (goods or service) or process, a new marketing method, or a new organizational business method, organized work and relations with the environment. Such innovation activities can be developed by the innovating enterprise itself, along with other enterprises, by another enterprise, or can represent adaptation or application of the processes originally developed by other enterprises or institutions. Simple resale of new products and services purchased from other enterprises is not considered innovation. Innovation should be new at least for the observed enterprise. In some cases, innovative enterprises may cooperate with other entities in the business environment, and partners for cooperation may be found in other countries.

3. RESEARCH RESULTS[3]

The research focused attention on the examination of the links between innovativeness of SMEs, on the one hand, and employment and income, as important enterprise performance indicators, on the other hand. The basic assumption is that innovative SMEs recruit more workers and have better production processes through which they are able to, with less investment of labour and capital, achieve higher income.

Accordingly, the following research hypotheses were defined:

H0: Innovative small and medium-sized enterprises create more new jobs and generate higher income;

H1: Innovative small and medium-sized enterprises do not create many new jobs and do not generate higher income.

[3]The obtained results of econometric research should be interpreted with caution, since the data series of only two years is short for this kind of research, which reduces the possibility of reliable and solid conclusion, but is a good basis for future research.

To analyse these hypotheses, the following two equations were used:

$$Emp = c + c_1 Inov + c_2 Erd + c_3 Inc + \varepsilon \quad (1)$$

$$Inc = c + c_1 Emp + c_2 Erd + c_3 Inov + \varepsilon. \quad (2)$$

Emp – Number of employees in the surveyed small and medium-sized enterprises;
Inov – Dummy variable for innovation (in the event that the enterprise declared itself as a non-innovator, it takes the value of 0, and if the enterprise declared itself as an innovator, it takes the value of 1);
Erd – Number of employees in research and development in the surveyed small and medium-sized enterprises;
Inc – Generated income of the surveyed enterprises.

The first equation proves the first part of the hypothesis, based on which innovative small and medium-sized enterprises create more jobs. The obtained result shows that the number of employees in small and medium-sized enterprises is statistically significantly affected by the number of research and development employees within the enterprise and income of the enterprise, but not its innovation activity (Table 1).

Table 1 Employees in the surveyed small and medium-sized enterprises

Dependent Variable: Emp
Method: Least Squares
Date: 25/02/16 Time: 17:52
Sample (adjusted): 1,794
Included observations: 790 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	89.60895	29.11450	3.077812	0.0022
INOV	-16.80740	22.17116	-0.758075	0.4486
ERD	26.41740	1.185967	22.27499	0.0000
INC	2.05E-06	7.75E-07	2.647385	0.0083
R-squared	0.397535	Mean dependent var		256.4342
Adjusted R-squared	0.395235	S.D. dependent var		957.1531
S.E. of regression	744.3455	Akaike info criterion		16.06794
Sum squared resid	4.35E+08	Schwarz criterion		16.09159
Log likelihood	-6342.836	Hannan-Quinn criter.		16.07703
F-statistic	172.8800	Durbin-Watson stat		1.912994
Prob(F-statistic)	0.000000			

Based on the results of the second equation, it can be concluded that the income of small and medium-sized enterprises statistically significantly depends only on the number of employees in a particular enterprise, not on innovation and the number of employees in research and development (Table 2).

Table 2 The income of the surveyed small and medium-sized enterprises

Dependent Variable: INC				
Method: Least Squares				
Date: 25/02/16 Time: 21:37				
Sample (adjusted): 1,794				
Included observations: 790 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2439354.	1339918.	1.820525	0.0691
EMP	4309.823	1627.955	2.647385	0.0083
ERD	27054.43	69434.32	0.389641	0.6969
INOV	-581395.8	1016572.	-0.571918	0.5675
R-squared	0.017733	Mean dependent var		3463872.
Adjusted R-squared	0.013984	S.D. dependent var		34364798
S.E. of regression	34123676	Akaike info criterion		37.53393
Sum squared resid	9.15E+17	Schwarz criterion		37.55759
Log likelihood	-14821.90	Hannan-Quinn criter.		37.54302
F-statistic	4.729916	Durbin-Watson stat		2.024413
Prob (F-statistic)	0.002809			

Based on these results, H0 hypothesis cannot be accepted, but H1 hypothesis can, based on which innovative SMEs do not create more jobs and do not generate higher income, compared to non-innovative small and medium-sized enterprises in the Republic of Serbia.

CONCLUSION

Income of SMEs statistically significantly depends only on the number of employees in a particular enterprise, not on innovation and the number of employees in research and development departments. The results obtained prove that innovative SMEs do not create more jobs and do not generate higher income, compared to non-innovative small and medium-sized enterprises in the Republic of Serbia.

Innovative SMEs do not create more jobs. The obtained result shows that the number of employees in small and medium-sized enterprises is significantly affected by the number of employees in the research and development within the enterprise and enterprise income, but not its innovation activity.

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UTICAJ INOVACIJA NA ZAPOLJŠAVANJE I PRIHOD MALIH I SREDNJIH PREDUZEĆA U REPUBLICI SRBIJI

Mala i srednja preduzeća su "pokretačka snaga" savremenih privreda zbog doprinosa koji se ogleda u zapošljavanju, povećanju izvoza, dinamiziranju konkurencije, itd. Nova i postojeća inovativna MSP doprinose povećanju ukupne produktivnosti i konkurentnosti privrede, istiskujući manje efikasna preduzeća sa nižom produktivnošću. U radu je putem konstruiranja odgovarajućeg ekonometrijskog modela dokazano da prihod MSP statistički značajno zavisi samo od broja zaposlenih u konkretnom preduzeću, ne i od inovativnosti i broja zaposlenih u istraživanju i razvoju. Na osnovu dobijenih rezultata dokzano je da inovativna MSP ne kreiraju više novih radnih mesta i ne stvaraju veći prihod u odnosu na neinovativna mala i srednja preduzeća u Republici Srbiji.

Ključne reči: *inovacije, mala i srednja preduzeća, inovativna mala srednja preduzeća*

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MEASURES OF AGRICULTURAL POLICY IN THE REPUBLIC OF SERBIA WITH EMPHASIS ON THE SITUATION IN NISAVA DISTRICT

UDC 338.43(497.11)

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Abstract. *The authors give a brief overview of the situation in the implementation of agricultural policy in Serbia. They introduce us to support measures which are an important factor for maintaining agricultural production. Serbia is obliged to harmonize its agricultural policy with the common agricultural policy of the European Union CAP. This process of harmonization needs to be done now that the Republic of Serbia has become a candidate country for EU membership. In the current economic conditions, the survival of farms is threatened. A key problem is the ownership structure of farms in Serbia, which are located in small areas of land. This also represents agreat fragmentation of land. It is necessary to carry out procedures of land consolidation and land redistribution in order to achieve agglomeration, which would result in an increase in the quantity and quality of agricultural production. At the end, the authors provide a study on the state of implementation of agrarian policy in the Nisava district. The aim of the research is to analyze the results of the use of agricultural policy measures.*

Key words: *agricultural policy, the Republic of Serbia, agrarian budget subsidies.*

INTRODUCTION

The market support includes pricing, support and subsidy funds to support the farms, storage of wheat and direct payments to producers (premium for wheat, industrial crops, hops and milk, direct payment to producers of wheat, soybeans certified seed incentive, bonus and livestock breeding queen bees, encouragement raising perennial plants in fruit growing, viticulture and the production of hops, lemon balm incentive to raise the basic planting material, recovery of fuel and fertilizer).

The government subsidies are assets used for compensation of producers to achieve cost-effective production done in the previous period. These funds are primarily used for further investments in raw materials and working capital. Subsidies are non-refundable

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and free resources. The funds that are not subsidies means that the agricultural system can use them at their own discretion. The state is the one that determines the production in a given year, and the wider social interest. Also state determines the amount of compensation per unit of production date and in accordance with these subsidies pays to producers for the actual production. In this way the government through subsidies and premiums artificially creates positive financial effects in certain industries. (Vasiljević Z., 2008, 76.) The countries encourage producers of the following year to found the same product through subsidies.

1. THE FUNDS FROM THE AGRICULTURAL BUDGET

If we look at what the contribution of agriculture to the formation of gross domestic product is, we can point out that the share of the agricultural budget in the Budget of the Republic of Serbia in all these years has been relatively small, and in 2009, 2010 and 2011 was extremely low (Table 1). In the period from 2004 until today, with the introduction of a registered farms system, the three crucial years for the farm subsidies can be ascertained. In 2004, the largest real agricultural budget funds were granted to only 38,000, or 4.8% of the total number of farms in Serbia. In 2008, the subsidy program was applied per hectare and livestock that had more character than social development policy, and used by around 418,000 registered farms, or 53.7% of the total number of individual farms. (Simonović Z., 2014, 177).

Table 1 Agricultural budget in the period 2004-2015 Year

Republic of Serbia			
Year	Total expenditures and expenditures for the purchase of non-financial and financial assets	Budget of the Ministry of Agriculture, Forestry and Water Management	
		The funds from the budget	Participation in % of total expenditure RS
2004	362.045.252.000	18.059.553.000	4,99%
2005	400.767.778.000	16.269.962.000	4,06%
2006	505.820.602.000	23.593.481.000	4,66%
2007	595.517.786.100	21.410.029.000	3,60%
2008	695.959.075.793	27.634.337.342	3,97%
2009	719.854.143.000	15.964.071.000	2,22%
2010	825.884.941.052	20.572.438.000	2,69%
2011	818.344.423.000	22.033.208.000	2,45%
2012	940.157.524.000	36.600.000.000	3,90%
2013	1.067.880.560.900	39.349.382.000	3,68%
2014	1.110.120.984.547	39.358.511.000	3,54%
2015	1.082.988.184.000	41.433.438.000	3,82%

Source: Ministry of Finance and Economy of the Republic of Serbia and calculation of the authors.

In 2009, small agricultural budget subsidies were available for only 84,000 registered farms, or 10.8% of the total number of family farms. A smaller part of this small group of users consists of a subsidy for 20,000 registered farms in the so-called marginal areas. The second, larger part of this group of users of drastically reduced subsidies are only registered farms whose owners or holders of the so-called household accepted the obligation to pay

contributions for pension and disability and health insurance as well as farmers. In the period since 2012, there has been a slight increase in the agricultural budget by 1% compared to the previous period.

It is estimated that about 400,000 households located on the edge of existence and the question of how to design production in the next production year. The number of land owners to experience their fate in the coming years is difficult to predict. This situation poses a great risk for the country that fails to amortize the transitional impacts in agriculture and the countryside. It brings about the creation of new vulnerable groups of farmers that will continue to rely on social funds because they no longer have their working capital. In practice, this means that those who have a debt, but have spent dedicated funds or had an unfavorable climatic year, with the growth of the euro will not be able to repay the loans that have already been reprogrammed one or more times.

2. TYPES OF SUBSIDIES

The subsidies and incentives in the Serbian agriculture system include the following measures:

- Premiums for certain agricultural products.
- Pay for the use of biological growth factors and other production costs.

In this sense, the premiums for certain agricultural products branch continue the following segments that are subsidized:

- The production of fresh milk.
- For breeding calves.
- For fattened cattle.
- For the production of basic crops.

In order to encourage greater use of biological growth factors of agricultural production, fuller utilization of specific regional agro ecological resources and reducing total input costs in agricultural production vertical, it is necessary to provide grants for production inputs, namely:

- For high-quality varietal seed wheat and soybeans,
- Seeds of forage crops (leguminoze, grass and grass mixture)
- For high-quality varietal seed potatoes,
- For high-quality planting material of fruit crops and virus-free spools of certain varieties of grape.

The payment of subsidies of 14,000 dinars (in 2009 of 12,000 dinars) per hectare of arable land covers around 750,000 ha (in 2009, about 620,000 ha) in about 63,000 households. In this way the production of 23% (in 2009 20%) of arable land in Serbia was supported. The exact number of farms enrolled in the registry is not known as well as the exact number of farms that have achieved direct support per hectare due to the apparent lack of transparency of the Ministry.

Support for the market price of wheat was done in 2004 by purchasing of administrative prices for the purpose of forming strategic commodity reserves of the Republic Directorate for Commodity Reserves. (Popović V., Katić B., 43).

Subsidizing grain storage was planned in the amount of 750 dinars per ton of stored wheat at authorized storekeeper to surrender the quantity of generation of 2005, but up to 4 tons per hectare. (Official Gazette of the Republic of Serbia no. 60/05, 71/05.) In 2006,

subsidies were related only to the storage of wheat to natural persons who are registered holdings, provided that the wheat storing is done in case of legal entity or the entrepreneur whose business is storing wheat.

Milk producers in all the previous years were entitled to the premium which has to some extent improved their economic situation. Manufacturers of cow, sheep and goat milk were entitled to the premium provided that they meet the prescribed quality of milk that is produced in the Republic of Serbia and that it is handed over to the milk producer located in the territory of the Republic of Serbia. The premium is granted according to the latest Regulation for legal entities which have a share of at least 90% of the state capital and private persons who are holders of domestic commercial individual farms. (Official Gazette of RS, no. 7/10.)

The EU Member States, unlike Serbian producers of raw milk, are mainly owners or participate in the property's dairy industry. The state of Serbia has never recognized its mistakes in the privatization of the food industry which includes the dairy industry. In 2004, the premium of 800 million liters of cow's milk was 4 to 4.4 dinars per liter, that is 0.05 euros per liter, while in 2009 the premium for milk and coverage premium liters was significantly reduced (price premium is around 414 million liters a premium of 1.0 + 1.0 din of extra class) while in 2010 premiums amounted to 1.5 dinars / liter. After the revised budget for 2010 and providing an additional 650 million dinars, the Ministry of Agriculture announced increase in milk premiums in the fourth quarter. Also the inclusion of legal persons in the support system for milk production was announced.

In the case of state subsidies in dairy production, in particular premium per liter of milk, we can see how little attention is paid in Serbia to subsidizing milk production. Subsidies on milk production are the lowest in Serbia with 1.4 eurocents, while in Bosnia and Herzegovina they amount to 11 euro cents, while in Croatia they are 12 euro cents per liter. (Veljković, B., Vico, G., Koprivica, 2009).

The measures to protect the milk production were high in 2004, and in subsequent years measures were inadequate and non-permanent. During this period, however, there have been desirable structural changes in this branch of agriculture, among other things because the largest owner of industrial milk (Salford) was tasked to improve this production among its suppliers, primarily in the quality of milking and increase the volume of production per head, reduce number of suppliers but also maximize its own profit in order to facilitate sales. It turned out that such a policy created by the majority owner does not coincide with the interests of the state. (Simonović Z., 2014, 180).

Since 2001, the bonus has been awarded to breeding cattle and milk premiums. In 2007, they were given incentives for fattening cattle. In 2008, the support for the production of pork and fattening breeds procurement for the expansion of livestock and meat production in cattle farming was abolished. Support for the production of pork, beef and poultry meat is completely missing as this production is mainly oriented to the domestic market with the occasional import. Subsidies for cattle in 2004 (along with support for investments in the production and processing of milk and meat from 800 million dinars), amounted to about 37% of the total budget for agriculture, and in 2009 only about 7 % of budget dedicated to agriculture was allocated for livestock.

The subsidizing purchases or breeding quality cows of certain types of livestock have been practiced over a longer period of time. This facilitates the acquisition of livestock breeders or breeding this kind of cattle. Lately particular attention is paid to autochthonous species of animals and in particular to the following types: Podolian Cattle, Busha, domestic buffalo,

domestic mountain horse, Nonius, Balkan donkey, pigs mangulica (white and red strain), Moravka, Resavka stranded wire (Pirot, Krivovir, Bardoka, Lipski, Vlach Vitoroga, Karakachan) Čokansko Tsigai, Balkan goat, poultry Kaporka, Banat and Svrljig chicken. (Official Gazette of RS, no. 15/10). The incentives that are allocated for beekeeping have been present in Serbia for several years. The right to these incentives is held by natural person's holders of farms. (Official Gazette of RS, no. 25/10).

The result of the current policy of the state in the livestock sector of Serbia, is a very low share of animal husbandry in total agricultural production value of only 30.7% (in Vojvodina only 24%), while the share of animal husbandry in the total value of agricultural production in most EU countries is over 60% . The Central Serbia has 0.33 and Vojvodina only 0.25 of conditional heads of cattle per hectare. The most extensive EU country is Greece with 0.38 livestock units per hectare and the most productive the Netherlands with 0.98 livestock units per hectare. This is best illustrated by the extensive nature of agriculture of Serbia as a whole.

The aim of incentives for planting new orchards, vineyards and plantations of hops is to improve fruit and grape production in Serbia. Unfavorable situation in orchards and vineyards is characterized by the presence of unsuitable varieties and plant diseases in orchards, as well as reducing the area under vineyards. The incentive measures should contribute to increasing the production, productivity and competitiveness. Latest decree regulates the conditions and manner of use of incentives to raise production orchards of fruit trees and berries except the production of vineyards and hops. (Official Gazette of RS, no. 24/10). It is not known why the Ministry of Agriculture in 2010 did not plan funds to support the purchase of grapevine and special needs fruit seedlings due to changes in production structures in this direction and to increase the area under orchards, although there is a regulation. The same is the case with support for implementation of the Law on public warehouses.

The program of distribution and use of funds for subsidies in agriculture, forestry and water resources is intended for reimbursement of mineral fertilizer and fuel (diesel fuel, bio diesel and euro diesel). The mineral fertilizers and fuels in terms of the last Regulation refer to raw materials. (Official Gazette of RS, no. 7/10).

The Government of Serbia, through the relevant Ministry of Agriculture, has provided interest subsidies for short-term loans to nearly 9,000 farms in the status of natural persons whereby the potential of 11 banks placed 3,345.000.000 dinars (32 million euros) in short-term loans. (Official Gazette of RS, no. 33/11 and 38/11). The credit support is designed to encourage agricultural production, the development of farming, horticulture, viticulture and vegetable production, the development of animal husbandry, for investments in agricultural machinery, credit support for investment in agricultural facilities and others. These measures are a good trend because the credit activity was relocated to commercial banks. On the other hand, the access to credit is not enabled to the majority of households that have a need for it. If one takes into account the average investment in raw materials in the production of wheat, this measure covers the investment for only about 90,000 hectares of wheat, indicating a very small value of these loans.

3. STAGES IN THE IMPLEMENTATION OF AGRARIAN POLICY OF SERBIA

Systemic and structural reforms of the agricultural sector in the Republic of Serbia started after 2000. Since then, agricultural and rural policy in Serbia has gone through several stages.

In the period 2001-2003, the scarce resources in the budget intended for agriculture did not provide enough space for more radical reforms. In support measures, significant support was given for prices for certain "strategic products" (premiums for oilseeds, sugar beet, wheat, etc.). The average share of the agricultural budget in the national budget during this period was 3.13%.

In the period 2004-2006, there have been significantly diverted obligations and mechanisms for the implementation of measures of agricultural and rural policy. A system of direct payments, then, support system, investment in rural development, which enabled: favorable loans in relation to the market, renting farmland and encouraging the registration of farms. The average share of the agricultural budget in the national budget during this period was 4.57%.

The period 2007-2009 was dominated by the system of direct payments per hectare of sowing areas, or per head of cattle, and continued to support investment in rural development and modernization of agriculture, the use of subsidized loans. The average share of the agricultural budget in the national budget during this period was 3.26%.

In 2010, the dominant model was that of direct payments and in comparison with the previous period,measureswere to a large extent focused on the implementation of rural development policy. The average share of the agricultural budget in the national budget during this period was 2.26%.

For 2011, the most important elements in the reform processwere: market liberalization, support for the development of agriculture by encouraging family farms and improving living conditions in rural areas, adjusting the foreign trade policy by neccesarry development of agriculture and processing industry, the gradual harmonization in accordance with the rules and principles of the WTO, the introduction of technological innovations in the production process, strengthening production capacity and professionalization of services in agriculture, strengthening institutional support sector modernization and reform of existing laboratories and veterinary inspection services. The average share of the agricultural budget in the national budget in 2011 amounted to 2.45%.

In the year 2012 the most important elements of agricultural policy in the reform processwere: continued support for the development of agriculture by encouraging family farms and improving living conditions in rural areas, adjusting the foreign trade policy by necessarrydevelopment of agriculture and processing industry, the gradual harmonization in accordance with the rules and principles of the WTO, strengthening production capacity and professionalization of services in agriculture, strengthening institutional support to the sector by increasing the number of employees in professional advisory services in the field, as well as the modernization of existing laboratories, inspection and veterinary services. The system of incentives for the first time included both natural and legal persons.

It was envisaged that the design of agricultural policy for 2013 would be based on the full recovery of agriculture, the National Program for Agriculture was established, with its financial consolidation and affirmation of intensive production structure. All this was supposed to be implemented from the support of the agricultural budget, which in 2012 amounted to 30.6 billion and represented only 2.4 percent of the total budget of the Republic of Serbia for the year 2012.

According to the aforementioned draft law, for the purpose of the implementation of activities in the field of their competence, the budget in the amount of 39,349,382,000 dinars has been placed at the disposal of the Ministry of Agriculture, Forestry and Water Managementof, which makes 3.68% of the total national budget. If you include the allocation of additional revenue, the total budget amounts to 40,179,382,000 dinars, or 3.78% of the national budget. Funds intended for subsidies in agriculture amounted to 32,802,298,000 dinars, and were distributed in accordance with the Law on Incentives in Agriculture and Rural Development (draft) for agricultural production in 2013.

The incentives for agriculture are in line with the applicable Law on Agriculture and Rural Development of the Republic of Serbia (Official Gazette of RS, No. 41/09). In 2013, the measures envisaged direct and structural incentives, but missed the market and institutional incentives.

In 2014 the strategy of Agriculture and Rural Development was written. The strategy is a fundamental and long-term strategic document that defines the objectives, priorities and frameworks of political and institutional reforms in the field of agriculture and rural development. In addition, this document defines a framework of budgetary support (total and by pillars rate), which clearly reflects the commitment of the new development strategy. This document will establish the foundations of a new agricultural policy, defined in accordance with the principles of modern management of public policies and in line with the clear commitment of the Ministry of Agriculture and Environmental Protection for the gradual takeover of the European model of agriculture support. All this means that this document defines the status of agriculture, which should be: economically profitable, market-oriented and attractive for farmers and agricultural companies that are engaged in this activity for purely economic - profit reasons, leaving the other competent authorities to deal with social policy at the village and for a period not shorter than 10 years (following the Law on agriculture and rural development from 2009).

We believe that in 2015 there came in some way a missed opportunity to increase agricultural production at a rate of about two percent. It had been possible with the use of appropriate agricultural policy measures, primarily by increasing the agricultural budget funds, the Fund for developments banks - the fund for the development of agriculture in the model with the Agrobank, funds for the development of republics and provinces and local governments, business banking and other domestic and foreign financial institutions.

Distribution and use of funds of the National Budget for 2016 should be regulated by the Law on Budget of the Republic of Serbia for the year 2016.

4. Results of the Agrarian Policy in the Nisava District

In order to show the status of the application of agricultural policy in the Nisava district we have done the research. The aim of the research is to analyze the results of the application of the concept of the usage of agricultural policy in the transition process. For this survey prepared a special questionnaire.

According to the state from 2012, the Nisava district has 31,709 farms. The poll surveyed 159 owners of farms, or 0.5% of the total number of farms in the Nisava district.

The author filled a good number of questionnaires himself on the field While completing, he led a discussion with the persons surveyed and became acquainted with the state instruments of labor, buildings, orchards, etc. That is to say, that in addition to polling methods, there were somewhat present interview methods too (interview as a method of direct observation and insight into the farm).

5. ISSUES RELATED TO THE IMPLEMENTATION OF AGRICULTURAL POLICY

As shown in Table 2, it can be concluded that one-third of the respondents have very little or no knowledge of any of the measures of the Ministry of Agriculture and incentive funds that are committed to agricultural production.

Table 2 Awareness of agricultural holdings on granting incentives

Answers of respondents	No poll	Participation in %
A lot of is known	36	22,64
Moderate	67	42,14
Little	48	30,19
It is not known	8	5,03
In total n=159	159	100,0

Source: Calculation of the authors based on survey

Almost half of the respondents used the support programs of the Ministry of Agriculture.

Table 3 Users of the measures of the Ministry of Agriculture in 2012

Answers of respondents	No poll	Participation in %
Yes	69	43,40
No	88	55,35
No answer	2	1,26
In total n=159	159	100,0

Source: Calculation of the authors based on survey

The percentage structure only applies to users of agricultural policy measures which are less than 50% of respondents. As can be seen, the number of those satisfied is different.

Table 4 Are you satisfied with the support you receive from the Ministry?

Answers of respondents	No poll	Participation in %
Yes	20	12,58
No	17	10,69
Indifferent	32	20,13
No answer	90	56,60
In total n=159	159	100,0

Source: Calculation of the authors based on survey

More than half of the holdings owners think that the State has bad attitude towards farmers.

Table 5 Awareness of agricultural holdings on granting incentives

Answers of respondents	No poll	Participation in %
Very bad	35	22,15
Bad	57	36,08
Neither good nor bad	48	30,38
Satisfactory	17	10,76
Good	1	0,63
In total n=159	159	100,0

Source: Calculation of the authors based on survey

Over 90% of respondents included suggestions on the questionnaire.

Table 6 Do you have any suggestions or proposals to the Ministry of Agriculture in the future direction and encouragement of agriculture?

Answers of respondents	Participation in %
Wrote	91,82
Did not write	8,18
In total n=159	100,0

Source: Calculation of the authors based on survey

Cognitive process takes place mainly through television and newspapers, although the internet is also not negligible , or even all three sources of information.

Table 7 How are you coming to the knowledge of the measures of the Ministry of Agriculture?

Answers of respondents	No poll	Participation in %
Press	7	4,49
TV	35	22,44
Internet	12	7,69
Press and internet	45	28,85
TV and internet	20	12,82
Press and internet	1	0.64
All three sources	36	23,08
In total n=159	159	100,0

Source: Calculation of the authors based on survey

Reformed agricultural policy with the implementation of technical - technological and ecological standards in the agricultural sector of a country should be able to form the current models of agricultural producers and entrepreneurs, which would be equal to the agrarian entrepreneurs in the European Union.

CONCLUSION

In the early nineties a series of documents were adopted, intending to reform agricultural policy. Agricultural policy in Serbia, on the basis of these documents, was designed on the principle of the market economy. Defined as a set of long-term directions and goals of

agricultural development, structural, ownership and organizational change, the mechanism of stabilization and market management introduced the institution of the agricultural budget, and defined the role of commodity reserves in the system of market economy and so on. It is defined by society's attitude towards the agricultural farms as businesses. It was stressed that agricultural farms were the basic operators of agricultural development. It completed the delimitation size of their holdings and opened the process of their transformation into commodity producers, and begun the process of creating large farms.

At the beginning of the 21st century there has been a changing agricultural policy and its adaptation to European standards. Unfortunately, these changes are not accompanied by the appropriate agrarian legislation, serious investment and finance. A frequent problem is the phenomenon of dissatisfaction with the increasing number of agricultural stakeholders, institutions, and many other subjects. The concept of sustainable agriculture has not been reached yet. This brings about the fact that the reform of agricultural policy has not yet yielded some results. One gets the impression that the main feature of the reform of agricultural policy in the period from 2000 to 2015 was its unpredictability and inconsistency.

Serbia is currently in the implementation phase of the process of harmonization of schemes and incentives to the requirements of the EU Agriculture and the WTO. These requirements relate to the reduction in payments under the volume of production, such as the premium for milk, and reduction of export subsidies. On the other hand, Serbia used the pre-accession period for the retention of certain measures, which directly affects the growth of productivity and the reduction of untreated surface (subsidizing inputs). Achievements of this harmonization are generally not sufficiently visible, bearing in mind that the level of overall support in Serbia is much lower than the corresponding one in the EU.

Finally, if Serbia wants to increase productivity and foster the growth of the agricultural sector, they need to align the goals of their agricultural policy with the objectives of the CAP. Primarily, it is necessary to harmonize domestic legislation with EU legislation. Given that it is not enough just to have adequate legislation, the next step is the formation of effective institutions and the provision of financial resources for the implementation of measures and programs CAP. The key problems of the possession structure of households in Serbia are that they have a small area of land and fragmentation of plot. It is necessary to carry out procedures of land consolidation and land redistribution in order to achieve agglomeration, which would result in an increase in the quantity and quality of agricultural production.

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PRIMENA MERA AGRARNE POLITIKE U REPUBLICI SRBIJI SA OSVRTOM NA STANJE U NIŠAVSKOM OKRUGU

Autori u radu daju kratak prikaz stanja u primeni agrarne politike u Srbiji. Upoznaju nas sa merama podrške koje predstavljaju važan faktor za održavanje poljoprivredne proizvodnje. Srbija se nalazi u obavezi da harmonizuje svoju agrarnu politiku sa Zajedničkom agrarnom politikom ZAP Evropske unije. Taj postupak harmonizacije je potrebno uraditi sada kada je Republika Srbija postala zemlja kandidat za članstvo u EU. U postojećim uslovima privređivanja opstanak poljoprivrednih gazdinstava je ugrožen. Ključni problem predstavlja posedovna struktura gazdinstava u Srbiji koja se nalaze na malim površinama zemljišta. Takođe je zastupljena i velika usitnjenost parcela. Neophodno je sprovesti postupke komasacije i arondacije u cilju ukrupnjavanja poseda, što bi rezultiralo povećanjem kvantiteta i kvaliteta poljoprivredne proizvodnje.Na kraju rada autori daju istraživanje o stanju primene agrarne politike u Nišavskom okrugu. Cilj istraživanja je da se sagledaju rezultati korišćenja mera agrarne politike.

Ključne reči: *agrarna politika, Republika Srbija, agrarni budžet, subvencije.*

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SOCIO-ECONOMIC DETERMINANTS OF IMPROVED RICE TECHNOLOGIES' ADOPTION AMONG SMALL SCALE FARMERS IN KOGI STATE, NIGERIA

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Abstract. *This study examined the socio-economic determinants of the adoption of improved rice technologies by small scale farmers in Kogi State, Nigeria. It specifically investigated the influence of socio-economic characteristics on the adoption of improved rice technologies, adoption level of farmers and constraints against adoption of rice technologies. Multistage random sampling was used to pick 120 registered rice farmers with the Kogi State Agricultural Development Project (ADP). Frequencies, percentages, mean, mode, mean scores and ordered probit regression were used to analyze the data. From the result, all the farmers adopted the use of agrochemicals (100%) and the farmers were categorized into low, medium and high adopters, with 60% of the farmers being high adopters. The result also showed that lack of infrastructural facilities was a major constraint experienced by farmers in the study area having a mean score of 3.7. However, the ordered probit revealed that membership of cooperative (1.029277 at 1% significance), source of fund (0.0100499 at 1% significance)) and source of labour (0.2746477, at 10% significance) determined the adoption of rice technologies while marginal effect on farm size, household size, contact with extension agents favoured the adoption of all the eight most important rice technologies which could be used as a measure towards pleasant disposition to commercial rice farming. The study recommends that private rice industries should utilize this positive disposition for rice farmers towards rice technology adoption by establishing rice processing industries in the study area and making the farmers' rice out growers to feed the industries.*

Key words: *rice, improved technologies, adoption; socio-economic determinants*

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INTRODUCTION

Small scale farmers have consistently remained the major producers of rice in Nigeria producing over 80% of the total output (Ohajianya and Onyenweaku, 2002) yet they are discriminated against in the scheme of agricultural policies and programs with the presumption that they are less technically efficient than large farmers (Enwerem and Ohajianya, 2013).

The demand for domestic rice in Nigeria has not been met as a result of continued fluctuation in rice production which is an indication of limited capacity of Nigerian economy. This can also be as a result of the inability of the rice farmers to obtain maximum output from the resources committed to enterprise (Kolawole, 2010). An average yield of rice in Nigeria is 1.8 tons per hectare compared to 3.0 tons per hectare from countries like Cote D'iviore and Senegal (West African Rice Development Association (WARDA), 2001). The production level of rice in Nigeria therefore, reflects low level of production among rice farmers.

Some of the reasons for the deficit in rice production are connected with attendant dangers of flood, inadequate water supply at the end of dry season, shortage of agrochemicals, usage of unimproved seeds, crude mode of production, and high cost of labour among others (Atala and Voh, 1994). Studies have shown that rice production in Nigeria is primarily done by small scale producers with average farm size of 1.259ha (Okoruwa and Ogundele, 2006), who are constrained by some factors that do not promote effective and efficient rice production.

This unsatisfactory development calls for a comprehensive research to further identify the factors influencing rice production among small scale farmers in Nigeria. Goni *et al.* (2007) opined that "the low agricultural productivity in Nigeria is revealed by the actual yields of major crops such as rice compared with potential yields". In a related manner, Biyi (2005), reported that, Nigeria has the potential to increase her domestic share of the rice market in a medium to long term investment strategy that can develop into self-sufficient industry locally. This implies that there is the tendency to increase output of rice in Nigeria with the available land if productive resources and technologies are introduced to the farmers by agent of change and if they are adopted and used efficiently by Small Scale Farmers in Kogi State.

The increase in the production of rice has not been enough to meet the consumption demand of the ever increasing population in Nigeria. Despite the importance of Nigerian rice production within the West African context, a comprehensive and up to date picture of rice production and processing in particular is lacking (Akpokodje *et al.*, 2001). In spite of its contribution to the food requirements of the Nigerian population, rice production in the country is put at about 3.2 million tones (Babafada, 2003). This has been shown to be far below the national requirement as over $600 million worth of rice is annually being imported into the country (Adeoye, 2003).

Several factors have been associated with adoption behaviour. These are the independent factors like personal, institution, environmental and socio – economic factors (Matata *et al.*, 2001). Adesina and Baidu-Forson (1995) asserted in their study that a probit regression on socio-economic determinants revealed that age was negatively related with probability of participating in rice development projects, though Asante *et al.* (2011) recorded a positive relationship.

According to Adetiloye (2012), most peasants are uneducated and ageing, the introduction of sustainable credit into agriculture will attract the youth and the educated, but in Kogi State, the population of the youths in the rural area has been greatly vitiated by rural-urban migration, as most youth want to obtain white collar jobs and are not interested in farming. Lawal and Shittu (2006) posited that lack of access to credit causes setbacks to the productivity of farmers as a result of the fact that, these farmers do not have resources to procure improved seedlings, chemicals and hired labour, as well as transport and market their produce which would have improved their productivity.

The State Agricultural Development Project (ADP) is an intervention initiated by the World Bank to assist farmers in adopting improved agricultural production technologies as a means of achieving high productivity among the farmers. Kogi State is endowed with vast arable land and human resources for rice production. However, it seems that rice farmers in Kogi State have not been able to explore all these favourable variables to farmers to adopt and achieve desirable increase in yield. This could be due to some problems such as the inability of the farmers to adopt improved seed varieties, credits and use of agrochemicals, could also be as a result of the fact that most rice producers in the State are the aged farmers who are somewhat less inclined to adopt new practices as asserted by (Bryon *et al*., 2005). In order to improve on the production of rice in this area, one may want to know the following:

i. What are the socio-economic characteristics of small scale rice farmers in the study area?
ii. What are the socio-economic characteristics that determine the adoption of improved rice technologies among small scale rice farmers in the study area?
iii. What is the level of adoption of improved rice technologies by farmers in the area?
iv. What are the factors that militate against the adoption of improved technologies?

Objectives of the study

The main objective of the study is to analyze the socio-economic factors determining the production of rice among small scale farmers in Kogi State, Nigeria.

The specific objectives are to:

i. Describe the socio-economic characteristics of small scale farmers growing rice
ii. find out the influence of socioeconomic characteristics of small scale farmers on the adoption of improved rice technologies
iii. Find out the level of adoption of improved technologies.
iv. Find out the constraints against the adoption of improved rice technologies.

1. Research Methodology

1.1. The study area

The study was carried out in Kogi State, Nigeria. The State lies on Latitude 71' 49^{o} North and Longitude 61' 45^{o} East with a geographical feature depicting young sedimentary rocks and alluvium along the riverbeds, which promotes agricultural activities and has an average maximum temperature of 33.2^{o}C and average minimum of 22.8^{o}C. It shares

common boundaries with Niger, Kwara, Nassarawa and The Federal Capital Territory to the north. To the east, the state is bounded by Benue State, to the South by Enugu and Anambra States, and to the West by Ondo, Ekiti and Edo States. Ethnically, Igala, Okun, Egbira, Nupe and Bassa form the main ethnic groups. Kogi State occupies 29,833 square kilometers and has a population of 3,314,043 out of which 1,672,903 are male and 1,641,140 female (NPC, 2007). The State has two distinct weathers, the dry season, which lasts from November to March and rainy season that lasts from April to October. Annual rainfall ranges from 1016mm to 1524mm retrieved from Kogi State website, 17th May, 2015.

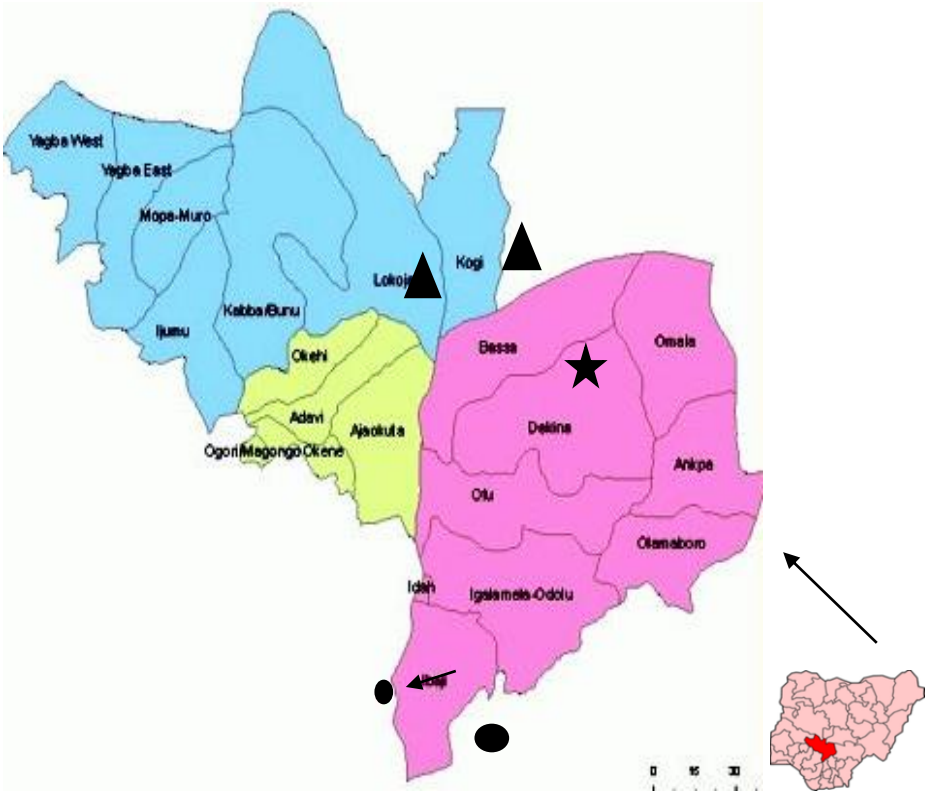

Fig. 1 Map of Kogi State, Nigeria

Key

ADP Zone B – Bassa
ADP Zone C – Koto-karfe and Lokoja
ADP Zone D- Ibaji and Idah

1.2. Sampling procedure

The sampling frame for this study consists of farmers growing rice under various cropping systems in selected zones of Kogi State. Kogi State has four agricultural zones (A, B, C, and D), but B, C and D were purposively selected based on their involvement in rice production. A multistage sampling technique was used to select a total of 120 farmers (respondents) from the three zones. Two blocks were selected from each zones, making 6 blocks in whole. A cell was also selected from each block to make 6 cells. Finally, random sampling technique was used to select 20 contact farmers from registered rice farmers from each cell making a total of 120 contact farmers. Each cell contained between 25 and 35 registered farmers. The sampled farmers were representative of the registered rice farmers.

1.3. Method of data collection

The data for this study were from primary source, since they were collected from respondents using structured questionnaire, personal interview and informal discussion. Structured questionnaire was used for literate farmers and interview schedules for the illiterate ones. The data collected were subjected to statistical analysis using descriptive and inferential analysis.

1.4. Method of data analysis

Data collected were analyzed based on the stated objectives.

Objective I: The socio-economic characteristics of respondents were analyzed using descriptive statistics such as frequency, percentage, mean and mode

Objective II: The socio-economic characteristics of rice farmers that determine the adoption of improved rice technology were analyzed using the ordered probit regression model. The implicit form of the model is given thus:

$$Y^* = x^1\beta + e_1$$

Where y* is the exact but unobserved dependent variable
X is the vector of independent variables and
B is the vector of regression coefficients which is estimated.

$$Y = (X_1 + X_2 + X_3 + X_4 \ldots\ldots\ldots X_n) + e$$

Where: Y = Adoption level of improved rice technologies
X_1 = Age of farmers in years (numbers)
X_2 = Level of education (years spent in school)
X_3 = Marital status (Married=1, others = 0)
X_4 = Sex (dummy variable; 1 = male, 0 = female)
X_5 = Household size in numbers
X_6 = Farmers experience in years
X_7 = Farm size in hectare (ha)
X_8 = Membership of Farmers' Association (dummy variable;
1 = members, 0 = Non-members)
X_9= source of labour
X_{10}= Contact with extension agents (Yes=1, No=0)
e = Error term

Objective III: The adoption levels of the various innovations, practices, systems and technologies were placed on a binary or dichotomous variable where the farmers were asked to indicate if they have adopted a set of listed technologies or not. Their response categories are as follows: Yes-1 and No-0 and were further analyzed using descriptive statistics. The farmers were further grouped under three categories (High, Medium and Low adopters) using frequencies and percentages.

Objective IV: Constraints militating against adoption of improved rice technology. A list of constraints were presented to the rice farmers to select the extent to which the constraints affects them. A 4-point Likert type scale of very severe (VS), moderately severe (MS), less severe (LS) and not severe (NS) with values of 4, 3, 2 and 1 were used. The sum total of 4, 3, 2 &1=10 when divided by 4 gave an average of 2.5. Any mean score below 2.5 would be considered not severe or less severe and above 2.5 would be considered either as very severe or moderately severe.

2. Results and Discussion

2.1. Socio-economic characteristics of small scale rice farmers in the study area

The result of the socio-economic characteristics of small scale farmers in the study area analyzed using frequency and percentage is shown in table below. They were Age, Sex, Marital status, household size, size of land, source of labour, source of fund, contact with extension agents, cooperative membership, farming experience and educational level.

Table 1 Distribution of the various socioeconomic characteristics of the respondents

Variable	Frequency	Percentage (%)	Mean/Mode
Age(Years)			
20-29	13	10.8	42.25
30-39	25	20.8	
40-49	65	54.2	
50-59	10	8.3	
60 and above	7	5.8	
Total	120	100	
Sex			
Male	75	62.5	75
Female	45	37.5	
Total	120	100	
Marital Status			
Single	10	8.3	36
Married	36	80.0	
Widowed	11	9.2	
Separated	3	2.5	
Total	120	100	
Educational Qualification			
No Formal Education	33	27.5	52
Primary Education	20	16.7	
Secondary Education	52	43.3	
Tertiary Education	15	12.5	
Total	120	100	

Farming Experience(Years)			
1-5	15	18.3	14.0
6-10	30	25.0	
11-15	13	10.8	
16-20	35	29.2	
21 and above	26	21.7	
Total	120	100	
Household Size			
1-5 persons	17	14.2	10.6
6-10 persons	80	66.7	
11-15 persons	19	15.8	
15-20 persons	2	1.7	
21-25 persons	2	1.7	
Total	120	100	
Size of Farmland (Ha)			
1-5	73	60.8	5.375
6-10	37	30.8	
11-15	10	8.3	
16-20	0	0	
21-25	0	0	
Total	120	100	
Cooperative Membership			
Yes	67	55.8	67
No	53	44.2	
Total	120	100	
Source of Fund			
Personal Savings	74	61.7	74
Family	16	13.3	
Cooperative Loans	30	25	
Total	120	100	
Source of Labour			
Family	38	31.7	49
Hired	33	27.5	
Both	49	40.8	
Total	120	100	
Contact with Extension Agents			
1-3 times	102	85	2.45
4-6 times	18	15	
7-10 times	0	0	
11-15 times	0	0	
Total	120	100	

Source: Field Survey, 2015

Table 1 shows that 5.8% of the respondents were older than 60, 8.3% were between the ages of 50-59, 54.2% were between the ages of 40-49, 20.8% were between the ages of 30-39 and 10.8% were between the ages of 20-29. This implies that the dominant age of the respondents was between the economically productive ages of 40-49, which is in agreement with Okoruwa and Ogundele (2006) that the average age of rice farmers was estimated to be between 42 and 45 years.

There was an indication that majority of the respondents were males with 62.5% and women with 37.5% as presented in Table 1. This implies that the majority of the rice farmers in the study area were males. This result tallies with ILO (2007). However, the percentage of women involvement was significantly high, this is in harmony with Ibrahim and Klock, (2002) that contribution of women farmers in agricultural production is highly recognized, but in practice, they are less represented in most agricultural oriented development plans. Eighty percent (80%) of the rice farmers were married. This is an indication that some of them may have support from their family members in carrying out the production of rice. Others were 8.3% single, 9.2% widowed and 2.5% were separated.

Educational qualification showed that majority of the rice farmers constituting 72.5% had various forms of education ranging from primary to tertiary education. This will help to broaden the farmers' knowledge and makes adoption of improved technologies easy. Which is in accord with Okoruwa and Ogundele (2006) that the average year of schooling for the traditional rice farmers ranges between 7 -12 years, but contrary to Mbah (2006) who reported that most of the rice farmers with 69% being either illiterates or semi-illiterates and 27.5% of the rice farmers had no formal education.

The Table further indicates that 66.7% had a family size ranging from 6-10 persons, with the implication that most of the rice farmers had large family size, and may need little additional labour outside their family to complement farming activities and operations which the family size cannot supply. This result supports the findings of Mbah (2006), who said that greater number of rice farmers have large family size of about 10-25 members.

The Table 1 also brought out the fact that 60.8% of the rice farmers had the size of farmland ranging from 1-5 hectares, with most of them having between 1-1.3 hectares and also small scaled, which is similar to the report of Amaza and Maurice (2005) that most of the rice farmers in Nigeria are of small to medium scale categories with an average of 1.2 hectares. Also, the table shows that 55.8% of the respondents were members of cooperative societies, while 44.2% were non-members of any cooperative society at all. The locality, distance, level of interactiveness could have made some of the rice farmers not to be members of cooperative. The fairly high percentage of cooperative membership could be due to benefit such as loans, inputs, sharing of ideas and full support from their opinion leaders who are well-educated, which complements the findings of Idiong *et al.* (2007) who affirmed that membership of cooperative affords the farmers opportunities of sharing information on modern rice practices.

Table 1 shows that 61.67% of the respondents used their personal savings as their major source of fund, 13.33% got support from their families and 25% from cooperative loan. Contact with extension agents on Table 1 indicates that 85% of the respondents had contact with extension agents within the range of 1-3 times in a year and 15% had contact with extension agents between the range of 4-6 times, which indicates that few of the farmers had opportunity of getting adequate interaction for basic information on improved technologies. This result is in agreement with Umunna (2008), who in his study reported that, 88.1% of the farmers that he investigated ranked extension agents as the highest source of agricultural information.

2.2. Socio-economic determinants of the adoption of improved rice technologies

The Table 2 below shows the socio-economic determinants on the adoption of the most important eight (8) improved rice technologies by the respondents. The technologies

are: Use of improved varieties, agrochemicals, fertilizer, proper spacing, improved nursery, timely transplanting, improved processing and improved storage methods.

Table 2 Regression result of the influence of Socio-economic characteristics on the adoption of improved rice technologies

Variables	Coefficients	Standard Error	P>|z|
X_1 Age	-0.1593593	0.1916627	0.406
X_2 Sex	0.2837989	0.2507697	0.258
X_3 Marital status	0.0040531	0.2379737	0.986
X_4 Educational level	-0.1435379	0.2661899	0.590
X_5 Farming Experience	-0.1206955	0.1101299	0.273
X_6 Household size	0.0291158	0.1933426	0.880
X_7 Member of Cooperative	1.029277	0.3253801	0.002**
X_8 Size of farmland	0.2448807	0.2440001	0.316
X_9 Source of Fund	0.0100499	0.0757207	0.894
X_{10}Source of labour	0.2746477	0.1626295	0.091*
X_{11} Contact with extension agents	0.069027	0.3180996	0.828

Source: Field Survey, 2015

Number of Obs	=	120
LR chi^2 (13)	=	53.86
Prob > chi^2	=	0.000
Pseudo R^2	=	0.1243

NB: figures in parentheses are z-values* and ** denote 10% and 1% significance respectively.

From the result of the Ordered Probit Regression on Table 2, the coefficient of determination (LR) of 53.86 and adjusted (Pr) 0.000 which implies that 100% of the changes experienced in the total adoption level of the farmers were explained by the variables in the model and the Pr ratio of 53.86 was significant at 1%. It could be observed in the table that age, educational level and farming experience were negatively related, which implies that a year increase in age, educational level and/or farming experience could lead to a probable decrease in the adoption of all the selected most important eight(8) improved rice technologies, which is in agreement with Adesina and Baidu-Forson (1995), that age was negatively related with probability of participation in Rice Development Projects, but contrary to the findings of Asante *et al.* (2011) and Gbetibouo (2009) that a positive relationship exists between age and adoption of improved technologies. Education had negative contribution to the adoption of rice technologies. This is in accord with Martey et al, (2012) who asserted that the negative effect of education on adoption level suggests the strong competing effect of diverting skills of household heads to other off-farm employment opportunities. More so, the educated farmers may be willing to select out of the eight most important rice technologies. However, Tambo and Abdoulaye (2011) reported that education enhances access to information processing for technology uptake and higher farm productivity.

Other variables such as sex, marital status, household size, membership of cooperative, size of farmland, source of fund and contact with extension agents, all had positive contributions to the adoption of the eight selected improved technologies, which implies that an increase in these variables will lead to an increase in the adoption level of all the rice technologies and as such determine sustainable adoption of rice technologies. In contrast with Asante *et al*. (2011) and Gbetibouo (2009) who asserted that older farmers are more

experienced which allows them to assess the attributes of an improved technology relative to younger household heads, this study holds that even with the longer years of farming experience of older farmers, younger farmers could be more innovative in terms of technology adoption and are more likely to take risk than older household heads.

Findings on marital status in this research, disagreed with Martey *et al*. (2013). According to them, marital status was negatively associated with lower probability of participation in adoption of improved technologies. Married household heads were less likely to participate in adoption process, which could be due to other off-farm responsibilities that they are also committed to. However, in this study, marital status formed a positive determinant of adopting rice technologies.

Cooperative membership and source of information were not only positive but significant at 1%, while source of labour was significant at 10%. This further indicates that membership of cooperative, source of fund and labour source and availability would strongly determine the successful adoption of rice technologies for sustainable rice production in Kogi State, Nigeria.

2.3. Marginal effect of socio-economic characteristics on adoption of improved rice technologies

The Table 3 below shows the marginal effects of socio-economic determinants on adoption of improved rice technologies at different levels ranging from Adoption of between 1-8 numbers of technologies adopted.

Table 3a Marginal effects of socio-economic characteristics from 1-8 rice technologies adopted

	Adoption levels (ADL)							
Variables	ADL=1	ADL=2	ADL=3	ADL=4	ADL=5	ADL=6	ADL=7	ADL=8
Age	0.0009277	0.0018096	0.0146719	0.0176624	0.0254763	-0.005494	-0.01541	-0.01541
Sex	-0.001868	-0.003529	-0.027460	-0.031841	-0.043574	0.0125942	0.0276827	0.0276827
Marital status	0.0000214	0.0000417	0.0003382	0.0004071	0.0005873	-0.000127	-0.000355	-0.000355
Educational level	0.0007964	0.0015802	0.0013148	0.0162595	0.0244971	-0.003647	-0.014148	-0.014148
Farming experience	0.0007096	0.001384	0.0112221	0.0135094	0.0194861	-0.004202	-0.011787	-0.011787
Household size	-0.000183	-0.000356	-0.002890	-0.003479	-0.005018	0.0010821	0.0030352	0.0030352
Cooperative membership	-0.009817	-0.016161	-0.108715	-0.113395	-0.142555	0.048741	0.0946369	0.0946369
Source of labour	-0.001599	-0.003120	-0.025299	-0.030455	-0.043929	0.0021903	0.0265712	0.0265712
Size of farmland	-0.001468	-0.002863	-0.023214	-0.027946	-0.040309	0.0086925	0.0243819	0.0243819
Contact with extension agents	-0.000369	-0.000721	-0.005850	-0.007042	-0.010157	0.0021903	0.0061438	0.0061438

Source: Field Survey, 2015

The marginal effect of ordered probit table shows the socio-economic determinants of the adoption level of improved rice technologies at different stages ranging from adoption of only one (1) technology all the way to adoption of eight (8) technologies.

As shown in the Table 3a above, it could be observed that age would positively determine the adoption of 1-5 technologies, which indicates that a year increase in age would lead to an increase in adoption of 1-5 technologies, but increase in the age of the rice farmers would turn negative when the number of rice technologies is increased to between 6-8. This implies that as the farmers advance in age, they lose the capacity of adopting more than 5 rice technologies. The maximum of adopting five out of the eight most important rice technologies was witnessed when marital status, education, farming experience were to determine number of rice technologies to be adopted, meaning that education and marital status (in the case of more married people as the mode) has a limiting effect to the number of rice technologies that could be adopted, in summary, the socio-economic factors that favour the adoption of only one to five rice technologies out of all the eight most important technologies are likely to be small scale rice producers that may not want to embrace large scale farming.

This could be interpreted to mean that the identified socio-economic variables that favour the use of all the eight rice technologies were socio-economic variables that were likely to determine the commercialization of rice production in the study area. In summary, many socio-economic variables that favour commercialization of rice production were found in the study area.

2.4. Adoption level of improved rice technologies in the study area

Table 3b below shows the distribution of farmers according to the rice technology adopted in the study area. Improved rice technologies considered were: use of improved varieties, use of agrochemicals, zero tillage, fertilizer application, proper spacing, improved nursery, timely transplanting, line planting, urea deep placement, planting depth, improved processing, improved storage methods, tube well and boreholes.

Table 3b Distribution of Respondents according to the rice technology adopted

Improved technologies	Frequency	Percentage (%)
Use of improved varieties	93	77.5
Use of agrochemicals	120	100**
Zero tillage	9	7.5*
Fertilizer application	106	88.3
Proper spacing	117	97.5**
Improved nursery	57	47.5
Timely transplanting	57	47.5
Line planting	112	93.3**
Urea deep placement	13	10.8*
Planting depth	108	90
Improved processing	87	72.5
Improved storage methods	67	55.8
Tube well	7	5.8*
Boreholes	54	45

Source: Field Survey, 2015

** =high adoption *=low adoption.

As indicated in table 3b above, technologies such as use of improved varieties (77.5%), use of agrochemicals (100%), fertilizer application (88.3%), proper spacing (97.5%), line planting (93.3%), planting depth (90%) and improved processing (72.5%) were widely accepted by the farmers in the study area because they have high adoption level. Improved storage methods was a little above average with 55.8%, while, zero tillage (7.5%), improved nursery and timely transplanting (47.5%), urea deep placement (10.8%), tube well (5.8%) and boreholes (45%) had low adoption rates, which implies that they were not widely accepted by the better percentage of the rice farmers in the study area. As such irrigation rice farming through the use of tube well could be less adopted by farmers in the study area.

The low adoption of tube well is similar to the findings of Olaolu *et al.* (2011) on the impact of national fadama development project II on rice farmers' profitability in Kogi State and contrary to the findings of Umeh and Chukwu (2013) where tube well and zero tillage were accepted.

2.5. Categorization of farmers into various groups of adopters

In Table 3c below, eight technologies were purposively selected to classify the farmers into various groups of adopters; Low adopters (1-3 technologies), medium adopters (4-5 technologies) and high adopters (6-8technologies) according to the number of technologies adopted. These technologies were selected because of the level of similarity the improved technologies had with existing farming practices. The technologies were: use of improved varieties, use of agrochemicals, fertilizer application, proper spacing, improved nursery, timely transplanting, improved processing and improved storage methods.

Table 3c Distribution of farmers by level of adoption of improved rice technologies

No of technologies adopted	Frequency	Percentage	Adoption level
1	1	0.83	Low adopters
2	2	1.67	Low adopters
3	11	9.17	Low adopters
4	11	9.17	Medium adopters
5	23	19.17	Medium adopters
6	29	24.17	High adopters
7	15	12.50	High adopters
8	28	23.33	High adopters
Total	120	100.00	

Source: Field survey, 2015

Out of the eight technologies, any farmer who adopted 1/3 × 8, which culminate to 2.66 approximately 3 technologies can be regarded as a low adopter, while farmers with 2/3× 8, which is equal to 3-5.3 technologies approximately were classified as medium adopters and 6-8 as high adopters. The Table above shows that 11.67% of the respondents were low adopters, 28.33% of the respondents was medium adopters and 60% were high adopters. This implies that rice technologies were adopted in the study area.

2.6. Constraints Militating against the Adoption of Improved Rice Technologies

Table 4 Respondents according to their constraints in the study area

Various Constraints	VS	MS	LS	NS	Total	TVS	TMS	TLS	TNS	Total	Mean Score	Remark
Lack of tractor hire service	45	48	24	3	120	180	144	48	3	375	3.1	Moderately Severe
Illiteracy	43	25	37	15	120	172	75	74	15	336	2.8	Moderately Severe
Lack of awareness of improved technologies	20	21	47	32	120	80	63	94	32	269	2.2	Less Severe
Fluctuation in climatic conditions	70	45	4	1	120	280	135	8	1	424	3.5	Very Severe
Lack of Infrastructural facilities	95	18	0	7	120	380	54	0	7	441	3.7	Very Severe
Inaccessibility to cooperative organization	17	21	33	49	120	68	63	66	49	246	2.1	Less Severe
Lack of extension services	22	34	57	7	120	88	102	114	7	311	2.6	Moderately Severe

Source: Field Survey, 2015

As indicated in Table 4 above, problems such as fluctuation of climatic conditions with mean score of 3.5, lack of infrastructural facilities having a mean score 3.7 were perceived to be very severe by the farmers in the study area. Problems such as illiteracy with mean score 2.8, lack of tractor hiring service with mean score 3.1 and lack of extension services (mean score 2.6) were perceived to be moderately severe, while lack of awareness of improved technologies and inaccessibility to cooperative organization with mean score of 2.2 and 2.1 respectively were perceived to be less severe problems. These findings are in agreement with Guerin and Guerin (1994), that there are several constraints to the adoption of improved technologies and innovation by farmers: these include the extent to which the rice farmer finds the new technology to be complex and difficult to comprehend.

CONCLUSION

Findings from this study have revealed that rice farmers in Kogi State adopted improved rice technologies in various degrees. They will be willing to adopt between 6 to 8 selected most important technologies. This implies that adopting all eight most important rice technologies is a step towards commercialization of rice production. However, constraints such as availability of tractors and infrastructural facilities may not make the dream of rice commercialization realizable among the small scale rice farmers in the study area.

Recommendations

i. Farmers should receive more training and knowledge about improved rice technologies through steady flow of information by the extension agents.
ii. Rice processing industries should be established by private organizations to encourage commercial farming to support adoption of more improved rice technologies.
iii. The high indication of adoption of the rice technologies should be used to an advantage by private rice industries who can utilize these farmers as out growers to feed their rice industries.
iv. Enabling environment should be provided through public private partnership to provide policies fashioned to help provide adequate infrastructural facilities in the study area.
v. Inputs and credit facilities should be made readily available to the farmers by their various cooperative societies in the study area.

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SOCIJALNO-EKONOMSKE DETERMINANTE USVAJANJA UNAPREĐENIH TEHNOLOGIJA PROIZVODNJE PIRINČA OD STRANE MALIH PROIZVOĐAČA U DRŽAVI KOGI U NIGERIJI

Ova studija je ispitivala socijalno-ekonomske determinante usvajanja unapređenih tehnologija proizvodnje pirinča od strane malih proizvođača u Državi Kogi u Nigeriji. Posebno je istražen uticaj socio-ekonomskih karakteristika na usvajanje unapređenih tehnologija proizvodnje pirinča, nivo usvajanja od strane poljoprivrednika i ograničenja protiv usvajanja ovih tehnologija. Metodom slučajnog uzorka u više faza izabrano je 120 registrovanih proizvođača pirinča u okviru Projekta poljoprivrednog razvoja Države Kogi. Frekvencije, procenti, srednje vrednosti, modus, srednje ocene i uređena probit regresija su korišćeni za analizu podataka. Rezultati navode da su svi poljoprivrednici prešli na upotrebu agrohemikalija (100%), kao i da su poljoprivrednici kategorisani prema stepenu usvajanja (nizak, srednji i visok stepen usvajanja), pri čemu je 60% poljoprivrednika zabeležilo visok stepen usvajanja. Rezultati su takođe pokazali da je nedostatak infrastrukturnih objekata shvaćen kao velika prepreka od strane poljoprivrednika u proučavanom području, sa srednjom ocenom od 3,7. Međutim, uređena probit regresija je otkrila da su članstvo u zadruzi (1,029277 na 1% značaja), izvor finansija (0,0100499 na 1% značaja)) i izvor radne snage (0,2746477, na 10% značaja) imali uticaj na usvajanje tehnologija proizvodnje pirinča, dok je marginalni efekat na veličinu poseda, veličinu domaćinstva, kontakt sa savetodavnim agentima povoljno uticao na usvajanje svih osam najvažnijih tehnologija proizvodnje pirinča koje se mogu koristiti kao mera naklonjenosti komercijalnoj proizvodnji pirinča. Studija preporučuje da privatne industrije pirinča treba da iskoriste ovaj pozitivan stav proizvođača pirinča ka usvajanju tehnologije proizvodnje pirinča tako što će otvarati pogone za obradu pirinča u posmatranom području i pretvoriti male proizvođače pirinča u glavne snabdevače industrija.

Ključne reči: *pirinač, unapređene tehnologije, usvajanje, socijalno-ekonomske determinante*

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