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Journal of Applied Economic Sciences

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Modelling a System of Evaluation of the Efficiency of the Course of a Group Decision-Making Process

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Abstract:

In this paper, the authors present a proposed model for the evaluation of the efficiency of the course of a group decision-making process. It is a proposal for the structure and the ties between the elements of a model system and an analysis of its behaviour. Based on knowledge of the elements of the model and their ties and behaviour, it is possible to assess the efficiency of the course of the induced group decision-making process. In reaction to the identified reality, it is then possible to propose and implement any correction in its course, in order to bring the course into correspondence with the model-derived effective behaviour of the system describing the course of a group decision-making process. By publishing these ideas, we wanted to stimulate discussion on the issues of analysed evaluation of the efficiency of implemented group decision-making processes, with the possibility of searching for ways to raise the level of efficiency achieved.

Keywords: group decision-making process, efficiency, system structure and behaviour, perceived difference of opinions, group cohesiveness

JEL Classification: M12, M54, J53

1. Introduction

Our investigation is oriented toward the creation of a model system for the evaluation of the efficiency of the course of a decision-making process, with a focus on the group decision-making process (decision-making in a group acting as a team). The style of decision-making also has a group character. The implementation of a group decision-making process within a company is expedient to initiate in the event of the occurrence of fulfilment and interconnection of certain preconditions (factors) associated with the conditions of the course of this process - see e.g. models by Vroom and Yetton (1973) and Vroom and Jago (1988). It involves, for example, a combination of the following conditions (factors) and their links: factor-wise, a high quality decision is required, as the head manager does not have sufficient information and expertise on their own to make a high quality decision, the objectives, methods of solution of the problem and even the criteria for their evaluation are not known, and the head manager is not able to obtain the information for their determination on their own; the decision made must be accepted by subordinates in terms of its feasibility, and remaining unknown is the probability of whether the decision will be accepted by the subordinates and whether the subordinates (co-workers) of the head manager are oriented to fulfilling the company objectives. Under the conditions above (their status and links), it is representatively rational and to think in a group decision-making style.

2. Efficiency of the course of a group decision-making process

In order to define our approach to examining the issues of possible evaluation (analysis) of the efficiency of the course of the decision-making process in a company, it is first necessary to specify the substantive concept of the characteristics of efficiency and the course of the group decision-making process (hereinafter referred to as the decision-making process).

Under the term "decision-making process", which is in the competence of a certain decision-making group (team), we understand the implementation of an informational process, whose output will be the determination of the optimum decision, if possible, for the solution to a problem that has arisen in the company. This may involve, for example, a problem associated with a situation of non-fulfilment of a given company objective (objectives). The solution to this problem is the responsibility of a decision-making team, e.g. the managers of a given management level in the hierarchical management and organizational system of the company. This means that the task of these managers is to find a solution to the problem by calling upon the decision-making process, with the aim of determining a decision regarding its solution. The problem-initiated decision-making process is actually

an informational process realized on the basis of communication between the members of the decision-making team formed by managers. The communication relates to the exchange of information about how to resolve the problem. It means determining a decision on the solution to the problem, determining the procedure for the implementation of the solution, and the realization of monitoring of the success of the decision-making process. All this is supposed to be lead to the removal of the registered problem in the company.

As recognized in literature (Festinger 1999, Adair 2013, Šnapka and Kašík 2013) and practice (authors' surveys and structured interviews carried out with about 80 managers of different managing levels in Czech companies), we will specify the efficiency of the course of the information process through which the decision-making process is being implemented with two variables (characteristics, criteria, indicators).

We will label the first characteristic as the perceived difference of opinion of the members of the decision-making team about how to deal with the problem. This means the difference of opinion on the determination of the optimum decision about the solution to the registered problem, the implementation of the decision and the monitoring of the realization of the decision-making process. At the same time, the efficiency of the information process, and thus the decision-making process, as is known from the literature (Festinger 1999, Adair 2013, Šnapka and Kašík 2013) and practice, will increase with the level of reduction of the difference of opinion of the members of the decision-making team in the course of the exchange of information (communication) between the members of the group. The ideal would be a total removal of difference of opinion between the members, i.e. finding (determination) of the optimal decision, which would be fully accepted by all the members of the decision-making team.

The second characteristic (scale, criteria, etc.) we shall consider in the evaluation of the level of the efficiency of the course of our reflectively analysed information process, and thus the course of the decision-making process, is one labelled as the cohesiveness of the members of the decision-making team. Corporate practice and research in the field of analysis of management processes indicates that an increase in the success and efficiency of the course of the decision-making process in a company is associated with a rise in, or maintenance of, the corresponding level of cohesion among the members of the decision-making team. This means that along with the rise in the level of cohesion of the members of the decision-making team also increases the effort to find a common resultant decision on the solution of the registered problem. Also growing is the integral interest in participation by all members in the promotion and implementation of this integrally determined resulting decision, and the members of the decision-making team are willing to participate in additional problem-initiated decision-making processes in the company, with the aim of providing effective decisions for their solution.

In connection with the above facts confirmed by practice and research (Forsyth 2010, Šnapka and Kašík 2012) relating to the characteristics (variable) of cohesiveness, it is possible to conclude that the level of efficiency of the course of the decision-making process as well as the information process on the basis of which the decision-making process is implemented will increase when the level of cohesiveness of the members of the decision-making team rises.

We can say that the level of efficiency of the course of the decision-making process in the company, with regard to the level of both characteristics for its evaluation, will rise if the levels of both characteristics (variables) change in the desired direction. This means that difference of opinion of the members of the decision-making team on the solution of the registered problem will be removed or minimized (finding a common, and if possible optimal solution), and an adequate level of cohesiveness among the members of the decision-making team will be achieved.

The more places of difference of opinion among the members of the team are resolved (eliminated) in the determination of the resulting decision during the decision-making process, and the higher the willingness (motivation) of team members to participate in the implementation of the established decision and in continuing to participate in other decision-making processes, the higher the efficiency achieved in the course of the decision-making process.

It is structurally logically obvious that we shall consider both of the above-mentioned variables defined for the evaluation of the efficiency of the decision-making process in the context of a proposed system (model) of this evaluation as a structural component of input variables of this model. Similarly, they are also a structural component of the output of this model. A change in the level of these two variables when comparing their level at the end of the decision-making process with its beginning level actually allows us to evaluate the efficiency of the course of the decision-making process in time.

It is clear, however, that the assessment of the optimality of the determined decisions in terms of the content factuality of the solutions to the given problems is relative with respect to the level of competence of the

members of the decision-making team. In this discussion, however, we consider the level of efficiency during the decision-making process based on the fact that the output (after it finishes) of the given decision-making process determines a decision which will deal with the problem in the company that was being decided upon. This means that in terms of the objectives for which it was invoked, the decision-making process has fulfilled its purpose relative to the level of competence of the members of the decision-making team. We can also state that the optimal decision from the point of view of decision-makers is given by the expected level of utility of the determined decision on the solution of the decision-making situation for the decision maker (on the solution to the problem about which the decision-making team is deciding), as well as the acceptable level of risk associated with the implementation of the established decision.

It is also must be noted that the issue of a variable labelled as a difference of opinion on resolving a problem in the context of a decision-making process and the elimination of this difference during the decision-making process can attain a specific status. For example, it may involve a situation where within the decision-making process is to be considered a proposal for a totally innovative solution to a given problem about whose solution the decision-making team is to decide. One member of the team suggests such a considered innovative solution and the other members will not e.g. be able to decode the information content of this solution in a relatively short time. This will then lead to prolonging the time for unification of opinions on the solution of the given problem and the determination of the resulting decision. It will also mean a decline in the achieved level of the efficiency standard during the decision-making process. In the interest of efficiency of the course the decision-making process in the company and the efficiency of the conduct of members of the decision-making team, this situation should initiate pressure for change in the level of the variable hereinafter labelled as the ability to perceive information from other members of the decision-making team. If both the team and the course of the decision-making process are effective, then the arising of the mentioned decision-making situation would be linked with a partial extension of the time for the determination of an effective innovative decision. This extension would be associated with the fact that the remaining members would expeditiously get the information required for their full informational participation in the determination of the resulting decision in the context of the unification of opinions on this innovative decision.

The achieved levels of both variables for the measurement, analysis and evaluation of the efficiency of the course of the decision-making processes in the company are therefore dependent, as already stated, on the level of the course of the information process associated with the determination of the resulting decision. They are its reflection. This decision is determined by the members of the decision-making team at the end of the decision-making process, which was invoked in order to solve the problem registered in the company. Structural elements (variables) that enable and affect and progress (implementation) of the information process, associated with the decision-making process (thereby also influencing the progress and resulting efficiency of the course of the decision-making process), are elements that we can label as systemic transformation elements. This means that the level of intensity of their transformational action affects the course of transformation of the inputs (levels of variables) that initiate an information process, which is the basis of the given decision-making process associated with the emergence and solution of the problem registered in the company. For analytical investigation, we shall consider the information process associated with the decision-making process whose efficiency we are supposed to evaluate as a system. This means that it is necessary to define its elements, which have their input and output, special purpose connections and behaviour, with the possibility of subsequently describing, on the basis of the connections of the elements, also the structure and behaviour of the entire system, which is considered to include both the information process as well as the decision-making process. The decision-making process is factually realized precisely on the basis of the analytically considered information process.

The system elements are identical in content with the variables (magnitudes) that initiate the decision-making process and affect the efficiency of the course. The initiation of the decision-making process and its progress is realized on the basis of information flows, which is model-depicted by input/output ties between the model elements. This is actually about the flows of information, which reflect changes in the level of the individual variables of the model system. Each element of the model system has an input (inputs) and an output (outputs), and so does the entire system. The input and output of the various elements of the model system of evaluation of efficiency of the course of the decision-making process are actually information about the level of the variables associated with the reactions of the people who make up the decision-making team (group). This team, as we know, is supposed to address the arisen problem, i.e., decide on the solution (the decision-making process is initiated). We can also mention that the input and output of the various elements of the model system are the variables that affect the course of the decision-making process. Changes in their level (value) in time and the

direction of change determine the level of efficiency of this course. Before we present the structure of the model system for the evaluation of the efficiency of the course of the decision-making process, we will present the criteria description for possible quantification of the efficiency of the course of the decision-making process.

3. Quantification criterion for the efficiency of the course of a group decision-making process

This criterion will be based on the general concept of efficiency evaluation (E) for a particular process as the ratio of the value (level) of the output (O) of a given process to the value of its input (I) at a given time (t). This means that

$$E(t) = \frac{O(t)}{I(t)} \tag{1}$$

In the evaluation of the efficiency of the course of the decision-making process, we will set up this criterion according to the already referred to concept of evaluation of the efficiency. This means that the output for the evaluation of efficiency will be, on the one hand, the change (reduction) in the level of the difference of opinion between the members of the decision-making team about the problem and the determination of the resulting decision on its solution. At the same, another output is the possible change in the level of cohesiveness among the members of the decision-making team (the growth).

Thus conceived, the criterion of efficiency of the course of the decision-making process (Edp) can be expressed with the following formula:

$$E_{dp} = \frac{CDO}{\Delta t} \wedge \frac{CCM}{\Delta t} \tag{2}$$

CDO expresses the amount (level) of change (with effort to reduce) in the difference of opinion of the members of the decision-making team on the solution to the problem and the determination of the resulting decision, i.e. the difference at the beginning of the decision-making process and at its end.

CCM expresses the amount (level) of change (with effort to increase) in the cohesiveness between the members of the decision-making team during the decision-making process, i.e. the change in the level of cohesiveness at the beginning of the decision-making process and at its end.

An input for the evaluation of the efficiency of the course of the decision-making process will be the factor of time. This means the period of duration of this process, during which there should be a change in the level of perceived difference of opinion of the members of the decision-making team in the direction of unification and, if possible, an increase in the level of cohesiveness. We can express this period as a time interval indicated by (Δt). The referred to relationship (1) for the evaluation of the efficiency of the course of the decision-making process will be used in describing and structuring the resulting behaviour of the model system of evaluation of the efficiency of the course of the decision-making process.

In addition, we will present the characteristics of the structure of the model system for the evaluation of the efficiency of the course of the decision-making process.

4. Description of the structure of the model for the evaluation of the efficiency of the course of the decision-making process

The proposed model system of evaluation is shown in Figure 1 with the structural definition of the subsystem of inputs (input elements) of this system, and the structure and ties of the already indicated transformation elements that make up the so-called transformational subsystem of the model system and its subsystem of outputs (output elements).

Subsequently, on the basis of the description of the behaviour of the elements of each of the subsystems and the ties of their elements, we describe the structure and behaviour of the entire system for the evaluation of the efficiency of the model during the group decision-making process.

In terms of system modelling, it must be noted that each element of the system with regard to its special purpose properties exhibits certain behaviour. This behaviour is activated by the transformation of the input of the given element into its output. Structural instrumental linking of the elements of the model as a system, occurring on the basis of the linking of the input (inputs) of the following element (elements) of the model, which is formed by the output (outputs) from the structurally previous element (elements) of the model, forms the behaviour of the entire system. This means the behaviour of the model considered as a system (see Figure 1). In this sense will also be described the behaviour of individual subsystems of the model system as well as the system as a whole.
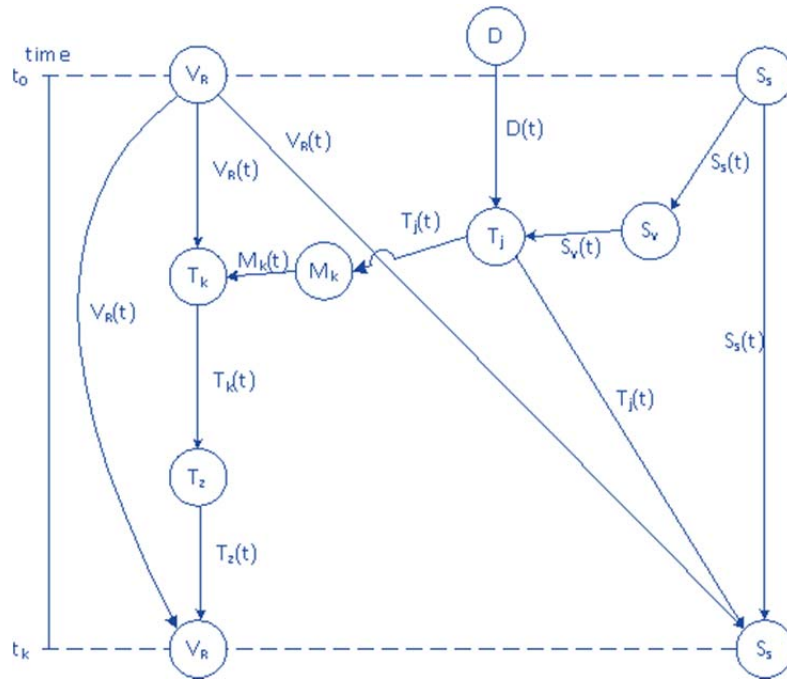
Source: Šnapka and Kašík (2013)

Figure 1 – Model elements and their links

For a description of the transformation of changes in the input (inputs) of the individual instrumentally defined elements of the model system into changes in their output (outputs), i.e. for a description of their behaviour and within their systemic structural links (ties), and also the behaviour of the entire system, we will use the transformational equations. For the definition of the value direction of transformations, we will analytically determine so-called transmissions. This means the level of transmission of changes in the value of the input (inputs) of the given system element to changes in its output (outputs). We will determine transmissions analytically by employing partial derivatives of the output variable (output) according to the input variable (input) in the context of each element in the model system. The transmission will then actually be the ratio of the change in the output level of the given system element to the element change in the value of its input (inputs). Since this is a depiction of changes in the level of variables through information flows, on the basis of which is realized the analysed decision-making process, it also may be said that it is a ratio of the information about changes in the level of the output of the given element of the model system through the influence of changes in the level of its input (inputs). The model-required trend of transmission of changes will be expressed as a signed integer value of the status of the level of the partial derivative set for the particular transformation equation. This means for the given analytically determined transmission.

By the term "status of the level of transmission of change" we understand either a positive value, i.e., a transmission level greater than zero, or negative, i.e., a level of transmission less than zero, or there is no change in the system and the level of transmission is zero. Otherwise, we can also say that, in the case of a plus partial derivative, the change in the level of the output magnitude (variable) is directly proportional to the change in the level of the input magnitude realized in the given time of the course of the decision-making process. An inversely proportional change is realized in the case of a negative partial derivative sign (level of transmission). By the term "required level of the trend the transmission" we understand such a level of change (positive, negative, or zero) that will lead to the achievement of efficiency by the course of the analysed decision-making process. This will of course also lead to the growth of the efficiency of the information process, through which the decision-making process is realized.

In the interest of evaluation of the level of efficiency in the course of the decision-making process in business practice and the identified deficiencies (weak points) that lead to a reduction in the possible level of efficiency of the course decision-making process, it is necessary to analyse the existing level of the trend of influential changes in variables (component transmissions) in the framework of the structural elements of the model system. The detected levels must then be compared with the required levels of inputs and outputs for

individual systemic model elements affecting the efficiency of the course of the analysed decision-making process. In the case of the level of the first input variable, which is the difference of opinion on the solution to the problem, a reduction of its level is supposed to occur by the end of the decision-making process compared to the initial level, i.e., at the beginning of the decision-making process. This means that the level of the transmission describing the change in the framework of this variable in the course of the decision-making process (to its end) is negative (less than zero). In the case of the second resulting output variable, i.e., the cohesiveness of the members of the decision-making team, we on the contrary want, in the interest of achieving the desired efficiency of the course of the decision-making process, the level of the resulting transmission to be positive (greater than zero). We thus want that at the end of the decision-making process the level of cohesiveness of the members of the decision-making team increases, and at a minimum we require that the level of cohesiveness, as opposed to the initial value, does not decrease, i.e., that the level of the transmission indicates a zero value.

Our considered model evaluation system will, as already indicated, be structurally composed of three subsystems, as follows:

- The subsystem of the inputs (the input elements, input variables, input information) that are connected in the model system with identical elements depicting the inputs of the model system;
- The subsystem of transformational elements that in reciprocal ties realize the transformation of information from the subsystem inputs into output information of the model system, i.e., into the subsystem of resulting outputs of the model system;
- The subsystem of final outputs (output elements, output variables, output information) that are associated in the model system with identical elements depicting the final outputs of the model system.

We will then present the definition of the individual elements of the subsystems of the model with the rationale of why we think structurally of these elements and their inputs and outputs, i.e., the variables associated with them. Furthermore, we will present the structural systemic ties of elements and their behaviour. We will then present the whole model evaluation system for the evaluation of the efficiency of the course of a group decision-making process.

The definition of the above characteristics of the individual subsystems of the system model for the analysis and evaluation of the efficiency of the course of the decision-making process, with the possibility of subsequently proposing and implementing system changes in the course of the decision-making process with the aim of achieving higher efficiency, is carried out on the basis of knowledge (secondary research) from the literature that discusses the issue of decision-making processes (Šnapka and Kašík 2013, Drucker 1967, Saaty 2000, Simon 1997, Aguado *et al.* 2014, Clarkso and Simon 1960) and from the literature concerning modelling and sociological research (Šnapka and Kašík 2012, Belbin 1985, Belbin 1993, Daft 2012, Gil *et al.* 2005, Hicks 2004, Proctor 2010, Rico *et al.* 2008, Bhunan and Rai 2004). We have also drawn on knowledge from several years of our own practical experience in connection with the performance of various managerial functions. These included, for example, directing functions in the position of the economic-financial director of a company, chairman of the board of directors, chairman of the supervisory board, the director of the institute for doctoral and managerial studies within a university, head of the professional department of a faculty, etc. In essence, this was an expert contribution to the primary research on the relevant issues.

5. Definition of the elements of the model system, their structural links and behaviour for the evaluation of the efficiency of the course of a decision-making process

We shall now define the previously referred to individual subsystems of the model system.

5.1. The subsystem of inputs (input elements, input variables, input information

The elements of this subsystem are defined on the basis of known findings in the literature related to the decision-making processes (Adair 2013, Belbin 1993, Daft 2012, Institute of Leadership and Management 2007), the referred to practical experience, as well as research analyses focused on the issues of management (Šnapka and Kašík 2013, Šnapka and Kašík 2012). In defining the input elements of this subsystem, we accept previously presented information about the variables (criteria), on the basis of which the efficiency of the analysed decision-making process is evaluated.

Based on this information, we can say that the input elements of the input subsystem of the model system will be as follows:

▪ The members' of the decision-making team perceived importance of the problem (problem situation) that has to be resolved by the team (by decision on its solution and implementation). We label this input element (D). From the literature and from the managerial activities of the authors, it is an obvious fact that the invocation of a

decision-making process is associated with the emergence of a problem, whether situational (an obvious problem) or potential in character, with the necessity of its solution (deciding on its solution). Criteria-wise, we can consider as most important to solve those problems (problem situations) that threaten the existence of the decision-making team (or possibly important members of this team), if the team shows significant cohesiveness in terms of strategic interests and objectives of the members of the decision-making team.

In the conclusion to this element as well as the other elements of the individual subsystems of the model system we will present the information outputs from individual elements. In the case of the element labelled (D) which now concerns us, it will involve the information output (variable) represented as $/D(t)/$. This output presents information about the perceived importance of the problem, about which is supposed to be decided by the members of the decision-making team.

▪ As already mentioned, the next input element of this subsystem will be associated with the already mentioned and analytically justified criterion for the evaluation of the efficiency of the course of the decision-making process, which is the perceived difference of opinion of the members of the decision-making team about the arisen problem and its solution. We label this input element (V_R). In the case of this element, what will be involved is the information output (variable) represented by $/V_R(t)/$, which presents information about the perceived difference of opinion among the members of the decision-making team on the arisen problem and its solution in time (t). In the case of perceived difference of opinion in the beginning of the decision-making process, it will be the level represented as $/V_R(t_0)/$.

▪ The last defined input element of the input subsystem will also be associated with already referred to criterion for the evaluation of the efficiency of the analysed decision-making process, which is the cohesiveness of the members of the decision-making team. We label this input element (S_S). In the case of this element, what will be involved is the information output (variable) represented by $/S_S(t)/$, which presents information about the cohesiveness of the members of the decision-making team in time (t). In the case of cohesiveness at the beginning of the decision-making process, it will concern the level represented by $/S_S(t_0)/$.

All of the above defined information outputs from the elements of the input subsystem of the model system actually consist of the basic inputs for the invocation (initiating) of the decision-making process and for its subsequent course, with the possibility of evaluation of the level of efficiency of its course.

The factor of time labelled as (t) is an important factor for variables in the evaluation of the efficiency of the course of the decision-making process, because this course is directly linked with time. The whole model system must be considered as a dynamic system, as during the course of the decision-making process changes occur in the levels of input and output variables (at the level of inputs and outputs) in the framework of individual structural elements of the model system.

In the following text, in the context of the definition and the characteristics of the subsystem of transformational elements, which is systemically linked to the already presented input subsystem, we will present how the relevant informational output from a given element of this subsystem forms the input of the given element of the transformational elements subsystem of the model system. The structure of the subsystem of transformational elements, their behaviour and ties to the outputs of the elements of the input subsystem of the model system, will be presented on the basis of hypotheses verified by practice and acquired by the study of the literature (Festinger 1999, Šnapka and Kašík 2013, Forsyth 2010, Šnapka and Kašík 2012, Saaty 2000, Aguado *et al.* 2014, Belbin 1993, Proctor 2010), the already referred to practical experience of the authors in managerial functions, and carried out analyses of the decision-making process. The structural ties between the elements are also evident from the Figure 1.

5. 2. The transformational elements subsystem of the model system

As we have already mentioned in the text of the paper, the activation of the elements of this subsystem depicts the transformation of the inputs of the model system into the output of this system for the analysis and evaluation of the course of a given decision-making process. In the framework of the analysis of the decision-making process, it then activates the possibility of realization of changes during the course of the analysed decision-making process, in order that at its end may be determined a resulting decision whose implementation will lead to a solution of the problem (problem situation). By their behaviour (the transformation of their input or inputs into output) and their links, the elements of this subsystem describe the realization of the course of the decision-making process as an informational process, which the decision-making process actually is in its essence.

The definition of individual transformational elements of this subsystem, their links and the characteristics of their behaviour, will be carried out based on the information we obtained from the mentioned literature (secondary research) and our own experience from managerial practice and analyses of the decision-making processes, i.e., in the framework of primary research. The information collected has been processed into the following hypotheses:

Hypothesis no. 1

The pressure to exchange information between the members of the decision-making team (pressure to communicate), expressed as $/T_K(t)/$, with the purpose of eliminating the difference of opinion among the team members on the arisen problem and its solution in the context of the decision-making process is the greater, the greater is the difference of opinion $/V_R(t)/$ concerning this problem. Two elements of the model system are connected with this hypothesis. One element labelled (T_K) is a part of the subsystem of transformational elements within the information process, in the framework of which the decision-making process for solving the given problem is carried out. The second element labelled (V_R) is the already referred to element of the input subsystem of the model system. From this hypothesis it follows that there is a reciprocal link (serial link) between the two elements, and the behaviour of the element labelled as (T_K) also follows, with regard to the change of the trend level of its output (output variable) labelled as $/T_K(t)/$.

As we know, we can describe the behaviour of the model elements through their transmission (transmission characteristics). The trend level of transmission as the characteristics of behaviour of the element (T_K) will rise with the rise of the level of change of its output (output variable) labelled $/T_K(t)/$ through the influence of the rise in the level of change of its input (input variable) labelled $/V_R(t)/$. This means that with the existence of a high a level of difference of opinion among the members of the decision-making team, there is growing pressure to communicate between these members with the objective of resolving the existing difference of opinion. In the case of the beginning of the decision-making process, the level of the output variable of the element (V_R) has the designation $/V_R(t_0)/$. The level of transmission, as follows from the presented hypothesis no. 1, is positive, i.e., greater than zero.

Hypothesis no. 2

The pressure to exchange information between the members of the decision-making team (pressure to communicate between the members), labelled (T_K), with the purpose of eliminating the difference of opinion among the team members on solving the problem, is the greater, the greater is the pressure registered by the members of the decision-making team, which aims to achieve a unity of opinions on the arisen problem and its solution in the course of the decision-making process. This pressure, which is represented by another element of the subsystem of transformational elements of the subsystem, is labelled (T_j). The output (output variable) of this element in time (t) is labelled $/T_j(t)/$. This pressure manifests itself through the activation of another transformational element, which enables communication of information about the level of $/T_j(t)/$ for influencing the output levels $/T_K(t)/$ of the transformational element (T_K). This intermediate element in the system's serial ties for connecting elements (T_j) and (T_K) is the transformational element labelled (M_K). We can characterize this transformational element as the element representing the pressure to look for and find possibilities of appropriate informational connection of the members of the decision-making team in the course of the decision-making process during the time (t). The transformational element labelled (M_K) has an output (output variable) in the course of time (t) denoted as $/M_K(t)/$.

The presented hypothesis no. 2 implies a reciprocal tie between the elements (T_K) and (T_j) and the behaviour of the element labelled (T_K), which is dependent on the change in the level of the output trend of the transformational element (T_j) through the transformational element (M_K).

In the context of achieving the required efficiency of the course of the decision-making process, the trend of change of the output level $/M_K(t)/$ from the transformational element (M_K) must follow the trend of change in the output level (output variable) $/T_j(t)/$ from the transformational element (T_j). In the framework of the above hypothesis no. 2, the behaviour of the transformational element (T_K) is also formed, i.e., as changes in the level of its output $/T_K(t)/$ through the influence of changes in the level of its input, which is formed by the output of the transformational element (T_j). This means by its output labelled $/T_j(t)/$ acting via the transformational element (M_K).

Hypothesis no. 2 further implies that the trend level of transmission (as the characteristics of behaviour of the element (T_K)), describing the necessary level of change in output (output variable) labelled $/T_K(t)/$ through the influence of the rise in the level of change of the input of this element, must be positive (greater than zero), in

order to achieve positive behaviour of the element (T_K) and so that the course of the decision-making process could be effective. This will be achieved due to the change in the input of transformational element (T_K), which is formed by the informational output (output variable) from the transformational element (T_j) via the element (M_K). This means that changes in the level of input and output in the case of the transformational element (T_K) must be proportionately consistent with the rising characteristics of their changes. The trend of the transmissions of changes must be positive (greater than zero).

Hypothesis no. 3

The pressure registered by members of the decision-making team, which aims toward achieving a unity of opinions on the arisen problem and its solution in the course of the decision-making process $/T_j(t)/$ is the greater, the greater the degree (level) of importance of the problem (the problematic decision-making situation) is for further action (functioning, activities) of the decision-making team. The input element in the form of the importance of the problem has been labelled (D) and its information output (output variable) in time (t) as $/D(t)/$.

From the above hypothesis no. 3, it is clear that the output of $/D(t)/$ forms the informational input (input variable) for the transformational element (T_j), thereby interconnecting the already presented ties (output – input) of the structural elements of the model system for the analysis and evaluation of the efficiency of the course of the decision-making process, from element (D) up to the transformational element labelled (T_K).

From Hypothesis no. 3 also follows both a reciprocal link between elements (T_j) and (D) as well as the behaviour of the element labelled (Tj), dependent on the change in the level of the output trend $/D(t)/$ of the input element (D). With regard to hypothesis no. 3, it is obvious that the trend level of transmission (as the characteristics of behaviour of the element (T_j)), describing the necessary level of change in output labelled $/T_j(t)/$ via the influence of the rise in the level of change of the input of this transformational element, must be positive (greater than zero), in order to achieve positive behaviour of the element (T_j) and so that the course of the decision-making process could be effective. This state will be achieved in a situation where the information about the importance of the problem for the members of the decision-making team will be available in such an extent and informational quality, that the members of the team realize, in the maximum achievable extent, the importance of the problem to the be solved for further activity of the team and for the fulfilment of the objectives of the company.

In the component final transformational communication process in the context of the decision-making process, is necessary that the level of the pressure to communicate, i.e., $/T_K(t)/$, rises, in order to eliminate the difference of opinion of the members of the decision-making team concerning the determination of the resulting decision on the solution to the given problem and the implementation of this solution. This fact is implied from reference to the conclusions associated with the previous hypothesis, i.e., hypothesis no. 2.

Hypothesis no. 4

The pressure registered by members of the decision-making team, which aims toward achieving a unity of opinions on the arisen problem and its solution in the course of the decision-making process $/T_j(t)/$ is the greater, the greater the cohesiveness of the members of the decision-making team.

The input element in the form of the cohesiveness of the members of the decision-making team is labelled (S_S), and its informational output in time (t) is labelled $/S_S(t)/$. The influence of the level of output $/S_S(t)/$ from input element (S_S) on the change of the level of output $/T_j(t)/$ of the element (T_j) is realized via another transformational element, labelled (S_V). This transformational element refers to the ability and willingness of the members of the decision-making team to perceive the influencing of their opinions on the given problem and its solution as a result of the exchange of information with other team members in time (t). The informational output (output variable) from this element, which forms the information input in time (t) into the transformational element (T_j), with which it is serially linked, is labelled $/S_V(t)/$.

The presented hypothesis no. 4 implies both a reciprocal tie between the elements (T_j) and (S_S) and also the behaviour of the element labelled (T_j) in connection with the change in the level of the output trend of the input element (S_S) via the transformational element (S_V). These facts are dependent (as follows from hypothesis no. 4) on the trend level through the influence of changes in the output (output variable level changes) $/S_S(t)/$. The transformation of the output of element (S_S) is realized by the transformational element (S_V) with informational output $/S_V(t)/$, in that through its action (transmission of information) a change occurs in the output level $/T_j(t)/$ of the transformational element (T_j).

In the context of achieving the required efficiency of the course of the decision-making process, the trend of change of the output level from the transformational element (S_V) must follow the trend of change in the output level of the output element (S_S) of the subsystem of input elements. Also formed in the framework of the above hypothesis no. 4 is the behaviour of the transformational element (T_j), i.e., changes in the level of its output /$T_j(t)$/ through the influence of changes in the level of its input, which is formed by the output of the element (S_S). This means by its output labelled /$S_S(t)$/ acting via the transformational element (S_V).

From hypothesis no. 4 it follows that the trend level of transmission (as characteristics of behaviour of the element (T_j)), describing the necessary level of change in the output /$T_j(t)$/ of this element through the influence of the rise in the level of change of its input, must be positive (greater than zero). It is necessary in order to achieve positive behaviour of the element (T_j) and in order that course of the decision-making process could be effective.

Through the description and analysis of hypothesis no. 4 of the structuring of the model system, we have presented further systemic ties of the created model for analysis and evaluation of the efficiency of the course of the decision-making process. It involved the presentation of additional elemental links for the transformational element (T_j), with that the input of this transformational element is influenced by the level of input from the input elements that are labelled (D) linked to hypothesis no. 3 and (S_S). Depending on the characteristics of the transmission describing the behaviour of transformational element (T_j), a change in the level of the outputs from the input elements (D) and (S_S) then influences a change in the output (its level) of transformational element (T_j). In the following ties presented, what is represented is the initiation of a change in the output of another transformational element, labelled as (T_K). This means a change in the level of its output /$T_K(t)$/.

Hypothesis no. 5

The magnitude of the change in the difference of opinion (with the aim of reducing the difference) of the members of the decision-making team on the solution to the problem (the determination of the resulting decision on the solution of the problem and the implementation of the solution) is the greater, the greater is the pressure from the members of the team to reduce the difference in their opinions /$T_Z(t)$/ as a result of increased pressure between the members to mutually communicate /$T_K(t)$/ about the solution to the problem.

At the same time, the rise in the output level /$T_K(t)$/ from transformational element (T_K) leads to influencing (with the aim of a rise) the output level /$T_Z(t)$/ from the transformational element (T_Z) and vice versa. In the framework of hypothesis no. 5, this fact formulates the behaviour of element (T_Z), i.e., changes in the level of its output /$T_Z(t)$/ through the influence of changes in the level of its input formed by the output from the transformational element (T_K) in the form of variable /$T_K(t)$/. Hypothesis no. 5 further implies that the trend level of transmission (as the characteristics of behaviour of the given element (T_Z)), describing the necessary level of change in output /$T_Z(t)$/ of this element through the influence of the rise in the level of change of its input, must be positive (greater than zero), in order to achieve positive behaviour of the element (T_Z) and in order that the course of the decision-making process could be effective. This must be ensured in the implementation of the decision-making process in practice.

It was already mentioned in characterizing the systemic ties of the model system that a change in the output level of element (T_K), labelled /$T_K(t)$/, which is the input of element (T_Z), is realized through a serial systemic link via elements, namely: the transformational element (T_j) and elements (S_S) and (V_R) of the system model (with a link to the input level of their output). The information flow associated with the implementation of the information process enabling the realization of the decision-making process to solve a problem situation will proceed in accordance with the initiation of the already presented links between the given elements according to their described behaviour.

The output level /$V_R(t)$/ of element (V_R) (in the position of the output element of the model system) influences, in addition to the already presented pressure to reduce the difference of opinion of the members of the decision-making team, i.e., the output level labelled /$T_Z(t)$/, also the initial level of the perceived difference in opinion on the solution of the problem of the members of the decision-making team, i.e., the level /$V_R(t_0)$/. In terms of systemic transmission it is obvious that the greater the difference of opinion at the beginning of the decision-making process, the harder it will be to get rid of this difference during the decision-making process. It is also clear that the greater the difference of opinion at the beginning of decision-making, the smaller the reduction in this difference can be expected at the end of the decision-making process. It will also be necessary to exert greater effort towards increasing pressure to reduce the difference of opinion among the members of the decision-making team. On the other hand, it is obvious and confirmed by practice that the higher pressure achieved to reduce the difference of opinion on the solution to the problem /$T_Z(t)$/, the greater the reduction in the perceived difference of opinion of the decision-making team members on the solution of the arisen problem.

The link of changes in the output level $/T_Z(t)/$ of the transformation element (T_Z) and output $/V_R(t_K)/$ of the model system, i.e. the transmission of change, is negative. A rise in the pressure $/T_Z(t)/$ leads to a decrease, or even to the elimination of the difference of opinion among the members of the team at the end of the decision-making process.

Hypothesis no. 6

The magnitude of change in the cohesiveness of the members of the decision-making team $/S_S(t)/$, i.e., the conformity of the target orientation of their needs reflected in the actions (the efforts) of the members of the team, is proportional to the magnitude of pressure registered by the members of the decision-making team$/T_j(t)/$. This pressure is directed towards achieving the unity of opinion of the members of the decision-making team on the arisen problem and its solution in the course of the decision-making process.

The level of change in pressure $/T_j(t)/$, as the output from the transformational element (T_j), is dependent, as we know from the analysis of hypothesis no. 3, on the level of importance of the problem $/D(t)/$ for the members of the decision-making team (the output from the input model system element (D)) and on the level of output $/S_S(t_0)/$ from the element (S_S) (in the position of an input element of the model system) via the output $/S_V(t)/$ of the transformational element (S_V).

As previously noted, both the level of output $/V_R(t_K)/$ and the level of output $/S_S(t_K)/$ at the end of the decision-making process are for each of these variables affected by their initial magnitude (level). In the case of the output level (output variable) $/S_S(t_K)/$, it is affected by the initial level of the input variable $/V_R(t_0)/$.

From group processes realized in practice, it is known that the higher the initial difference of opinion on the solution to the arisen problem, the more often is there a significant reduction in the cohesiveness of the members of the group. This occurs in the presence of low efficiency of the already presented transformational process (informational process) to enable the realization of decision-making process (affects its progress). What we want at the end of the decision-making process, however, is to be able to evaluate its course as effective. This means that we want to achieve the state leading to a significant reduction, or even better, elimination of the difference of opinion of the members of the decision-making team on the solution to the problem. In the case of the cohesiveness of the members, we then want to reach a state of at least maintaining the initial level of cohesiveness, or even better a state of increase in the cohesiveness of the members of the decision-making team. These facts will be expressed in the outputs of the elements of the subsystem of final outputs in the model system.

5. 3.The subsystem of final outputs of the output elements of the model system

The character of the elements of this subsystem follows from the above-mentioned concept of the efficiency of the course the decision-making process. This efficiency is formed, on the one hand, by the magnitude of change in the initial level of perceived difference of opinion of the members of the decision-making team on the solution of the arisen problem in relation to the level of the (magnitude) of the difference of opinion at the end of the decision-making process. Furthermore, the efficiency of the course of the decision-making process is also formed by the level of any change in the cohesiveness of the members of the decision-making team at the end of the decision-making process in comparison with the level of cohesiveness in the beginning of the decision-making process.

This means that one of the elements of this subsystem will be the level of perceived difference of opinion at the end of the decision-making process, i.e., the element labelled (V_R) with output $/V_R(t_K)/$.

The second element of this subsystem is the cohesiveness of the members of the decision-making team, which is labelled (S_S) with the output $/S_S(t_K)/$. This output provides information about the level of cohesiveness of the members of the decision-making team at the end of the decision-making process. The decision-making process terminated by the determination of decision about the solution of the given problem proceeds within a time interval, which we have labelled (Δt). This interval has a duration from time (t_0) – the beginning of the decision-making process, to the time (t_K) – the time of the end of the decision-making process.

On the basis of the given specifications of the individual subsystems, their elements, links, and behaviour derived from the presented hypotheses relating to group informational processes linked to group decision-making processes, we will further present the description of the structure and behaviour of the model system for the evaluation of the efficiency of the course of group decision-making using the so-called transformational equations. These equations allow us to express algorithmically the structure and behaviour of this model system, and also

derive transmissions for the description of the behaviour of the elements of the model and the behaviour of the entire model system.

6. Description of the links of the elements of the model and its behaviour via transformational equations

It was noted that the level and magnitude of changes in individual inputs and outputs of the elements of the model system and the system as a whole are scanned by means of information in time. Therefore, the inputs and outputs of each of the elements of the model, i.e., their input and output variables, are considered as dynamic variables connected to time. In the application of transformational equations within the model they will be marked with the time factor (t). This means, for example, that the output variable (output) - the pressure toward unity of opinion, is labelled /$T_j(t)$/. This notation of variables has already been used in the description of the hypotheses utilized for the construction of the model. The behaviour of the model system will be understood as the trend reaction of the output of the given elements of this system to the change of the trend level of their input (inputs). This means that if we want to achieve the required levels of efficiency in the course of the decision-making process, it is necessary to ensure the following presented reactions of the elements of the system, and then according to their links the entire system, with the ultimate objective of reducing, or if possible eliminating the initial difference of opinion of the members of the decision-making team on the solution of the given problem at the end of the decision-making process, and maintaining or increasing the initial cohesiveness of the team members with the objective of implementation of the determined resulting decision.

These trend reactions (as already mentioned) will be referred to as so-called transmissions. It will involve the transmission of the component elements of the model system and transmissions of component structural parts of this system or the system as a whole. The concept of transmission within the system is the concept used for the examination of dynamics (the reactions of output – input in time) in the case of dynamic systems. We reiterate that we will understand the transmission of a given element as well the system as a whole as the relation of the change in the trend (increase or decline) of the output (output variable) of this element with the event of a trend change in its input (input variable). Depending on the analysed structural links of the inputs of the elements in the system, this is then either the behaviour of a part of the system or the system as a whole.

To determine these transmissions of the model system, we will use the following transformation equations and the partial derivatives of functions, which are formulated in the framework of these equations. The mathematical formulations of these transmissions will involve partial derivatives of dependent variables (outputs) of the individual elements of the presented system according to the input variables (inputs) of these elements using the transformation equations.

6.1. Transformational equations of the model system and transmissions of its elements

The transformation equations are compiled on the basis of the above description of the elements and their links within each of the subsystems of the model system for the evaluation of the efficiency of the course of the decision-making process. The links between the elements of the model are also obvious from Figure 1. The transformation equations describe both the reciprocal links of the output and input of a given element of the model, as well as the reciprocal links between elements of the model system, and thereby the links in the context of the entire system.

The transmission characteristics of the elements of the model of the system and the system as a whole will enable us to determine analytically in what direction the output of the given element of the system should develop over time, in order to achieve the required level of efficiency of the course of the decision-making process. It will further determine how the transformation of the input (inputs) of a given element of the system into its output (outputs) should proceed (should be realized). This involves determining how through a change in the level of its output an element should react to a change in the level of its input (inputs) in order to achieve its effective behaviour, and within the structure of the linking of the elements of the model system then the effective behaviour of the system as a whole.

We can state the transformational equation describing the model system in the following form:

The following transformational equations (3) to (5) are based on hypotheses no. 1, no. 2 and no. 3.

$$T_K(t) = T_K(V_R(t), M_K(t)) \tag{3}$$

$$T_K(t_0) = T_K(V_R(t_0)) \tag{4}$$

$$M_K(t) = M_K(T_j(t)) \tag{5}$$

Transformational equations (6), (7) and (8) are based on hypotheses no. 3 and no. 4.

$$T_j(t) = T_j(D(t), S_V(t)) \qquad (6)$$

$$T_j(t_0) = T_j(D(t_0)) \qquad (7)$$

$$S_V(t) = S_V(S_S(t_0)) \qquad (8)$$

Transformational equations (9) and (10) are based on hypothesis no. 5.

$$T_Z(t) = T_Z(T_K(t)) \qquad (9)$$

$$V_R(t_K) = g_1(T_Z(t)) \qquad (10)$$

Transformational equation (11) is based on hypothesis no. 6.

$$S_S(t_K) = g_2(T_j(t)) \qquad (11)$$

Since the level of efficiency of the course of the decision-making process, as was presented in the analytical description of the concept of this efficiency, is reflected in the change of the levels of two variables of the model system over time (i.e., in the interval of duration of the decision-making process), it is possible to describe the level of efficiency by the change in the level of variables $V_R(t)$ and $S_S(t)$. To describe this change, it is possible to use differential (transformational) equations, namely equations (12) and (13).

Equation (12) functionally describes the change in the level of difference of opinion among the members of the decision-making team, and has the following form:

$$\frac{dV_R(t)}{dt} = f(T_Z(t), V_R(t)) \qquad . \qquad (12)$$

Equation (13) functionally describes the change in the level of cohesiveness of the members of the decision-making team, and has the form:

$$\frac{dS_S(t)}{dt} = h(S_S(t), T_j(t), V_R(t)) \qquad . \qquad (13)$$

In differential form it will then be:

$$\Delta V_R(t) = V_R(t_K) - V_R(t_0) \qquad (14)$$

and

$$\Delta S_S(t) = S_S(t_k) - S_S(t_0) \qquad (15)$$

6.2. Description of the behaviour of the model system of efficiency of the course of a group decision-making process

In the framework of the methodological procedure of analysis of the efficiency of the course of the decision-making process, we have said that modelling the behaviour of this system will be realized on the basis of analysis of the trend level of so-called component transmissions by the elements of the system, component overall transmissions of defined parts of the model system and the transmission of the entire system.

With regard to the system concept of the efficiency of the course of the decision-making process and its analysis, we will be interested, on the one hand, in the valuation trend character of the resulting transmission of the model system, oriented toward the change in the level of the variable $/V_R(t)/$ with a trend change of decrease in its level over time, i.e., in the direction of the end of the decision-making process. We will be furthermore be interested in variable $/S_S(t)/$ in the direction of at least maintaining its initial level or its increase by the end of the decision-making process.

In the framework of the examination of the behaviour of the model system, we must establish a chain of intermediate transmissions describing the behaviour of the individual elements of this system and the trend level of these transmissions, because the resulting transmission reflecting the character of the changes in the level of

the resulting output variables of the model system $/V_R(t)/$ and $/S_S(t)/$ is dependent on the reciprocal links and the trend level of the transmissions of the individual elements of this system.

When establishing the chains of component transmissions, it actually involves determining which elements of the system must be activated in time and how as time progresses a change must occur in the values of the level of the input and output variables informatively describing the behaviour of these elements, in order that the system would exhibit the desired behaviour, derived from the objectives in the area of efficiency of the course of the decision-making process. The level of the transmissions, i.e., the signs of the partial derivatives, through which transmissions are expressed (formalized), will be determined either on the basis of hypotheses (referred to in the preceding parts of the paper), which concern the communication processes in decision-making teams, or through calculation based on knowledge about the character of the resulting transmission and from the knowledge about some of the component transmissions, which in the chain of component transmissions are dominant for the investigated resulting transmission. These transmissions must be evaluated in terms of their level, so that through the composition of the signs of the component transmissions of individual elements of the model system is reached the required partial derivative sign – transmission determining the trend value (level) of the resulting transmission.

The character of the transmission according to the sign of the partial derivative can be interpreted in such a way that in the case where the sign of transmission – partial derivative is greater than zero, then the change in the value of the output variable of the given element is directly proportional to the change in the value of its input variable over time. Conversely, the change is inversely proportional in the case that the sign of the transmission is negative (less than zero).

Reciprocal links of the elements of the model system are direct, i.e. serial links, as is evident from Figure 1 and from the description of the hypotheses on the basis of which the model system was built.

The linkage of elemental structural chains for the description of the behaviour of the model system is functionally described through the already mentioned transformational equations. This means that it will be an analysis of the behaviour of the model system of efficiency of the course of the decision-making process through the analysis of the behaviour of the output subsystem of this model, with linkage to the subsystem of transformational elements and the subsystem of resulting inputs.

6.3. Analysis of the behaviour of the model of the system in relation to the change in the trend level of variable $/V_R(t)/$

As has already been emphasized, the first resulting variable whose changes over time affect the efficiency of the course of the decision-making process is the variable $/V_R(t)/$. With regard to this fact, we will first analyse the possible change over time for this variable while specifying under what conditions, i.e., with what behaviour must this analysed subsystem operate to achieve a reduction or the complete elimination of the difference of opinion (the unification of opinion of the members of the decision-making team) on the solution to the problem (the determination of the resulting decision).

The change in time of the variable $/V_R(t)/$ is defined by equation (12), i.e.,

$$\frac{dV_R(t)}{dt} = f\big(T_Z(t), V_R(t)\big),$$

while

$$T_Z(t) = T_Z(T_K(t)). \tag{16}$$

If we place this relationship describing the serial linkage of elements (T_K) and (T_Z) into the differential transformational equation (12), then equation (12) will be in the form:

$$\frac{dV_R(t)}{dt} = f\big[T_Z\big(T_K(t)\big); V_R(t)\big]. \tag{17}$$

From this equation, we can determine transmission (F_1), which describes the behaviour of the analysed subsystem of final outputs. This is the ratio of the change in value (level) of one of the outputs of this subsystem, namely variable $/V_R(t)/$ (in the position of the output variable of the model system) through the influence of the change in value (level) of its input variable $/T_K(t)/$ operating through the transformational element (T_Z) and its output (output variable) $/T_Z(t)/$. At the same time, a change in the value of the output $/V_R(t)/$ will reflect the rate of change in its value over time, and a change in the value of its input will reflect the change in the value of the

variable /TK(t)/ over time until the end of the decision-making process. We will then analyse this transmission under the condition that there exists a certain level of difference of opinion among the members of the decision-making team on the solution to the arisen problem.

Transmission (F_1), which is depicted through the partial derivatives of the composite function (17), will then be in the form (18):

$$F_1 = \frac{\partial f}{\partial T_K(t)} = \frac{\partial f}{\partial T_Z(t)} \cdot \frac{\partial T_Z}{\partial T_K(t)} \tag{18}$$

With regard to the mentioned hypotheses no. 1, 2, 4, and 5, and the requirements placed on the efficiency of the decision-making process, it must be valid that $F_1 < 0$, which means that the rate of change toward the unity of opinion of the members of the decision-making team, i.e., in the direction of reducing the difference of opinion of the members on the solution to the arisen problem, will be the greater, the greater will be the pressure to communicate.

With regard to the achievement of efficiency of the course of the decision-making process and hypothesis no. 5, it must be true about the level of component transmission $F_{1a} = \dfrac{\partial f}{\partial T_Z(t)}$, which is a structural part of the transmission (F_1), that the trend value (level) of this component transmission must be less than 0, which means that $F_{1a} < 0$. This fact means that the greater is the pressure achieved over time to reduce the difference of opinion of the members of the team on the solution to the given problem /T_Z(t)/, the greater the reduction in the level of the difference of opinion over time. The speed of change of the level of difference of opinion among the members of the decision-making team increases. With regard to the character – sign of the transmission (F_1), it then must be valid that the second component transmission $F_{1b} = \dfrac{\partial T_Z}{\partial T_K(t)}$ of transmission (F_1) must attain a trend value greater than 0, i.e., $F_{1b} > 0$. This is necessary in order that within the context of the decision-making process there comes about, through an increase in the pressure to communicate, a determination of the resulting decision based on the desired objective of the unity of opinion of the members of the decision-making team. This is one of the requirements placed on the efficiency of the course of the decision-making process.

In this sense then, a significant variable, one may a "junction" variable, whose value changing over time affects through changes in the value of variable /T_Z(t)/ the change in the value of variable /V_R(t)/, is variable /T_K(t)/. This is because as a result of changes in the frequency of information exchanges (the frequency of communication) between individual members of the team, i.e., with an increase in the frequency of such exchanges, a boost is given to the possibility of a rise in pressure /T_Z(t)/, on the basis of which comes about a reduction in the difference of opinion on the solution to the problem (determination of the resulting decision on the solution to the problem). For this purpose it is necessary to determine the component transmissions in the transformation subsystem and the subsystem of inputs of the model system, where the output variable is the variable /T_K(t)/. We determine these component transmissions through chains of component transmissions by the elements (their serial system links), on the basis of whose activation and their trend level of information transmissions are brought about changes in the component values of variable /T_K(t)/. The first input variable of change, whose values in time influence a change in the value of the variable /T_K(t)/, is variable /D(t)/. A change in the value of this variable affects the change in the value of variable /T_K(t)/ through activation of the component elements of the model system in the elemental chain, i.e., from element (D) up to element (T_K). The behaviour of a thus defined component system with respect to changes in the variable /T_K(t)/ as a result of a change in the value of the variable /D(t)/ over time will be described through transmission $F_2 = \dfrac{\partial T_K(t)}{\partial D(t)}$. As regards the level of this transmission, i.e., its sign, then in accordance with hypothesis no. 2 and the requirements placed on the efficiency of the decision-making process the transmission (F_2) must be is greater than 0 ($F_2 > 0$), since a reduction of the difference of opinion of the members of the decision-making team on the arisen problem and its solution as well as the determination of the resulting decision is conditional upon an increase in pressure to communication among team members. Transmission (F_2) will have a trend characteristic (level) in the form (19):

$$F_2 = \frac{\partial T_K(t)}{\partial D(t)} > 0 \tag{19}$$

The transmission of changes in the value (level) of the input model variable /D(t)/ in time to changes in the value of the output model variable /T_K(t)/ in the context of the transmission (F_2) is realized (as already indicated) in the chain of elemental links of the transformational and input subsystem. The elements involved range from the model element (D) to the model element (T_K), via the activation of elements (T_j) and (M_K). We can depict the transmission of componential changes through elements (T_j) and (M_K) by the component transmissions (F_{2a}), (F_{2b}) and (F_{2c}), with the component transmission (F_{2a}) expressed in the form

$$F_{2a} = \frac{\partial T_j}{\partial D(t)}$$

The component transmission (F_{2b}) will then be in the form:

$$F_{2b} = \frac{\partial M_K}{\partial T_j(t)} \quad \text{and} \quad F_{2c} = \frac{\partial T_K}{\partial M_K(t)} \, .$$

In accordance with the hypotheses no. 2 and no. 3, it must be true that the trend level of the component transmission (F_{2a}) is greater than zero ($F_{2a} > 0$). In connection with this condition, we shall then set the trend level of the two remaining component transmissions (F_{2b}) and (F_{2c}) in linkage with the trend level (sign) of transmission

$$F_2 = \frac{\partial T_K(t)}{\partial D(t)} \, .$$

The sign of the component transmissions (F_{2b}) and (F_{2c}) must be positive, i.e., greater than zero or negative. From empirical findings (during the analysis of decision-making processes), it is clear that with growth in the importance of the problem /D(t)/ for the members of the decision-making team also rises the pressure to achieve uniformity /T_j(t)/, and that this happens at a certain level of cohesiveness of the members of the decision-making team /S_S(t)/. In the case of positive signs of transmissions (F_{2b}) and (F_{2c}) while the level of the variable /T_j(t)/ rises, the rise of the level of variable /T_K(t)/ occurs on the condition of a rise in the level of the variable /M_K(t)/ in time.

This means that the conditions have been created for the possible effective communication concerning the solution of the arisen problem about which the decision-making team is supposed to decide.

In the case of negativity of the signs of these component transmissions, an intensive increase in the values of /T_K(t)/ comes about as a result of increasing frequency of exchanges of information between the team members with the aim of reducing the difference of opinion on the given problem and its solution, even with a decreasing frequency of individual sessions, meetings, etc. of the members of the decision-making team. The nature and importance of the problem have in this case become so clear among the team members, that there is no need to seek out other options of information exchange for the clarification of the problem and its solution.

The second variable from the subsystem of input elements of the model system that affects the trend level of variable /T_K(t)/ is the variable /S_S(t)/. Changes in the trend level of this variable affect the change in the level of variable /T_K(t)/ via the activation of the elements of the model system defined in the framework of the structural links of the elements shown in Figure 1. This means the range of elements from element (S_S) to element (T_K). The behaviour of the model system with respect to changes in the trend level of variable /T_K(t)/ as a result of changes in the level of the variable /S_S(t)/ over time will be described through the transmission $F_3 = \dfrac{\partial T_K(t)}{\partial S_S(t)}$. The level of this transmission, i.e., its sign (in accordance with hypotheses no. 1, 2, 3 and 4) and the requirements for efficiency of the course the decision-making process, must always be greater than zero. This conclusion follows from the recognition that with rising cohesiveness of the team, the team members will seek the greatest possible frequency of exchange of information, in order to achieve, if possible, the optimal decision according to the opinion of the team members.

In accordance with transformational equations, it is possible to break down transmission (F3) (with regard to the serial structural linking of the elements of the model system) structurally into component transmissions, namely (20):

$$\frac{\partial T_K(t)}{\partial S_S(t)} = \frac{\partial T_K}{\partial M_K(t)} \cdot \frac{\partial M_K}{\partial T_j(t)} \cdot \frac{\partial T_j}{\partial S_V(t)} \cdot \frac{\partial S_V}{\partial S_S(t)} \tag{20}$$

The trend level, i.e., the sign of the component transmissions (F_{2c}) and (F_{2b}) which are parts of the transmission (F_3) when variable $/T_j(t)/$ is rising, was discussed in the context of the examination of transmission (F_2).

In the interest of the efficiency of the course of the decision-making process, we require the occurrence of an increasing value of the variable$/S_S(t)/$ over time. At a minimum, we require that the level of this variable does not decline. With regard to the initial hypotheses, then when the level of variable $/S_S(t)/$ rises via the element (S_V) and its output $/S_V(t)/$, a rise occurs in the level of variable $/T_j(t)/$. On the basis of these assumptions, i.e., the trend levels – the sign of transformation (F_3) and the possible trend levels (signs) of component transmissions (F_{2c}) and (F_{2b}), then component transmissions $F_{3a} = \dfrac{\partial T_j}{\partial S_V(t)}$ and $F3b = \dfrac{\partial S_V}{\partial S_S(t)}$ must attain trend levels (signs) consistently greater than zero, or must be less than zero.

In the case of positive signs of these transmissions, the rise in the level of variable$/T_j(t)/$ during a rise in the level of variable $/S_S(t)/$ is conditional on a rise in the level of the variable $/S_V(t)/$ in time. All team members are not only willing, which is a condition, but also able to fully participate in the search for a common solution to the arisen problem. In the case of a negative sign of component transmissions (F_{3a}) and (F_{3b}) during a rising level of variables $/S_S(t)/$and $/T_j(t)/$ then there will be a decrease over time in the level of the variable $/S_V(t)/$, because team members, even if they are willing to exchange information with other members of the team, are not all able to participate at a certain level (e.g., professional, etc.) of exchange of information, but fully "trust" an individual or a limited number of team members who determine a solution to the problem. The last input variable of the subsystem of inputs of the model system which affects the change in the level of the variable $/T_K(t)/$ is the variable $/V_R(t)/$ in terms of its initial level.

We will describe the behaviour of the system with respect to changes in the variable $/T_K(t)/$ as a result of different initial levels of variable $/V_R(t)/$ through the transmission (F_4) by the relationship (21):

$$F_4 = \frac{\partial T_K(t)}{\partial V_R(t)} \tag{21}$$

In accordance with hypothesis no. 1, the trend level (sign) of this transmission must be positive, i.e., $F_4 > 0$. On the basis of analysis of the above transmissions, we have defined the behaviour determined by one of the requirements affecting the efficiency of the course of the decision-making process, which is the reduction in the difference of opinion of the members of the decision-making team on the solution to the arisen problem (the determination of the resulting decision) and its implementation in practice.

6.4. Analysis of the behaviour of the model system with linkage to the desired level of output variable $/S_S(t)/$

The second resulting output variable of the model that over time affects the course of the efficiency of the decision-making process and the motivation of all the members of the decision-making team to implement the resulting decision in practice, in a situation where changes in its level occur, is the variable $/S_S(t)/$, i.e., element (S_S) in the output position within the model. This means that we want the trend level of this variable at the end of the decision-making process to be at least on the same level as at its beginning or that this level increases. With regard to this fact, we will analyse the behaviour of the model system in its linkage to the change of the trend level of this variable over time. We will also deduce under what conditions, i.e., what behaviour must the model system achieve through the behaviour and links of the component model elements that influence the level of variable $/S_S(t)/$ over time, and the activation of which will enable us to achieve the desired level of this variable at the end of the decision-making process.

We will then analyse the progress of change that variable $/S_S(t)/$ must make over time so that the system at the end of the decision-making process achieves a dynamic equilibrium state once again with regard to the variable $/S_S(t)/$, i.e., so that $\Delta S_S(t) = 0$. In such a case the transition of the model system from one equilibrium state to another does not reduce the cohesiveness between the members of the decision-making team. The decision-making process in an organization induces a disequilibrium state through the emergence of a problem that the members of the decision-making team are supposed to solve, and simultaneously, in many cases, also the existence of a possible difference of opinion of the members of the team on how to solve the problem. This means the difference of opinion associated with the formation of the decision on the solution to the problem.

A new equilibrium state of the analysed system comes about through the termination of the decision-making process, i.e., in determining the decision, based on which it will be possible to deal with the problem in the organization. With regard to the requirement of efficiency of the course of the decision-making process during the decision-making process, i.e., in the transition of the system from one equilibrium state to another, the level of cohesiveness of the members of the team must not decrease. In the framework of a new dynamic equilibrium state of the system, the variable $/S_S(t)/$ must attain a trend level at which it is possible to achieve the successful implementation of the determined decision in practice. This means that the members of the decision-making team will fully participate in the successful implementation of the determined decision in practice.

The change in time of the cohesiveness of the decision-making team members during the decision-making process is defined by an equation in the form (22):

$$\frac{dS_S(t)}{dt} = h(S_S(t); T_j(t); V_R(t)) \qquad (22)$$

Assuming that the function $h(S_S(t); T_j(t); V_R(t))$ is differentiable, or that it has, at a given point $(S_{Sp}; T_{jp}; V_{Rp})$ – the point of equilibrium – a total differential, then we can determine the change in the trend level of variable $/S_S(t)/$ during the decision-making process, i.e., $\varDelta S_S(t)$, through a total differential function $h (S_S(t); T_j(t); V_R(t))$, which will be in the form (23):

$$\varDelta S_S(t) = \frac{\partial h}{\partial V_R(t)} \cdot dV_{Rp}(t) + \frac{\partial h}{\partial T_j(t)} \cdot dT_{jp}(t) + \frac{\partial h}{\partial S_S(t)} \cdot dS_{Sp}(t) \qquad (23)$$

With regard to the requirement concerning the level of variable $/S_S(t)/$ upon attaining a new equilibrium state (an unreduced level of cohesiveness among team members), it must be true that $\varDelta SS (t) = 0$.

The meaning of differentials $dS_{Sp}(t)$, $dT_{jp}(t)$ and $dV_{Rp}(t)$:

- $dS_{Sp}(t)$ – the required change in the level of variable $/S_S(t)/$ at the beginning of the transition of the system from one equilibrium state to another, ensuring the successful implementation of the determined decision in practice by attaining the appropriate level of motivation for all team members for the implementation of this decision,
- $dT_{jp}(t)$ – the change in the level of the variable $/T_j(t)/$ at the end of the decision-making process, i.e., at the time of the new equilibrium state,
- $dV_{Rp}(t)$ – the change in the level of the variable $/V_R(t)/$ at the end of the decision-making process, i.e., at the time of the new equilibrium state.

From equation (11) we know that the rate of change of the cohesiveness of the members of the decision-making team is affected by changes in the levels of the variables $/T_j(t)/$, $/V_R(t)/$ and $/S_S(t)/$ at a specific time. A reduction of the level of cohesiveness in the team during the decision-making process can come about if the appropriate changes fail to occur in the levels of the variables of the model system that affect changes in the variable $/S_S(t)/$, i.e., in the three variables mentioned above. It is precisely with regard to these variables that we will examine the equilibrium state of the model system, and deduce what the trend level of transmissions in the model system must be for variables $/V_R(t)/$ and $/T_j(t)/$ so that, given the link to variable $/S_S(t)/$, a reduction of the level of cohesiveness of the members of the team did not come about, i.e., so that $\varDelta S_S(t) = 0$.

In the absence of the required change in the level of the variable $/V_R(t)/$ in the direction of unification of opinion on the problem and its solution during the decision-making process, then the $dV_{Rp}(t) = 0$. This means that the difference of opinion of the members of the team remains the same over time. In this case, the condition for an equilibrium state of the system with regard to variable $/S_S(t)/$ has the state (24):

$$\frac{\partial h}{\partial T_j(t)} \cdot dT_{jp}(t) + \frac{\partial h}{\partial S_S(t)} \cdot dS_{Sp}(t) = 0 \qquad (24)$$

Transmission (F_5), describing the behavior of the system in terms of necessary changes in the trend level of variable $/SS(t)/$ in the event of a change in the level of the variable $/T_j(t)/$ and under the condition $dV_{Rp}(t) = 0$, will be in the form (25):

$$F_5 = \frac{dS_{Sp}(t)}{dT_{jp}(t)} = -\frac{\dfrac{\partial h}{\partial T_j(t)}}{\dfrac{\partial h}{\partial S_S(t)}} \qquad (25)$$

Transmission (F_5) of the above changes is composed of two component transmissions of changes, namely transmissions (F_{5a}) and (F_{5b}). Component transmission $F_{5a} = \dfrac{\partial h}{\partial T_j(t)}$ and component transmission $F_{5b} = \dfrac{\partial h}{\partial S_S(t)}$.

This means that the component transmission (F_{5a}) characterizes the trend level of the speed of change in the cohesiveness between the members of the decision-making team through the influence of a change in the level of the variable /$T_j(t)$/ over time. The component transmission (F_{5b}) then characterizes the trend level of the speed of change in cohesiveness as influenced by changes that occur over time in the value of this variable itself with regard to the course of the decision-making process, and changes in the levels of other variables affecting, even intermediately, the level of variable /$S_S(t)$/.

If the requirement of efficiency of the course of the decision-making process is to be fulfilled, i.e. the initial hypothesis and the condition of equilibrium state of the model system, the character of transmission F_5 must be greater than zero ($F_5 > 0$), because with an increase in the magnitude of change of the trend level of variable /$T_j(t)$/ induced by the degree of importance of the problem for the team, the trend level of required changes in variable /$S_S(t)$/ must increase as well, i.e., the motivation of the members of the decision-making team for implementation of the determined decision must increase, even though a change in the difference of opinion of the members of the team on the solution to the problem does not come about.

At the same time, under this condition, the growth rate of change of the trend level of variable /$S_S(t)$/ in time must also rise while the level of the variable /$T_j(t)$/ rises. This means that the component transmission $F_{5a} = \dfrac{\partial h}{\partial T_j(t)} > 0$. This is necessary in order that a reduction in the levels of the variable /$S_S(t)$/ did not come about at the end of the decision-making process, i.e., at the determining of the decision (e.g. on the basis of external pressure from the team's environment or from an individual member of the team) which is accepted by the team's environment. The increase of the team's cohesiveness in time must then be realized on the basis of the action of intensive exposure to different information exchanges between members of the team, i.e., focused in a different direction than to solving the arisen problem. This can include information exchanges on the basis of friendly relations, external significant threats aimed at the team's existence as such, or the positions of individual team members, etc.

With regard to the sign of the resulting transmission (F_5), i.e., $F_5 > 0$ and the trend level of transmission (F_{5a}), it must be true, in order to achieve an equilibrium state of the model system of efficiency of the course of the decision-making process, that the component transmission $F_{5b} = \dfrac{\partial h}{\partial S_S(t)}$ is less than zero, i.e., that $F_{5b} < 0$. This condition stems from the consideration that the greater the change in the level of cohesiveness of a team at a given time (t), the lower can be the rate of change of this variable in the following time intervals of the decision-making process versus time (t), given the condition of an equilibrium state of the system and the limitation of the change required in variable /$S_S(t)$/ for the achievement of the equilibrium state of the system, and vice versa.

In the case of a reduction in the value of the variable /$T_j(t)$/ during the decision-making process (e.g. the degree of importance of the problem decreases), the character of the transmission will be preserved, only a change will occur in the requirement on the character of the course of the level of output variables for transmission (F_5) due to the trend level of transmission (F_{5a}) in the direction of reducing its value in time in the interest of achieving an equilibrium state of the model system.

If during the decision-making process a change does not occur in the level of variable /$T_j(t)$/, i.e., $dT_{jkp}(t) = 0$ while the model system is in transition from one equilibrium state to another, then the condition for the equilibrium state of the system with regard to variable /$S_S(t)$/ will be in the form (26):

$$\frac{\partial h}{\partial V_R(t)} \cdot dV_{Rp}(t) + \frac{\partial h}{\partial S_S(t)} \cdot dS_{Sp}(t) = 0 \qquad (26)$$

Transmission (F_6), describing the behavior of the model system in terms of necessary changes in the level of variable /S_S(t)/ in the event of a change in the level of the variable /V_R(t)/ and when $dT_{jp}(t) = 0$, will be in the form (27):

$$F_6 = \frac{dS_{Sp}(t)}{dV_{Rp}(t)} = -\frac{\frac{\partial h}{\partial V_R(t)}}{\frac{\partial h}{\partial S_S(t)}} . \tag{27}$$

With regard to the requirement of efficiency of the course of the decision-making process, the initial hypotheses and the condition of an equilibrium state of the system, the character of transmission (F_6) must be positive, i.e., $F_6 > 0$. This stems from the fact that with the rise in the level of the variable /V_R(t)/ during the decision-making process, which is conditional on the existence of inadequate pressure on toward the unity of opinion (the magnitude of the variable /T_j(t)/ during the decision-making process remains unchanged), an increase must occur in the required level of change for variable /S_S(t)/, i.e., the motivation of the members of the decision-making team to implement the determined decision.

An unchanged level of pressure on opinion unity may be invoked, for example, by the fact that certain members of the decision-making team at the time do not consider the problem to have such a level of importance as the other members do. Simultaneously, under this condition of the behaviour of the system, the rate of change of the level of variable /S_S(t)/ must rise over time, i.e., the component transmission $F_{6a} = \dfrac{\partial h}{\partial V_R(t)} > 0$, to avoid a reduction in the level of the variable /S_S(t)/ at the end of the decision-making process. Growth of group cohesiveness in time must then be realized as in the previous case of analysis of the equilibrium state of the system with regard to variable /S_S(t)/, on the basis of the intensive action of other information exchanges between the members of the decision-making team. With regard to the sign of the resulting transmission (F_6), i.e., $F_6 > 0$, its form and the character of transmission $F_{6a} > 0$, it must be true that in order to attain an equilibrium state of the model system the transmission $F_{6b} = \dfrac{\partial h}{\partial S_S(t)}$ must be less than zero, i.e., $F_{6b} < 0$. This condition follows from the consideration (just as in the previous case of analysis of transmission (F_5)) that the greater the change in the level of cohesiveness of a team at a given time (t), the lower can be the rate of change of this variable in the following time intervals of the decision-making process, given the condition of an equilibrium state of the system and the limitation of the change required in variable /SS(t)/ with the objective of the achievement of an equilibrium state of the model system.

In the case of a reduction in the level of variable /V_R(t)/ during the decision-making process (there exists adequate initial pressure on opinion unity), the character of the transmission will be preserved, only a change will occur in the requirement on the character of the course of the input variables of the given transmission, in the sense of reducing its value in time in the interest of achieving an equilibrium state of the model system, namely with the transmission (F_6) and with the transmission (F_{6a}).

In the above analysis of the resulting transmission (F_6) and component transmissions (F_{6a}) and (F_{6b}) describing the behaviour of the model system of efficiency of the course of the decision-making process in group decision-making with regard to the required state of the variable /S_S(t)/ in the transition of the system from one equilibrium state to another, we have determined what the character of these transmissions must be, i.e., what kind of behaviour must the system exhibit in order to attain the required changes in the level of variable /S_S(t)/ during the decision-making process.

Conclusion and further research activities

Since decision-making is the most important component continuous function of the decision-making process, which is connected with all of the other component structural functions of this process, it appears to be important to monitor and evaluate the efficiency of the course of the decision-making process. That means evaluate (determine) the level of this efficiency, analyse the weaknesses in its course with the possibility of determining the measures for their solution, and thus achieve growth in the efficiency of the course of the decision-making process (processes) within business entities, thereby also increasing their efficiency in their business activities.

Our research (whose content is presented in brief in this paper) also contributes to this what may be said to be strategic objective in the area of company management, and the necessity of continuing research work on this model system and the application of the gained insights in practice is evident.

In the following, we want to define, at least briefly, further directions in the orientation of research activities:

- By publishing our research considerations and insights, we want to initiate further discussion about the complexity of the model system we have presented for the evaluation of the efficiency of the course of the group decision-making process, along with obtaining further information, ideas to enhance the quality and functionality of the proposed model system, with the possibility of its further improvement, etc.
- Carrying out primary research in companies related to the measurement of the level of individual variables of the constructed model system, together with obtaining data to verify the possibility of quantifying the level of efficiency of the course of the group decision-making process.
- Verification of the anticipated target behaviour of the model system for the analysis of the level of efficiency of the course of the group decision-making processes in companies.
- Determination of bounds for the levels of individual variables in the model that will ensure the attainment of the desired level of efficiency of the course of the group decision-making process (group decision-making style).
- Investigating and formulating measures leading to the desired growth in the efficiency of the course of group decision-making processes in companies.

It has already been pointed out that decision-making is the most important component continuous function of a complex management process. This component function (process) is applied in all sequential component functions of this complex process. This means that the efficiency of the decision-making process in organizations significantly affects the level of efficiency of the complex management process implemented by managers in organizations, and thus the level of performance of these organizations in all their functional areas. The examination and solution of the problems of the decision-making processes, with a target orientation of increasing their efficiency, is therefore of fundamental importance. Through their research activities, the authors of this paper are also striving to contribute in this sense.

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Regional Development based on Target Adaptation of a Transport Infrastructure to Innovative Changes

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Abstract:

This article proposes a differentiated approach to the choice of regional strategies for the development of transport systems, due to the high differentiation of regions by existing and future cargo and passenger transportation, excellent geographical and climatic features, different population density. The author presents an approach based on the matrix "innovative improvement index of the transport system in the region" - "index of the regional development level", which justifies the direction of innovative improvement of transport systems, proposes the implementation typology of regional strategies for innovative improvement of the transport system. The concept "innovative transport system of the region" has been introduced. In contrast to existing approaches, it is formed based on implementation of the results of the scientific and technological progress, it provides consolidation of innovative features of system elements and represents a new level of transport systems aimed at solving problems of regional social and economic development. It is also a basis for the expansion and development of transport infrastructure in the region in the context of innovative changes in the economy. The role of innovative changes in the transport infrastructure of the region is determined. The author examines the mechanism of pre-active adaptation of the transport infrastructure to innovative changes of the economy, which consists in search determining the objectives and forming alternative scenarios for the transport infrastructure development, which ensures strategic effectiveness of the social and economic development of the region.

Keywords: socio-economic development of the region, transport infrastructure, innovative transport system.

JEL Classification: L91, O18, P25.

1. Introduction

Socio-economic development of the region is directly linked with the development and operation of a highly efficient transport system, which, in turn, should create favourable conditions for the continuous transport process with positive dynamics of development. Given that each region has different potential and strategic directions, innovative improvement of the transport system will be different.

In this article, the author answers the questions: What development strategy options of the transport system can be implemented in different types of regions? What is the place of innovative changes in the transport infrastructure? What is an innovative transport system? What is the mechanism of socio-economic development of regions based on target adaptation of the transport infrastructure to identified contradictions in development of the region? What are the formation stages of an innovative transport system in the region?

2. Methods

In the choice of strategic directions for innovative improvement of the transport system, it is advisable to use a differentiated approach, which is due to high differentiation of regions on the existing and upcoming freight and passenger transportation, excellent geographical and climatic features, different population density.

Consequently, one of the objectives is to develop an approach that allows determining the direction of innovative improvement of the transport system.

The process of identifying directions of innovative improvement of the transport system consists of the following stages:

- selection of indicators characterizing socio-economic development of the region, analysis of the indicators and substantiation of regional groups;
- grouping of regions in accordance with the selected indicators;
- determination of the type of regional development, which is necessary to substantiate directions of innovative improvement of the regional transport system.

It is feasible to use a matrix "innovation improvement index of the regional transport system" – "index of the regional development level" as a basis, needed to determine directions of innovative improvement of the regional transport system.

The index of the regional development level is seen as an integral characteristic, which is determined based on an assessment of factors by the following indicators: gross regional product, volume of foreign trade, total volume of retail trade turnover and paid services to the population, the volume of investments in stock capital, fixed assets of industries, density ratio of roads, density ratio of railroads, density ratio of navigable inland waterways.

The innovation improvement index of the regional transport system is calculated based on determining the role of an innovative transport system in the economy of the region (amount of transported goods, level of transportation costs).

Indicators of the regional development level and innovative improvement of the regional transport system are a convolution of more specific properties and criteria of this concept, which can be presented as various combinations of accounting statistics indicators, and in certain cases, expert estimates.

In the modeling process of integrated indicators of regional development level and innovative improvement of the regional transport system the resulting absolute value of the regions will be affected by the following factors: 1) the choice of base for comparison; 2) sample of accounting statistics indicators; 3) the choice of the integration method of individual specific indicators into the consolidated characteristic.

Matrix for substantiating directions of innovative improvement of the transport system in the region can look in the following way (Table 1):

Table 1 – Matrix for substantiating directions of innovative improvement of the transport system in the region

Index of regional development level		INNOVATION DEVELOPMENT INDEX OF THE REGIONAL TRANSPORT SYSTEM	
	High	Low	High
		1B development despite existing negative factors	2B the state of equifinality
	Low	4B critical state	3B positive development despite constraining negative factors

Two hypotheses underpin the matrix:
- The region with a high index of innovative development of the transport system, takes a competitive position in comparison with other regions. In fact, it determines the increase in freight and passenger traffic, increases population mobility and business activity. Essentially, there will be an increase in aggregate commercial and social effect, and therefore, the index of regional development will increase. Therefore, a regional policy should be aimed at the introduction of an innovative transport system.
- Availability of an innovative transport system in the region indicates the formation of an innovative market of transport technologies. This will lead to the selection of the transport industry, emergence of new innovative transport systems, which in the given conditions (regional features) will allow determining directions of innovative improvement of the transport system in the region as accurately as possible.

The following domestic and foreign scholars dedicated their works to the development of a management methodology of system changes: R. Ackoff, I.Ansoff, M. Porter, P. Drucker *et al.* (Ansoff 2009, Drucker 2008, Mesarovic, Mako & Takahara 1973, Yevenko, Meskon and Hedourk 1998, Porter and Alpina 2007). Based on the works of these scholars, the following approaches to managing changes are identified: 1) reactive; 2) inactive; 3) pre-active; 4) interactive. Implementation of the reactive and inactive approach presupposes maintenance of the past state or of the equilibrium state. In case with the implementation of the pre-active or interactive approach, the system is focused on the best changes in the future, including the implementation of innovations. The author believes that it is the pre-active approach that is the most promising for developing a mechanism for adaptation of the transport infrastructure to innovative changes.

3. Results

3.1. The typology of regional impact strategies of innovative improvement of the transport system on the regional development is elaborated

Based on these hypotheses, four groups of regions classification, which correspond to the different directions of the innovative improvement of the transport system, can be identified (Table 2). Thus, regional strategies aimed at innovative improvement of the regional transport system, depending on the quadrant in which they are located, can be formulated as follows:

1B. Given that the social and economic potential of the region is high, it is necessary to focus efforts on improving performance of the region's economy and creating the conditions for the integrative processes of science-production-market (operation), which will allow forming an innovative transport system in the region.

2B. Regions with developed industries and transport infrastructure, large transport companies. To avoid the chances of existing transport companies (transport monopolies) creating obstacles, it is necessary to develop organizational, legal and economic conditions for stable (active) research, development, production and operation activities in the field of transport innovations.

Table 2 – The typology of regional impact strategies of innovative improvement of the transport system on the regional development (Sandakova 2013)

Classification of the region	Characteristic of the region	Prospective development strategy	Implementation mechanism
1B. Development despite existing negative factors (high level of the region development / low level of the innovative development of the transport system)	Promising regions. There is a high socio-economic potential for the formation of an innovative transportation system	The strategy of focusing	The integration of science-intensive industries, including R & D, production, market. Creating favourable conditions for all its participants (legal entities) of the organization of an innovative transport system.
2B. Equifinal level (high level of development of the region / high level of innovative development of the transport system)	Regions-leaders. The share of these regions in the country's GDP is consistently high. The level of development of the transport infrastructure is high, above Russian average indicators. Innovative improvement of the transport system in these regions means keeping competitive advantages in the market.	Retention strategy (defense)	Creation of organizational, legal and economic conditions for stable (active) research, development, production and operation activities in the field of transport innovations.
3B. Positive development despite constraining negative factors	Regions with significant potential for innovation in the field of transport technologies. The prerequisites for the formation of an innovative transportation system are formed.	The strategy of vertical integration	Innovative environment is formed. Support of innovative research and their implementation at all levels. A high level of intellectual protection of innovative development (internal and external market).
4B. Critical state (low development level of the region / low development level of the innovative transport system)	Regions with low socio-economic potential. The low level of the transport infrastructure, high unemployment, a decline in production.	The anti-crisis strategy	Identification of internal development resources in the region. Attracting investments in order to create an innovative transport system capable of increasing population mobility and strengthening the real sector of economy.

3B. Creation of organizational, legal, and economic conditions for the integration of existing innovative research in the field of transport technologies with the real sector of the economy. Support for innovative research and its implementation at all levels. A high level of intellectual protection of innovative developments (internal and external markets).

4B. Promotion of innovative developments in the field of modern transport technologies. This promotion consists in establishing prescribing measures for the improvement of innovative transport systems at the federal level. At the same time, it is feasible to consider options of public-private partnership, which includes subsidies from the federal level, regional level and funds of legal entities for implementing these activities, or to update the existing federal programme "Development of the transport system in

Russia (2010- 2020)" (Decree of the Government of the Russian Federation No. 1734-p, 2008) and the State Program of the Russian Federation "Development of Transport System" (Chuprov 2012).

Further implementation of the formation strategy of regional innovative transport system in its formulation and implementation should be based on the following principles:

- focus on the priority directions in the field of innovative transport research;
- activization of state influence in conjunction with the observance of the competition mechanism in the innovation sphere;
- creation of a motivational system, including the methods of direct and indirect support of innovative transport system formation;
- principle of cost-effectiveness;
- consideration of regional conditions in the formation of an innovative transport system;
- the systemic principle, which supposes the development of the formation mechanism of an innovative transport system, including the integration of R & D, production of vehicles and the market, as well as conformity and interrelatedness of all levels of government (federal, regional, municipal, corporate).

Development possibilities of an innovative transport system depend on the strategic choice in the region, which can change under the influence of external and internal factors (Denisov and Kolesnikov 1982, Sadovsky and Yudin 1969, Casti 1982)

3.2. Adaptation of the transport infrastructure to innovative changes

3.2.1. The role of innovative changes in the transport infrastructure is determined

As an interdisciplinary concept, adaptation refers to the adjustment process to changing environmental conditions. Adaptation allows evaluating the system's ability to identify target-oriented adapting behaviour in complex environments (conditions) and the stages of the adjustment process in view of adaptation, that is, a variety of conditions to which the system can be adapted by changing its structures. Two kinds of adaptation are distinguished. Adaptation of the first kind is transition of the system from one state to another, both by virtue evolutionary changes taking place within the system, and external changes, related to the processes of economic homeorhesis. Adaptation of the second kind is maintenance of the system operation within the limits of a single state subject to changes in its structures within the possibilities of self-financing, and is related to economic homeostasis.

When exploring the issues of adaptation of the transport infrastructure, it is important to understand the role of innovative changes, development prospects of new transport systems. Determination of new prospects for the development of transport systems is one of the biggest challenges of long-term prognosis. It is feasible to divide all factors into groups: demand, supply, and regulatory. Demand factors include the need to develop new areas, the need to develop the mineral resource base of the Siberian and Far Eastern regions, the need for fast and affordable cargo and passenger transportation. Supply factors include scientific and technical developments in the field of new transport technologies, new vehicles. Regulatory factors include legal documents, regulating regional development, transport and the transport system.

One of the main challenges in the introduction of innovative transport systems into the transport infrastructure is observed in the recent moral aging of existing generic transport systems and, above all, generic vehicles, the slowdown in demand for these generic vehicles. A striking example is the river transport system, characterized by low speed (up to 70 km/h), limited passableness and seasonality. Against the background of the current demand for year-round and high-speed transport, the river transport system cannot compete with other types of transport systems. On the other hand, the demand for the air transport system is also limited in view of the high cost of tariffs for the transportation of goods and passengers. The rail and road transport systems occupy the main niche of freight traffic in the country. The demand for these types of transport systems does exist, but there are limitations due to the absence of developed rail and road infrastructures, especially in the Siberian and Far Eastern Federal Districts. Thus, it can be assumed that the functional niche for innovative changes in the transport infrastructure exists and presents new technologies that allow meeting needs of the society and the economy in high-speed, affordable, year-round transport with maximum traffic capacity, which do not require significant investments in the transport infrastructure.

3.2.2. The essence of innovative transport system is determined

The strategic goal of creating an innovative transport system in the region is to meet the needs of population, enterprises and organizations of the Siberian Federal District in high speed, year-round transportation of passengers and various types of cargo.

In the opinion of the author of the article, an innovative transport system is a transport system, the quality development of which is implemented based on the development and introduction of vehicles with high ecological –technical-economic characteristics, the development and introduction of new transport technologies and improvements in the transport process as a whole. (Sandakova 2014)

In mathematical terms, an innovative transport system (ITS) is a set of components, provided that the need for capital investments, required for the construction of infrastructure, cost of transportation and ecological impact on the environment, tends to minimum, and the speed of cargo and passengers' transportation tends to maximum.

$$ITS = (k, s, p, e) \tag{1}$$

where k – investment → min;

        s – speed of transportation → max;

        p – cost of transportation → min;

        e – ecological load → min.

It is innovative transport systems that are able to bring the transport infrastructure of the region to the priority development level in relation to the economy of the region as a whole, and not vice versa. A situation where regional budgets finance local passenger transport is common, but unnatural in a market economy. Therefore, it is necessary to present new requirements for vehicles, consider new approaches to the formation and operation of transport systems, which will allow the regional transport infrastructure to integrate into a unified transport system of Russia effectively, and in the context of globalization into the global transportation system.

Additionally, it is envisaged that an innovative transport system provides special services and functions that allow reaching a new level of guaranteed social services for population:

- Rescue;
- Emergency technical and medical assistance;
- Patrol, ferry and travel;
- Geological exploration and mail;
- Other specialized tasks.

Innovative improvement of the transport infrastructure is of a multi-level character:

- Improvement and development of new vehicles and service systems;
- Improvement and development of new transport systems;
- Improvement and development of the regional transport infrastructure as a whole.

Depending on the intended purpose, a complexor a combined variant of innovative development are possible. The main improvement directions of innovative transport systems are presented in Table 3.

Table 3 – Innovative improvement directions of innovative transport systems

Direction	Main point
Increase in efficiency	Technical and organizational improvement aimed at improving the quality of economic and technical characteristics
Combination of properties	Combining features of various kinds of transport systems into a single unit in order to expand the availability area by technical and economic parameters
Change in the principles of operation	Application of the results of scientific and technological progress in practice in order to create new types of transport systems and vehicles.

An equally important point is the demand for the development of the territories of the Siberian Federal District with the aim to include a rich mineral resource base of the region into the turnover. Implementation of the Strategy of socio-economic development of Siberia until 2020 (Decree of the Government of the Russian

Federation No. 1120-p, 2010) envisages the increase in dynamics of economic development of the Siberian Federal District in 1.65 times in comparison with 2007. This will require new approaches to the organization of freight traffic in the region. According to the innovative variant defined by the Transport Strategy of the Russian Federation for the period up to 2030 (Decree of the Government of the Russian Federation No. 319, 2014), the development of the transport system will be based on accelerated and balanced development of the transport infrastructure of the country, allowing the transport conditions for the development of an innovative component of the economy, improvement in the quality of life of the population and the transition to a polycentric model of spatial development of Russia (Economic aspects of the development of the Russian transport strategy, 2003).

In contrast to the target demand, which satisfies specific needs, the demand for innovative changes in the transport infrastructure will be formed by the offer of innovative vehicles and technologies. At the same time, the emergence of innovative vehicles will create conditions for their production and promote the positive dynamics of the demand.

3.2.3. The role of innovative changes in the transport infrastructure is determined

Examining the role of innovative changes, it is important to understand in what niche their competitive properties can manifest themselves more fully.

Currently, the modern transport infrastructure is represented by air, railway, road, river and sea transport systems. Functional features of the air transport system lie in the ability of high-speed long-distance traffic. In view of the high cost of tariffs, the air system is usually represented by passenger traffic (90%). The growth rate of air traffic steadily grows and reflects the level of income growth. Not one generic transport system can compete with the air system in terms of speed (up to 700 km/h). The functional characteristics of the railway transport system refer to the independence from weather conditions, acceptable tariffs and developed infrastructure (particularly in the central part of Russia). Growth rates of cargo traffic tend to increase. However, high energy consumption, capital intensity, insufficiently high level of logistics flows management, seriously affect the development of this transport system on new territories. The road transport system is characterized by a developed transport infrastructure, weakly dependent on weather conditions, it has relatively low tariffs for cargos, but requires a significant investment in the construction and maintenance of roads in proper condition, and also has a high share of fuel costs. The river transport system practically ceased to exist, due to the high costs of dredging, lines equipment, low-speed of traffic, moral aging of ships. The share of the cargo river transport system is insignificant and is generally carried out in areas where the exploitation of other types of transport systems is limited. The maritime transportation system also has serious problems in its development, which are associated with the global trend towards high-speed traffic and the absence of demand for all the fleet.

Thus, it can be assumed that the emergence of innovative changes in the transport infrastructure that are able to take a pre-existing niche of the river and maritime transport system and will not cause major fluctuations in cargo among existing generic types of transport systems, but will be able to bring maritime and river traffic to a new level. That is an existing developed network of the water transport system can become promising operation routes of innovative vehicles, provided that additional costs for dredging and the construction of additional infrastructure will not be required.

Modern inter-city passenger and long-distance cargo motor transport enterprises as the most streamlined transport systems in Europe and the USA, can serve as an analogue for implementing innovative changes in the transport infrastructure.

In the Siberian Federal District and in a range of RF entities, in view of low population density, special climatic conditions and systematic problems of the "Northern Supply Haul", it is rational to form two characteristic types of transport systems:

- Cargo and passenger transport system (CPTS) for passenger services and supply of settlements with life support products (consumer goods, food, etc.). The prototype is taxis, auto-lines, intercity express buses.
- Cargo transport system (CTS) for the transportation of industrial goods, supply of companies in the region (fuel, building materials, production of companies). The prototype is air transport aircrafts AN-12, IL-76, AN-124.

Undoubtedly, the first type of the systems is of priority, as it will ensure population viability in the region, the second type of systems will be able to contribute to the development in the region. Characteristic standard sizes and technical appearance of new vehicles, given their specific designated purpose, must correspond to each variant of the systems.

3.2.4. The mechanism of socio-economic development of regions, on the basis of target adaptation of the transport infrastructure to the identified contradictions in the development of the region, is suggested

The following provision may be the goal of the transport infrastructure adaptation to innovative changes:
- Formation of a competitive transport service (innovative technologies);
- Introduction of new vehicles (innovative product);
- Development of new territories (innovation growth);
- Formation of a new organizational structure, systems for development control (organizational and managerial innovations).

It can be assumed that the choice of the strategic development goal may be limited both by one target provision and by the whole set.

As a condition for a system change, environment is traditionally viewed as external and internal. It is considered that the internal environment is an environment formed within the system. In our case, the influence factor of the internal environment is associated with the scientific potential of the transport infrastructure, innovative management potential, innovation-investment potential, production potential, human resources potential and innovative marketing potential. The external environment influences the development of the transport infrastructure by means of such factors as demand (presence of consumers), competitors (innovations development level of competitive systems), natural factors, political factors and social factors, including demographic, economic factors, scientific and technical progress.

Modern scholars (Zainetdinov 2005, Akkof 1974, Gerlovin 1990, Chuprov 2012) pay more and more attention to the structures that are able to reproduce themselves, their own capabilities and possibilities of its own production. Typically, the clusters are considered. These clusters have such a synergetic property as self-organization and are able to keep a balance "between order and chaos", have some degree of flexibility and adaptability. In general, stable relations, information efficiency, a certain specialization, the ability to generate innovations, characterize clusters.

The mechanism for implementing innovative changes in the transport infrastructure is based on a process of target adaptation and the development of innovative transport systems within the framework of changes in the economic space of the region (Figure 1) (Sandakova 2015).
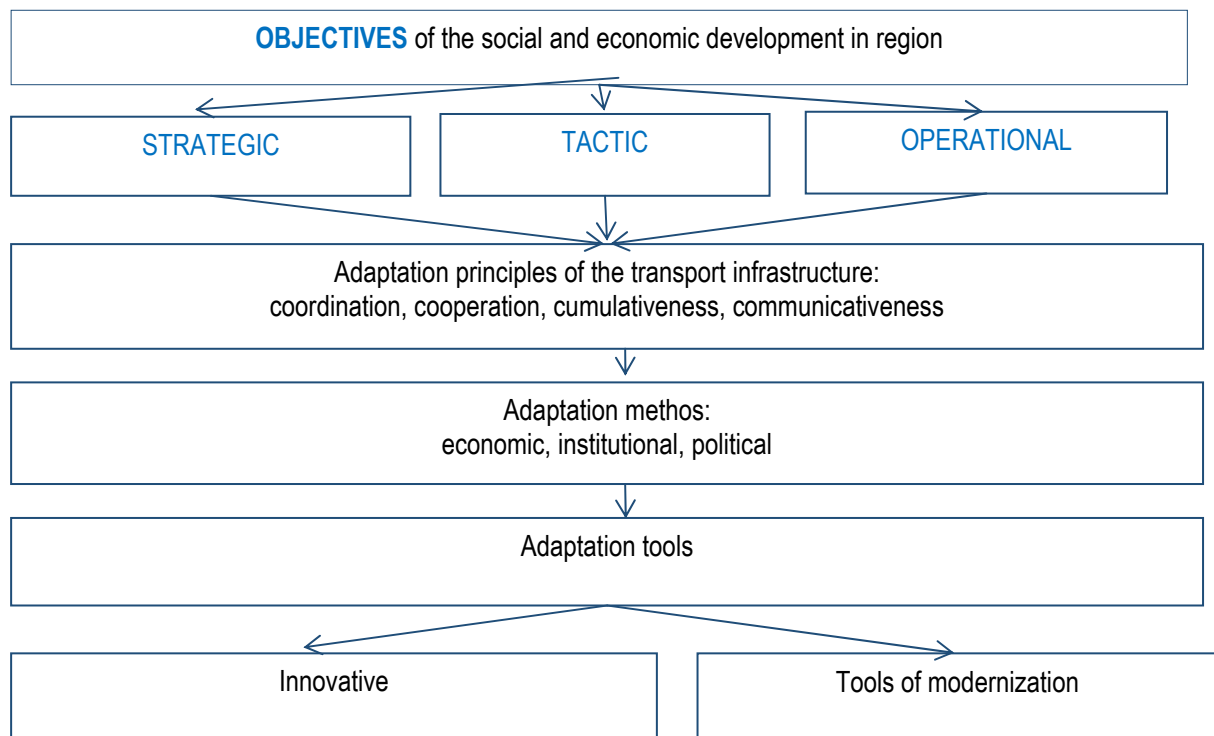
Figure 1 – The mechanism of regional socio-economic development based on the target adaptation of the transport infrastructure to identified contradictions in the development of the region

The adaptation methods of the transport infrastructure may refer to economic, organizational and political methods (Figure 2).F or the accelerated development process of the transport infrastructure, the practical support of the federal and regional governments will be required, which reinforces the role of political methods of influence on the adaptation mechanism of the transport infrastructure. Formation stages of an innovative transportation system are presented in Table 4.

Table 4 – Formation stages of an innovative transportation system

FORMATION STAGE	THE STAGE CONTENT
To identify opportunities and the need to develop transport potential	To define prerequisites for the formation of the innovative transport system by identifying contradictions in the development of economic space
To define the development principles of the transport potential	Intensification of the processes of resources exchange in the region contributes to the unification, supplementation, replacement, output and input of transport systems to ensure their comprehensiveness, flexibility, adaptability and efficiency
To develop an innovative transport system	To transfer innovations from other regions, develop intra-regional innovative transport systems based on the formation of the research and production complex (innovation cluster)
To implement the innovative transport system	To introduce the innovative transportation system into the existing transport infrastructure in the region through the development of the research and production transport cluster
To evaluate the effect from the introduction of the innovative transport system	To determine the effectiveness of the innovative transport system implementation for the socio-economic development of the region.

This procedure allows introducing innovative transport systems into the region's economic space as an addition to the basic space within the paradigm of viable and self-developing systems. The result of target adaptation of the transport infrastructure to the identified contradictions will be the emergence of an innovative transport system in the region.
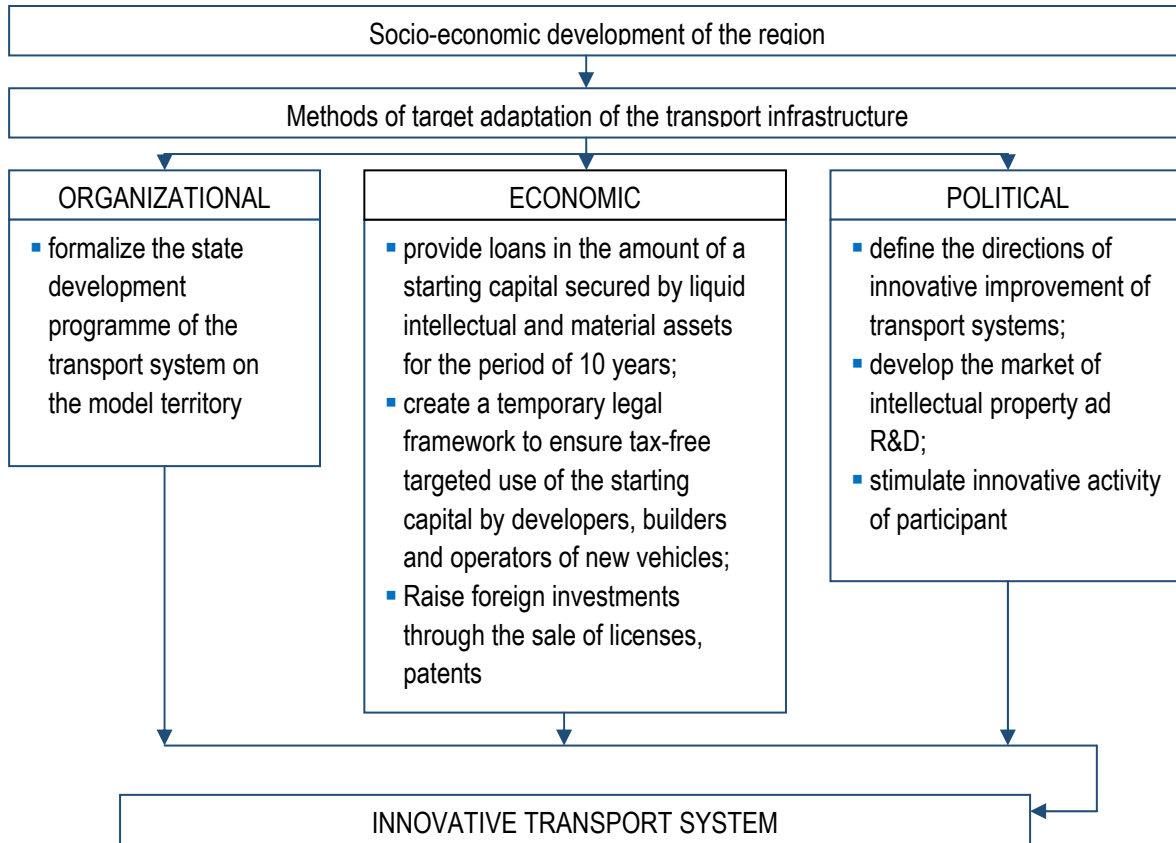
Figure 2 – Methods of target adaptation of the transport infrastructure

4. Discussion

To summarize, the author brings the following provisions to the discussion:

▪ The demand for innovative changes in the transport infrastructure will be formed by the offer of innovative vehicles and technologies. At the same time, the emergence of innovative vehicles will create prerequisites for their production, and stimulate the positive dynamics of demand.

▪ The river and maritime transport systems can become a potential niche for the emergence of innovative changes in the transport infrastructure. This will not cause major fluctuations in cargo traffic among existing generic types of transport systems, but will bring maritime and river transport to a new level.

▪ Promising directions of innovative development are currently based on the synergistic association of properties and advantages of the traditional forms of transport systems, as well as the introduction of new transport technologies and means.

▪ In general, for the regions with low population density and special climatic conditions, the innovative transport system must meet the following requirements: to provide year-round transportation and be little dependent on weather and climate conditions; not to require large capital expenditures for the construction of land capital facilities; have a high efficiency; have a sufficiently high speed; have a high traffic capacity.

▪ In the author's opinion, the most promising approach for developing the adaptation mechanism of the transport infrastructure to innovative changes is pre-active.

▪ The mechanism of target adaptation of the transport infrastructure to the changes in the economic space of the region is based on the pre-active approach. The purpose of the transport infrastructure adaptation to innovative changes in the economic space can be for the following: formation of a competitive transport service (innovative technologies); introduction of new vehicles (innovative product); exploration of new territories (innovation growth); formation of a new organizational structure, the system for control development (organizational and managerial innovations).

▪ The mechanism for introducing innovative changes into the transport infrastructure is based on the process of deliberate adaptation and development of innovative transport systems within the framework of changes in the economic space of the region.

Conclusion

The author would like to thank the international scientific community, the business community, as well as the administrative structures of the region for their assistance in the preparation and for their interest in this work. Special thanks to the East Siberian State Technological University, with the means of which this article has been prepared.

Further research on this topic will be aimed at developing the organizational and managerial mechanism of introducing innovative transport systems into a regional transport infrastructure, at assessing the effect of the innovative transportation system on the social and economic development of the region, at elaborating the development strategy for the transport infrastructures of the regions with low population density and large territories.

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The Analysis of Significant Common Attributes of Websites in the Context of the Most Prestigious World Universities

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Abstract:

The aim of the article is to describe specificities of using e-marketing tools on the websites of selected internationally important institutions of higher education. The article summarizes the theoretical basis of Internet marketing, focusing on higher education institutions. Based on the research the article describes the current state of the use of e-marketing tools by the websites of the selected internationally important institutions of higher education. In addition, the article also provides the technical point of view on the issue. Another aim of the article is to evaluate the opportunities this issue brings for marketers and it also shows its pitfalls.

Keywords: e-marketing, website, higher education institutions, top universities

JEL Classification: M30, M31.

1. Introduction

Online environment offers organizations a wide range of promo possibilities, easy dissemination of information about products, services or brand. Online environment represents an undeniable advantage and strong communication channel. It should be emphasized that funds invested in online marketing activities are negligible compared to other forms of promotion, and online advertising is accessible continuously. Targeting in the online marketing is much more direct than conventional methods. The high degree of interaction helps to build good relationships with customers, from this perspective Internet has introduced new types of communication rules in field of marketing that generates new dimension between customers and organizations through efficient relations affecting primarily reputation and image of the organization. The individual components of the marketing mix and online communication are areas that are very closely linked which significantly helps to promote new products and services, reach out to new target groups of customers and also helps to build a positive image. This form of communication has certain positive characteristics such as precise targeting, personalization, interactivity, usability of multimedia content, and easy efficiency measurability at relatively low cost (Šoltés 2013, Šoltés 2015, Szabo *et al*. 2013; Castro *et al*. 2004).

These facts appear to be crucial from the viewpoint of their utilization in business sphere marketing activities, as well as in academic environment. There are authors who presents the opinion that institutions of higher education should be presented more outward, like it is with corporate brands (Pudło and Gavurová 2012, 2013, Schüller and Chalupský 2012). According to the authors as Whelan & Wohlfeil (2006) or Maringe & Carter (2007) academics and managers of higher education institutions have to consider the marketing not as an outside idea imported from the business world, but as both a suitable logic and system for building up a higher education sector which meets the needs of home-based and international customers.

In relation to this topic, numerous authors specialise in e-marketing communication tools, where the main focus is on website evaluation, e.g. Nielsen (2000), Bauer and Scharl (2002), Khan (2013). Their research focuses on the possibilities of the use of e-marketing tools for marketing communication and enhancing the quality of websites as well. Higher education institutions marketing is becoming increasingly debated issue. We meet with the opinion of the authors (Kaplan and Haenlein 2010, Krombholz *et al.* 2012; Durkasree and Ramesh 2011, Carlos and Rodrigues 2012), that marketing does not belong to this field, since comparing institutions of higher education to profit-seeking organizations is, at least, unethical. On the other side there is an opinion that has explicitly positive attitude and argues in favour of marketing management of organizations. The development

of the society and the development of management and marketing training of organizations caused greater awareness about the marketing among public and also private institutions of higher education.

We can agree, that higher education institutions are focusing primarily on providing services similar to other market subjects, where the students represent the customers who realise their buying decisions, it is the choice of an educational institution based on available information, as well as the image (Shanka, Quintal and Taylor 2006).

The current image of a higher education institution is commonly based on its earlier reputation and at the same time displays relative stability. For this reason, change can only be effectuated by long-term and patient work. The image is influenced by subjective and also objective characteristics of the selected higher education institution. In case of objective features, their change is very complicated (Světlík 2009). In many cases, it requires increase in the marketing budget (Michalski 2014).

Notional physical distance is overcome in environment of the Internet with ceaseless communication using organisation website and other tools of e-marketing (Belch and Belch 2007, Keegan and Green 2008). We can find many authors concentrate on these issues, such as Hew and Cheung (2013), Rahimnia & Hassanzadeh (2013), Gray *et al.* (2013), Krombholz *et al.* (2012), Durkasree and Ramesh (2011), Michalski (2010) and Kaplan and Haenlein (2010), Bauer and Scharl (2002).

Based on the above and on research carried out in this field, the aim of this paper is to describe the findings of the research aimed to identify common significant attributes of the websites of few internationally important higher education institutions as well as to describe the findings of the analysis focused on technical implementation of their web sites.

2. Methodology

When carrying out the research - identifying significant common attributes of websites of internationally important institutions of higher education – we used the ranking system "Webometrics Ranking of World Universities", which, as the only one in the world, evaluates educational institutions based on the values of selected attributes. Rating process is carried out twice a year, conducted by the largest public research body in Spain "Investigaciones Científicas Consejo Superiorde." The base set for this case consisted of 11,992 universities and the research sample consisted of 100 top-ranking educational institutions. The aim of the ranking is to promote web presentations of educational institutions with the aim of increasing the transfer of scientific and cultural knowledge acquired at universities. Therefore, the existence and regular update of such a list is one of the most powerful tools for implementing the changes necessary in the academic world with the regard to the long-term strategy. The task of such ranking list is to motivate educational institutions and academics to reflect their academic excellence online in full light.

The above-described ranking is based on the evaluation of multiple variables with regard to the online presentation of higher education institution. Specifically, there are two main evaluation areas that are then decomposed into specific evaluation criteria (Webometrics 2015):

- Visibility – 50%
    - *Impact* - The basis for calculating this indicator consists of the total number of back links - the links pointing to a website of the educational institution and the total number of domains from which these backlinks come from.
- Activity – 50%
    - *Presence* – 1/3 - This indicator represents the value of the total number of static and dynamic web pages located at the domain of educational institutions including subdomains. For the purposes of this indicator we take into account the number of indexed websites in Google.
    - *Openness* – 1/3 - The indicator reflects the number of scientific publications (in pdf, doc, docx, ppt) published in the academic search engine Google Scholar.
    - *Excellence* – 1/3 - This indicator represents the number of publications in scientific journals with high impact factor. It takes into account 10% of the most quoted publications in the scientific field of the educational institution.

During the research we used custom analysis and subsequent synthesis of the findings in the form of common attributes. The data for the subsequent analysis and synthesis took place in the first half of 2014. The analysis focused on the design, function and content elements of the examined websites. When obtaining the data (number of images, number of links, the proportion of links within institution domain, portion of original links, the number of errors in the source code) we used online tool Site-analyzer.com.

Results and Discussion

As we mentioned above, the research sample comprised of 100 top-ranking higher education institutions according to the above ranking. This group of educational institutions was dominated by institutions from North America with a share of 73%. The second most represented group was represented by educational institutions from Europe with a share of 16%. Asia accounted only to 9% of educational establishments and the smallest proportion belongs to Latin America with a share of 2%. Based on the analysis of above mentioned survey sample and the subsequent synthesis of the findings we identified these significant common attributes of websites:

A navigation menu focused on the target audience (functional element) – In up to 71% of the analyzed educational institutions' websites we have identified a navigation menu focused on the target audience. Specifically, these were website sections containing information for academic staff of the institution, students, jobseekers, graduates, parents, visitors and the local community. This element in most cases formed a part of the main navigation menu in the header of the website or was clearly visible in another section of the website (the main body or the side panel or the web page).

Presenting the content through a slideshow (design / functional element) - This dynamic form of presentation was identified in up to 82% of the analyzed websites. A slideshow can be compared to the classic billboard that provides the user with only a fraction of the information and encourages him to obtain full information. Often the content of the slideshow presented the major news events in the educational institution and links to static content such as information on admission procedures or the achievements of the individual institutions. This element is placed on the home web page as the content with clearly visible body (part of the website), with the range of 2, ideally up to 5 slides. Formally, the slideshow consists of the visual field (quality photos, video), text and a link (hyperlink) to the target website.

Information about upcoming events (content element) – This attribute found in a form of separate section devoted to the planning of the event was present in 62% of institutions. The same information presented in the form of content blocks (in the form of posts) was placed on the home web page of the institution referring to the section containing all the posts within this section in the limited extent. The home page features recently added events or those current - future events (2-5 references). In most cases information on upcoming events featured as a twin to the general updates that were present in 91% title pages of surveyed educational institutions.

Content-rich website footer (design / functional element) – In 54% of the analyzed websites we identified content "rich" website footer. The term rich website footer means the part of the website in which are placed links to important sections of the website, or other links. The section also features links to institution profile of social networks, contact information or a simple contact form. From a functional point of view it is a supplement to the main navigation menu, enabling users to access the content - each section of the website - faster. Despite almost 54% representation of this feature we consider it to be an important part of websites, especially for large content websites of educational institutions.

Links to social network profiles (functional element) – Up to 89% of the analyzed websites contained links to the institution's profile on a social network. In most cases it was a clearly identifiable grouping of links to these social networks that had visual character (logo of social networks) or combined visual element and text. It should be emphasized that up to 79% of educational institutions surveyed use more than two social networks.

Another interesting finding is the fact that 35% of the surveyed educational institutions use five or more social networks to communicate with the target audience. The group of social networks used by educational institutions was dominated by social networks like Facebook (88%), Twitter (87%) and YouTube (78%). The significant finding is that social network Instagram focusing on photo sharing is used by 33% of surveyed educational institutions. On the other hand, LinkedIn network is used only by 31% of surveyed educational institutions.
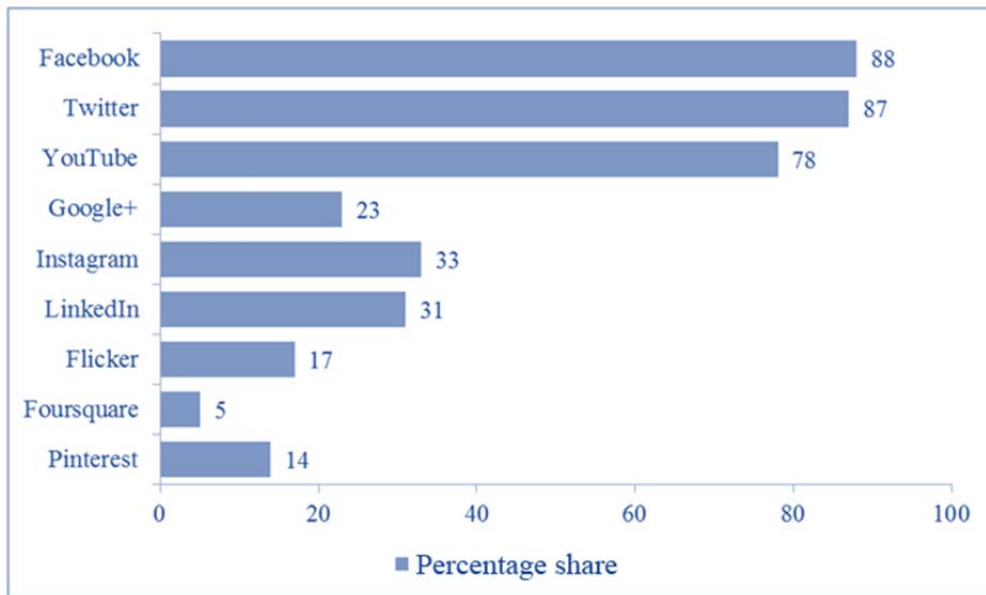
Source: Own work

Figure 1 - The share of identified social networks

The section dedicated to alumni – (content element) - Another common attribute of the surveyed websites is a section dedicated to graduates that was identified in 89% of the institutions. In most cases, the reference to that section was located in the navigation menu aimed at the target audience. In addition to general information about the alumni club the section dedicated to the alumni club included information on membership, news, links to profiles on social networks or planned events and also a closed section for members of the club. It should be emphasized that 71% of educational institutions has alumni club web site on a separate domain – a subdomain, for example Alumni.harvard.edu.

Published articles in the form of a blog (content element) – The theme - specific articles in the form of a blog were identified in 94% of the analyzed websites. For this e-marketing communication instrument it must be stressed that the instrument was used at the university level as a whole, at the level of faculties, also by academics and students themselves. It is worth noting that in some cases educational institutions had a blog aimed at potential students – future applicants. Appendix N includes the actual example of the attribute.

E-mail newsletter (functional element) – Regularly sent e-mail newsletter, like profiles of educational organizations on social networks and posts published in the form of a blog is a channel of communication the organization uses to communicate with the target audience. In the field of education a newsletter can be considered an appropriate tool for marketing strategy called "push" that can be used to deliver relevant and important information to the target audience (eg. major events - news, important dates, announcements related to studies, etc.). It should be stressed that only 2% of surveyed web pages featured a subscription form for a newsletter (or a link to log in) on the front web page. Overall, this tool is used by 89% of surveyed educational institutions. Like the blog, this tool is used broadly, as it focuses on prospective students, students, parents, alumni, as well as the academics themselves. It is worth noting that in some cases the content of the newsletter (a separate issue) was published on the website of the educational institution in the form of the archive. In the case of this attribute we expect its usage also on internal (non-public) level in terms of intranet or within a database of email addresses of the organization.

The above-described common attributes of the analyzed websites are considered to be significant for a number of reasons. The first reason is their large occurrence within the selected group of educational institutions. One could say that in some cases they are standard or it is a standardized structure of a web page. Specifically, these are attributes such as navigation menus aimed at the target audience, slideshow, links to profiles on social networks, or rich footer of the website. Another reason is the fact that these are functional elements of websites whose role is to clarify and simplify user navigation on these websites. These websites also feature identified attributes such as navigation menus aimed at the target audience, or rich footer website. It is also about the very content through which educational institutions present themselves to target audiences and communicate through it. In this case these are the identified attributes such as news, information about current events, extensive section dedicated to graduates or thematically diverse blogs. Last but not least, there are marketing tools of

communication policy such as profiles on social networks or a newsletter through which an organization actively reaches out to the target audience. From the perspective of educational institutions these are considered to be ancillary channels of communication within the main communication channel - the organization's website through which the institution can directly reach target audiences with relevant information.

In order to identify significant common attributes of educational institutions' websites we also focused on the analysis of graphic elements frequency (images in jpeg, jpg, png, gif, etc.), frequency of links and the frequency of errors in the source code on the front web page of the institution. The reason for examining these variables was our aim to explore the general characteristics of websites of globally important educational institutions, namely their home web pages that represent imaginary gateway for its users.

Table 1 - Examined variables t the home page

Examined variables at the home page	Median	Modus	Average
Number of pictures	13,00	11,00	17,89
Number of links	123,50	106,00	146,71
The proportion of links within own domain	57,95	78,70	59,39
The proportion of original links	81,15	87,7	80,03
The number of errors in the source code	11,00	18,90	25,37

Source: Own work

For graphic elements, their average number in the group of surveyed websites was 18, where the min. number was 10 images and max. 93 links. In this case it should be noted that this figure should be taken into account as indicative and not decisive, because the very nature and structure of the arrangement of graphic elements is not dependent on the maximum number, but rather on the quality of processing and ultimately on the individual's subjective assessment. On the other hand, if the number of links on the home web page is high, this situation can be seen mostly as unfavorable due to a possible lack of clarity – resulting in a problematic orientation for the user. It should be emphasized that, as in the case of the graphic elements, a perception of the user depends on the overall layout of the web page – its design. The average number of link on the home page of educational institutions amounted to 147, where min. value consisted of 49 links and max. value was 611 references. Another examined area was the structure of the aforementioned links. We focused on the portion of links leading to web pages within the same domain (excluding subdomains) and links leading to other domains. This variable assesses whether the website is a gateway or an exit to the websites of other domains. The recommended value for this indicator in terms of SEO is 50% or more (VSI Technologies 2014). Observed average value for this indicator represented 59% (min. value: 5, max. value: 99), corresponding to SEO requirements. One of the other variables in terms of SEO was the number of duplicate links to home web page. In this case the average value of original links represented 80% (min. value: 47, max. value: 98), which can be considered as a positive outcome since the recommended share, according to SEO values, represents more than 90% (VSI Technologies 2014) . It should be emphasized that duplicating can also be intentional. An example is a content-rich "footer" of the website that features this links in order to facilitate user navigation. Based on similar principles we can identify duplicated links throughout the website.

A final research variable within the general web analysis of the specified research sample is the number of errors in the source code according to standards (ie, character set, rely on XHTML) on which a website is created. The purpose of these standards is to ensure a full display of a webpage by Internet browser and web accessibility robots (crawlers) of Internet search engines such as Google or Yahoo. Found mean value of errors in the source code for the examined websites amounted to 25 (min. value: 0; max. value: 509). In terms of SEO, there is no minimum value of acceptable number of errors in the source code, since the nature of any error can have different nature, ie some errors are not noticeable to the user and others are visually recognizable. The same can be applied to the robots search engines. The reason for errors in the source code is the content that is added by the owner of the website (for instance the dynamic sections such as news, events, or changes in static content sections that were originally created by the creator of the website and so on).

Conclusion

It is common that the quality of higher education institutions is not sufficiently manifested in their marketing activities, as is the case of the Internet environment. We agree with author Štefko (2003) that many researches increasingly point to the fact that high quality and respected higher education institution is mainly the product of a good management that is not afraid to change established stereotypes and also understands the institution as an entity which has to be efficient and active in field of marketing.

It should be emphasized that in the context of the research we identified a greater number of common attributes shared by surveyed websites. The reason for their absence among the most important factors is the fact that their character is highly generic / generally applicable when creating a website. It is mainly about design and content elements such as horizontal navigation menu identified in 80% of educational institutions or the presence of the search option in the top right corner of the web page, which was identified in 95% of surveyed websites and so on. The opportunities offered by online Internet environment to educational institutions generally represent the creative possibilities of using a wide variety of marketing tools which, in conjunction with the website, can be characterized as a cost-effective. Furthermore there is the possibility of immediate progress monitoring, and its management in real time. These facts push the online environment of the Internet as a medium to the fore against traditional media and forms of advertising. Internet thus becomes undeniable tool in building a positive image and reputation of any organization.

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Innovative Aspects of Development of the Customs Union under the New Economic Conditions. Problems and Prospects

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Abstract.

This article examines the impact of economic integration on national economies of the Customs Union. Scientific works of both domestic and foreign authors were reviewed and analyzed for this purpose. The study showed that in a globalized economy, the regional economic integration is an important factor in strengthening the interaction and interdependence of countries in the regions, which resulted in the national economy moving to a new level of development. The positive and negative effects of integration are revealed. The rationale for the development of innovative ways of integrating the economies of the Customs Union member states and forming a single economic space is provided. The experience of successful integration associations of the world and the prospects of development of relations between the member states in the format of the Eurasian Economic Union allow to consider the integration potential as a significant positive factor in economic development in the long term. The authors conclude that integration contributes to the formation of an effective model of adaptation to geo-economic changes occurring in the global economy and helps coordinate the participation of countries in solving global economic problems. Favorable prospects for increasing the global competitiveness of the Eurasian Economic Union in the field of innovation and investment policy are due to the presence of a potentially large market of the Union, existing technical structure, common tasks of reform to modernize the economy and strategy of development of industrial enterprises and production. Based on the analysis, the priorities of further deepening of the integration process of the three countries under the conditions of building the Customs Union were identified

Key words: integration, the Customs Union, innovative development, competitiveness of national economies.

JEL Classification: F15.

1. Introduction

The novelty of this work is determined by the fact that the processes of integration in the world economy are today one of the basic laws of the development of economic relations, but at the same time one of the main ways to increase the problems caused by globalization. Benefits, which are resulting from the integration and incorporation of economic potentials of the states with the aim to obtain the effect of the development of national economies, allow to build an entirely new strategy for economic and trade cooperation, largely restore the broken bonds and create new mechanisms of interaction, which would correspond to the modern geopolitical realities (Atarov and Sandu 2014).

International experience shows that integration contributes to the formation of an effective model of adaptation to geo-economic changes taking place in the global economy and helps coordinate the participation of countries in solving global economic problems. Favorable prospects for increasing the global competitiveness of the Customs Union member states in the field of innovation policy are determined by the presence of potentially capacious market of the Community, the current technical structure, the common tasks of reforms aimed at the modernization of the economy, the development strategy of industrial enterprises and productions.

The need for modernization of the economy is closely linked to innovations, which ensure the quality of investments (Romanova and Noskova 2014, Noskova and Romanova 2014). The central task of the Customs Union member states is the formation of a new innovation policy that would integrate scientific, technical, economic, financial and organizational capacities of the countries in the field of innovation.

The task of this work was to validate the innovative aspects of development of the Customs Union under the new economic conditions, evaluate the prospects of development of the Customs Union member states and define the priorities for cooperation between Russia, Belarus and Kazakhstan in the process of deepening integration processes.

2. Methodology

The research was based on fundamental methodological and theoretical studies of Russian, Kazakh and foreign scientists and experts in the field of integration processes and the priority directions of innovative development of the economies of the Customs Union member states.

The methods of comparative, structural, functional, abstract and logical analysis, statistical processing of empirical data and forecasting were used to achieve the goal of the work. Individual facts were analyzed, grouped and systematized.

Theoretical methods: abstraction, deduction, formalization and general logic wereapplied to formalize and generalize the results of the research. The works by Viner J., Meade J., Shimko P., Gurova I., Akopova E., Voronkova O. and Gavrilko N. served as the theoretical basis for the study of integration processes and their impact on the competitiveness of the economies.

In the process of developing the topic, the works of the leading domestic and foreign scientists on economic cooperation in the deepening of the integration processes of the Customs UnionTemirbekova A.B., Nikolaeva I.P., Muzaparova L., Baliev A., Enin Yu.I., Sarsembekov N., Mansurov T., Korneev A.N., Vasiliev I.V. and Abramov M.M. were used.

At the same time, the issues of investment cooperation in the deepening integration processes and the prospects of forming a common strategy of economic development of the Customs Union member states continue to be controversial and necessitate their theoretical understanding and clarification.

3. Outcomes

3.1. Integration and competitiveness of the economies

Competitiveness and integration are related processes. Integration of the country into one or another regional grouping aims to achieve some positive effect, which should raise the competitiveness of the national economy, its industries and enterprises. However, this goal can only be realized under certain conditions.

In general, the impact of integration on the competitiveness of the national economy can be expressed in the implementation of the comparative advantages and economic interests, reducing production costs due to economies of scale, improvement of the economic performance of enterprises and industries mainly at the regional level.

However, the economic integration affects the competitiveness of national economies in two ways: both in the direction of dynamism and strengthening and towards aggravation of contradictions and loss of competitiveness. It all depends on the correct economic policy, correct evaluation of the economic and political situation in the country, the presence or absence of economic resources.

In general, the process of integration is a powerful tool for rapid development of regional economies and increasing competitiveness in the world market of member states of integration groupings.

A grounded theory of the impact of integration into the national economy was created by a Canadian-born American scientist Jacob Viner. He identified two main types of effects arising from economic integration: a trade creation effect and a trade diversion effect. The trade creation effect is expanding trade within the integration association.

Viner J.believes that the increase in production within the customs union is limited: "If the customs union does not provide a significant increase in the mobility of production factors between the union member states, it does not increase the scale of the national economy in terms of the conditions of production, even if there is such an increase in terms of the size of the protected market" (Viner 1950).

Meade J. identifies the following effects of economic integration: a trade diversion effect and a trade forming effect.

Based on the market analysis in several European countries, Meade J. concluded that integration could result in reorientation of production from low-cost to high cost, which is "uneconomic and wasteful". Meade J.

notes that "the customs union leads to diversion of international trade from all other countries in favor of one of the partners, which now, in terms of customs barriers, enjoys a privileged position in the market of the importing country; it is a non-economical innovation". Meade J. attributes the disadvantages of economic integration to the fact that "the creation of a customs union means a reduction in income derived from fees for the countries forming that union" (Meade 1953).

Russian scientist Shimko P. proposes to consider accession to the integration union from the perspective of the static and dynamic analysis. As part of the static analysis, he identifies two possible consequences of accession of the country to the integration trade and economic grouping:

- flow forming effect (trade creation effect): switching of the demand of the country and therefore consumption from domestic manufacturers with higher costs to the foreign manufacturer with lower costs;
- flow diverting effect (trade diversion effect): switching of the demand of the country and therefore consumption from themanufacturer outside the union, which has lower costs, to a manufacturer with higher costs but a member of the union.

Researchers Akopova E., Voronkova O. and Gavrilko N. distinguish the "demonstration effect" and the "domino effect" as a result of integration. They explain the "demonstration effect" with the fact that in countries that have established integration associations, "the improvements usually occur (faster economic growth, lower inflation, employment growth, and so on) that has some psychological impact on other countries". They explain the "domino effect" with the fact that the countries not included in the integration groupings are experiencing some difficulties associated with the reorientation of economic ties of the integrated countries to each other, which leads to a reduction in trading of the third countries (Temirbekova *et al.* 2015).

Thus, as our study showed, none of the authors referred to the consequences of integration unambiguously: integration has both positive and negative effects.

3.2. The economic integration of the Customs Union member states in the world trading community

Formation of the Eurasian Economic Union imposes new requirements for the operation and further development of the most important field of the national economies, which provides food security in partner countries. Regional economic integration within the common market, which the EurAsEC is, should contribute to the creation of a single market of consumer products based on both absolute and comparative advantages of each country in agriculture and associated agricultural industries, while not reducing the competitiveness of the agricultural field, but creating incentives for its growth.

World experience shows that the creation of the Customs Union as a specific format of integration is an objectively necessary stage for the transition to higher levels of integration. The Customs Union that unites the strengths of its three most active countries – Russia, Kazakhstan and Belarus – started functioning in the system of the Eurasian integration since January 2010.

A strategic platform of the Eurasian Customs Union was formalized at the beginning of the development of integration processes in the post-Soviet space, but it took quite a long time to realize it. This was due, on the one hand, to the scope of the preparatory work, and on the other hand – to the integration expectations of the Customs Union, both positive and negative. Objectively, the functional upgrade of integration processes in the format of the Customs Union carries more positive contribution than unwanted results. The main thing is that for creation of such an integrated formation, they succeeded to mostly agree on the customs policy and to form a common legal framework for its effective implementation.

Difficulties of formation of institutions of integration in the post-Soviet space have objective reasons. The key issue is the mechanism of coordination of interests (Troshin *et al.* 2014). Compared with the European Union, the CIS has fundamentally different composition of the integration groups (Shuchun and Qingsong 2014). While the European integration involves a number of almost comparable states by economic and political weight, which allows to combine the principles of "parity" and "one country – one vote" when taking decisions, in the post-Soviet integration Russia has virtually no comparable counterweight. In these circumstances, both the principle of "parity" and the principle of "one country – one vote" will inevitably lead to infringement of interests of either Russia, which surpasses the partners by economic and political potential, or all the other participants of the integration process, whose "weight" in the voting "on parity" is extremely small.

Under the Treaty on the Customs Union Commission, the votes between the Parties in the Commission are distributed as follows: Republic of Belarus – 21.5; Republic of Kazakhstan – 21.5; Russian Federation – 57, giving rise to talk about the "hegemony" of Russia in the organization. But at the same time, the decisions of one

of the most important bodies of the integration association – the Joint Board – are adopted by consensus, where each Customs Union member state has one vote (Wisniewska 2013).

Integration potential accumulated in the Customs Union is of sufficient scale to address global problems also at the level of geo-economics, allowing member states to enter the more efficient integration processes, thus enhancing opportunities for their business environment, improving the investment climate and increasing the competitive edge of their products on international markets. Particular attention is paid to the promotion on these markets of not the traditional positions of the commodity sector of the economy, but of the processing industries, for which new opportunities emerge on the basis of uniform standards in the Customs Union (Jarosiewicz and Fischer 2015).

In general, the integration in the specific format of the Customs Union is in fact economically advantageous for each of its member states, because it means:

- the abolition of customs duties in trade between the Customs Union member states;
- cheaper energy in the common space of the Union;
- the goods can be freely transported and sold in the territory of the member states, thus opening up new opportunities for business and for exchange of business ideas;
- all this makes the goods in the local markets cheaper and of higher quality. Experts say it has a significant impact on the efficiency gains of the economies and will allow to annually increasing the countries' GDP by 1-2% per year (the Treaty on the Customs Union Commission, 2007).

Negative expectations on the formation of the Eurasian Customs Union focused on two interconnected units – economic and political. The first is that the common customs duties are taken from the Russian duties, while Russian export is bigger than those of Belarus and Kazakhstan and gives Russia an advantage. The second is that more competitive imports can displace domestic goods, if the government does not take steps to support and protect domestic manufacturers. The third is that the close integration ties between the individual companies of the partner countries may lead to oligopolistic collusion, which would entail an increase in prices for the relevant products (Nikolaeva 2006).

3.3. The need to develop the knowledge economy of the Customs Union member states.

Expansion of international cooperation in the framework of integration associations of high level allows access to new knowledge and technology, in the first place through dissemination and transfer of technology to the less developed sectors of the economy and expansion of possibilities of cooperation in the field of education and science. The Customs Union and the Single Economic Space of Russia, Belarus and Kazakhstan, as a new form of deeper trade and economic integration, provides free transportation within the common customs territory of these states of not only goods, but also services, capital and labor resources, thus creating favorable conditions for the formation of the knowledge economy. It is considered the basis for the transition to a higher organizational form of integration, Eurasian Economic Union, opening up broad prospects for the development of a knowledge-based and competitive economy to the participants (Enin 2012).

Expansion of global markets of new technologies and at the same time international integration in the scientific and industrial sector is characteristic of the emerging global economy and dominates the strategy of economic growth of the industrialized countries. In these countries, the share of new or improved technologies, equipment and other products containing new knowledge or solutions, is 70 to 85% of gross domestic product. They concentrate more than 90% of the world's scientific potential and control 80% of the global high-tech market, which is estimated at 2.5 to 3 trillion dollars, which exceeds the market of raw materials and energy resources. It is expected that in 15 years it will reach 4 trillion dollars.

The successful implementation of the innovative way in many respects depends on such factors as the scale of investment in research and development, availability of highly skilled scientists and experts and the existing legal and organizational institutions that form the national innovation system of the country (Ryzhenkova *et al.* 2014).

To evaluate and compare the degree of development of the knowledge economy, the World Bank proposed the so-called knowledge economy index, which establishes the relationship between the scientific and technical support for the economy and economic growth, as well as the competitiveness of the country (Adyasov 2010). In accordance with the "Knowledge Assessment Methodology", the assessment includes 109 grouped structural and qualitative indicators. Formalized indices and sub-indices of knowledge take values from 0 to 10, and the closer to 10, the higher the level of development of the knowledge economy of a country.

Table 1 - Knowledge indices of CU member states (Russia, Belarus, Kazakhstan), 2011-2012

COUNTRY (Ranking)	Knowledge Economy Index	Knowledge Index	SUBINDICES			
			Economic Incentives	Innovation	Education	ICT
Russia (55)	5.78	6.69	2.23	6.93	6.19	7.16
Kazakhstan (73)	5.04	5.40	3.96	3.97	6.91	5.32
Belarus (59)	5.59	6.62	2.50	5.70	7.37	6.79

Competitive ability of education and economy are interdependent, which is confirmed by the experience of the countries that have succeeded in international competition in certain areas of innovation (Aghion, Harmgart, Weisshaar 2010).

The Customs Union member states should pay more attention to the development of human capital in order to increase the potential of its growth and create a favorable innovation environment (Sarsembekov 2013).

At the present stage of modernization of education, the priorities of state education policy in CU member states should be: development and improvement of the quality of vocational education, ensuring access to quality education and investment attractiveness of education. The knowledge economy can develop successfully at the formation of the national economic system.

3.4. Problems and prospects of the Customs Union

Integration in the trade and economic field and structural reforms in the CU member states are inextricably linked processes. Therefore, trading links between the CU members are an important tool for economic stabilization and recovery from the economic crisis. It is known that the functioning of the Customs Union should give its participants substantial economic benefits.

Firstly, the use of a common customs tariff in respect of third countries will allow them to provide greater protection from foreign competition and put barriers to smuggling and re-export of their goods, including strategic raw materials and dual-use goods. First of all, we are talking about local markets, which will be protected from competing imports from third countries by high duties. In addition, according to forecasts of the Ministry of Economic Development of Russia, Russia will also get the most benefits from the elimination of customs barriers within the Customs Union. In particular, according to preliminary estimates, Russia will get more than 90% of all import duties collected by the Customs Union (Knowledge Assessment Methodology, 2012).

Secondly, in such a situation, the investment of the partner countries of the EurAsEC in the economy of each other may provide some impetus for the rapid development and modernization of the agricultural sector. Today, the facts of investments are rare due to objective and subjective reasons. The objective reasons include the capacities inherited from the Soviet system of management, which do not meet modern requirements in productivity, safety and quality of the food products. The significant problem is the growing competition from manufacturers in China, Turkey, South Korea, Japan, UAE, USA, Canada and EU countries that have more advanced technology and well-known brands. The subjective factors include: a significant proportion of administrative participation, growing protectionism in interstate commerce and investment, difficulties encountered in the process of payment and transport of goods, etc. Solution of some problems is delayed due to different positions of individual countries on specific issues that require negotiation process and political will.

Thirdly, the unification of the external economic legislation of the Customs Union and the gradual alignment of the business environment will provide more favorable conditions for cooperation of business structures of the Customs Union member states.

In particular, the Russian machine-building companies want to enter the Kazakhstan's market, as they are interested not only in selling products, but also in the creation of industrial sites on the territory of Kazakhstan, due to its much milder tax climate in comparison with Russia. After the introduction of new import duties on the outside imports and removal of interstate customs barriers, Russian manufacturers of clothing, confectionery, home appliances, oil and gas equipment will also be able to count on effective sales in Kazakhstan.

Fourthly, with the development of the Customs Union, real conditions for the priority development of trade among its members will be created, in order to better provide with the essential forms of energy, raw materials, machinery and electronic products, food and consumer goods produced in the Customs Union member states.

Today, Kazakhstan exports not many kinds of products to Russia – mainly products of heavy equipment and mining industries. In monetary terms, the major share of exports (70%) is taken by iron ore for steel mills, rolled ferrous metals, coal, uranium fuel assemblies for nuclear power plants and non-ferrous materials. For these

positions, based on the forecast requirements of Russian consumer companies, a substantial increase in exports is not expected. However, the Kazakhstan consumer goods that have demand in the Russian Federation (food products, flour and grain, spirits, hides and skins, raw cotton) will achieve the desired effect if the export is increased by at least four times (Muzaparova 2011).

Fifthly, it is the establishment of agricultural clusters as innovative direction of integration in the agricultural sector of the Customs Union and single economic space. An agricultural cluster is an important innovation towards integration of agriculture and industry in the framework of integration associations, especially if this association has deeply entrenched industrial and technological links at all levels of the agricultural sector. The Customs Union is no exception and the establishment of joint agricultural clusters in it will enhance the competitiveness of not only agriculture industries, but also of the supporting and auxiliary industries.

Prerequisites for the formation of agricultural clusters as innovative directions of integration within the Customs Union already exist, but only at the level of the creation of industrial clusters. The next stage must involve the agricultural clusters. Thus, the Belarusian Republican Association of Industrial Enterprises, the National Chamber of Entrepreneurs of Kazakhstan and the Union of Machine Builders of Russia signed a joint memorandum on technical re-equipment of the CU and the SES in 2013. In this case, interstate industrial clusters will be set up, which will significantly improve the competitiveness of engineering products, primarily in international markets. However, not all the problems are solved yet, and the main one is the development of a common customs tariff policy for import of intermediate and finished machinery products (Ikonnikov 2009).

However, the formation and functioning of the Customs Union not only opened up prospects, but also generated a number of problems to be solved. The main problem of the present stage of development of a single economic space is to overcome the problems caused by the peculiarities of the post-Soviet economic policy and the situation on the world market, and the creation of a single modernized and innovative space (Baliev 2013).

For the Customs Union member states, possession of large natural resources and, at the same time, an outdated base for processing predetermined the formation of appropriate structural policy aimed at priority development of the commodity sector to the detriment of other sectors of the economy. Under such conditions in the Customs Union, the member states with similar problems have the most real prospects to take advantage of existing expertise, especially in the development of the CIS markets. In addition, the Customs Union member states, in particular Kazakhstan and Russia, can actually develop new technologies for a full-fledged participation in the global energy and food markets.

Therefore, today the agenda of a single economic space should consider the provisions governing the fields of investment, intellectual property, services, environmental protection, space exploration, labor standards, etc. Thus, a single economic space should solve a lot of questions that do not relate solely to a simple reduction of tariffs (Mansurov 2013).

It is obvious that at the formation of the common policy of the single economic space, the negative impact of the world market manifests itself in the preservation of the potential hazard level of social and economic development of member states in view of the same structure of the economy and the focus of foreign policy on raw materials. On the other hand, within the framework of the Customs Union and the single economic space, both Russia and Kazakhstan, whose export basket is dominated by only competitive commodities, can easier develop a common scenario of increasing competitiveness, based on the rapid development of the latest global knowledge and technology, development of their own R&D and innovative production, reform of academic science and the creation of a single innovation system.

Solution of the identified problems will allow bringing together the national economies to a qualitatively new innovation direction of integration of the Customs Union and the single economic space member states.

4. Discussion

The main goal of the economic policy of a single economic space at the current stage of regional integration should be the development of the scenario of increasing competitiveness, which on the one hand brings together the key strategic positions of modernization program for the economies of Belarus, Kazakhstan and Russia, and on the other hand serves as the basis for a common economic strategy that combines the goals of development of the Customs Union and the single economic space in the global market.

Despite the undeniable need for modernization and innovation development, the economic modernization for the countries of the single economic space at the present stage is mostly seen as a short- and medium-term strategy, while the innovative economy is seen as a long-term strategy of the post-industrial development in the context of a single economic space. Thus, the only possibility for transition to innovative economy is the boost of

modernization processes at the state level (or the adoption of a strategy of accelerated modernization), which actually takes place in Kazakhstan, Russia and Belarus.

However, despite the common economic problems of the Customs Union, modernization of national policies and the need to create a single economic space as soon as possible, the program documents of the EurAsEC do not indicate the need to move to the innovative economy as a goal of modernization programs in the common integration space. Therefore, there must be a concept of the created innovative space that combines the scientific field, education and innovation of the single economic space member states, which would indicate the terms (or stages) of the modernization, the expected structure of the economy and sources of investment in innovation.

Obviously, in the case of the successful implementation of process modernization programs of the member states and modernization programs of the common integration space, the role of a single economic space as a regional integration organization in addressing economic issues of international cooperation will increase. One of the tools of this policy is the development and implementation of interstate programs and projects in the field of development of infrastructure of agro-food markets, rural development, research in genetic engineering and selection, energy-efficient technical solutions and new forms of organization of production.

Conclusion

The phenomenon of integration is of particular importance in today's globalized world economy and general liberalization of economic policy. The integration makes it possible not only to expand markets, reduce transport and customs costs, but also to stand together against external threats of various kinds, combine different resources to implement large and strategically important projects and reforms.

The emergence of trade effects and the development of investment cooperation are only the first steps in the development of integration processes in the Customs Union member states. And, therefore, the integration between the member states of investment cooperation should be expanded to other areas. So, an important direction (and of the most priority in the long-term prospect) must be the integration of scientific and technological potential. Implementation of joint scientific and technological projects, the integration of the Russian, Belarusian and Kazakhstan's sectors of research may be much more important by its significance than just the development of mutual trade. A high significance should be given to the qualitative development of innovative, scientific, technical, financial and other relationships between the countries of investment cooperation – these are just the first steps in the development of integration processes in the Customs Union member states.

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Network Industries Economics. A Comparison of Rail Infrastructures Output in Key European Countries

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Abstract

Infrastructure is widely recognized as a key ingredient in a country's economic success. However many issues surrounding infrastructure management are not well analysed. This paper assesses the performance of rail infrastructures management. Focusing on key European countries this study monitors the factors directly related to the effective allocation of resources. Results suggest that the outperforming system is the Swedish, characterised by reduced cost, and the German, marked by significant scale economics. The Italian case follows these two. The expenses for running the Spanish infrastructure are relatively low but this advantage is outweighed by weak traffic. If on one hand the cost of the British network appears to be above the average, on the other hand it is compensated by the intensive use of the network. The French infrastructure presents an average production cost along with moderate productivity; a remarkable average loading makes up for this performance gap. Main limitations stem from the fact that the railway industries and their development greatly differ across European countries since the infrastructure were built on national bases. This study serves as an entry point to further assessments and evaluation of the efficacy of policies regarding the management of rail infrastructures in Europe.

Keywords: rail infrastructure, productivity, utilities regulation, transportation, network industries.

Jel Classification: L2, L92.

1. Introduction

In the early and mid-twentieth century, many countries, especially in the developing world, sought to provide utility services by forming state-owned monopolies. Restructuring the industry generally involves the separation of the potentially competitive portions of the sector from the non-competitive or natural monopoly portions and the guarantee that non-discriminatory access of rivals to the non-competitive portions, which should be considered essential facilities. This separation of competitive from non-competitive may be accomplished through structural separation, functional separation, or unbundling. Railway companies used to exercise both infrastructure and transport services in almost all of the European countries. This structurally rigid supply, exacerbated by a series of other factors, started at the same time of/as the development of the EU railways and lasted until the Swedish reform process through which the separation began, i.e. 1988. In such market conditions the output corresponded to levels of traffic. Although scholars have considered a variety of regional models relating to infrastructure productivity, in many cases these models are formulated without taking into consideration spatial interactions (Kelejian and Robinson 1997). Therefore, reliable and comparable information on the cost and output of the rail networks is essential. We develop this idea in detail in an effort to determine what kind of improvements are called for, to analyse how other infrastructure managers achieve their performance levels, and, to provide policy makers with consistent information.

More specifically this study reconstructs comparable industrial and economic data for measuring the productivity and cost of rail infrastructure networks over a five year period. The key industrial data used for this paper are: rail network length (tracks), distance (train-km) and the traffic unit transported, whether measured in terms of passenger-km or ton-km. The indicators stem from analysis focused on six key European rail infrastructure networks as per extension and traffic levels i.e. Germany (DE), France (FR), Great Britain (UK), Italy (IT), Spain (ES) and Sweden (SE). Despite significant regional variation both between and within different markets, most of the data are comparable. Our results suggest two outperforming networks: Sweden and Germany, the Italian case is ranked third. Figures coming from the Spanish, British and French cases show mixed results. Although this paper used different types of information to reach its conclusions and the terms of reference were adequate, major challenges, especially of data availability was faced. The foremost benefit of this

analysis is to support decision making by providing facts and judgements about the efficiency, effectiveness, and thus sustainability of the rail infrastructure management in Europe. Such information is crucial for fine-tuning existing or planning new policies and for setting governmental priorities and allotting resources.

The remainder of the paper is organized as follows: In the first section, we discuss the output and productivity of rail infrastructure networks. We then discuss the methodology for calculating the unit costs of railway networks. This is followed by a survey of total cost, unit cost and productivity of rail infrastructure managers, our assessment follows, and we conclude with a discussion of implications.

2. Background and related works

Networks include a large number of sectors such as telecommunications, broadcasting, transport, energy, utilities. Prior research suggests that the growing importance that these sectors have in the modern economy has led to a significant development of the so-called network economics. A major feature of network industries is that they show competitive network externalities. One central objective of organisational reforms in many industries is to create a competitive environment, with a vertical separation policy viewed as one option for stimulating competition (Matsushima and Mizutani 2014). Traditionally, the regulation of network industries in Europe was based on sector-specific rules rooted in the theory of natural monopoly and justified the granting of exclusive rights. Several researchers have investigated how the structure of vertical organisations is determined in competitive environments (Lin 2006, Matsushima 2009). There is evidence in support of the relationship between competition and efficiency of firms. Regulations, or anti-competitive behaviour preventing entry and expansion, may therefore be particularly damaging for economic growth. Competition also improves the productive efficiency of firms (OECD 2014). Davies *et al.* (2004) provides some illustrative cases, particularly noting significant price effects from deregulations that had the effect of introducing competition (for example, low cost airlines within Europe). Step by step, the European Union has been pursuing a top-down reform process leading to the gradual reorganisation aimed at the creation of a truly integrated market across Member States (de Hauteclocque 2013). The roadmap toward a single transport area represents a thought-provoking topic in the field of European transport economy. The European Commission (2011) has offered, for example, a strategy to revitalise the European railways by creating a sound financial basis, ensuring freedom of access to all traffic and public services and promoting the integration of national systems and social aspects. Early EU legislation laid down the basic principles guiding the improvement of rail efficiency via progressive market opening, establishment of independent railway undertakings and infrastructure managers and separation of accounts between them. In 2012, parts of the legislation were simplified, consolidated and further reinforced by Directive 2012/34/EU. To mark the enforcement of regulations on railways, this study focuses on the key rail infrastructures. The estimates of degrees and path of economic impact of infrastructure by various macroeconomic models are different. Lakshmanan (2011) reviews recent theoretical developments to identify the multiple causal mechanisms which link transport and economic growth such as: market expansion, gains from trade, technological shifts, processes of spatial agglomeration and processes of innovation. Although several measures to promote railway development, in particular, those from the first package of measures formed by directive 91/440, the level of competition on European railroad markets is still considered unsatisfactory (Knieps 2012). Efficiency of railway companies has often been studied in terms of effects of the regulatory measures and reforms. Cantos and Maudos (2001) focus on the types of reforms on technical and revenue efficiency and conclude that the separation between infrastructure and services achieved the most beneficial impact. Friebel *et al.* (2003) measure the impact on efficiency of a series of reforms as being introduced either sequentially over time or all together and suggest a positive effect of deregulation on efficiency for countries where reforms were implemented sequentially. To this extent it must be considered that the producer's endogenous effort depends on the constraints exerted by the regulatory environment that it faces (Laffort 1994). After the liberalisation process started, firms provided a significant effort level to reduce cost inefficiency (Urdánoz and Vibes 2013). They further this idea by testing the independence of infrastructure managers from operations and show that countries which decide on a clear separation face lower costs for providing an effort, allowing them to reduce inefficiency. Previous literature also proposes life cycle costing approaches for measuring rail infrastructure (Zoeteman 2001). As far as we know, few studies specifically analyse key industrial and economic information on the rail infrastructure and its management even if the information would serve the regulatory bodies. It is generally agreed in fact that among the approaches to regulating the overall price level, rate of return (or cost of service) regulation, price cap regulation, revenue cap regulation, and benchmarking, or yardstick regulation play a major role (King 1998). These approaches are widely used together worldwide, nevertheless their interaction, requires special attention.

3. Output and productivity of rail infrastructure networks

Competitiveness and performance of transport industries have been widely researched, however, several methodologies are available to address how they shall be evaluated (Di Foggia & Lazzarotti 2014). This paper takes into consideration six cases: RFI for Italy (I), RFF for France (FR), DBnetz for Germany (DE), Network rail for Great Britain (UK), Adif for Spain (ES), Trafikverket for Sweden (SE). To guarantee comparable information of financial statements, the analysis comprises five years: from 2009 to 2013. Since most of the EU's network were designed at country level to be a single network, rail infrastructure in the EU is likely to remain a natural monopoly in the medium term. Existing EU legislation therefore requires a degree of separation between infrastructure managers, which run the network, and services (railway undertakings, RUs) which run the train services on it, with the aim of ensuring fair and equal treatment of all RUs. Full independence of charging and capacity allocation is required, as these were seen as key to ensuring equal access, to this extent Gibson (2003) examines the nature of capacity on a railway network and identifies the key features of rail timetables and track access rights that need to be accommodated in any capacity allocation mechanism. Nevertheless as natural monopolies, IMs do not always react to the needs of the market. Information asymmetries lead to competitive advantages for incumbents and there is a persistent risk of cross-subsidisation due to the lack of complete financial transparency (European Commission 2013a). Rail network output and productivity have only recently emerged as critical in understanding the railway industry. Previously, this information appeared meaningless in the century and a half gap between the advent of the railways to the first separation of the network, which took place in Sweden in 1988. In fact, railway companies used to be vertically integrated, exercising both infrastructure and transport services. In such market conditions output corresponded to levels of traffic i.e. both passenger and freight. However, in the light of the current separation of infrastructure from operations, as required by the European Commission, such a quantity only represents the output of transport (passenger or freight) service operations. It is taken for granted that rail infrastructure networks produce transit capacity and that such capacity corresponds to a supply aimed at satisfying the demand of transport service companies. In this study, the main measure of network production is given in terms of the train-km circulating on the network over a given time period. However, alongside the stated variable, one should also consider as network output the passenger-km as per passenger services and the ton-km when considering freight services. The rail infrastructure networks thus produce train-km directly and passenger-km or ton-km indirectly, which can be conventionally merged to integrate an indicator of production defined as traffic unit (UT). The measurement of the network output using both train-km and traffic unit allows, through the interaction with measurements of network size, the calculation of productivity indicators. Subsequently the next step involves the calculation of the unit cost of the networks and requires both a preliminary and consistent total cost (TC) configuration with the scope of permitting yearly comparisons across companies after controlling for network amplitude and traffic. These indicators represent the premise for performance assessment.

4. Setting the unit costs

Quinet (1997) presents and discusses pertinent literature on the cost estimation of transport and the related scientific and political issues: especially the methodology of calculation as well as the impact of these transportation cost calculations on policies. As for other productive activity, the unit cost stems from the total cost of production over the level of production. Rail infrastructure networks principally produce train-km (therefore, a single-product). However, the product is not homogeneous since it includes freight trains and passenger trains (in turn, regional and long distance). However, this heterogeneity does not significantly impact upon the cost of the infrastructure manager having UC as the unit cost, TC the total cost, UT the traffic unit, TKm the train-km, KoT the km of tracks, a viable configuration of unit cost is formalised in Eq. (1) as the ratio between the total cost and train-km:

$$UC = \frac{TC}{\text{TKm}} \tag{1}$$

However, it should be noted that this value is influenced by the productivity of the network, meant as the ratio of the train-km of the period and the extension of the network. The train-km measurement represents a variable that is weakly influenced by the choices of rail infrastructure managers and instead, depends largely on the level of demand for rail transport, goods and passengers. It is therefore preferable to decompose this configuration of unit cost in order to represent it as the cost per km of network times and as the inverse of the network productivity, so formalised in Eq. (2).

$$UC = \frac{TC}{TKm} = \frac{TC}{KoT} * \frac{KoT}{TKm} \tag{2}$$

An additional configuration of unit cost is introduced in this way, one arising from the management cost per km of network, since we can reasonably expect to be, to a significant extent, under the control of the rail infrastructure managers. The manner in which this cost translates into cost for train-km depends on the productivity of the network, along with the intensity of its use. Moreover, it becomes useful to consider these differences, taking into account the load average. In this way, it is possible to consider one more definition of output – the total traffic unit – so calculating the unit cost of network per traffic unit as analytically represented in Eq. (3).

$$\frac{TC}{UT} = \frac{TC}{KoT} * \frac{KoT}{TKm} * \frac{TKm}{UT} \tag{3}$$

To improve the reliability of our analysis and make it consistent, the income statements of the infrastructure managers have been reclassified according to uniform criteria. Traffic data is then reconstructed accurately in the same manner. Nevertheless, we should take into consideration that: (i) unit costs higher than the average may be derived from the influence of unfavourable factors outside this economic model, whose effects should not be interpreted as inefficiency; and (ii) unit costs below the average may instead be influenced symmetrically by favourable exogenous environmental variables, which are not to be interpreted as greater efficiency. One could add that outside this economic model the price cap may automatically adjust for changes in specific prices that have strong implications for the profitability of the regulated firm.

Well-managed infrastructures enable economies of scale, shrink costs of trade, and are thus vital ingredient to economic growth and development. For railway infrastructure, benchmarking is an effective tool that can support the management in their pursuit of continuous improvement (Åhrén and Parida 2009). By focusing on maintenance performance indicators, the authors present case studies dealing with the application of benchmarking and maintenance performance indicators for the railway infrastructure. Similarly the International Union of Railways developed the Lasting Infrastructure Cost Benchmarking, an international benchmarking project (UIC 2008). More recently, the European Commission has started to benchmark the efficiency of infrastructure managers in terms of reliability and punctuality, capacity and availability), safety, asset management, maintenance and renewals (European Commission 2013b).

It is now possible to the productivity of the networks according to the indicators of train per km of rail track and traffic unit per km of rail track. Here, the German figure comes first, Italy and Great Britain follow, then the French network, Sweden comes later and the Spanish network is ranked lowest ranked. As previously mentioned, we should specify that the performance of a network depends on many factors. On one side, management decisions in conjunction with decisions concerning the planning, investment and financing of the infrastructure as well as the regulatory choices; on the other side, the presence of external factors which may or may not be favourable. The intensity of the network use, for example, increases with the population density of an area and the propensity of the demand for rail transport services. To this extent, those countries with low population density such as Sweden, Spain and France are disadvantaged in comparison to symmetrically advantaged countries with high population density such as Great Britain and Germany. These two measures are affected by the composition of demand for rail transport services. The higher the proportion of rail freight transport the higher the value of productivity that refers to traffic units, but at the same time, the lower the value for the productivity indicator referring to the train-km. In fact, freight transport usually concentrates many traffic units per train, more than passenger transport. Symmetrically a high proportion of the short-distance passenger service is, in turn, characterised by a lower number of traffic units per train, so thus influencing the productivity indicator relative to the train-km while penalising the indicator referring to traffic unit. With reference to cost indicators, the two most significant among those considered appear to be the costs per train-km and the cost per traffic unit. In this case, the countries with the best performances appear in the left corner. On the basis of these figures one can infer that a network outperforms in the presence of low values of both indicators or likewise lower values of an indicator in the presence of an identical value of the second indicator. According to the information contained in table 1 and table 2, it is possible to rank the productivity of the networks as per the cost per train-km and cost per traffic unit. First cames the Swedish rail network followed by Germany, Italy and Spain, then France and Great Britain. The French network appears at the tail group, along with Spain and Great Britain, even if no unique ordinal value applies with respect to Spain and Great Britain. This is because the French network outperforms Spain and Great Britain according to the traffic unit indicator but not in the case of the train-km indicator. It is also considered appropriate to monitor the evolution of the networks capacity over time. In fact the above analysis can be extended to five years.
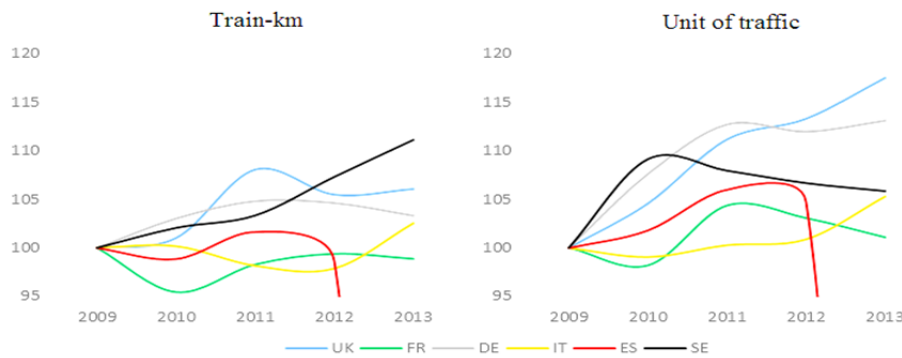
Source: own elaboration

Graph 1 – Evolution of train-km and UT

Graph 1 shows that both train-km and traffic unit have increased in the Swedish and Italian networks. Among other possible interpretations, one viable explanation for this is the liberalisation of the Swedish network, introduced in 2010, and the advent of competition in the Italian high-speed (HS) market segment in 2012. However, the traffic level or even traffic expressed through the train-km is not a reliable indicator to capture the dynamics of the levels of transportation that would otherwise be better expressed through the traffic units. In fact, the average load of trains could evolve over time and this has happened in Germany and Great Britain. Taking into consideration the total train-km, these two countries ended up with a weak increase (+5%). Instead, these two countries have registered stronger dynamics in terms of traffic unit. Graph 1 also confirms the steadiness of the Spanish and French networks. More recently, the good performance of the Italian network has been a consequence of the growth in supply followed by the increase in high-speed passenger service demand. The case of Sweden is less inspiring, where the increased supply in the passenger segment has not found a corresponding growth in demand; freight service traffic has also decreased. These foregoing considerations, connected to the production levels of the networks, can also be transposed to productivity levels, providing a picture of the substantial invariance of the infrastructures throughout the period considered. Instead, it is essential to observe the dynamics of the average cost, whether related to train-km or traffic unit. The mentioned facts may serve policy makers in different stages of the decision process, e.g. in the ex-ante evaluations, conducted prior to the implementation of a policy to contribute to its design and cost-effectiveness, and in interim evaluations, applied during implementation to improve the management of the policy. The same facts also play an important role in ex-post evaluations, which are made after the completion of a policy to assess the results achieved.

5. Costs and output

The process of comparing business processes and performance metrics to market bests or best practices within an industry has become vital in competitive markets. It is generally recognised that intra-industry comparisons allow those firms that operate in the sector to develop plans and it future allows policymakers to legislate better laws. The approach to making comparisons involves using more aggregate cost along with production information to identify strong and weak performing units. Using reliable and comparable data on cost and output Table 1 show industrial results mainly related to traffic intensity. In fact, as for vertical separation the effects change according to the traffic intensity. The situation that emerges from the analysis of the information collected shows a sector that is rooted in each of the six cases. First comes the length of the network. Table 1 indicates that only two out of the six networks exceed thirty thousand km; namely, the German rail network with thirty three thousand km and the French rail network with thirty one thousand km. Three networks are of similar length, ranking in the middle (the Spanish, the British and the Italian, which range from fifteen to seventeen thousand km) while the length of the Swedish network is roughly eleven thousand km. Second comes the length of track. Similarly, the networks of France and Germany are more extensive when compared with the remaining four networks; in these two, both infrastructure managers handle over fifty thousand km of tracks. The length of the other networks can then be ordered: 32 000 km in the case of UK, 24 000 km in Italy, 21 000 km in Spain, and 16 000 km in Sweden. Third comes the total train-km, representing the production network. One network exhibits an outstanding total level of traffic - the German network - hosting more than 1 billion train-km. Two networks (France and Great Britain) show an average traffic - which host more than 500 million train-km. Italy,

with 330 million, ranks immediately after, while the Swedish and the Spanish networks host less traffic, both slightly below 200 million. Forth comes the yearly trains per km of rail track, as an indicator of network productivity. The average value of the six networks (as a simple mean) is 12700 yearly trains; or 35 daily trains per km of rail track. The Italian network ranks slightly above the mean value. Germany, with 47 trains and Great Britain, with 46 trains are above the average. The remaining three countries rank below average: France and Sweden with 27 trains, and Spain with 25 trains. Fifth becomes the average traffic unit per train. This represents the load of a train and here the average of the six networks combined is a little less than 200 units. The Italian data is identical to the medium, while the German figure slightly below. France and Sweden rank above average. France, due to of the effect of long-distance TGV trains, and Sweden, thanks to the substantial number of freight trains. Sweden and Great Britain lie below the average value due to the predominance of short distance passenger trains. Sixth becomes the traffic unit per km of rail track, representing a further indicator of productivity of the networks. The average value of the six networks is almost 2.5 million traffic units per km of rail track. Italy's figures are slightly above the average, as can be seen in Table 1 Sweden, France and Great Britain present data in line with the average. The Spanish network scores below, the average, while the German figures are much higher (over 3 million). Seventh becomes the row containing data referring to the average tracks per km of network. This data is aimed at transforming the cost per km of network to cost per km of rail track.

Table 1 – key industrial data

Variable	DE	FR	IT	UK	ES	SE
Length of network (Km)	33 300	30 600	16 800	15 800	15.100	11 000
Length of tracks (Km)	61 200	50 700	24 300	32 200	20 500	15 500
Total train-km (million)	1 042	500	332	541	185	151
Trains per km of rail track	17 000	10 000	14 000	17 000	9 000	10 000
Traffic unit per train	192	239	197	153	178	222
Traffic unit per km of rail track (million)	3 300	2 400	2 700	2 600	1 600	2 200
Tracks per km of network	1.8	1.7	1.5	2.0	1.4	1.4

Source: own elaboration; year 2012 – Adif; year 2013-14 – Network Rail; 2013 others.

Assuming that a reasonable set of data is available, it is important to measure performance from different perspectives, Table 2 contains key economic facts to be analysed along with industrial output. As one may expect, the total cost of the rail infrastructure appears to be correlated with its extension. The cost is higher in Germany at EUR 3.8 billion, stations considered, whereas in France the total cost amounts to EUR 2.9 billion and in Great Britain to EUR 3 billion. As can be seen in Table 2 the cost is not as much as in the residual countries. The average cost per km of network is EUR 102 000. Italy and France score in the middle at EUR 98 000 and EUR 95 000 respectively. Germany level is slightly above the average at EUR 115 000. The outliers are, on the one side, the British network with EUR 190 000 and, on the opposite side, the Swedish and Spanish with a cost approximately half of the average. The cost per km of rail track highlights an average value of EUR 60 000 over the six networks. Three networks come close to that value: the French with EUR 58 000, the German with EUR 62 000 and the Italian with EUR 67 000. The cost of the British rail network comes in at 50% higher than the average, EUR 93000. In terms of medium ranking value, the Spanish are at EUR 46 000, and the Swedish, EUR 35 000, correspondingly. The average cost per train-km is EUR 4.8. Amongst the networks selected, two countries present data close to the amount mentioned: Italy at EUR 4.9 and Spain with EUR 5.1. The higher values corresponds to Great Britain totalling up to EUR 5.5 (more expensive and more traffic than the median) and France with EUR 5.8 (more expensive and less traffic than the average). In contrast, Germany figures at EUR 3.7 (greater average cost and greater traffic than the median), while Sweden comes to EUR 3.6 (cheaper and less traffic than the average). The average cost per traffic unit amounts to EUR 0.25. The Italian (EUR 0.25) and the French (0.24) data are close to the arithmetic mean. Meanwhile, the cost per unit of the Spanish network (EUR 0.28) and the cost per unit of the British network (EUR 0.36) are above average. The average cost is higher than the German value (EUR 0.19) and the Swedish value (EUR 0.16) respectively.

Table 2 – Key Economic data (values in EUR)

Variable	DE	FR	IT	UK	ES	SE
Total cost of rail network managers (million EUR)	3 800	2 900	1 600	3 000	900	500
Cost per km of network	114 600	95 500	97 700	190 000	61 900	49 800
Cost per km of rail track	62 400	57 600	67 400	93 300	45 700	35 300
Cost per train-km	3.7	5.8	4.9	5.5	5.1	3.6
Cost per traffic unit	0.19	0.24	0.25	0.36	0.28	0.16

Source: own elaboration; year 2012 – Adif; year 2013-14 – Network Rail; 2013 others

From table 2 some interesting insights emerge; among others the good result of the Italian infrastructure both in terms of productivity and unit costs of the network. The cost of the British network results to be high but this disadvantage is partly offset by the intense traffic. The cost of the French network aligns itself in the middle, but, it is characterised by weak network productivity in terms of traffic density, which only a higher loading factor of the trains can rebalance. Two networks outperform: the German and the Swedish.

6. Average production cost and access charge

It is commonly recognized that network industries share some characteristics; nevertheless, each network industry has its own characteristics and specificities. On the one hand, the infrastructure segment displays features of natural monopoly and is thus usually subject to regulation on pricing and access to the network. This applies to the transmission and distribution networks in e-communications, energy, and transport infrastructures. On the other hand, as long as each operator gets a fair and transparent access to the infrastructure, competition can be ensured in service provision.

Among scholars of regulatory economics, the models for regulating optimal output, tariffs, and surplus subsidy schemes play a remarkable role which are aimed at regulating firms in a way that induces them to both produce and to price efficiently (Trail 1991). It is understood that a healthy regulatory environment will guarantee fair access to essential facilities, specifically in the presence of vertically related markets (Arrigo and Di Foggia 2014). Economic literature suggests a price-cap regulation is one of the most suitable forms to regulate access charges for essential monopolistic infrastructures (Carlton and Perloff 1994). Price cap regulation, as an alternative to traditional rate-of-return regulation, developed as a practical regulatory tool in the early 1980s, since then, price cap regulation has been adopted in a wide range of countries and industries. This tool of charge regulation defines ex-ante a price cap for a regulation period. Given a portfolio of products i, where i =1, ...,n products of quantity q and price p, by means of a measurement of current prices or quantities in relation to those of a selected base period i.e. the Laspeyres price index in the left-hand side of the formula, the price-cap formalisation becomes the following.

$$\frac{\sum_{i=1}^{n} q_{it-1}p_{it}}{\sum_{i=1}^{n} q_{it-1}p_{it-1}} \le I_t - X_t \tag{4}$$

According to Eq. (4) the increase of the regulated access charge is linked to the increase of inflation for the inputs It minus the increase of productivity Xt. The inflation for the input I and the increase in productivity X have to be chosen by the regulator. This regulatory scheme limits the infrastructure manager only as regards the price but not regarding the quantity of products and therefore revenues (Link 2013). The same author also advocates that within a price cap regulation, the regulatory body shall outline the inflation rate for the inputs It as well as the productivity growth X. By putting the government funding for rail infrastructure on the left-hand side of the price cap formula as part of the revenues as suggested by Mitusch *et al.* (2011), the regulated infrastructure manager shall limit the increase of its revenues by the differential between the inflation and productivity growth rate. Thus, as illustrated in Eq. (5) where S represents government funding for infrastructure.

$$\frac{\sum_{i=1}^{n} q_{it-1}(p_{it}-p_{it-1})+S_t-S_{t-1}}{\sum_{i=1}^{n} q_{it-1}p_{it-1}+S_{t-1}} \le I_t - X_t \tag{5}$$

In case of no government funding, Eq. (5) collapses into Eq. (6) i.e. the standard formula. This also holds if government funding increases with the same growth rate $I_t – X_t$. this happens, for example if $S_t = S_t\text{-}1 (1 + I_t – X_t)$. Previous literature suggests that the control of governments funding has become a prominent topic to protect fair competition in Europe. State aid control should more effectively target sustainable growth enhancing policies while encouraging budgetary consolidation, limiting distortions of competition and keeping the single market open (Arrigo and Di Foggia 2013). Finally, if public expenditure remains constant in nominal terms, e.g., if $S_t=S_t\text{-}1= S$, the price-cap formula converges in the Eq. (6).

$$\frac{\sum_{i=1}^n q_{it-1} (p_{it}-p_{it-1})}{\sum_{i=1}^n q_{it-1} \, p_{it-1}+S} \leq I_t - X_t \tag{6}$$

This analysis of unit cost concludes with a comparison with the average revenues from access charges. As shown in Table 3, the access charge varies according to the adoption of different charging models in different countries. Sweden, for example, has opted for a marginal cost charging model, hence applying low charges – EUR 0.5 per train-km in 2013 – that are integrated by transfers from the public sector up to the complete coverage of the cost. In the same token, the Spanish case is relatively close to the Swedish one, with relatively low access charge for the use of the conventional network and the cost coverage ratio through access charges at about 40%. Italy represents an intermediate case given that the average access charge for use of the infrastructure, EUR 3.3 per train-km, is aimed at covering approximately two-thirds (67%) of the average cost, and is supplemented by EUR 1.6 of government subsidy to cover the cost. In Great Britain, 90% of the average cost per train-km is covered by the access charge. In Germany, the average access charge, EUR 4.4 per train-km, ends up being higher than the average cost per train-km that amounts to EUR 3.7, since it is aimed at covering investment and depreciation costs. Finally, the French case is not fully comparable with the others as per access charges; in fact, those charges for regional services are borne by the public sector, therefore, represent transfers rather than access charges from the market.

Table 3 – Cost and access charge

	DE	FR	IT	UK	ES	SE
Cost per train-km (EUR)	3.7	5.8	4.9	5.5	5.1	3.6
Access charge (EUR)	4.4	6.6	3.3	4.9	2.1	0.5

Source: own elaboration

7. Breakdown output of the rail infrastructure networks

Table 4 – Facts of the British rail infrastructure

Great Britain	2009	2010	2011	2012	2013
NETWORK		*(Thousand km)*			
Length of network	15.8	15.8	15.8	15.8	15.8
Length of tracks	32.2	32.2	32.2	32.2	32.2
Tracks per km of network	2.0	2.0	2.0	2.0	2.0
TRAFFIC		*(million)*			
Passenger train-km	470.6	476.8	510.4	497.9	500.6
Freight train-km	39.6	38.7	40.8	40.2	40.4
Total train-kilometre	510.2	515.5	551.2	538.1	541.0
TRANSPORTED QUANTITY		*(billion)*			
Passenger-km	51.4	54.5	57.3	58.4	60.1
Ton-km of goods	19.1	19.2	21.1	21.5	22.7
Traffic unit (passenger-km + tons-km)	70.5	73.7	78.4	79.9	82.9
PRODUCTIVITY OF TRAINS		*(unit)*			
Average passenger per passenger train	109	114	112	117	*120*
Average tons per freight train	481	497	517	534	*561*

Average traffic unit per train	**138**		**143**	**142**	**148**		*153*
PRODUCTIVITY OF NETWORK			*(thousand)*				
Yearly trains per km of network	32.3		32.6	34.9	34.1		*34.2*
Yearly trains per km of rail track	15.9		16.0	17.1	16.7		*16.8*
			(million)				
Yearly traffic unit per km of network	4.5		4.7	5.0	5.1		5.2
Yearly traffic unit per km of rail track	2.2		2.3	2.4	2.5		2.6

Source: own elaboration on data ORR. Office of Rail Regulation. Latest available year provisory

Table 5 – Facts of the French rail infrastructure

France	2009	2010	2011	2012	2013
NETWORK	*(Thousand km)*				
Length of network	30.9	30.3	30.4	30.6	30.6
Length of tracks	51.3	50.3	50.4	50.7	50.7
Tracks per km of network	1.7	1.7	1.7	1.7	1.7
TRAFFIC	*(million)*				
Passenger train-km	422.8	407.4	425.1	426.9	430
Freight train-km	82.9	75.4	72.0	75.7	70
Total train-km	505.7	482.8	497.1	502.6	500
TRANSPORTED QUANTITY	*(billion)*				
Passenger-km	85.9	85.9	89.0	89.1	87.3
Ton-km of goods	32.1	30.0	34.2	32.6	32.0
Traffic unit (passenger-km + tons-km)	118.0	115.9	123.2	121.7	119.3
PRODUCTIVITY OF TRAINS	*(unit)*				
Average passenger per passenger train	203	211	209	209	203
Average tons per freight train	388	397	475	430	457
Average traffic unit per train	233	240	248	242	239
PRODUCTIVITY OF NETWORK	*(thousand)*				
Yearly trains per km of network	16.3	15.9	16.3	16.4	16.4
Yearly trains per km of rail track	9.9	9.6	9.9	9.9	9.9
	(million)				
Yearly traffic unit per km of network	3.8	3.8	4.1	4.0	3.9
Yearly traffic unit per km of rail track	2.3	2.3	2.4	2.4	2.4

Source: own elaboration on data RFF, *Comptes des Transports* and Eurostat.

Table 6 – Facts of the German rail infrastructure

Germany	2009	2010	2011	2012	2013
NETWORK	*(Thousand km)*				
Length of network	33.7	33.7	33.6	33.5	33.3
Length of tracks	62.0	62.0	61.8	61.6	61.2
Tracks per km of network	1.8	1.8	1.8	1.8	1.8
TRAFFIC (estimated)	*(million)*				
Passenger train-km	780	783	794	788	782
- Long distance	151	149	152	144	140
- Local (regional)	629	634	642	644	642
Freight train-km	229	256	263	267	260
Total train-km	1.008	1.039	1.057	1.055	1.042
TRANSPORTED QUANTITY	*(billion)*				
Passenger-km	81	83	86	88	*89*
- Long distance	35	36	37	37	*37*
- Local (regional)	47	48	50	51	*52*
Tons-km of goods	96	107	113	110	*112*

Traffic unit (passenger-km + tons-km)	177	190	199	198	*200*
PRODUCTIVITY OF TRAINS			(unit)		
Average passenger per passenger train	104	106	108	112	*114*
- Long distance	232	242	244	257	*265*
- Local (regional)	75	76	77	79	*81*
Average tons per freight train	420	419	430	412	*430*
Average traffic unit per train	175	183	189	188	*192*
PRODUCTIVITY OF NETWORK			(thousand)		
Yearly trains per km of network	29.9	30.8	31.5	31.5	31.3
Yearly trains per km of rail track	16.3	16.8	17.1	17.1	17.0
			(million)		
Yearly traffic unit per km of network	5.2	5.6	5.9	5.9	*6.0*
Yearly traffic unit per km of rail track	2.9	3.1	3.2	3.2	*3.3*

Source: own elaboration on data BnetzA, DB Competition Report, Eurostat.

Table 7 – Facts of the Italian rail infrastructure

Italy	2009	2010	2011	2012	2013
NETWORK			*(Thousand km)*		
Length of network	16.7	16.7	16.7	16.7	16.8
Length of tracks	24.2	24.2	24.2	24.3	24.3
Tracks per km of network	1.4	1.4	1.4	1.5	1.5
TRAFFIC			*(million)*		
Trenitalia's Train-km on the network managed by RFI	307.2	301.8	275.5	259.3	266.1
M - Medium-long distance passenger	*80.1*	*78.1*	*76.6*	*71.1*	*77.5*
- Local (regional) passenger	*187.1*	*189.2*	*157.7*	*154.8*	154.5
- Total passenger	*267.2*	*267.3*	*234.4*	*225.8*	*232.1*
- Goods	*36.1*	*30.8*	*28.9*	*28.7*	*27.8*
Train-km generated by other railway undertakings on the network managed by RFI	16.3	22.1	41.8	57.1	65.6
Total train-km	323.4	323.9	317.4	316.4	331.6
TRANSPORTED QUANTITY			(billion)		
Trenitalia					
- Passenger-km Trenitalia medium-long distance	*22.2*	*20.6*	*20.2*	*18.4*	*18.9*
- Passenger-km Trenitalia local (regional)	*22.2*	*22.7*	*19.2*	*19.0*	*18.9*
Total passenger-km Trenitalia	*44.4*	*43.3*	*39.4*	*37.5*	*37.8*
Tons-km of goods Trenitalia	*15.2*	*13.4*	*13.0*	*12.8*	*11.9*
Total traffic unit Trenitalia	59.6	56.8	52.3	50.2	49.7
Other railway undertakings (estimated)					
- Passenger-km other railway undertakings	*0.0*	*0.0*	*3.7*	*5.5*	*8.2*
- Tons-km of goods other railway undertakings	*2.5*	*4.8*	*6.3*	*7.0*	*7.6*
Total traffic unit other railway undertakings	*2.5*	*4.8*	*10.0*	*12.5*	*15.7*
Total traffic unit	62.2	61.6	62.3	62.7	65.4
PRODUCTIVITY OF TRAINS (only Trenitalia)			(unit)		
Average passenger per passenger train	166	162	168	166	163
- Long distance	278	264	263	260	243
- Local (regional)	118	120	122	123	122
Average tons per freight train	422	436	448	445	429
Average traffic unit per train	197	190	199	197	191

PRODUCTIVITY OF NETWORK		**(thousand)**			
Yearly trains per km of network	19.4	19.4	19.0	18.9	19.8
Yearly trains per km of rail track	13.4	13.4	13.1	13.0	13.6
		(million)			
Yearly traffic unit per km of network	3.7	3.7	3.7	3.7	3.9
Yearly traffic unit per km of rail track	2.6	2.5	2.6	2.6	2.7

Source: Own elaboration on data RFI, Trenitalia and Conto Nazionale dei Trasporti.

Table 8 - Facts of the Spanish rail infrastructure

SPAIN	**2009**	**2010**	**2011**	**2012**	**2013**
NETWORK		*(Thousand km)*			
Length of network	13.5	14.0	14.1	14.1	15.1
Length of tracks	18.1	19.2	19.4	19.4	20.5
Tracks per km of network	1.3	1.4	1.4	1.4	1.4
TRAFFIC		*(million)*			
Passenger train-km	161.2	159.4	164.1	160.7	168.8
- Cercanias (local)	*59.8*	*59.2*	*60.1*	*103.1*	*108.4*
- Medium distance	*41.7*	*41.4*	*44.2*		
- Long distance	*59.7*	*58.8*	*59.7*	57.6	60.3
Freight train-km	26.1	25.8	26.3	24.1	23.9
Total train-km	187.3	185.2	190.4	184.9	192.7
TRANSPORTED QUANTITY		*(billion)*			
Passenger-km	21.8	21.0	21.5	21.1	22.6
- Cercanias (local)	7.6	7.3	7.5	10.7	10.6
- Medium distance	3.4	3.3	3.4		
- Long distance	10.8	10.4	10.6	10.4	11.9
Tons-km	7.9	9.2	9.9	10.0	10.4
Traffic unit (passenger-km + tons-km)	29.7	30.2	31.5	31.1	33.0
PRODUCTIVITY OF TRAINS		*(unit)*			
Average passenger per passenger train	135	132	131	132	134
- Cercanias (local)	126	123	125	104	98
- Medium distance	81	80	78		
- Long distance	181	177	177	181	198
Average tons per freight train	304	357	378	412	435
Average traffic unit per train	158	163	165	168	171
PRODUCTIVITY OF NETWORK		*(thousand)*			
Yearly trains per km of network	13.9	13.2	13.5	13.1	12.7
Yearly trains per km of rail track	10.3	9.6	9.8	9.5	9.4
		(million)			
Yearly traffic unit per km of network	2.2	2.2	2.2	2.2	2.2
Yearly traffic unit per km of rail track	1.6	1.6	1.6	1.6	1.6

Source: own elaboration on data *Observatorio del Ferrocarril, Adif, Renfe Operadora* and Eurostat.

Table 9 – Facts of the Swedish rail infrastructure

SWEDEN	**2009**	**2010**	**2011**	**2012**	**2013**
NETWORK		*(Thousand km)*			
Length of network	11.1	11.2	11.2	11.1	11.0
Length of tracks	15.5	15.5	15.6	15.6	15.5
Tracks per km of network	1.4	1.4	1.4	1.4	1.4
TRAFFIC		*(million)*			
Passenger train-km	95.4	98.0	97.0	106.0	113.0

Freight train-km	40.4	40.6	43.4	39.7	37.9
Total train-km	135.8	138.6	140.3	145.7	150.9
TRANSPORTED QUANTITY	(billion)				
Passenger-km	11.3	11.2	11.4	11.8	11.8
Tons-km	20.4	23.5	22.9	22.0	21.7
Traffic unit (passenger-km + tons-km)	31.7	34.6	34.2	33.8	33.6
PRODUCTIVITY OF TRAINS	(unit)				
Average passenger per passenger train	119	114	117	111	105
Average tons per freight train	504	577	527	555	574
Average traffic unit per train	233	250	244	232	222
PRODUCTIVITY OF NETWORK	(thousand)				
Yearly trains per km of network	12.2	12.4	12.5	13.1	13.8
Yearly trains per km of rail track	8.8	8.9	9.0	9.3	9.8
	(million)				
Yearly traffic unit per km of network	2.8	3.1	3.1	3.0	3.1
Yearly traffic unit per km of rail track	2.0	2.2	2.2	2.2	2.2

Source: own elaboration on data Trafa – Trafik analys, *Bantrafik 2013.*

Concluding remarks

The last decade has seen significant developments in the liberalisation and deregulation of the railway industry in Europe. One characteristic has been vertical disintegration and the separate regulation of previously state-owned companies.

This study has focused on the measurement of the quality of rail infrastructure managers' policies, infrastructure output and productivity. The objectives of the benchmarking have been targeted to determine what and where improvements are called for and to analyse the determinants of high performance levels in those organisations that have been shown to maintain high quality standards in their service delivery. That is why this paper has founded worthwhile to reclassify, using homogeneous criteria, the income statements of six European rail infrastructure managers. In an effort to fine-tune the analysis the paper has also rebuilt the traffic data in these countries in order to compute productivity and cost indicators for the rail infrastructure networks.

The results, based on indicators of unit cost, suggest that the two most productive rail network is in Sweden, with a network that is efficiently managed leading to reduced cost, and Germany, which has a network characterised by significant rail traffic, which is then able to improve productivity and to bring down the unit cost.

The Italian case is ranked third among the six networks and is also to be considered the only rail infrastructure in which traffic and productivity have increased while the production cost has decreased. The remaining three networks show mixed results. The cost of the Spanish rail network is relatively low but this advantage is eroded by weak traffic. Great Britain has a rail infrastructure that is fairly expensive in terms of production cost and this factor is only partially offset by an intense circulation.

The French network, finally, has a production cost in line with the average, along with aproductivity below the average in terms of trains per km of rail track and where only a higher average train load can rebalance this situation. Sweden deserves some additional considerations being that it has been shown to be the most sustainable in this study, and is therefore considered the benchmark for all the others. Being that the low Swedish network cost is only partly offset by the productivity of the network, one lower than the European average, Sweden is a case of high interest that should be investigated in depth to verify how the mentioned performance stems from an organisational model unique in Europe.

The Swedish model is characterised by (i) public management that is integrated with the management of the road network by the public agency named Trafikverket; (ii) outsourcing of line maintenance where maintenance services are assigned via an efficient system of tenders; and iii) flexible organizational structure. The strong performance of the Italian infrastructure was made possible both by the reduction of production cost and through an increase in traffic, particularly in the liberalised segments. The above statements also provide support for policy. The incentive for managers to pursue activities that reduce costs will depend on the rewards that they receive from any cost reduction. The higher benefit of any cost reduction the higher (and socially desirable) the incentives to pursue activities that reduce costs, and vice versa. This paper has political implications for regulatory bodies since it has provided pieces of information to serve them in issues such as the regulation according to objective criteria to improve performance. On the basis of the results obtained, regulatory

bodies are supported in establishing clear and consistent objectives through a strategy of growth, investment and repercussion that the services provided generate on the general wellbeing.

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The "Chinese Model" of the Economy. Analysis of Reforms and Development Trends

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Abstract

The article describes the whole long period of reform of the economic system of the People's Republic of China, which has led to the emergence of the "Chinese model" of the economy. The periods of the planned economy and market economy in China were highlighted and analyzed by stages. The period from 1949 to 1978 was considered a "period of the planned economy" of China, where four phases was distinguished. The problem areas of the planned economy period were highlighted according to the following parameters: internal environment, state enterprises, and state policy. The period from 1978 to the present is described in the article as a period of market economy, where three phases are distinguished. The authors consider the basic most important events in chronological order, both in political and in economic terms, which made it possible to generalize the experience of reforms and give an answer to a question of what the "Chinese model" of the economy is. The approach proposed by the authors allowed to identify and justify the individual directions of the "Chinese model" of the economy and to identify their characteristics and potential for use in other countries. The analysis of the periods and stages of China development makes it possible to state that the "Chinese model" of economy is unique and is a model of flexibility in governance, which combines centralized management and market mechanism.

Key words: economic reform, government regulation, Chinese economic model.

JEL Classification: P11, P21.

1. Introduction

Economic reform and the "policy of openness" held in China for the past 30 years has made it possible for China economy to achieve great progress. The question arises: what is the "Chinese model" of economy? What features of the economic reforms should be considered, what conclusions can be made on the basis of experience of the reforms for a sufficiently long period of time?

After the founding of the PRC, there have been several economic reforms in the country. The analysis shows that it is quite difficult to distinguish specific stages of development of the PRC economy, and the opinions often diverge in various studies, as it is difficult to adopt a common standard for a certain period. In general, the approach is applied where historical periods in the economy of the whole society are distinguished on the basis of the change in the mode of production, and the decisive factor in the allocation of a certain stage is often the transformation of the national economy. "In addition, the political event and a special "movement" is also often a turning point in the development of the economy" (Juan Chzhilyan 2005), for example, the Chinese Cultural Revolution.

The analysis shows that the "Chinese economic model" covers four main development trends that are interdependent. In the literature, these trends are presented as separate models (Juan Chzhilyan 2005), but if we take a look at the Chinese model of economy as a whole, it is better to treat these components as "development trends". The authors have attempted to critically analyze the existing trends.

2. Method

In this article, the main method of research was the historical analysis of the process of reform of the economic system in China for the last half of the past century. In this, transformations are analyzed taking into account the peculiarities of the approaches of Chinese researchers and economists to defining certain categories

of the economic system, which contributes to the elucidation of the general trend of specific steps of the economic reform to strengthen the economic system with the specific nature of China.

In the study of the features of the theoretical concept of the PRC national economy, the authors proceed from the fact that the concept of reform was based on three points (Wei Xi Hong, 2004):

- continued political foundations of society;
- consideration of national specificities;
- verification of the theory of reforming the economy through business practices.

The specifics of the Chinese theoretical platform are to combine modern market economic concepts with the current interpretation of the political economy legacy of Karl Marx and Vladimir Lenin. The focus of the theory of political economy in the PRC is on the analysis of the social aspects of development of the national economy.

The Chinese scholars and ideologists of economic reforms are Dan Honsyun, Xu Tszoshe, Tsai Zhentsyun, Xu Tszytse, Tsai Zhentsyun, Luyu Xuan, Liu Guoguang, Liu Tszunsyu, Peng Neytyan, Song Tao, Sun Ju, Wu Dakun, Wu Chzhenkuy, Chen Xiaoxing, Ho Chzhentsin, Cheng Syushen *et al.* Chinese scientists conducted a comparative study of the economies of several countries at the beginning of the process of reforming the economy. Therefore, China's reform is based on a comparative analysis of the evolution of the sectors of the economy of various countries to determine the parity of their development (Wei Xi Hong 2004).

Simultaneously, in the framework of world economic relations, the Chinese scientists have carried out an analysis of the development of national economies, and their results were compared to highlight the positive factors that improve economic development rates and accelerate the country's movement to the level of advanced countries of the world (Wei Xi Hong 2004).

3. Results

3.1. Result 1

3.1.1. Analysis of the periods and phases of the reform process in China

- Period and stages of the planned economy.

Overall, the entire process of reform in the PRC, based on economic restructuring, changes in economic growth and a number of historical events, can be divided into two periods: from 1949 to 1978 and from 1978 to the present. 1978 was a landmark year of the third plenum of the CC of the CPC of 11th convocation, where the idea to reform the economic system of Chin and the concept of "openness to the outside world" emerged.

The period from 1949 to 1978 is usually called "the period of the planned economy" in the research. This sufficiently long period in the development of the country can be divided into the following stages:

- *First stage:* the stage of reconstruction and development (1949-1952) is characterized by the fact that after the formation of the PRC, a new economic system was created, which nationalized private property under the idea of socialism. In three years, the Chinese government has restored the national economy and moved to a massive economic construction.

- *Second stage:* the stage of "first five-year plan" (1952-1957). With the help of the Soviet Union, the construction of 156 objects was commenced, including 106 civil objects located in the north-eastern and central parts of China and 50 military objects located in the central and western parts of the country (Report of the Government of China, 1952). The centralized economy was also built based on the experience of the USSR. But summing up the first five-year plan had revealed a lot of problems of economic development back then. The main problem of the centralized economy was the inequality of regional development. Industrial growth in 1954 and 1955 in the inner region was 22.4% and 32.3%, while in the coastal region it was just 13.7% and 17.3%, respectively (Fuchun 1992). Despite the fact that the first five-year plan was fulfilled with over-fulfillment and China's GDP in 1957 reached 106.8 billion yuans, the government adopted a new reform of the equal and stable development of the national economy on this issue in 1958. The 8th congress of representatives of the CPC approved the second five-year plan, which stated the need to increase the scale of economic construction on the previous basis and pay special attention to the active industrial development of the coastal region of the country (Zedong 1956).

- *Third phase* (1958-1966): this period is often called "a period of great economic development", "the Great Leap Forward" in the literature (Sanzhina and Wen Yuzhu, 2012). At this point, there was an active search for the path of socialist economic construction, and this may explain the tragic moments that happened during this period. The absolute priority of the development of industry at the beginning of this stage led to the destruction of agriculture and eventually to mass starvation in the provinces of China. According to official statistics, over 30

million people died of starvation over those years. The government has done everything possible to change the situation as soon as possible, and the last years of this period are characterized by changes in development priorities. Thus, the proposed "great leap forward" in industrial production led to a shift in the industry, but in the presence of complex contradictions, the overall GDP for the period fell sharply.

▪ *Fourth stage* (1966-1976gg.): the Cultural Revolution as a political movement had a great influence on the development of the country. However, from an economic perspective, there are different opinions in the scientific literature about how well or badly the Cultural Revolution influenced the economic performance in comparison with other stages.

As a result of the deterioration of relations with the Soviet Union, complex internal situations such as a movement of "national communism", "cultural revolution", as well as other economic and political factors, China was closed from the world economy, which immediately reflected in the sharp decline of the country's economy.

1.2. Period and stages of the market economy.

After enduring a lot of failures of the planned economy, having difficulties and even tragedies as a consequence of the introduction of collective ownership, China began a new search for the path of economic development. On December 3, 1978 at the Congress of the CC of the CPC, in his speech, Deng Xiaoping proposed a new mechanism of state support. State support should be focused, firstly, on the development of certain regions, secondly, on the development of certain enterprises and, thirdly, on the development of entrepreneurs; each of these elements should develop and eventually become the locomotive in its own area. Later, at the suggestion of Deng Xiaoping on the basis of generalization of experience of the balanced development of regions, the government clarified the strategy for the development of the regional economy of the country, in which priority was given to the coastal provinces (Xiaoping 1994).

The period from 1978 to the present time in the literature is usually called the period of the market economy (Haypin 1993). Let's consider the basic steps that can be identified, in our opinion, in this period:

▪ *Fifth stage,* best known as the initial period of the transition of the economic system of the PRC to a market economy (1979-1991).

Thanks to the introduction of the reform of establishment of a private property in the villages and priority policy of the state "to feed people", rural enterprises have acquired the status of priority enterprises of the national economy. In 1984, the reform affected state-owned enterprises. It was mainly about the increase of taxes and change of the priority status of state enterprises. The refusal of the PRC government on the state monopoly on foreign trade and the rejection of the policy of "closed" country should be noted as the most important point of this stage. As a result, special economic areas and open cities were created in the coastal regions. In 1984, the sixth five-year national plan was fulfilled a year earlier and became the best-effective five-year plan after formation of China.

Despite the fact that after that, between 1986 and 1987, there was a slowdown of the economy, the PRC government pursued its policy. 1988 is characterized by prices being formed on the products, and the period from 1989 to 1991 related to the "cleaning of the illegal trading activities". The government sought to restore the country's image, which had by then emerged as a "country of counterfeit goods", resulting from mass illegal activities and sweeping the world with counterfeit products. China's economy just began to develop and gained a steady and fast pace.

▪ *Sixth stage:* the period of establishment of the market economic system (1992-2002). After modernization and creation of a socialist market economic system, the strategy of the priorities in the economic development was replaced with a strategy of even development, whose main task was to reduce interregional differences, and it was the beginning of equal development of regions.

In 1992, the results of economic development, transition to a reform and "openness to the world" were approved at the 14th congress of the CPC representatives, and the objective of the reform was stated as "to create a socialist market economic system" (World Bank 1995). The main objectives of the reform were: regulation of activity of the population, reform of the pricing system, system of commodity circulation, financial system, as well as reform of state enterprises, etc. Thanks to a number of these reforms, the planned economic system was taken apart – gradually, brick by brick.

In 2002, the foundation of a socialist market economic system was already established in China: the level of government interference in the activities of enterprises and private businesses fell sharply, and the market has become the main way to allocate resources.

▪ *Seventh stage:* the period of improvement of the market economic system (2002 – present). At present, China pays attention to the development strategy of the country and is on the way of improving the socialist market economic system (Chzhichin 2003). During this period (from 2002), the administration and management system of the country was reformed; agricultural and stock-raising taxes, taxes on special agricultural products, etc. were abolished. Legislation has been enacted to protect private property, create the conditions for fair competition and allow foreign exchange transactions in order to gradually increase the investment activity of enterprises. In 2008, China became the third largest in the world in terms of GDP, which amounted to 4,300 billion US dollars.

3.2. Result 2

Based on the above, we can highlight the following problem areas of the planned economy period (1949-1978):

▪ State policy. A course was set for the implementation of the planned economy, and the equal distribution of resources is carried out. State policy focusing on the model of development of the Soviet Union gives priority to the development of heavy industry. The largest state and the central enterprises with the help of the Soviet Union are created, but the absolute priority to the development of heavy and military industry slows down and negatively affects the development of other industries, such as light industry.

▪ Internal environment. After the formation of the PRC, the political power in the country was unstable, the complete liberation occurred only in 1951. In such an unstable political situation, it was quite difficult to carry out reforms on the economic development of the country. It should be noted that in view of these problems, the government has carried out a reform on the division of land into private ownership for the people during this period of time. After that, the main task of economic development was to be the restoration and development of agriculture as the basis for the restoration of all the other industries. But the initial plans were changed by the adopted policy of "Great Leap Forward" and the priority development of heavy industry, which resulted in an unacceptable reduction in the population living standards.

▪ State-owned enterprises. State ownership and management of enterprises, even in the priority sector – heavy industry, as well as the planned production and distribution, absence of elements of a market economy has led to a low technological and managerial level of production.

Analyzing the twenty-year period from 1978 to 1958, one is struck by the tremendous work carried out by the People's Republic of China in such a short period of time, the work on a critical analysis of victories and defeats, correction of mistakes and the ability to change a situation in such a short period of time. According to the State Bureau of Statistics of China, during the "cultural revolution" in 1976, the industrial growth was 79%, agricultural growth – 53%, national income grew by 77.4% compared to 1966 (annual statistical reporting of the PRC, 1977). Based on these data, we can conclude that despite the fact that the political movement severely hampered the development of the economy in this period, the national economy is still developing on the rise, making it possible to go to the next period of reform.

"The Chinese economic model" encompasses four main development trends that are interdependent (Chzhilyan2005). Features of these trends lie in the fact that they take into account, firstly, the peculiarities of politics and public administration, and secondly, the peculiarities of the national mentality.

Role of the state in governance or a "model of development under the leadership of the government", as it is mentioned in the literature. The government has a huge impact on economic development (both direct and indirect). This model is to some extent consistent with the Keynesian theory that the balance ensuring full employment is not peculiar to the market economy. Therefore, the state should regulate the economy by influencing the aggregate demand: increasing money supply, lowering interest rates (stimulation of investment activity) (Keynes 2007), and with the stagnation of the market, the government should make a direct, necessary intervention and regulation of the economy. The intervention and regulation of the economy by the government of the PRC is carried out by the adoption of laws and regulations that are aimed at maintaining order in the market. In the area of economy, the state regulation includes fiscal and monetary policy, taxation, etc. The government policy is based on the fact that ensuring employment, maintaining the stability of prices of products and monitoring the balance of foreign trade is enough for the economy development. Industry departments at the government carry out a constant control and monitoring of the national economy, while acting as independent

market participants in the form of large public sector companies, such as the Ministry of Railways, Ministry of Energy and Resources. The main instrument of government intervention in the economy is state-owned enterprises. Currently, only the aggregate fixed assets of state enterprises have exceeded twenty thousand billion yuans (not including regional and municipal enterprises) (Xin 2007). The investment policy of the country's governance is the most significant. Although the share of public investment has steadily decreased in relation to private investment after the reform and implementation of the policy of openness, it is still large enough.

The effectiveness of the investment process, or "the model of investment flow development", which allows to introduce investment as a part of the process of economic development. The PRC's economy is growing rapidly (9% per year) (Chinese economy. The structure of the Chinese economy, 2015).

Table 1 – The growth rate of China's GDP, % (http://www.ereport.ru, 2015)

YEAR	VALUE
2004	10.1
2005	11.3
2006	12.7
2007	14.2
2008	9.6
2009	9.2
2010	10.4
2011	9.3
2012	7.7
2013	7.7
2014	7.4

The increasing share of the average annual GDP growth of the country is determined by the increasing volumes of domestic and foreign investment in fixed assets. According to the statistics of 2010, capital formation was 54.8% in relation to GDP growth. In comparison with it, the ultimate measure of consumption made up the ratio of GDP growth of 37.3%, while private exports of goods and services amounted to only 7.9%. Hence, the annual rate of growth is 10.3% (in terms of investment, consumption and exports – 5.6, 3.9 and 0.8%), more than half of the contribution is investments (Website of the State Bureau of Statistics of China, 2015). Indeed, the given figures speak about the high rate of development, but some negative aspects should also be noted. In particular, the model of investment flow development makes the economy quite unstable and dependent on consumption. In an effort to maximize GDP, excess of production emerges, formed by excessive investment, which has recently become quite a relevant problem for China. Currently, there is an already established phenomenon of "excess production" and "re-manufacturing" in China in both traditional and new sectors. This phenomenon directly reduces efficiency and, of course, influences the intensification of production. According to statistics, every year billions of yuans of the state investment in various sectors and areas appear ineffective or not effective enough, which becomes widespread. Thus, after the implementation of reforms and the policy of "openness to the outside world", a situation emerged which raised a question of slowing down the investment flow and dropping GDP growth.

Integration of the national economy into the global system of world economic relations, or "the export development model." China ranked ninth as a leading exporter of goods and 11th as an importer of goods. It accounts for almost 10% of global foreign direct investments, as well as 40% of all foreign direct investments made in foreign countries. Such a high share of China in the global investment market is due to a rather peculiar reason. Almost 80% of all foreign investors in the Chinese economy are ethnic Chinese (Huaqiao) living abroad. The overseas Chinese control more than half of all economic activity in the countries of South East Asia (http://www.ereport.ru). After the reforms, China was and still is one of the major emerging countries, which has a surplus of labor. To redress the lack of funds for the economic development of the country, the course was set on the development of exports. Attracting foreign investments through the export has made it possible to increase the volume of funds for development of the domestic economy. Thus, stimulating the development of exports in the past enabled the sustainable growth of China's economy in the present (Izhan 2010). It should also be noted that in this case, China has implemented the law of comparative advantage of D. Ricardo in practice: the country should specialize in the export of the goods, in production of which it has the largest absolute advantage (if it has an absolute advantage in both goods) or the smallest absolute disadvantage (if it has no absolute advantage in

any of the goods). But a critical analysis of the situation in this area shows that the course set on exports development also demanded rethinking and adjustment. High export promotion, attracting foreign funds in huge numbers – all this increases the amount of foreign currency and leads to the large scale of its reserves, which in the future may cause, and sometimes is already causing problems in international trade.

In addition, in order to develop exports and increase trade surplus, many enterprises reduce the cost of production through cutting "internal costs" off schedule and using low technology. Thus, as a result, businesses get meager profits, and as a consequence, it is the main reason for the low wage of workers. Low wages and low living standards of workers lead to conflict between the enterprises and employees (Guanchang 2008).

The primary state support of industrial development or a "model of the priority development of the industry", which suggests the strategy of "priority" development of the industry as a basis for the growth of the Chinese economy. At present, the industrialization of China's national economy is becoming more evident. According to statistics, after the tenth five-year plan (2001-2005), China's gross industrial output is more than 70% relative to the total gross output of the country (Website of the State Bureau of Statistics of China 2015).

Reforms in China have led to changes in the distribution of business activity and industry. In the days of Mao Zedong's new iron and steel plants, facilities of the automotive industry and mechanical engineering were built mainly in the north and north-east of the country, in cities such as Anshan, Shenyang, Jilin, etc. The large industrial centers were inherited from the past, such as Shanghai.

China currently leads the world in coal, iron, manganese, lead, zinc, antimony and tungsten ores and timber production; it is the world's largest producer of coke, pig iron, steel and steel pipes, aluminum, zinc, tin, nickel, televisions, radios and mobile phones, washing and sewing machines, bicycles and motorcycles, watches and cameras, fertilizers, cotton and silk fabrics, cement, shoes, meat, wheat, rice, sorghum, potatoes, cotton, apples, tobacco, vegetables, silkworm cocoons; it has the world's largest population of poultry, pigs, sheep, goats, horses and yaks and also leads in the catch of fish. In addition, the PRC is the world's largest car maker. Oil, gas, rare earth metals are produced on the territory of China (molybdenum, vanadium, antimony, uranium (Chinese economy. The structure of the Chinese economy, 2015).

Priority development of the industry, on the one hand, makes it possible to rapidly develop certain industries according to the plans and goals, but on the other hand, a rapid development of the industry is causing serious damage to the environment and is depleting resources. The issue of environmental pollution is the reverse side of the marginal product in the development of the industry. According to statistics, the annual damage due to environmental pollution is 10% relative to the total GDP (Website of the State Bureau of Statistics of China, 2015). The Chinese model of the economy in the long run is not a model of the market system, though the goal of the reform was formulated at the 14th congress of representatives of the CPC as the creation of a "socialist market economic system". The main objectives of the reform are regulation of activity of the population, reform of the pricing system, system of commodity circulation, financial system and reform of state enterprises, etc. Despite the presence of state regulation in the economy, the state sector in the industry still accounts for about 30% of GDP (The growth rate of China's GDP, 2015). China is characterized by the development of market relations and private property, a large percentage of foreign investment.

The new period presents new challenges, and at the moment the Chinese government realizes that the modernization of the country leads to the increasing pollution of the environment, and at the moment this issue is given prime importance. "The ecological model", "circulating model" and "the strengthening of cooperation between regions" are the main tasks that are set for the Chinese economy.

4. Discussion

The Chinese economic model has its own characteristics, but the main thing is that the economic development is controlled by the Communist Party and the government. Analysis of the acquired 30-year experience of reforms made it possible to assess the advantages and disadvantages of the way made, and at the moment the country is going through a transition to a more progressive model of development on the basis of macro regulation, regulatory market control (Yiming 2006). Firstly, the task is to accelerate the reform of the state system and to move from a model of economic development "under the guidance of the government" to the model of economic development "under the direction of the market". On the instructions of the Party and government, the function of the state should withdraw from direct intervention in the economy and confine to the formation of legislative base and indirect regulation of the market. The state should concede the leading position on the market directly to private enterprises and reduce the monopoly of state-owned enterprises in some areas. Secondly, the development of the economy on the path of "the model of investment flow increase" should be changed and sent to the path of growth in consumption, although this way of development is also fraught with

imbalance, and one of the basic functions of the state is to strike a balance. Thirdly, it is necessary to adjust the model of development of export and move to the criterion of the balance of foreign trade and turnover. This policy should primarily be the policy of the enterprise, which should focus on the amount of wages and living standards of workers. To do this, enterprises must follow the path of introduction of new technologies, training of workers and improving product quality. The state aims to balance the development of light and heavy industries.

Conclusion

We have tried to retrospectively examine and analyze the whole long process of reform in the People's Republic of China in this article. The analysis of the periods and stages of development of China makes it possible to state that the "Chinese model" of economy is unique and is a model of flexibility in state governance, which combines centralized management and the market mechanism.

Naturally, negative aspects are also shown in the process of functioning. State intervention in the economy often crosses certain limits of market regulation, market mechanisms stop working, and the province's economy cannot ensure the normal development of the region, which leads to debt bondage of the regional economy from the center (Di 2010). The excessive state intervention in the economy is particularly felt in comparing various regions of the country; thus, the main regions of China are in a socialist regime, while regions such as Hong Kong, Taiwan and Macao, due to the current political causes, are developing as the free markets. Thus, the direct state intervention in the market economy has become one of the reasons for the dependence of the provinces' economy from the center.

The main task of the new reform is the transformation of the "Chinese model" of economy into the system, and work in this area is just beginning, which makes it possible to adjust, modify the "Chinese model" and as a consequence, assign it a new path of development. The "Chinese model" of economy remains topical and interesting for the economies of all countries of the world. On the basis of generalization of the historical experience, by studying and analyzing the contradictions arising in the course of practice, the "Chinese model" of the economy can be improved, adapted and applied in other countries.

Acknowledgement

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Impact of Municipality Size on Economic Performance.
Evidence from Slovakia

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Abstract:

In the last 50 years, amalgamation processes have been carried out in most European countries with the aim of consolidating the settlement structure. The main targets of such reforms have been the cost advantages as well as the effort to improve the quality of public services. The Slovak Republic belongs to one of the countries with the most dispersed municipalities within Europe, where 67% municipalities have a population of 1,000 or under. This paper deals with the impact of a municipality's size on its economic performance. It summarizes the results from empirical studies and also includes an analysis of selected financial indicators in municipalities of various sizes in Slovakia. The results confirm the impact of a municipality's size on its economic performance.

Keywords: economies of scale, municipalities, amalgamization, public services, economic performance.

JEL Classification: H71

1. Introduction

The settlement structure in Slovakia is one of the most dispersed within the EU member states and is marked by a large number of small municipalities. During socialism between 1950 and 1989, the number of municipalities in Slovakia was reduced from 3,344 to 2,698. After 1990, major fragmentation took place and the number of municipalities was increased to its current 2,891. Almost 67% of the municipalities have a population of less than 1,000 and they only represent 17% of the total population. (Statistical Office of Slovak Republic, 2014) In contemporary Europe, only several countries have not initiated the amalgamation of small economically inefficient municipalities such as the Czech Republic and France. Between 2002 and 2005, administrative and fiscal decentralization took place in Slovakia. A communal reform was also planned and should have resulted in territorial amalgamation although this has yet to be implemented. While decentralization has created a basic financial framework for the development of governmental competences of municipalities, further development has been limited by the atomized settlement structure.

Generally, small municipalities have a problem to produce real tax incomes as they depend to a certain degree on the balancing and transfer from central budgets. This is reflected through the low efficiency of local public services and high administrative costs. However, there is a different situation in Slovak towns. In towns (According to Slovak legislation, town means a municipality with a population of more than 5,000. Currently, there are 138 towns out of 2,891 municipalities) more public services are provided and there is the added pressure of effective provision. However, empirical studies have suggested that the economies of scale may not be a clear result of the amalgamating processes. Thus, it is very complicated to determine the optimum size of a settlement unit.

The aim of this paper is to analyze the economic performance of small municipalities in Slovakia. The paper is divided into two parts. The first part contains a summary of the theoretical knowledge about the optimum size of local governments and economies of scale. The second part contains the outputs of analyzes in the Slovak Republic.

2. Overview of the literature

Empirical studies have previously shown a correlation between the economic conditions in municipalities and their size as measured by the number in the population (*for example* OECD 2006, Hirsikoski 2007, Christoffersen, Larsen 2007, McKinlay 2006, Hemmings 2006). Given that the municipalities are responsible for a major part of the development of local economics and are the largest providers of public services, they may be

considered as „producers"of such services. Therefore, approaches from microeconomics may be applied in the analysis of their economic efficiency and in particular the concept of economies of scale[1].

The concept of economies of scale is based on the assumption that if there are significant fixed costs in the budget of a local government, the average costs show a decreasing tendency with increasing population in the monitored municipality. Thus, the production efficiency of the municipalities is expressed by decreasing the cost function (Figure 1). The fixed costs in Slovak conditions mean the everyday expenditure of the municipalities such as administration which is in accordance with the Danish model (Christoffersen and Larsen 2007). The application of the concept of economies of scale means that local governments need a sufficient population in order to be able to minimize the average costs of administration. The basis of this concept is that a system of many small local governments means a higher expenditure for provision of the same output, versus a system with fewer large local governmental units.
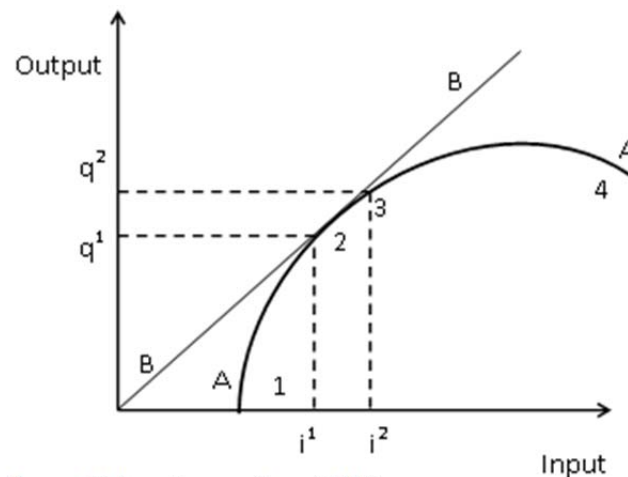
Source: Dollery, Byrnes, Crase (2008)

Figure 1 - Economies of scale GDP

In the analyzes of local governments which provide various public services, every „output" has its own slope of production function, which correspond to the features of the provided service (the required material and human resources). In the real milieu, the technical non-efficiency in ensuring public assets and services frequently results in the fact that combinations of input are not provided at the level of the production efficiency values (Dollery, Byrnes, Crase, 2008).

The literature from the Scandinavian countries has confirmed several hypotheses relating to the low economic efficiency of small municipalities. The specialization within the organization of municipal offices in large towns may result in economies of scale, while in small villages; little specialization creates pressure on the growing costs of the local government. A further finding has been that small local governments substitute their cost inefficiency by imposing higher local taxes. The pressure of costs, which is created in small municipalities, is not only necessarily reflected in the higher taxes of small municipalities. To the contrary, it may be expected that the municipalities apply a compromise solution ("trade off") between the income effect and taxes, and the substitution effect between the growing expenditure and the quality of the provided public services determined by the law (Christoffersen, Larsen 2007).

However, economic efficiency is only one of the criteria which may be applied to determining the optimum size of a local government and in making decisions about the method of municipal reform. It is important to consider other equally important criteria such as the principle of democracy in local government, equal distribution of services and opportunities for local development.

2.1. Optimum size of local government

Opinions about the optimum size of local government have developed over time. They also differ according to the system of public administration in selected countries. The issue of the optimum size of a town

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[1]The paper deals with the concept of economies of scale, which is most often applied to local governments. The literature also provides for other applications, e.g. the size economies, or economies of two and more products (economies of scope). The differences between these concepts at the municipal level are provided e.g. by Dollery, Fleming (2006).

was also discussed by Plato in Ancient Greece. He came to the conclusion that the ideal population of a town, which was sufficient to perform all important functions, was 5,040. (Swianiewicz 2002).

According to older studies in the Scandinavian countries, municipalities with a population above 5,000 have been considered as the optimum size (e.g. the Danish model of 1970)[2]. A different approach identified as the least costly municipalities were those with a population between 30,000 and 50,000 (e.g. Houlberg 2000 In Lotz 2006). According to surveys from Switzerland, an effective settlement unit is a population above 500 (OECD 2006). A survey from Australia (Soul 2000 in Dollyre, Byrnes, Crase, 2008) has stated that the lowest costs for the operation of municipalities are within a population of 100,000 – 316,000 in the local governmental unit.

Bikker, Linde (2015) tested Dutch municipalities between 2005 and 2014 using simplified unrestricted Laurent function to provide the optimum model. The optimum size for municipalities covered around 57,500 inhabitants. Disaggregated analyses on annual data showed that the optimum size had increased over the studied period to 66,260 inhabitants in 2014 from around 49,000 inhabitants in 2005 (Bikker and Linde 2015).

Slovak empirical studies in this field of research are weak as are the political documents. In 2004, the proposal "Municipal Reform" was presented for public discussion in Slovakia, where the Government proposed the reduction of municipalities to between 239 and 300, with a population of 20,000 to 30,000 (Municipal Reform, 2004). The proposal was criticized by local governments, and the discussion on the need to implement territorial consolidation was deferred. There is lack of research about the optimum size of Slovak municipalities. One of the few has been the study which examined the efficiency of regular expenditure of local government through general public services. The study revealed that the best average efficiency of 81.70 % was achieved by the municipalities with a population between 20,001 and 50,000 (Černenko 2013).

In the last 60 years, there have been many countries in Europe where consolidating tendencies have prevailed, more or less, in respect to the local settlement structure. Since 1950, the number of municipalities has been reduced in Lithuania by 90%, in Sweden by 87%, in Denmark by 80%, in Belgium by 78%, in Great Britain by 77%, in Germany by 51%, in The Netherlands by 44%, in Austria by 42%, in Norway by 41%, in Finland by 17%, in Spain by 12%, in Switzerland by 7%, in France by 5% and in Latvia by 4%. On the other hand, there are countries where in the last 60 years; the number of municipalities has grown. Such growth has been 4% in Italy while in the Czech Republic it has been 51% (Klimovský 2009).

The Slovak Republic is one of the most fragmented European countries from the aspect of the size of territorial units. More than 67% of all Slovak municipalities have a population of less than 1,000. At the end of 2010, 2,891 municipalities were in the Slovak Republic, and the largest share (27.5 %) was represented by the municipalities with a population of between 200 and 499 (Table 1).

Table 1 - The size of municipalities in Slovakia

The size of the municipality	Municipalities			Number of cities	Inhabitants		
	Number	%	Cumulative share in %		Number	%	Cumulative share in %
Up to 199	380	13,14	13,14	0	47 363	0,88	0,88
200-499	794	27,46	40,60	0	273 080	5,08	5,96
500-999	775	26,81	67,41	0	547 161	10,17	16,13
1 000-1 999	555	19,20	86,61	2	774 448	14,39	30,52
2 000-4 999	259	8,96	95,57	19	753 922	14,01	44,53
5 000-9 999	56	1,94	97,51	45	386 411	7,18	51,71
10 000-19 999	32	1,11	98,62	31	452 325	8,41	60,12
20 000-49 999	29	1,00	99,62	30	844 944	15,71	75,3
50 000-99 999	9	0,31	99,93	9	639 585	11,89	87,72
100 000 and above	2	0,07	100,00	2	660 814	12,28	100,00
TOTAL	**2,891**	**100.00**		**138**	**5 380 053**	**100,00**	

Source: Statistical Office of Slovak Republic

2.2. Economies of scale

Does amalgamation really result in economies of scale? It is difficult to empirically measure the economies of scale of municipal reform in practice. The relationship between the size of local government and the efficiency

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[2] According to the study by Christoffersen, Larsen (2007), the average costs per capita in providing social services were falling up to the size of the municipal unit with a population of 5,000, while in the municipalities with a population above 5,000, the average costs were almost constant.

of its financial activities is one of the most important questions of local government studies. Yet, there have been studies which are skeptical about using territorial amalgamation as a way of improving financial conditions of the fiscally under-funded local governments (for example Dollery, Crase, 2004).

Dollery and Fleming (2006) analyzed the economies of scale during the municipal reform in Australia. Their findings have suggested that it is impossible to determine one standard size of municipality that would ensure the most effective conditions for the provision of all municipal services. The services which demand more human capital (e.g. health service, social services) generate low economies of scale because the growth of these services means their character requires a higher number of employees. On the other hand, in respect to the 'capital intensive' services such as waste removal and sewage, interesting trends may occur as the services are provided to a greater number of households. During the last two decades, at the level of local government authorities in Australia, the „capital/intensive" services have shifted to „work/intensive" municipal services. As the result, the impact of the economies of scale on operational costs has been continuously falling. The research in capital intensive local services was conducted by Bel (2012) and has validated the empirical evidence of economies of scale which take into consideration that their size depends on the settlement structure of locality, on the specifics of the public service and on the model of production. Similar, results have been shown in Irish municipalities (Callanan *et al.* 2014).

Thus, the amalgamation of municipalities is effective in that it allows a higher degree of using the fixed assets owned by the municipality, using the benefits of specialization in addition to the savings made in purchasing inputs in larger volumes. Savings in the purchase of services and property may be implemented by the municipalities also in the case of effective inter-municipal cooperation. This common obtaining of services has also taken place in Slovakia through the institute of the Common Municipal Office. On the other hand, certain problems may occur as a result of amalgamation, connected with management of larger territory and the disturbance of the relationships between the representatives of the local government and the population.

Generally, most territorial amalgamation is combined with the thesis that larger municipalities operate more efficiently compared with the small ones. The importance of the economies of scale also grows in respect to the fact that within the decentralization process, local governments provide more and more new and more specific public services.

However, the economies of scale have not been clearly demonstrated in every amalgamation process. Byrnes and Dollery (2002) summarized 22 empirical studies about the amalgamation in Great Britain and the US between 1959 and 1998. They investigated the statistical dependence between the size of the municipality and the average costs for provision of a public service. While they found the economies of scale in 8% of studies, 24% of studies identified increased costs, 29% of studies revealed both the economies and „non-economies" of scale, and 39% of studies failed to reveal either of them. Thus, the economies of scale have not been clearly demonstrated, and the uncertainty of its existence is enhanced by the problem of not having sufficient and comparable statistical data.

In spite of this, the economies of scale in municipal reform have been shown in Denmark. In 2007, the number of municipalities in Denmark was reduced from 270 to 98 with an average population of 55,000. Although they declared achievement in economies of scale, the main benefits of the reform were particularly demonstrated in the quality of the provided services, which was the main motive of the Danish reform (Lotz 2006).

An OECD study (2006) stated that the reason for the given differences may be the timing of the research. While the study by Brynes and Dollery (2002) covered a period of almost 40 years, the Danish studies have been contemporary. Thus, it is probable that the economies of scale change depending on the time variable. Some studies state that the main effect of the economies of scale is manifested in the short time, while the effect is low in the long-term.

The later Danish studies (e.g. Christoffersen, Larsen, 2002 in Lotz, 2006) have revealed that the economies of scale went up significantly between the years 1990 and 2000, ascribing it to the effect of the penetration of information technology into public administration. The IT services were more effective in large towns than in small villages.

It should be noted that in identifying the economies of scale, several problems have arisen. A major role has been played by the quality of the data base and the applied methodology. Byrnes and Dollery (2002) use the term 'engineering estimates' that are used in the calculation of the economies of scale. They are based on the calculations of experts from various areas such as economists and geographers and need not be objective due to the fact that they are based on summary statistical calculations that do not account for the specific features of every municipality. The calculations are mainly based on the relationships between the size of the municipality

and the total expenditures per capita, but neglect the relationships between the individual municipal organizations and their unit costs.

In view of the available information, the majority of studies have been aimed at the „firm-specific effects" [3] which compare the total expenditure with the size of the local government. Only a few Danish analyzes have been aimed at the "plant-specific effects" which compare the unit costs and the size of local governmental institutions such as schools and medical facilities[4]. The latter types of studies have demonstrated lower importance of the economies connected with amalgamation. It has been shown that large municipalities do not have proportionally larger schools when compared with smaller municipalities (European Committee on Local and Regional Democracy, 2009).

In addition, some studies about the economies of scale are focused on the administrative expenditure of municipalities although it is clear that this expenditure only represents a small part of their total expenditures. In other areas, the issue of economies is related to the size of the institutions that provide specific public services. In education, most of expenditure such as the wages of teachers, material and buildings are spent at the level of individual schools. Thus, the question must be asked as to whether the large schools operate with higher efficiency than the small ones (Blom-Hansen 2012, Bönisch *et al.* 2011, Soukopová *et al.* 2014).

Any conclusion with respect to the economy strongly depends on the degree of decentralization of the administration in the given municipality. As larger municipalities have a tendency to decentralize the administration of provided services, it leads to the impression that the unit costs for their administration are lower (Blom- Hansen, 2005 in European Committee on Local and Regional Democracy, 2009).

Slack – Bird (2012) have summarized the results of the amalgamation from Canada and Finland. Found (Found, 2012 in Slack – Bird, 2012) states that according to the analysis of 445 municipalities in the province of Ontario in Canada, the most significant economies of scale were in the municipalities with a population of approx. 20,000. On the contrary, the police services were the most effective in municipalities with a population of 45,000. The Finnish studies suggest that the optimum size for medical services and education is a municipality with a population of between 20,000 and 40,000. The Danish studies consider a population of between 50,000 and 100,000 as the optimum size of a municipality for primary schools.

A more precise study with a complex view on the economies of scale was conducted by Blom-Hansen, Houlberg, Serritzlew (2011). They isolated the effects of amalgamation in the Danish municipalities during the period of 2005 to 2010. They also accounted for additional factors such as the level of urbanization, the changes in functional structure, the status of the Island, the social conditions, the fiscal conditions and the decentralization of administration. They created a regression model which resulted in functions for both the amalgamated and non-amalgamated municipalities. In the analysis, they discovered that the administrative expenditure grew until 2009 in both groups, while in the amalgamated municipalities group; they grew at a slower rate and at lower level. In 2010, the administrative expenditure started to fall in both groups of municipalities as a response to the financial crisis. The difference between both functions suggests that amalgamation may contribute to efficiency.

The basic points of criticism against the economies of scale that are stressed in the territorial reforms are based on the following facts. Firstly, the studies apply the size of a population as a benchmark for the size of output regardless of the structure of the population in the settlement unit. Additionally, they fail to account for the overhead costs of different public services as well as failing to differentiate between the economies at the level of the „institution" and at the level of the sector. The studies also fail to account for the time aspect (Byrnes, 2002 in European Committee on Local and Regional Democracy, 2009).

3. The evidence from Slovakia

Decentralization in Slovakia was carried out between 2002 and 2005 when more than 400 competences were transferred to the local governments. Moreover, the regional level of local governments was divided into 8 regions. In Slovakia, a concept was implemented that each municipality, regardless of size would have the same competences. It means pressure on small municipalities to initiate intermunicipal cooperation and to mutually ensure personal and costly competences. The cooperation is carried out in the form of the Common Municipal Offices ("CMO") that are established on a voluntary principle. The municipalities establish the CMOs solely for certain selected competences such as building procedures, common school offices and common environmental

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[3] Moeller *et al.* 2001 in Lotz 2006 also provide for the product specific economies.

[4] In Slovakia, the „plant-specific effects"were investigated partially within the benchmarking projects, e.g. Benchmarking of Slovak Towns 2004-2008 (Nižnanský *et al.,* 2009), that was aimed at the efficiency of elected public services in elected towns in the Slovak Republic.

offices. They mutually agree where the office will be based and what the membership contributions paid by individual municipalities will be. The majority of common municipal offices are in the area of building procedures. In 2014, 233 CMOs operated in Slovakia. The CMOs for individual competences have various numbers of co-operating municipalities (between 2 and 62 municipalities) and operate in various structures and scopes of competences. It is assumed that strengthening the CMO model as a result of voluntary cooperation between the municipalities could represent an appropriate interim level of non violent amalgamation.

Therefore, certain elected financial indicators for all Slovak municipalities and the impact of decentralization on the financial power of municipalities are presented in the paper. The tax power of the municipalities means the amount of funds from taxes, converted to the amount per capita. The financial power of municipalities means the total amount of funds from taxes and subsidies from the state budget, converted to the amount per capita. The graph shows that as the fiscal decentralization was allowed to increase, the incomes of municipalities in the period of 2002 – 2005 by almost 2 billion EUR, the tax power of municipalities doubled and the financial power tripled.
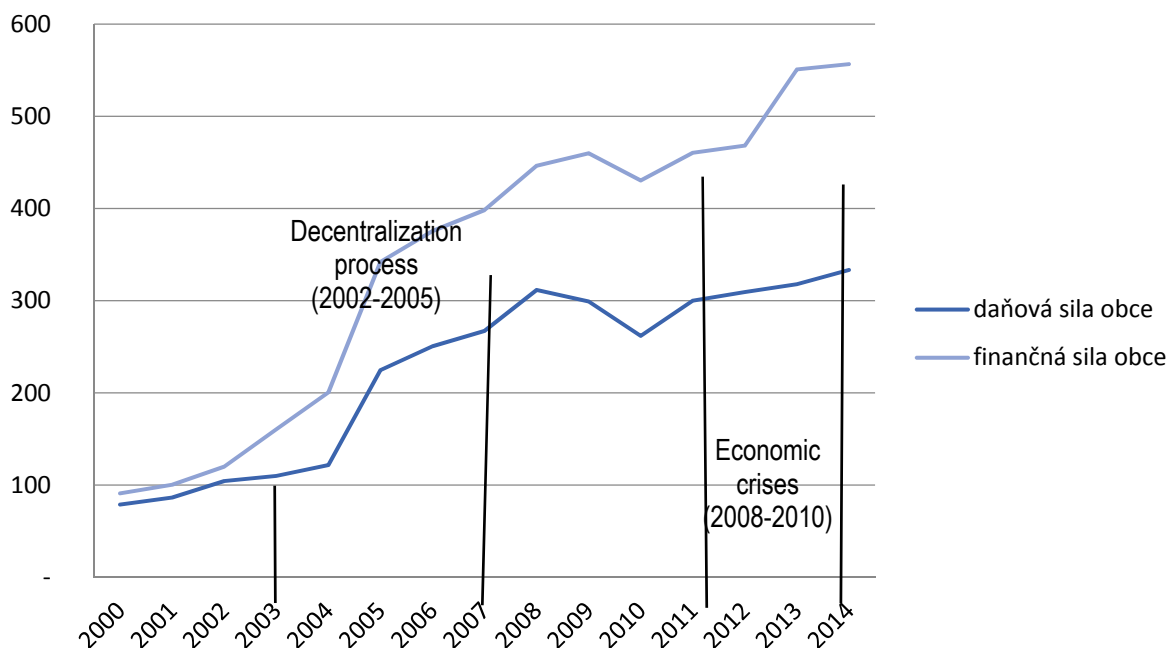
Note: Financial power is black, tax power is grey.
Source: Compiled by author based on data taken from Statistical Office of Slovakia
Figure 2 - Economic performance of Slovak municipalities.
Tax and financial power of municipalities 2000-2014

In spite of the significant fiscal strengthening of the municipalities, the small municipalities still remain financially underfunded. The small municipalities have insufficient economic capacity and do not produce any real tax incomes. This fact significantly limits their fiscal independence and results in a lack of qualified workers for the provision of public services. This is connected with low efficiency in local public services and high administrative expenditure. The economic inefficiency of small municipalities is the result of the structure of their expenditure. Their own incomes, from local taxes and duties, in municipalities with a population below 1,000 fail to even cover the wages and duties of the employees, which represent a major part of the expenses in small villages. The everyday expenditures are between 60 and 70% in Slovak municipalities with a population below 1,000.

4. Economic performance of municipalities of different sizes

Quantitative research methods were applied in the paper. The objects of research were the municipalities in a selected Slovak region. The Košice Self-Governmental Region ("KSGR") is one of the 8 regions in Slovakia. The KSGR has a population of 791,723. The settlement structure of the region is dispersed. The total number of municipalities is 440 and the district with the highest number of municipalities is the district of Košice and its surroundings. The population is 119,227. The largest share in the size structure of municipalities are represented

by the municipalities with a population of between 500 and 999 (149 of municipalities) and the second largest number as those with a population between 200 and 499 (154 of municipalities).

In order to express the relationship between the financial condition of municipalities and the size expressed by the number in a population, the following hypotheses have been tested:

H1: The size of the municipality has an impact on the performance of the economic indicators of the municipality.

H2: Small municipalities with a population below 1,000 are the least effective group of municipalities in terms of the financial indicators in Slovakia.

For this analysis, 145 municipalities (32%) were selected. The municipalities were analyzed in six size categories. In determining the given sample, the assumption was that the economy of municipalities may be affected by the size of the municipality, measured by the number in the population. The input data for the analysis were obtained from the budgets of the selected municipalities. In Slovakia, there is not an available database of required data. Therefore, the data were sought on the websites of the municipalities or they were contacted to provide the study with the required data. The municipalities were selected according to the availability of data. In the analysis, the average in the given group for the individual size groups of municipalities was calculated.

A detailed analysis of performance indicators of the municipalities with a population below 10,000 was the focus, as it was difficult to obtain information for a deeper financial analysis.

Table 2 - The size of 145 analyzed municipalities

The size of municipalities	The number of municipalities in analysis
0-199	20
200-499	29
500-999	30
1000-1999	30
2000-4999	28
5000-9999	8

Source: Own compilation

There were 11 indicators (municipal fiscal indicators) examined in the study: tax power of municipalities, financial power of municipalities, debt capacity, rate of self-financing, rate of financial subsistence, gross asset power, net asset power, reproduction power, reproduction ability of assets of the municipalities. In view of the limited size of the paper, only some of them will be described in detail. Financial and tax power are used in some countries in order to determine the level of horizontal financial balancing which, based on the determined criteria, balances the financial capacity of the income-weak local governments (Dugasová 2012). It is based on the assumption that each municipality should provide public services to its population at the required standard. The tax power measures the tax yields of the municipalities and expresses the total amount of taxes that are paid per capita in the territory of the municipalities. The tax incomes in the budget of the municipalities represent fixed incomes and reflect the tax autonomy of the municipalities.

Tax power of municipality (Žárska 2007): amount of funds from taxes, converted to the amount per capita.

Tax power of municipality = local taxes+share taxes

$$\textit{Per capita} \tag{1}$$

Financial power is composed of the incomes from taxes and transfers coming into the budgets of the municipalities from the state budget of the Slovak Republic. Financial power of municipality (Žárska 2007): amount of funds from taxes and subsidies, converted to the amount per capita.

Financial power of municipality = local taxes+share taxes+subsidies

$$\textit{Per capita} \tag{2}$$

Such transfers are determined for specific purposes and may not be used for any other. They mostly finance the competences that were transferred to the municipalities from the state administration after 2002 such as schools. Thus, financial power reflects the dependence of municipalities on governmental financing. The use

of tax incomes is decided by the municipality independently. The tax incomes and subsidies should be revolving, anticipated, and stable for the municipality.
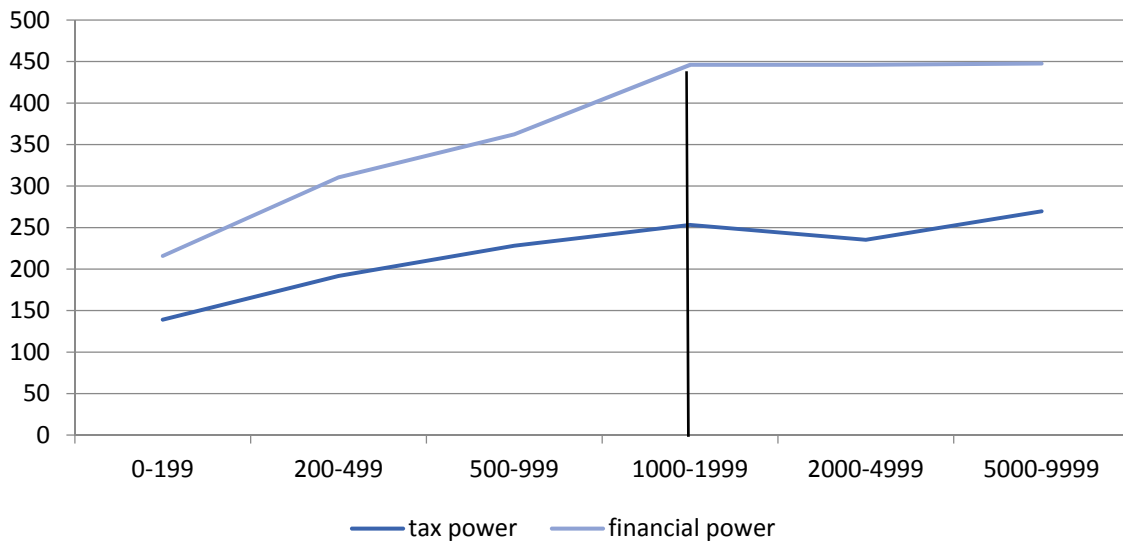
Figure 3 - The tax power and financial power in the selected group of municipalities

In the current analysis, both indicators raised with the size of municipalities, which means that the municipalities with a higher population have higher incomes from local taxes, because they have a real tax basis – the business entities. Usually, in larger municipalities, higher local tax rates are accepted, when compared with small villages, and the collection of taxes should be more effective from the aspect of economies of scale given the lower administrative costs. They also have a higher income from shared taxes. In the municipalities with a population up to 1,000, such ratios are stable, which suggests that the critical limit is a population of 1,000, which probably creates real tax incomes with much greater difficulty. The financial power indicator rises with the size of population because larger municipalities also perform a larger number of local governmental competences for which they receive transfers and subsidies from the state.

Figure 4 - The gross asset power and net asset power in the selected group of municipalities

The indicators which evaluate the volume and reproduction of assets in a municipality were better in the categories of the larger municipalities. The gross asset power of the municipalities shows that larger municipalities have larger assets per capita. The net asset power shows that larger municipalities have on average lower obligations per capita. Low asset power significantly affects the possibility for small municipalities to finance any development activities such as the possibility to obtain more beneficial credits, incomes from business activities performed with municipal assets and so on. These indicators also show a critical limit of a population of 1,000.
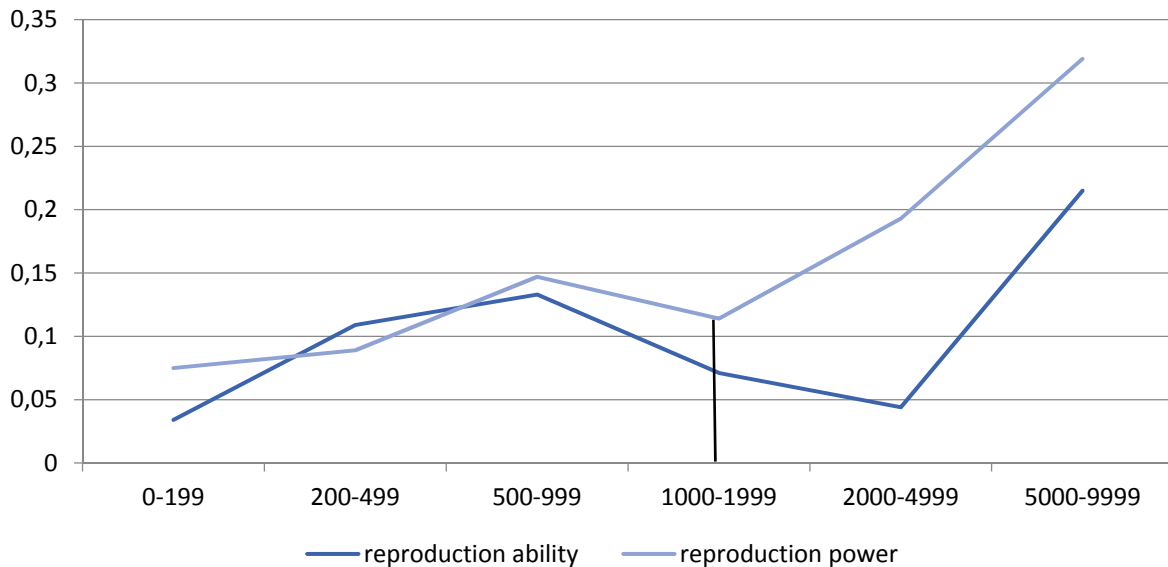
Source: Own compilation

Figure 5 - Reproduction ability and reproduction power in the selected group of municipalities

On average, asset reproduction indicators have a tendency to grow with the number in the population. They reach their lowest values in the lowest category of municipalities. The asset reproduction ability in this size category is only 3%, while the value of this indicator of the municipalities in the largest size category exceeds 30%.

The analysis shows a certain rate of dependency between the selected financial indicators and the size of the surveyed municipalities. This is in accordance with the general hypothesis on low economic efficiency of the smallest municipalities. The detailed review of the values in the selected size categories of the municipalities has revealed relatively positive results of all indicators in the group of municipalities with a population over 1,000. The results suggest that the first step in consolidation would be the amalgamation of the smallest municipalities, which would probably result in the best economies of scale for Slovakia.

Conclusion

It is evident from the empirical studies that the desirable economies of scale are not clear in the case of territorial amalgamation. Yet, in spite of that, the positive effects of municipal reform have been presented and particularly with respect to improving the quality of public services. The analyzed theoretical and empirical studies show that the criticism is based mainly on the following. Firstly, every self-governmental unit is a dynamic, complex and unique system from the aspect of its social and economic characteristics. It is not only the number, but also the structure of the population, the climatic and other geographical conditions. Therefore, it is difficult to determine the optimum size of local governments on a general basis for the whole national territory. Furthermore, there are different production functions for each type of public service and the „plant-specific" effects. In view of this, when the amalgamation process is prepared in Slovakia, it will be required to carry a qualitative analysis as well as a quantitative one.

In terms of the selected financial indicators, the financial conditions in various sized municipalities have been analyzed. Thus, the size of a municipality affects its economic performance. From the analysis of indicators, it can be seen that better values of the monitored indicators in larger size categories of municipalities were found.

In the researched group of 145 municipalities in Košice with a population of between 0 and 10,000, financial and tax power rose with a rising number in the population while the rate of self-financing fell. This is due to a higher share of transfers and subsidies for the transferred competences in larger municipalities. The rate of subsistence was apparently not dependent on the size of the population and the debt capacity was clearly higher in the larger municipalities. The same applied for the gross and net asset power. The detailed review of the values in the selected size categories of the municipalities revealed relatively positive results for all indicators in the group of municipalities with a population above 1,000. Thus, it can be assumed that the critical level with low performance parameters is the municipalities with a population below 1,000.

The analysis has confirmed that smaller municipalities have bigger problems with efficiency and have insufficient funds for the reproduction of their assets. This is reflected in the values of the capital incomes and expenditure of such municipalities. Their low credibility and little possibility to raise funds for their development activities represent a serious problem for these municipalities. This is connected with lower quality public services. From the foregoing, it is clear that the number of municipalities in Slovakia will have to be reduced. Thus, the issue of municipal reform in Slovakia is increasingly serious because the low economic efficiency of small municipalities affects the competitiveness of the whole Slovak economy.

Acknowledgement

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Bond Liquidity Indicators: Can New Thomson Reuters Indices explain Difference in Bond Returns?

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Abstract

The rapidly growing Russian national currency bond market is demonstrating attractive yield levels after global crisis 2008-2009. A significant share of ruble bond issues has relatively low trading volume, so liquidity risk is of particular importance for potential investors.

This article provides an analysis of theoretical approaches to the construction of bond liquidity integral indices and reviews existing practice in the Russian market. First, it compares methodologies of Russian investment banks (Trust, Gazprombank, Zenith and others) and a new cyclic algorithm introduced by Thomson Reuters Agency (TRLI 2015). In empirical part of our research Thomson Reuters' integral indices of bond liquidity (weighted and non-weighted) are tested in the context of explaining the difference in yields of 1118 Russian national currency bonds outstanding (including government, municipal and corporate bonds). The multi-factor cross-sectional regression analysis results show that the influence of both Thomson Reuters liquidity indices on Russian bond yields is fairly stable. Duration and S&P rating also exert stable influence on bond yields. The non-weighted liquidity index has better explanatory power than the weighted one.

Keywords: Russian bond market, liquidity indices, bond returns, YTM

JEL Classification: G12

1. Introduction

Liquidity of a financial asset is an important characteristic determining its investment attractiveness (Chen *et al.* 2007, Chordia *et al.* 2005, Schultz 2001, Tychon and Vannetelbosch 2005). Depending on an asset liquidity level an investor faces certain risks of loss in the situation demanding immediate trading position closure. For instance, there may be financial losses in case an asset sale price turns out to be lower than the price at which it was purchased, even if its median price for the day or certain period considered is even higher than the price of initial purchase. Traditionally this risk of suffering losses in trading due to low liquidity is called liquidity risk. As may be expected the lower the liquidity of an asset the higher is the yield investors demand to compensate for this risk. The investigatory task arises from the fact that liquidity is a very multilateral concept and providing a quantitative integral index for ranking asses (bonds, in our case) by their liquidity is far from easy. In this article we shall compare such bond liquidity indices that are already presented in literature and used by practical analysts in investment companies, as well as analyze new liquidity index, offered by Thomson Reuters analysts for Russian market, in its explanatory potential for differences in bond returns (yield to maturity, YTM).

Our motivation is related to the fact that different investment companies develop their own techniques for bond liquidity indices. A wide range of original techniques is considered in academic literature. The question 'which approach does better explain differences in bond returns?' is open to discussion.

The objective of our research is to test new Thomson Reuters' integral indices of bond liquidity in the context of explaining the differences in bond returns (YTM) in the Russian market. This paper is organized as follows. Literature review is given in Section 2. Investment companies' approaches to building integral liquidity indices for the Russian bond market are compared in Section 3. Section 4 introduces hypotheses of our research and describes empirical methodology and data. Regression analysis results are given in Section 5 and 6. Finally, our conclusions are presented.

2. Literature review. Previous researches regarding bond liquidity indices

Liquidity is a complex characteristic of financial assets. Some papers are devoted to equity markets (Amihud *et al.* 2005). Most specialists underline its general property - rapid transformation of asset into money. The less time it takes to strike a deal, the more liquid the asset is. But this is only the first approach towards

understanding this complex issue (Longstaff *et al.* 2005). The second matter is forming a system of indices or one integrative index to measure assets' liquidity (in our research it will be bonds) for solving a variety of problems.

Following Pastor and Stambaugh (2003) we spell out four following projections in liquidity: time, trading volume, costs and price of an asset. Specifying liquidity characteristics allows us to put forward the following definition: bond liquidity means the ability to buy or sell this or that bond in relatively big quantities (considering specific features of any given market) at a price close to the market one and without significant influence of transactions on this price.

Comprehension of qualitative sense of four projections outlined allows us to propose quantitative measures for collating assets with respect to their liquidity. Depth shows possible trading volume without seriously affecting the price; tightness is connected with transaction costs and shows the distance between transaction prices and median market ones; resiliency reflects speed at which prices reach new equilibrium level after strong fluctuations caused by effecting major transactions; immediacy registers time necessary for transaction settlement. Each of projections presented is matched with a set of indices calculated, as a rule, on the basis of intra-day data of deals and "blotter" condition.

However, calculating liquidity indices within the framework of projections specified does not constitute the final step for assets' ranking. Further, transformation from quantitative to qualitative form is required to assign valid meaning to indices' values.

Recognizing trade turnover as key liquidity index has its traps, at some periods high turnovers cannot be the foundation for considering an issue liquid. Thus trading volumes may also be high in periods of low liquidity, for instance, in times of market recession and high price volatility. Moreover, we need to consider that high securities turnover is observed in periods preceding disclosure of information about companies' incomes due to speculative demand. Díaz (2006) shows that high relative market turnover index reduces risk premium for bonds.

The number of transaction for a definite period is the simplest liquidity index widely used in practice (Eltra invest company 2007, Micex rules for liquidity index calculation 2003, 2009 (Russia)). Big transaction numbers imply good trading activity and high liquidity (Biais 2007; Lawrence 2006). On the other hand, transactions volumes in highly volatile periods may increase even under low bond liquidity. The problem with this index is that, similar to trade turnover, it may signify both high liquidity and high market volatility. Han and Zhou (2006) showed strong correlation of this index with other liquidity indicators describing bond characteristics: issue volume, coupon rate, time after issue, time before redemption. So far as Russian market is concerned, there is practically positive correlation between the number of transactions at government bonds market and trading turnover.

Another popular liquidity index is the number of missing prices (Lesmond 2005) and zero-yield days (or simply "zeros"). Dokhod investment company (Russia) uses proportion of trading days over a security to overall number of days in circulation as the basic liquidity indicator (Table 1).

The next index traditionally characterizing potential investor costs is bid-ask spread. Amihud and Mendelson (1991) found positive correlation between bid-ask spread and bonds yield. But bid-ask spread index also has its limitations in practical use. Firstly, this index is good at diagnosing situation for small transactions volume, since big-scale transactions are, as a rule, conducted in negotiation mode and are, therefore, not reflected in recorded spreads. Secondly, big spreads are typical for volatile periods with increasing uncertainty about bond price. For example spreads tend to get narrower in periods preceding disclosure of important information about the issuer.

Hui-Heubel ratio collates the difference between maximum and minimum prices over 5 last days and turnover coefficient over the same period (Sarr and Lybec 2002). We also meet such indices as: price volatility, Martin index, etc. (Aitken 2005; Ranaldo 2001).

If analysts choose only one liquidity characteristic there is no need for transformation, since index values can be directly interpreted by liquidity level scale. A number of works support the position of choosing one key liquidity indicator and rank assets by it exclusively (Crabbe and Turner 1995, Dimson and Hanke 2004, Kempf and Uhrig–Homburg 2000, Chordia *et al.* 2000, Alonso *et al.* 2004). Russian Dokhod investment company estimates liquidity level by trading frequency index: the ratio of trading days over a security to overall number of trading over a period considered, while Trust investment bank (Russia) has developed its own liquidity indicator based on weighting quote volumes according to their bid-ask spreads.

Chen *et al.* (2007) analyze influence of liquidity on corporate bond returns. They use Bloomberg and Datastream data to construct three different liquidity indicators: bid-ask spread, an indicator of zero liquidity costs (zero return method) and an indicator of transaction costs (LOT model). The sample consists of 4000 US high-quality and high-yield bonds. Results show that there is a significant causal relationship between corporate bond return (YTM) and three liquidity indicators: bonds with lower liquidity have higher spreads. Also, Chen *et al.*

(2007) analyze dynamics of liquidity levels and bond spreads. Results of panel regression analysis (9 years) show that liquidity explains more than half of variation in corporate bond yield spreads.

Chung and Hung (2010) build a semiparametric model for government and corporate bonds (from 1997 to 2005, weekly data). They take difference between average yields of 'recently issued' and 'more mature' bonds as liquidity proxy. Convertible bonds and bonds with rating BB- and less were excluded from the sample. The objective of their research was to test explanatory power of liquidity in bond yield spreads.

Fewer studies are devoted to analysis of influence of bond liquidity on their yields in emerging markets. Usually authors investigate US market and underestimate perspectives of emerging markets analysis. It is worth noting that the level of liquidity is directly related to the level of market development. Becaert *et al.* (2007) analyze 19 emerging markets from 1993 to 2003. They use a number of liquidity indicators: their own integral liquidity index, trading volume turnover (total trading volume to total capitalization of securities), the number of days with zero trading volume. Indonesia market characterizes by the least level of liquidity (the maximal number of days with zero trading volume).

Lepone and Wong (2009) investigate factors explaining differences in bond yield spreads in Australia's market (from 2003 to 2007). The explanatory variables were similar to those chosen in (Collin-Dufresne 2001) for the US market. They construct SFF (standardized fund flows) liquidity indicator on the base of inflows in bond funds. SFF shows bond fund capital growth rate (the more capital growth rate, the more is the level of liquidity). Their regression model explains 60% of variation in bond spreads, but liquidity indicators have no significant influence on bond spreads in Australia's market. This result is contrary to previous studies.

Tarek (2009) analyzes relationship between corporate bond price and liquidity level for Tunisian market from 2004 to 2008. Liquidity level is measured as natural logarithm of issue volume (in mln dinars). Average bond duration is 2.5 years (from 0.2 to 5 years), issue volume varies from 2.3 to 3.4 mln dinars. Each year from the issue date reduces bond spread (between yields of corporate and government bond) by 2.5%, which corresponds to one of the hypotheses. But increase in issue volume by 1 mln dinars leads to increase in bond spread by 10%, this positive relationship contradicts to the other hypothesis.

Dick-Nielsen *et al.* (2012) propose their own liquidity index. They analyze not only influence of liquidity on bond yields, but also elasticity measure and its dynamics in crisis periods. The sample comprises noncallable nonconvertible corporate bonds without put option and with fixed coupon from 2005 to 2009. By the principal component analysis Dick-Nielsen *et al.* (2012) defined the most significant indicator explaining bond yield spread – influence of deals on price. This indicator was first included in integral liquidity index. Then other factors were included in the integral liquidity index: transactions costs and their standard deviation.

Houweling *et al.* (2005) consider different proxies to measure euro corporate bond liquidity (including issued amount, yield volatility, age, listed, etc.). Other sources of risk (interest rate, credit risk, maturity and rating differences) also were controlled. Houweling *et al.* (2005) confirmed significant liquidity premia in bond return for eight liquidity proxies.

Aussenegg *et al.* (2015) analyze monthly excess returns for 23 Euro-denominated corporate bond indices and propose a new specification for bond asset pricing models. They also examine term and default risk factors and liquidity risk. They demonstrate different sensitivities of risk factors before and after recent financial crisis.

3. Integral Index of Bond Liquidity. World and Russian Practice

If analysts favor multiple approaches in considering liquidity characteristics, there appears a problem of assigning weights. Determining weight coefficients done either by expert or by mathematical methods. For building comprehensive liquidity indicator equal weights technique may be applied, like, for instance, it is done in European central banks (Bank of England, 2007, European Central Bank, 2007). Russian Expert RA rating agency, ELTRA investment company (Russia), NOMOS bank (2005, Russia) use expert method for assigning weights.

Converting quantitative indices into qualitative form (liquidity level qualitative estimate) may be executed either by expertise or mathematical statistics techniques. Expert method in academic literature is provided in works by Ranaldo (2001), Chacko (2006), Nashikkar *et al.* (2008). Significant advantage in building comprehensive liquidity indicator is provided by factor analysis, when separate liquidity indices are clustered into weakly-correlated groups (factors). E.g., first factor explaining major part of dispersion in liquidity indices is analyzed. For security market such idea is contained in papers by Chen (2005), Korajczyk (2007). On practice this approach is implemented at bond market by Renaissance Capital investment bank (2006, Russia). The

method of Renaissance Capital analysts in forming comprehensive indicator presupposes linear convolution of three first liquidity factor values considering their contribution into explaining overall indices' dispersion.

The Russian national currency bond market is rapidly growing (Teplova and Sokolova 2014). In December 2014 the total volume of ruble government, municipal and corporate bonds outstanding reached 20.5% of GDP (in December 2013 – 17.2% of GDP, in 2006 – 9.5% of GDP). The second peculiarity is that stock exchange trading volume accounts for more than 90% of the total trading volume (for comparison, in China – 3%). In 2013 Russia ranked 11th in the world by stock exchange trading volume to GDP (MICEX - 20.8%, for comparison, Taipei Exchange – 2.9%, National Stock Exchange India – 7.8%). The large share of stock exchange turnover motivates investment companies to construct liquidity indices. In March 2015 the total number of ruble bonds outstanding was 1118, but only 778 could be admitted relatively liquid (their monthly trading volume was non-zero).

In Russian practice, expert method is used to calculate corporate bond index in Zenith Bank and Dokhod Investment Company (see Appendix). Analysts of Renaissance Capital used a combination of mathematical statistics (discriminate and cluster analysis) and expert methods to differentiate bonds by liquidity groups.

We consider the best market practices; brought to Russian market by Gazprombank, Trust bank and Dokhod Investment Company in 2006-2007 (Table 1), as well Thomson Reuters analysts' technique, open to practitioners since 2015. A more detailed calculation of liquidity indices is shown in Appendix 1.

Table 1 - Acting Russian market practices comparison. Liquidity ratios calculations for bond market

Description	Gazprombank	Trust (free-access liquidity estimates are not cited)	Dokhod
Time interval	1 month (20 working days)	1 month	5 last working days
Bid-ask spread	Weighted by volume (minimum asks and bids)	Weighted by volume (minimum asks and bids)	bid-ask spread is not used
	Relative spread (in % from median price) is used, weighted by trade period time share	Not weighted by trade period time share	-
		Absolute spread is used	-
Trading volume (for overall time interval)	Trading volume is multiplied on ratio obtained by principal components method	Not used	Ratio of daily average volume for a bond to daily average volume for all bonds of the same quotation list
Number of transactions (for overall time interval)	Number of transactions is multiplied on ratio obtained by principal components method	Not used	Ratio of daily average volume for a bond to daily average volume for all bonds of the same quotation list is used. By comparing Dokhod IC indicator (LI) to one it is convenient to compare liquidity level of a bond to market (quotation list) liquidity level.
Zero days account	Percentage of days to trading time interval is multiplied on ratio obtained by principal components method	Not used	Not used

Source: Gazprombank (2012, 2015), Trust (2007), Dokhod Investment Company (2006, 2007)

For its indicator Gazprombank uses a scale with five liquidity level grades (from 0 (min) to 4 (max)). Instruments having equal liquidity level are not graded between themselves. Number of securities having liquidity level 4 is 10 units, 9 for level 3, 8 for level 2, 18 for level 1, all the rest are assigned level 0. Dokhod Investment Company builds an indicator displaying how many times liquidity of a particular security exceeds the average market figure. At that, all sample bonds are ranked, as opposed to ranking by groups (as they do it in Gazprombank). It should be noted that comparison of ratings assigned on the basis of Gazprombank and Dokhod investment company estimates in Top-10 and Top-45 clusters shows that the estimates coincide in 30% and 35% of cases respectively.

4. Empirical Methodology: Hypotheses of Our Original Research, Data and Control Variables

Hypotheses of our investigation:

H1. New bond liquidity indices developed by Thomson Reuters analysts are significant for explaining bonds' yield under control of traditionally used duration, rating, etc.

H2. Liquidity index and weighted liquidity index are good for explaining differences in bonds' yield at Russian market, but they differ in their explanatory power. Non-weighted liquidity index explains differences in bonds' yield better.

Thomson Reuters analysts use a cyclic algorithm with a few components in an order book: bid volume, ask volume, total accumulated volume and relative bid-ask spread. Two estimates (Liquidity Index and Weighted Liquidity Index) are employed by Thomson Reuters in projecting Yield Map for dynamic filtering and other applications, such as Bond Liquidity Board. $L(t)$ by Thomson Reuters technique indicates how fast an investor can execute a certain trading volume at minimum cost. It is the instantaneous liquidity ratio and it equals 0 at initiation of the calculation.

The idea of Weighted Liquidity Index is similar to traditional liquidity index calculation, but with one exception: analyst or investor use summary accumulated as weight rather than as an averaged component (Eq. (1)):

$$LQX_w(t) = L(t) \times Total\ Accumulated\ Volume\ (\%) \tag{1}$$

As basic explanatory variables our research uses *Ln_YTM* и *Ln_YTM_filt* (see Table 2). When using *Ln_YTM* 5% of observations with maximum *YTM* (over 45%) are excluded from consideration. With *Ln_YTM_filt* no upper limitations are imposed, since *YTM*>45% values are substituted for 45%. For all regressions we also exclude values of *YTM*<3% (only 2 observations, RU000A0JTD37 и RU000A0JSLR8; the next minimal *YTM* value being bigger than 6%).

Since explanatory variables *Vol_main*, *Vol_main_NDM* and *Issue_vol* are calculated in rubles, we introduce natural Logarithms into our regression. But variables *Vol_main* and *Vol_main_NDM* contain many enough zero values, which leads to the loss of some part of observation in taking a logarithm, therefore we conduct calculation in two versions; excluding zero variables and keeping them. The version with keeping zero values is realized in the following way: all values of *Vol_main* and *Vol_main_NDM* before taking a logarithm from them are increased to minimum observable value of appropriate variables in a sample.

Variables *Liq* and *Liq_w* also have many zero values. Calculations demonstrate the expediency of placing them into a separate group. Hence, we introduced appropriate dummy variables taking the value of 1 in case of non-zero values and 0 for zero ones.

We construct different specifications of the following multifactor linear regression model (2):

$$Bond\ RETURN = \alpha + \sum_i \beta_{1,i} \cdot Bond\ Characteristic_i + $$
$$+ \sum_j \beta_{2,j} \cdot Liquidity\ Characteristic_j + \varepsilon \tag{2}$$

We consider the following bond characteristics: industry, indicator of repo eligibility, coupon, duration, S&P rating (Table 2). Liquidity characteristics (trading volume, Thomson Reuters liquidity indices – see Table 2) are also included in the model (2).

Similar linear regression models were constructed by Amihud *et al.* (2005), Aitken (2005) for the equity market, Amihud and Mendelson (1991) for the bond market. Amihud and Mendelson (1991) used bid-ask spread as a liquidity indicator for the bond market. Chen *et al.* (2007) as well as Ericsson and Renault (2006) tested bond liquidity in the context of explaining time-series variation of spreads. Houweling *et al.* (2005) tested influence of nine liquidity proxies of corporate bonds on yield spreads. They constructed a four-variable model to control for other risk factors (see also Section 2 for details).

Unlike previous papers, we focus on new Thomson Reuters indices as bond liquidity measure. We include in the model a number of original factors – industry and sector dummy, S&P rating, repo eligibility.

Our multi-factor regression constructions include agencies' rating in two ways: as *rating_SP_dummy,* and as a set of separate dummies described above. When employing dummy set as basic category rating BB+ is used.

Bond Issuer Company belonging to a particular economic sector is also taken into account in regression analysis through fitting a company into one of 18 sector groups. "Banks" sector group is taken as basic (as having the biggest number of issuers). Besides, we take into account the division of bonds into corporate, municipal and government. This division is set by three additional dummy variables: 19, 20 and 21. Corporate bonds are taken as basic category.

Among dependent variables used results based on *Ln_YTM* appear more adequate (see Figure 1-4) but conclusions drawn with using other variables, even *YTM и YTM_filt*, differ but slightly on the whole.

Table 2 - Notations used (explained and explaining variables)

Variable	Description
Explained Variables	
YTM	Average YTM (March 2015)
YTM_filt	Values of YTM more than 45% are Replaced by 45%
Ln_YTM	Ln(YTM)
Ln_YTM_filt	Ln(YTM_filt)
Explaining Variables	
Repo	Repo Eligible
N_Payments	Coupon Frequency (Number of Payments per Year)
floating	Floating Coupon Rate (0 – No, 1 – Yes)
Vol_main	Trading Volume (Main Trading Mode), Rub bln
Vol_main_NDM	Trading Volume (Main Trading Mode + Negotiated Deal Mode), Rub bln
Ln_Vol_main	Ln(Vol_main)
Ln_Vol_main2	Ln(Vol_main + Minimal Nonzero Value of Vol_main in the Sample)
Ln_Vol_main_NDM	Ln(Vol_main_NDM)
Ln_Vol_main_NDM2	Ln(Vol_main_NDM + Minimal Nonzero Value of Vol_main_NDM in the Sample)
Issue_vol	Issue Volume (Rub bln)
Ln_Issue_vol	Ln(Issue_vol)
Dur	Average Duration, years
Ln_Dur	Logarithm of Average Duration
Liq	Liquidity Index
Liq_w	Weighted Liquidity Index
Liq_dummy	0 – If Liq=0; 1 – Otherwise
Liq_w_dummy	0 – If Liq_w=0; 1 – Otherwise
rating_SP	S&P LT Issuer Rating
rating_SP_dummy	0 – If rating_SP="NR"; 1 – Otherwise
rating_SP_0	1 – If rating_SP="BBB-", "BBB", "AAA"; 0 – Otherwise
rating_SP_1	1 – If rating_SP="BB+"; 0 – Otherwise
rating_SP_2	1 – If rating_SP="BB"; 0 – Otherwise
rating_SP_3	1 – If rating_SP="BB-"; 0 – Otherwise
rating_SP_4	1 – If rating_SP="B+"; 0 – Otherwise
rating_SP_5	1 – If rating_SP="B", "B-", "CCC"; 0 – Otherwise
rating_SP_NR	1 – If rating_SP="NR"; 0 – Otherwise
Industry	Sector Dummy (20-Government, 19-Municipal, Other – Corporate)
gov	1 – If Industry =20; 0 – Otherwise
mun	1 – If Industry =19; 0 – Otherwise
priv	1 – If Industry ≠19 & Industry ≠20; 0 – Otherwise
Ind_1-21	Industry Dummy (21 industries, including banks and non-financial companies)

The analyzed sample includes 1118 ruble bond issues of Russian issuers (government and companies) outstanding in March 2015. The sample consists of 964 corporate, 112 municipal and 42 government bond issues. Descriptive statistics is given in Table 3 (for more details, please refer to Table 4). Total volume of corporate bonds in circulation amounted to RUR 6.4 bln, that of government bonds RUR 6.8 bln, and RUR 0.9 bln for municipal ones. By the number and volume of bond issues in circulation banking sector takes the lead among corporate bond issuers (347 issues with aggregate volume of RUR 1.9 trln).

5. Sample Descriptive Statistics and Regression Analysis Results

The best median yield to maturity (calculated over floating bond issues of sector emitters) in March 2015 was demonstrated by metallurgy and food companies' bonds, as well as developer companies. Median yield to maturity over corporate and municipal bonds' samples was practically similar (15.81% and 15.83% respectively), while median duration over municipal bonds' sample was actually twice higher than that of corporate bonds (1,5 and 0.7 years respectively). Median yield to maturity over government bonds' sample was much lower: 12.85% with 3.6 year duration (Table 3).

Table 3 - Descriptive Statistics

Sector	YTM, % (all bond issues)		YTM, % (bond issues with YTM > 45% are excluded from sample)		Liquidity Index		Weighted Liquidity Index		Duration		Total Num-ber of Bond Issues	Num-ber of Bond Issues with YTM >45%	Total Amount Out-stan-ding, Rub bln
	median	mean	median	mean	median	mean	median	mean	median	mean			
Corporate Bonds	15,81	26,54	15,66	16,18	7,0	17,7	0,0	4,7	0,73	1,18	964	45	6 437
Banks	16,17	22,42	16,08	16,43	14,1	19,4	0,0	4,9	0,54	0,87	347	15	1 861
Oil&Gas	13,95	14,14	13,95	14,14	0,0	16,0	0,0	5,9	1,82	1,84	70	0	1 459
Municipal Bonds	15,83	16,16	15,83	16,16	26,6	26,9	0,0	5,5	1,51	1,58	112	0	891
Government Bonds	12,85	13,13	12,85	13,13	60,2	54,0	29,4	44,2	3,56	3,82	42	0	6 785

Source: Cbonds, Thomson Reuters, authors' calculations

Table 4 - Probability Distribution by S&P Rating

rating_SP_name	Frequency	Percent	Cumulative Percent
AAA	7	0.6	0.6
B	35	3.1	3.8
B-	7	0.6	4.4
B+	39	3.5	7.9
BB	37	3.3	11.2
BB-	54	4.8	16.0
BB+	311	27.8	43.8
BBB	9	0.8	44.6
BBB-	3	0.3	44.9
CCC	1	0.1	45.0
NR	615	55.0	100.0
Total	1118	100.0	

Source: Thomson Reuters Eikon, authors' calculations

45 corporate bond issues (including 15 bank bonds) demonstrated extremely high yield to maturity values, over 45% for a year. As an example of bond issues with YTM exceeding 100% we may refer to Svyaznoy Bank, UTAir Finance, Mechel, SU-155 Capital.

The influence of variables built in liquidity ratios is fairly stable (calculation results are shown in Table 5, 6). In multi-factor regression *Liq* has negative coefficient and *Liq_dummy* positive one. Due to this inclusion of only one *Liq* variable without *Liq_dummy* is incorrect (i.e., in setting zero liquidity in regression *YTM* is, on the average, lower). But if liquidity ratio is positive (non-zero) the bigger it is the lower the *YTM,* which corresponds to our expectations and earlier studies.

Liq_w shows much weaker results in all regressions. In some specifications both ratios at *Liq_w* and *Liq_w_dummy* turn out to be insignificant.

Also stable influence on *YTM* is exerted by *Ln_Dur* and S&P rating variables. Ratio at *Ln_Dur* is significantly negative in all regressions. Credit rating diminishes *YTM*. Rating quantitative value also influences *YTM*, but statistically significant difference is observed only in some rating categories. *YTM* values in 0 category (AAA, BBB, BBB-) do not differs from those in category 1 (BB+). In other categories *YTM* is higher though differences from category 3 (BB-) are statistically insignificant in some regression model specifications.

Among trade volume variables indices based on overall volume (master mode and negotiation deals mode) are preferable. On the whole they exert positive influence on *YTM* but with trade volume zero values excluded statistical significance is not constant. I.e., under zero trade volume *YTM* level is lower but the size of positive volume does not influence *YTM* significantly. Ratios at *N_Payments*, *floating* and *Ln_Issue_vol* are also inconstant. We should note relatively lower *YTM* value of municipal bonds (differences in some specifications are statistically insignificant) and higher *YTM* values of construction and developer companies.

Statistical significance of *Repo* explanatory variable is also unstable. Its exchangeability with S&P rating variables was not revealed because it can both be significant under these variables inclusion and insignificant even after their exclusion.

Residue distribution in regression cannot be fully characterized as normal, though deviation from normality is not particularly expressed (see histograms Figure 1). We also realize possible endogeneity problem in regression analysis conducted. Bad news on a company's financial solvency may simultaneously raise both bond trade volumes (holders actively sell) and yield to maturity. One of the paradoxical results of calculations that *YTM* is lower under zero liquidity ratios may be caused by the influence of some unaccounted-for factors both on liquidity and on *YTM*.

Table 5 – Calculation Results. Bonds with Zero and Positive Liquidity Indices (4 Model Specifications)

Calculation Number / Variable	1 Ln_YTM	2 Ln_YTM	3 Ln_YTM	4 Ln_YTM
N	848	848	689	846
R2adj	0,182	0,035	0,291	0,292
Constant	161,3***	249,5***	48,4***	50,4***
Repo			1	2,2**
N_Payments			1,3	1,2
floating			1,8*	1,3
Ln_Vol_main				
Ln_Vol_main2				
Ln_Vol_main_NDM			1,9*	
Ln_Vol_main_NDM2				3,4***
Ln_Issue_vol			-0,5	0,5
Dur				
Ln_Dur			-5,1***	-6,6***
Liq	-4***		-3,1***	-3,2***
Liq_w		-3,3***		
Liq_dummy	12,9***		9,7***	9,8***
Liq_w_dummy		5,7***		
rating_SP_dummy				
rating_SP_0			0,3	0,1
rating_SP_1				
rating_SP_2			2,4**	2,3**
rating_SP_3			1,7*	1,7*
rating_SP_4			4***	3,5***
rating_SP_5			5***	4,3***
rating_SP_NR			4,3***	4,4***
gov				
mun				
priv				
Ind_1				
Ind_2			-0,4	0,8
Ind_3			0,2	0,3
Ind_4			0,7	0,6
Ind_5			1,2	1,4
Ind_6			-1,4	-1,7*
Ind_7			0,2	0,9
Ind_8			1	0,4

Calculation Number Variable	1 Ln_YTM	2 Ln_YTM	3 Ln_YTM	4 Ln_YTM
Ind_9			1	0,5
Ind_10			1,5	1,4
Ind_11			2,4**	2,4**
Ind_12			-0,6	-0,1
Ind_13			0,2	-0,2
Ind_14			2,1**	2,1**
Ind_15			0,8	1,1
Ind_16				0
Ind_17			-0,7	-0,6
Ind_18				
Ind_19			-1	-0,8
Ind_20			-0,2	-0,7
Ind_21			0,4	1,5

Note. * - 10%, ** - 5%, *** - 1% significance level

Table 6 – Calculation Results. Bonds with Positive Liquidity Indices (8 Model Specifications)

Calculation Number Variable	1 Ln_YTM	2 Ln_YTM	3 Ln_YTM_filt	4 Ln_YTM_filt	5 Ln_YTM	6 Ln_YTM	7 Ln_YTM_filt	8 Ln_YTM _filt
N	605	236	634	253	605	236	634	253
R2adj	0,029	0,088	0,032	0,095	0,245	0,53	0,305	0,541
Constant	181,4***	162,8***	142,7***	110***	49,4***	37***	43***	28,3***
Repo					-0,8	-2,6***	-3,2***	-4,2***
N_Payments					0,4	0,6	0	-0,9
floating					1,4	0,5	0,7	0,3
Ln_Vol_main _NDM2					4,8***	3,7***	4,6***	1
Ln_Issue_vol					-2**	-2,7***	-2,4**	-2,5**
Dur								
Ln_Dur					-4,1***	-0,5	-5,2***	-0,3
Liq	-4,3***		-4,7***		-3***		-2,6***	
Liq_w		-4,9***		-5,2***		-1,3		-0,9
rating_SP_0					0,7	-1,3	1	-0,2
rating_SP_1								
rating_SP_2					2**	1,9*	1,7*	1,3
rating_SP_3					1,5	1,3	1,3	0,1
rating_SP_4					3,7***	2,3**	2,4**	0,7
rating_SP_5					3,3***	4,2***	2,4**	2,7***
rating_SP_NR					4***	2,3**	4,1***	1,7*
Ind_1								
Ind_2					0,1	4,8***	0,1	2,7***
Ind_3					0,9	1	0,7	0,7
Ind_4					1,1	0,2	0,8	-0,5
Ind_5					1,6	2,9***	1,1	1,3
Ind_6					-1,5	-0,7	-1,6	-1,5
Ind_7					0,9	-0,5	5,2***	6,8***
Ind_8					1,3	3,3***	0,7	1,6
Ind_9					3,7***		1,9*	
Ind_10					1,8*	1,4	0,7	-0,1

| Calculation Number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
Variable	Ln_YTM	Ln_YTM	Ln_YTM _filt	Ln_YTM _filt	Ln_YTM	Ln_YTM	Ln_YTM _filt	Ln_YTM _filt
Ind_11					4,1***	7,2***	6***	6,3***
Ind_12					-0,4	0,4	-0,5	-0,2
Ind_13					0,7	2,9***	-0,5	0,5
Ind_14					1,9*	1,6	0,4	0,1
Ind_15					-0,6	0,4	-1,6	-1,6
Ind_19					-0,7	0,3	-1,1	-0,4
Ind_20					0,5	0,2	1,2	0,6
Ind_21					2,5**	1,8*	1,6	0,4

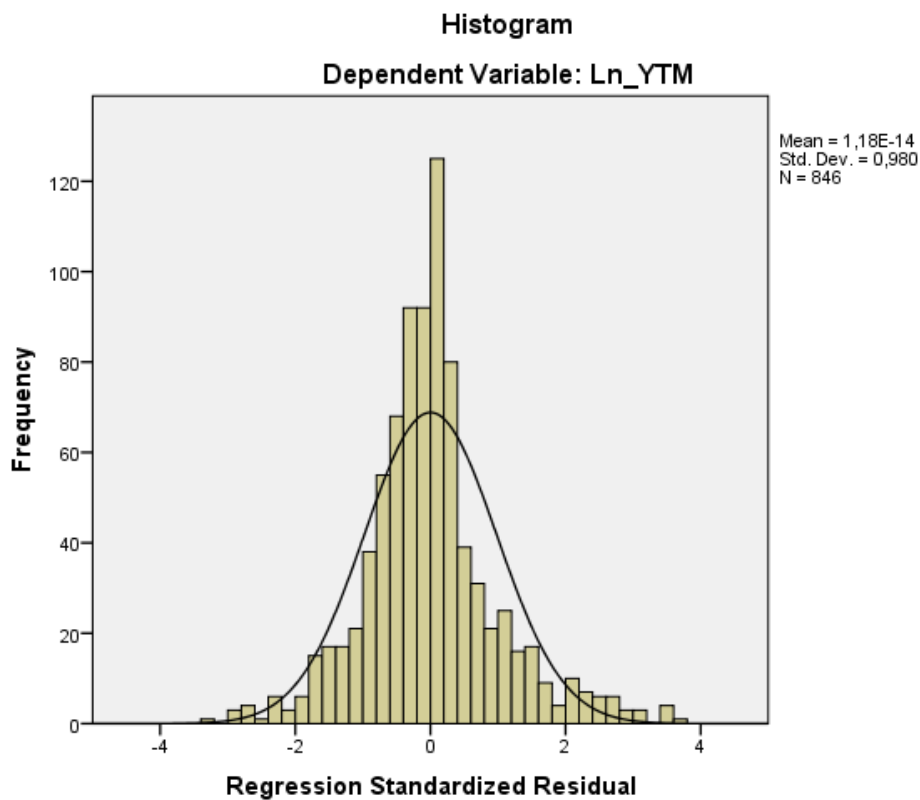*Note:* * - 10%, ** - 5%, *** - 1% significance level

Figure 1 - Histogram. Dependent Variable: Ln_YTM
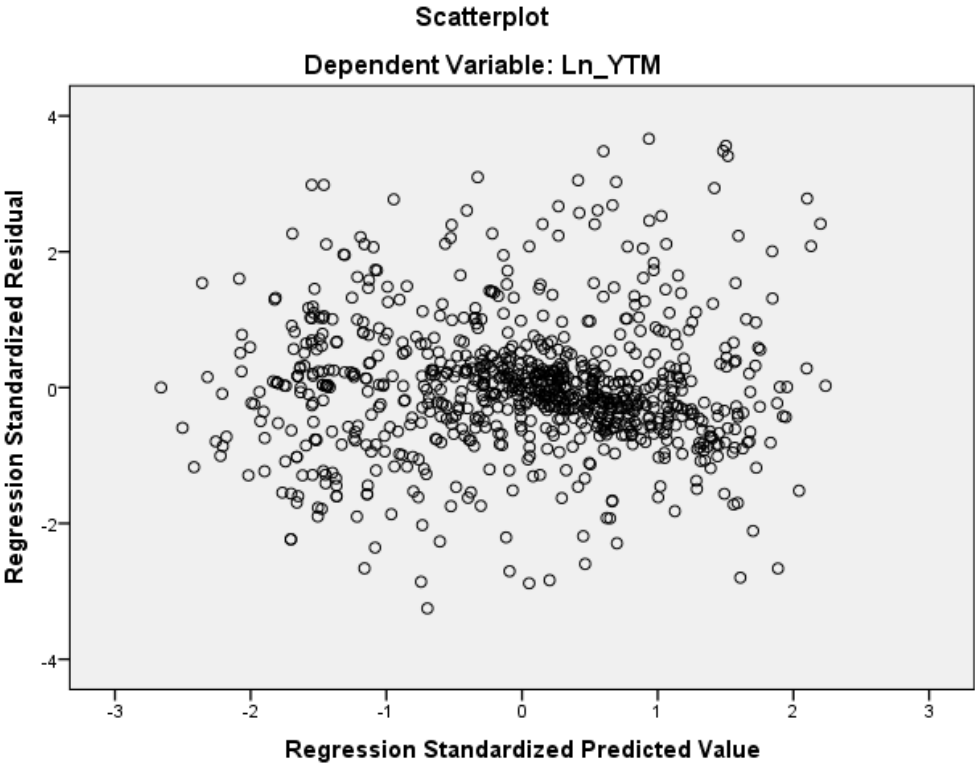
Figure 2 - Regression Standardized Residual and Standardized Predicted Value. Dependent Variable: Ln_YTM
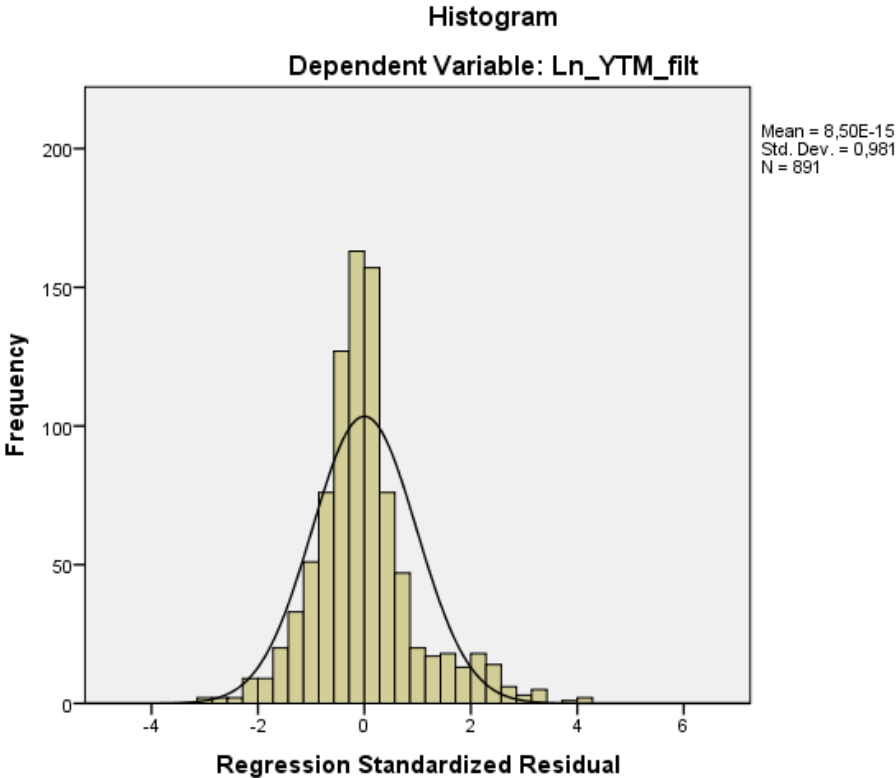
Figure 3 - Histogram. Dependent Variable: Ln_YTM_filt
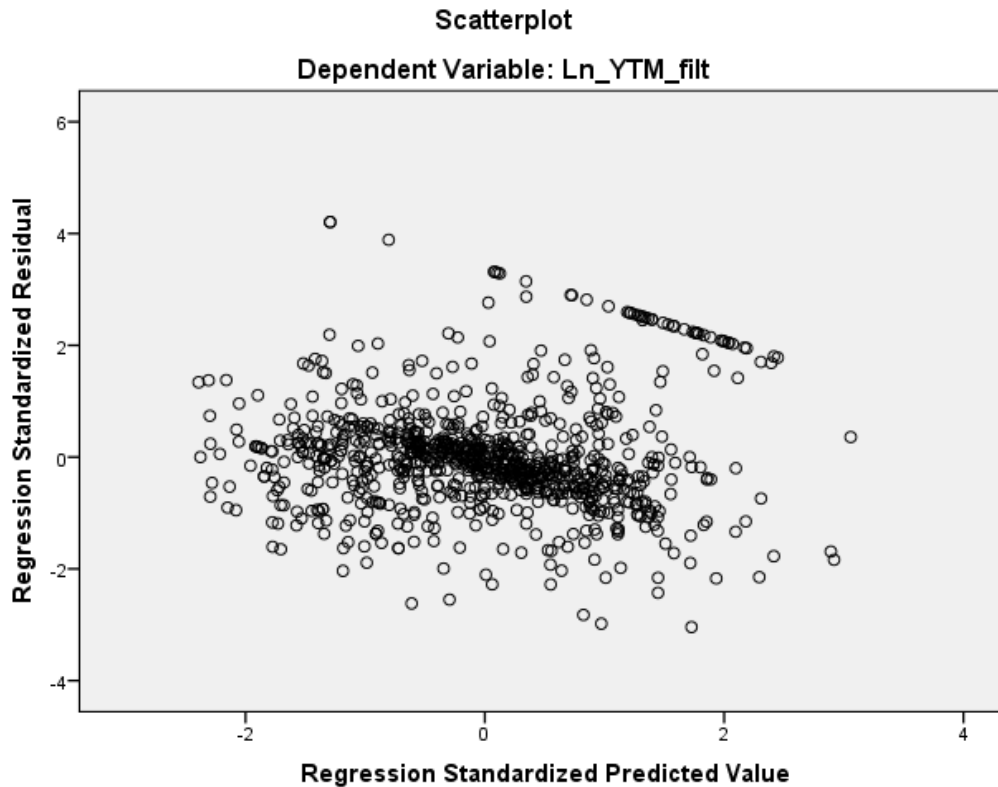
Figure 4 - Regression Standardized Residual and Standardized Predicted Value. Dependent Variable: Ln_YTM_filt

6. Comparing two Thomson Reuters indices by explanatory power on bond yields

In treating the sample at large, including zero liquidity observations, we see that the Liq variable describes dependent variables better. To estimate liquidity influence on exclusively positive liquidity sample eight additional regressions were built, including coupled and multi-factor regressions from *Liq* and *Liq_w* for dependent variables *Ln_YTM* and *Ln_YTM_filt* (see Table 6).

In coupled regressions *Liq_w* results are somewhat better than those of *Liq* (R^2 is noticeably higher, ratio t-statistics is slightly higher), but the samples differ strongly: over 600 observations for *Liq* against 250 for *Liq_w* (in initial data *Liq_w* zero values twice exceed those in *Liq*: 855 against 427). In multi-factor regressions ratio is significant at *Liq* and insignificant at *Liq_w*, but resultant R^2 in *Liq_w* is significantly higher. I.e., comparatively better results of *Liq_w* in coupled regressions are explained, most likely, by difference in sample size. To check this assumption fore more regressions from *Liq* were built but on the sample previously used to check *Liq_w* influence, i.e., under condition *Liq_w*≠0. Liq results in all cases (two dependent variables, coupled and multi-factor regressions) are better than Liq_w.

Conclusion

The Russian bond market is one of the biggest in the world by stock exchange trading volume (95% on exchange trading, $184 billion on the end of 2014). Yield levels in the Russian bond market in 2014-2015 looked attractive to investors, given low return rates in the European and American markets (in euro and dollars). One of the important risk factors that prospective investors should consider is the difference in bond liquidity. Another factor of risk is currency risk.

Liquidity is significantly different for government, municipal and corporate bonds. The share of bond issues with zero trading volume is high (340 from 1118 bond issues in March 2015). Our study analyzes several liquidity projections which can rank differently bond issues when constructing an integral liquidity indicator. Practices of major Russian investment companies in the bond market are compared. The empirical part of this investigation is devoted to testing of the explanatory power and the comparison of the two liquidity indices (the cyclic algorithm) proposed by Thomson Reuters analysts to Russian investors in 2015.

Based on our multi-factor linear regression analysis, we can conclude, that the influence of variables built in liquidity ratios is fairly stable. The objective of our research is to test new Thomson Reuters' integral indices of bond liquidity (TRLI 2015) in the context of explaining the differences in bond returns (YTM) in the Russian market. Among trade volume variables indices based on overall volume (main mode and negotiation deals mode) are preferable. On the whole they exert positive influence on *YTM*. If Thomson Reuters Liquidity Indices are non-zero, the bigger they are, the lower the *YTM.* This fact corresponds to our research expectations and earlier studies. Thus, the first hypothesis is confirmed.

One of the paradoxical results of our research is that bond's *YTM* is lower under zero liquidity ratio. It may be caused by the influence of some unaccounted-for factors both on liquidity and on *YTM*. It follows that zero-liquidity bonds (observations) form a separate group (separate cluster for analysis).

In the Russian bond market, duration and S&P rating also demonstrate stable influence on *YTM* (influence of duration is significantly negative in all regressions). *YTM* values in rating category 0 (AAA, BBB, BBB-) do not differ from those in category 1 (BB+). In other categories *YTM* is higher though differences from category 3 (BB-) are statistically insignificant in some regression model specifications.

The second hypothesis is confirmed: TR indices - *Liq* and *Liq_w* have different explanatory power. We come to the conclusion that *Liq* index explains the difference in *YTM* of Russian national currency bonds better than the weighted integral index *Liq_w* (over both samples, one including zero liquidity observations and the other excluding them). It should be noted that although *YTM* decreases with the growth of liquidity, it is lower under zero liquidity than under positive one (this result is paradoxical).

Results of our research of Russian bond market coincide with the results of Amihud and Mendelson (1991), Houweling *et al.* (2005), Dick-Nielsen *et al.* (2012): the liquidity factor significantly affects bond returns (YTM) and bonds with less liquidity have a risk premium. Similarly, Chen *et al.* (2007) as well as Ericsson and Renault (2006) show bond illiquidity to be positively correlated with default risk and overall bond volatility.

The new result of our investigation is that bonds with zero liquidity form a special cluster. Contribution of our paper is that we first tested explanatory power of new Thomson Reuters' bond liquidity indices (TRLI) for a large sample of bonds outstanding in the Russian market (1118). The sample includes corporate, government and municipal bonds. The regression analysis results show that the influence of both Thomson Reuters liquidity indices on bond yields is fairly stable.

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APPENDIX 1. Different Techniques for Bond Liquidity Integral Measure

Gazprombank's Technique for Liquidity Index

$$L = \sqrt{L1 \times L2} \tag{3}$$

where L is bond's liquidity, while $L1$ and $L2$ stand for its potential and factual liquidity, averaged over last 20 trading days.

$$L1 = \sum_t \frac{V \cdot \Delta t}{\frac{\Delta bid}{ask}} \tag{4}$$

where $L1$ is potential liquidity, V – volume in rubles (minimum value of purchase and sales volume is taken), Δt is time share at which the spread held (in % from trading period), $\dfrac{\Delta bid}{ask} = 2 \cdot \dfrac{ask - bid}{ask + bid}$ is relative bid-ask spread (in % from average price).

$$L2 = a \cdot V + b \cdot N + c \cdot D \tag{5}$$

where $L2$ is factual liquidity, V is trade volume over last 20 trading days, in units. D is percentage of days (over last 20 trading days), when transactions for a bond took place, in %; a,b,c – ratios obtained through principal components method.

Trust Bank's Technique for Liquidity Index

$$L(t) = \frac{1}{30} \sum_{i=t}^{t-29} M(i) \tag{6}$$

where $L(t)$ is bond liquidity indicator at day t,

$M(t)$ is calculated by algorithm:

1. M(t) = 0

2. Are there any volumes on both sides (bid or ask)? If none at least on one side, calculation is terminated.

3. Take min.volume = minimum between volume of best bid and that of best offer.

4. Take bid-ask spread = spread between yields of best bid and those of best offer.

5. M(t) = M(t) + min.volume/(bid-ask spread).

6. Subtract min.volume from best bid and best offer volumes, as if it has been bought (sold).

7. Return to Step 2.

Dokhod investment company's Technique for Liquidity Index

$$LI = \left(\frac{V_i}{\overline{V}} \right)^a \cdot \left(\frac{NT_i}{\overline{NT}} \right)^b \tag{7}$$

where LI is bond liquidity index; V_i – average daily trading volume over i-th bond for 5 past trading days; $\overline{V}$ – average daily trade over all bonds of the same quotation list, to which i-th belongs, for 5 past trading days; NT_i – average daily volume of transactions over all bonds from quotation list to which i-th bond belongs, for past 5 trading days; a, b – coefficients equal to: $a = 0.3, b = 0.7$.

Thomson Reuters' Technique for Liquidity Index. New Liquidity Measure

Thomson Reuters' technique allows to assign liquidity index to each issue considering bid and ask prices in order book and volume of such orders. Liquidity index assigning technique is described below.

As the first step liquidity ratio L(t) for a bond issue is determined by the following formula:

L(t) = L(t) + MIN [Bid Size, Ask Size] / [Bid-Ask Yield Spread] (8)

L(t) indicates how fast we can execute a certain trading volume at minimum cost. It is the instantaneous liquidity ratio and it equals 0 at initiation of the calculation.

Then the trading volume adjustment is imposed by calculating the sum of accumulated volumes from the main trading mode and the NDM mode. The results are grouped into percentiles with 100% attributed to bonds with the largest trading volume and 0% to the least traded bond. The Liquidity Index *LQX(t)* is calculated as an average of the indicator and volume sum values:

LQX(t) = [L(t) + Total Accumulated Volume (%)] x 0.5 (9)

The Weighted Liquidity Index *LQXw(t)* is calculated similar to the Liquidity Index, but total accumulated volume is used as a weight:

LQXw(t) = L(t) x Total Accumulated Volume (%) (10)

First component (market depth) calculation algorithm is given below.

Liquidity rating is used to bring component L(t) to comparable scale. As was described above, L(t) grows with the growth of volume and decrease of bid-ask spread. Normalization is done as follows:

LQX$_{rating}$(t) = log$_{10}$(L(t))

Essentially, liquidity shows how fast we can realize a certain asset volume at minimum costs.

L(t) is momentary liquidity level that takes zero value at reference point. Since we are attempting to estimate liquidity level at which 2nd-level volumes may "fold up", the calculation is cyclic and initial data for minimum volume are made up of next size level and previous maximum size minus previous minimum. Iterations stop when there are no more size data for bid or ask. Below is the calculation of liquidity level for Bond A:

Bond A.

Bid Size	Bid Price	Bid Yield (%)	Ask Yield (%)	Ask Price	Ask Size
11	97.5	16.1	13.21	99.9	202
5	97.36	16.35	12.92	100.15	5000
112	97.35	16.47			

L(t) = 0;

1) L(t) = 0 +Min [11,202]/[16.1-13.21] = 11/2.89 = 3.8;

2) Since Bid Size equal to 11 was minimal, we subtract it from Ask Size: 202-11 = 191

3) L(t) = 3.8 + Min [5,191]/[16.35-13.21] = 3.8 + 5/3.14 = 5.39;

4) We have used Bid Size again, therefore we subtract the size used from Ask Volume: 191–5=186.

5) L(t) = 5.39 + Min [112.186]/[16.47-13.21] = 5.39 + 112/3.26 = 39.74;

6) Further data on the bid side are missing, so iterations stop at liquidity level of 39.74.

Statistical Research on Spatial Differentiation of the Innovation System of the Russian Federation

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Abstract

Global changes in the production technologies of goods and services are connected with the development of the innovation system. Spatial differentiation plays an important role for the Russian Federation. It is associated with the in homogeneous distribution of economic activity and the historically formed structure of the economy, which ultimately determine the inhomogeneity of the economic space and in the spatial differentiation of the innovation system as well. A presented method for evaluating and analysing the structure of the innovation system by region confirms a significant inhomogeneity of the Russian Federation subjects in terms of expenditures on technological innovations of organizations. The article presents the application areas of statistical tools for levelling the impact of economies of scale of the regions with excess expenditures. We proposed measures aimed at overcoming adverse conditions and barriers for the transition of the national economy to the knowledge-model within the innovation system.

Key words: innovation system, knowledge economy, post-industrial society, spatial differentiation.

JEL Classification: O32, D83, O14.

1. Introduction

Modernization and innovation development are crucial directions, the directions that determine changes in the socio-economic system of the Russian Federation. It is the state of the innovation system that determines the efficiency of the national economy, creates potential possibilities and determines long-term horizons of growth and development of the region' economy at the regional level. The potential of the innovation system becomes a determining factor in the creation of new and unique products and services, technologies and management practices, which in turn serves as a basis for increasing the competitiveness of economic subjects. (Potapov and Atanov 2010)

The development of an innovative system is associated with social and economic development of the society, features of the demographic situation in the country. Development and implementation of measures aimed at improving the innovation system should be based on the analytical model that allows getting the long-term forecast for the given parameters of development. Drawing up the analytical model of the innovation system requires a high-quality statistical data, development of the data processing technology, accounting for spatial features of the innovative development by the RF regions. In this regard, elaboration of the statistical research methodology for the status and development of the innovation system, as well as spatial differences, specific to the subjects of the Russian Federation, which influence the long-term sustainability of the system, becomes particularly relevant.

A peculiarity of the Russian Federation, which must be taken into account, when carrying out a statistical research on the innovation system, is the incomparability of the conditions for the social and economic development of individual areas: natural and climatic conditions, availability of natural resources, transport accessibility. (Sadykova and Ochirova 2014)

Specified circumstances contribute to the urgency of finding ways to implement the strategy of innovations production and to improve the competitiveness of economic entities and regions based on that, which ultimately would lead to a decrease in the spatial differentiation by regions in terms of the innovation system development.

Application of the "innovation" concept became widespread in the transitional economy of Russia. The application of the concept is associated with the designated concept of related notions: innovative solution, innovation process, innovation system, innovation etc. Modern theorists and practitioners of economics commonly refer to innovations as to the final result, which is implemented as: 1) new or improved product or service; 2) new or improved technological process. On the contrary, western researchers adhere more to the process approach more often. (Baranova 2012) From the point of view of the "result" approach, the term "innovation" is identical to the term "innovative product". On the contrary, from the point of view of the process approach, an innovation activity is an implementation of practical steps in the areas related to achieving innovation goals, i.e. introduction of new goods or services into production. It is also important to note that in its essence both of them are a process, however, it is the process of innovation that serves as a result of innovation activity. (Slepneva 2013)

At an early stage, the result of the innovation process is primarily new unique knowledge (which is implemented as fundamental, basic technologies). At the next stage, a prototype or a trial model serves as a result of the innovation process. At the third, final stage, the result of innovation is the documentation that provides the state registration of intellectual property rights for single or mass production. Thus, each company is not only interested in selling the created unique product or service, but also in the ability to use the results of the innovation process by selling these results as a commodity. (Beck 1992)

We selected specific features of the innovation activity that underpin the innovation system: uncertainty in the future and a related time lag between the creation and application of innovations; discrepancy between public and private effects; asymmetry of information, available to researchers, potential investors, consumers; substantial investment risks; strict requirements to recruitment and the state of a quality management system. It is important to note that peculiarities of the innovation activity may differ even for enterprises, operating in the same industry or in the same area. A part of enterprises is engaged exclusively in innovation projects (including the development and introduction of a new product or service); others mainly make changes to existing products or services, manufacturing operations and processes.

2. Methodology

The methodological base for the research on spatial differentiation of the innovation system is a diagnostic analysis (Khokhlova 2005). At the first stage, the goal and objectives of the diagnostic research are formulated, objects, observation units, reporting units are determined; the research concept of the object is developed. The object of research is a set of regions in which the innovation system operates. The reporting unit is the object's constituent element, which is a carrier of the studied traits. The research programme includes a list of issues to be monitored. In our case, these are spatial differentiation indicators of the innovation system of the Russian Federation. At the first stage, the main method is a method for constructing a "tree of goals."

The next stage implies planning organizational measures for conducting a diagnostic research, i.e. to make a list and a sequence of activities within the framework of the research, the system of economic indicators, determining the spatial differentiation of the innovation system, taking into account time limits, existing tangible and intangible factors, estimated results.

At subsequent stages of the diagnostic research on the innovation system, application of statistical methods and techniques for data array becomes crucial:
- creation of a source database;
- analysis and evaluation of the innovation system;
- identification of the innovation system;
- comparative analysis of the innovation system characteristics by regions with average values of parameters, etc.;
- impact assessment of significant factors and other determining conditions of the innovation system;
- modelling of the innovation system and forecasting.

Official statistical bodies receive the data. Data array includes monitoring for 2010-2013 for 81 subjects of the Russian Federation, reliability and comparability of source data.

Result 1

In narrow understanding, the innovation system is a set of all economic entities that are engaged in the creation and further application of scientific knowledge and technology in the real economy for sustainable growth and development of the economic system at the federal and regional levels. (Badlueva and Ayurzanayn 2015)

Depending on the level of formation and further implementation of the innovation process features in matters of accumulation and application of acquired knowledge, the following types of innovation systems are distinguished: global, national, regional. The specified classification of innovation systems by their formation level takes into account the organizational characteristics of the economic activity, characteristics of the creation and implementation of new knowledge at every level. (Garicano 2000)

It should be noted that the system for creating and using new knowledge further cannot and should not be limited to the scope of an individual level (global, national, regional). (Information Society Commission, 2002) The innovation system is characterized by internal duality: innovation processes, occurring in a particular area, have unique inherent features due to specific local features. On the other hand, the innovation system is an open system, for which an important key feature is the flow of knowledge within the system, as well as external communications that provide the exchange of scientific and technical expertise, innovative technology and experience in the formation of an innovative infrastructure. (Egorova, Osodoeva and Vanchikova 2014)

Overview of the modern economic literature suggests three stable approaches to the definition of a "regional innovation system":

- Institutional, it determines the regional innovation system as a set of relatively stable structures and interrelated organizations in terms of production and further commercialization of the acquired knowledge and technologies;
- Functional, it is based on the connection between the innovation system in the national economic complex at the regional level and their functions within the intellectualization of the economy and its transition to the knowledge-path;
- Integrated, it takes into account a set of internal elements and the relations and interconnections built between them based on the systematic approach.

Modern Russia is characterized by increased attention to the issues of priorities search for the innovative development in the social and economic aspect, decrease in spatial differentiation of RF subjects on the levels of both economic and social development. At the state level, further expansion of the innovation system is the only alternative associated with balanced innovative development of the country's regions. (Baginova and Nikolaeva 2012, Belomestnov 2012)

The processes of growing globalization and regionalization, particularly in the last two or three decades at the turn of the millennium, make the formation issues of regional innovation system at the meso-level quite relevant. This is dictated by external challenges and threats, as well as by internal problems, related to significant spatial differentiation of regional development and the subsequent need to level the economic space of the Russian Federation.

A regional innovation system in terms of its transition to an innovative type of development is becoming crucial in the regional policy of Russia and becomes more relevant. Increase and implementation of the accumulated innovation potential of the country's regions contribute to the transformation of existing local resources into innovative products and services. The specified strategy creates economic and administrative conditions for the implementation of innovation activity at the regional level.

During the initial stages of high-tech production of goods and services within the regional innovation system and the use of the accumulated intellectual potential, associated with it, organization and support can ensure growth of innovative development of a specific region and thus, the well-being of the population. Production based on the use of unique knowledge and technologies, promotion of these goods and services, associated with fundamentally new management processes, is the result of the operation of the regional innovation system, which is exactly the basis for modern technical and technological development of the Russian Federation.

Result 2

Expenditures on technological innovation of individual economic entities, as well as national and regional economies play a leading role in the operation of the innovation system. (Tsyrenov and Biliktueva 2014) Expenditures on technological innovation of organizations are inhomogeneous across regions, which is due to the economies of scale, different economic specialization, social and economic situations. The analysis of the

innovation system structure by region confirms a significant inhomogeneity of the Russian Federation subjects in terms of expenditures on technological innovations of organizations (Tsyrenov 2014).

The city of Moscow takes the first place in terms of expenditures on innovation activity (12.1% of expenditures are directed to technological innovations of organizations), the Leningrad region (7.48%) – the second place, followed by the Moscow region (7.31%), the Krasnoyarsk Territory (6.09%), Samara region (5.92%), the city of St. Petersburg (5.73%), Nizhny Novgorod region (5.47%), Tyumen region (5.22%). The last places are taken by the Republic of Adygea (0.01%), Republic of Dagestan (0.01%), Republic of North Ossetia (0.01%), Republic of Kalmykia (less than 0.01%), Republic of Khakassia (0.01%), the Altai Republic (less than 0.01%), and Republic of Tyva (less than 0.01%).

In order to carry out a qualitative comparative analysis of the innovation activity expenditures at the level of the Russian Federation subjects, it is necessary to consider the expenditure indicator for technological innovations of organizations calculated per capita. By the indicator per capita, the Sakhalin region takes the first place (the indicator value is 42.76 ths. rub.), followed by the Krasnoyarsk Territory (23.73 ths. rub.), Samara region (20.51 ths. rub.), Nizhny Novgorod region (18.55 ths. rub.), the Republic of Tatarstan (16.79 ths. rub.), Kaluga region (15.5 ths. rub.). The smallest value is in the Republic of Kalmykia (30.98 rub.), The Republic of Tuva (109.14 rub.), The Altai Republic (110.53 rub.), Republic of Karelia (267.08 rub.), Republic of Khakassia (304.73 rub.), Republic of Adygea (339.26 rub.), the Ivanovo Region (362.26 rub.), Karachay-Cherkess Republic (364.96 rub.), Kaliningrad region (459.15 rub.).

There is strong differentiation of the Russian Federation subjects by volume of expenditures on innovation activity per capita, as demonstrated by the value of the variation coefficient, which is equal to 82.6%. To assess the inhomogeneity degree of this type of expenditures distribution by region suggested, we suggest using the Gini coefficient, which is calculated by the total expenditures on technological innovations of organizations in per capita (Table 1).

Table 1 – Results of the distribution inhomogeneity assessment of expenditures on innovative activity by the regions of Russia in 2010-2013

Indicators	Values of the Gini coefficient			
	2010	2011	2012	2013
Expenditures on technological innovations	0.30	0.31	0.32	0.35

The calculation results indicate a spatial inhomogeneity in the distribution of expenditures on innovation activity. Values of the Gini coefficient do not allow us to judge the nature of indicator distribution, the prevalence of the "poor" or "rich" regions.

The average value of expenditures on innovative activity by regions totalled 5.97 thousand rubles per one inhabitant, the median value of the indicator amounted to 3.25 ths. rub. More than half of the regions are characterized by expenditures on technological innovations that are below the average. During the reporting period, the inhomogeneity of distribution of the indicator values by region increased, it is demonstrated by the variation values. A left-sided asymmetry in the distribution of indicator values is observed, that is the regions with the low value of the studies indicator prevail.

The basis for the use of statistical methods is the assumption that the distribution indicator corresponds to the normal law. To test the hypothesis on the law of distribution of the random variable to the normal law, we used the Pearson criterion χ^2. The results of testing the hypothesis regarding normality of the expenditures distribution law for innovation activity, calculated per one inhabitant of the region, using χ^2 - Pearson criterion, showed that the indicator distribution does not correspond to the normal law: critical value of χ^2 - criterion amounted to 63.08, it misses the 5% confidence region of the criterion. Then we carried out the selection procedure for a distribution law, tested the hypotheses on the distribution of expenditures on innovative activity calculated per capita by the exponential, lognormal, gamma and χ^2 - distribution types. The results of these statistics are presented in Table 2.

Table 2 – Testing the hypothesis on the distribution type of expenditures on technological innovations of organizations per 1 citizen by the Russian Federation subjects

Types of the distribution law	χ^2 criterion	The number of degrees of freedom	Confidence region
Exponential	65.7	6	[1.23-14.4]
Gamma	21.2	4	[0.48-11.1]
Lognormal	13.2	7	[1.69-16.01]
χ^2	32.0	2	[0.05-7.37]

The value of χ^2 - criterion, calculated for the hypothesis on the correspondence of the test indicator distribution to the lognormal distribution, is in the confidence region. Distribution of expenditures values of innovation activity calculated per capita by the subjects of the Russian Federation has the lognormal distribution. To ensure proper distribution of the studied indicator, its values are converted by taking logarithms. Converted values of the indicator correspond to the normal distribution law. The average value of the expenditures indicator for innovation activity calculated per capita by the RF subjects corresponds to the median value; the asymmetry coefficient has a value close to zero. Based on the converted values of the studied indicator, we constructed a statistical grouping of regions, grouping intervals are determined with the use of standard deviation and the average value (Table 3).

Table 3 – Groups of the Russian Federation subjects by the level of expenditures on technological innovation of organizations in 2013

No.	Expenditures on technological innovation of organizations	Level of expenditures	Number of regions	Share of a group, %
1	below 340.23	Low	8	6.2
2	340.23-982.37	Below average	12	14.8
3	982.37-8763.96	Average	44	54.3
4	8763.96-16583.02	Above average	10	16.1
5	above 16583.02	High	6	8.6

Bringing the distribution of the indicator values to the normal law by taking logarithms allowed us to construct a statistical group, which takes into account the differentiation of regions with median expenditures to a greater degree. That is the centre of statistical grouping shifted from the average to the median value. The impact of the economies of scale of regions with excess expenditures is levelled.

The first group includes 8 regions with the low level of expenditures on innovation activities, the second group – 12 regions with the level of expenditures below-average, the third group consists of 44 regions with the average level of expenditures on technological innovations of organizations, the fourth group includes 10 regions with the level of expenditures above average, the fifth group consists of 6 regions with the high level of expenditures. The identified groups of regions had been stable during the period of 2010 - 2013, significant changes in the composition of the groups were not found. The situation in the Sverdlovsk region improved (the region passed from the third to the fourth group), the situation in the Lipetsk region worsened (from the fourth to the third), as well as the situation in the Kostroma region (from the third to the second).

Thus, the composition of identified groups of regions by the level of expenditures on technological innovation of organizations per capita is stable. Movement of regions is observed between the second, third and fourth groups, that is improvement or deterioration of the situation in the region, with respect to other RF subjects, is possible in connection with the leading or lagging development dynamics of the factors, affecting innovation expenditures in the region. The composition of groups with extremely high and low expenditures on technological innovation of organizations is unchanged, which is a consequence of objective reasons for being a leading or lagging region: natural and climatic conditions, geographical location, historically formed economic specialization, distance from sales markets, transport accessibility.

Results 3

Below is a brief economic characteristic of the selected groups of regions that reflects geographic, economic features. The first group consists of regions, which are characterized by a critical socio-economic position. The geographical position of these regions is adverse; there is no access to external markets; the

transport and infrastructure situations of urban settlements are adverse. The regions are characterized by a complex political and social situation: high levels of unemployment, social conflicts.

The second group includes regions with low levels of socio-economic development. The main reason for lagging is low competitiveness of the regional production due to an outdated technology base, poor transport situation, competition from neighbouring regions, "takeover" of the regional consumer market by neighbouring regions.

The third group includes regions with an average level of socio-economic development, including old industrial and underdeveloped regions. Regions experience a structural crisis of the economy, production of leading industries becomes unclaimed and uncompetitive in the market. Further development requires restructuring of the economy through the implementation of major regional projects, which involve budget, private investments.

The fourth group consists of industrialized regions with a growing economy, which have a favourable geographical position and are major transport hubs. The regions have a high scientific and technical potential, high level of urbanization has a positive impact on their development.

The fifth group includes the centres of federal significance – Moscow and the Moscow Region, St. Petersburg and the Leningrad region, as well as raw materials regions specializing in the production and export of fuel and energy resources. Raw materials regions are characterized by low population density due to unfavourable natural and climatic conditions.

Expenditures on technological innovations by the subjects of the Russian Federation are characterized by inhomogeneity due to spatial distribution features of the innovation system. The share of regions with low levels of expenditures on technological innovation prevails in the Russian Federation. The highest expenditure per capita is in the regions with raw materials specialization.

3. Discussion

Stable socio-economic development of the Russian Federation regions with significant spatial differentiation by the level of innovation development, largely depends on the choice and implementation of unique and innovative strategies that are based on the use of unique intellectual resources and opportunities inherent in a particular territory that open up due to that.

The importance of a differentiated approach, which takes into account individual characteristics of the regions, the choice of strategic ways of innovative development, are substantiated in the works of theorists and practitioners of economics. (Antohonova 2014)

Overview of the approaches to the classification of innovative strategies, presented in contemporary literature, shows their great diversity in terms of a large number of classifications that underpin the type design.

According to the degree of involvement in the innovation process, the strategies of decentralized control, active intervention and mixed effects are distinguished. The classification by the stimulation object distinguishes a strategy that focuses on leadership in science, the spread of innovations and stimulation of innovations. (Verkhovets and Puzina 2007)

Transition of the national economy to an innovative knowledge-based model requires implementation of the following basic measures.

▪ To resolve the problem of mutual distrust, which became an all-out all over the country: between society and government, between business and government, between society and business, etc. Satisfying public demand for objectivity, restoring trust in a vertical manner are basic elements to force start driving forces of the economy, including the one based on knowledge.

▪ To improve efficiency of the education system solely by improving its quality. Fold increase in the number of people with higher education has become a characteristic feature of modern Russia. Among them, economists, lawyers and other humanitarians prevail. In the Soviet period, the percentage of university entrance among high school graduates ranged from 20 to 25%, today the range of those who have not entered universities is the same. In addition, upcoming problematic demographic proportions in the country reduce the time horizon for the use of the accumulated intellectual capital. Having spent huge sums on the socialization of the individual and further training of a highly qualified specialist, the society needs to maximize returns from the accumulated intellectual capital of the nation. At the same time, short life expectancy and high mortality rate due to injuries and illnesses reduce the potential time of using human resources, thereby reducing returns from education expenditures.

- The growing number of institutions of higher education on the background of long-term reduction of state funding led to the commercialization of knowledge in universities. In these circumstances, the criterion for graduation is not knowledge, but tuition fees. Extensive development of higher education through the commercialization leads to such situation when national education is gradually forced out into the marginal sector in the world ranking of universities.

- To form the system of state organizational, legal and economic measures for the selection of the knowledge economy. The state policy regarding the knowledge-based economy must comply with 3 principles: a) the primacy of the state in those segments where the applied innovation theory is formed up to the moment when it is implemented in a commercial product; b) support for real types of innovation activity instead of helping specific organizations; c) promotion of productive interaction between education, science and business, and the formation of innovation clusters on this basis (for example, the partner countries of the BRICS). (Saktoev and Haltaeva 2011)

- Gradual replacement of the outdated accumulated capital structure in Russia, inherent at the early stages of the industrial society. In the post-industrial era the main factor in state development is to create conditions for the production of intellectual products and the corresponding pace of technological renovation. (Atanov and Potapov 2013)

- The problem of introducing scientific developments into the real economy is a chronic disease of Russian science and practice. A productive relationship between science and the real production, characteristic of developed economies, is implemented in Russia fragmentarily, except for the defence sector. On the one hand, industries do not create demand for research and development, and on the other hand, science often does not have units for commercialization of their developments. Thus, movement of science and economy is parallel and does not cross, which leads to the fact that Russian business imports advanced technology from abroad and the domestic science exports its scientific ideas and developments. According to Rospatent in 2013, non-residents have patented more than half of domestic scientific developments. Scientific inventions, not implemented in innovative means, are scientific materials, which are exactly the same as hydrocarbon and others raw materials. Thus, in this situation we need a mechanism to overcome the so-called "valley of death" between science and practice. (Chikov 2013, Munkueva 2014)

Formation of functioning institutions – conductors of the scientific and technological progress into the economy, in our opinion, needs to be started with the establishment of an independent department in the Government of the Russian Federation, responsible for the scientific and technical policy of the Russian state. For example, at the end of 2000's the Government of the Republic of Korea reorganized the Ministry of Economy into the Ministry of Knowledge Economy. Twenty-year practice of combining the state educational and scientific functions in one ministry has shown its ineffectiveness, that has led to the loss of education quality and the increasing scientific and technological gap between Russia and the world's leading countries.

Overcoming the "valley of death" between science and practice presupposes a revival of industrial science, responsible for research and development. Taking into account today's realities and trends, most likely, it must be built into technological and industrial parks and large corporate entities such as "Rosnano", "Rostekhnologii" and others. It is necessary to revive public institutions, promoting STP, starting with the reanimation of the Society of Inventors and Innovators with the state support of private initiatives, information communications (e.g. centres of scientific and technical information) and the promotion of scientific and technological knowledge in the media.

Such or similar state actions, aimed at restructuring the national scientific and technological complex, are the first and the most important step for the formation of the emerging framework of the Russian knowledge economy and further expansion of the knowledge innovation system.

Conclusion

Innovative activity of economic entities and their potential opportunities are important subjects for identification and analysis. At the level of the regional economy, there is a number of problems that are associated, primarily, with the presence of significant spatial differentiation of the innovation system of the Russian Federation.

Objective reasons associated with the inhomogeneous distribution of economic activity, historically formed economic structure, which ultimately determine the inhomogeneity of the economic space, underpin the differentiation of the RF subjects in terms of the innovation system development.

It is determined that the innovation activity features are the following: uncertainty in the future and a time lag between the creation and application of innovations, which arises from the former; discrepancy between public and private effects; asymmetry of information, available to researchers, potential investors, consumers; substantial investment risks; strict requirements to recruitment and the state of a quality management system.

The presented method for evaluating and analysing the structure of the innovation system by region confirms a significant inhomogeneity of the Russian Federation subjects in terms of expenditures on technological innovations of organizations. To ensure proper distribution of the studied indicator, its values are converted by taking logarithms. The value of χ^2 - criterion, calculated for the hypothesis on the correspondence of the test indicator distribution to the lognormal distribution, is in the confidence region. Converted values of the indicator correspond to the normal distribution law.

The proposed method for regions classification allows obtaining the distribution values of the expenditure indicator of technological innovation, in accordance with the normal law, that is, taking into account the differentiation of regions with median expenditures to a greater degree. The centre of statistical grouping shifted from the average to the median value. The impact of the economies of scale of regions with excess expenditures is levelled.

The resulting classification of regions allows us to formulate proposals for further development of the innovation system of the Russian Federation at the regional level, taking into account the unique features inherent in each subject.

We determined basic contradictions and problems on the way to further development of the innovation system and construction of the Russian model of the knowledge economy. We proposed measures aimed at overcoming adverse conditions and barriers for the transition of the national economy to the knowledge-model within the innovation system. It is noted that such and similar state actions will contribute to further expansion of the innovation system.

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Investors' Perspicacity of Risk Associated with Gold Exchange Traded Fund in India

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Abstract

In India, Gold is a preferred asset for its liquidity and appreciation in value. It can also be used against inflation and this glittering metal provides stable returns and easy marketability to the investors. Though conventional investment options like jewellery, gold bars and coins still exist, the people also prefer GETF. Gold Exchange Traded Funds (GETF) is another effective way to invest in the yellow metal and it is safest investment than all others. Primary data were collected from the investors who are already trading in equity shares and Gold ETFs and the secondary data were collected from NSE website for ranking the companies based on their NAVs and offers gold exchange traded fund (GETF). The investors' behaviour on GETF is analysed by using tools like percentage analysis and Chi – Square Test. The study has also focused on the risk associated with return based on the Beta value and risk measuring tools like Sharpe ratio, Treynor ratio and Jensen – Alpha Measure. From the analysis, it is found that the investors are willing to purchase gold in the form of jewels, gold bars and others from retailers only, even though they are not much aware about the purity and other risks involved in the same. When purchasing gold in the form of jewels, gold bars, the investors may lose their value for money at the time of purchase and also during exchange. The investors who invest their money in gold for their future purposes are willing to invest in GETF. Finally, it is concluded that the investors may invest in GETF for their additional investment with the mutual fund companies which offers this type scheme by creating proper awareness about GETF to the investors.

Key words: Exchange Traded Fund (ETF), Gold, Gold Exchange Traded Fund (GETF), Net Asset Value (NAV).

JEL Classification: G11, G20

1. Introduction

Exchange traded funds (ETF) can be dealt in stock exchanges like common stocks and it facilitates the investors with the diversification of a mutual fund. ETFs are not directly sold to the investors and it is issued as a sponsor of underlying assets which are known as creation units. These units are bought by the authorised participants, known as market makers, specialist or institutional investors and place them in a trust. These authorised participants divide these creation units into ETF shares. These ETF shares will have a legal claim over the assets in the creation unit and then ETF shares are dealt in the secondary market at a premium or a discount to its actual worth. The distinction between the ETF and a unit of an open-ended mutual fund is that the units of ETF can be traded during market timings and units can be sold short like other securities.

In India, gold is treated as not only a precious metal but also it has emotional connectivity. India is one of the largest consumers of gold. In India, Gold is a preferred asset for its liquidity and appreciation in value. It can also be used against inflation and this glittering metal provides stable returns and easy marketability to the investors. Though conventional investment options like jewellery, gold bars and coins still exist, the people also prefer GETF. Gold Exchange Traded Funds (GETF) is another effective way to invest in the yellow metal and it is safest investment than all others. In comparison with asset classes, gold is considered the most powerful investment as it responds to the rates of inflation and exchange rate fluctuations. Investing gold through ETF is the best decision to be made by the investors because these funds can be traded closely with the price of

physical gold without the carrying cost of physical gold. Every ETF unit consist of gold weight of one gram in a demat form. Gold ETF can be invested by an investor by having an online trading account with any registered broker.

2. Literature review

Saranya *et al.* (2014) have revealed that GETFs help the investors to invest in 99.5% pure gold which are listed in stock exchanges and one unit of fund represents one gram of gold. James M. Poterba and John B. Shoven (2002) have concluded that ETFs provide tax paying investors a way of having a widened range of stocks that carry returns compared to low-cost index funds. Prashanta Athma and Mamatha (2013) have stated that ETFs exhibit an improved performance when compared with Index funds showing an enhanced potential for ETFs. Leonard Kostovetsky (2003) has revealed that ETFs are suited for large investors and these can be better utilised by long-term retail investors. Lixia Wang and Iftikhar Hussain (2010) have stated that GETF is preferred because of its security in storage, convenience in transaction and transparency in transactions. Fuhr (2001) has stated that ETFs are prosperous type of securities which helps the investors to deal the portfolio basically and quickly in a one transaction. Lin *et al.* (2006) have revealed that ETFs provides the benefits of diversification in portfolio without in high transaction costs to the investors. Ferri (2007) has said that ETFs are dealt as similar to stocks through registered brokers on a stock market. Swathy M. and Krishna Reddy B. (2014) have stated that GETF are having higher market share compared to Equity ETFs and they have also suggested that the investors should aim to receive the benefits of portfolio diversification by investing in ETFs. Prashanta Atma and Mamatha B (2012) have revealed that investors are more attracted by GETFs because of its low costs, tax efficiency and similarity to stock's features. Senthil Kumar *et al.* (2012) have found that the modern investors are purchasing gold ingots or they trade in e-gold. They have also stated that gold is the proven asset diversifier in the investment portfolio which in turn decreases the risk of the general portfolio by and large.

3. Significance of the study

India is one of the largest consumers of gold. Conventional investment options like jewels, gold bars and coins still exist, and the people also prefer only this type of investment as their long term investment. But, Gold ETFs are another effective way to invest in the yellow metal and it is safest investment than all others. Hence, the study aimed to analyze the preference of the investor in the selection of the best Gold ETF. Primary data were collected from the investors who are already trading in equity shares and Gold ETFs and the secondary data were collected from NSE website for ranking the companies based on their NAVs and offers gold exchange traded fund (GETF).The investors' behaviour on GETF is analysed by using the tools like percentage analysis and Chi – Square Test. The study has also focussed on the risk associated with return based on the Beta value and risk measuring tools like Sharpe ratio, Treynor ratio and Jensen – Alpha Measure.

4. Analysis and discussion

Thirteen companies were selected and the risks involved in gold exchange traded fund (GETF) offered by mutual fund schemes has been found by calculating Beta value as follows.

Table 1 - Consolidated performance measures for all Gold Exchange Traded Funds

S. No.	NAME OF SCHEME	AVERAGE RETURN	STANDARD DEVIATION	BETA	SHARPE RATIO	TREYNOR RATIO	JENSEN ALPHA
1	AXIS GETF	-0.006813	0.04256	-0.07617	-0.1601	0.089451	-0.00681
2	BIRLA SUN LIFE GETF	0.003222	0.15862879	1.00820	0.02031	0.003196	0.00322
3	CANARA ROBECO GETF	0.0024161	0.04714017	1.01145	0.05125	0.002389	0.00241
4	GOLD BEES GETF	-0.0005643	0.03944559	0.91715	-0.0143	-0.00062	-0.00056
5	HDFC GETF	-0.00650692	0.04313382	0.830081	-0.15085	-0.00784	-0.00651
6	ICICI GETF	-0.00665241	0.04247441	0.947334	-0.15662	-0.00702	-0.00665
7	IDBI GETF	0.00165224	0.03990842	1.018926	0.041401	0.001622	0.001652
8	KOTAK GOLD	-0.00665379	0.042414738	0.812218	-0.15687	-0.00819	-0.00665
9	MOTILAL OSWAL GETF	0.001840619	0.042517248	1.013431	0.043291	0.001816	0.001841
10	QUANTUM GOLD	-0.00660428	0.04323169	0.832452	-0.15276	-0.00793	-0.0066
11	RELIANCE GOLD	-0.00748648	0.04290667	0.94978	-0.17448	-0.00788	-0.00749
12	SBI GOLD	-0.00670941	0.04286056	0.823305	-0.15654	-0.00815	-0.00671

S. No.	NAME OF SCHEME	AVERAGE RETURN	STANDARD DEVIATION	BETA	SHARPE RATIO	TREYNOR RATIO	JENSEN ALPHA
13	UTI GOLD SHARE	-0.00660596	0.04328087	0.833906	-0.15263	-0.00792	-0.00661

Source: Secondary data

From the above table (Table 1), the study shows performance measures of all companies taken for the analysis to find the average and composite rank. Average return values of these companies' shows that rate of return earned by the investors from the investment. Standard deviation is used to know possible return from investment by comparing with all months NAV of the fund. Beta value shows that the risk involved in the investment. Sharpe ratio reveals that the degree of risks involved in the investment, whether it is low or high. Treynor ratio reveals that rate of return one can earn from the investment compared with the benchmark level. Jensen's Alpha is used to know the return of the particular scheme compared with the market price of the gold.

AXIS GETF has average return of -0.006813, beta value is-0.07617 and composite rank is 7. It is cleared that it has less risk and will produce less return. BIRLA SUN LIFE GETF has average return of 0.003222, beta value is 1.00820 and composite rank is 2. It is cleared that it has high volatility and will produce high return. CANARA ROBECO GETF has average return of 0.0024161, beta value is 1.01145 and composite rank is 1. It is clear that it has high volatility and will produce high return. GOLD BEES GETF has average return of .0005643, beta value is 0.91715 and composite rank is 5. It is cleared that it has high risk and will produce average return. HDFC GETF has average return of -0.00650692, beta value is 0.830081 and composite rank is 6. It is cleared that it has less risk and will produce less return.

ICICI GETF has average return of -0.00665241, beta value is 0.947334 and composite rank is 9. It is cleared that it has high risk with less return. IDBI GETF has average return of 0.00165224, beta value is 1.018926 and composite rank is 4. It is cleared that it has high volatility and will average return. KOTAK GETF has average return of -0.00665379, beta value is 0.812218 and composite rank is 12. It is cleared that it has less risk and will produce less return. MOTILAL OSWAL GETF has average return of 0.001840619, beta value is 1.013431 and composite rank is 3. It is cleared that it has high volatility and will produce high return. QUANTUM GETF has average return of -0.00660428, beta value is 0.832452 and composite rank is 9. It is cleared that it has less risk and will produce less return. RELIANCE GETF has average return of -0.00748648, beta value is 0.94978 and composite rank is 13. It is cleared that it has high risk with less return. SBI GETF has average return of -0.00670941, beta value is 0.823305 and composite rank is 11. It is cleared that it has average risk and will produce less return. UTI GOLD SHARE has average return of -0.00660596, beta value is 0.833906 and composite rank is 7. It is cleared that it has average risk and will produce less return.

The Primary data has been collected from the investors who are already involving in trading Gold ETFs to assess the level satisfaction with the help of Percentage Analysis and Chi – Square test. This primary data analysis has been made to cross verify the results of composite rank of each obtained from secondary data analysis.

Table 2 - Socio – Economic profiles of the respondents

Age (Years)	No. of respondents	Percentage to total	Occupation	No. of respondents	Percentage to total
21-30	29	19.2	Govt. Service	13	8.7
31-40	64	42.7	Business	29	19.3
41-50	31	20.7	Self - Employment	64	42.7
51-60	13	8.7	Professional	31	20.7
61-70	13	8.7	Retired	13	8.6
TOTAL	**150**	**100**	**TOTAL**	**150**	**100**
Education	No. of respondents	Percentage to total	Annual Income (Rs. In Lakhs)	No. of respondents	Percentage to total
UG	60	40.0	Less than 2	34	22.7
PG	35	23.3	2 -5	62	41.3
Professional	45	30.0	5 - 8	24	16.0
Others	10	6.7	8 & above	30	20.0
TOTAL	**150**	**100**	**TOTAL**	**150**	**100**

Source: Primary Data

From the above table (Table 2), the study infers that 19.2% are in the age group of 20-30 years, 42.7% are in the age group of 30-40 years, 20.7% are in the age group of 40-50 years, 8.7% are in the age group of 50-60 years and 8.7% of the respondents are in the age group of above 60 years and 40% of respondents are possessing UG qualification, 23.3% of respondents are possessing PG qualification, 42.7% are in the age group of 30-40 years, 21% are in the age group of 40-50 years, 8.7% are in the age group of 51-60 years and 8.7% of the respondents are in the age group of above 60 years and 8.7% of respondents are government employees, 19.3% are business people, 42.7% are self – employed, 20.7% are professional and 8.7% are retired and 22.7% of respondents are in the income group of less than Rs. 2 lakhs, 41.33% are in the income group of Rs. 2 – 5 lakhs, 16% are in the income group of Rs. 5 – 8 lakhs, 20% are in the income group of Rs. 8 lakhs and above.

A Hypothesis has been set to study the influence of age over the factors influencing investment in Gold ETFs and it is analyzed with the help of Chi – Square Test.

H$_o$: There is no significant relationship between age and factors influencing investments decisions in Gold ETFs.

Table 3 - Relationship between age and factors influencing investment decisions – Chi Square test

S.No	Influencing factors	P- Value	Result
1	Awareness level about Gold ETFs	0.0005	Rejected
2	Percentage of investments in Gold ETFs	0.0005	Rejected
3	Liquidity Perception regarding Gold ETFs	0.0005	Rejected
4	Risk reduction perception in Gold ETFs	0.002	Rejected
5	Satisfaction Level in Gold ETFs	0.0002	Rejected
6	Future investments in Gold ETFs	0.0005	Rejected

Source: Primary Data (at 5% level of significance)

From the above analysis (Table 3), it is interpreted that, there is relationship between age and factors influencing Gold ETFs like awareness level, percentage of investments, liquidity perception, risk reduction perception, satisfaction level and future investments in Gold ETFs. P value is less than 0.05. Therefore, H$_0$ – null hypothesis is rejected. To Sum up, the investment decisions are related to the age of the investors. People those who need gold for investment as well as for own use, will invest in such kind of financial investment products.

A Hypothesis has been set to study the influence of occupation over the factors influencing investment in Gold ETFs and it is analyzed with the help of Chi – Square Test.

H$_0$: There is no significant relationship between occupation and factors influencing investments in Gold ETFs.

Table 4 - Relationship between occupation and factors influencing investment decisions – Chi Square test

S. No	Influencing factors	P - Value	Result
1	Awareness level about Gold ETFs	0.0005	Rejected
2	Percentage of investments in Gold ETFs	0.0005	Rejected
3	Liquidity Perception regarding Gold ETFs	0.0002	Rejected
4	Risk reduction perception in Gold ETFs	0.005	Rejected
5	Satisfaction Level in Gold ETFs	0.0002	Rejected
6	Future investments in Gold ETFs	0.0005	Rejected

Source: Primary Data (at 5%level of significance)

From the above table (Table 4), it is interpreted that, there is relationship between occupation and factors influencing Gold ETFs like awareness level, percentage of investments, liquidity perception, risk reduction perception, satisfaction level and future investments in Gold ETFs. P value is less than 0.05. Therefore, Ho – null hypothesis is rejected. To Sum up, the investment decisions are related to the occupation of the investors. People can invest in such kind of financial investment product for their future needs.

A Hypothesis test have been set to study the influence of annual income over the factors influencing investment in Gold ETFs and it is analyzed with the help of Chi – Square Test.

H0: There is no significant relationship between annual income and factors influencing investments in Gold ETFs.

Table 5 - Relationship between annual income and factors influencing investment decisions – Chi Square test

S. No	Influencing factors	P - Value	Result
1	Awareness level about Gold ETFs	0.872	Accepted
2	Percentage of investments in Gold ETFs	0.56	Accepted
3	Liquidity Perception regarding Gold ETFs	0.535	Accepted
4	Risk reduction perception in Gold ETFs	0.656	Accepted
5	Satisfaction Level in Gold ETFs	0.445	Accepted
6	Future investments in Gold ETFs	0.489	Accepted

Source: Primary Data (at 5% level of significance)

From the above table (Table 5), it is interpreted that, there is no relationship between annual income and factors influencing Gold ETFs like awareness level, percentage of investments, liquidity perception, risk reduction perception, satisfaction level and future investments in Gold ETFs. P value is higher than 0.05. Therefore, H0 – null hypothesis is accepted.

To Sum up, the investment decisions are not related with annual income of the investors. Thus shows investment in Gold ETFs can be done irrelevant to the annual income, because, irrespective of annual income, the respondents invest in such kind of financial investment products as a part of their future savings.

Suggestion and conclusion

The unpredictability in prices of gold is not as much of as compared to the equities market which inspires assurance in the mindset of the investors to possess gold confirming it to be a well-built asset category. The investors may invest in Quantum Gold ETF fund, because every fund has 1gram of gold as 1 unit but Quantum fund is having an half gram of gold as 1 unit, thus can be easily bought and sold in the market. Quantum Gold ETF expense ratio is low when compared to other funds. Only the few mutual fund companies offer the Gold ETF's in the market and there are more number of mutual fund companies will emerge in future offer in India. Gold ETF will be a safe investment rather than buying the gold in physical form as they have to face some problems like wastage, service charge, tax and security. Initiatives are to be taken by the Mutual Funds companies offering Gold ETFs, Government, SEBI and the Members of the Stock Exchanges to create awareness among the investors.

From the observation on gold exchange traded fund (GETF) in India, the investors are willing to purchase gold in the form of jewellery, gold bars and others from retailers only, even though they are not much aware about the purity and other risks involved in that. When buying of physical gold is compared with GETF, investors may lose their value for money at the time of purchase and also during exchange. The investors who are investing their money in gold for their future purposes are willing to invest in GETF. Finally, it is found that, the investors may invest in GETF for their additional investment if the mutual fund companies offer this type scheme by creating proper awareness about GETF to the investors.

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Volatility Spillovers and Contagion in Emerging Europe

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Abstract:

What is the relationship between the two largest emerging financial markets of Eastern Europe, Russia and Poland, and how do they impact the region's stock markets? The purpose of this paper is to examine the role of these two countries in regional volatility by examining their effect on two separate phenomena: financial volatility, defined here as long-term interrelations, and contagion, a more short-term phenomenon. Utilizing bivariate DCC-GARCH modeling, this paper estimates long-term volatility spillover effects and short-term contagion effects and their origins during several periods of financial crisis in the Central and Eastern European region. Our results show that the long-term impact of volatility in the Russian market is much more substantial than that of Poland in Central and Eastern Europe, with this disparate impact corresponding to each country's level of market capitalization. Additionally, our results show that Russia served as a source of short-term contagion for neighboring countries during its banking crisis in 2004 and during the Russian stock market fall in 2008. Poland had comparatively less effect on the region during the Global Financial Crisis. Moreover, the entrance of Poland into the European Union in May 2004 had no impact on stock markets in the region in terms of enhancing contagion.

Keywords: DCC- GARCH, volatility spillovers, contagion, Poland, Russia.

JEL Classification: C58, E44, G01, G15

1. Introduction

Long-term interaction amongst, and short-term contagion between, global financial markets appears to have increased in recent years, mainly due to the greater integration of real economies via international trade and labor and capital market liberalization. Early research on financial volatility showed the existence of these interrelationships between international and local equity markets (including King and Wadhwani 1990; Hamao, Masulis and Ng 1990; Neumark, Tinsley and Tosini 1991; Von Furstenberg and Jeon 1989) using techniques such as cross-correlations analysis (Lin, Engle and Ito 1994) or cointegration analysis (Richards 1995). Later extensions to this work utilized more sophisticated volatility modeling techniques including vector autoregression (VAR) or generalized autoregressive conditional heteroskedasticity (GARCH) models, as well as focusing on the integration of developed country markets or discrete groupings of countries. In particular, work such as Liao and Williams (2004) and Booth and Ciner (2005) found that German markets are a key source of volatility for European financial markets, while US volatility affected nearly all global stock markets, including the UK (Tanizaki and Hamori 2009) and the rest of Europe (Dhesi and Xiao 2010).

However, much of the attention paid to the issue of market integration has focused exclusively on volatility spillover effects in-between developed markets (Liao and Williams 2004, Syriopoulos 2007, Theodossiou and Lee 1993, Karolyiet and Stulz 1996) with a comparatively less (but still robust) emphasis on the transmission of volatility from developed to developing economies (recent work includes Chiang, Jeon and Li (2007) for a comprehensive analysis of spillover from mature to emerging markets, Booth and Ciner (2005) and Martinez and Ramirez (2011) for research focused on Latin America).

To our knowledge, there are far fewer pieces that apply the same econometric rigor to testing volatility and contagion between emerging markets (Cho and Parhizgari (2008) and Barassi, Dickinson and Le (2012) are notable exceptions that touch on this issue, while Syllignakis and Kouretas (2011) is of special interest to us). Noting this hole in the literature, this paper aims to expand our knowledge of financial markets linkages to examine the integration between emerging markets that display similar attributes to the developed-developing

dynamic proven elsewhere. In particular, we examine the financial linkages created by the two largest emerging markets in Eastern Europe, Poland and Russia, and their effects on the financial space in Central and Eastern Europe. Our main hypothesis is that Russia and Poland, as the markets with the biggest capitalization in this geographic region, should behave in the same manner as large and distant developed markets, acting as a source of volatility and contagion for other, smaller markets in the area. This hypothesis has been somewhat tested before in the extant literature for Russia (Syllignakis and Kouretas 2011), but work incorporating Poland is non-existent.

A second key contribution of this paper builds on Hamao *et al.* (1990) and Kaminsky and Reinhart (2008) to model volatility spillover effects and contagion as two separate phenomena with very different time-frames. In our estimation, volatility spillover effects reflect *long-term* stable links between various markets, or the reflection of interconnections that already have been built over time. Conversely, contagion effects are symptomatic of *short-term* effects, induced by exogenous economic shocks and possibly unrelated to prior interactions. Our analysis will thus focus on the identification of the two separate effects based on their time component, and provide a deeper understanding of the effects of Poland and Russia in the region. Moreover, the data we employ here stretches throughout several crisis periods, allowing us to examine after-crisis links, expanding previous research results regarding volatility transmission. Here as well, we are not aware of any prior research that explores these two separate phenomena in the context of Russia and Poland.

For this exercise, we follow from a wealth of prior literature devoted to contagion effects, including those on stock markets (Forbes and Rigobon 2002), currency markets (Nagayasu 2001), bonds and derivatives markets (Gravelle, Kichian and Morley 2006; Tai 2003) and different types of markets, particularly, among stock and currency markets within one country and on a global scale (Dungey, Fry, Gonzalez-Hermosillo and Martin 2006; Ito and Hashimoto 2005). However, in trying to evaluate contagion effects, researchers find difficulties in specifying the correct test for identification of these effects; this is mainly due to the fact that market correlations are strongly linked to volatility correlations, which can intensify due to increasing market variance during turmoil periods, but do not indicate a real reinforcement of the underlying links between markets. Methods of identifying contagion effects proposed in the previous literature are diverse, with the most popular being cross-correlation analysis (Longin and Solnik 1995), univariate GARCH and volatility interconnections analysis (Theodossiou and Lee 1993: Karolyi and Stulz 1996), probit and logit models (Eichengreen, Rose and Wyplosz 1996), conditional correlation calculation (Forbes and Rigobon 2002, Corsetti, Pericoli and Sbracia 2005), and Markov regime-switching models (Fratzscher 2003, Mandilaras and Graham 2010). Another econometric stumbling block encountered is that, even having quantitatively estimated contagion effects, previous work has been hampered by an inability to define which market is a source of contagion and which has its own internal sources of volatility.

Our own work (Asaturov and Teplova 2014) has already touched upon volatility spillover effects among key international markets, including in emerging Europe. In this previous work, we estimated the key sources of volatility of globally, which allowed for understanding the transmission mechanisms of shocks via both volatility spillover channels. In distinction to this earlier work, this current paper focuses exclusively on emerging Europe to identify particular events which may have significant effect on the markets in the region. Thus, the paper builds on our previous work to further examine the financial interrelationships in the region.

In particular, this paper will tackle the issues of volatility and contagion in a manner similar to Barassi *et al.* (2012) and Cho and Parhizgari (2008), through utilization of an ARMA-DCC-GARCH model on daily stock market data from Poland, Russia and the countries of Central and Eastern Europe. The nature of stock market data creates difficulties in normal econometric estimation, due to pervasive serial correlation issues and conditional heteroscedasticity (Chiang *et al.* 2007) and the GARCH family of models can account for these difficulties. In terms of our research question, the ARMA-DCC-GARCH model is able to simultaneously identify volatility spillover effects and contagion effects due to dynamic conditional correlation analysis; its main advantage is that it takes into account conditional information, which is essential for calculating volatility and correlations (Baillie and Myers 1991).

Given that we would expect to see these two effects at their strongest during times of turmoil in either stock market, this paper will accordingly examine the existence of financial contagion between the two large markets of Poland and Russia and other financial markets by separating out particularly tumultuous times and relatively "tranquil" periods. For the crisis times, we will concentrate on the periods of the Russian banking crisis of 2004, the entrance of Poland into the European Union in May of 2004, the global financial crisis of 2007-2009, and the specific financial crisis in Russia from 2008-2010; specifically, we test whether the Russian market was a source of contagion for the countries of Central and Eastern Europe during the Russian banking crisis of 2004

and the global financial crisis, and whether the Polish market had volatility or contagion effects during global financial crisis and after the accession of Poland into the European Union in May 2004.

Our paper is structured in the following manner: the next section will offer a brief review of the literature on financial market connections, while Section 3 will lay out our hypotheses and Section 4 will explore the DCC-GARCH model and tests for contagion. Section 5 will explore the results of the influence of Russia and Poland on the Central and Eastern European equity markets, while Section 6 concludes.

2. Literature review

Even as the relationships between developed markets have been well-documented, work between emerging markets has been relatively less frequent, with the Russian market in particular making only a few notable appearances and Poland remaining nearly unexplored. Ramaprasad and Nikolova (2009) analyzed connections between the BRIC countries writ large and several markets, including the world, Asian markets, the US, and European indices. Using a bivariate EGARCH model to account for leverage effects, Ramaprasad and Nikolova (2009) found that the Russian market was heavily influenced by European markets, with additional causality running from global markets (as proxied by Morgan Stanley's All Countries World Index) to Russia. In a similar article more focused on Russia by itself, Achsani and Strohe (2004) examined interrelationships between Russia and other European, Japanese, and US markets over 1994 to 2001, with an eye on understanding the impact of the Russian Financial Crisis of 1998. Based on a VAR model and correlation analysis, they concluded that the Russian financial crisis had a demonstrable impact on each of the other global markets they considered; however, they were unable to indicate if the transmission channels of these shocks from Russia were direct or indirect.

While these papers have documented somewhat the influence of Russia, the set of research grows even smaller when considering what factors influence emerging stock markets, including the influence of emerging markets themselves on others of their ilk. Syriopoulos (2007) was one of the first to explicitly focus on interconnections between emerging markets of Central Europe and major developed exchanges, using daily close prices of stock indices (WIG (Poland), PX50 (Czech Republic), BUX (Hungary), SAX (Slovakia), DAX (Germany), S&P500 (US)) between January 1997 and September 2003 to examine the influence of the US and Germany on these markets. His results showed that emerging markets appear to be connected with developed markets much more strongly than they are with each other, an intuitive conclusion that acknowledges the importance and size of developed country financial markets. But Syriopoulos' (2007) analysis left out the "bear in the room," Russia, one of the most important emerging markets, especially in relation to Central and Eastern Europe. In an important step forward, and closer to the research question we are interested in here, Saleem (2009) studied the interdependencies between Russia and the US, European, Asian, and emerging European countries, using GARCH-BEKK modelling. He concluded that, before the 1998 crisis, there were two-sided effects among Russia, the US, and emerging European markets, with one-sided volatility spillover effects also occurring from the European markets to Russia. Recently, Syllignakis and Kouretas (2011) also studied the relationships within Central Europe and between Central European markets and US, Germany, and Russia, showing that the global financial crisis led to a substantial regime shift in correlations; however, their work did not examine spillover effects, focusing on contagion. Caporale and Spagnolo (2011) used a VAR-GARCH model to analyze weekly data of stock exchanges in Russia, the UK, the Czech Republic, Hungary, and Poland over December 1996 to December 2008, their work showed significant spillover effect from the Russian and UK markets to the markets of Central and Eastern Europe (Czech Republic, Hungary, and Poland), but no volatility transmission in the opposite direction. Finally, the direct precursor to this paper, Asaturov and Teplova (2014), employed DCC-GARCH model to estimate volatility spillover effects between stock markets in South and North America, the US, and European markets. They found that the US market (as proxied by the S&P500 index) is the key source of volatility globally, while the UK, German, and French stock markets are major volatility transmitters in the European region.

Only in the past 15 years have researchers turned to the topic of dynamic correlation analysis in order to estimate contagion (short-term) effects among local and international markets (Chiang *et al.* 2007 and Barassi *et al.* 2012), as distinct from longer-term volatility spillovers. These studies have been clustered on specific financial crises, including the internet crash in the early 2000s, the global financial crisis of 2007-09, and the Eurozone crisis, and they have focused on contagion from developed to developing markets. The advent of the Global Financial Crisis brought with it a renewed interest in contagion effects within and between various markets (stocks, bonds, and derivatives), with a focus on the reality that the US stock market was a prime source of contagion for emerging markets (Sharkasi, Ruskin and Crane 2005). Other recent papers have scrutinized the

impact of the Eurozone Crisis on stock market integration, with Samitas & Tsakalos (2013) employing ADCC and Copula models to data of 8 stock markets to measure contagion emanating from Greece. Their results show that Greece was not the only source of contagion during the crisis, but was a trigger affecting greater economies in the region, which in their turn spread a negative economic shock.

3. Hypotheses

In a sense, there is thus quite a large body of research on the financial linkages of developed markets to emerging markets. However, we believe that there is time for breaking new ground through examining the emerging markets of Central and Eastern Europe and their relations to each other. Thus, our study concentrates on three specific and related research questions (RQs):

> *RQ1. What is the long-term impact of Russia and Poland on the volatility of Central and Eastern European stock exchanges?*

We hypothesize that:
- Statistically significant volatility spillovers were directed from Russian and Polish equity markets to the countries of Central and Eastern Europe.
- The long-term impact of the Russian stock market on the Central and Eastern Europe exceeds that of the Polish stock market, due to their differential sizes.

> *RQ2. What are the short-term contagion effects between Russia and the countries of Central and Eastern Europe?*

Our beliefs in regard to this RQ are:
- Contagion occurred from Russia to the countries of Central and Eastern Europe during the Russian banking crisis in 2004.
- Contagion effects were observed between Russia and countries of Central and Eastern Europe during the decline in the Russian stock market index (RTSI) beginning in 2008.

> *RQ3. What are the short-term contagion effects between Poland and countries of Central and Eastern Europe?*

Finally, we hold that:
- Contagion did occur from Poland to countries of Central and Eastern Europe after the accession of Poland into the European Union in May of 2004.
- Contagion effects were observed between Poland and the countries of Central and Eastern Europe during the Financial Crisis of 2007-2009.

4. Data and methodology

Our data includes the daily closing prices of 11 indices in local currencies (as in Karolyi and Stulz 1996, Koutmos and Booth 1995, Theodossiou and Lee 1993) we examine returns isolated from exchange rate dynamics) from European emerging markets: Russia (RTSI), Poland (WIG), Bulgaria (SOFIX), Estonia (TALSE), Slovakia (SAX), Latvia (RIGSE), Lithuania (VILSE), Ukraine (PFTS), Hungary (BUX), the Czech Republic (PXI) and Romania (BET). The sample we analyze includes data from January 2001 to December 2012. In order to justify employed methodology we carried tests for stationarity (Augmented Dickey-Fuller and Phillips-Perron), the Ljung-Box test for autocorrelation, and an LM test to determine the presence of ARCH errors.

Although the stock exchanges of the markets shown here operate in different time zones, the gap between trading hours does not exceed 24 hours, which we believe makes it possible to use daily closing prices without any adjustment. Additionally, this approach is heavily utilized in the literature in countries within a region (Dhesi and Xiao 2010, Hassan and Malik 2007, Saleem 2009), where daily closing prices are used to identify markets interrelationships (that is, the information embodied in closing prices is enough to understand market influences on each other). This approach of course has its drawbacks, but on the other hand, the use of weekly or monthly data reduces the sample size, which can be crucial for model estimation. But reverting to the method of synchronized prices (for example, the closing price of one market and a price of another at particular moment of time) while testing several volatility centers does not allow us to test our central thesis, which is the presence of volatility spillover effects from different regions. Finally, the closing price is considered to be a more reliable indicator of a market's dynamics and its mood, with Jondeau and Rockinger (2006) showing that non-synchronized trading hours makes little difference in practice to the interconnectedness of different markets.

For contagion estimation during the Russian banking crisis of 2004, the global financial crisis of 2007-2009, the fall of the RTSI index in 2008, and the accession of Poland into the European Union in 2004, differences in the dynamic conditional correlations between "turmoil" and "tranquil" periods are tested. As the starting point of turmoil period is taken a date, when a stock market index of the country is assumed to be a source of contagion began to drop. It is done to analyze whether the fall of the index caused a collapse of the other markets. A stable period represents the time before the crisis, when a market was not exposed to any significant shock. Turmoil period is assumed to last two years as it was assumed in the previous research to define contagion period longitude.

For the purpose of delineating the "turmoil" from the "tranquil," the reference points of the Russian banking crisis is marked in our data as 1 June 2004, which ended 5 years of stability pre-crisis (the tranquil period). The fall of the RTSI index it is coded as starting on 19 May 2008, the date when the index started a sharp decline as the global financial crisis reached the Russian market. This turmoil is contrasted with the 2-year period of (relative) tranquility that existed prior to the crash.

Concerning Poland, two events were tested for contagion: the accession of Poland to the EU in 2004 and the Global Financial Crisis. For the accession to the EU, a one year period was considered as the turmoil period, as we believe that the dislocation centered on accession would have dissipated within a years' time (if not much sooner). In regards to the financial crisis, we date the start of the crisis in Poland from July 6, 2007, the date of peak in the Polish WIG index. Unlike EU accession, the turmoil period for the Financial Crisis was much longer, dated as the 2-year period from mid-2007 to 2009. The tranquil periods for both the Polish accession to the EU and the global financial crisis were the preceding 5-year and 2-year time periods respectively, reflecting the periods of relative calm in the Polish markets.

We employed the DCC-GARCH model, introduced by Engle (2002), to detect linkage in each pair of market indices separately. The DCC-GARCH model has the advantage of being able to capture not only volatility interconnections between different financial markets, but also time-varying correlations among them. It makes the model very useful for aims of our research. The index returns equation is determined by an ARMA (p,q) process:

$$r_{it} = \alpha + \sum_{j=1}^{p} \beta_j r_{i,t-j} + \sum_{j=1}^{q} \gamma_j \varepsilon_{i,t-j} + \varepsilon_{it} \tag{1}$$

$$\varepsilon_t | \Omega_{t-1} \sim N(0, H_t)$$

$$H_t = D_t R_t D_t$$

where: r_{it} is returns of index i at time t; ε_{it} are residuals at time t; H_t is the variance-covariance matrix; R_t is a time-varying correlation matrix; Ω_{t-1} is a conditional information set; and D_t is a diagonal matrix of conditional variances. The return of each asset is calculated as:

$$r_t = (\ln P_t - \ln P_{t-1}) \times 100\%$$

In case there is no data for certain date, this date was removed from the analysis for this particular pair of indices, an approach that is standard in the literature (see, for example, Koutmos and Booth 1995).

The order of p and q was determined by Box-Jenkins method based on the minimization of the Akaike information criterion (AIC).

As the target of this paper is volatility spillover within regions (as well as due to the length of the time period examined here) we do not include the US or other world market returns in the ARMA equation (as was done by Lee (2009) as part of the examination of volatility transmission in Asian markets). This omission is mainly because we are looking at the Russian and Polish economies as part of their own closed system; we are not concerned with how volatility is generated within the Polish or Russian market, but rather on how this radiates outward in the region. Put another way, we are examining Poland and Russia as two points in a pond after a rock is thrown into it. We are not concerned about the shape and size of the rock or where it came from, but what ripple effect it causes. This holds true in our paper, as we aim to define long-terms volatility links of local markets, even if they are just transmitting the volatility of the stronger economies. Moreover, the benefit of our model below is that it can isolate short-term contagion effects that originate from external factors, thus separating out the external economies from those of Poland and Russia. Thus, in the case of no volatility transmission, the model

will show no statistical significance of the volatility spillover parameters (if the markets actually are affected by US or global markets). However, the model allows for estimation of any contagion effects, which can be generated from a third party outside of the system.

A correlation matrix R_t is computed as:

$$R_t = (diag(Q_t))^{-\frac{1}{2}} Q_t (diag(Q_t))^{-\frac{1}{2}} \qquad (2)$$

where: Q_t is a variance-covariance matrix of standardized residuals ($z_t = \varepsilon_t / \sigma_t$), which takes the following form:

$$Q_t = (1 - \omega_1 - \omega_2)\overline{Q} + \omega_1 z_{t-1} z'_{t-1} + \omega_2 Q_{t-1} \qquad (3)$$

$$\overline{Q} = \frac{1}{T} \sum_{t=1}^{T} z_t z'_t$$

$$\omega_1 + \omega_2 < 1 \ \omega_1, \omega_2 > 0$$

where: $\overline{Q}$ is an unconditional variance-covariance matrix of standardized residuals and z_t is a standardized residual at the time *t*.

Note that the number of parameters to be estimated for the conditional correlation matrix is not related to the number of variables in the DCC-GARCH model. On the one hand, this property of the model makes the optimization process easier, but on the other hand, such a model structure would force all of the correlation processes to have the same dynamic behaviour. This explains why we use the bivariate DCC-GARCH model.

The elements of D_t are estimated as:

$$\begin{pmatrix} h_{11,t} \\ h_{22,t} \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \end{pmatrix} + \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} * \begin{pmatrix} \varepsilon^2_{1,t-1} \\ \varepsilon^2_{2,t-1} \end{pmatrix} + \begin{pmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{pmatrix} * \begin{pmatrix} h_{11,t-1} \\ h_{22,t-1} \end{pmatrix} \qquad (4)$$

where $h_{11,t}$ and $h_{22,t}$ are conditional variances.

The diagonal elements a_{11} and a_{22} reflect volatility shocks, which define the impacts of the past squared innovations on the current volatility. Non-diagonal elements a_{12} and a_{21} capture the cross-volatility shocks, which represent the influence of the lagged innovations of index 2 on the current volatility of index 1 and vice versa. In a similar way, the diagonal elements g_{11} and g_{22} measure the own volatility spillover, which should be considered as the impact of the past volatilities on the current volatility. Eventually, the non-diagonal elements g_{11} and g_{22} reflect the cross-volatility spillovers, which denote influence of the past volatility of index 2 on the current volatility of index 1 and vice versa. Note that the volatility effect will be confirmed only in case of statistical significance of the parameter, which represent appropriate volatility spillover. As the elements capturing the volatility spillover effect cannot exceed 1 according to a stationary condition, they are presented in a percent format.

A log-likelihood function utilized to estimate all the coefficients takes the following form:

$$L(\theta) = -\frac{1}{2} \sum_{t=1}^{T} \left(n \ln(2\pi) + \ln|D_t R_t D_t| + \varepsilon'_t (D_t R_t D_t)^{-1} \varepsilon_t \right) \qquad (5)$$

where: T is the number of observations; n is the number of variables; θ is a vector of unknown parameters.

In the DCC-GARCH model, as dynamic conditional correlation is based on standardized residuals, it is not affected by heteroscedasticity. It then allows us to estimate contagion effects based on links adjusted to volatility of analyzed series. Thus, dynamic conditional correlation is the perfect basis for contagion recognition. The distinction of dynamic conditional correlation between the tranquil and turmoil periods is examined with a

Student's t-test for mean differences, the Mann-Whitney-Wilxocon test for median differences, and the Smirnov (or Kolmogorov-Smirnov) test for empirical distribution differences.

Student's t-test is used to define if difference in mean is significant or not. If the difference in mean is statistically insignificant, absence of contagion effect is confirmed. In our case Student's t-test examine the following hypotheses:

$$H_0 : \overline{p}_{stable} = \overline{p}_{turmoil}$$
$$H_1 : \overline{p}_{stable} < \overline{p}_{turmoil}$$

where $\overline{p}_{stable}$ and $\overline{p}_{turmoil}$ are conditional correlation mean values during stable and turmoil periods respectively.

The second criterion for contagion, the Mann-Whitney-Wilxocon test, examines whether the median values of two samples are statistically different. If the difference in median is statistically insignificant, we can infer that there is no contagion effect present. The null and alternative hypotheses are presented as:

$$H_0 : \tilde{p}_{stable} = \tilde{p}_{turmoil}$$
$$H_1 : \tilde{p}_{stable} < \tilde{p}_{turmoil}$$

where: $\tilde{p}_{stable}$ and $\tilde{p}_{turmoil}$ are median values of conditional correlation during stable and turmoil periods respectively.

The last criterion is the Smirnov test. This test is applied to dynamic conditional correlation to define whether its empirical distribution differs for stable and turmoil periods. If there is no difference in empirical distribution, no contagion effect is confirmed. The Smirnov criterion tests the following hypotheses:

$$H_0 : F_{stable} = F_{turmoil}$$
$$H_1 : F_{stable} \neq F_{turmoil}$$

where: F_{stable} and $F_{turmoil}$ are empirical cumulative distribution functions of conditional correlation during stable and turmoil periods.

We define a contagion effect as existing only the basis of the significance of all three tests jointly. While the first two tests define whether conditional correlation changes in absolute values, the third one tell us whether its empirical distribution differs during stable and turmoil periods. In our view stable and turmoil periods are characterized by not only increased conditional correlation but also various distribution moments (such as variance, skewness, and kurtosis). Otherwise a simple trend can be identified as contagion effect. Therefore, the contagion effect is confirmed to take place only if all three tests support its presence and the parameter reflecting volatility spillover effect is statistically significant.

In mathematical terms the latter condition is justified by the fact that conditional correlation analysis can only tell us whether contagion in a particular period takes place. However, without a volatility spillovers examination, it is indeterminate which market in each pair is a source of contagion. In the case of mutual volatility spillover effects, the contagion effect is also considered to be mutual. If volatility spillover effects for a pair of indices are not revealed, contagion effects are regarded as indirect. In the other words, it means that both analyzed markets were affected by other third party or factors, which caused a correspondingly greater correlation between them. We believe that this criteria for testing contagion effects avoids identification of a simple leap in markets interconnections as contagion (Forbes and Rigobon 2002), while also allowing us to define the source of contagion in each pair of indices.

5. Results

RQ1. What is the long-term impact of Russia and Poland on the volatility of Central and Eastern European stock exchanges?

Table 1 - Volatility spillover effects from Russia and Poland to Central and Eastern European stock exchanges

Spillover direction	Volatility spillover	P-value	Spillover direction	Volatility spillover	P-value
RTSI → PFTS	20,45%***	0,00	PFTS → RTSI	1,77%	0,88
RTSI → PXI	17,94%**	0,01	PXI → RTSI	13,13%**	0,02
RTSI → BET	14,87%**	0,03	BET → RTSI	13,22%	0,30
RTSI → SOFIX	13,91%**	0,02	SOFIX→ RTSI	6,68%	0,91
RTSI → TALSE	13,51%***	0,00	TALSE → RTSI	6,83%	0,54
RTSI → WIG	13,44%***	0,00	WIG → RTSI	6,09%	0,20
RTSI → BUX	12,47%***	0,00	BUX → RTSI	6,05%	0,60
RTSI → VILSE	12,4%**	0,04	VILSE → RTSI	0,90%	0,87
RTSI → SAX	11,61%**	0,01	SAX→ RTSI	0,07%	1,00
RTSI → RIGSE	9,22%**	0,01	RIGSE→ RTSI	0,07%	0,99
Spillover direction	**Volatility spillover**	**P-value**	**Spillover direction**	**Volatility spillover**	**P-value**
WIG → PFTS	17,14%*	0,05	PFTS → WIG	3,97%	0,88
WIG → BET	13,97%***	0,00	BET → WIG	5,89%	0,71
WIG → BUX	10,13%***	0,00	BUX → WIG	4,04%	0,70
WIG → TALSE	10,03%	0,14	TALSE → WIG	3,42%	0,57
WIG → SOFIX	9,94%	0,32	SOFIX → WIG	2,56%	0,92
WIG → SAX	9,1%**	0,01	SAX → WIG	2,11%	0,97
WIG → PXI	8,42%**	0,01	PXI→ WIG	2,62%	0,74
WIG → RIGSE	8,41%**	0,02	RIGSE → WIG	4,48%	0,94
WIG → VILSE	7,83%	0,28	VILSE → WIG	4,85%	0,88

*Note: *** shows significance at the 1% level, ** is at the 5% level, and * at the 10% level.*

▪ Statistically significant volatility spillovers were directed from Russian and Polish equity markets to the countries of Central and Eastern Europe. *Partially confirmed.*

The volatility spillover effects from Russia and Poland to the emerging European stock markets are presented in Table 1. The results show a significant impact of the Russian market on each of the stock indices of Central and Eastern Europe markets (a result distinct from Syllignakis and Kouretas (2011), whereas the Polish WIG has no influence on Hungary, Estonia, Bulgaria, Slovakia, Lithuania and Russia. The Russian RTSI has its strongest effects on Ukrainian equity markets (with spillovers estimated at 20.5%), while it has the least impact on the Latvian RIGSE (9.2%). In terms of the causality running towards Russia from other emerging European markets, only the Czech market appears to influence the Russian market (13.3%). These relationships between Russia and other markets seem to be replicated in regards to Poland, with Latvia displaying a fierce independence streak and the smallest spillover effect from Poland (8.4%), while Poland influences Ukraine the most of all country pairings (17.1%).

▪ The long-term impact of the Russian stock market on the Central and Eastern Europe exceeds that of the Polish stock market, due to their differential sizes. *Fully confirmed.*

When considered on a pairwise basis, the volatility spillovers from Russia are of greater magnitude and significance than the same spillovers from Poland, showing the greater significance of Russian equity markets in the region. Moreover, the Polish market is almost wholly insignificant in regards to some countries of Central and Eastern Europe (including Hungary and, somewhat surprisingly, Lithuania). At the same time, the Polish stock market has a notable exposure to the volatility of the Russian market (13.44%). This demonstrates that Russia, which possesses the largest capitalization in the region, has a stronger impact within emerging Europe.

RQ2. What are the short-term contagion effects between Russia and the countries of Central and Eastern Europe?

The Figure 1 shows the dynamic conditional correlations between RTSI and the market indices of Central and Eastern Europe. The 2-year period of Russian banking crisis starting from June 2004 is indicated with red vertical lines and the 2-year period of the Financial Crisis in Russia is shown with green vertical lines. Dynamic conditional correlation increased sharply after the Russian banking crisis in the following pairs: BET-RTSI, BUX-RTSI and WIG-RTSI. In the rest of pairs, the rise in correlation was not as dramatic, as their links were too unstable. During Financial Crisis in Russia, dynamic correlations mainly had an upward trend. Only in the pairs of BUX-RTSI, RIGSE-RTSI, SAX-RTSI and TALSE-RTSI correlation was stable during the crisis period. Of note is the fact that dynamic correlation was notably higher after 2008 in most of the pairings.

Dynamic conditional correlation between TALSE and RTSI

Dynamic conditional correlation between SOFIX and RTSI

Dynamic conditional correlation between VILSE and RTSI

Dynamic conditional correlation between WIG and RTSI
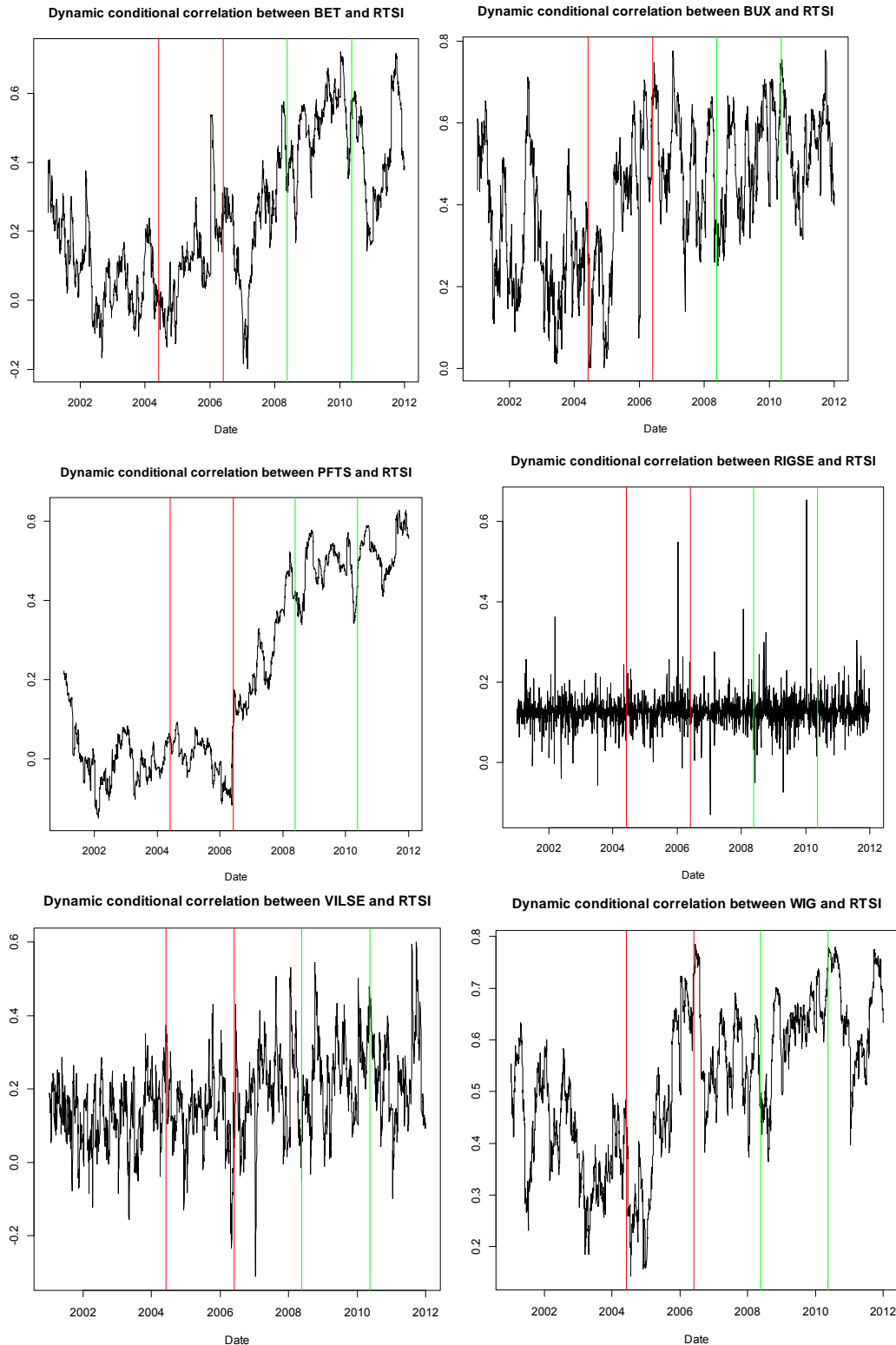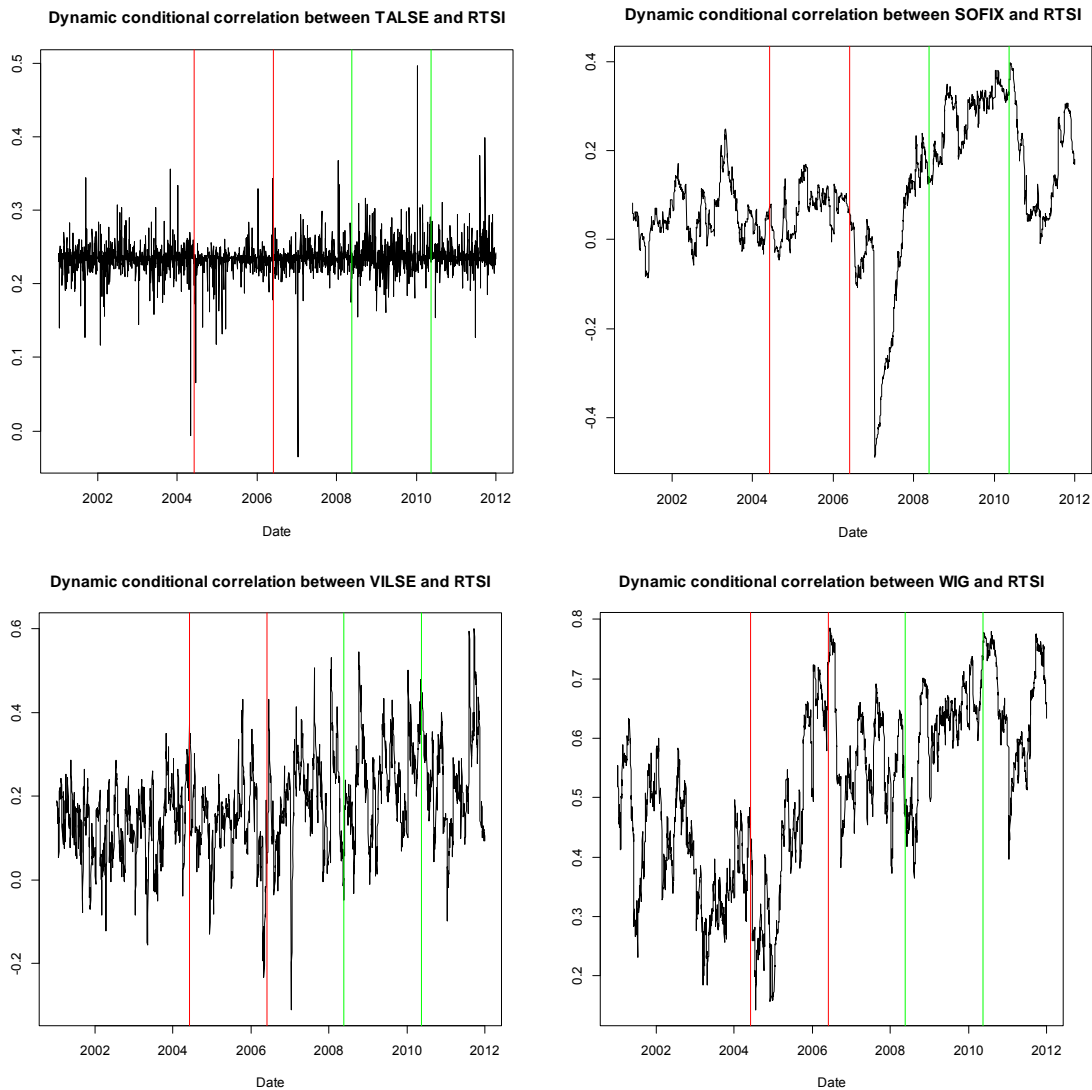
Figure 1 - Dynamic conditional correlation between RTSI and market indices of Central and Eastern Europe.

Table 2 presents results of Student's test, a Wilxocon test, and Smirnov tests for contagion effect estimation between Russia and countries of Central and Eastern Europe during Russian banking crisis in 2004.

Table 2 - Contagion effects between Russian and the countries of Central and Eastern Europe during Russian Banking Crisis (01.06.2004 – 01.06.2006).

Pair of indices	Dynamic conditional correlation (turmoil period)		Dynamic conditional correlation (tranquil period)		Student's t-test	Mann-Whitney-Wilxocon test	Smirnov test	Contagion effect?
	Mean	Median	Mean	Median	P-value	P-value	P-value	
BET and RTSI	0,093	0,110	0,091	0,103	0,01***	0,05**	0,01***	Yes
BUX and RTSI	0,314	0,381	0,271	0,421	0,00***	0,00***	0,00***	Yes
PFTS and RTSI	0,003	0,000	-0,005	0,012	0,79	0,038**	0,00***	No
PXI and RTSI	0,399	0,430	0,406	0,441	0,00***	0,00***	0,00***	Yes
RIGSE and RTSI	0,126	0,128	0,128	0,128	0,06*	0,11	0,55	No
SAX and RTSI	0,005	-0,001	0,004	0,002	0,97	0,96	0,05*	No
SOFIX and RTSI	0,054	0,066	0,042	0,077	0,00***	0,00***	0,00***	Yes

TALSE and RTSI	0,234	0,232	0,235	0,235	0,98	0,99	0,00***	No
VILSE and RTSI	0,130	0,135	0,141	0,144	0,16	0,16	0,2	No
WIG and RTSI	0,410	0,447	0,407	0,436	0,00***	0,00***	0,00***	Yes

*Note: *** shows significance at the 1% level, ** is at the 5% level, and * at the 10% level.*

- Contagion occurred from Russia to the countries of Central and Eastern Europe during the Russian banking crisis in 2004. *Partially confirmed.*

Contagion effects during the Russian banking crisis are confirmed to take place in the pairs of BET-RTSI, BUX-RTSI, PXI-RTSI, SOFIX-RTSI, and WIG-RTSI. Among countries not affected by contagion are the three Baltic countries, namely, Estonia, Lithuania and Latvia, with which Russia has much less economic and political links rather than the other countries of Central and Eastern Europe. It is worth mentioning that Russian interrelationships with Ukraine and Slovakia also did not change during the crisis. Contagion between Russia and the Czech Republic was mutual, while there were also volatility spillover effects evidenced between the two countries.

Table 3 shows results of Student's t, Mann-Whitney-Wilcoxon, and Smirnov tests for contagion effect estimation between Russia and countries of Central and Eastern Europe during the Financial Crisis in Russia.

Table 3 - Contagion effects between Russia and the countries of Central and Eastern Europe during Financial Crisis 2008-2010 in Russia (19.05.2008 – 19.05.2010).

Pair of indices	Dynamic conditional correlation (turmoil period)		Dynamic conditional correlation (tranquil period)		Student's t-test	Mann-Whitney-Wilxocon test	Smirnov test	Contagion effect?
	Mean	Median	Mean	Median	P-value	P-value	P-value	
BET and RTSI	0,229	0,507	0,253	0,533	0,00***	0,00***	0,00***	Yes
BUX and RTSI	0,507	0,515	0,514	0,546	0,15	0,14	0,02**	No
PFTS and RTSI	0,262	0,477	0,240	0,487	0,00***	0,00***	0,00***	Yes
PXI and RTSI	0,555	0,593	0,564	0,619	0,00***	0,00***	0,00***	Yes
RIGSE and RTSI	0,128	0,129	0,128	0,128	0,31	0,55	0,23	No
SAX and RTSI	0,006	0,002	0,004	0,004	0,89	0,6	0,8	No
SOFIX and RTSI	-0,050	0,278	-0,025	0,305	0,00***	0,00***	0,00***	Yes
TALSE and RTSI	0,235	0,238	0,235	0,235	0,02**	0,12	0,01**	No
VILSE and RTSI	0,191	0,238	0,198	0,239	0,00***	0,00***	0,00***	Yes
WIG and RTSI	0,574	0,613	0,554	0,637	0,00***	0,00***	0,00***	Yes

*Note: *** shows significance at the 1% level, ** is at the 5% level, and * at the 10% level.*

- Contagion effects were observed between Russia and countries of Central and Eastern Europe during the decline in the Russian stock market index (RTSI) beginning in 2008. *Partially confirmed.*

Contagion was confirmed to exist for all the pairs shown, with the exception of BUX-RTSI, RIGSE-RTSI, SAX-RTSI and TALSE-RTSI. The majority of Russia's neighboring countries were exposed to contagion from Russian markets, apart from two Baltic countries (Estonia and Latvia), Slovakia, and Hungary. In case of the Czech Republic contagion was two-sided as volatility spillover effects between the countries were also mutual (as well as during the Russian banking crisis).

RQ3. What are the short-term contagion effects between Poland and countries of Central and Eastern Europe?

In the Figure 2 the dynamic conditional correlations between the Polish WIG and the market indices of Central and Eastern Europe are shown. The one-year period beginning with Poland's accession to the EU is indicated with red vertical lines, and the two-year period of the global financial crisis is shown with green vertical lines, representing both of the turmoil periods. The one-year period after Poland's accession to the EU showed no evidence of increased correlation with any other exchange apart from Bulgaria. On the contrary, the unexpected

exogenous shock of the global financial crisis greatly affected the links of Polish stock market with the ones of Romania, Ukraine, Bulgaria, and Lithuania. Correlations in these pairs sharply grew during the turmoil period.

Dynamic conditional correlation between BET and WIG

Dynamic conditional correlation between BUX and WIG

Dynamic conditional correlation between PFTS and WIG

Dynamic conditional correlation between PXI and WIG

Dynamic conditional correlation between RIGSE and WIG

Dynamic conditional correlation between SAX and WIG

Dynamic conditional correlation between SOFIX and WIG

Dynamic conditional correlation between TALSE and WIG

Dynamic conditional correlation between VILSE and WIG

Figure 2 - Dynamic conditional correlation between WIG and market indices of Central and Eastern Europe.

Table 4 shows results of Student's t-test, Mann-Whitney-Wilcoxon test and Smirnov test for contagion effect estimation between Poland and countries of Central and Eastern Europe after Poland's accession to the European Union.

Table 4 - Contagion effects between Poland and the countries of Central and Eastern Europe after entering of Poland into EU (01.05.2004 – 01.05.2005).

Pair of indices	Dynamic conditional correlation (turmoil period)		Dynamic conditional correlation (tranquil period)		Student's t-test	Mann-Whitney-Wilxocon test	Smirnov test	Contagion effect?
	Mean	Median	Mean	Median	P-value	P-value	P-value	
BET and WIG	0,127	0,082	0,129	0,070	1,00	1,00	0,00***	No
BUX and WIG	0,518	0,531	0,548	0,522	0,04**	0,64	0,00***	No
PFTS and WIG	0,043	0,046	0,039	0,028	0,29	0,34	0,00***	No
PXI and WIG	0,456	0,399	0,470	0,390	1,00	1,00	0,00***	No
RIGSE and WIG	0,084	0,084	0,084	0,084	0,14	0,54	0,95	No

SAX and WIG	0,003	0,003	0,002	0,003	0,55	0,44	0,93	No
SOFIX and WIG	0,001	0,118	0,000	0,127	0,00***	0,00***	0,00***	No****
TALSE and WIG	0,229	0,223	0,230	0,229	0,95	0,94	0,02**	No
VILSE and WIG	0,187	0,186	0,189	0,191	0,70	0,54	0,24	No

*Note: ****Absence of statistically significant volatility spillover effect supporting the existence of a contagion source; *** shows significance at the 1% level, ** is at the 5% level, and * at the 10% level.*

- Contagion did occur from Poland to countries of Central and Eastern Europe after the accession of Poland into the European Union in May of 2004. *Rejected.*

According to Table 4, it can be inferred that the entrance of Poland into the EU did not influenced the correlation with the markets of Central and Eastern Europe (apart from the case of Bulgaria, which is confirmed but is shown to be indirect, as there is no volatility spillover effect observed between two countries). This is most likely due to the fact that the EU accession was long expected, and markets had already priced in the effects the event would have on the equity markets of each respective country.

Table 5 shows results of tests for contagion effect estimation between Poland and countries of Central and Eastern Europe during Financial Crisis 2007-2009.

Table 5 - Contagion effects between Poland and the countries of Central and Eastern Europe during Financial Crisis 2007-2009 (07.06.2007 – 07.06.2009).

Pair of indices	Dynamic conditional correlation (turmoil period)		Dynamic conditional correlation (tranquil period)		Student's t-test	Mann-Whitney-Wilxocon test	Smirnov test	Contagion effect?
	Mean	Median	Mean	Median	P-value	P-value	P-value	
BET and WIG	0,146	0,405	0,166	0,407	0,00***	0,00***	0,00***	Yes
BUX and WIG	0,600	0,597	0,607	0,617	0,68	0,13	0,00***	No
PFTS and WIG	0,014	0,375	0,044	0,371	0,00***	0,00***	0,00***	Yes
PXI and WIG	0,573	0,677	0,582	0,688	0,00***	0,00***	0,00***	Yes
RIGSE and WIG	0,084	0,085	0,084	0,084	0,21	0,30	0,05**	No
SAX and WIG	0,002	0,002	0,002	0,002	0,69	0,91	0,01***	No
SOFIX and WIG	0,018	0,164	0,041	0,180	0,00***	0,00***	0,00***	No****
TALSE and WIG	0,229	0,237	0,229	0,236	0,01***	0,00***	0,00***	No****
VILSE and WIG	0,195	0,245	0,194	0,237	0,00***	0,00***	0,00***	No****

*Note: ****Absence of statistically significant volatility spillover effect supporting the existence of a contagion source; *** shows significance at the 1% level, ** is at the 5% level, and * at the 10% level.*

- Contagion effects were observed between Poland and the countries of Central and Eastern Europe during the Financial Crisis of 2007-2009. *Partially confirmed.*

The global financial crisis of 2007-2009 led to conditional correlation reinforcement between Poland and certain countries in Central and Eastern European regions (Romania, Ukraine, the Czech Republic, Bulgaria, Estonia and Lithuania). However, in case of Estonia, Bulgaria, and Lithuania contagion effects are unable to be accepted as statistically significant volatility spillover effect supporting its existence are not observed. It means that contagion of these countries and Poland were indirect, or in the other words, caused by another trigger. It is proved by the fact that correlation between Poland and these countries strongly increased during the turmoil period. Thus, contagion effects are confirmed only in the pairs BET-WIG, PFTS-WIG and PXI-WIG.

Conclusion

This paper examined the transmission of volatility and contagion among equity markets of Central and Eastern European region with Russia and Poland assumed to be a volatility and contagion source in the area. Using a bivariate DCC-GARCH model, we estimated volatility spillover effects and dynamic conditional correlation among European emerging markets from January 2001 to December 2012, with a focus on the effects among the countries of Central and Eastern Europe. Our results show that the influence of Russian market volatility appears

to exceed the influence of the Polish market in the Central and Eastern European region, which corresponds to the level of their market capitalization. This also appears to prove the results of Ramaprasad and Nikolova (2009) and Saleem (2009) about the influence of the Russian market in Europe, as well as the conclusions of Syriopoulos (2007) concerning the presence of volatility interconnections among the emerging markets.

Moreover, in a first for the literature, our analysis also revealed contagion effects from the Russian and Polish stock markets for the Central and Eastern European countries during the Russian stock market crash of 2008 and the global financial crisis. However, the accession of Poland to the EU had no effect on the other markets.

In our view, the results of this study contribute to a deeper understanding of the stock market interrelationships in the global economy. In particular, they shed light on the volatility and contagion transmission linkages in the Central and Eastern Europe. Our findings can help investors, asset management companies, international banks, and investment funds who are seeking portfolio diversification in the region, in regards to the extent of interconnections among key stock indices and emerging markets. We think further research can continue this analysis as regional shocks (such as Ukraine) continue to develop our knowledge about both volatility spillovers and contagion. Thus, a full comprehension of the formation of links in the global economy and particularly in Central and Eastern European region may help to reduce investment risks, as well as allows financial regulators to carry out appropriate politics.

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Diagnoses Related Group System in Slovakia

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Abstract:

   Financing of health care system has undergone in the last twenty years with many changes. The defrayment of ambulatory and acute inpatient care were used in different ways, what leaded to diametrically different hospitals behaving. The DRG offers entirely different perspective on financing health care than the traditional performance system or defrayment of inpatient hospital care capitation. It´s leading from the payment of treatment to the payment of final product, that´s mean treated or cured patient. The DRG is a management tool, which describes the production of the hospital, allows the definition of cost, their comparison, the strategic management of hospitals and also creates optimal conditions for the rational conclusion of contracts. Submitted article is just focused on the above aspects. Its aim is to mention the specificities of DRG system in Ireland and Germany and these specifications connect with the planned activities related to the implementation of DRG in Slovakia.

Keywords: strategic management of hospitals, DRG classification system, SWOT analysis of the DRG system.

JEL Classification: I19

1. Introduction

   The first attempts to create a classification system as a useful global system for effective management of hospitals dates back to 1852. In 1965, thanks to developments in technology as well as thanks to a rapidly increasing cost health care get to the forefront the question of effective hospital management system. Work on the development of the classification system began in 1967 at Yale University. The main researchers' effort was to find and investigate the relationships between diseases and costs of their treatment. The result of their efforts and solutions was the casemix classification system, which was named DRG - Diagnosis Related Groups or group of patients with a related diagnosis. DRG system development process was long and complicated, it represented a process consisting of evaluating the hundreds of thousands medical records of patients, as well as defining important elements of treatment processes to determine the routine cases and review those cases that their course were different.

2. Development of the diagnoses related groups system

   The primary reason for the DRG system development from managerial point of view was especially efficient management of the hospital. At a later phase, the system began to use also in controlling costs and payments for health care. DRG system therefore appears to be the most appropriate tool with which can be establish financial ties so as to discourage hospitals to provide health care more expensive than they would tolerate an open market. DRG systems currently are used not only for monitoring and management of financial flows, economic and clinical processes, but also as a tool for determining long-term strategies from the perspective of hospitals, regions, insurance companies or state. Information from the DRG system are used by hospital management, hospitals founders, government, professional societies, and individual health care payers. Through the DRG it is possible to increase efficiency of the healthcare, work of individual facilities and medical departments. To individual hospital facilities provides better overview of the funds consumption, enables easier and demonstrable health care billing between providers and payers, more equitable redistribution of available resources and thereby more effective planning (Gavurová *et al.* 2014).

3. The original application of diagnoses related group system options

   The original DRG intention was to create an efficient management tool for hospital managers. Its functions with the further development were increasing and DRG started to be used for costs control of health care and their reimbursement. In an environment of continuous increase in the cost of hospital care, the importance of the DRG system has also increased due to the fact that through it could be assessed a financial rate that would prevent hospitals provide expensive health care than would be possible in an open market. On the other hand, in the interest of eliminate the possible poor quality outcomes of health care at the hospital was established a "Peer review" mechanism (i.e. control system, respectively review by the contractors) to ensure a certain minimum

quality level. This contributed to the subsequent formation of the recommended medical procedures (Pudlo and Szabo 2014; Dorčák *et al.* 2014). "Peer review" control conducted chosen doctors who were in charge of controlling the medical procedures on the basis of obtained rules, that is, whether the patient has received all the services that the medical procedure contained (and which was also to the hospital paid).

It was necessary to define the hospital product with special focus on efficiency - performance and effectiveness of its use (Šoltés and Gavurová 2014, 2015; Szabo and Sidor 2014). Subsequently, were defined patients class (who have the same clinical symptoms, respectively symptoms of a selected and monitored elements) that were treated by similar medical procedures. In patients coding was used the International Classification of Diseases 9th revision (USA), and its clinical modification (ICD-9-CM).

In DRG groups creating have been used the following criteria:
- class definitions using information that hospitals are routinely recording (UHDDS),
- manageable number of classes,
- a similar characteristic intensity of resources within the class,
- a similar type of patients in the class from clinically view.

DRG system was necessary to continually reviewing, due to the developments and changes in disease diagnosis coding and coding of medical services, as well as the application of the conceptual models in the use of health services (Kožen 2010).

DRG classification system used approach in terms of organ systems. Process of creating spread into two phases. In the first phase, the diagnosis was considered. ICD-9-CM codes are representing diseases and disabilities (consideration was that codes will be patient's principal diagnosis) were arranged into 23 mutually exclusive categories (major diagnostic categories - MDC), and contain approximately 10,000 diagnostic codes ICD-9-CM. In the second phase of classification process were selected from surgical system codes ICD-9-CM codes for those medical procedures that required the use of surgical hospitals sections providing acute care. By this was determined 22 surgical MDC in terms of organ systems inferred from the underlying diagnosis. In the next step system creators seek mutually statistical association in each MDC and between them. Certain types of secondary conditions relevant for the identification of differences in therapeutic practice were defined. It achieved the distribution of secondary diagnoses in classes, which interact with the underlying disease and procedure required different sources costs.

Mentioned first DRG version of the classification system was created at the Yale University in the years 1980 - 1981 and was used for hospital reimbursement in Medicare health insurance program. In 1989 was introduced "All patient (AP) DRG" DRG version for New York extended by the MDC HIV infection and MDC of multiple trauma, neonatal DRGs according to birth weight, new DRGs for cystic fibrosis, pediatric patients, lead poisoning, risk obstetric patients and DRGs for tracheostomy. This DRG version was extended to other countries and in 1989 already contained 617 DRGs.

DRG system was constantly improving year by year, creating the new subclass, using other classification aspects. Critical responses to the original DRG system were directed primarily at the highly latent focus on disease severity and excessive focus on the intensity of resources. Several basic DRG systems were created:
- DRG Medicare,
- RDRG/Refined DRG,
- AP-DRG/All Patient DRG,
- SDRG/Severity DRG,
- APR-DRG/All Patient Refined DRG.

Each of mentioned systems was established in response to specific restrictions, respectively eliminating gaps on previous DRG systems. DRG philosophy has spread around the world and began to emerge many other similar systems. In its rapid development also played a big role the using of computer technology (Kožen 2010).

Within the European countries we can classify three groups using DRG system (SME 2012)]:
- Countries using DRG system without changes or only minor changes (e.g. Ireland (AR-DRG Australia), Poland (HRG England), Spain (AP-DRG Australia), Portugal (HCFA-DRG USA), Switzerland (G-DRG Germany).
- Countries using the original foreign DRG system, but with significant customization (e.g. France GHM (HCFA-DRG USA, AP-DRG Australia), Germany G-DRG (AR-DRG Australia), the Nordic countries NordDRG (HCFA-DRG USA).

▪ Countries using separately created classification system (using self-developed classification system (England - HRG, Austria - LKF, Netherlands - DBC).

Also in the construction of DRG systems are chosen different procedures:
▪ DRG + grouper + all relative scales are taken over,
▪ DRG + grouper are taken over, relative scales are counted locally,
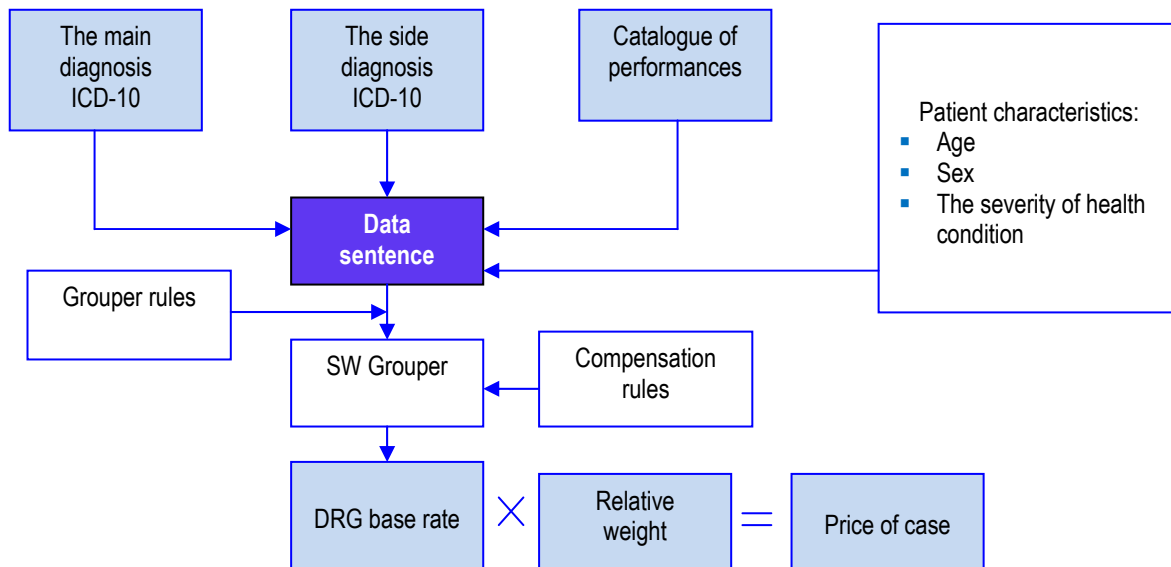▪ DRG + grouper + relative scales are creating locally.

Figure 1 – Declares the basic structure of the DRG system functioning

4. Diagnoses related groups system in Ireland and Germany

The Irish health service is characterized by central funding, managed by the Ministry of Health and Youth. In 2005, Ireland introduced AR-DRG system and related classification coding ICD-10-AM. Successful operation of the Irish DRG system including the associated database for Case Mix and cost calculation was based on the Australian model and from this stemming Australian cooperation that was evident even in the training of more than 200 specialized coders. Compared with Australian approach in Ireland was applied centralized policy of using a single national grouper throughout Ireland. It was developed and maintained by private provider under a contract for support and maintenance (Kalman 2007).

The German health care system on the other hand is characterized by a decentralized structure of financing and management (called Selbstverwaltung - SV), in which have an important role health insurances. Germany introduced AR-DRG system also based on the Contract for the license and support with Australia, but two years earlier than Ireland. Important role in this process also played a reform of the health system in the year 2000, in which DRG system already fulfilled an important function. The process of choosing the correct DRG system in Germany was realized systematically, executed two studies was guided not only by foreign but also domestic experts.

The final solution was the same as in Ireland - AR-DRG, and the prevailing argument in his election was also significant support from Australia. This support Germany planned reduce to five years, this independence planned to obtain with very ambitious system of learning, annual adjustments within the classification of diagnoses ICD-10-GM and performance classification OPS-301 (Kožený 2010).

The DRG system introduction affected all stakeholders in Germany, primarily hospitals and health insurance companies. Hospitals improved their health care provision processes, reviewed composition of their services and increased the professionalism of its management and so on.

In DRG system success can be seen in particular the following aspects:
▪ First is creating supply system, as well as penal sanctions, which greatly motivates hospitals to providing high quality data on medical procedures and cost. Quality coding of diagnoses with a good setup of motivation system only highlighted and it was visible even low quality coding, respectively intentional classifying diagnosis to more expensive category.

▪ Under the title Convergency Phase (CP) was introduced a formal framework of the transformation process, with the necessary definitions, project milestones, financial regulatory mechanisms with which were managed not only to health insurance companies, but also health service providers. The aim was to mitigate the possible negative impact of introducing the G-DRG for hospitals with high costs in the beginning of the project. In the first two years of CP transformation program are cost factors and from them derived individual base rates budgetary neutral. In the following years individual base rates gradually converged to uniform nationwide, but the annual cost decrease on 1% to 3% was limited by imposing limits. The budgets of hospitals with basic rates less than nationwide were increased. This significantly increased the willingness of hospitals to participate in the changing of processes, because as a result of enough time organizations could adequately prepare for the introduction of fundamental changes. Fears of too risky change processes, by reason of large budget deficits prompted the restructuring processes through privatization and contributed to the development of new forms of regional cooperation, which also can be described as positive effects from the introduction of the DRG system (Kožený 2010).

Interest in the G-DRG system also increased outside Germany, e.g. in 2006, Switzerland has decided to adopt this system in 2011 and concluded agreement with the InEK to provide comprehensive support for five years. In spite of many their differences, the Irish and German DRG system approach has many common features, which declares Table 1.

Table 1 – Comparison of German and Irish characteristics of the Case Mix

Aspect of the system DRG	Ireland	Germany
Financing and management of health care	Centralized	Decentralised
The initial study duration of alternatives for DRG	More than 12 months	More than 6 months
Precision of defined DRG objectives	high	high
Policy and regulatory DRG framework	Established in the beginning, considerable changes during	Established in the beginning, considerable changes during
External support for Case Mix	Australia	Australia
Existing experiences with DRG	HCFA-DRG	None
Classification coding	Introduced new	Used until now
Head office for Case Mix (CMO)	Extension of an existing institution	Create a new
Competences and tasks of the CMO	Extensive leading role, subordinate to the Ministry	Extensive leading role, subordinate to control by stakeholders
The main use of DRG	The resource allocation system	Gradual transition to price system
The system range of DRG	All hospitalized, daily receives, no psychiatric patients	All hospitalized, daily receives, no psychiatric patients
The principle of grouper contractor	Nation wide tender, a single contractor selected	More suppliers, every year certification
The schedule of introduction	Immediate extensive implementation	First year voluntary after compulsory
Basic rate	Type of hospital	Individual, rates converge to hospitals nationwide rate
Determination of base rate	Set from the center	Regional negotiations
Speed of budget changes	Gradual	Gradual in the years 2005-2009
Subsequent DRG adjustments	Minimal	Extensive
The cycle of grouper changes	Typical after four years	Yearly
Data collecting about procedures for DRG	Modification of the existing system	Created a new
Methodology of costs calculation	Modification of the existing system	The newly created
Collection of costs data for DRG	Mandatory for all hospitals with acute cases	Voluntary, 12% of hospitals for acute cases
Quality control of related data	Extensive audits of coding and case mix data	Extensive audits of coding and case mix data
A system of accreditation and quality control (e.g. ISO certification, etc.).	Local accreditation schemes	Active participation in national and international accreditation and quality management
Standards and care planning systems	They are not nationally established	In limited, but increasing

		extent
Miera prijatia zúčastnenými stranami	High	High, but from doctors side medium
The impact of changes on hospital	Intermediate	Medium to high
External connections, support, interest in system	None, certain interest in the UK	Switzerland, Middle East, Asia
The existing dependence on support from Australia	Intermediate	None

Source: prepared in accordance with (Kožený 2010)

The data in the table declare a high flexibility, robustness and relevance of the Australian classification Case Mix, as well as support of related mechanisms. An example from Ireland and Germany clearly declares the fact that the DRG system can be adapted for the various historical circumstances, national specificities, as well as using different approaches.

In the neighboring Czech Republic, the first experiments with DRG system began in the mid-nineties after the introduction of the Institute of health insurance companies. With the newly introduced "fee for service" system were in selective framework used the AP-DRG2 system and later IRDRG3 system, particularly for the purposes of analysis and in a limited extent for budgeting. In the last 20 years in the Czech Republic they invested considerable resources related to the implementation and use of DRG, but it remained still in the experimental phase. In the next period is planned further development of the DRG and its implementation in payments for ambulatory care, thus would be opening further possibilities in the use of DRG cost analysis.

Table 2 declares comparison of strengths, weaknesses, opportunities and threats of DRG system - a SWOT analysis, which is the analytic-synthetic method used in the strategic management of organizations, regardless of its type. The SWOT analysis main aim of DRG system is the most complex analyze its strengths and weaknesses, therefore, the possibility of its further development, as well as the potential threats that may functioning and application adversely affect.

Table 2 - SWOT analysis of the DRG system

Strenghts	Weaknesses
▪ orientation on final product not on performance, ▪ quality control, ▪ tool for strategic and internal management of the organization, ▪ possibility of price modeling where it is impossible to clearly determine prices based on market principle, ▪ reducing of hospitalization time, ▪ motivation to moving health care into the ambulatory care, ▪ demands increasing on nursing staff, ▪ tendency to change the structure or the reduction of hospital beds, ▪ transparency, ▪ the possibility of benchmarking also strategic, ▪ pressure for greater cooperation well as inside hospital, ▪ massive information source.	▪ financially very costly, ▪ the high costs also in the early phases of implementation, ▪ the issue of the relative weighting determination, ▪ the issue of the basic rate determination, ▪ the issue of critical performance and DRG markers, ▪ the issue of high cost cases, ▪ list of unsatisfactory procedures with point values, ▪ insufficient support from all stakeholders.
Opportunities	**Threats**
▪ the possibility of system developing and its adaptability according to user needs, ▪ the possibility of introducing a similar system for ambulatory sector with chronic inpatient care, ▪ Creating your own classification system of procedure for DRG system, ▪ creation of a sanctions system for the use upcodingu forms.	▪ insufficient and inadequate motivational principles of providers, ▪ absence of sufficiently strong legislative support, ▪ high introductory and administrative costs, ▪ insufficient financial security, ▪ excessive complexity of the system, ▪ low quality of encoding, ▪ it is not optimal for the use of all health facilities, ▪ lack of sufficient audit system by health insurance companies.

Source: prepared in accordance with (Matušek 2011).

5. Diagnoses related group system in Slovakia

The first mention of the DRG system introduction in Slovakia occurs in 1995, even indirectly, in the Manifesto of Slovak Government for the years 1994 to 1998. Just in this period in many European countries introduced DRG system for funding of inpatient care organizations. Considering negative development in the health sector it was in 1997 deaden work that would lead to the introduction of the DRG system, as it was in other countries.

Up to onset of government in July 2006, this again has incorporated a draft of financing solutions for hospitals in the Manifesto of Slovak Government (MoSG), has this issue reopened. Concretely in the Manifesto of Slovak Government is written a statement: "An important objective of the government will be support of new, objective payment mechanisms for health care procedures" (MoH 2012). In the document Elaboration of the MoSG to the conditions of the health sector we further learn that was adopted specific aim. This aim was formulated as follows: "To achieve rational and equitable allocation of scarce resources among healthcare providers so as to take account of merit and in order to be motivating. For the institutional health care area it is the DRG system and for the field of general practitioners system it is weighted capitation payments based on the achieved cost on capitated insured persons" (MoH 2012). For the implementation of this specific objective were adopted two tasks with specific deadlines. First, the introduction of the DRG system as a compensation mechanism for healthcare facilities will be fulfilled on 31st of December 2010. The second task of the Ministry of Health was introducing until the 31st of December 2009 weighted capitation payment as compensation mechanism for general practitioners. With hindsight it can be seen that the individual tasks are not met and therefore the overall objective for the introduction of the DRG system was not filled.

In August 2010, to following Government was approved the Manifesto of Slovak Government. In that document again it is part of the DRG system introduction and it is in specific form: "The Government will introduce a fair system of health care financing for all health care providers. The Government will support the implementation of more innovative, transparent and objective payment mechanisms, in particular payments for diagnosis (DRG system) "(MoH 2006). From the abovementioned text it follows aim adopted by the Ministry of Health, which states that it must establish the methodology of creating fair prices for health care, as well as to achieve equitable reallocation of resources for individual institutes of health care with the aim of improving the effectiveness of health care in health services as a whole. With creating a single financing platform for hospital services by DRG system will contribute to the comparability of health care provision and its costs of each facility to give a wider range of information for decision-making and control process (MoH 2006). To achieve this objective, it was necessary until 31st of December 2011 submit an analysis of the steps and the implementation of the DRG system introduction and its implementation as compensation payment mechanism for inpatient healthcare and identify specific tasks and procedures (MoH 2006). By legislative amendment will transfer competences of abovementioned tasks at Health Care Surveillance Authority (HCSA).

This last initiative has led to the fact that since the autumn 2010 took place intensive work negotiations led by the HCSA and with the participation of health insurance companies, the Ministry of Health, the Association of Slovak Hospitals and the Association of faculty hospitals, already on these negotiations were defined all the processes and schedule of work, which resulted in the signing of the Memorandum on cooperation in ensuring and implementation of a classification (DRG) system in Slovakia on 17th of March 2011 (HCSA, 2012). On 09th of December 2010 the National Council of Slovak republic approved an amendment to Act 581/2004 Coll. on health insurance companies with effect from 1st of April 2011, the HCSA became a Center for the classification system. At this time (November 2010) was established working group for the DRG implementation in Slovakia, from November 2010 to June 2011 they analyzed the DRG systems in the world (20 countries) and created a group of five DRG systems - the American, Australian, French, German and Nordic (HPI 2012). In the end of this phase, on 10th of June 2011 was established a Steering Committee and adopted a decision on the selection of the German system.

German DRG system is operated and maintained by the institution (Institut für das Entgeltsystem im Krankenhaus - Institute for payment systems in hospitals), with which was on 13th of December 2011 in Siegburg signed agreement on cooperation in the development and implementation of the new compensation system in hospitals. This institution will also train the national experts from the HCSA. To date 07th of January 2012 was the financial amount confidential, but under the pressure of public and media, came to a consensus and in this day was disclosed the amount of 1,666 million € (SME 2012) for a contract with InEK. This amount contains price for the development of the Slovak DRG system and annexes of agreements containing know-how support and consultancy services for the implementation (SME 2012).

Contractual relationship is for three years. This amount will be paid in four installments; the first installment amount is € 238,000 (Hunková 2012). The first Slovak version suitable for implementation will be prepared by 30th of June 2012, which will be adjusted to 01st of January 2013 and from this date will be launched DRG system under the name AR-DRG 1.0.

Project education of participants in the system within the DRG implementation

Participants are divided into target groups A, B, C, D and E. While the target group A will consist of national experts for the DRG system and they will be employees of the Center for classification system HCSA in number of persons 8. These experts are trained directly in Germany through the InEK organization. In the target group B are national methodologists for the DRG system they are 48 people and they will be trained by national experts. In the next target group C are specialists for coding diagnoses and performances in number 2080. Upcoming target group consists of DRG system user management, in number 800 people. In the last target group E are qualified persons for the DRG system in the number of 190 people. Total number of participants reaches 3,126 and the total time training of participants will be in the range of 2012 - 2013. Financing the training of these persons will be through the European Social Fund, from which was requested amount of 6.2 million € (Hunková 2012).

Conclusion

As is clear from the present contribution DRG system brings significant changes to the existing system of health care financing in the country. DRG system has undergone its development and now represents the tool for management and financing of health care. Each system has its strengths and weaknesses and it is same with DRG system. Despite registered weaknesses it presents the best and in many countries the only one real and useful tool not only to finance acute inpatient care, but also to measure its productivity. Its objective is to eliminate the weaknesses of the still used financing approaches for acute inpatient care, which was primarily an effort to get the highest rewards from provided health care, which only deepened and fixed the funding system imbalance. The implemented DRG system brings to doctors, hospitals management as well as to other market hospital services players common and understandable communication tool and also a tool of management, financing and subsequent benchmarking (with the possibility of a later automation of this process type described in (Janke 2011), which output is understood by all interested parties. With application of uniform financing principles creates an opportunity to compare performances and other treatment parameters between health care facilities, as well as inside it. Thus hospital management is gaining a significant tool for influencing production, strategic planning and helps reduce information asymmetry towards doctors of medical facilities. From above mentioned SWOT analyse results, that DRG system has many more strengths. The extent to which Slovakia can gain significant benefits from this powerful tool will be shown in our near future.

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Performance of Minority Data in Financial Distress Prediction Models. Application of Multiple Discriminate Analysis, Logit, Probit and Artificial Neural Network Methods

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Abstract

This paper presents a financial distress prediction model that combines the approaches of multiple discriminant analysis, logit method, Probit method andartificial neural network for distinguishing between healthy and financially distressed firms. Financial distress prediction is a key issue in finance. Past research has largely ignored the precision of the minority group and focused on the overall accuracy percentage. This paper suggests artificial neural network isthe best high performance method for both the groups. The suggested method serves as an earlywarning system for firms in financial distress.

Keywords: Financial distress, prediction models, SMEs

JEL Classification: G17, G33

1. Introduction

The financial distress is biggest problem for small and medium enterprises (SMEs) in Thailand. Most SME entrepreneurs are new entrepreneurs who lack operational experience. Consequently, within a few years, many SME businesses close down. Of the total number of businesses in the country, over 99% are SMEs.SMEs play a significant role in employment and growth distribution, and are important contributors to all economic sectors. Specifically, theyaccounted for 77% of the total employment in 2012 (Institute for Small and Medium Sized Enterprises Development, 2015). Therefore, it is necessary to develop methods that act as an early warning system before businesses fail. This can help entrepreneurs prepare in advance and take preventive steps. Such methods benefit governments, private institutions, and financial institutions. There are several methods for predicting financial distress, but each method gives a different prediction. In order to minimize prediction error, it is important to determine the most appropriate and accurate method for predicting financial distress

In this study, we compare four failure prediction models—MDA, logit, probit, and ANN—based on their predictions regarding the failure of SMEs in Thailand. The models used in this paper may help various user groups in Thailand such as accountants, investors, auditors, managers, creditors, and regulatory agencies to predict the probability of business failure. Despite the considerable costs of failure of companies and the significant contribution of SMEs to the economy, relatively few studies have focused on the failure of SMEs.

2. Literature review

There are several benefits of using statistical methods for predicting financial distress. First, such methods can determine the importance of a variable in the prediction process. Second, the prediction results using statistical multiple discriminant analysis (MDA) involve dichotomous classification (Altman, 1968; Beaver, 1966; Deakin 1972), while the logit and probit methods yield probability measures (Chancharat and Chancharat 2011; Darayseh, Waples and Tsoukalas 2003; Ohlson 1980) In addition, some tools like artificial neural networks (ANNs) can process information better (Carvalhal and Ribeiro 2007; Coats and Fant 1993; Wilson and Sharda 1994). The probit, logit, and ANNs models used in this paper have higher prediction accuracy and possess the ability of generalization (Altman and Narayanan 1997; Atiya 2001; Zmijewski 1984). The best and the most stable performancesare those of the probit and logit models (Canbas, Cabuk ans Kilic 2005; Lin 2009; Zhang 1999). However, if the data does not satisfy the assumptions of the statistical approaches, then the ANN approach can achieve higher prediction accuracy Atiya (2001) and Pai, Annapoorani and Pai (2004). In addition, the models used in this paper have higher prediction accuracy and possess the ability of generalization as compared to those of (Altman 1968; Ohlson 1980). Different models yield different findings (Press and Wilson 1978).

In this study, we compare four failure prediction models - MDA, logit, probit, and ANN - based on their predictions regarding the failure of SMEs in Thailand. The results of our paper may be useful in providing early

warning signals regarding financial problems of SMEs before the businesses actually fail. Despite the considerable costs of failure of companies and the significant contribution of SMEs to the economy, relatively few studies have focused on the survival or failure of SMEs.

3. Data and training methods

3.1. Data

Financial accounting data for 30,463 SMEs in Thailand were obtained from the Department of Business Development, Ministry of Commerce. SMEs were classified as "failed" if they had entered receivership, been liquidated, merged, or declared bankrupt. Otherwise, they were classified as "non-failed."

We used four financial ratios as core independent variables: 1) current liabilities as a percentage of sales, 2) net capital assets, 3) net sales, and 4) earnings before interest and tax liabilities. This data was collected from the balance sheets and income statements for 2011 and 2012 published on the Department of Business Development's website that provides the most up-to-date set of financial statements ("Institute for Small and Medium Sized Enterprises Development," 2015). Since this data was utilized in the predictive model, it was important that the sample was complete and accurate. Therefore, the data was derived from financial statements and included only businesses with complete records. SMEs with missing data (for example, current assets equal to zero) were excluded and the final sample comprised 30,463 SMEs; of these, 19,903 were classified as non-failed and 10,561 were classified as failed.

3.2. Variables

All the models used in this paper are based on the 12 ratios obtained from the financial statements of the SMEs in Thailand (see Table 1).

Table 1 - Financial ratios that form the basis of the models.

Variable name	Financial ratios
X1	Current Liabilities / Sales
X2	Sales / Current Liabilities
X3	Net income / Current Liabilities
X4	Working Capital Turnover / Total Assets
X5	Net income / Shareholder
X6	Total Assets/ Shareholder
X7	Total Liabilities/ Shareholder
X8	Net income / Sales
X9	Earnings before Interest and Taxes / Current Liabilities
X10	Current Assets / Shareholder
X11	Shareholder / Current Assets
X12	Total Liabilities / Sales

3.3. Training methods

3.3.1. Multiple discriminant analysis

MDA is a multivariate statistical tool that allows analysts to classify subjects or observations (SMEs in this paper) into appropriate a priori groups (out of sample). In the case of two groups, MDA reduces the task of examining the differences between the groups based on a large number of descriptor variables for a univariate problem. The calculated multiple discriminant function can be used to simultaneously distinguish between subject classes on the basis of multiple independent variables.

For predictive purposes, the essential output from the MDA technique is a linear equation referred to as the discriminant function and is of the form:

$$Z_i = \beta_1 X_{1i} + \beta_2 X_{2i} \ldots + \beta_n X_{ni} \qquad (1)$$

where: Z: failure group and survival group,

X_i: explanatory variables of the prediction model, i = 1 . . . n,

β_0: regression intercept, and

β_0: coefficients of the explanatory variables, i = 1 . . . n.

The MDA model uses a score of 2.675 to distinguish between failure and non-failure. If a company scores below 2.675, the business is classified as a failure, whereas if it is above 2.675, it is classified as a non-failure (Altman 1968).

3.3.2. Logit model

This section analyses the predictive ability of logit and probit models for identifying financially distressed and financially sound corporates. Several different models were estimated by experimentation. Logit analysis is very similar to probit analysis, except that the former assumes that the error term has a logistic distribution. Thus, the logit regression model for financial distress prediction is defined as:

$$\text{Pr (failure)} \quad = \frac{1}{1+e^{-Z_i}} \tag{2}$$

$$\text{Pr} \quad = \frac{\exp(\beta_0+\beta_1 X_1+\cdots+\beta_n X_n}{1+\exp(\beta_0+\beta_1 X+\cdots\beta_n n)} \tag{3}$$

where: Pr: the probability of financial distress,

X_i: explanatory variables of the prediction model, i = 1 . . . n,

β_0: regression intercept, and

β_i: coefficients of the explanatory variables, i = 1 . . . n.

The logit regression approach is often preferred over Discriminant Analysis (Press & Wilson, 1978)

3.3.3. Probit model

The final probit function is given as:

$$\text{Pr (failure)} \quad = \int_{-\infty}^{X_i} \frac{1}{\sqrt{2\pi}} \exp(\frac{-Z^2}{2})dz \tag{4}$$

In the logit and probit models, the cut-off point to distinguish between failed and non-failed businesses is set at 0.05. If the score is below 0.05, the company is classified as a failure, whereas if it is above 0.05, it is classified as a non-failure (Vanichbuncha 2008).

3.3.4. Artificial neural network

Finally, the ANN weights using the initial 0.3 hidden configuration equal 5, and the cycle is equal to 3,000. The ANN method differs from the other models in terms of the intersection or the learning data. The data is divided into two parts—70% of the data (21,326 observations) is used for learning and 30% (9,139 observations) for testing.

In Figure 1, these inputs are combined in the left portion of the neuron. The right portion of the neuron calculates the degree to which this sum is important using a transfer function (F), thus producing an individual output.

$$f \sum_{i=n}^{n} w_i x_i \tag{5}$$

where: w: weight vector w = $(w_1, w_2 \ldots w_n)$

x: input vector x = $(x_1, x_2 \ldots x_n)$

The learning algorithm of the parameter in the hidden nodes is self-organized while that of the connection weights is supervised. The goal of the hidden node parameter learning is to arrange these hidden nodes in a manner that they can effectively represent the clusters of input vectors. The selection of the transfer function typically depends upon the nature of the output of the network. Because the output of this paper is continuous in nature and ranges from 0 to 1, we use the sigmoid transfer function.

$$f(\acute{w}x) = \frac{1}{1+e^{(-\acute{w}x)}} \tag{6}$$

The estimated coefficients and standard errors of the parameters for the MDA logit, and probitmodel, and the hidden layer and number of cycles of the ANN models are shown in Table 3. To evaluate the predictive validity of the model for 2012, we divided the overall sample into two training samples. The accuracy of the logistic regression models was evaluated using hold-out samples.

A widely used measure of the predictive accuracy of a model is the percentage of correct classifications. Two types of misclassifications are possible. In this case, recall correctly classifies a healthy firm based on actual positive financial information, while precision correctly classifies a healthy firm based on positive predictions. The classification of a firm is determined by the cut-off value - a firm with a predicted value lower than the cut-off value is considered to be in financial distress; otherwise, it is classified as a healthy firm.

4. Training results

The first experiment uses models based on the 12 financial ratios presented in Table 2. There are six significant variables: X1, X2, X3, X4, X8, and X9.

Table 2- Significance of the 12 ratios.

Variables	Score	Df	Sig.
X1	16.222	1	0.002
X2	19.341	1	0.000
X3	17.273	1	0.000
X4	23.272	1	0.000
X5	6.565	1	0.073
X6	8.406	1	0.062
X7	5.103	1	0.077
X8	37.748	1	0.000
X9	28.237	1	0.000
X10	3.345	1	0.150
X11	0.657	1	0.405
X12	4.772	1	0.125

In Table 3, there are three interrelated variables—X2, X3, and X9; as X9 has a higher score than X2 andX3, we exclude the latter. Thus, the models used in this paper are based on four variables: X1, X4, X8, and X9.

Table 3 - Correlation coefficients among variables.

VARIABLES	TEST	X1	X2	X3	X4	X8	X9
X1	Pearson Correlation	1	-.026	-.017	-.014	-.521**	-.019
	Sig. (2-tailed)		.605	.737	.774	.000	.702
X2	Pearson Correlation		1	.971**	.040	.341**	.866**
	Sig. (2-tailed)			.000	.428	.000	.000
X3	Pearson Correlation			1	.027	.363**	.879**
	Sig. (2-tailed)				.589	.000	.000
X4	Pearson Correlation				1	.007	.030
	Sig. (2-tailed)					.887	.553
X8	Pearson Correlation					1	.318**
	Sig. (2-tailed)						.000
X9	Pearson Correlation						1
	Sig. (2-tailed)						

Note: Correlation is significant at the 0.01 level (2-tailed).

The coefficient estimates for the MDA, logit, and probit models are presented in Table 4. Most variables have a level of significance of 0.05 and 0.01; in particular, x1, x4, and x9 have a level of significance of 0.01.

Table 4 - MDA, logit, and probit estimates.

VARIABLE		CONSTANT	X1	X4	X8	X9
MDA	Coefficient	-	-0.310***	0.280***	0.233***	0.796***
	Std. Error	-	0.007	0.027	0.156	0.018
Logit	Coefficient	0.623***	-0.065***	0.196***	1.327***	0.169***
	Std. Error	0.015	0.01	0.019	0.071	0.005
Probit	Coefficient	0.410***	0.081***	0.077***	0.122**	0.060***
	Std. Error	0.008	0.005	0.006	0.01	0.002

Notes: *, **, and *** indicate 0.10, 0.05, and 0.01 levels of significance, respectively.

Table 5 presents a comparison of the accuracy of the four models in forecasting the failure of SMEs based on recall and forecasting accuracy. Recall is the accuracy percentage of the minority group (fail group) or actual positive; the model can predict positive per number of actual positive, positive plus actual positive, and negative occurred. The MDA model correctly classified 67.9% of the businesses, with recall at about 55.3%. The logit model correctly classified 61.8% of the businesses, with recall at 25.9%. The probit model correctly classified 71.1% of the businesses, with recall at 42.7%. The ANN model correctly classified 80.6% of the businesses, with recall at 95.6%. These results confirm the high predictive ability of ANN models.

Table 5 - Comparison of the predictive accuracy of the models regarding SME failure.

Model	Recall (%)	Forecasting Accuracy (%)
MDA	55.3	67.9
Logit	25.9	61.8
Probit	42.7	71.1
ANN	95.6	80.6
	Predict positive	**Predict negative**
ActualPositive	TP (potential positive prediction)	FN (type one error)
Actual Negative	FP (type two error)	TN (potential negative prediction)

Notes: Recall (%) = (TP/TP+FN), Forecasting Accuracy (%) = TP+TN/(TP+FN+FP+TN)

Table 5 shows that the ANN method displays the best prediction performance for imminent bankruptcies, better than the logit, MDA, and probit models; specifically, the ANN method has higher forecasting accuracy and high recall and precision as compared to the other models. The recall for the logit, probit, and MDA models is 25.9%, 42.7%, and 55.3%, respectively; thus, the three models provide less recall for financial survival. We highlight three critical contributions of our analysis:(1) the empirical results show that the ANN method provides the best prediction performance for imminent bankruptcies; in particular, the ANN method has a higher recall as compared to the other models; (2) we show that the logit and probit methods provide less recall for financial survival; and (3) as SME data is diverse, the simple linear models may have high prediction errors. Finally, the paper found that, in general, the predictive accuracy of the four most commonly used financial distress models was lower for the 2012 data. Further, the failed SMEs have a higher debt ratio than those that survived.

Conclusion and discussion

The following observations are made in this paper. The results presented in Table 5 indicate the performance of the ANN method was relatively much higher than that of the probit, MDA, and logit models. These findings are consistent with (Zhang, Y Hu, Patuwo and Indro 1999), but contrasts with (Lin 2009) that suggests that the probit model provides high performance prediction for financial failure.

This paper illustrates the power and limitations of confidence intervals for estimating the probability of bankruptcy. The analyses compared the efficiencies of four models - MDA, logit, probit, and ANN models. The analyses results provide the optimal levels of the ratios for one- and two-year predictions. Our results are consistent with the findings of (Aziz and Lawson 1988), (Bahnson 1987; Casey and Bartczak 1985; Darayseh *et al.* 2003; Lin 2009). These results confirm the high predictive ability of the ANN model that can accurately predict business failure. The model consistently predicts SME failures more accurately than the logit, MDA, and probit models, although the other two models also provide accurate predictions of failures in the year prior to the failure. The logit and probit models are also highly flexible and easier to use and understand than the ANN model. Of the

four models, the ANN model is the most accurate and simple to use. However, this paper contrastsconceders recall, we show that the ANN method provides the best prediction performance among the four models. The forecasting accuracy of the ANN model accuracy is higher than that of the other models due to its adaptability. Since SME data is diverse, the use of simple linear models may lead to high prediction errors.

Future studies can use various statistical tools that accurately forecast financial problems and can explore intelligent techniques such as fuzzy logit models and hybrid ANN decision trees. In addition, future work can integrate other variables such as corporate governance and financial variables into the financial distress prediction models and compare their predictive ability with the results of this paper. However, we should separately highlight the data variables to be considered as they affect the predictive ability of the four models. Finally, there are other test samples that can be used to evaluate the relative performance of the four models. In addition, equity markets tend to be highly predictive regarding not only the health of a firm, but also the health of the economy, which in turn affects the creditworthiness of the firm

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Influence of Socio-Economic Profile and Agents on Awareness Levels of Health Insurance Plans in Punjab. A Study

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Abstract

Health insurance is the type of financial tool to finance the health care expenditures of the individuals. Since the financial year 2011-12 the health insurance industry consistently registered around 17% growth rate, yet it is less than the growth of life insurance industry. Various reasons are attributed to the lower penetration of health insurance in India such as ignorance and lack of awareness, not sure of timing of availing policies, preference to earn profits and considering investment in insurance as tax –saving instrument. The present study is an attempt to know the influence of socio-economic profile and agents on bringing awareness about health insurance among the people of Punjab. The study was conducted based on the primary data collected from 356 respondents using a questionnaire during February- April, 2014. For the purpose of analysis, inferential statistics such as multiple regression and independent Sample t- test were applied. The results explains the positive influence of employment, annual income and education on level of awareness while gender, age, type of family and number of dependents explains the negative influence on the level of awareness. The role of agents has significant influence on the bringing the awareness and motivating the individuals to subscribe the health insurance plans.

1. Introduction

Health insurance business has been defined in the IRDA's Regulations on Registration of Indian Insurance Companies, which covers indemnity type benefits as well as assured benefits. The definition is: *"health insurance business" or "health cover means the effecting of contracts which provide sickness benefits or medical, surgical or hospital expense benefits, whether in-patient or out patient, on an indemnity, reimbursement, service, prepaid, hospital or other plans basis, including assured benefits and long term care"* (Subrahmanyam 2004).

Health insurance gives the facility to individuals to finance their medical expenses which lessen the financial burden on them. It gives partial reimbursement to the people for expenditure on various diseases (Ghosh 2013). Health insurance is the type of insurance where the insurer pays medical cost for the insured due to illness and accidents (Yelliah 2012). Health insurance is a largely recognized and preferable tool to finance the health care expenditure to the individuals (Bawa and Ruchita 2011). Health insurance is considered not only as a desirable and affordable tool but also diversifies the financial risks, potentially raise income levels and can offer large welfare gains. The health insurance works on a principle of pooling of risks of unexpected illness and needing hospitalization by charging premium from people (Reshmi and Sabu 2007).

The awareness towards health insurance among the people is increasing due to awareness campaigns done by various bodies such as IRDA, General Insurance Council, NGOs and Channel Partners of Health Insurance Companies. Still the large chunk of population is spending huge out-of-pocket expenses for their health care. Various reasons attributed to the lower penetration of health insurance in India when compared with life insurance such as ignorance and lack of awareness, not sure of timing of availing policies, preference to earn profits and considering investment in insurance as tax – saving instrument.

2. Review of literature

Healthcare Expenditure is an important variable affecting health insurance purchase (Yelliah 2012). "Out-of-Pocket" health expenditure made poor households financial conditions more vulnerable and they tend to spend larger proportion of their total budget on health care (Joglekar 2013). Health care expenses affected the demand for health insurance purchase decision. Rise in health care expenses leads to increase the interest for buying health plans in a country (Bhat and Nishant 2006). The main aim to buy health insurance plan was to protect against financial risk (Grignon and Bidenam 2009).

Health risk determines one of the important factor for buying voluntary health insurance plans in India (Vellakkal 2013a, Vellakkal 2013b). People having higher chances of requiring hospitalization had higher probability of buying health insurance. Households with morbid conditions and already faced hospitalization situations were more interested to enroll themselves in health insurance schemes (Ghosh *et al.* 2013). However, people gave more importance to their health as compared to do investment in health insurance as a tax savings (Gurunathan and Mohanasundari 2010).

Various studies tried to know the reasons for low penetration of health insurance in India. The literature review suggests that knowledge and awareness are very important determinants for health insurance subscription and low level of awareness is major barrier in subscription among individuals (Bawa and Ruchita 2011, Ramamoorthy 2013, Sheth 2013). Adibe *et al.* (2011) also assess the low level of awareness among Nigerian employees and it associated with demographic variables. Sarwar and Qureshi (2013) found that 82 percent of individuals were heard about health insurance but 65% of individuals know the difference between health and life insurance. Yellaiah (2013) also assess the low level of awareness in Hyderabad and it is positively associated with high income and high education. The level of awareness in South Indian population was reasonable but not so high and it is significantly associated with occupation, family income, educational status, religion and socio-economic status. People having white collar jobs with good income level had high level of awareness (Reshmi, Sabu 2012). In spite of being aware, the major reason for health insurance was family protection as compared to tax savings (Gurunathan and Mohanasundari 2010). Vanithamani (2013) found that majority of the women workers in industry were unaware about the existence of private health insurance schemes. Ghosh (2013) also assess the low level of awareness in Darjeeling district and main source for awareness was tax and agent consultant. Reshmi et al (2010) also found low level of awareness in Karnataka and main reason for this was low socio-economic status of people. A study conducted by Ghosh (2013) found that people were aware but not to that extent that they subscribed themselves.

Income is also another important determinant which influences the purchase decision of health insurance in India. Income found the most important determinant to buy micro health insurance schemes in India (Bhat and Nishan 2006). Makoka *et al*. (2007) examined income as a significant determinant to affect the demand for private health insurance in Malawi district. Level of income affected the purchase decision for buying health insurance policies (Panchal 2013). People with high income and good health were shown more interest to pay for supplementary health insurance plans (2008). Christiansen *et al.* (2002) found that chances of more coverage for health insurance were increased with rise in income. Moreover, incomes of employees directly impact the claims in an unexpected way (Peroz and Sinha 2006). The main reason for less coverage was low income or uncertainty of income among the rural people of Bangalore (Madhukumar, Sudeepa and Vishali 2012).

Health insurance schemes in India are characterized by multiple options and the contracts are also written with much technical jargon which is difficult for an ordinary individual. Agents/brokers play an important role in offering guidance and counseling the individuals in reducing the search costs of suitable health policy when the markets are more competitive (Mandic, Peter and Roger 2013). Vellakal (2013a, 2013b) and Sarwar and Qureshi (2013) also assess the role of insurance agents to bring awareness and willingness to buy private health insurance in India. But there is also a contradictory study that found agents related problems which affected the demand for purchasing health insurance negatively (Kansra and Gaurav 2012).

Lack of accessibility and availability of services were found major drawbacks in health insurance industry. Moreover, lack of intermediaries, lack of comprehensive coverage and prefer to invest money in some other areas were also obstruct to be subscribed (Bawa and Ruchita 2011). Sarwar and Qureshi (2013) also assess narrow policy options is a major reason for not purchasing a policy. People who were aware but not interested to subscribe to health plan, because of involvement of hidden cost and narrow policy options (Bawa and Ruchita 2011).

Another set of factors which are found important in the literature of health insurance are socio-economic variables. Socio-economic and cultural characteristics of household significantly associate with demand for health insurance. Different Occupations of people had different views regarding purchase decisions (Yelliah 2012). Age has been found positive and significant impact on the probability of buying insurance (Reshmi, Sabu 2007, Yelliah 2012). Gender also plays an important role in the insurance decision through its impact on medical consumption (Reshmi, Sabu 2007, Selvan 2012). Similarly, demographic variable like religion act as a barrier. People believed that their God will always with them to face any unexpected mishappening in a life (Reshmi, Sabu 2007). The characteristics of the family and their health condition as a unit are also important variables to study.

The review of literature emphasized on the influence of socio-economic variable on the level of awareness and willingness to pay. In this regard there were contradictory findings among Yelliah and Ramakrishna (2012)

and Kansra and Pathania (2011) with respect to significant relationship between age, gender and awareness. Studies pertaining to influence on level of awareness which is moderated by the socio-economic determinants and the role of the agents before and during the subscription for health insurance policy need to be conducted which forms the background of the study.

3. Research objectives

The objectives of a study set on the basis of gap identified after conducting the previous studies.
- To study the level of awareness on health insurance among the people of Punjab.
- To study the influence of socio economic profile and the level of awareness on health insurance among the people of Punjab.
- To study the role of agents in health insurance sector in Punjab.

4. Hypothesis

H1: Socio economic profile of individuals has significant influence on the level of awareness of individuals of Punjab.

H2: There is no significant influence of role of agent in bringing awareness and inducing to buy health policies on the number of health policies subscribed.

5. Research methodology

Data Source: The study is based on both the primary and secondary data. The Secondary data is collected from various annual reports of Insurance Regulatory and Development Authority (IRDA) and Published data from World Health Organization. The Primary data is collected by canvassing a well-structured questionnaire.

Period of Study: The primary data was collected by canvassing a questionnaire during February – April, 2014.

Sampling Area: The sample area was Majha, Doaba and Malwa regions and considered one district from each area. Amritsar from Majha, Jalandhar from Doaba and Ludhiana from Malwa are selected as the sample area for the study.

Questionnaire: The data was collected using a modified questionnaire of Bawa and Ruchita (2011).The questionnaire was pretested on a sample size of 80 respondents and made rigorous modifications to get maximum unbiased information. Finally actual survey was done on the sample size of 384 respondents in Punjab. Some questionnaires were eliminated due to the partial completion of the instrument and biased information and 356 are selected for a final study.

Sampling Technique: Convenience sampling is used for the research. During survey, it was tried to cover rural, semi-urban and urban area of the districts of Amritsar, Jalandhar and Ludhiana so that actual picture will comes out for the trend of health insurance in Punjab.

6. Results and discussion

The results from the survey are presented in three sections. Section one presents the socio-economic profile of respondents. Section two reveals the level of awareness of respondents whereas section three covers the influence of socio demographic profile of respondents on the awareness level of respondents. Section four discloses the role of agents in bringing awareness and inducing the respondents to subscribe for health policy.

Section 1: Socio – economic profile of respondents

The demographic profile of the respondents presented in the table 3 that covers the entire gamut of respondents.

Table 1 - Table showing the socio-demographic profile of respondents

Gender	Number of respondents	Percentage
Male	233	65.4
Female	123	34.6
Age	Number of respondents	
25-35 years	156	43.8
35-45 years	108	30.3

45-55 years	55	15.4
Above 55 years	37	10.4
Employment	**Number of respondents**	**Percentage**
Government Employee	64	18
Private Employee	114	32
Own Business	70	19.7
Retired	17	4.8
Labor	20	5.6
Agricultural	32	9
Any other	39	11
Annual Income	**Number of respondents**	**Percentage**
Less than Rs.1 lac	111	31.2
Rs.1 lac-2 lac	90	25.3
Rs. 2 lac-3 lac	65	18.3
Rs.3 lac-4 lac	42	11.8
Above Rs. 4 lac	48	13.5
Education	**Number of respondents**	**Percentage**
Illiterate	13	3.7
Middle	23	6.5
Matric	20	5.6
Higher Secondary	63	17.7
Graduation	90	25.3
Post Graduation	70	19.7
Vocational	68	19.1
Any other	9	2.5
Type of Family	**Number of respondents**	**Percentage**
Joint	197	55.3
Nuclear	159	44.7
Number of Dependents	**Number of respondents**	**Percentage**
Less than 2	135	37.9
Between 2-4	162	45.5
Between 4-6	55	15.4
Above 6	4	1.1
Health Expenses (Per Month)	**Number of respondents**	**Percentage**
Rs.200-500	142	39.9
Rs.500-800	59	16.6
Rs.800-1100	59	16.6
Rs.1100-1400	36	10.1
Above Rs.1400	60	16.9

Source: Primary Data

Table 1 presents socio-demographic profile of respondents. The gender profile from the table shows that 65.4% of total respondents are male and rest are female (34.6%). The age group categorized into four groups (as per the financial literacy declared by) shows that age group from 25-35 have highest proportion in population (43.8%) followed by 35-45 age group (30.3%) and 45-55 age group (15.4%). The employment profile of respondents shows that majority of population have private jobs (32%) followed by own Business and government employees (19.7% and 18%). Respondents having agriculture occupation are only 9% whereas labor and retired are 5.6% and 4.8% respectively in the population. It is also observed that the highest % in a population is below 1 lakh of annual income (31.2%) followed by income level of Rs. 1 lakh- 2 lakh (25.3%), Rs. 2 lakh- Rs. 3 lakh (18.3%), Above Rs. 4 lakh (13.5%) and Rs. 3 lakh – Rs. 4 lakh (11. 8 %). This shows that major proportion that is 56.5% of population is below 1 lakh and in between the income level of Rs. 1-2 lakh. The education level of respondents showing major proportion of graduation and post graduation respondents in a population (45%) followed by higher secondary (17.7%) and vocational (19.1%). Table 4 presents type of families of respondents. Majority of respondents related to joint families (55.3%) and rest are belongs to nuclear families (44.7%). It is revealed from the table that highest proportion of respondents have between 2-4 dependents in a family. 37.9% respondents have less than 2 dependents followed by number of dependents (15.4%) between 4 – 6%. Table shows the Health expenses per month of respondents that is categorized into four categories as per

the annual health expenses of Indians mentioned by WHO in annual report of 2012-13. The major proportion of respondents lie between the health expenses from Rs. 200-Rs. 500 per month (39.9%) followed by health expenses above Rs.1400 (16.9). The percent of respondents that have health expenses between Rs.500-800 and Rs. 800-1100 (per month) is same (16.6%). Only 10.10% of respondents have health expenses between Rs. 1100-1400.

Section 2: Level of awareness on health insurance among the people of Punjab

Objective – 1: To study the level of awareness on health insurance among the people of Punjab.

The awareness levels about health insurance has gained momentum over the few years due to rigorous efforts of IRDA, yet the awareness levels have reached to the extent of demanding the product. Still, health insurance product is considered as 'sell' product rather 'buy' product.

Table 2 - Table showing the awareness status and sources of awareness about health insurance policies.

	Particulars	No of respondents	Percentage
Awareness of heal health insurance	Yes/ Subscribed	52/182	28.57
	Yes/unsubscribed	130/182	71.43
	No	174	48.9
	TOTAL	**356**	**100**
Sources of Awareness	Agents	59	32.4
	Companies	8	4.4
	Hospitals	15	8.2
	Advertisement through Print Media and Electronic Media	34	18.7
	Banks	21	11.5
	Friends	20	11
	Colleagues	8	4.4
	Relatives	15	8.2
	Any other	2	1.1
	TOTAL	**182**	**100**

Source: Primary Data

Table 2 shows the awareness of respondents that shows major proportion in population is aware about health insurance (51.1%) and rest are unaware about it (48.9%). These respondents not even heard about health insurance.

In the era of wireless and broad band communication there is no dearth for the individuals to update themselves with the information. Wider sources of communication are available to the individuals to know the costs and benefits of health insurance. An attempt was made to know the sources of awareness among the people of Punjab to know about the health insurance. For the purpose of study various sources are identified and accordingly the individuals' responses are tabulated. As can see from the Table 2, majority of respondents get aware about health insurance through agents and it is a preferred mode for 32.4% of respondents to know about health insurance. It is also observed that 18.7% of respondents depend on advertisements through print media and electronic media followed by banks (11.5%). An equal number 8.2% of respondents rely on relatives and hospital for reliable information about the health insurance whereas colleagues and companies are the reliable source of information about the health insurance for only 4.4% of respondents. Therefore it can be inferred that agents followed by print and electronic media is the most preferred source of information to get aware about the health insurance schemes and their costs and benefits.

SECTION 3: Influence of socio economic profile and the level of awareness on health insurance among the people of PUNJAB

Objective-2: To study the influence of socio -economic profile and the level of awareness on health insurance among the people of Punjab.

There is a dearth in the study to check the level of awareness and therefore the study used conditions available as per the Consumer Education Website initiated by IRDA. The investors are expected to possess the knowledge on the conditions to be checked while purchasing the health insurance policy. The conditions need to

be checked are tabulated in Table 3. The present study used those conditions to analyze the awareness levels of individuals in Punjab.

Table 3 - Table showing the statements for level of awareness on Interval scale

S. NO	STATEMENTS	AWARENESS IN %	ON SEVEN POINT SCALE
1	Sum Assured	0-14 %	Extremely unaware
2	Bonus	15-29 %	Highly unaware
3	Cost of health check up	30-42 %	Unaware
4	Minimum period of stay in hospitals	43-58 %	Moderate
5	Pre and post hospitalization facility	58-72 %	Aware
6	Cash less facility	73-86 %	Highly aware
7	Portability facility	86-100 %	Extremely aware

Source: Compiled from the data collected from www.irda.gov.in

An attempt was made to know the level of awareness among the people of Punjab assigning the equal weightage to each criterion. The level of awareness among the respondents was calculated and presented in the Table 3. If an individual is aware about any two criteria, then the level of awareness is (2/7)*100, round up to the next highest number. Suppose the individual is aware about all the criteria then his/her level of awareness is calculated as (7/7)*100. It is expected that each respondent should be aware of at least one criterion for the subscription to the health insurance.

Table 4 - Table showing the level of awareness among the respondents

S. NO	LEVEL OF AWARENESS	NO. OF RESPONDENTS	%
1	Extremely unaware	92	50.2
2	Highly unaware	25	13.7
3	Unaware	26	14.3
4	Moderate	23	12.6
5	Aware	7	3.8
6	Highly aware	1	0.5
7	Extremely aware	8	4.4
TOTAL		182	100.0

Source: Compiled from primary data

As can be seen from the Table 4, majority of 50.5% of respondents' level of awareness lie in between 0-14% stating that they are aware at least one criteria among seven criteria followed 30-43% (14.3%), 15-29% (13.7%) and 44-57% (12.6%). This shows that the respondents are aware for only few criteria while buying health policy. It is also observed from the table that nearly 8.7% of respondents, put gather, know about health insurance to the extent of 58-100%, which signifies that the level of awareness among the individuals is still low in spite of the efforts of IRDA from the past few years (Bawa and Ruchita 2011, Kansra and Gaurav 2012). Therefore, it is clearly indicating the need for rigorous steps in addition to the traditional ways and means of spreading insurance to avoid pitfalls in the front of the individuals.

H1: Socio -economic profile of individuals has significant influence on the level of awareness of individuals of Punjab.

The health insurance schemes have received greater attention due to consistent efforts of Government, NGOs, and Community Bodies and other stakeholders such as hospitals, print and online media. Still the socio economic conditions of the individuals and self interest matter when it comes to understand the conceptual issues in health insurance scheme. Therefore, the hypothesis statement whether socio- demographic profile of individuals have significant influence on the level of awareness of people of Punjab. To test the hypothesis, multiple regression analysis is applied for the responses collected through primary survey.

Table 5 - Table showing Model Summary of Multiple Regression

Model	R	R-Square	Adjusted R Square	Std Error of the estimate
1	0.651	0.423	0.083	1.556

Source: Compiled from Primary data

The result from the multiple regression analysis from the Table 5 reveals that the model derives a good prediction level at 0.651 or 65.1%. The R-square value which is a coefficient of determination that determines the proportion of variance in the dependent variable at 0.423 or 42.3% explains the variability of the dependent variable.

Table 6 - Table showing the Model Fitness in Multiple Regression

	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1181.237	7	168.748	92.273	0.000
	Residual	318.208	174	1.829		
	TOTAL	1499.444	181			

Source: Compiled from Primary data

The F- ratio in the ANOVA table from Table 6 measures the overall regression model fit for the data. The table reveals that the independent variables are statistically significant at $F_{(7, 174)} = 92.273$, $p < 0.05$ which shows that the model is good fit for the data.

Table 7 - Table showing Coefficients from Multiple Regression models

Coefficients[a]						
MODEL		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.823	0.961		3.976	0
	Gender	-0.563	0.263	-0.165	-2.14	0.044
	Age	-0.229	0.131	-0.148	-1.748	0.002
	Employment	0.11	0.085	0.01	0.124	0.002
	Annual Income	0.116	0.099	0.1	1.177	0.041
	Education	0.125	0.099	0.104	1.266	0.007
	Type of Family	-0.547	0.252	-0.167	-2.169	0.031
	Number of Dependents	-0.368	0.19	-0.152	-1.932	0.055

Note: a. Dependent Variable: Level of awareness about conditions in percentage

Source: Compiled from Primary Data

The estimated form of the regression equation for the hypothesis is:

Level of awareness = 3.823 + (-0.563) (Gender) + (0.229) (age) + (0.110) (employment) + (0.116) annual income + (0.125) education+ (-0.547) type of family + (-0.368) number of dependents.

The Table 7, presents the unstandardized coefficient for Gender is equal to -0.563, age (-0.229), employment (0.110), Annual income (0.116), education (0.125), type of family (-0.547) and number of dependents (-0.368). The values explains the positive influence of employment, annual income and education on level of awareness while gender, age, type of family and number of dependents explains the negative influence on the level of awareness. As far as to know the significant level of significance of the socio economic profile of respondents influence on the level of awareness, 't' and 'sig' values are considered. From the table, the independent variables are statistically significant at $p < 0.05$.

Therefore the regression results of our study indicate that the family characteristics are insignificant where as the individual specific profiles have significant influence on the level of awareness of health insurance. The results of our study support the findings of Yelliah and Ramakrishna (2012), Bhat and Jain (2006), Makoka *et al.* (2013), Bolhaar *et al.* (2008), Christiansen *et al.* (2002), Mandic *et al.* (2013), Velakkal (2013a, 2013b), Sarwar and Qureshi (2013) and Selvan (2012) where as the contradiction to the findings of Kansra and Pathania (2012).

SECTION 4: Role of agents in bringing awareness and induce to buy health insurance plans in Punjab

Objective-3: To study the role of agents in bringing awareness and induce to buy health insurance plans in Punjab.

Insurance contracts are based on the premise of 'uberrimae fidei' means that contracts are underwritten based on the values, commitment and trust lie between the buyers and the seller that builds the long term relationships among them. Today, the insurance market is penetrated into the markets due to wide expansion of

network of 15 lakh agents across the country. Health insurance market at 35% market penetration is still nascent stage when compared to life insurance market in India. The role of agents in bringing awareness and influencing willingness to pay has relevance due to their impact directly on the buyer-seller relationships. An attempt was made to know the role of agents in buying-selling transaction to influence the subscription towards health insurance on the individuals and the responses are tabulated in table 8.

As can be seen from the table 8, a majority of 53.8% of respondents agreed that the agents convinced them to continue policy and avail the advantages of it while 51.9% of respondents opined their agent cleared all the doubts and misconceptions towards the premium amount for the contract. 44.2% of respondents declared that their agent offered complete information to complete all the required formalities to get insurance contract whereas 57.7% of respondents argued the inefficient role of agents to provide the details to use portability facilities in health insurance contracts. It was also observed from the Table 8, 42.3% of respondents opined their agents provided the necessary information about the network of hospitals and the coverage of diseases that policy covers. An equal number of respondents, 36.5% of respondents agreed that the agents provided necessary information about the penalties and conditions for a policy and the type of policies with their features. It is known fact that health insurance policies are of two type, Cashless facility and Reimbursement facility. It is expected that insured to be aware of pros and cons of each kind of policy and in this regard, the agent has an important role to provide the necessary information. 30.8% of respondents agreed they are aware through the agents about the pros and cons of various kinds of policies. Thus, it can infer from the above analysis that the agents render their services towards offering dear information about the health policies and motivated the insured to subscribe for the health insurance policies.

Table 8 - Table showing the role of agents to bring awareness and induce to buy health policy among the respondents.

S. No	Statements	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	TOTAL
1	Agent made me clear about the formalities required for a policy	1 (1.9%)	4 (7.7%)	8 (15.4%)	23 (44.2%)	16 (30.8%)	**52 (100.0%)**
2	Agent made me clear about the penalties and the conditions of lapsation of policies, if premiums are not paid.	3 (5.8%)	2 (3.8%)	17 (32.7%)	19 (36.5%)	11 (21.2%)	**52 (100.0%)**
3	Agent made me clear about the amount to be paid as a premium	0 (0.0%)	0 (0%)	1 (1.9%)	24 (46.2%)	27 (51.9%)	**52 (100.0%)**
4	Agent explained me about the pros and cons of cashless and reimbursement facility of a policy.	3 (5.8%)	11 (21.2%)	15 (28.8%)	16 (30.8%)	7 (13.5%)	**52 (100.0%)**
5	Agent made me clear about the health policies in comparison with other insurance packages.	1 (1.9%)	6 (11.5%)	19 (36.5%)	14 (26.9%)	12 (23.1%)	**52 (100.0%)**
6	Agent helped me in understanding the advantages of continuation of health policy.	2 (3.8%)	1 (1.9%)	9 (17.3%)	28 (53.8%)	12 (23.1%)	**52 (100.0%)**
7	Agent provided necessary information about types of policies, their features and advantages.	1 (1.9%)	8 (15.4%)	10 (19.2%)	19 (36.5%)	14 (26.9%)	**52 (100.0%)**
8	Agent made me clear about the formalities of portability of insurance package	30 (57.7%)	5 (9.6%)	10 (19.2%)	2 (3.8%)	5 (9.6%)	**52 (100.0%)**
9	Agent provided me the necessary information about the network of hospitals and diseases the particular health policy covers	2 (3.8%)	7 (13.5%)	11 (21.2%)	22 (42.3%)	10 (19.2%)	**52 (100.0%)**

Source: Compiled from Primary Data

H2: There is no significant influence of role of agent on getting aware and induced to buy health policies on the number of health policies subscribed.

In order to test the hypothesis the respondents have been classified into two categories a) the respondents with less than 3 policies b) the respondents with 3 and more than 3 policies.

These two categories are considered as independent variables while all the factors which are taken as dependent variables. Independent variables sample t-test was performed to compare the mean value of the two groups of respondents.

Table shows that the majority of respondents have less than 3 health insurance policies. It is revealed in both the cases, number of policies held by the respondents and the difference in the means of two groups is significant. It is observed from the Table, the respondents who held more than 3 policies, are significantly influenced by the agent in subscribing for the health policy.

As can be seen from the Table 9, t -test of the equality of means reveals that there is no significant difference between the two categories of respondents for the statements. The Levene's test for the equality of variance is also applied. The F-statistics value had a respective significance of more than 0.05 for the statements. This would mean for the statements stated above, the null hypothesis was failed and get rejected. This reveals that the agent has a significant influence on bringing awareness and inducing the individuals to subscribe for the health policy. However, the results of our study is in consistent with the findings of Mandic *et al.* (2013), Velakkal (2013a, 2013b) and Sarwar & Qureshi (2013) which provide significant scope for further research about the role of agents in bringing awareness about health insurance.

Table 9 - Independent Samples Test for factors influencing policy holders to opt for LIC for purchasing insurance policy

S. No	Statements	Number of Policies held	N	Levene's Test for Equality of Variances		t-test for Equality of Means	Sig. (2-tailed)
				F	Sig.	t	
1	Agent provided necessary information about types of policies, their features and advantages.	>= 3.00	14	1.958	.168	-1.743	.088
		< 3.00	38			-1.555	.136
2	Agent made me clear about the formalities required for a policy.	>= 3.00	14	.033	.858	-.061	.952
		< 3.00	38			-.064	.950
3	Agent clears me about the amount to be paid as a premium.	>= 3.00	14	.364	.549	0.000	1.000
		< 3.00	38			0.000	1.000
4	Agent provided me the necessary information about the network of hospitals and diseases the particular health policy covers.	>= 3.00	14	1.220	.275	-.681	.499
		< 3.00	38			-.780	.441
5	Agent made me clear about the health policies in comparison with other insurance packages.	>= 3.00	14	.442	.509	.363	.718
		< 3.00	38			.377	.709
6	Agent made me clear about the formalities of portability of insurance package.	>= 3.00	14	.395	.532	.522	.604
		< 3.00	38			.554	.584
7	Agent helped me in understanding the advantages of continuation of health policy.	>= 3.00	14	.266	.609	.117	.907
		< 3.00	38			.134	.894
8	Agent made me clear about the penalties and the conditions of lapsation of policies, if premiums are not paid.	>= 3.00	14	1.735	.194	-.261	.795
		< 3.00	38			-.315	.755
9	Agent explained me about the pros and cons of cashless and reimbursement facility of a policy.	>= 3.00	14	.040	.843	-.416	.679
		< 3.00	38			-.407	.688

Source: Compiled from Primary Data

7. Suggestions

The present study found lot of drawbacks in health insurance sector which should be improved as per the requirements in a market. The first and foremost suggestion for all the bodies relate to this sector is to bring awareness. Lack of awareness and lack of knowledge about this sector is the major reason for low subscription towards health insurance in a country.

Suggestions to insurers:

- It is suggested for the companies to make clear cut policies providing information related to all aspects because most of the disputes born due to the hidden information provided by the companies.
- The private insurance companies are advised to reduce their premium prices so that it is easily affordable by all the segments.
- The companies are also suggested to make policies that target to middle and poor class segments.
- Companies are advised to reduce the formalities regarding the claim settlements and make easy the process of settlements.

Suggestions to IRDA:

- Insurance frauds are likely to register more in health insurance schemes. This phenomenon affect on the credibility of the sector, which could make the existing shareholders may either with draw or discontinue in future renewals. Therefore, it is suggested for a database management system to retrieve the data base of each transaction in such a manner to minimize any frauds.
- In spite of consistent efforts taken by Central, State Governments and IRDA, still there is a dearth in the awareness level among the individuals. It is proposed to have a broad linkage through appropriate database management system to streamline the process of transactions done by the individuals among the stake holders.

Suggestions to Government:

- Government of India could initiate a proactive role of SHGs and NGOs to wide spread the concept of health insurance as these two bodies have significant contribution towards the financial inclusion.
- The habit of savings among the individuals cannot be built in a day. This practice need to cultivate from their childhood. It is better suggested to make "Concept of Insurance" and "Health Insurance" as a part of curriculum at least from 10th Standard.

8. Scope for further research

The findings of the present study are presenting the scope for further research which is presented below:
- The present study provides future insights for the researchers to commence longitudinal study among the respondents.
- Further, the researchers can explicitly conduct a study on the willingness to pay for specific health insurance schemes such as Private health insurance schemes, Government sponsored schemes, community based schemes, micro health insurance schemes.
- Further research could also be extended considering the role of third party administrators and hospital service providers which would be worth ful to find the gap between the stake holders.
- Another aspect worthy of the investigation for the researchers is to examine the factors that influence the people to restrict them to buy the health insurance policies.
- Moreover, the future studies focus on the role of self-help groups and NGOs in instigating the people to buy the health insurance plans.

9. Limitations of study

- Due to time constraint, only three areas of Punjab are covered. For more heterogeneity in data, the sample size and sample areas should be more that will brings more actual picture of a State for the Demand of health insurance in Punjab.
- The study is not focused on specific schemes in health insurance such as Private health insurance schemes, Government Sponsored schemes and community based health insurance schemes. The study attempted only to present the demand status of health insurance in Punjab as a whole but not specific. This limitation drive home for further scope of research.
- Every effort is made to minimize unbiased responses from the respondents. Still, there can be chances of biased responses to some extent.
- Where ever the secondary data is used, it is rounded to next highest value for analysis. Exact figures may not be presented.

Conclusion

Health insurance market is burgeoning year – on – year due to changes in life styles, improvement in purchasing power of the people, wide spread awareness, and propagation of insurance companies and IRDA. In reality, the picture is different when it comes to semi-urban and rural areas, especially, in middle and low income class segment the level of awareness is quite low in comparison to other Asian nations. The study is conducted to know the relation between the socio – demographic profile of the people and willingness to pay for the health insurance plans.

Finally, it is observed that the financial constraints are the most important reason to get restrained to buy the health insurance plans. Though Central and several State Governments have floated various schemes to support the middle and low class segment, it is not only the agents, Third party administrators, insurance companies and Government, it is the individuals to maintain the financial discipline and instigate to buy the health insurance plans. In this regard, the role of agents is vital in removing the misconceptions and disbeliefs towards the health policies.

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Labor Theory of Value in the Methodology of Researching Economic Systems

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Abstract:

The present article researches theoretic and methodological regularities of the labor relations genesis in the process of evolution of social and economic systems. The approach developed by the authors allows allotting basic blocks of the labor relations system taking into account operating subjects and objects of the relations. Taken as the basis, such approach allows describing labor relations of any economic system. The allotment of mandatory elements (objects) and subjects in the structure of labor relations allows revealing the content of the "labor relations" category.

Keywords: labor relations, theory of value, economic systems.

JEL Classification: D46, P00, F66.

1. Introduction

The urgency of theoretic researches of the economy characteristics on the substantial level, the increase in the interest to methodology and theory of economic cognition are stipulated by the controversy and alternativeness of the contemporary stage of the development of the world economy and universal society as a whole. For the Russian society such researches are determined by the exclusive complexity of transformational processes and perspectives of their evolution.

The problem of the initial relation is directly related to the method of ascendancy from the abstract to the specific. It absorbs genetic differences of structural levels of economic relations and transformations that reflect them, as well as historical perspectives in the process of economic systems development. The above method is the most strongly marked form of the systematic, logical method in the economic research. Its application allows establishing the interrelation between the categories, to reproduce the world of economy as a product of self-development, to understand it from the historical point of view, and to synthesize notions into a strict subordinated system.

2. Methodology

When acknowledging the priority of the abstract analysis, it is necessary to understand as the economic theory approaches the business practice, its object must include not only general regularities of the development but also specific mechanism of economic entities functioning. Thus, the method of ascendancy from the abstract to the specific allows explaining, from the essence, the form of its appearance that includes the whole richness of the most developed state of this entity (Solomon, Cohen 2014).

Our approach to regularities of the development of the structure of social and economic systems is based on the notion of labor as a kind of human activity that is peculiar to a specific historic period of the economic system development. Social labor acts as the basis of all types of rational activity. Labor makes up the content of the initial category as a gnoseological form of fixing cause-to-effect dependence that dominates over all the rest and defines the quality of economy, its substantial characteristics. Taking into account the complexity and disputable character of the problem, as well as the fact that the economic theory has not formed a unified concept

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of the initial economic relation and initial economic category, we will state some methodological provisions that, as we think, can explain our position (Sycheva 2003), as follow:

- The initial category is an ultimate scientific abstraction, where there is still the measure of the phenomenon, and whereof other relations are generated and developed. At the same time the initial relation is an abstraction that stands for a real object.

- The initial relation forms a condition and form of functioning and developing of the system of economic relations. The basic relation defines the goal and social focus of functioning and developing. The initial and basic relations connect all other relations in a single system. The initial relation has a bearer: the first one acts as a sort of content, and the other acts as a form. We use the above terms as synonyms.

- Regarding labor as an initial category, we take into account the defining role of the production in relation to the allocation, exchange and consumption. As labor relations are formed due to the production of material benefits, they have an embodied form, i.e. they have material and embodied content and present the unity of the material and the ideal. Material benefits created by its internal substance always contain labor, and finally the initial relation is always a labor relation.

- Labor contains a nucleus of contradictions of the given social and economic system. It shows a basic genetic relation as the latter one, creates a link between various economic systems, and acts as prerequisite of forming the basic economic relation. Under this approach the basic relation is deduced from the initial one and bears its features. However, it is not identical to the initial relation. The implementation of the initial relation aims to fulfil the basic economic relation. The outgrowth of initial relation to the basic one must be regarded as a principle vector of the self-movement of social and economic systems.

3. Results

The similarity but not the identity of the social and economic form of the initial and basic relations lies in the fact that they characterize the labor process in the same social conditions of the production. Herewith, the basic relation shows deeper essence of the labor process. We regard the initial relation as the one that arises between people in the realization of their capacity for labor. Labor as the capacity for the activity, an abstract level of considering the labor through defining the character and the mechanism of combining the production factors in the labor system shows the content of the initial category. Any labor process assumes a specific way and character of connecting the employee with the production means. The form in which the employee is included in the process of social production makes up the content of the initial relation. The means of connecting the employee with the production means is a mandatory, initial and the most significant moment of forming and functioning the economic system. Thus, the most abstract definition of the initial relation as the one between people in relation to the implementation of their capacity for labor is specifically expressed in the way of connecting the employee with the production means.

The initial relation does not exist in and of itself. On the one hand, it is implemented via the whole system of productive relations, and on the other hand, via labor relations. Productive and labor relations are various levels of abstraction: productive relations act as concretization of labor relations.

In the basic relation, who arises in relation to the labor activity as a fact due to the necessity of maximum satisfaction of the society needs, the character and way of uniting the production factors are implemented in the operation of economic subjects.

Basic tendencies of the movement of the labor system as an internal source of the self-development of the social and economic system are revealed in the formational concept of the development. The method of uniting producers with production means was taken as a social and economic (content) criterion of delimiting the formations (or ways of production). The form of owning production means serves the universal economic basis, the indicator of character, and the way of uniting the production factors. Theoretic separation of social and economic, and production and economic sides of the way of uniting production factors is an important methodological prerequisite for the research of the way of uniting the production factors.

The combination of personal and embodied factors of the production in the process of production itself, their joint production application without social and economic relations that define the character and way of this combination covers only the production and economic side of the way of combining factors. It is mandatory in any economic system, and is fulfilled everywhere. Social and economic combination of embodied and personal factors of the production is also mandatory and takes place in all ways of production. However, it differs according to its social form. The essential part of this way is represented by the relations that are established in the process of separation and combination of personal and embodied factors of the production within the economic system.

Following the formational concept of development, we will note that today's popular concepts of civilizational development of the humankind (in accordance with them, economic systems are developed under the influence of not only economic (internal) but also non-economic (external factors in relation to the economy) factors of the post-industrial, informational society, etc. allow to reveal the availability of general prerequisites and regularities of establishing the system of labor, increase in its productivity and efficiency. Based on the above, we consider them to be mutually reinforcing, and do not oppose them each against the other. Thus, the initial relation that arises between employees in virtue of the realization of their capacity for labor defines the quality of the economic system and its substantial characteristics. It is a gnoseological form of fixing the effect-and-cause dependence in economy, and it dominates over all other relations.

How is the initial relation implemented on the "subjective" level? How does it turn into a theoretically consequential system and act on the economy surface? We will follow the logics of implementing the initial relation in the structure of social and economic systems according to the chain: social and economic system – structure of the system – system of productive relations - labor relations - elements (objects) of labor relations.

The possibility of cognizing the object as a system is fulfilled through researching its structure and functions; herewith they are not taken apart but through mutual influence, and stipulation, i.e. in the unity. The object content cannot be revealed beyond its functioning. The latter is a source and basis of the system development as it is the stage of functioning when prerequisites arise for the system transfer to a higher level of its development. Herewith, the structure is an expression of the essence mediated by the functions, a sort of organizational, reverse function of the system. The function is an ability of the system to meet a specific need. Thus, structural and functional methods of the research mutually supplement each other, and they provide the most complete knowledge of the object essence only in their combination and unity (Burmeister 1980).

The plurality of criteria of classifying economic systems is based on the objective variety of its features. As for the detailed view, here criteria of economic systems can be classified into three groups: structure forming (criteria on the part of structural elements that form the subject of the economical theory), 2) social and economic (criteria based on defining the principal parts of keeping the economic system; they may include the way of connecting employees with the production means, the way of connecting the production and consumption (way of coordinating economic activity), level of the development of industrial and economic beginnings, etc.), 3) volume and dynamic criteria (they characterize the complexity of the economic system, and its mobility: statics or dynamics of the system, homogeneity or diversity, etc.).

Usually researchers regard the following structure forming criteria of classifying social and economic systems we are interested in: 1) system of productive relations, 2) system of functional relations, and 3) institutional systems (Johnson 2010, Toms 2006). We will note that in the reality all the above criteria interweave and superimpose on one another. That's why the integral image of economy as a self-developing system can be received only by considering the whole combination of criteria and classifications.

4. Discussion

While analyzing economic systems on any level, social and economic approach is required, i.e. the research of productive relations and separation of structure forming factor of the economic system which we regard as labor relations. The basis of the integrity of social and economic systems is labor. Productive relations are always labor relations whose specificity within the system is defined by the ownership relations, way of uniting factors of production (Oswald 1993).

In this regard today it is possible and necessary to talk about a specific succession of the development of all social and economic systems in spite of the whole controversy of separate ones. There is "common" and "specific" in the development of all systems. What has a priority? It is generally known that the specific is always a form of revealing the general. Nowadays the world integration process, high level of internationalization of production and exchange causes general tendencies of the economy development. Herewith, it derogates the role of the specific in forming the type of the social and economic system (Mallick 2010). That's why, in our opinion, nowadays we cannot regard "the specific" as "the structure forming". While defining the perspectives of any economic system development, the freedom of choice is restricted by the social and economic potential that has been achieved, and predetermines, first of all, the system of relevant ownership and labor relations. The succession in the development of economic systems is just created by this successive movement of productive forces. Psychological motivation of the economic behavior is an integral attribute of any system of rational economic management. The economic principle i.e. the principle of achieving the maximum results with the minimum expenses always requires the correlation of economic benefits between one another and with the

required labor inputs. Such understanding of the production efficiency assumes that the personality is in the center of the economic system. At the same time, todays' economic thinking pays more and more attention to the highest values and motives (Pigou, Marshall *et al.*). This contradiction contains the contradiction of all laws of rational conduction of economic activity realized through monetary correlation of expenses and the obtained result. In general, the contradiction between direct goal of the production and final goal of the social production is a deep contradiction of any economic system that defines the source of its self-development and boundaries of functioning (Conover, Shizgal 2005).

It appears that contemporary economic systems are characterized by a fundamentally new phenomenon – conscious formation of the goal within the whole society and its implementation. Conscious forms of the purposeful activity within the social and economic system fasten the development of those areas of social life where the progress falls behind the rapid development of engineering and technology (Addison *et al.* 2014). The objective goal is a sort of invariant in this capacity in relation to any economic systems, and, for example, such important moments as specific means and methods of its achievement, availability of specific controversy of some specific goals, various images of the principles of social justness, etc. Along with this, this succession requires a deeper qualitative elaboration of the issues related to agreeing and comparing the goals of various social and economic subsystems, social and economic interests of social groups. It would contribute to the enrichment and concretization of our contemporary ideas of the level of social freedom and economic welfare as a criterion of the society development (Schöb, Wildasin 1997).

Secondly, one formation is transferred to another on the dialectical basis through the contradictive unity of negation and succession, since the change of features of social relations is a historical process that, as a matter of principle, is irreversible as a qualitative characteristic of the economic system state.

Thirdly, every formation undergoes three basic stages in its development: becoming, maturation and expiration stage. These stages are real, since they are based on a specific change of the quality of productive forces within one formation that predetermines the state of all social relations, and above all, productive.

Fourthly, the transfer from one formation to another is a combination of evolutionary and revolutionary ways of development without absolutizing either of them.

Fifthly, every new formation has various fundamental advantages over the preceding one. Its historical progress is defined by the ability to solve those problems of the humankind that the preceding formation could not solve in principle (Cherkovets 2006).

We think that both formational and civilizational concepts of economic systems development (whose advantage includes the multidimensionality and its irreducibility to narrowly economic dimensions) allow revealing the existence of common prerequisites of becoming and functioning of structure forming elements of the system. We regard labor relations as the latter ones, and the structure of economic systems is researched in the aspect of labor relations development (Horva 1989). We regard the differentiation and genesis of economic systems and their structural elements through the development of labor relations. It allows singling out common regularities of social development and is the basis of self-preservation and self-development of any economic system. Systems are developed through the transformation (qualitative conversion unlike quantitative changes that mean the growth) of its structural elements by means of exogenous and endopathic factors and functions of the system, to which we in particular refer the development of labor relations. Having separated the latter ones as a structure forming factor of economic systems, we continue with defining the content of labor relations and regarding their elements – subjects and objects. Every element of the labor relations system must be described according to the unified principle for the general picture of labor relations both in Russia and any other economic system to be made of "mosaics" at any moment. (Trunin 2007)

The relations that can be regarded as a system of labor relations arise in every labor process as well as between various labor processes. Two basic initial ranks of labor relations can be found on the highest level of the abstraction: "person – nature", and "person – person". If we regard these "global" relations from the perspective of a more partial classification, they can represent relations between owners and employers in relation to terms and conditions and prerequisites of labor; relations that are formed in the process of labor; relations with respect to results allocation (Sy, Tinker 2010).

It is necessary to acknowledge that on the levels of common and partial classification, labor relations are subordinated in a certain way. It means that the relation "person – nature" is an interrelation of two elements of the production process. Based on the subordination of two parties of the production method – productive forces and productive relations in the formational concept of development – the relation "person – nature" is initial, while "person – person" relation is secondary, and its derivative. The issue related to priority and replication on the level of partial classification is solved in the same manner. In this case the relation in respect to the terms

and conditions and prerequisites of labor will be initialed, and relations that are formed in the process of labor and appear in respect to the labor results will be secondary.

The above points define such a principle factor as correlation of functioning and genesis of economic systems and laws of their organization, functioning and development. Similar approach assumes the consideration of laws of functioning and development as identical, and unified (Foley 2000). Only in this case of acknowledging the unity of functioning and development laws as unified, historical and logical research will allow to realize the logics about economic systems that successively change each other for the research of labor relations in the market economy. At the first stage we will abstract common elements of labor relations from their developed state and analyze them as separate, quire individual, but simple features of the subject under research. In the dynamic aspect the system of productive relations is represented as a unity of labor and ownership relations. Herewith, this unity is inseparable. In the reality these relations do not exist apart from each other. Labor relations are direct forms of productive forces development, and changed under their direct influence. Changes in productive forces fixed by labor relations witness about the availability of the process related to the stipulation of productive relations by productive forces. They allow feeling the impact of changes in the productive forces of the ownership relation. That's why labor relations stipulate, assume, and determine various qualitative conditions of the system of ownership relations, and are the basis of changes of these relations both within the given social and economic system and while transferring from one economic system to another. If compared to ownership relations, labor relations are deeper (Straoanu, Pantazi 2011). The coherence of labor and ownership relations can be characterized as the interrelation, since their mutual impact on each other causes mutual changes. As a result of this interrelation, the ownership relations act both as initial, and defining (since their state fixes the specificity of the labor relations system), and as secondary, and defined (the change of the states of the ownership relations system is defined by labor relations).

On the other hand, understanding labor relations as a way of including employees in the labor and production and economic activity, labor relations can be also defined using a number of more specific characteristics that must reveal the peculiarities of employees' functioning in various social and economic systems.

Generally speaking, basic elements of labor relations in the pre-industrial economic system hardly differ from the use of slave, bonded or wage labor. That's why in our opinion it is necessary to regard the following elements of labor relations as common for all economic systems:

- a way of uniting the employee with the production means,
- incentives and labor motives,
- labor allocation and cooperation,
- forms of allocating the labor results (social product) (Sycheva 2000).

It is necessary to regard the level of adequacy of social production in relation to the complexity of the employee's personal development as a criterion of economic systems maturity. It is based on labor relations. We define labor relations as a structure forming factor and basics of integrity of social and economic systems. The interrelation between the development of labor relations system and type of economic systems is revealed in the fact that the content and social form of labor genetically and functionally defined the type of the social and economic system (Heinrich Bortis 1996). Labor relations can act as an accelerator (transfer to technologically and socially and economically more progressive stages of economic systems) or as a stabilizer, or a preserver that restrains incremental development of social and economic systems and its structural elements. The meaning of labor relations as the basis of the social organization of any production lies in the fact that they lead to the basics of social and economic structure of the society (Gunther, Schmid 1993).

The research methodology that has been developed allows singling out the blocks that form the system of labor relations taking into account objects and subjects of the latter. Such approach allows describing the system of labor relations of any economic system.

Conclusion

In conclusion we will say that the national literature of the recent period has offered and offers various combinations, versions, theories about "diffusion" and "synthesis" of scientific political economy with "neoclassical synthesis", marginalism, Keynesian theory, institutionalism, Neoricardianism and neoclassics. At the same time no classical school has offered its unified "synthetic" variant in the area of neither subject nor the research method. Moreover, according to some researchers, the reality of historical development of the world economic thought includes the existence of maximum two economic schools – Marxian and neoclassical (Liubinin 2012).

The life shows that today is the time of dialectic and labor classics, because the most reliable source of the development of any social and economic system is an increase in the labor efficiency on the basis of neo-industrialization and vertical integration of productive forces of the society. The labor paradigm was formed by virtue of analysis and synthesis. It determines the labor as the fundamental basis of all productive relations and value forms. More than that, it is the classical political economy that is a connector between "the capitalistic today" to the post-capitalistic future. By operation of law of the socialization of productive forces, becoming and expanding of direct social relations is a general tendency of the contemporaneity. We will recollect that K. Marx introduced the dichotomy of directly social and indirectly social. Herewith, he showed the antecedence of the directly social under the conditions of the capitalistic way of production. Under capitalism, because of the supremacy of the private and capitalistic ownership, the social is objectively mediated by the particular. This is what the classical political economy teaches us. In virtue of the above, sooner or later the private, and capitalistic, and price way of assumption must make way for the social and non-price. Consequently, the renaissance of classics and labor paradigm is in the future.

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Market Concentration and Investment Efficiency among Publicly Quoted Petroleum Marketing Companies in Nigeria

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Abstract

Market concentration becomes important when the firm attempts to show market leadership that might be injurious to consumer welfare in addition to the strong investment in the firm as the responsibility of shareholders since they have the residual claim on the firm. The study investigated the relationship between market leadership and investment efficiency of the firms in the Nigerian petroleum marketing sub-sector. Given the length of data available on the publicly quoted petroleum marketing companies, the study adopted shareholders fund, fixed assets and turnover as the concentration parameters and return on investment as efficiency parameter. Univariate and multivariate regressions were used as techniques. Results show that concentration parameters all tend to converge over a number of years. Turnover is the most representative with both the HHI and CR measures. Furthermore, the results also show that big does not always mean better as the firms with the highest market shares have poor investment efficiency.

Also, results further show that the Nigerian market is slightly highly concentrated and this seems to be increasing over the years. Recommendation suggested concerns empowerment of the entrepreneurial and small private petroleum marketing firms to break through the barrier of capital intensity of the market as they are observed to be more active in the market when there is products scarcity than when products flow is normal.

Keywords: market concentration, petroleum marketing firms, Hershman-Hirfindhal index, return on investment.

JEL classification: M21, M31, M38.

1. Introduction

The public sector divestment process released some firms and companies to the private sector for management and profitability. This affected the petroleum sector, especially the downstream sector where the marketing companies in which the government had shares, for the purposes of exercising control over the market and the sheer inability of Nigerians to put resources together to own one before now, were divested. Since the government has divested fully, many scenarios are being witnessed in the corporate structure and control in the industry and the direction of market leadership. The recent exercise of the Central Bank of Nigeria in the banking sector which encouraged mergers and acquisitions (a practice completely alien to the Nigerian business environment) has brought about new dimensions in corporate ownership and market structure in the downstream petroleum sector in Nigeria.The implications of the present circumstance is that the ascension of powerful firms strong enough to dictate price in the petroleum industry should give cause for concern as the products being sold is of economic and social importance. It is necessary to know the level of market concentration in specific industries to enable the government know how powerful the firms in such industries are and to know if antitrust laws are desirable. For firms in the petroleum marketing industry in Nigeria the need to know this is important as it brings to light the influence a firm can exert on the energy market, especially in the market for other products apart from premium motor spirit (pms). The study of market concentration also becomes important when the effect of particular firms decisions' can lead to dire social and economic consequences where horizontal mergers and consummated.

The basic objective of this study is tofind the determinantsof, and the levels of market concentration and investment efficiency of the publicly listed petroleum marketing firms in Nigeria. The paper is organized as follows: section two follows immediately after this, and it deals with conceptual issues and the review of available literature. Methodology and measurement of concentration parameters and investment efficiency are dealt with in section three and results are discussed in section four. Section five makes recommendations and concludes the paper.

2. Conceptual issues and literature review

Market power or control is the extentions to which the firm is in control of the industry and is able to, as a result, influence or dictate the direction of price and general growth of such industry. The line between the industry and the firm is clearly defined as the firm is about allocation of resources by fiat but price commands the allocation of resources in the industry (Adegbite 2006). The choice of the firm may often bebased on some corporate goal or business plan as envisioned by management or owners rather than by price or cost considerations. The industry is defined along production or producer lines while the market is defined alongside productlines and is usually measured by the closeness of substitutes of its product (Jinghan 2003). Market concentration refers to the degree in which a particular firm is in control of the market, and consequently the industry. Thus total production attributes rather than inputsconsumption is the important criterion in classifying the industry. The firm's concern in the process of allocating resources is to maximize whatever is available for the benefit of the firm's shareholders' wealth, which is the regarded as the most superior of the firm's objectives. In the industry where cross-border merger and acquisition is occuringthedomestic subsidiaries may be left with no choice in spite of the national government aversion tosome kind of merger arrangements by the Head Offices of Multinationals. However, antitrust agreements and clauses in national laws can address such issues as horizontal mergers that tend to aggravate or increase the market power of any firm.

Typically, any study that claims to test the relationship between price and the level of market concentration is also testing whether the market definition (according to which market concentration is being measured) is *relevant*: that is, whether the boundaries of each market is not being determined either too narrowly or too broadly so as to make the defined "market" meaningful from the point of the competitive interactions of the firms that it includes (or is made of). One of the basic reasons for the measurement of market concentration is that it is useful as an economic tool as it reflects the degree of competition in the market.

Tirole (1988) notes that: Bain's (1956) original concern with market concentration was based on an intuitive relationship between high concentration and collusion in an industry where few firms exist. Oligopolies are necessarily made strong by barriers (Stigler 1968) to entry, of which capital intensity of the industry is one. The study of the market structure of oligopolies enables the understanding of how firms behave and react to the stimuli introduced by anyone them in the form of changes in price or quantities produced inducing the performance of one another. The earliest model (Cournot's), of influencing the market control is the use of quantity produced in order to corner the market and crowd out the products of other firms while Bertrand's is on the use of price to influence market conditions favourably towards oneself. However, Cournot's model is more relevant here given the structure of the market and the inability of a marketer to administer a price.

Under a Bertrand structure, the firms in the market maximize their profit by choosing a price level, assuming all other firms hold their price constant, and then sell the quantity demanded at this price. In a Bertrand model, with a homogeneous product (i.e. $\tilde{a} = 1$) only the firm with the lowest cost will produce or sell. This has led many national governments to watch closely the activities of foreign oligopolists operating within its economy.Thus one hardly ever finds foreign firms in an essential sector such as energy. A firm is independent or market dominant, if it can act independently of competing firms, customers and suppliers (Häckner 2001). Therefore, encouraging more firms to participate in the industry was viewed as a way of expanding the market, achieving intra-industry economies of scale and reducing concentration (Harris and Cox 1983), which can be achieved through deregulation of such industrial sectors. The Structure-Conduct-Performance paradigm, according to Aleksandranova and Lubys (2002) is now seen as a case of intra-industry competition and that concentration in itself does not impact the profitability of the individual firms. It is also believed in certain quarters that increased market size no longer guarantees less concentrated markets (Sutton 1991).

The firms deal in homogenous products which indicate that there is perfect product substitutability betweenfirms, though the firms are multi–product rather than multi-market. Weisman (2003) shows that mergers that increase both market concentration and multi-market participation can yield non-increasing prices when demands are complementary. A key finding is that mergers that increase both market concentration and multi-market participation can yield lower prices, higher profits and hence increase economic welfare despite the absence of merger economies. In other words, consumers can benefit from the integration of two complementary firms despite the reduction in competition *per se*. In contemplating a price increase, a firm will generally have to contend with possible loss that may be reversed during a scarcity, which though may be infrequent. Mergers can increase concentration in the petroleum marketing sector (GAO 2003) as in the American market and therefore it is important to calculate and evaluate the results on regular basis to monitor the trends.

When considering a price increase in a differentiated products market (a market governed by Bertrand pricing), the proportion of marginal customers is crucial. A large proportion of loyal customers are not enough to allow a safe price increase if the proportion of marginal customers is even slightly larger. Those who would cease to purchase the firm's products in response to a small increase in relative prices are the firm marginal customers whose numbers become important during a scarcity. The parameters involved in measuring the level of domination of a company in any market has always been the firm's installed capacity (GAO Reports, 96) which is seen as being more reliable because of the firms' ability to contract and expand production at will, depending on the market mood. This addresses the productive assets base of the firms.

2.1. Efficiency of investment

Various forms of efficiency exist in disparate literature. Popular ones are technical, productive, allocative, dynamic, social and of recent in finance, investment. Each of these considers the maximum benefits available for lower or equal quantities of inputs. Social efficiency looks at the welfare of the population generally to weigh the cost of an action againstits benefits. Dynamic efficiency is mostly viewed in the long-term as it makes more outputs available at higher quality for the benefit of the consumer. In consideration of the efficiency of investment for the firm, this study adopts the measurement that most magnifies returns toits investors: the shareholders. While this is very important, it also necessary to establish the issue of over- or under-investment in firms with the appreciation of the fact that inefficiency of investment by firms underscores management incompetence and losses on the part investors and shareholders. This is the view of this paper.

The size of the firm is often a major parameter to measure efficiency (Soderbom and Teal 2003). Reference is often made to the influence of foreign ownership of the firm (i.e. as Multinational Corporations) as being a key determinant in the efficiency ratio of firms. Age is also important while labour cost is seen as a major cause of inefficiency in large firms. The study postulates that capital intensity is inversely related to that of labour though substitutable, but not at the same rate. The study concludes that the elimination of the problem of labour will hugely increase the efficiency of the firm. The linkage between investment and capital is the pass-through of its usage. The study by Biddle *et al*. (2009) brings capital investment efficiency of the firm to the fore by establishing a negative relationship between the quality of financial reporting and firms' investment, and documents that investment rates of firms deviate less with the quality of financial reports. The value ascribed to investment efficiency has often been a subject of controversy as the main measures are subject to manipulation. So important is the issue that the IFRS are used to ascertain the level of disclosure required in reporting the rates of investment (Li and Wang 2010). The paper finds that the composite constructed to specify quality of disclosure indicates that there are significant over- and under-investment among the listed firms sampled on the stock market. Mcdermott (2011) also documents that higher quality reporting improves CSR investment efficiency by mitigating moral hazards, resulting in investment in CSR that benefits shareholders by improving future financial performance. Mohammadi (2014) reports a strong significant level of correlation between the financial reporting quality and investment efficiency, and a direct linkage between firm size and growth opportunities in about 90 listed firms on the Tehran Stock Exchange. Given the that the introduction of IFRS is of recent origin, then transparency quality enables the investors to make good investment decisions and allocate capital more efficiently since there are more factors determining investment in the financial system than deal with information quality.Unfortunately most studies in investment efficiencyneither relate to the level of market concentration nor highly capitalised sectors like the petroleum.

2.2. Theoretical framework and parameters

The structure of the market in the petroleum downstream sector is two-tier as deciphered through supply channels. Competition rules the marketing level because the firms are all price takers from the Pipelines Products Marketing Company (PPMC,) a subsidiary of Nigerian National Petroleum Corporation (NNPC) which sells products at prices recommended by the Petroleum Products Price Regulatory Agency (PPPRA).With this it effectively insulate prices from undue fluctuation while subsidy is provided to cushion high prices of imported refined products. The efficiency of the distribution system itself calls to question the involvement of some bodies in the downstream sector: especially the PPMC whose distribution processes is the greatest challenge in the market (CBN, 2000).The PPMC has abandonment of the pipelines (which has been variously and continuously vandalised in recent times) to a large extent and its continuance reliance on trucks and tankers whose drivers are strike-prone (Arosanyin 2005).

Crude petroleum is normally refined into three different categories namely fuels such as petrol, premium motor spirit or gasoline and others like AGO. Finished non fuel lubricants such as grease make the second and

feedstock such as naphtha for petrochemicals. In all, the importance of PMS is seen from the analysis above. The other products have different prices according to different grades which have alternatives and substitutes in the different marketing companies. Since blending (further distillation) is possible to change one product to the other, the policy of discriminatory pricing is adopted to direct the taste of the market and consumer (Borestein 1993). Most marketing companies sell or dispense petrol either on wholesale or retail basis. It is one product that influences the prices of other factor and non-factor goods and services (Odoko *et al.* 2005) in any economy. This has made the sector to command attention from the Federal Government and for it to be careful on any issue that has to do with pricing of petroleum products. It then follows, that most of, if not all, the petroleum marketing companies are involved in the sale of petrol.

The market is defined as the network that integrates the firms through the price signal (Adegbite 2006). In the petroleum marketing sector, products are perfectly substitutable such that it is immaterial which particular firm supplied one product or the other. Okurounmu (2004) in a chart contends that the downstream sector of the petroleum industry is a monopolistic arrangement, as a result of the heavy involvement of the NNPC through the PPMC. The eight basic as determined by Jhingan (2003) fully feature in the downstream sector. However, the case of the marketers is not different as they all buy directly or otherwise from the PPMC. With the economics of petrol pricing, the agency says it subsidizedproduct consumption with ₦540 billion ($4.538 billion at ₦119/$1) between 2006 and 2007 (DPR, 2008) which rose through the roof via financial corruptive tendencies to ₦2,340 billion ($15.97 billion at ₦198/$1) as at 2013 year end. Few studies on market structure have been carried out either as a result of the fact that state monopolies are in place or the market is simply fuzzy, lacking in character. The World Bank (2010) omitted all the major petroleum producing and exporting countries including Nigeria, indicates that the lowest concentration level is diluted and highly concentrated in others. For instance Mali is *HHI* 915 *CR₄* 46 and 53 firms for *HHI CR₄* and number of firms respectively representing a highly diluted market while Niger records 2959, 83 and 18. A properly concentrated market is represented in the structure of Uganda with *HHI* of 1831 and Burkina Faso and Kenya both with 1931 and 1963 respectively. South Africa that consumed the highest quantities of products at 26 million metric tons of fuel is some how diluted and has *HHI* of 1699 with *CR₄* of 71 for a total of 9 firms. The study concludes that the figures do not depart from the norm. Apart from the study referred to above, there seem not to be any other study on the market structure of the downstream petroleum firms, especially those in distribution and marketing.

2.3. Analytical framework

Since the exact number of firms registered as petroleum marketing companies in Nigeria is not known, only those that are in business can be reckoned with as a result of entry costs which are very enormous. However the authoritative web marketing company (Nigeria big yellow, 2012) reports that there are about 225 active marketing companies in the country. The list includes the eight firms marketing petroleum products that are registered and listed on the Stock Exchange. Petroleum products are sold to onlysix out of the eight quoted companies. For the other privately limited marketing firms to get products to sell, they must establish an affiliation with one of the six. Products sold by the PPMC are recorded as going to the registered marketing company though some would be for the privately-owned firms in marketing agreement with a publicly quoted company. Quantities of products consumed over the years are shown in Table 1.The figures do not seem to follow any particular pattern as there are increases and as decreases. It is a known fact that the market for petrol (pms) is suspect to smuggling as well as corruptive tendencies since the issue of subsidy arose which has generated debate about whose benefit it is.

Table 1 - Petroleum products consumption in Nigeria (Measured in *M²)*

Year	PMS	HHK	AGO	Total
2004	6,073,330.35	1,132,879.89	1,437,457.09	8,643,667.33
2005	7,224,161.76	1,773,771.27	2,030,507.76	11,028,440.79
2006	8,846,928.57	2,073,820.14	1,358,199.19	12,278,947.90
2007	7,725,762.20	1,759,120.98	626,283.02	10,111,166.20
2008	7,206,728.55	1,949,836.76	1,273,203.12	10,429,768.43
2009	6,876,576.84	1,898,721.85	648,416.86	9,423,715.55
2010	9,090,469.69	2,996,466.65	1,336,361.20	13,423,297.54

Year	PMS	HHK	AGO	Total
2011	8,042,354.23	2,869,295.52	1,750,464.63	12,662,114.38
2012	8,391,032.37	3,123,278.64	1,013,222.78	12,527,533.79
2013	7,822,127.04	3,691,370.52	1,113,304.89	12,626,802.45

Source: NNPC Annual Statistical Bulletin (2013): *Legend*: PMS, HHK and AGO for Premium Motor Spirit, Household Kerosene and Automotive Gas Oil respectively.

The concentration ratio (*CR*) measures the share of the four or three biggest firms. While *CR* shows the size controlled by the largest firms it does not show the size disparities between the firms and within the industry. A share of less than 10% or CR_{10} is regarded as competitive while CR_{90} of one firm is regarded as absolute monopoly and cannot be used to compare for two different industries and it is a stagnant measure of size as changes can occur over the years. For the Hershman - Herfindahl Index (HHI) the market is regarded as *un*concentrated or *diluted* when measurement is less than 1000, between 1000 and 1800 moderately concentrated and above 1800 it is highly concentrated. The Department of Justice in the United States believes that conditions that would warrant a 100 to 200 change in HHI measuregive serious antitrust concerns in highly concentrated market.

3. Measurements and methodology

The study adopts the data from NNPC Annual Statistical Bulletin (2013) from where the products sold in the country are obtained. From the Annual Reports of the firms data on turnover (*Tover)* was obtained as well as data on the fixed assets (*FAssets)* held in each of the firm and the shareholders fund position (*SHfund*). Return on Investment (ROI) was derived from the financial statements to measure the efficiency level of the firms. The annual reports of the listed firm were limited to 2012 for the purpose of uniformity as some do not have full reports for 2013.The three parameters were then used to measure the efficiency of the firms in order to ascertain which of the parameters is most significant by ordinary least square process.The general models of measuring market concentration are Concentration Ratio and Hershman-Herfindahl Index which are expressed as:

$$CRm = S_1 + S_2 + S_3 + …………...+ S_m$$

where: CR represents concentration ratio and S_1 is the market share for the ith firm. The Hershman Herfindahl Index corrects the short fall of Concentration Ratio by giving a more complete picture of competition within the industry expressed as follows:

$$HHI = S_1^2 + S_2^2 + S_3^2 +………...+ S_m^2$$

Following from Biddle *et al.* (2009) and Mohammadi (2014) investment efficiency is stated as *PBT/NWA (profit before tax/net working assets)* and expressed as a %. The study adopts the regression process to estimate the impacts of each of the variables on the next endpoint. Thus the final endpoint is profit and related to return on investment as formulated above, while a simple univariate linear regression is:

$$y= α_0 + β_1x_1 + ε_1 \tag{1}$$

Four are formulated explicitly as:

$$ROI = β_{Income} + ε_1; \quad Income = β_{Tover} + ε_1; \quad Tover = β_{FAssets} + ε_1;$$

$$and\ FAssets = β_{SHfund} + ε_1 \tag{2}$$

and multivariate regression is of:

$$y = α_0 + β_1x_1 + β_2x_2 + β_3x_3 …. B_nx_n + ε_1 \tag{3}$$

explicitly represented as: $ROI = β_{Income} + β_{Tover} + β_{FAssets} + β_{SHfund} + ε_1 \tag{4}$

3.1. Market shares

Taking the level of consumption of the products and comparing it with the level of turnover of the firms can only estimate the market share attributable to any of the marketing firms and helps to know the market share of the particular company and its share of total consumption of the products. Table 1 shows the consumption of petroleum products in Nigeria between 2000 and 2012, the period covered in this study.With the above scenario, it is clear that over the ten-year period of the complete data, Oando plc had the highest percentage share of the

market. Concentration parameters: *Tover, SHfund* and *FAssets* are estimated andpresented inTables 4 and 5 and represented by Figure1. Within the period of study Oando and Forte raised capital to boost operational activities.
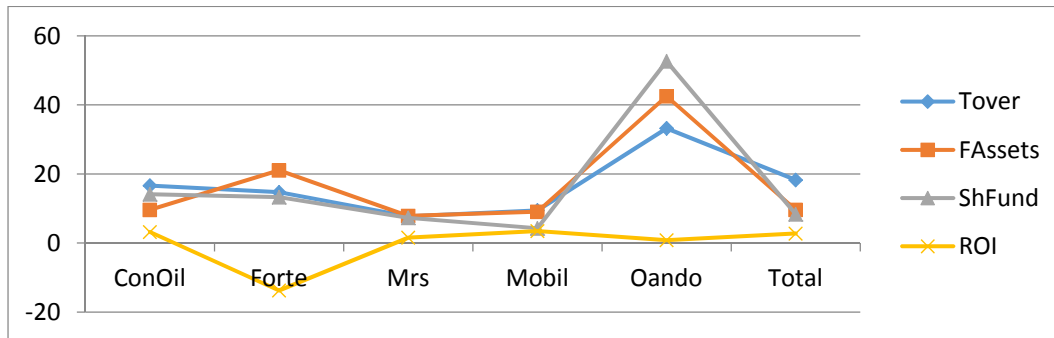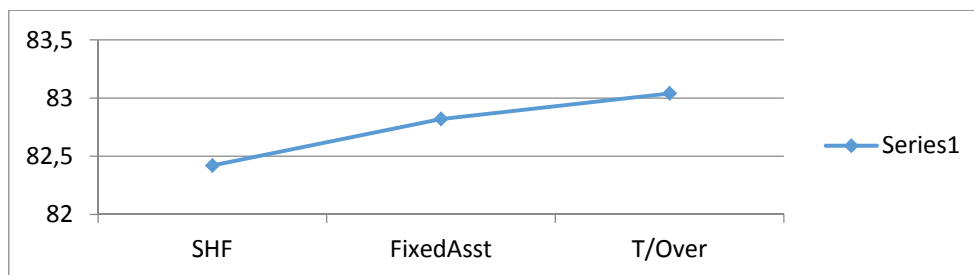

Source: Author's calculations

Figure 1 - ROI and parameters to measure concentration

4. Results and discussions

4.1 Measurement of market concentration and return on investment

It is possible to measure the level of concentration in the market by employing the two known methods: Concentration Ratio (CR) and Hershman-Hirfindhal Index (*HHI*). Concentration Ratiohas some basic challenges in that it does not inform on the disparities in the size of the market and the intra size disparities in the size of the firms included as the biggest and the smallest. The conclusions with the use of the HHI index is that the market is slightly concentrated with the value of *HHI* calculated at 2000, since *HHI*> 1800 determines that the market is slightly concentrated and there are just few big firms in the market. Empirical findings of this study supports the theoretical expectations in that there few major petroleum-marketing firms in the country. Concentration Ratio shows that the market is slightly highly concentrated since the number of firms on the exchange is far fewer than those actually registered to do business.

Furthermore, the CR_4 in this industry shows that more than eighty per cent of the market is controlled by four of the firms, while the remaining two cannot sufficiently control 20%. Therefore we can conclude that for the petroleum marketing firms in Nigeria, the concentration ratio is CR_4= 82.4, 82.82 and 83.04 respectively for *SHfund, FAssets and Tover* parameters as shown in Figure 2. The results are fairly comparable in all respects.

Source: Author's calculations

Figure 2 - Concentration of CR_4 for the Nigerian petroleum marketing industry

Table 2 - Descriptive of the variables and parameters

	FASSETS	SHFUND	TOVER	ROI
Mean	21438385	17729816	1.33E+08	-0.047018
Median	10050959	7367949	95011773	0.22
Maximum	1.33E+08	1.24E+08	6.73E+08	0.28
Minimum	3219636	-7568785	7894142	-12.15
Std. Dev.	31551399	26719731	1.20E+08	1.723535

	FASSETS	SHFUND	TOVER	ROI
Skewness	2.540399	2.582166	2.788414	-6.382105
Kurtosis	8.105438	9.125344	11.59041	44.53019
Jarque-Bera	123.215	152.4516	249.1283	4483.245
Sum	1.22E+09	1.01E+09	7.56E+09	-2.68
Sum Sq. Dev.	5.57E+16	4.00E+16	8.02E+17	166.352
Observations	**57**	**57**	**57**	**57**

Source: From the Annual Reports and Authors Calculations

The investment efficiency measure, the *ROI* indicates theefficiency of capital and investment of the respective firms. Table 2 shows the descriptive of the data. The variable is highest at 28% and lowest at -12.15 with a mean of -0.04%. The results are revealing to the extent that it can be inferred that investment efficiency in the petroleum marketing sub-sector is poor. Of the parameters used to measure market concentration, *Tover* is the most significant and most important (Table 3), while firms have adopted some other measures (including various means of assets acquisition) to achieve the turnover effect to indicate the level of market power that they have attained. In addition, market power varies overtime as it is not static. This means parameters may deteriorate over time when improvements are not recorded and the firm is not responsive to changes in the market. Next in significance are *FAssets* and *SHfund,* in that order.*CR* within the firms interestingly shows that *SHfund* is the most *in*significant as well just like the *HHI* reported above. The CR_4 in the market power analysis indicate that *Tover* is a still a good measure of concentration in this industry.

Table 3 - Correlation Analysis

Correlation *t*-statistic	FXASSET	ROI	SHFUND	TOVER
FXASSET	1.000000			

ROI	0.043296	1.000000		
	0.321389	-----		
SHFUND	0.703356	0.060025	1.000000	
	7.338149***	0.445965	-----	
TOVER	0.819784	0.084503	0.755868	1.000000
	10.61634***	0.628943	8.56187***	-----

*Source:* Data from Annual reports, *** *sig level 0.01*

Efficiency in the industry that requires so much investment in fixed asset indicates poor returns for investors generally. The *mean* ROI is negative or lowfor these highly capitalised firms, while smaller firms generally have positive ROIs (Table 5). The situation is perceivably aggravated by the negative equity of one of the firms in a particular year. Over the period of study, ROIs of the industry discriminated against size, especially where firms have high levels of *SHfund* and *FAssets.*

Table 4 - Herfindahl-Hirschman Index for the Petroleum Firms

Parameters	2004	2005	2006	2007	2008	2009	2010	2011	2012
SHFund	7117	3201	3107	5024	3837	3166	3673	4266	4254
T/Over	1806	1981	2089	1943	2259	2327	2569	3088	3675
F/Assets	1871	1895	1877	3903	4399	5115	4005	4135	4262

Source: Authors' calculations from Annual Reports

The correlations of the parameters with the ROI show a measure of independence but for *SHfund* and *FAssets,* and *SHfund* and *Tover* at *r* 0.82 and *r* 0.76 respectively. The other relationships are insignificant as shown in Table 3. The level of concentration by *HHI* is shown in Table 4 which indicates that the three parameters are close at the end of the study period. This is more graphically shown in Figure 3.
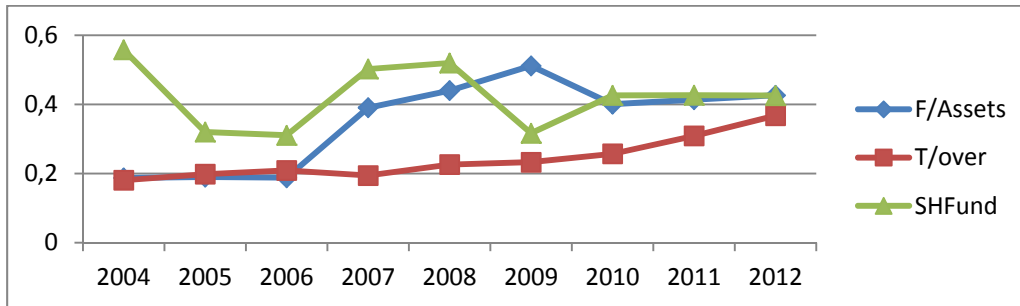
Source: Authors compilation from various Annual Reports

Figure 3 - Various HHI measures of Concentration

The summary results of the concentration measures and ROI is indicated in Table 5. The regressions in Table 6 show that each of the variables has significant impact on the next stage of use. For instance, *SHfund* is highly significant beyond 0.01 on *FAssets*. *FAssets* is highly significant on *Tover* which is also impactful on *Income* and *Income* on ROI. All of the significant levels are at 0.01. The R^2 indicate that *FAssets* on *Tover* has the highest R^2 at .67 followed by *SHfund* to *FAssets* at 0.495 and *Tover* to *Income* and *Income* to *ROI* at 0.194 and 0.153 respectively. Profits were not mostly derived from operational activities. Thus there is some inefficiency and likely over investment within the system. The overall performance of the model indicates a very poor output with R^2 at 0.185. The results infer that the variables are poor predictors of the investment efficiency in the petroleum marketing companies. More importantly, it show that the level of market power assumed by the firms do not translate into the efficiency for the firms. Table 5 shows the level of market power and the corresponding *ROI*.

Table 5 - Market shares by shareholders fund, turnover and fixed assets

Firm	ConOil	Forte	Mrs	Mobil	Oando	Total
By Turnover	16.62	14.69	7.71	9.45	33.23	18.28
By Fixed Assets	9.61	21.04	7.85	9.05	42.52	9.61
Shareholders' Fund	14.13	13.29	7.30	4.27	52.64	8.34
(ROI)	3.21	-13.74	1.55	3.47	0.82	2.74

Source: Authors calculations from Annual Reports

Other results are explained as follows:

▪ The results also indicate that the measures all tend to converge over a period of time. This is an important discovery of this study as the three measures: *SHfund, FAssets* and *Tover* all show a convergence at the tail end of the study. This brings to mind that all tend toward certain level of efficiency as most have engaged the variables adopted in the study to a level where it should begin to impact on the efficiency of the firms.

▪ The efficiency of the firms (ROI) shows the various levels of efficiency attained by each of the firms confirms that the use new capital does not immediately add value to the firms until sometime later. Figure 4 shows the ROI of each of the firms over the years. This indicates that firms' efficiency does not reflect additional (or freshly raised) capital in the short or immediate term.
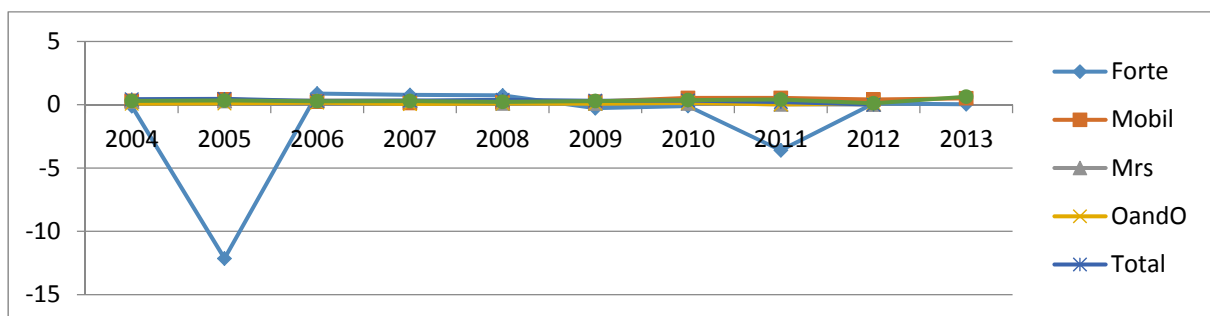
Source: From Author's Calculations

Figure 4 - Return on Investment (ROI) for each firm

▪ The petroleum marketing sub-sector of the industry shows a level of high level of concentration by all the parameters. The *HHI* for each of the parameters is higher at any time than the benchmark of 1800 that indicate a moderately concentrated market as depicted by Table 4. The observation in the study show that the marketing companies have increased in size by various means and are increasing continually in market power. Any merger by any of the four in the *CR4* in the industry (for example Oando and Forte or Total) will increase the *HHI* to a near monopolist state where anti-trust legislation may need to be brought in.

▪ Other results show that the other parameters i.e. *SHfund* and *FAssests* are potential to the level of concentration that can be achieved by the firms as the *Tover* level may not be significant enough to command the level of market power that may make the firm to acquire significant influence or leadership in the industry. It is also observed that continuous investment by the firms has the tendency to raise the concentration level. The overall *F.stat* indicates the *FAssets* to *Tover* has the best.

▪ Finally, the efficiency level of the firms do not necessarily depend on the investment in assets and increase in shareholders fund but the effective use of the assets to achieve a higher level of productivity and profitability. One of the firms (*Forte*) invested heavily in fixed assets with shareholders fund that resulted in higher level of turnover but consequently in lower profitability and therefore lower efficiency. Of course, bigger capital does not mean more efficient.

Table 6 - Univariate and multivariate regression outputs

Dependent / Independent	ROI	FAssets	Income	Tover	ROI
FAssets	--			3.109	-1.47E-08
	-			(10.61)***	(-1.147)
Income	1.53E-07				1.89E-07
	(3.118)***				(3.315)***
SHfund	-	0.830543			-5.43E-10
	-	(7.34)***			(-0.042)
Tover	-		0.016227		1.44E-09
	-		(3.600)***		(0.398)
R-Squared	0.153	0.495	0.194	0.672	0.185
Adj. R-Sqd.	0.137	0.486	0.179	0.666	0.121
F Stat	9.724	53.849	12.958	112.767	2.89
D W Stat	2.097	1.483	1.620	1.280	2.129

Source: Output of the univariate and multivariate regressions of the variables

Other observations specific to the firms are below:

▪ The marketing companies engage in little advertisement to promote products because there is ready market to absorb whatever is produced and offered for sale. This situation is aided by the barriers to enter the industry which, apart from being capital intensive is highly regulated. Documentation requirements are enormous. This is one of the major reasons why there has not been any serious change in the market structure for a long time but rather a continuous consolidation of the existing ones. The firms listed above were all expatriate firms at the time they came into the economy and are still dominant in the downstream sector. For these reasons investors efforts at establishing a meaningful and enduring presence in the market is focused on acquisition and possible buy-in. It is clear that undisputed leadership belongs to Oando but this has not translated to efficiency of investment for it. This belongs to Mobil.

▪ Overseas induced mergers (by Multinationals) can have serious impact in the domestic markets where the firms concerned are those with high market share (for example Oando and Total). Equally a firm can progressively become market dominant as Oando over the years by steadily increasing its working capital assets to increase its market share. Unless the assets are properly used for increasing turnover, magnitude of increase may not linearly translate to increase in efficiency. From the analysis the firms are few and measurement truly reflects the state of affairs.

5. Recommendations

From this study the following recommendations become necessary:

▪ The oligopolistic structure of the market needs to be broken by the empowerment of the independent marketers to be able to operate without having to go through the established marketers. It is obvious that they are far from being organized as their number cannot be fully ascertained. There is a need for a reorganization to enable them play a meaningful role in the downstream sector. In this light, a merger and acquisition or buyouts through recapitalization need to be considered by the authorities in order to force mergers to make the member firms strong enough to operate independently.

▪ An issue for concern is the deregulation of the downstream sector to allow private refineries operate, produce and market the products while the government concerns itself with the regulatory side of the market. It is only then that the much touted subsidy can be clearly seen by Nigerians. Given the importance of the product and the effect that volatile rise in prices can induce, adequate regulation important.

▪ Liquidified Petroleum Gas (LPG) usage is low for an economy producing and exporting petroleum. It is one the potential products in the market that can be used to increase the turnover and market shares of the respective firms. However, conscious effort by the government must be put in place to encourage the use of gas industrially and domestically. This would result in less flaring that has been going on for years.

Conclusion

This paper studied marketing concentration in the Nigeria downstream oil sector and attempted to correlate this with efficiency of investment, thus attempting a relationship between market leadership in a highly concentrated market with investment efficiency of the firm. The market is highly concentrated and becoming more so. Investment efficiency is related to the benefits of the shareholders, while concentration can be traced to management. While various studies have looked at the transparency as key issues in investment efficiency, the paper finds out that the highly investment-efficient firms are not the ones with market leadership. Rather the efficient firms are the mid-size firms. This suggest that there inefficiencies with the usage of capital by the big firms. Empirical study of this the market show that concentration does not necessarily make for efficiency in investment and bigger may mean worse. While Oando has the market leadership by all parameters used in this study, it is not the most efficient in the use of capital. Efficiency in investment belongs to Mobil.The unorganized state of the independent marketers will need to be addressed to wrest the control been enjoyed by the some of the firms and therefore see a gradual dilution of the market for the benefit of consumers through deregulation.Only then can the subsidy being discussed be fully appreciated.

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