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AIMS AND SCOPE

Transition is the widely accepted term for the thorough going political, institutional, organizational, social, and technological changes and innovations as well as economy-wide and sector changes in societies, countries and businesses to establish and enhance a sustainable economic environment.

Managing Global Transitions is a social sciences' interdisciplinary research journal. The aim of this journal is to publish research articles which analyse all aspects of transitions and changes in societies, economies, cultures, networks, organizations, teams, and individuals, and the processes that are most effective in managing large scale transitions from dominant structures to more evolutionary, developmental forms, in a global environment. The journal seeks to offer researchers and professionals the opportunity to discuss the most demanding issues regarding managing of those transitions to establish and enhance a sustainable economic environment.

TOPICS COVERED

- Business (accounting, entrepreneurship, finance, marketing, informatics, technology, innovations, . . .)
- Business law, law and economics, business ethics
- Demographic and labour economics, human resources, knowledge management
- Econometric and mathematical modelling of business and economic processes, operations research
- Globalisation, international economics
- Historical transitions, transition experiments, transition pathways and mechanisms, visions of the future
- Macroeconomics (growth, development, business cycles, government regulation, fiscal policy, monetary and public economics, welfare, . . .)
- Microeconomics (theory and applications, industrial organisation, market structure, competition, innovation, . . .)
- Sociological, psychological and politological issues of transitions
- Sustainability issues, environmental business and economics
- Urban, rural, regional economics

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Managing Global Transitions publishes original and review articles and case studies.

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Institutional Environment and Development of Business Networks in South East Europe: An Introduction to the Thematic Issue

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International journal *Managing Global Transitions* is striving to address and present key issues in international research, first of all from the area of business, economics and management. This thematic issue is following the MIC 2016 International Conference Managing Global Changes.

The selected papers are focusing on different determinants of institutional environment and development of business networks in South East Europe. South East Europe is a region full of surprises; conflicts and wars in past, on the one side, but huge growth potential on the other side. The history of Southeast European countries, their characteristics, their resources, their cultural roots and their political structures shape their paths. In almost all countries of the region, rapid privatization led to a range of long-term problems from which a significant number was related to crucial economic issues. In post-socialist transition of Southeast European economies, institutional environments were transformed, but alongside with formal institutional transition, business networks between countries, which once formed one market, have not managed to re-establish. The overall objective was to portray some of the challenges, problems and issues faced by companies and business networks and to disseminate important experiences from region.

The authors from worldwide locations such as Croatia, Slovenia, Portugal, Italy and the USA discuss different themes which are closely related to the developments of institutional environment and development of business networks and by that provide research findings which offer theoretical and practical implications for policies in this field.

The first contribution to the issue entitled 'Scenarios of The oil Industry of Croatia and the Region: Qualitative Approach' is authored by Radoslav Barišić. The paper focuses on scenario-based planning, which is a useful technique for preparation of appropriate strategy and responses to potential unforeseen emergencies. In this view the paper provides an insight into the importance and various approaches in using scenario

planning today and explains the potential long-term scenarios in the oil industry of Croatia and the region. The research is based on materials obtained in interviews with a number of experts in the oil industry and oil economy. Author founds that the use of scenario planning in the oil industry of Croatia and the region is a relatively new technique, and as such, brings a challenge of its application and adaptation. By using scenario planning, local companies can importantly improve their competitive strength, therefore, it is necessary to consider it in the future developments.

The second paper is devoted to the corporate governance. Danila Djokić and Mojca Duh in their paper entitled 'Corporate Governance Quality in Selected Transition Countries' set out the importance of understanding the corporate governance. The paper aims to broaden the understanding of the role of standards and codes of good corporate governance in improving governance practices. Authors found that not only formal regulations, standards, and governance codes, but also corporate governance indices are important in measuring and improving governance quality. Using the SEECGAN index methodology, authors indicated that mandatory requirements and voluntary recommendations of high governance standards had a positive impact on the corporate governance practice in Slovenia.

The subsequent paper focuses on the issue of privatization. Fernanda A. Ferreira and Flávio Ferreira, authors of the paper entitled 'Privatization and Optimum-Welfare in an International Cournot Duopoly,' aimed to analyze the relationship between privatization of a public firm and tax revenue for the domestic government in an international competition with import tariffs. In doing that authors consider a duopoly model where a domestic public firm and a foreign private firm compete in the domestic market as Cournot players. Using a numerical example, authors found that privatization raises the profits of both domestic and foreign firms and increases the tariff imposed to the imported good; however, it lowers the domestic welfare. Furthermore, authors demonstrated that a rise in the government's preference for tariff revenues raises the social welfare.

Massimiliano Kaucic and Roberto Daris in the paper entitled 'Prospect Theory Based Portfolio Optimization Problem with Imprecise Forecasts' proposed a novel interval optimization approach for portfolio selection problem, where imprecise forecasts are available. Authors considered investors acting their choices according to the prospect theory, where sce-

narios are provided in the form of approximate numbers. The resulting constrained nonlinear interval optimization problem is converted into two nonlinear programming problems using a total order relation between intervals. Authors thereafter compared the flexibility and the efficiency of the proposed model with those of the standard portfolio theory procedure from both a static and a dynamic point of view in a set of experiments involving 8 assets from the Croatian market. Findings showed that the proposed model is able to produce investment strategies superior to the standard portfolio theory model, in terms of both diversification and turnover.

Finally, Abe Harraf, Brandon Soltwisch and Kaitlyn Talbott in the paper entitled 'Antecedents of Organizational Complacency: Identifying and Preventing Complacency in the Work Environment' studied sources of complacency in organizations and identified in this respect four major areas: process, people, structure, and culture. Authors also developed a framework for assessing the need for environmental scanning based on the complexity and frequency of change in the environment. Using the market examples, the paper further provides managers with useful advice on how to identify and react to complacency in their organizations in order to remain competitive on an international scale.

We are pleased and proud to present to our readers this thematic issue of Managing Global Transitions, hoping that you will find the content up to time, relevant and insightful. We believe that by reading these papers you will recognize many interesting findings and results as also identify valuable ideas for further research.

Scenarios of the Oil Industry of Croatia and the Region: Qualitative Approach

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The oil industry is historically burdened by different turbulences and tremors having the significant impact on the market. In order to anticipate unforeseen and potentially harmful situations, some firms as a part of their long-term strategic plans pay attention to scenario-based planning, which is a useful technique for preparation of appropriate strategy and responses to potential unforeseen emergencies. Scenario planning is used for a detailed analysis of the current situation in the market and potential future development, creating a research framework for creating development scenarios. Scenario planning is especially highlighted in the context of oil industry considering the technique actually originated in this business (it was also used in previous military doctrine), where, because of using a scenario-based planning, some oil companies profited and gained a privileged position. The aim of the paper is to provide an insight into the importance and various approaches in using scenario planning today and explain the potential long-term scenarios in the oil industry of Croatia and the region, obtained by means of qualitative research and in-depth interviews with a number of experts in the field of oil industry.

Key Words: competitive advantage, oil industry, scenario planning
JEL Classification: L1

Introduction

In order to ensure a competitive advantage in turbulent and uncertain business conditions, Croatia and regional oil companies are forced to find new strategic tools and techniques. One of them is the Scenario Planning confirmed by Mintzberg's thesis as highly valuable as it shows how Scenario Planning at times when the traditional approach to strategic planning is already obsolete can be used (Mintzberg 1994).

Development of oil industry is presented based on the application of scenario analysis in the area of Croatian and regional oil industry development. This technique is used to present several potential directions of development in the industry, each with its own conditions and features (Wack 1985). Special attention in the context of the entire analysis was

given to INA Oil Industry, Plc. in respect to its role in the Croatian market and the region. Recommendations for further development of INA were given considering the results of the scenario analysis of oil companies, including its strategic positioning and adapting to the global competition.

Empirical research was based on materials obtained in interviews with experts in oil industry and oil economy. During the interviews, respondents stated their opinions on the outstanding issues related to scenario-based approach to oil industry. Their statements were synthesized and resulted in certain opinions and conclusions common for all experts during their interviews. We stress out that main subject of the research is analysis of scenario planning and thinking in terms of how to create productive business models and adjust the oil company's business strategy accordingly.

Approaches and Steps in the Development of Scenarios

SCHOOLS AND ORGANIZATIONS IN SCENARIO PLANNING

There are few scenario-based approaches to planning, mainly stemming from various organizations and schools that have gradually developed the technique of scenario analysis and enriched their approaches assisted by the different methods of computer support in evolution of the technical capabilities. Ringland (1998) highlights the following as the most influential approaches:

- Battelle's BASICS
- Comprehensive Situation Mapping (CSM)
- Computer Driven Simulations – STRAT*X
- Copenhagen Institute for Future Studies
- The European Commission's Methodology
- French School
- The Futures Group
- Global Business Network (GBN)
- NCRI
- SRI

Every of them are discussed in more detail below.

Battelle's BASICS. During the 1980s with the help of IT support many organizations developed their own methods of scenario planning. Consultancy seated in the United States began in 1980 development of methodology called BASICS (Battelle Scenario Inputs to Corporate Strategy). This

methodology was an enhanced derivative of the CIA techniques previously developed by RAND Corporation and the University of Southern California. Important new element in this approach was the expert judgment so the process involved the computer program with good customer support.

Comprehensive Situation Mapping (CSM). Within the scenario planning, the CSM method helps to develop a deeper insight into the systematic structure and its dynamic implications. CSM basic feature is the possibility to improve mental models of managers in strategic decision-making situations. Since the features of this method are related to computer simulations, the vital role of this tool is bridging the gap between qualitative descriptions and quantitative modelling. CSM as a tool helps to design the strategy from its initial phase of developing a situation model to the finalization of a strategic analysis. It includes the principles of Systems Dynamics and Systems Thinking, which comprises the overall situation.

*Computer Driven Simulations – STRAT*X.* The use of powerful simulation models is presented through following approach used by several companies that consider the question 'what if' in possible future directions, basing it on solid facts. This model was developed in Windows platform of business-simulation designed to bridge the gap between the theory and the practice in different industries. Original version MARKSTRAT was developed in 1977 while the version MARKSTRAT 3 was designed for the work of 6–30 managers divided into groups of 4–6 people. Each team was responsible for simulated management of a company in direct competition with other teams. This method allowed employees free environment to develop their creativity and vision. Participants performed different types of analysis in the process of decision making: market analysis, competition, business environment, financial analysis, etc.

Copenhagen Institute for Future Studies. This institute was established in 1970 as a non-profit organization by the former Danish Minister of Finance and OECD Secretary General Thorkil Christensen in cooperation with a several visionary companies and organizations keen to modernize their decisions by exploring the future. This scenario making approach focuses on the social factors that affect the other elements. Although the scenario planning in time significantly evaluated, this particular technique is still used as it takes the whole society as a valid basis for developing a scenario.

The European Commission's Methodology. Since it is often pointed out that the future has not been written yet and in principle cannot be predicted, the processes of reflection on the future and effects of the exploration of alternative future can have a striking effect on directing a company's future. But the assumption that the future can still be interfered rests at the core of the research performed by research departments of future events in the framework of the European Commission. The European Commission uses the method of 'design of factors – design of doers', involving a small group of selected experts and does not include questionnaires. The method represents less formal and adaptable approach to professional counselling. Pragmatism and adaptability of this method improves the application of knowledge of the partners inside and outside of the European Commission.

French School. During mid 70s' French strategy specialist, Michel Godet, started developing scenarios (Godet 1987). Its functions have changed over time, based on what was the importance of the orientation towards the future and accordingly continued to develop its methodology for developing scenarios. This approach is in line with Battelle BASICS methodology used forecasting methods in the assessment of interaction effects. Godet's approach developed gradually over the years and is comprised of a set of software tools, especially MICMAC (Matrix d'impacts Croises Multiplication and un Classement).

The Futures Group. Futures Group is a consulting firm specialized in the area of strategic planning which developed a scenario-based approach to planning, based on an analysis of the impact of trends (Cross Impact Analysis). A typical project consists of three phases: preparation, development of scenarios and reporting and use. The preparatory phase is primarily focused on defining the focus searching for answers to several questions revealing the limits of scenario application. Apart from these questions, key drivers of the system and the environment that should be recorded are determined. In the development phase, comprehensive sets of future world scenarios are constructed. Then the sets are reduced to a smaller, concise number of major events. Development phase is than finalized by projecting the time trend for each of the variables highlighted by those in charge of the scenario. The final phase consists of reporting on the findings by various documents, as different graphic layouts and presentations describing the assumed future. For the scenario findings to be used and benefited at the highest managerial level, effective communi-

cation on assumptions and outcomes of the scenario findings is of crucial importance.

Global Business Network (GBN). Peter Schwartz along with Jay Ogilvy formed the organization after leaving Shell (Ogilvy and Schwartz 2004). The basic idea was to provide the customers with high quality information and to contribute to the development of their perceptive on alternative futures added by the scenario analysis method. The idea of conducting business with this method evolved even further and the network of consultants evolved working on individual projects, exchanging ideas, opinions, observations, etc. Therefore the GBN has become king of a club, a community, working with clients and using an unconventional approach, atypical of other consulting companies.

NCRI. This approach was developed by Northeast Consulting Resources Inc., on whose initials the name was made up. It is based on the screenplay technique called 'Future Mapping'. Its methodology uses two sets of tools, 'Endstates' or alternative visions of the future and 'Events' or specific events. The first observes the industry specimens to a certain future time extend, usually four or five of them. They are able to describe incomplete or polarized points of view requiring mutual integration. Several alternative visions does not necessarily have to be mutually exclusive, therefore one vision can mutually exist with completely different vision of business model. Events such as different set of tools are specific, concrete and visible manifestations of the most important future trends and questions. Finally this method comes down to a collection of conclusive events and alternative visions focused at the development of marketing strategies.

SRI. SRI International and the Royal Dutch/Shell initially developed an approach of intuitive logic. Scenarios must present a framework for structuring the perceptions of management on alternative future environments in which decisions will be made. The main material of the scenario is not the idea of consultants and futurists, but the management perception regarding critical trends. The range of decision-making affected by these scenarios is very broad, from urgent decisions up to the long-term considerations such as strategic decisions on diversification of a company. In the late 70s SRI International revised its methodology scenarios to meet the corporations' needs for strategic analysis of future trends and the degree of uncertainty that direct implications have on strategic plans, investments and other decisions that are made in the present. Their

methodology, known as the SRIC is considered a role model of intuitive-logical access scenario-based planning, primarily because of its simplicity and practical application. SRIC method includes 6 steps through strings of analyses and workshops. In certain segments it is similar to the GBN's technique of scenario analysis implementation.

STEPS IN DEVELOPING OF THE SCENARIO

As we already presented, there are many approaches and recommended models in implementation of scenario planning, but most of them have similar premises and process logic in scenario developing. According to Schwartz (1991), the process of scenario making is divided into 8 steps, each separately including one unit:

1. Identifying focal issues and decisions
2. Defining the key factors in the local environment
3. Definition of the main driving forces
4. Ranking of the driving forces in order of importance and the degree of uncertainty
5. Selection scenarios logic
6. Scenarios' content enrichment
7. Explanation of the implications
8. Selection of leading indicators and guidelines

The First Step – Identifying Focal Issues and Decisions. When developing scenarios the key issues and areas of interest to be dealt with in the process of developing scenarios should be the starting point: which important matters will be considered by the decision makers and the management in the future? What are the decisions to be made in order to have long-term impact on the state of the company? Scenarios that are developed on the basis of macro-economic context may not be able to point out the he differences that have an impact on the object of analysis. Special attention in all scenarios is given to an environment that dictates the type of data which are the basis for the creation of the foundation the development of scenarios. Key decisions that have potentially important effects on the entire business must be singled out.

The Second Step – Identifying the Key Factors in the Local Environment. If the identification of focal points or observed questions is the first step, then listing the main factors that influence the success or failure of these

decisions is the second step. Facts about customers, suppliers, competitors and etc. are investigated. The questions are raised: What would managers like to know when making key decisions? What will be regarded as a success and what as a failure? What kind of circumstances will shape the final outcome?

Third Step – Main Driving Forces. After mentioning all the main factors, the third step involves defining the driving forces in the macro-environment influencing key factors identified earlier. In addition to the list of social, economic, political, environmental and technological forces, it is important in this phase to answer the question which kind of drivers are standing behind those factors of the micro-environment defined in the second step? Some of them are predefined (e.g. demographics) and some distinctly unsafe (as public opinion). It is extremely useful to know what is inevitable and important, and what is unpredictable and yet essential. Let us imagine ourselves asking these questions in the future: 'What would we do if we knew about the changes in the tax system, interest rates, inflation level and so on'. In that way we could open certain perspectives and visions. This is the most intensive research step in the process, where we need to carry out a research in order to adequately define the driving force in the company. The market, new technologies, political factors, economic conditions, etc. are being examined. The research is conducted in the direction of reviling and defining current trends or the weakening and the disappearance of the same.

The Fourth Step – The Ranking of the Driving Forces in Order of Importance and the Degree of Uncertainties. The fourth step monitors the ranking of the driving trends based on two criteria: the first indicating the degree of importance of focal points or issues identified in the first step and the second, indicating the degree uncertainties characterized by these factors and trends. Analysis is made where the most characteristics are highlighted in order of importance and the degree of uncertainties whereby the goal is to identify two or three most important factors and trends standing out according to the highest level of importance or uncertainties.

The Fifth Step – Select the Scenario Logic. Scenario logic is defined as a research interaction between the most important and the least certain drivers constructing the research framework. The aim is to identify several scenarios whose discrepancies and special features are determined by the experts in charge of decisions making in the previous course of

the scenario. It is crucial to point out that the driving forces in the scenarios have to be a small number, thus avoiding excessive multiplication of scenarios, such as i.e. placing all possible uncertainties in the interrelationship and analysing it. Many events are possible, but only a few scenarios can be worked out in detail, thus avoiding the reduction of the effect of the process.

The Sixth Step – Enrichment of Content of the Scenarios. Main task of this step is the upgrade of the basic form of the scenario including the key factors and driving forces developed in the second and the third step. Scenarios are perfected by adding adequate roles to each key factor and each driving force. Each of the scenarios is developed by the exploring the reactions of parameters defined by the effect of the key driving forces on the assumed focal issues. The goal is to gather all the explored segments into one narrative whole.

The Seventh Step – Implications. After detailed development of scenarios, it would be wise to return to the focal issues and decisions defined in the first step. What can happen and have consequences on our points of interest, if certain factors emerge projected in each scenario?

The Eighth Step – Select the Leading Indicators and Signposts. Indicators should be identified which are used for the basis of current trends and in turn suggest scenarios that are fallacious but are potentially closest to the real situation. It is important to urgently recognize which of the made scenario is closest to the actual situation and the future. Thereby a company acquires a competitive advantage in relation to the other market participants, as it anticipates future events that could happen in the observed industry can accordingly adjust their strategies in the best possible way.

The entire scenario development process and taking of steps takes place in the manner of identifying key decisions and problems expected in the core of the analysis, its influence on strategic decision making and deciding on the planning horizon by scenario development (Shoemaker 1995). It is followed by identifying the main factors affecting the future. They are external and usually cannot be influenced upon. Factors most commonly studied are the size and the growth rate of a specific market, long-term economic conditions, price trends, availability and the cost of capital, etc. (Van der Heijden 1996).

The third step analyzes the important environmental conditions shaping the future of a company's business. Analysis is performed in two seg-

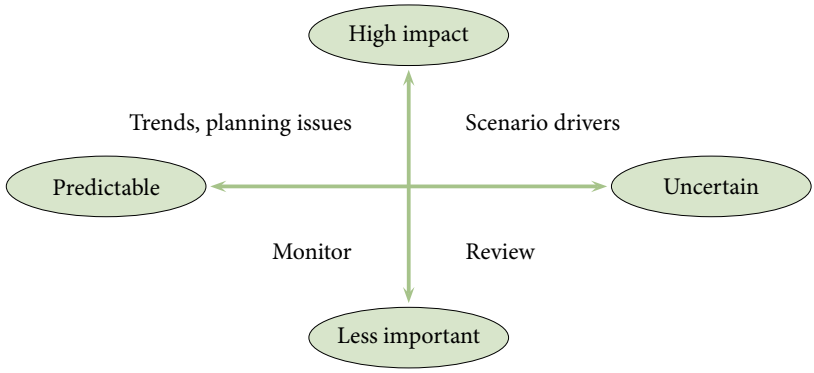

FIGURE 1 Matrix of the Scenario Impact/Uncertainties (adapted from Ringland and Young 2006)

ments, by analysing the macro-environment (to which the company has to adjust) and analysing the industrial environment (to which the company can have influence by adjustment). It is important to recognize the importance of particular drivers and its possible impact to the structure of future environment. Impact/uncertainty matrix can be helpful to the system with its simple principle of evaluation: high, medium and low. If a certain drive has a high level of impact and high level of uncertainty than it is a scenario key driver.

Potential Development Scenarios for oil Industry in Croatia and in the Region

Scenarios are created by qualitative research (in-depth interviews) with a number of eminent experts from the Croatian oil industry and with experts across the region. Steps in conducting the research have been implemented by respecting the guidelines and recommendations of the SRI approach. Experts went through structured interviews, answering a series of questions that ultimately formed the entire composition required for the construction of scenarios by using this approach.

At the beginning the subject of research was determined which served as a basis to all other process components. Immediately after defining the subject, analysis of the factors having an impact on the final result of the determined research objectives followed. Than all factors and drivers were ranked according to its characteristics and selected as those having the most influence to the research subject and at the same time least secure of forecasting. Than the drivers were attributed with the opposite

characteristics along two intersecting axes constructed from four different scenarios.

The final phase represents the determination of the implications arising from the scenarios and indicators pointing to future development in a in a precise determined direction.

QUALITATIVE RESEARCH METHODOLOGY THROUGH IN-DEPTH INTERVIEWS WITH EXPERTS

Methodology of open type interview was used in the research performed through thematic units. During the interviews through semi-structured interviews, i.e. a series of open questions the respondents were asked about their views on elements defining the research area, searching to verify that the respondents were in the wake of the joint conclusions at hand. Data obtained through interviews through open issues in the context of qualitative research assisted the researcher to sublimates perception, experience and knowledge of participants through in-depth interviews. Result of this approach is a comprehensive picture broadly interpreting the examinees' vision, without limiting factors that may diminish the creativity and foresight during the research process (Patton 2002).

After determining the research problems, we decided to use the interview method as the best suited method for collecting the data needed for finding answers to the research questions. Although conducting interviews is usually considered as the 'best' technique for collecting data, there is a risk of underestimating the complexity of implementation and research methods. In-depth interviews can be defined as a process in which knowledge of the social world is constructed through interaction. The process of interviewing is not just a neutral exchange of questions and answers. The key of successful implementation of the interview is active nature of the process that results in a contextually rich content.

Deliberate sample of respondents was selected (10 top oil industry experts, all of high-ranking employees of companies and institutions engaged in the oil and energy sector) according to the expertise and knowledge of the strategic planning and prospects of development in the oil business. Respondents selected in this method had the ability of making good illustrations of the focal problem and they were well informed about the topic during the interviews. The principle of defining the patterns in qualitative researches as typically 'meaningful' or 'theoretical' was followed, as opposed to random sampling or some other approach which aims to ensure statistical representatively. All interviews were conducted

over a period of approximately two months and every single interview lasted from 30–60 minutes.

Respondents were approached by telephone or by direct contact, depending on their availability, and free time. Interviews were conducted partly at the respondents' workplaces, within their conference rooms and sometimes in the places completely unrelated to their job. All participants at the beginning of the interview were informed with the principle of discretion and the confidentiality of their identity in writing of the papers. Also the consent for using the dictaphone during the conversation was requested. Since all respondents reacted positively to the dictaphone during the interview, all conversations were recorded and stored as audio track, keeping the comprehensiveness of obtained thoughts and information. The length of each interview depended on the availability of the respondents.

During the interviews, respondents were asked various questions on oil business and strategy. Responses intended to explain the problems set in the centre of the research. With regard to the methodology used in the work, questions were not asked by strictly defined order, but with the idea to ultimately they handle all topics.

The research was aimed at discovering potential directions of oil industry development in Croatia and the region within the period of the next 20 years. Based on the responses of interviewed oil experts, potential scenarios should shape the future picture of the oil industry and determine how important is to anticipate events and adapt strategies accordingly in business.

Background knowledge about the geopolitical and other situations that shape the future course of events on the oil market can be obtained by the direct approach. In this research, respondents are given the role of descriptors of all essential elements for creating and distinctions within a few scenarios. Quantitative research could not give the right results in understanding the essence of the process and in the generation of new knowledge (Patton 2002).

Subsequent analysis of qualitative data involves organizing and explaining the data, briefly finding the meaning in the data according to the respondent's definition of the situation, finding patterns, themes, categories and regularity.

After describing the characteristics of qualitative research, taking into account the tackled and the objectives to be achieved in the research, it can be concluded that the qualitative method of research was a good

choice by which we reached the goal of research – construction of potential development directions in the oil industry in Croatia and the region.

QUALITATIVE RESEARCH RESULTS AND CONSTRUCTED SCENARIOS

After carrying out the interviews with all responders and making the transcripts, next step was to further analyse the data obtained in this research (Patton 2002). The analysis was carried out in the form of detecting codes profiled during the interviews, and proved a certain consistencies and causality in the visions of the experts in the context of all thematic sections. During the process of interviewing of the respondents the basic intention was to obtain the professional reflection on scenario-based planning as a strategic tool and examining the future of the oil industry under the different thematic sections that have a crucial role in forming of the oil future.

All the respondents respectively accented on the importance of application of scenario planning. Since all respondents were highly profiled managers who worked or had contact with the market leaders, their knowledge and a comprehensive understanding of scenario planning and its benefits is not surprising.

The fundamental question raised as an object of study in the development of scenarios is the oil industry development perspectives at global and regional level for the next 20 years. What are the potential directions of development of the market and subjects which have a role in the exploration, production, processing and distribution of oil and oil derivatives? An important assumption was the projecting of the development of the global situation because it has a decisive influence on events in smaller, dependent regions reliant on raw materials and geo-political developments on the overall market.

Driving forces observed in the process of making scenarios represent the trends in the macro environment and have a direct effect on the observed basic question from the previous step. Added by the PESTLE model it is possible to observe in detail the factors from several major focal areas of company's business: political, economic, socio-cultural, technological, legal (legislative) and environmental (Porter 1985). Besides historical features, due diligence and other facts, the driving forces were pointed out by the experts during the interview and were repeatedly emphasized.

As the most important drivers the following was stressed: development

TABLE 1 Ranking the Main Driving Forces by the Importance and Uncertainty

Driving force	Importance	Uncertainty
Development of the alternative energy sources	10	8
Oil demand	9	7
Economic situation	10	10
Oil prices	10	9
Availability of oil	10	10
Political environment	9	9
Technological development	9	8
Demographic trends	8	7
Transport development	9	7
Environmental regulations	10	8

NOTES 1 – very small importance/uncertainty, 10 – very high importance/uncertainty.

of alternative energy sources, economic situation, demand for oil, oil prices, availability of the oil, political environment, technological development, demographic development, transport development of the market and environmental legislations. Each of these drivers was given a certain rating according to the importance of the impact on the area of research, while a level of uncertainty was considered as a second aspect i.e. a small possibility to forecast future outcomes related to these drivers.

From the comparative table 1 it is evident that the most important drivers with the highest degree of uncertainty are the economic situation and availability of oil. The economic situation is a key driver because it determines the future financial power of governments, businesses, shareholders, customers and other stakeholders to spend or invest in different directions that will shape the industry. They may be technical in nature, in the form of subsidies, acquisitions and consolidation, etc. The availability of oil on the other hand, has a significant impact on the supply and price and therefore, consequently, on the overall picture of the industry and market.

Once we defined and separated those factors that were rated as the most important ones, i.e. the most uncertain in the future business operations of the company, their presentation in made on the basis of two matrix axes of opposing characteristics that define the aforementioned drivers: sufficient or insufficient, that is, the development or stagnation.

From the displays of the matrix interrelation four potential develop-

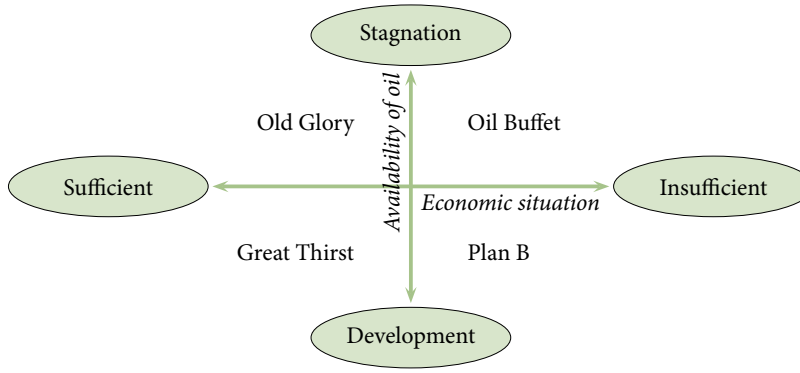

FIGURE 2 Matrix of 4 Potential Scenarios

ment scenarios can be determined; each with its own characteristics and development direction, depending on the combination of key drivers it exists on. Special attention was paid to giving names easy to remember, but also descriptive representing the direction of development it was processing. Each of the potential scenarios is presented in more detail through processing of concepts that shape them and by entering into a deeper area of interest that defines them. Implications for each scenario are presented with indicators that give clues to early detection and identification of each potential direction.

Oil Buffet. Represents a scenario characterized by assumed high economic growth and high accessibility of oil. Regional economic growth moves in a positive direction resulting in the increase of economic activities, higher traffic frequency larger transfer of commodities and goods reflecting in an increase in oil demand as a basic energy source in all economy sectors. Determinants of this scenario have double impact on the technological development, since economic growth encourages rapid application of innovation and improvement in every technological sense. Ecology has an important role in the further development, predominantly in times of economic prosperity, when environmental standards increasingly tighten hindering company's business. Since the availability of fossil fuels remains large, alternative energy and energy efficiency are developing only to the extent ordered proscribed by state laws. Implications arising from this scenario are the progress of the overall economy, progress towards sophisticated technologies; a large number of new, modern petrol stations, increasing refining capacity, companies' revenue

growth caused the oil price hike. Indicators suggesting a potential development in this direction are high GDP growth, political stability and a sense of well-being. Strategies of oil companies in this scenario are focused on the use of appropriate situation and to make the best of it. Everyone will consolidate its position in the upstream and downstream, strongly focusing on the downstream business, where margins are the highest. All processing and distribution channels must be fully involved in order to meet the demand economy that is building a steam.

Plan B. In this scenario, economic growth is high, but the availability of oil is decreasing. The economic situation stimulates economic activity, which ultimately generates development of the market, transport, living standard and the general consumption. Thanks to the good economic situation and the available resources, larger funds are invested primarily in technological development, modernization of production plants, transport and refining. Oil supply is reduced, while demand is growing steadily resulting in a supply disruption on the market and the participants with continuously higher prices of oil on the market find themselves in the situation of a new oil shock. Thus, the alternative fuels have an important role as a substitute for oil. Most evident restructuring is going in the direction of gas as a more versatile energy source. Economic development has enabled governments to generously subsidize the production of fuels from renewable energy sources. Special attention is paid to energy efficiency which is reflected in decreasing of consumption which partially reduces oil dependence. Both electric and hybrid cars are becoming increasingly popular in traffic. Taking care of environmental protection and climate change imposes ecology as an important factor. Implications imposed are huge companies' investments in advanced technology and innovation. Indicators are constant economic development where GDP is rising, traffic is continuing to grow, as well as the level of population mobility. The construction of nuclear power plants supports the entire energy sector and has become more accepted in the public eye. Company strategies in this scenario-based direction are primarily aimed at restructuring towards alternative energy sources. It is important to timely modernize technological and move to promote the new generation of fuel so that the market leaders provide sufficient amounts of fuel to a deficit market.

Old Glory. Due to the stagnation in the economy and reduced volume of many economic activities, demand for motor fuels is also falling, while

the availability of oil is continuously high. Companies in the region have large unused availability of capacity due to the fall in consumption, with high fixed costs. Low prices are also contributing to the reduction of income and funds available for development. Technology becomes obsolete since the economic situation is not favourable to investment and modernization. Environmental management is completely deteriorated, standards are neglected, a new alternative energy sources are not even remotely innovated as proscribed by instructions and laws requirements. Energy efficiency is poorly developed which is degraded as secondary with regard to readily available raw materials and lack of funds for investment in the energy efficiency system. The energy obtained by exploiting renewable energy also has a very small percentage in the total consumption. Implications are the decline in the attractiveness of the oil business without a prospect of global recovery, consolidation and divestments of unused refining capacities and unprofitable parts of the retail network. Indicators are reflected in a large decline in demand, price deflation, a constant decline in GDP, the recession, causing decrease in the mobility of the population, reducing the value of the shares of oil companies and high illiquidity. Strategic moves demanded by the situation include optimizing operational performance with minimal employed capacity, narrowing of all activities with no market demand. Technology is maintained sufficient for operating without major investments and modernization.

Great Thirst. The economic stagnation and low availability of oil is determined by economic instability, geopolitical conflicts and deepening of the financial crisis. Due to low or negative economic growth, demand for oil and its derivatives have been reduced to the minimum amount. The availability of oil is decreasing, as the world's oil reserves have already been exhausted while the lack of resources prevents investment in technology development and improvement in the process of exploration and extraction of oil, and later, processing and distribution of oil. Oil prices steady decline after initial rise due to the scarcity of the raw material and the reduced sales volume, resulting in lower earnings for all market participants, and thus the value of the company. Alternative fuels are being developed, in direction of renewable energy sources such as wind, sun and water potential. Electricity occupies a significant role in the transport sector as available and already well-known energy source, without larger investment needs in exploration. The use of resources and the transfer of knowledge and experience provide potential existence in the context

of large global corporations that have the power to endure in the market and in the most unfavourable business conditions. Implications of this scenario are characterized by the poor economic situation in the market which causes the acquisitions of smaller, feebler companies by large predators. Indicators which lead to this scenario-based direction are reduced GDP and economic activity, transport sector in decline, especially in terms of mobility of the population and goods. Geopolitical disputes are being led regarding the oil exploitation, reflected in a decreasing availability and the rapid growth rate generating a decline in consumption, decline in stock prices of leading smaller companies in the region and their illiquidity.

Conclusion

The role and the application of scenario analysis is presented through a number of approaches and schools that served as the basis for the scenario of Croatian and regional oil industry development. It is important to understand the explained steps, and to be able to apply them in correct way to create were prepared scenarios which include all necessary attributes.

In this regard, the scenarios made for future development, aim to represent a framework for the future development of companies with the respective signals that alert to the obligation for adjusting the strategy in the coming turbulent period. Their development path was presented with the future strategic shifts within their basic activities, their investment and expansion in the market, adapting to new trends in the oil business, their competitive environment, and attempts to spread via the acquisition or establishment of strategic alliances. Also, geo-political conditions were processed on the regional market where these businesses actually operate.

Drafting of scenarios in this paper was carried out with the help of qualitative research and in-depth interviews with experts who gave their reflections on key issues affecting the development scenarios in the oil business. Different and also the uncertain factors that can potentially lead to dramatic changes in the global, regional and ultimately Croatian oil market were taken into account. With the help of their augmented and creative visions for the future oil business development, future development scenarios were made.

However, there are some limits of research in terms of focus on specific questions by the experts and also their dedication and impartiality

in answering. The interpretation of collected qualitative data also represents a particular challenge and a potential limit as claims of experts have to be transposed in the codes and then in the conclusions, and if there is any mistakes in the process, then it is possible that the final interpretation is also partly incorrect. The recommendation is to try to cover a wider group of experts and subsequently find credibility in the answers to make sure that we properly interpret the claims of experts and that we brought the correct conclusions based on them.

As final conclusion, the use of scenario planning in the oil industry of Croatia and the region is a relatively new technique, and as such, is an innovation in strategic thinking and a challenge in the application and adaptation of the same strategies in local oil companies in order to prepare for the energy (but also geostrategic) battle of oil giants from the East and the West. By using scenario planning, local companies can improve their competitive strengths, therefore it is highly recommended to start thinking proactive on future development of oil industry our region.

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Corporate Governance Quality in Selected Transition Countries

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Important questions that concern the notion of good corporate governance focus on what good corporate governance is, who benefits from good corporate governance, and how corporate governance quality can be measured. The aim of our study was to broaden our understanding of the role of standards and codes of good corporate governance in improving governance practices. We found that not only formal regulations, standards, and governance codes, but also corporate governance indices-which make the assessment of companies' governance practices possible-are important in measuring and improving governance quality. The results of the research based on the SEECGAN Index methodology indicated that mandatory requirements and voluntary recommendations of high governance standards had a positive impact on the corporate governance practice in Slovenia.

Key Words: corporate governance, index, quality, transition country
JEL Classification: G34, P20

Introduction

Numerous cases of fraud, accounting scandals, and other business failures in companies worldwide, often leading to lawsuits or even bankruptcy, have made corporate governance an extremely important topic in academic and professional discussion and research. Behind these cases is an assumption that the major cause of these problems lies in bad corporate governance (Larcker and Tayan 2011). In order to prevent such deviations in corporate governance, several formal regulations (i.e., hard law) as well as informal guidelines, recommendations and codes (i.e., soft law), and standards have been developed on the national and global level. Many of them have been proposed and established by different professional and international associations (e.g., OECD, ECGI, IFAC, SAC, IAASB) in different fields (e.g., legal, accounting, audit). Their main purpose is to

determine basic rules and recommendations of good governance. Their abundance and content differ across national economies, reflecting the specifics of the national economy as well as the prevailing governance system (e.g., 'shareholder centric' in the UK and US or 'stakeholder centric' in Germany). However, some research studies have shown that systems of corporate governance in different surroundings have been converged (Nestor and Thompson 1999; Martynova and Renneboog 2010).

The main questions that we address in this paper are how a quality corporate governance system of a particular company or state can be defined, explained, and developed; which criteria should be considered in assessing corporate governance quality; and who should recognize the quality in order for investors to approve it and react. We focus our empirical research on transition economies where we are lacking in-depth insights into the specifics of corporate governance practices and their quality (Zattoni and Van Eees 2012; Kumar and Zattoni 2015).

In light of the previously stated research questions, we have structured our contribution in several chapters. The first chapter introduces the issues. In the second chapter, we explore some global approaches for improving the quality of corporate governance, among which special attention is devoted to standardization, corporate governance codes and 'comply or explain' principles, and different attempts to measure the corporate governance quality. In particular, we explore the most recent approach to measuring corporate governance quality using the SEECGAN Index, developed to address special circumstances in transition countries. In the third chapter, we present research on the corporate governance quality using the case of Slovenia. We discuss the research results related to the quality of corporate governance measured by the SEECGAN Index in Slovenia and provide findings from the comparative analysis of corporate governance with a selected transition country. We conclude our contribution with cognitions on expected future development in this field.

Good Corporate Governance

Good corporate governance is expected to reduce agency costs and information asymmetry stemming from separation between ownership and control (Bauwhede and Willekens 2008; Healy and Palepu 2001). Sound corporate governance is characterized by effective monitoring and disciplining mechanisms that should prevent the opportunistic behaviour of top managers (Renders, Gaeremynck and Sercu 2010; Tipurić et al. 2016) and provide a framework for the protection of shareholder inter-

ests (Patel and Dallas 2002). It encourages excellence and the optimal use of available resources, leading to improved company performance (Renders, Gaeremynck and Sercu 2010).

Traditionally, the governance literature has defined two governance systems. The open (Anglo-American) system of corporate governance is characterized by a fragmented ownership structure, an active market for corporate control, strong shareholders rights, and short-term equity financing. The closed (Central European) system of corporate governance is characterized by long-term debt financing, concentrated block holder ownership, inactive markets for capital control, and a substantial role of banks (La Porta, Lopez-de-Silanes, and Shleifer 1999; Larcker and Tayan 2011; Renders and Gaeremynck 2012). Solutions for corporate governance problems differ in these two systems. The market for corporate control and managerial compensation are prevalent mechanisms in the open system of corporate governance. In the closed system, control by large shareholders together with the board is the dominant mechanism for aligning the interest of managers and owners (Larcker and Tayan 2011; Tipurić et al. 2016).

STANDARDS AND PRINCIPLES OF GOOD CORPORATE GOVERNANCE

The OECD (2015) traditionally establishes standards, principles, and recommendations for good corporate governance. The proper and good execution of the competences of the management bodies are presented and explained in different corporate governance codes worldwide. Professional accounting, auditing, and other organizations (IFAC, IASB, etc.) prepare the accounting and auditing standards that should be followed by internal and external auditors in order to establish and/or supervise the execution of the competence of the different management bodies of the corporations. The assessment of the quality of the particular process of the production, services, organisation, etc., is also realized by quality standards such as ISO 9000, ISO 14000, ISO 26000, and EFQM.

ISO 14001 concerns the field of environmental management systems, environmental assessment, environmental performance evaluation, etc. Derivative standards derived from this standard are conducted to meet the requirements. ISO 14030+ represents the direction to achieve the performance and control of environmental management systems. All this concerns the attitude and conduct of the management of public companies regarding the environment and includes issues of reporting to share-

holders as well as the enforcement of sustainable development policies of public companies).

ISO 26000 (International Organization for Standardization 2010) standard on social responsibility concerns organizations' activities to implement social responsibility. This standard started to develop more intensively in 2010. It provides only guidelines regarding the operation of the management bodies, which at this stage of development cannot yet be certified. Instead, this standard clarifies the concept of social responsibility and its contents. This allows businesses and organizations to follow the principles of social responsibility and translate them into measures providing the best management practices in the field of social responsibility (ISO 26000).

All such activities need to be reported to the shareholders. The obligations to report non-financial data have recently been demanded at the European Union level as well. The tendencies to standardize the reporting of non-financial aspects are detected in the terms of Accounting Directive 2013/34/EU (The European Parliament and the Council of the European Union 2013).

The assessment of practices and standardized operations of enterprises in several directions, not just in terms of production processes, are taking the path to the future (ISO 26000). They raise the question of how to report the demands and the pursuit of excellence to shareholders, which are corporate governance matters. Information for investors about the methods and consideration of the factors of the environment and sustainability are becoming increasingly important for stakeholders as well. They concern questions of the quality of the general leadership and management of companies and the costs created in these processes. They concern the general attitudes about corporate governance.

OECD 2015 principles of corporate governance target the following topics to enable equitable and fair relationships and treatments:

- Ensuring the basis for an effective corporate governance framework.
- The rights and equitable treatment of shareholders and key ownership.
- Institutional investors, stock markets, and other intermediaries.
- The role of stakeholders in corporate governance.
- Disclosure and transparency.
- The responsibilities of the board.

OECD principles 2015 stress the importance of high ethical standards, stating they are in the long-term interests of the company as a means to make it credible and trustworthy-not only in day-to-day operations, but also with respect to longer-term commitments. The overall framework for ethical conduct goes beyond compliance with the law, which should always be a fundamental requirement.

CG CODES AND 'COMPLY OR EXPLAIN' PRINCIPLE

Corporate governance (CG) codes play a crucial role in improving corporate governance practice (Nowland 2008). In most EU member states, compliance with CG codes and disclosure on corporate governance systems and practices are largely voluntary and based on the 'comply or explain' principle. The 'comply or explain' approach is the most common approach to corporate governance in the world. In addition to the EU member states, it is applied in Australia, New Zealand, Singapore, Hong Kong, and many other countries. The main idea of establishing and using CG codes stems from differences in the type and severity of agency costs that reflect the companies' ownership and control structures. As the ownership and control structures differ across countries and industries, corporate governance regulations (i.e., mandatory and voluntary ones) and practices should reflect such differences.

Another approach for regulating corporate governance is the 'one size fits all' corporate governance regulation, which is the legislated mandatory governance model (e.g., the most well-known version is the SOX-based regime in the US) that prescribes the same corporate governance practices for all types of companies (Bauwhede and Willekens 2008; Luo and Salterio 2014; Renders and Gaeremynck 2012). In Asian countries, considerable pressure has been placed on companies to improve governance practices due to the crisis. Voluntary corporate governance codes have been established in order to encourage companies to improve their governance and transparency practice and disclose more information in a timelier manner to different groups of stakeholders (Nowland 2008).

In Slovenia, the first CG code (i.e., Code of Governance of Public Companies) came into force in March 2004. The Ljubljana Stock Exchange, the Managers' Association of Slovenia, and the Slovenian Directors' Association adopted it. Several changes were introduced in 2005 and 2007; in 2009, a new code (Ljubljanska borza 2009) was enforced and is still in power in Slovenia. The provisions of the Slovenian CG Code have the nature of recommendations, which are not legally binding; the main pur-

pose of this code is to define in more detail the governance and management principles of public companies and to recommend such principles to companies that have not gone public, but have the form of a joint stock company. Public companies should disclose any deviations from this code and reasons for them. Non-public joint stock companies that base their corporate governance statement on the Slovenian CG Code (Ljubljanska borza 2009) must also disclose all such deviations following the 'comply or explain' principle.

Few analyses have been carried out regarding the implementations of the CG codes in Slovenia (Djokić 2012; Ljubljanska borza 2012; 2015). The Ljubljana Stock Exchange, together with the Slovenian Director's Association, conducted the last analysis on the disclosure of the explanations of deviations from the Slovenian CG Code (Ljubljanska borza 2009) of the corporations between 2011 and 2014. A much bigger sample of companies was included in the analysis than in the previous one (i.e., 58 companies for 2011 and 2013, 57 companies for 2012, and 60 companies in 2014, all listed on the Ljubljana Stock Exchange). The results of the analysis show that the number of companies using the Slovenian CG Code (Ljubljanska borza 2009) increased from 63.8% in 2011 to 71.7% in 2014. The great majority of companies do not use any other corporate governance codes, even though the law enables such a solution. The average compliance with the Slovenian CG Code (Ljubljanska borza 2009) was 89.8% in 2011, 90.6% in 2012, 89.9% in 2013, and 89.8% in 2014. Half of the most frequent deviations are those from the transparency principles and recommendations. The results of the analysis show several improvements in corporate governance practice in Slovenia that follow the regulations of the legislation (i.e., Companies Act) and the provisions of the Slovenian CG Code (Ljubljanska borza 2009).

CORPORATE GOVERNANCE RATINGS AND INDICES

The idea of measuring corporate governance quality is a relatively new concept, and several approaches have been developed thus far (Daines, Gow, and Larcker 2009; Larcker and Tayan 2011; Renders, Gaeremynck, and Sercu 2010; Tipurić, Dvorski, and Delić 2014). One group of these approaches uses the form of ratings; numerous examples have been developed by consulting companies (e.g., Risk Metrics/ISS, Governance Metrics International/GMI, and the Corporate Library/TCL). The major purpose of such approaches is to rank companies by applying a set of corporate governance criteria. Companies with higher ratings are considered

to be less risky and the most likely to grow the value for shareholders whereas those with lower ratings are believed to be riskier and have a higher potential for failure or fraud (Larcker and Tayan 2011). Some research results (Renders, Gaeremynck, and Sercu 2010) show a positive relationship between corporate governance ratings and performance. Nevertheless, Daines, Gow, and Larcker (2009) believe that commercial ratings do not provide useful information for shareholders as they 'do not predict governance-related outcomes with the precision or strength necessary to support the bold claims made by most of these firms' (p. 1). According to Larcker and Tayan (2011), the accuracy and predictive power of different ratings have not yet been proven. In the authors' opinion, ratings encourage a 'check-the-box' approach to governance while overlooking important contexts. The authors suggest that measuring corporate governance quality should be approached on a case-by-case basis that considers the interaction of various governance structures influencing the company's performance.

Another group of approaches takes the form of indices. Academic researchers in particular have been trying to develop models to measure corporate governance quality (Larcker and Tayan 2011). Corporate governance indices differ regarding governance dimensions incorporated in a particular index (Tipurić, Dvorski, and Delić 2014). Academics usually incorporate those governance dimensions in indices that they find to be an important component of good corporate governance practice (Bhagat and Bolton 2008; Larcker and Tayan 2011). A corporate governance index should make possible a comparison of a company's corporate governance practice with governance regulations and recommendations that are considered to be examples of the best governance practices (Tipurić, Dvorski, and Delić 2014).

According to Tipurić et al. (2016), there are several reasons for the development and implementation of corporate governance indices. First, corporate governance indices could significantly contribute to the governance regulatory framework and companies by providing an incentive to adopt better practices of corporate governance. Second, a corporate governance index calculated for a particular company provides important information to the investment community and other groups of key stakeholders. Third, companies with a higher index (i.e., with better assessed corporate governance practice) can develop on this basis a competitive differentiation in the market and consequently long-term business success and survival.

The SEECGAN Index and Its Application in Transition Countries

THE SEECGAN INDEX METHODOLOGY

The beginnings of the application of the SEECGAN Index of Corporate Governance for measuring corporate governance dates back to 2014, when the index was published as the result of research efforts of the members of the South East Europe Corporate Governance Academic Network. At the time, members were invited to apply the SEECGAN Index methodology in their countries in order to make possible comparisons of corporate governance practice and its quality in South Eastern European countries (i.e., Croatia, Bosnia and Herzegovina, Serbia, Montenegro, Slovenia, and Macedonia). The application of this methodology not only enables an in-depth study of governance practice and its quality in a particular company, but also provides insights into the quality of corporate governance within a national economy and makes it possible to compare governance practice among those countries where the same methodology is applied. This is especially important for former socialist countries sharing many historical, cultural, political, and economic similarities that make such comparison a fruitful approach for improving corporate governance practice and quality.

In order to provide comprehensive insights into such a complex phenomenon as corporate governance and to assess its quality, the SEECGAN Index methodology is based on seven broad categories believed to reflect the major corporate governance areas. These categories are (Tipurić, Dvorski, and Delić 2014; Tipurić 2015): (1) structure and governance of boards, (2) transparency and disclosure of information, (3) shareholders' rights, (4) corporate social responsibility, (5) audit and internal control, (6) corporate risk management, and (7) compensation/remuneration. In the case of Slovenia, the first category is divided into two subcategories (i.e., structure and governance of management board, and structure and governance of supervisory board) in order to reflect the country's specifics. Namely, the legal framework in Slovenia enables joint-stock companies to decide between a one-tier or a two-tier governance system. In the case of a two-tier governance system, two separate boards exist in a corporate structure system: the management board and the supervisory board (Djokić et al. 2015; Tipurić et al. 2016).

For each of the previously mentioned categories, several questions were prepared for measuring purposes; each question can be answered

in the affirmative or negative in order to ensure objectivity (Patel and Dallas 2002; Tipurić 2015). A ponder is assigned to each question because the SEECGAN Index is developed as a weighted index. The score is then calculated for each category, presenting an index of that particular category, where the maximum score is 10 (describing the best possible practice) and the minimum score is zero (describing the worst possible practice). The overall SEECGAN Index score is the average value of scores of all seven categories, with zero being the lowest value and 10 being the maximum index value. The SEECGAN Index methodology enables the classification of the explored companies in different groups based on their index score (either of a particular category or for all categories). First-class companies are those where the value of the SEECGAN Index is equal to or higher than 7.5. Companies with good governance practice are those where the value of index is equal to or higher than 5.00 and lower than 7.5. Companies with unsatisfactory governance are those with the index value equal to or higher than 2.5 and lower than 5.00, and companies with poor governance practice have an index value lower than 2.5 (Tipurić 2015).

CORPORATE GOVERNANCE QUALITY IN SELECTED TRANSITION COUNTRIES

Sampling and Data Collection

During 2014–2015, the SEECGAN Index methodology was applied in three countries: Slovenia, Croatia, and Macedonia. A comparison of corporate governance practices among these three countries is possible and worth exploring because, in all three countries, the closed system of corporate governance is present and they have similar historical backgrounds. However, there are some indications that they differ regarding the developmental level of corporate governance mechanisms (Tipurić et al. 2016).

Research in Slovenia was done on a sample of 22 public companies listed in June 2014 on the Ljubljana Stock Exchange. Of these 22 companies, nine were companies of the prime market and 13 of the standard market (Djokić et al. 2014). The standard market is intended for larger companies that have a dispersed ownership structure and high levels of transparency of their operations while the prime market is a prestigious market intended for larger established companies renowned for their liquidity and transparency of operations (see http://www.ljse.si/cgi-bin/jve.cgi?doc=8371). Companies' annual reports were the major source

of data. These annual reports also comprise corporate governance statements, in which companies disclose their compliance with the Slovenian Corporate Governance Code. Additional data were collected from the companies' websites (internal acts of the management boards, documents, reports, information for different groups of stakeholders). Governance practice for every company from the sample was assessed using 98 attributes based on the SEECGAN Index methodology. The results of the assessments were stored in computer files. The database (Djokić et al. 2014) for our study was created this way to enable an in-depth investigation of governance practice of a particular company and comparisons among companies from the sample as well as comparisons with countries that applied the same index methodology (i.e., Croatia and Macedonia).

In Croatia, 32 firms listed on the Zagreb Stock Exchange participated in the survey by responding to a questionnaire prepared based on the SEECGAN Index methodology. Half of the surveyed companies were listed on the official market and half on the regular market (Tipurić 2015). In Macedonia, 29 companies were included in the ongoing research (Vrboski and Hadzivasileva Markovska 2016; Tipurić et al. 2016). Research teams analysed responses and collected additional information from the companies' websites; when needed, interviews with responsible persons were conducted.

Results and Discussion

In this section we present research results on the corporate governance quality for Slovenia and the results of a comparative analysis with Croatia, for which detailed results were published in 2015 (Tipurić 2015). A comparative analysis with Macedonia was able only on the aggregated level because not all detailed results are available yet.

The average SEECGAN Index score of the listed companies in Slovenia is 5.49 (figure 1). Thus, the average listed company in Slovenia is characterized by good corporate governance practice. The best first-class company in terms of governance quality achieved an 8.16 SEECGAN Index score while the lowest score was 2.26, indicating the presence of poor governance practice in that company. Research results show that half of the surveyed companies in Slovenia have a SEECGAN Index score greater than 5.26. That is true for the majority of prime market companies, leading to the conclusion that mandatory requirements and voluntary recommendations for the presence of high corporate governance standards-especially for prime market companies-actually have a positive impact on corporate governance practices.

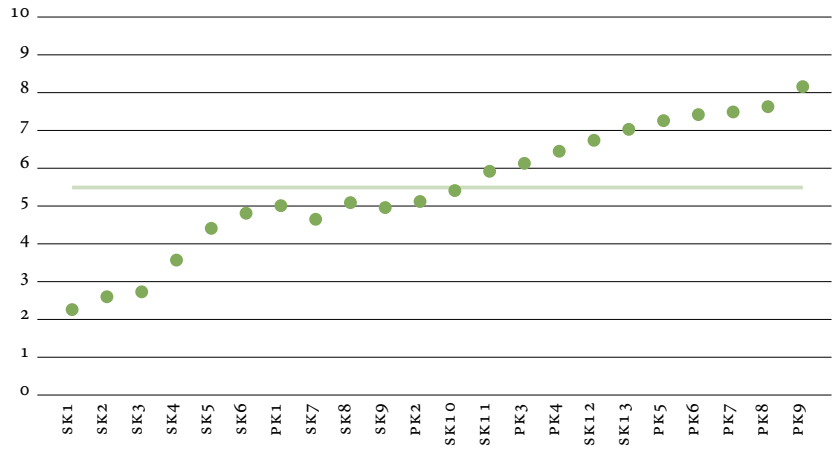

FIGURE 1 Companies' and Average Corporate Governance Index for Slovenia Based on the SEECGAN Index Methodology (dark – company's CG Index, light – average CG Index, PK – prime market companies, SK – standard market companies)

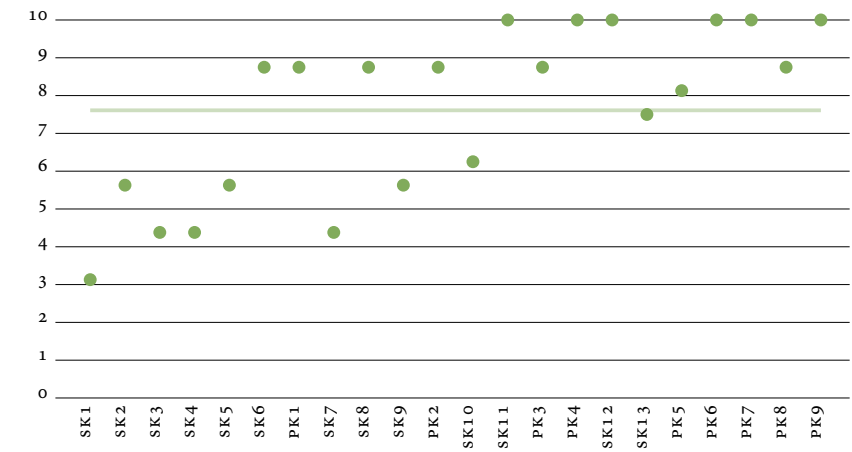

FIGURE 2 Companies' and Average Index in Risk Management Category (dark – company's Category Index, light – average Category Index, PK – prime market companies, SK – standard market companies)

Companies achieved the highest average index score in the risk management category (figure 2). The average company was assessed as a first-class company in this corporate governance category with an index score of 7.61. Half of the companies in this category have index scores higher than 8.75, indicating the first-class practice of risk management in such companies. Six companies (four prime market and two standard market companies) achieved the maximum index score in this category; all six

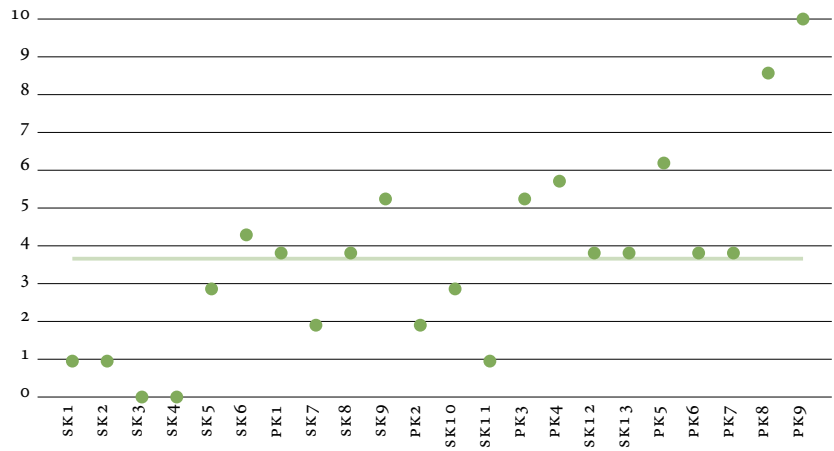

FIGURE 3 Companies' and Average Index in Social Responsibility Category (dark – company's Category Index, light – average Category Index, PK – prime market companies, SK – standard market companies)

companies were also above average for the total index score (see figure 1). The lowest score in this category was 3.13, indicating unsatisfactory risk management practices in that company (SK1). This was achieved in the company ranked as having the worst corporate governance practice among all the companies in the sample.

The category in which surveyed companies display poor and unsatisfactory governance practice is the social responsibility category (figure 3). An average company has unsatisfactory social responsibility practice, with an index score of 3.66 in this category. In this category, we can observe the highest deviation from the mean (2.55), and two companies even achieved a 0.00 index score. Seven companies were evaluated as having poor social responsibility practice, with an index score ranging from 0.00 to 1.90. Among these companies, one company (SK11) achieved an above average total CG index score. The by far best result in this category was company PK9 (with an index score of 8.57), which was also the highest ranked company on the total CG index. The results in this category indicate that, on one hand, academics' and professionals' special attention is needed on how to improve social responsibility practice; on the other hand, the SEECGAN Index methodology should be checked for this category and eventually improved. This could be done by using an in-depth study of individual cases and comparing the results and experiences among participating countries that apply the SEECGAN Index methodology in this category.

TABLE 1 Corporate Governance Index in Slovenia and Croatia Based on the SEECGAN Index Methodology

SEECGAN Index	Slovenia	Croatia
Total	5.49	3.91
Transparency and Disclosure of Information	6.62	4.91
Structure and Governance of Supervisory Board	5.66	3.19
Structure and Governance of Management Board	4.49	
Shareholders' Rights	4.79	4.66
Corporate Social Responsibility	3.66	4.03
Corporate Risk Management	7.61	3.87
Compensation/Remuneration	4.74	2.34
Audit and Internal Control	6.36	4.47

A cross-country comparison shows that corporate governance practice in Slovenia is better evaluated than in Croatia and Macedonia. Companies in Croatia have on average unsatisfactory governance practice, with an index score of 3.91 (Tipurić 2015). The same is true for Macedonia as well, where the average SEECGAN Index is 4.09 (Vrboski and Hadzivasileva Markovska 2015). The comparison of research results between Slovenia and Croatia indicates better corporate governance practice in all the SEECGAN Index categories in Slovenian companies with the exception of the social responsibility category (table 1). This is the lowest ranked category in Slovenia, while in Croatia social responsibility is ranked as the fourth best evaluated governance category. A comparison of the risk management category, where Slovenian companies on average have first-class practice and the category itself is ranked as the best evaluated category, shows that this category in Croatian companies ranks fifth (lower than social responsibility category), with an average index score of 3.87. The risk management category has the biggest differences among Slovenian and Croatian companies. A comparison of the research results between Slovenia and Croatia indicates that several differences exist in the corporate governance practice, calling attention to need for a more detailed analysis of particular categories and cases.

Conclusions

The state and quality of the corporate governance have been presented and evaluated in a particular company using different standards and principles or indexes and methodologies, which concern good practice and

show as well as measure the execution of the competences of the governance and management bodies in practice while also expressing the level of corporate governance. The results of corporate governance can also be summarized at the national level to provide investors, shareholders, and stakeholders with faster and more efficient access to the information on corporate governance.

The use of the SEECGAN Index and corresponding methodology in this article provided insights into the corporate governance practice and its quality on the national level, thereby pointing to those areas needing improvements by either mandatory or voluntary regulations and recommendations. The use of the same methodology in a similar context (i.e., in Slovenia, Croatia, Macedonia) enabled comparisons of the state of governance across these transition countries as well as the analysis of differences and similarities. Our cross-countries comparison showed that corporate governance practice in Slovenia is of better quality than in Croatia and Macedonia. However, despite this finding, our research results show that improvements are required in Slovenian companies, especially in those corporate governance segments where governance practice is evaluated as unsatisfactory. These segments need additional research, either as case studies or as the exploration of good practices in an international context with similar contexts. This should serve to develop proposals of measures to improve corporate governance practices at the company as well as national level.

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Privatization and Optimum-Welfare in an International Cournot Duopoly

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In this paper, we will analyse the relationship between privatization of a public firm and tax revenue for the domestic government in an international competition, with import tariffs. We consider a duopoly model where a domestic public firm and a foreign private firm compete in the domestic market, as Cournot players. Furthermore, the domestic government imposes a tariff to regulate an imported good, and may have a higher preference for tariff revenue than for social welfare. We compute the outputs at equilibrium and we show that privatization (i) will increase the profits of both domestic and foreign firms; (ii) will increase the tariff imposed to the imported good; and (iii) will decrease the domestic welfare. Furthermore, we demonstrate that a rise in the government's preference for tariff revenues raises the social welfare in both mixed and private models.

Key Words: game theory, industrial organization, Cournot model, privatization
JEL Classification: C72, L33

Introduction

Mixed oligopolies, where a public firm competes with private firms are common in developed and developing countries. Public firms compete against private firms in many industries, such as airlines, banking, electricity, steel, and so on.

Ferreira and Ferreira (2014) analysed the relationship between the privatization of a public firm and government preferences for tax revenue in a duopoly model, by assuming that the government payoff is given by a weighted sum of tax revenue and the sum of consumer and producer surplus. De Fraja and Delbono (1989) showed that privatization of the public firm may improve social welfare. Pi, Yang, and Zhou (2013) and

Ferreira and Ferreira (2016) investigated the economic impacts exerted by privatization in a model that considers environmental problems. They showed that, when the residents' environmental preference is introduced to the public firm's payoff function, privatization may increase the public firm's output, decrease the private firm's output and has no effect on social welfare. White (1996) studied effects of domestic production subsidies in a mixed oligopoly market. Pal and White (1996) investigated the effects of privatization in the presence of strategic trade policies in a market with foreign firms. In a mixed duopoly, Matsumura and Ogawa (2010) analysed whether private leadership or public leadership is robust in the observable delay game. They showed that private leadership is more robust than public leadership. Some authors examine price-setting mixed market models (see, for instance, Bárcena-Ruiz 2007 and Ohnishi 2011).

Many works on mixed oligopoly analysed domestic competitions. However, more recent literature in this field of industrial organization includes foreign private firms. The introduction of foreign firms affects, or may affect the results, since the social welfare does not include the producer surplus of the foreign firms (see Fjell and Pal 1996). Lee, Xu, and Chen (2013) showed that the equilibrium degree of privatization depends not only on the relative efficiency of the public firm, but also on trade policy. Moreover, they also demonstrated that competitive privatization with a tariff achieves a higher degree of privatization than without a tariff.

In this paper, we analyse the effects of privatization in a domestic market served by a domestic public firm and a foreign private firm, by assuming that the government imposes an import tariff. Furthermore, we allow the government may prefer tariff revenue more than social welfare. We show that increasing the government's preference for tariff revenues leads to reduction on the aggregate quantity in the mixed market, while the opposite is true after privatization of the public firm. Furthermore, a rise in government's preference for tariff revenues raises domestic public firm's profit; but it lowers domestic privatized firm's profit. Moreover, as the government's preference for tariff revenues increases, the social welfare becomes higher in both mixed and private models.

The remained of the paper is organised as follows. Section 2 describes the mixed model in which the government may prefer tariff revenue to the sum of consumer and producer surplus. In Section 3, we compute and analyse the equilibrium outcome. Section 4 solves the privatized model. In Section 5, we do a comparative static analysis. Section 6 compares the two models. Section 7 concludes the paper.

The Mixed Model

We consider an international mixed duopoly with one domestic public firm F_d and one foreign private firm F_j. We assume that both firms produce a homogeneous good and the market demand is given by

$$p = 1 - q_d - q_f,$$

where p is the price, q_d is the quantity produced by the domestic public firm and q_f is the quantity produced by the foreign private firm. Both firms have the same quadratic cost function

$$C(q_i) = \frac{q_i^2}{2}, \quad i = d, f.$$

Furthermore, we assume that the government of the domestic country imposes a tariff t on imported goods.

So, each firm's profit function is defined by

$$\pi_d = (1 - q_d - q_f)q_d - \frac{q_d^2}{2},$$
$$\pi_f = (1 - q_d - q_f)q_d - \frac{q_f^2}{2} tq_f.$$

The domestic public firm chooses its output that maximizes the sum of consumer's surplus and domestic producer surplus:

$$W = CS + PS = \frac{1}{2}(q_d = q_f)^2 + \pi_d.$$

The government's payoff is given by

$$U = W + (1 + \alpha)R,$$

where $R = tq_f$ and α is the parameter that represents the weight of the government's preference for tariff revenues. We consider $\alpha \geq 0$, i.e., the government values tariff revenues R more than social welfare W.

The timing of the game is as follows:

- In the first stage, the government sets the import tariff t;
- In the second stage, each firm, independent and simultaneously, chooses its quantity q_i, $i = d, f$, knowing already the import tariff imposed by the government.

Analysis of the Mixed Model

To obtain a subgame perfect equilibrium, the game is solved by backwards induction.

So, we differentiate the function W with respect to q_d and the function π_f with respect to q_f:

$$\frac{\partial W}{\partial q_d} = 1 - 2q_d = 0,$$
$$\frac{\partial \pi_f}{\partial q_f} = 1 - q_d - 3q_f - t = 0.$$

The above first order conditions yield the following results:

$$q_d^M = \frac{1}{2}, \quad q_f^M = \frac{1-2t}{6}.$$

Thus, the government's payoff function U can now be rewritten as

$$U = \frac{19 + 8t - 20t^2 - 12\alpha t(2t-1)}{72}.$$

Maximizing the function U, with respect to t, we get

$$\frac{\partial U}{\partial t} = \frac{2 - 10t - 3\alpha(4t-1)}{18} = 0,$$

which gives

$$t^M = \frac{3\alpha + 2}{2(6\alpha + 5)}. \tag{1}$$

By using (1), we get the following output level at equilibrium:

$$q_f^M = \frac{\alpha + 1}{2(6\alpha + 5)} \tag{2}$$

Furthermore, the aggregate quantity Q^M in the market, the firms' profits, consumer surplus, social welfare, tariff revenue and the government's payoff are given by:

$$Q^M = \frac{7\alpha + 6}{2(6\alpha + 5)},$$
$$\pi_d^M = \frac{4\alpha + 3}{8(6\alpha + 5)}, \quad \pi_f^M = \frac{3(\alpha + 1)^2}{8(6\alpha + 5)^2},$$
$$CS^M = \frac{(7\alpha + 6)^2}{(6\alpha + 5)^2},$$
$$W^M = \frac{73\alpha^2 + 122\alpha + 51}{8(6\alpha + 5)^2},$$
$$R^M = \frac{(\alpha + 1)(3\alpha + 2)}{4(6\alpha + 5)^2},$$
$$U^M = \frac{\alpha^2 + 14\alpha + 11}{8(6\alpha + 5)}.$$

The Privatized Duopoly

Now, let us consider the case where the public firm is privatized without cost. So, the objective function of the privatized firm F_d is now its profit

$$\pi_d = (\alpha - q_d - q_f)q_d - 1\frac{1}{2}d_d^2. \tag{3}$$

Utilizing the same way of calculation as in the previous sections, we get the following result (throughout the paper, we use the notation subscript P to refer to privatized firm):

$$t^P = \frac{2(8\alpha + 7)}{48\alpha + 41},$$

$$q_d^P = \frac{2(7\alpha + 6)}{48\alpha + 41}, \quad q_f^P = \frac{6\alpha + 5}{48\alpha + 41},$$

$$\pi_d^P = \frac{6(7\alpha + 6)^2}{(48\alpha + 41)^2}, \quad \pi_f^P = \frac{3(6\alpha + 5)^2}{2(48\alpha + 41)^2},$$

$$CS^P = \frac{(20\alpha + 17)^2}{2(48\alpha + 41)^2},$$

$$W^P = \frac{988\alpha^2 + 1688\alpha + 721}{2(48\alpha + 41)^2},$$

$$R^P = \frac{2(6\alpha + 5)(8\alpha + 7)}{(48\alpha + 41)^2},$$

$$U^P = \frac{(4\alpha^2 + 28\alpha + 21}{2(48\alpha + 41)}.$$

Numerical Example

Here, we present an example that will help us to illustrate the results presented in the paper. Consider a market with the parameter α, representing the weight of the government's preference for tariff revenues, equal to 0.5.

Table 1 shows the results for the mixed and private markets.

Comparative Static Analysis

Now, we do a comparative static analysis on the results presented above. In the mixed market, the import tariff imposed by the government is increasing in the weight of the government's preference for tariff revenues, while it is decreasing when the market is served only by private firms:

$$\frac{\partial t^M}{\partial \alpha} = \frac{3}{2(6\alpha + 5)^2} > 0, \quad \frac{\partial t^P}{\partial \alpha} = \frac{16}{(48\alpha + 41)^2} < 0. \tag{4}$$

Production of the foreign private firm is decreasing in the government's preference for tariff revenues, when it competes with a public firm, whose

TABLE 1 Results for Mixed and Private Markets

Mixed duopoly	Private duopoly
$t^M = 0.438$	$t^P = 0.338$
$q_d^M = 0.500$	$q_d^P = 0.292$
$q_f^M = 0.094$	$q_f^P = 0.123$
$Q^M = 0.594$	$Q^P = 0.415$
$\pi_d^M = 0.078$	$\pi_d^P = 0.128$
$\pi_f^M = 0.013$	$\pi_f^P = 0.023$
$CS^M = 0.176$	$CS^P = 0.086$
$W^M = 0.254$	$W^P = 0.214$
$R^M = 0.021$	$R^P = 0.042$
$U^M = 0.285$	$U^P = 0.277$

production is constant; after privatization, the production of the domestic privatized firm is decreasing and the production of the foreign private firm is increasing; and the overall effect is that the aggregate quantity in the mixed market is decreasing in the government's preference for tariff revenues, and it is increasing after privatization:

$$\frac{\partial q_d^M}{\partial \alpha} = 0, \quad \frac{\partial q_f^M}{\partial \alpha} = -\frac{1}{2(6\alpha+5)^2} < 0,$$
$$\frac{\partial q_d^P}{\partial \alpha} = -\frac{2}{(48\alpha+41)^2} < 0, \quad \frac{\partial q_f^P}{\partial \alpha} = \frac{6}{(48\alpha+41)^2} > 0,$$
$$\frac{\partial q^M}{\partial \alpha} = -\frac{1}{2(6\alpha+5)^2} < 0, \quad \frac{\partial q^P}{\partial \alpha} = \frac{4}{(48\alpha+41)^2} > 0.$$

Furthermore, in the mixed market, domestic public firm's profit increases in the government's preference for tariff revenues, while foreign private firm's profit decreases; After privatization, domestic privatized firm's profit decreases in the government's preference for tariff revenues, while foreign private firm's profit increases:

$$\frac{\partial \pi_d^M}{\partial \alpha} = \frac{1}{4(6\alpha+5)^2} > 0, \quad \frac{\partial \pi_f^M}{\partial \alpha} = -\frac{3}{4(6\alpha+5)^3} < 0,$$
$$\frac{\partial \pi_d^P}{\partial \alpha} = -\frac{12(7\alpha+6)}{(48\alpha+41)^3} < 0, \quad \frac{\partial \pi_f^P}{\partial \alpha} = \frac{18(6\alpha+5)}{(48\alpha+41)^3} > 0.$$

Consumer surplus decreases in the government's preference for tariff

revenues, in the mixed competition, and it increases when both firms are private:

$$\frac{\partial CS^M}{\partial \alpha} = -\frac{7\alpha + 6}{4(6\alpha + 5)^3} < 0, \quad \frac{\partial CS^P}{\partial \alpha} = \frac{4(20\alpha + 17)}{(48\alpha + 41)^3} > 0.$$

Now, we will do a comparative static analysis on the social welfare. We conclude that social welfare decreases in the government's preference for tariff revenues, in both, mixed and private, models:

$$\frac{\partial W^M}{\partial \alpha} = -\frac{\alpha + 1}{4(6\alpha + 5)^3} < 0, \quad \frac{\partial W^P}{\partial \alpha} = -\frac{4(\alpha + 1)}{(48\alpha + 41)^3} < 0.$$

Effects of Privatization

Comparing the payoff function of the government before and after privatization, we get

$$U^M - U^P = \frac{48\alpha^3 + 39\alpha^2 - 38\alpha - 31}{8(6\alpha + 5)(48\alpha + 41)}, \tag{5}$$

which is positive for values of $\alpha < \alpha_0$ and negative for $\alpha > \alpha_0$, where $\alpha_0 \in (0.89, 0.90)$ and $48\alpha_0^3 + 39\alpha_0^2 - 38\alpha_0 - 31 = 0$. Thus, we get the proposition below.

PROPOSITION 1. *In the duopoly model presented above, the government privatizes the public firm just if it put a high weight on the tariff revenues.*

Comparing the other equilibrium outputs in both mixed and privatized models, we get the following proposition that summarizes the effects of privatization.

PROPOSITION 2. *In the duopoly model presented above,*

(a) Privatization increases the value of the import tariff, the quantity produced by the foreign firm, the profits of both firms and the import tariff revenue;

(b) Privatization decreases the quantity produced by the domestic firm, the aggregate quantity in the domestic market, the consumer surplus and the social welfare.

Conclusions

In this paper, we studied privatization and government preferences for import tariff revenue in an international Cournot model. First, the government chooses the import tariff to maximize a weighted function of social welfare and import tariff revenue. Second, observing the value of

the import tariff, both domestic and foreign firms simultaneous and independently choose quantities. We presented the equilibrium outcomes of the mixed duopoly and of the privatized duopoly.

By doing a comparative static analysis, we showed that as the preference of the government for tariff revenue becomes large, the social welfare decreases in both mixed and privatized market competitions.

Furthermore, we also analysed the effects of privatization, and we concluded that privatization decreases social welfare.

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Prospect Theory Based Portfolio Optimization Problem with Imprecise Forecasts

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In this paper we propose a novel interval optimization approach for portfolio selection when imprecise forecasts are available. We consider investors acting their choices according to the prospect theory, where scenarios are provided in the form of approximate numbers. The resulting constrained nonlinear interval optimization problem is converted into two nonlinear programming problems using a total order relation between intervals. Static and dynamic analysis of portfolios involving assets from the Croatian market illustrate the potential of the method with respect to the standard procedure.

Key Words: prospect theory, random sets, interval orders, interval optimization, Croatian stock market
JEL Classification: C61, C63, G11, G15, G17

Introduction

The relationship between the theory of financial markets and the rational behavior of an individual has been discussed for many years. In particular, many mathematical models have been developed which take into account both the uncertainty deriving from the investments in a certain number of assets (portfolio theory) and the subjective risk aversion of a single investor (utility theory).

The modern utility theory began with Von Neumann and Morgenstern (1947). Their representation theorem asserts that any individual whose preferences satisfy some given axioms has a utility (or value) function, which is concave in case of risk aversion (i.e., refusal of a fair gamble with zero expected value takes place).

Modern portfolio theory (MPT) was introduced by Markowitz (1952; 1959). He adopted a quadratic utility function as a reasonable approximation of a rational investor's behavior with risk-return tradeoffs.

Bawa (1975) and Fishburn (1977) gave proofs that mean-lower partial moment models can implement Von Neumann and Morgenstern utility functions and, at the same time, can be easily related to first, second and third stochastic dominance. In these models the wealth of the investor is replaced by a return rate below a desirable target. A few years later Fishburn and Kochenberger (1979) and Holthausen (1981) introduced their upper and lower partial moment models (UPM-LPM), namely an extension of the previous models.

The prospect theory (PT) was developed in order to find an answer to the concerns arising from the paradoxes of Allais (1953) and Ellsberg (1961). Starting from UPM-LPM models, Kahneman and Tversky (1979) added the notion of a distorted probability, i.e. a nonlinear transformation of the probability scale which possibly overweights small probabilities and underweights moderate and high probabilities.

Since PT does not always satisfy stochastic dominance and it is not easily extended to prospects with a large number of outcomes, both problems can be solved by cumulative prospect theory (CPT), in which the rank-dependent (or cumulative) functional is considered (Tversky and Kahneman 1992). In recent years several nonlinear programming problems have been developed in order to define optimal portfolios achieving the maximum of the utility functions, both in PT and in CPT. De Giorgi, Hens, and Meyer (2007) developed an algorithm that finds the best asset allocation in PT, overcoming the difficulties caused by non-differentiability and non-concavity of the value function. On the other hand, Hens and Mayer (2014) maximized CPT along the Markowitz's mean-variance efficient frontier. They found that the difference between the two methods is negligible in case of normally distributed returns but becomes considerable if asset allocation data for pension funds are considered.

Differently from the aforementioned works on PT and CPT, we consider an extended model for the financial market in which securities have random interval payoffs, but with a fixed underlying probability space as explained in You (2013). The uncertainties are not from probabilities measures but from realizations of random variables. Thus, a random interval is here interpreted as an imprecise perception of a random variable (Miranda, Couso, and Gil 2005) and can be roughly defined as an interval whose two endpoints are random variables.

To the best of our knowledge, this is the first attempt to integrate imprecise forecasts as random intervals into the PT-based portfolio selection model. Moreover, from a computational point of view, we provide a

tractable formulation of the resulting interval optimization problem by means of two nonlinear programming problems. Solutions are detected on the basis of a genetic algorithm, whose efficiency in terms of both robustness and computational costs is also investigated. Static and dynamic analysis are conducted for both standard and interval-based PT portfolios on eight assets from the Croatian stock index. Results illustrate the potential of the proposed model.

The paper is organized as follows. The next section introduces some basic concepts which will represent the building-blocks of the developed model. The standard PT portfolio selection problem is described in the third section with asset returns modeled by means of random variables. The fourth section introduces the model with imprecise forecasts given as interval numbers. A numerical analysis is provided in the fifth section to verify the performance of the suggested optimal portfolios. The sixth section 6 concludes the paper with a summary and some remarks.

Background on Interval Analysis

INTERVAL NUMBERS

Following You (2013), an extended model for the financial market is considered in which securities have random interval payoffs with a fixed underlying probability space. In this environment, the uncertainties are not from probabilities measures but from realizations of random variables. This uncertain, imprecise and incomplete information can thus be incorporated into the portfolio optimization process by expressing data and/or parameters as intervals instead of single values. An adequate algebraic and probabilistic setting has to be defined in order to properly introduce the decision maker actions.

Definition 1. *An interval number, denoted as $\widetilde{a}$, is a bounded and closed subset of $\mathbb{R}$ given by*

$$\widetilde{a} = [a^l, a^u] \overset{def}{=} \left\{x \in \mathbb{R} \mid a^l \leqslant x \leqslant a^u\right\} \tag{1}$$

where $a^l, a^u \in \mathbb{R}$, with $a^l \leqslant a^u$, are the lower and the upper bounds of $\widetilde{a}$, respectively.

This representation of an interval number $\widetilde{a}$ is called endpoints (shortly EP) form. The set of all interval numbers on $\mathbb{R}$ is denoted as $\mathcal{K}_c(\mathbb{R})$.

Remark 1. *Note that if $a^l = a^u$ then $\widetilde{a}$ reduces to a real number.*

The sum of two interval numbers and the product of an interval number by a scalar are defined in terms of the corresponding Minkowski set-theoretic operations.

Definition 2. *For every* $\widetilde{a} = [a^l, a^u]$, $\widetilde{b} = [b^l, b^u]$ *in* $\mathcal{K}_c(\mathbb{R})$ *and* $\gamma \in \mathbb{R}$, *we have*

$$\widetilde{a} + \widetilde{b} \stackrel{def}{=} \left\{a + b \mid a \in \widetilde{a},\ b \in \widetilde{b}\right\} = [a^l + b^l, a^u + b^u]. \tag{2}$$

and

$$\gamma * \widetilde{a} \stackrel{def}{=} \{\gamma a \mid a \in \widetilde{a}\} = \begin{cases} [\gamma a^l, \gamma a^u] & \text{if } \gamma \geqslant 0 \\ [\gamma a^u, \gamma a^l] & \text{if } \gamma < 0. \end{cases} \tag{3}$$

The space $\mathcal{K}_c(\mathbb{R})$ with its arithmetic can be embedded onto the closed convex cone $\mathbb{R} \times [0, +\infty)$ of $\mathbb{R}^2$ by means of the so called t-vector function (Corral, Gil, and Gil 2011):

$$\begin{aligned} t \colon \mathcal{K}_c(\mathbb{R}) &\to \mathbb{R}^2 \\ \widetilde{a} &\mapsto (a^c, a^w) \end{aligned} \tag{4}$$

which maps an interval number $\widetilde{a}$ to an ordered pair of real numbers representing its center a^c and its radius a^w. With an abuse of notation, we will follow the customary of identify $\mathcal{K}_c(\mathbb{R})$ with its copy in $\mathbb{R}^2$. In this manner, a second characterization of an interval number is possible.

Definition 3. *An interval number* $\widetilde{a} \in \mathcal{K}_c(\mathbb{R})$ *is said to be in midpoint-radius (*MR*) form if it is encoded as the following vector of* $\mathbb{R}^2$

$$\widetilde{a} = (a^c, a^w) \stackrel{def}{=} \left(\frac{a^u + a^l}{2}, \frac{a^u - a^l}{2}\right) \tag{5}$$

where a^c *denotes the center of the interval and* a^w *is its half-width.*

By means of Eqn. (5), we can easily move from EP to MR encoding and vice versa. In particular, for every $\widetilde{a} \in \mathcal{K}_c(\mathbb{R})$, we have that

$$(a^c, a^w) = \{x \in \mathbb{R} \mid a^c - a^w \leq x \leq a^c + a^w\} = [a^l, a^u].$$

From these observations it emerges that the former encoding is suitable to introduce algebraic properties of intervals while the latter can be used to exhibit and explicitly manipulate the uncertainty in interval numbers.

RANDOM INTERVALS

We can introduce random intervals by exploiting the EP encoding of interval numbers as follows.

Definition 4. *Let* $(\Omega, \mathfrak{F}, P)$ *be a probability space. A multi-valued mapping* $\Gamma\colon \Omega \to \mathcal{K}_c(\mathbb{R})$, *given by* $\Gamma(\omega) = [\inf\Gamma(\omega), \sup\Gamma(\omega)]$, *where* $\inf\Gamma,\ \sup\Gamma\colon \Omega \to \mathbb{R}$ *are two real-valued functions such that* $\inf\Gamma \leq \sup\Gamma$ *almost surely, is said a random interval if* $\inf\Gamma$ *and* $\sup\Gamma$ *are real-valued random variables.*

A notion associated to the concept of random interval is the following.

Definition 5. *Let* $\Gamma\colon \Omega \to \mathcal{K}_c(\mathbb{R})$ *be a random interval. A random variable* $X\colon \Omega \to \mathbb{R}$ *is said a (measurable) selection of* Γ *if* X *is measurable and* $X(\omega) \in \Gamma(\omega)$ *for all* $\omega \in \Omega$.

The set of all measurable selections of Γ is denoted by $\mathcal{S}(\Gamma)$.

We assume that a random interval Γ represents an incomplete knowledge about the outcomes of a given random variable X. Thus, all the information we have available is that X is a measurable selection of Γ. Accordingly, let $\mathbb{E}(X)$ represents the Lebesgue expectation of a random variable X, the random interval corresponding to an imprecise/incomplete perception of $X(\omega)$ for all $\omega \in \Omega$ is the so-called Aumann expectation (Aumann 1965) and is defined as follows.

Definition 6. *Let* $(\Omega, \mathfrak{F}, P)$ *be a probability space and* $\Gamma\colon \Omega \to \mathcal{K}_c(\mathbb{R})$ *be a random interval such that all its selections are integrable, i.e.* $X \in L^1(\Omega, \mathfrak{F}, P)$ *for all* $X \in \mathcal{S}(\Gamma)$. *The interval number* $\mathbb{E}(\Gamma)$ *defined as*

$$\mathbb{E}(\Gamma) = [\mathbb{E}(\inf\Gamma), \mathbb{E}(\sup\Gamma)]$$

where $\inf\Gamma$ *and* $\sup\Gamma$ *are the two random variables specified in Definition 4, is called the expected (or mean) value of* Γ *in Aumann's sense.*

Remark 2. *In the definition of* $\mathbb{E}(\Gamma)$, *the set of all measurable selections* $\mathcal{S}(\Gamma)$ *is replaced by the subset of all integrable selections.*

The Aumann expectation is coherent with interval arithmetic (Molchanov 2005) and inherits many valuable probabilistic and statistical properties from expectation of a real-valued random variable, such as the satisfaction of the strong law of large numbers (Artstein and Vitale 1975). The next proposition, in particular, summarizes some results that will be used in the next sections to formalize the notion of expected interval (rate of) return and other related notions.

Proposition 1. *Let* $(\Omega, \mathfrak{F}, P)$ *be a probability space. The Aumann mean of a random interval satisfy the following properties:*

i) if Γ *is a random interval such that* $\Gamma(\Omega) = \{\widetilde{a}_1, \ldots, \widetilde{a}_n\}$ *and* $\{\Omega_i\}_{i=1}^n$ *is a partition of* Ω*, with* $\Omega_i = \Gamma^{-1}(\widetilde{a}_i)$*,* $i = 1, \ldots, n$*, then*

$$\mathbb{E}(\Gamma) = \sum_{i=1}^{n} P(\Omega_i) * \widetilde{a}_i;$$

ii) for every $\alpha, \beta \in \mathbb{R}$*,* $\widetilde{a} \in \mathcal{K}_c(\mathbb{R})$ *and* Γ, Υ *random intervals, then*

$$\mathbb{E}(\alpha * \Gamma + \beta * \Upsilon + \widetilde{a}) = \alpha * \mathbb{E}(\Gamma) + \beta * \mathbb{E}(\Upsilon) + \widetilde{a}.$$

Remark 3. *We have limited the presentation to the* $\mathcal{K}_c(\mathbb{R})$ *space, omitting the exposition for the general n-dimensional case, in order to avoid useless cumbersome notations since the results are almost the same.*

INTERVAL EXTENSION OF A POINT-VALUED FUNCTION

Now we explain how an interval extension of a point-valued function to an interval-valued mapping can be constructed in order to develop an interval model. The exposition specializes the arguments in Hickey (2001) to the continuous case, since only this type of functions will be handled in the next sections. Noting that a continuous point-valued function maps compact sets into compact sets, we can state the following definition for a multi-valued mapping extending a function.

Definition 7. *Let* $f : \mathbb{R} \to \mathbb{R}$ *be a continuous point-valued function. The natural interval extension of* f *is the multi-valued mapping* $\widehat{f} : \mathcal{K}_c(\mathbb{R}) \to \mathcal{K}_c(\mathbb{R})$ *given by*

$$\widehat{f}(\widetilde{\mathbf{x}}) \stackrel{def}{=} \begin{cases} \{f(\mathbf{x}) \mid \mathbf{x} \in \widetilde{\mathbf{x}} \cap \mathrm{dom}(f)\}, & \text{if } \widetilde{\mathbf{x}} \cap \mathrm{dom}(f) \neq \emptyset \\ \emptyset, & \text{otherwise} \end{cases} \tag{6}$$

where $\mathrm{dom}(f)$ *is the domain of* f*.*

The natural interval extension can be straightforwardly computed in the following case.

Lemma 2. *Let* $f : \mathbb{R} \to \mathbb{R}$ *be any monotone continuous point-valued function and assume* $\widetilde{x} \cap dom(f) = [x^l, x^u]$ *is non-empty, then it holds*

$$\widehat{f}(\widetilde{x}) = \begin{cases} [f(x^l), f(x^u)] & \text{if } f \text{ is increasing} \\ [f(x^u), f(x^l)] & \text{if } f \text{ is decreasing.} \end{cases} \tag{7}$$

The proof of this result is an immediate consequence of Eqn. 6 and of the Weierstrass' theorem.

As we will see more precisely in the following sections, the value function suggested by Tversky and Kahneman (1992) has a power function

form. Moreover, the same value function with the same parameterization has been adopted by De Giorgi, Hens, and Meyer (2007) to evaluate financial portfolios. Following these two studies, we tackle the portfolio selection problem when agents exhibit preferences in line with prospect theory and have imprecise information about the behavior of the market. Hence, we are interested to evaluate the natural extension of the power function. In particular, since the parameters of the value function in Tversky and Kahneman (1992) are rational, we analyze the case with rational exponents, i.e. $v(x) = x^{\frac{r}{s}}$, where r, s are coprime positive integers. Without loss of generality, we assume $\widetilde{x} \cap \mathrm{dom}(f) = \widetilde{x}$ and define the r-th power of an interval $\widetilde{x} = [x^l, x^u]$ as

$$\widetilde{x}^r \overset{def}{=} \begin{cases} \left[(x^l)^r, (x^u)^r\right] & \text{if } r \text{ is odd or } x^l \geqslant 0 \\ \left[(x^u)^r, (x^l)^r\right] & \text{if } r \text{ is even and } x^u \leqslant 0 \\ \left[0, \max\left\{(x^l)^r, (x^u)^r\right\}\right] & \text{if } r \text{ is even and } x^l \leqslant 0 \leqslant x^u \end{cases} \tag{8}$$

and its s-th root as

$$\widetilde{x}^{\frac{1}{s}} \overset{def}{=} \begin{cases} \left[(x^l)^{\frac{1}{s}}, (x^u)^{\frac{1}{s}}\right] & \text{if } s \text{ is odd or } x^l \geqslant 0 \\ \left[0, (x^u)^{\frac{1}{s}}\right] & \text{if } s \text{ is even and } x^l \leqslant 0 \leqslant x^u \\ \emptyset & \text{if } s \text{ is even and } x^u < 0. \end{cases} \tag{9}$$

Accordingly, the natural extension of the power function with rational exponents may be obtained by combining Eqns. (8) and (9) as follows

$$\widehat{v(\widetilde{x})} = \widetilde{x}^{\frac{r}{s}} \overset{def}{=} (\widetilde{x}^r)^{\frac{1}{s}}. \tag{10}$$

ORDER RELATIONS FOR INTERVAL NUMBERS

Mathematical programming involving interval numbers can be considered as optimization problems with uncertain or imprecise information in the objective function coefficients and/or constraints. Thereby, the preference relations for interval numbers play an important role to select the best alternative.

From a set-theoretic point of view, the set inclusion '$\subseteq$' represents a first example of partial order that can be used in decision-making problems involving interval numbers. However, since it fails to order pairs of intervals that are disjoint or overlapping, its use is limited. Several alternative approaches have been proposed in literature to fulfill these shortcomings. Depending on the methods used to define them, these order definitions can be divided in the following four groups (Karmakar and Bhunia 2012): general definitions of interval ranking that exploit the EP

and MR characterizations, orderings that depend on some particular indices or specified functions, interval rankings depending on probabilistic or fuzzy concept and diagrammatic representations.

In this paper, the preference relation due to Hu and Wang (2006) is considered since, from one hand, it exploits the metric structure of the $\mathcal{K}_c(\mathbb{R})$ embedding onto $\mathbb{R}^2$, and, from the other hand, it is one of the most suitable for ranking interval numbers according to the findings in Karmakar and Bhunia (2012).

Definition 8. *Let $\widetilde{a} = [a^l, a^u] = (a^c, a^w)$ and $\widetilde{b} = [b^l, b^u] = (b^c, b^w)$ be two interval numbers in $\mathcal{K}_c(\mathbb{R})$, then the Hu and Wang's (shortly, HW) relation is given by*

$$\widetilde{a} \preccurlyeq \widetilde{b} \iff (a^c < b^c) \vee (a^c = b^c \wedge a^w \geqslant b^w). \tag{11}$$

Furthermore,

$$\widetilde{a} \prec \widetilde{b} \iff \widetilde{a} \preccurlyeq \widetilde{b} \wedge \widetilde{a} \neq \widetilde{b} \tag{12}$$

defines the HW strict order relation on $\mathcal{K}_c(\mathbb{R})$.

Remark 4. *The HW ordering for $\mathcal{K}_c(\mathbb{R})$ is defined in terms of the corresponding order relation on the MR-coordinate space in such a way that between two intervals, the one with higher center or, if they present the same midpoint, with smaller width, is preferred.*

The Portfolio Selection Model under Prospect Theory

The financial market is modelled by a probability space $(\Omega, \mathfrak{F}, P)$ and consists of n risky assets, indexed from 1 to n. Agents allocate their wealth over a one-period investment horizon according to the following table of scenarios

$$\begin{pmatrix} \mathbf{r}_1 & \dots & \mathbf{r}_S \\ p_1 & \dots & p_S \end{pmatrix} \quad \text{with} \quad \sum_{s=1}^{S} p_s = 1 \text{ and } p_s \geqslant 0 \ \forall s \tag{13}$$

where S represents the number of involved scenarios, $\mathbf{r}_s = (r_{1s}, \dots, r_{ns})^T$ is the n-vector of rates of return for the s-th scenario and p_s is the associated probability of occurrence, $s = 1, \dots, S$. In this manner, the expected rate of return for the i-th security can be computed as the mean rate of return over the S scenarios, i.e.

$$\mathbb{E}(r_i) = \sum_{s=1}^{S} p_s r_{is}.$$

Now, in order to formulate the asset allocation problem, let x_i be the weight of the i-th asset in the portfolio and impose on weights the constraints

$$\sum_{i=1}^{n} x_i = 1$$

and $x_i \geqslant 0$ for all i, that means all budget is invested and short-sales are not allowed. The set of all feasible portfolios satisfying these conditions is denoted by $\mathcal{X}$. Each $\mathbf{x} \in \mathcal{X}$ defines a random variable that represents the portfolio rate of return with an expected value expressed in terms of the scenario realizations. More specifically, denoting the portfolio rate of return for a fixed $\mathbf{x} \in \mathcal{X}$ under the s-th scenario by

$$r_s^p \overset{def}{=} \mathbf{x}^T \mathbf{r}_s = \sum_{i=1}^{n} x_i r_{is} \quad \text{for } i = 1, \ldots, S, \tag{14}$$

it holds that the expected rate of return of the portfolio is

$$\mathbb{E}(r^p) = \sum_{i=1}^{n} x_i \mathbb{E}(r_i) = \sum_{i=1}^{n} x_i \sum_{s=1}^{S} p_s r_{is} = \sum_{s=1}^{S} p_s \sum_{i=1}^{n} x_i r_{is} = \sum_{s=1}^{S} p_s r_s^p. \tag{15}$$

A market participant is said to be a PT-investor, if she/he operates consistently with prospect theory. This means that the decisions related to investments are articulated on the basis of the following three assumptions. First, outcomes are evaluated in comparison to a certain benchmark rather then an absolute final wealth. This behavior is modeled by a reference point, which divides outcomes into gains and losses. The reference level of wealth, r^{ref}, may be represented by a target wealth fixed at the beginning of the investment period, or by an expected wealth, or by the value of a given weighted index of the random assets (Pirvu and Schulze 2012). Second, reactions toward probable gains and losses are different and the corresponding prospect value is decided by means of an S-shaped function that is concave for gains and convex and steeper for losses. This value function models the loss aversion and reference dependence besides the risk aversion for gains. Third, the PT-investor does not use physical outcome probabilities for the investment decisions, instead he considers probabilities distorted by a weighting function. Typically, this distortion overestimates low probabilities.

We now formalize the PT-portfolio selection problem by explicitly introducing the features just described. The value function and the weight-

ing function proposed in Kahneman and Tversky (1979) and Tversky and Kahneman (1992) are implemented. More specifically, a piecewise power value function is employed, which can be formulated in our context as

$$v(\mathbf{x}|\mathbf{r}_s; r^{ref}) = \begin{cases} \left(\mathbf{x}^T\mathbf{r}_s - r^{ref}\right)^{\alpha} & \text{if } \mathbf{x}^T\mathbf{r}_s \geqslant r^{ref} \\ -\beta(r^{ref} - \mathbf{x}^T\mathbf{r}_s)^{\alpha} & \text{if } \mathbf{x}^T\mathbf{r}_s < r^{ref} \end{cases} \tag{16}$$

where r^{ref} represents a reference rate of return for the investment, α denotes the risk aversion parameter and β is the loss aversion parameter. As previously mentioned, we follow Tversky and Kahneman (1992) and De Giorgi, Hens, and Meyer (2007) and set $\alpha = 0.88$ and $\beta = 2.25$. Figure 1, in the plot on the left, displays $v(x)$ with this parameter selection in the case $r^{ref} = 0$.

A scenario-based portfolio rate of return r_s^p is called a gain if it is greater than or equal to r^{ref}, otherwise is said a loss. The distortion of outcome probabilities for gains and losses is thus modelled by means of the following probability weighting function

$$w(p) = \frac{p^{\gamma}}{\left(p^{\gamma} + (1-p)^{\gamma}\right)^{1/\gamma}} \tag{17}$$

with $0 < \gamma \leqslant 1$. In line with Kahneman and Tversky (1979) and Tversky and Kahneman (1992), we consider $\gamma = 0.65$. Figure 1, in the right chart, displays $w(p)$ with this parameter selection and the no-distorted probability function, represented by $w(p)$ with $\gamma = 1$. From this comparison, we can see how the nonlinear transformation of the probability scale (17) overweights small probabilities and underweights moderate and high probabilities. Finally, the PT-investor formulates her/his investment decisions according to the solution of the following nonlinear optimization problem

$$\begin{aligned} \max \quad & f(\mathbf{x}|\mathbf{r}_1, \ldots, \mathbf{r}_S; r^{ref}) = \sum_{s=1}^{S} \pi_s v\left(\mathbf{x}|\mathbf{r}_s; r^{ref}\right) \\ \text{s.t.} \quad & \mathbf{x} \in \mathcal{X} \subseteq \mathbb{R}^n. \end{aligned} \tag{18}$$

The Interval Based PT Portfolio Optimization Model

The market is the same as that described in the previous section, i.e. with the same risky assets, indexed from 1 to n, and the same probability space $(\Omega, \mathfrak{F}, P)$. The novelty now is that rates of return are modeled by random intervals instead of random variables in order to represent imprecise and incomplete knowledge about the future dynamics of the market.

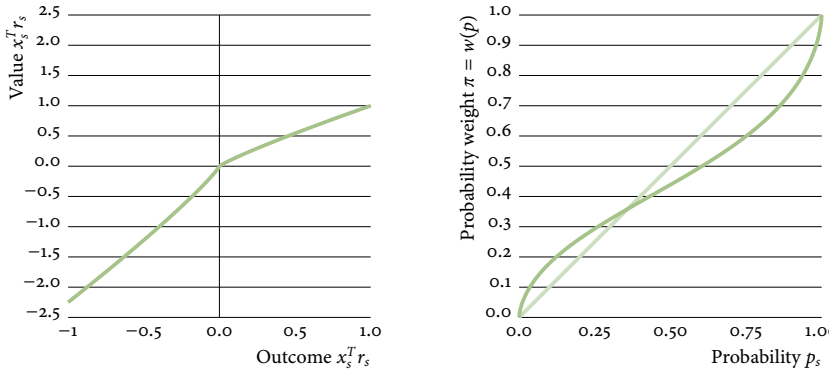

FIGURE 1 Value Function with $\alpha = 0.88, \beta = 2.25$ and $r^{ref} = 0$ (Left) and Weighting Function with $\gamma = 0.65$ (Right) as in Tversky and Kahneman (1992)

The interval counterpart of the financial quantities entering Problem (18) are to be established. More specifically, noting that the sum of random intervals is a random interval (Molchanov 2005), we can give the following definitions for the interval rate of return of a portfolio and for its expected value, respectively.

Definition 9. *Let* $\widetilde{R}_i = \left[R_i^l, R_i^u\right]$ *be the random interval rate of return of the i-th asset,* $i = 1, \ldots, n$*, with Aumann mean* $\mathbb{E}(\widetilde{R}_i) = \left[\mathbb{E}(R_i^l), \mathbb{E}(R_i^u)\right]$*. The interval rate of return of the portfolio with weights* $(x_1, \ldots, x_n)^T$ *in the n-dimensional simplex* $\mathcal{X}$ *is the random interval*

$$\widetilde{R}^p = \left[R^{p,l}, R^{p,u}\right] \stackrel{def}{=} \sum_{i=1}^{n} x_i \widetilde{R}_i = \left[\sum_{i=1}^{n} x_i R_i^l, \sum_{i=1}^{n} x_i R_i^u\right] \tag{19}$$

with Aumann mean given by

$$\mathbb{E}(\widetilde{R}^p) = \left[\mathbb{E}\left(R^{p,l}\right), \mathbb{E}\left(R^{p,u}\right)\right] = \left[\sum_{i=1}^{n} x_i \mathbb{E}(R_i^l), \sum_{i=1}^{n} x_i \mathbb{E}(R_i^u)\right]. \tag{20}$$

Remark 5. *If we remove the assumption of no-short selling,* (19) *and* (20) *are not true in general due to* (2)*.*

We assume the investor operates her/his decisions on the basis of the following table of interval scenarios:

$$\begin{pmatrix} \widetilde{\mathbf{r}}_1 & \ldots & \widetilde{\mathbf{r}}_S \\ p_1 & \ldots & p_S \end{pmatrix} \quad \text{with} \quad \sum_{s=1}^{S} p_s = 1 \text{ and } p_s \geqslant 0 \ \forall s \tag{21}$$

where $\widetilde{\mathbf{r}}_s = (\widetilde{r}_{1s}, \ldots, \widetilde{r}_{ns})^T$ is the n-vector of interval rates of return for the

s-th scenario, $s = 1, \ldots, S$, and p_s is the associated probability of occurrence for scenario s.

Remark 6. *The process of interval scenarios generation for the rate of return of asset i can be reduced to the construction of scenarios for the jointly distributed random variables $\left(R_i^l, R_i^u\right)$, representing the lower and the upper endpoints of the random interval $\widetilde{R}_i$, taking into account also the dependence on the other random interval asset rates of return. Moreover, we do not assume the outcomes of interval scenarios be disjoint, i.e. $\widetilde{r}_{is'} \cap \widetilde{r}_{is''} \neq \emptyset$, for $s', s'' \in \{1, \ldots, S\}$, in order to offer a larger degree of freedom in modeling uncertainty (Zhu, Ji, and Li 2015). In the empirical examples, for instance, a* PCA*-based method is used to generate point-valued scenarios and, successively, a perturbation technique is integrated in order to obtain interval scenarios. However other more complex techniques are also possible, like moment-matching and Monte Carlo methods, to adequately represent the distributions of asset rates of return (for a complete review of standard method for scenario generation, the interested reader may consult Mitra and Di Domenica 2010).*

The portfolio interval rate of return under the s-th scenario can thus be defined as

$$\widetilde{r}_s^p = \left[r_s^{p,l}, r_s^{p,u}\right] \stackrel{def}{=} \left[\sum_{i=1}^n x_i r_{is}^l, \sum_{i=1}^n x_i r_{is}^u\right]. \tag{22}$$

Similar to the case of random variables, it is easy to show that if

$$\mathbb{E}(R_i^l) = \sum_{s=1}^S p_s r_{is}^l \quad \text{and} \quad \mathbb{E}(R_i^u) = \sum_{s=1}^S p_s r_{is}^u,$$

for $i = 1, \ldots, n$, the expected (in the Aumann's sense) interval rate of return of the portfolio in Eqn. (20) can be directly evaluated in terms of the scenarios as

$$\mathbb{E}(\widetilde{R}^p) = \left[\sum_{s=1}^S p_s r_s^{p,l}, \sum_{s=1}^S p_s r_s^{p,u}\right]. \tag{23}$$

An analogous result can be obtained with the MR interval encoding.

In this financial environment, the PT investor articulates her/his choices relative to an interval reference rate of return, $\widetilde{r}^{ref} = [r^{ref,l}, r^{ref,u}]$, on the basis of the natural extension of the piecewise power function (16). Gains and losses are now defined on the basis of the preference relations (11) and (12): an interval rate of return is called a gain if it is preferred to

the interval reference point, conversely, it represents a loss. Maintaining the same parameter setting of the PT model, i.e. $\alpha = 0.88 = 22/25$ and $\beta = 2.25$, the interval extension of the value function (16) is defined as

$$\widehat{v}(\mathbf{x}|\widetilde{\mathbf{r}}_s;\widetilde{r}^{ref}) = \begin{cases} \left(\widetilde{r}_s^p - \widetilde{r}^{ref}\right)^{\alpha} & \text{if } \widetilde{r}_s^p \succcurlyeq \widetilde{r}^{ref} \\ -\beta(\widetilde{r}^{ref} - \widetilde{r}_s^p)^{\alpha} & \text{if } \widetilde{r}_s^p \prec \widetilde{r}^{ref} \end{cases} \tag{24}$$

where $\widetilde{r}_s^p$ is defined in (22).

According to the interpretation of a random interval as an imprecise perception of a random variable, we assume that the weighting function, describing the process of distortion for the probabilities of occurrence of a given scenario, depends solely on the center of the interval rates of return, and not on their width. Thus, the decision weights for our interval extension can also be evaluated by means of the function (17) of the PT model, with the same parameterizations. Finally, the PT-investor that takes into account also imprecise forecasts for her/his investment decisions has to solve the following nonlinear interval-valued programming problem

$$\begin{aligned} \max \quad & V(\mathbf{x}|\widetilde{\mathbf{r}}_1,\ldots,\widetilde{\mathbf{r}}_S;\widetilde{r}^{ref}) = \sum_{s=1}^{S} \pi_s \widehat{v}(\mathbf{x}|\widetilde{\mathbf{r}}_s;\widetilde{r}^{ref}) \\ \text{s.t.} \quad & \mathbf{x} \in \mathcal{X} \subseteq \mathbb{R}^n \end{aligned} \tag{25}$$

where 'max' is interpreted as the most preferred interval value for $V(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_S;\widetilde{r}^{ref})$ with respect to the order relation (11).

Remark 7. *If $\widetilde{r}^{ref}$ is a degenerate interval, i.e. has null radius, the* HW *ordering reduces to the $\leqslant$ order for the interval centers. Moreover, if no imprecision is assumed in forecasts, Problem* (25) *reduces to the standard* PT *portfolio selection Problem* (18).

Definition 10. *A point $\mathbf{x}^* \in \mathcal{X}$ is an optimal solution of Problem* (25) *if there does not exist another point $\mathbf{x} \in \mathcal{X}$ such that $V(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_S;\widetilde{r}^{ref}) \prec V(\mathbf{x}^*|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_S;\widetilde{r}^{ref})$.*

The next result permits to convert the nonlinear constrained interval optimization problem (25) into two nonlinear programming problems. In this manner we are able to solve our interval portfolio selection problem with standard nonlinear optimization solvers.

Proposition 3. *$\mathbf{x}^* \in \mathbb{R}^n$ is an optimal solution of the constrained nonlinear interval optimization problem* (25) *with respect to the* HW *order relation if*

and only if $\mathbf{x}^*$ *is a solution of the two scalar nonlinear optimization problems*

$$\begin{aligned} &max \quad V^c(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref}) \\ &s.t. \quad \sum_{j=1}^{n} x_j = 1 \\ &\qquad x_j \geqslant 0, \quad j = 1, \ldots, n \end{aligned} \tag{26}$$

and

$$\begin{aligned} &min \quad V^w(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref}) \\ &s.t. \quad \mathbf{x} \in \{\mathbf{y} \mid \mathbf{y} \textit{ is a solution of } (26)\} \end{aligned} \tag{27}$$

where $V^c(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref})$ *and* $V^w(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref})$ *are the center and the radius of the interval* $V(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref})$*, respectively.*

Proof. Let $\mathbf{x}^* \in \mathbb{R}^n$ be a solution of Problem (25) with respect to the HW order relation. This implies that for any $\mathbf{x} \in \mathcal{X}$ we have

$$V(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref}) = \left(V^c(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref}), V^w(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref})\right)$$

with $V^c(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref}) \leq V^c(\mathbf{x}^*|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref})$. Thus, $\mathbf{x}^*$ solves (26). If in particular $V^c(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref}) = V^c(\mathbf{x}^*|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref})$, by the HW order relation definition, we also have $V^w(\mathbf{x}|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref}) \geq V^w(\mathbf{x}^*|\widetilde{\mathbf{r}}_1, \ldots, \widetilde{\mathbf{r}}_s; \widetilde{r}^{ref})$ and we conclude that $\mathbf{x}^*$ satisfies (27).
The converse is verified by reverting this process. Thus, the theorem remains proved. □

Illustrative Examples

DATA DESCRIPTION

The experiments have been based on data relative to the Croatia Zagreb Stock Exchange index (CROBEX). The investment universe comprises the following 8 assets: Adris Grupa d.d. (ADRS), Atlantic Grupa d.d. (ATGR), Ericsson Nikola Tesla d.d. (ERNT), HT d.d. (HT), INA d.d. (INA), Konar Elektroindustrija d.d. (KOEI), Kras d.d. (KRAS), Ledo d.d. (LEDO), Podravka d.d. (PODR) and Valamar Riviera d.d. (RIVP). The time series include weekly closing prices covering the period from 20/04/2009 to 23/06/2016 for a total of 356 observations. The quotations are taken from `http://zse.hr`. In figure 2, the evolution of CROBEX prices over the investment period is displayed in the left plot and the corresponding weekly rates of return are represented in the plot on the right. We have selected this time frame according to the findings in Pesa and Brajkovic (2016), in order to avoid the structural break in the Croatian economy

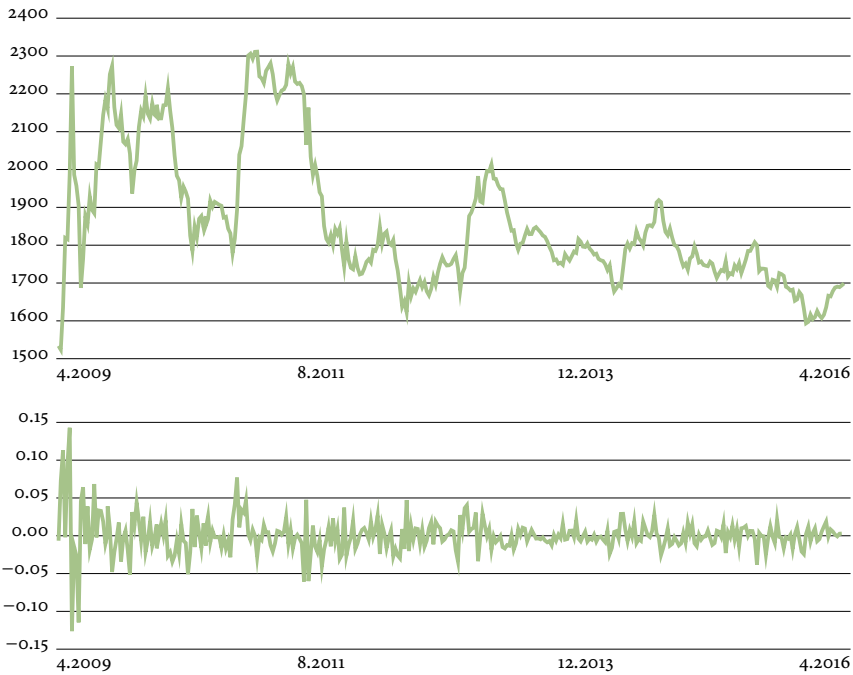

FIGURE 2 CROBEX Prices for the Period 20 April 2009 to 23 June 2016 (Top) and the Corresponding Rates of Return (Bottom)

during 2009 due to both the political crisis after Prime Minister's resignation for corruption cases and the subprime mortgages crisis in USA. The descriptive statistics for assets and index rate of return series are given in table 1. They reveal that, except for ERNT and HT, all the other assets have comparable values in terms of the first four moments, with a mean rate of return of about 0.26% (considerably greater than the 0.06% of the market), a standard deviation of about 3.35% (greater than the 2.33% of the market), positive skewness and kurtosis above 6. Instead, ERNT and HT present mean rates of return below the market (0.03% and –0.08%, respectively) and negative skewness.

The distributional characteristics of the rates of return are moreover analysed by means of the following set of tests: the Jarque-Bera, the Lilliefors and the Shapiro-Wilk tests are used to infer the assumption of normality; the Ljung-Box test has been adopted to verify the presence of autocorrelation; while the Engle's LM test checks the conditional heteroskedasticity effect in residuals up to the second order. Table 2 reports the corresponding statistics and *p*-values. The results confirm the non-

TABLE 1 Descriptive Statistics

Assets	Min.	Max.	Mean	Std. dev.	Skewness	Kurtosis
ADRS	−0.1459	0.1692	0.0030	0.0345	0.6215	7.9480
ATGR	−0.0743	0.1230	0.0020	0.0265	1.1175	6.2788
ERNT	−0.1811	0.1681	0.0003	0.0363	−0.3381	8.9328
HT	−0.1208	0.0900	−0.0008	0.0232	−0.5558	7.7699
KOEI	−0.1846	0.1538	0.0027	0.0294	0.2155	10.6474
KRAS	−0.1042	0.2326	0.0023	0.0340	1.5576	11.9749
LEDO	−0.2205	0.1833	0.0033	0.0384	0.4427	8.8284
PODR	−0.1213	0.2979	0.0024	0.0382	1.7176	13.8118
CROBEX	−0.1262	0.1429	0.0006	0.0233	0.5878	12.4975

NOTES Relative to the weekly rates of return from 27 April 2009 to 23 June 2016 for a total of 355 observations: Adris Grupa d.d. (ADRS), Atlantic Grupa d.d. (ATGR), Ericsson Nikola Tesla d.d. (ERNT), HT d.d. (HT), INA d.d. (INA), Konar Elektroindustrija d.d. (KOEI), Kras d.d. (KRAS), Ledo d.d. (LEDO), Podravka d.d. (PODR), Valamar Riviera d.d. (RIVP) and CROBEX index.

normality of assets rates of return and indicate serial autocorrelation in all time series, except for KOEI. The ARCH effect is present in 5 of the 8 time series (ADRS, ATGR, KOEI, KRAS, LEDO and PODR), thus the current rates of return of these assets are affected by spillover effects due to the rates of return of previous periods.

GENETIC ALGORITHM BASED OPTIMIZATION

In this subsection we describe the numerical methods implemented for both the generation of (interval) scenarios and for solving Problems (18) and (25).

As the distribution of asset rates of return is unknown, we make no assumption regarding either their joint and their marginal distributions instead we adopt the sampling procedure based on principal component analysis (PCA) developed by Topaloglou, Vladimirou, and Zenios (2002) to generate standard scenarios. It works as follows. First, a sufficient number of principal components (PC) for each asset is retained in order to capture most of the variability of historical samples. In the experiments we fixed a lower threshold for the represented historical variability equals to 80%. Second, the range of each PC is partitioned into several subintervals and the ratio of the number of samples within each subinterval to the total number of samples is used to represent the probability associated to that subinterval. Scenarios for each PC are then constructed with the

TABLE 2 Statistical Tests for Normality, Autocorrelation and Conditional Heteroskedasticity

Assets	Jarque-Bera	Lilliefors	Shapiro-Wilk	Ljung-Box	ARCH(2)
ADRS	384.9961**	0.0961**	0.9103**	23.0440	50.8836**
	(0.0010)	(0.0010)	(0.0000)	(0.2866)	(0.0000)
ATGR	232.9138**	0.1094**	0.9277**	30.8236	15.7314**
	(0.0010)	(0.0010)	(0.0000)	(0.0576)	(0.0004)
ERNT	527.3964**	0.1245**	0.8874**	17.2229	1.2951
	(0.0010)	(0.0010)	(0.0000)	(0.6385)	(0.5233)
HT	354.8119**	0.0771**	0.9245**	16.8107	1.3620
	(0.0010)	(0.0010)	(0.0000)	(0.6652)	(0.5061)
KOEI	867.8049**	0.1040**	0.8943**	51.8879**	45.2857**
	(0.0010)	(0.0010)	(0.0000)	(0.0001)	(0.0000)
KRAS	1334.9987**	0.1307**	0.8647**	23.4527	8.0778*
	(0.0010)	(0.0010)	(0.0000)	(0.2671)	(0.0176)
LEDO	514.0789**	0.1307**	0.8888**	18.5401	13.1084
	(0.0010)	(0.0010)	(0.0000)	(0.5519)	(0.0014)**
PODR	1903.6417**	0.0994**	0.8901**	31.1953	8.4204
	(0.0010)	(0.0010)	(0.0000)	(0.0527)	(0.0148)*

NOTES Relative to the weekly rates of return from 27 April 2009 to 23 June 2016 for a total of 355 observations. The p-values corresponding to the test statistics are reported in parentheses, ** and * denote rejection of the null hypothesis at 1% and 5% significance levels, respectively. ARCH(2) is the Engle's LM test for the ARCH effect in the residuals up to the second order.

midpoints of subintervals and the associated probabilities. Since the PCS are independent, the joint scenarios are given as the Cartesian product of scenarios of individual PCS. Finally, an inverse linear transformation derived by PCA provides the scenarios of asset rates of return. As indicated by the authors, in order to mitigate estimation risks, we revise the asset rates of return under each scenario by adding a Bayes-Stein correction term.

Interval-valued scenarios are obtained in this paper by applying to the point-valued scenarios the perturbation method proposed in Zhu, Ji, and Li (2015). More specifically, let $\mathbf{r}_s = (r_{1s}, \ldots, r_{ns})^t$ denote the n-vector of asset rates of return under the s-th scenario, $s = 1, \ldots, S$, then the corresponding perturbed interval-valued scenario is defined as

$$\widetilde{\mathbf{r}}_s = \left[r_{1s} - 1.96\frac{\widehat{\sigma}_1}{\sqrt{T}}, r_{1s} + 1.96\frac{\widehat{\sigma}_1}{\sqrt{T}} \right] \times \ldots \times \left[r_{ns} - 1.96\frac{\widehat{\sigma}_n}{\sqrt{T}}, r_{ns} + 1.96\frac{\widehat{\sigma}_n}{\sqrt{T}} \right],$$

where $\widehat{\sigma}_i$ is the standard deviation of rates of return for the i-th asset estimated by the T historical samples used to generate the traditional scenarios. In the MR form it can be compactly rewritten as

$$\widetilde{\mathbf{r}}_s = \left(\mathbf{r}_s, 1.96\frac{\widehat{\sigma}}{\sqrt{T}} \right)$$

with $\widehat{\sigma} = (\widehat{\sigma}_1, \ldots, \widehat{\sigma}_n)^t$. In this case, the interval portfolio rate of return under the s-th scenario (22) becomes

$$\widetilde{\mathbf{r}}_s^p = \left(\sum_{i=1}^n x_i r_{is}, \frac{1.96}{\sqrt{T}} \sum_{i=1}^n x_i \widehat{\sigma}_i \right) \tag{28}$$

for all $\mathbf{x} \in \mathcal{X}$ and $s = 1, \ldots, S$.

For detecting optimal solutions to Problems (18) and (26)–(27), due to non-differentiability and non-concavity of the objectives, we propose a procedure involving an evolutionary optimization technique, the so-called genetic algorithm (GA). This is a population based stochastic search method implementing the Darwinian principle of 'the survival of the fittest' and natural genetics (Goldberg 1989). The algorithm starts with an initial population of candidate solutions (called individuals) where each individual is represented using some form of encoding as a chromosome. These chromosomes are evaluated for their fitness and those with the highest value are selected in the population for reproduction. The selected individuals are then manipulated by two genetic operators, called crossover and mutation. The crossover is applied to create offspring from a pair of selected chromosomes while mutation is used to promote little modification/change in the offspring. The repeated applications of genetic operators to the relatively fit chromosomes result in an increase in the average fitness of the population over generation and identification of improved solutions to the problem under investigation. This process is applied iteratively until the termination criterion is satisfied. To implement the GA the following basic components are then to be considered: algorithm parameters (population size, probability of crossover and probability of mutation), chromosome representation, initialization of population, evaluation of fitness function, candidate selection process and genetic operators (crossover, mutation and elitism).

TABLE 3 Parameter Setting for the Considered GA

Parameter name	Value	Parameter name	Value
Generations	300	Crossover probability	0.50
Population size	100	Mutation scale	0.50
Seeding size	1	Mutation shrink	0.75
Elite size	1		

In this paper a variant of the algorithm by Kaucic (2012) is implemented. A real coding representation is adopted, i.e. a dimensional vector is used as a chromosome to represent a candidate optimal portfolio and an elite strategy is considered to clone the best individual from one generation to the next. The initial population is generated according to the following procedure for uniform vector generation over a simplex (Rubinstein 1982):

Step 1. Generate n random numbers from exponential distribution with parameter $\theta = 1$, i.e. $\lambda_i \sim \exp(1)$, $i = 1, \ldots, n$.

Step 2. Apply the following formula and deliver $\mathbf{x} = (x_1, \ldots, x_n)^t$ as a vector distributed uniformly on $\mathcal{X}$:

$$\mathbf{x} = (x_1, \ldots, x_n)^t = \left(\frac{\lambda_1}{\sum_{i=1}^n \lambda_i}, \ldots, \frac{\lambda_n}{\sum_{i=1}^n \lambda_i} \right)^t.$$

Selection is made by the stochastic universal sampling. Uniform crossover is used to avoid the positional and distributional bias that may prevent the production of good solutions. The Gaussian mutation operator modifies offsprings using the Gaussian distribution. A control on the composition of each offspring is then included to guarantee its feasibility. The parameter setting is listed in table 3.

Moreover, for the dynamic portfolio analysis, in order to generate solutions consistent over time, we implement a population seeding such that the best individual from the previous optimized population is copied in the initial population of the current optimization period.

STATIC AND DYNAMIC PORTFOLIO ANALYSIS

We test the flexibility and the efficiency of the proposed model with respect to the standard PT portfolio optimization procedure from both a static and a dynamic point of view.

The static portfolio analysis, in particular, focuses on the reaction of the PT and IPT optimal portfolios to changes in the reference point and

TABLE 4 Rates of Return and Corresponding Weights for the Optimal Portfolios to the PT-Based Problem (18) for Different Levels of the Reference Point r^{ref}

r^{ref}	0	0.0005	0.0010	0.0015
obj value	0.0013	0.0014	0.0014	0.0014
ADRS	0.2968	0.3044	0.3051	0.3051
ATGR	0.2154	0.2377	0.2982	0.2982
ERNT	0.0749	0.0378	0.0165	0.0165
HT	0.1440	0.0872	0.1122	0.1122
KOEI	0.0831	0.1408	0.1038	0.1038
KRAS	0.0725	0.1044	0.0820	0.0820
LEDO	0.0583	0.0579	0.0335	0.0335
PODR	0.0540	0.0298	0.0492	0.0492

reference interval, respectively. To this end, for the standard PT investor, the reference level r^{ref} is assumed to vary in the set $\{0, 0.0005, 0.0010, 0.0015\}$, while, for the PT investor with imprecise information, we assume that both center and radius of $\overline{r}^{ref}$ vary, with $r^{ref,c}$ coming from $\{0, 0.0005, 0.0010, 0.0015\}$ and $r^{ref,w}$ from $\{0, 0.0010, 0.0030, 0.0050\}$. For these experiments all data covering the period from 27/04/2009 to 23/06/2016 are used. 4 PCS are able to capture 81% of the variability and 3465 point-valued scenarios have been generated. The associated interval-valued scenarios are then constructed on the basis of (28). Due to the complexity of the objective landscape in (18) and in (25), we implement 50 simulations for each experiment and the solution with the maximum objective value has been identified as the optimal portfolio.

Table 4 reports the results for the experiments associated to the PT model. The 'obj value' row lists the rates of return reached by the optimal solutions and the remaining rows show the corresponding portfolio weights. It can be observed that the optimal rate of return is equal to 13 basis points when the reference point, r^{ref}, is set to 0, while it is equal to 14 basis points in the remaining cases. Moreover, for the last two experiments, GA detects the same optimal portfolio. These findings suggest that investment decisions are affected only marginally by the reference point when its magnitude is too large. In terms of prospect theory, it means that when agents present too optimistic expectations, portfolio constraints and market conditions play a crucial role in determining optimal portfolios.

The analysis for the interval-based PT model is more complex, involv-

TABLE 5 Interval Rates of Return for the Optimal Portfolios to the Interval PT-Based Problem (25) for Different Levels of the Reference Interval $\overline{r}^{ref}$

IPT		$r^{ref,c}$			
		0	5	10	15
$r^{ref,w}$	0	(15, 34)	(14, 33)	(15, 33)	(14, 33)
	10	(15, 43)	(14, 44)	(14, 43)	(14, 43)
	30	(14, 64)	(15, 64)	(14, 64)	(15, 64)
	50	(14, 81)	(15, 85)	(15, 85)	(14, 85)

NOTES Intervals are expressed in MR form.

ing 16 experiments. In the paper we limit to report results for the interval rates of return, omitting the portfolio weights, however these data are available upon request. Table 4 shows the interval rates of return for the identified optimal portfolios to Problems (26)–(27) in MR form to facilitate comparisons with the standard PT case. It emerges that the midpoints do not depend neither from the center of the reference interval nor its radius. We can not reach the same conclusion for the radii of the interval rates of return, since they increase proportionally to the width of the reference interval. Moreover, similar to the PT model, the composition of the optimal portfolios remains quite stable in all experiments.

The dynamic portfolio analysis is based on a sliding window procedure which focuses on the last six months of observations, from 16/11/2015 to 16/05/2016 (26 weeks). Here we test the following three aspects of the investment process for the proposed interval-valued PT-based portfolio optimization model:

i) the ability to identify profitable solutions;
ii) the level of diversification of these solutions;
iii) how the portfolio strategy can be expensive over time.

Scenarios are developed recursively by using a sliding window of 104 weeks of rates of return, which are updated as the process move on, by removing the first data and by adding the most recent information.

Figure 3 compares the evolution of the values of portfolios obtained by the interval-based PT strategy with those produced by the buy & hold strategy and by the standard PT portfolio selection model, respectively. It is assumed that the initial value is 10,000 kn at the starting date for all the investment strategies. We see that apart the last week of 2015 and the first week of 2016, when the buy & hold strategy is the most valuable, in the remaining weeks the PT models prevail. In particular, during Febru-

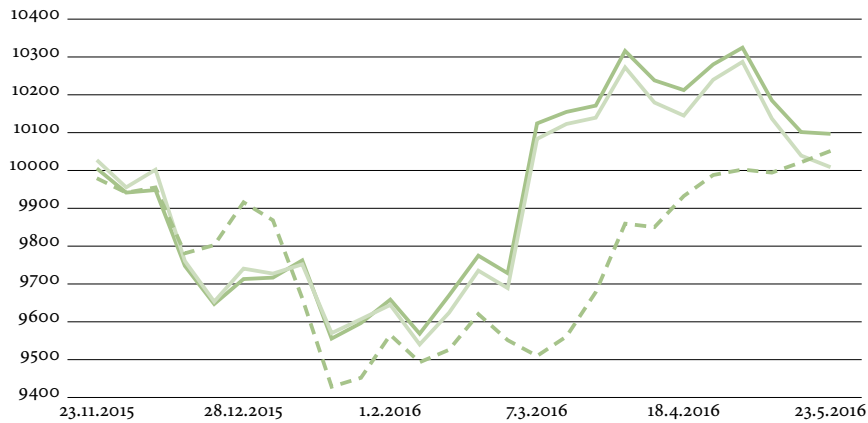

FIGURE 3 Evolution of the Optimal Portfolio Values for the Buy & Hold Strategy (Dashed), PT (Light) and Interval-Based PT (Dark) Models over the Period from 23 November 2015 to 23 May 2016; Initial Portfolio Value Fixed to 10,000 kn.

ary and March 2016 the PT models rise from the lowest to the highest levels (from around 9,500 kn to around 10,350 kn), while the buy & hold strategy remains below 9,800 kn. Qualitatively, the proposed model with interval data overperforms the standard model.

Diversification is useful to reduce risks and provide protection against extreme events by ensuring that one is not overly exposed to individual occurrences. In this paper we measure the degree of diversification of a given portfolio by means of the so-called diversification index (DI) defined by Woerheide and Persson (1993) as

$$\mathrm{DI}(t) = 1 - \sum_{i=1}^{n} x_{i,t}^2$$

where $x_{i,t}$ is the weight of the i-th asset in the portfolio at time t. A greater value of DI implies a greater diversification.

Trading cost is another crucial aspect to be taken into account when an investment strategy has to be evaluated. We consider the turnover, a measure of the changes in the portfolio composition from one period to the next, as an indirect estimate of trading costs due to the difficulty in directly modelling them. It is given by

$$\mathrm{turnover}(t) = \sum_{i=1}^{n} \left| x_{i,t} - x_{i,t-1} \right| .$$

The grater is the turnover and more expensive is the investment strategy.

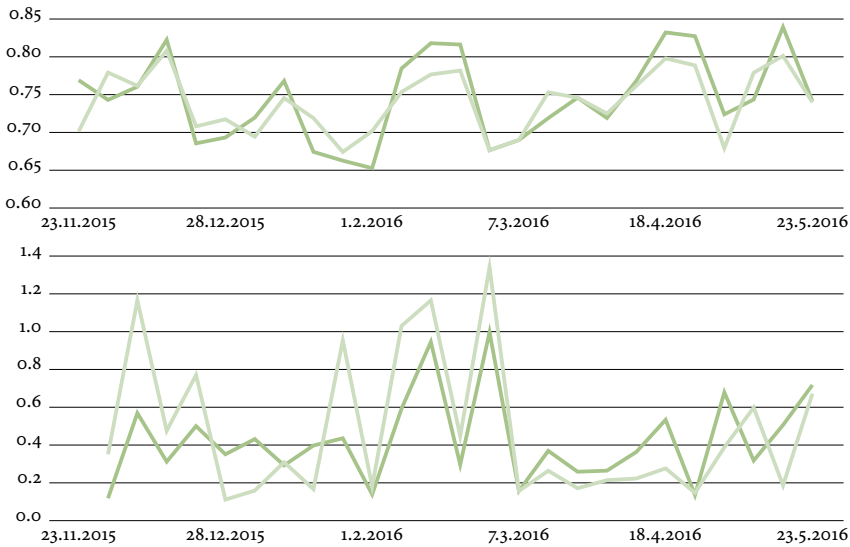

FIGURE 4 Diversification Index (top) and Turnover (bottom) of the Optimal Portfolio Values for PT (Light) and Interval-Based PT (Dark) Models over the Period from 23 November 2015 to 23 May 2016.

TABLE 6 Summary Statistics for the Buy & Hold Strategy, PT and Interval-Based PT Models over the Period from 23 November 2015 to 23 maXy 2016

Item	Buy & Hold	PT	IPT
Initial wealth (kn)	10000	10000	10000
Final wealth (kn)	10072	10009	10097
Rate of return (annualized %)	1.44	1.18	1.94
Diversification index (mean %)	—	74.08	74.60
Turnover (mean %)	—	47.70	42.72

In figure 4, we qualitatively compare, on the left chart, the diversification effect and, on the right, the turnover for the two PT investment strategies over time. Table 6 provides the mean of DI and turnover for the six months analyzed. Summing up, we conclude that the interval-based strategy present greater diversification and lower turnover with respect to the standard PT-based strategy.

Conclusions

In this paper we propose a novel interval optimization approach for the PT-based portfolio selection problem. The principal idea is to repre-

sent imprecise/incomplete information as random sets. An extension of the standard PT model is proposed that exploits interval analysis to define the interval counterpart of the value function. A model to generate interval-valued scenarios from point-valued ones is analyzed. The resulting constrained nonlinear interval optimization problem is converted into two nonlinear programming problems using a total order relation between intervals.

The flexibility and the efficiency of the proposed model are then compared with those of the standard PT portfolio selection procedure from both a static and a dynamic point of view in a set of experiments involving 8 assets from the Croatian market. A real-coded GA is developed to generate the solutions. Results indicate that the proposed model, incorporating imprecise knowledge, is robust with respect to the changes in the reference levels and is able to produce investment strategies that provide at the same time higher diversification and lower turnover than the standard PT model, which uses point-valued data.

These findings are very promising although there are several directions of improvement for the proposed model to manage imprecise and incomplete information in behavioural portfolios. First, our analysis covered a limited number of assets during a particular economic phase. Thus, we plan to involve more assets from different markets, covering a larger time window, in order to provide more conclusive results about the properties and capabilities of the model. A comparison with the classical mean-variance approach can be done to highlight the differences with the standard portfolio selection procedure. Second, we focus on an extension of portfolio optimization in a prospect theory environment, however, it is also possible to define a suitable interval counterpart of the model taking into account preferences based on cumulative prospect theory. This is of interest because of its consistency with first order stochastic dominance. Some details will indeed be given in a forthcoming paper. Third, the addition of uncertainty about forecasts has been modelled through random intervals, an alternative is represented by modelling returns as random variables with specific distributional assumptions and adding a degree of uncertainty relative to the parameters of the distributions.

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Antecedents of Organizational Complacency: Identifying and Preventing Complacency in the Work Environment

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Today's competitive global environment is more dynamic than ever and is one in which organizations cannot sit idly by. The financial crisis in the US economy provides a vivid example of what can happen when organizations fail to adjust to changes in their environment. However, little is known about the underlying causes of complacency and what managers can do to prevent it. This article identifies sources of complacency in four major areas: process, people, structure, and culture. We then develop a framework for assessing the need for environmental scanning based on the complexity and frequency of change in the environment. Finally, we use market examples to provide managers with useful advice on how to identify and react to complacency in their organizations.

Key Words: organizational complacency, strategic flexibility, change, adaption, organizational culture
JEL Classification: M12, M14

Introduction

> The tragedy of life is often not in our failure, but rather in our complacency; not in our doing too much, but rather in our doing too little; not in our living above our ability, but rather in our living below our capacities.
>
> Benjamin E. Mays

Complacency is not an option for 21st century organizations striving for longevity and sustainable profitability. The pace of business continues to

accelerate exponentially through technological and business process innovations, global expansion and interconnectivity and growing market pressures. Firms are increasing their focus on innovation as they seek to stay one step ahead of foreign and domestic competitors. Information and options are becoming more prevalent to consumers via the internet, thus placing added demand on companies to adjust their strategies to meet changing customer preferences. Global supply chains and free trade zones have changed the business landscape around the globe. As a result, more flexible firms often outperform their competitors as they can rapidly change to market conditions.

The research on agility has focused on the capabilities of firms to adjust to new market demands. Strategic flexibility is the capacity to react quickly to changing competitive conditions in order to maintain a competitive advantage (Hitt, Keats, and DeMarie 1998). This requires strategic leadership that is proactive in responding to new business opportunities. On the human resource front, it involves equipping employees to be able to handle new tasks and challenges. At the structural level, developing dynamic core competencies may create processes to exploit new market opportunities (Hitt, Keats, and DeMarie 1998). Although it is critical to be able to respond to new demands, the reaction becomes meaningless if the environmental threat is not accurately identified. Therefore, we argue that the first step in increasing strategic flexibility is to reduce complacency.

Complacency was abundant in the financial services industry during the time period leading up to the financial crisis in 2008 (Soltwisch 2015). At the individual level, overconfidence in current business practices allowed managers to continue investing in risky mortgage securities. At the group level, social pressures and groupthink allowed boards to overlook important indicators suggesting that borrowers could no longer afford their mortgage payments. And at the organizational level, technology and structures built around profitable investment activities created tremendous rigidity, allowing banks to overlook the growing systemic risk in the market (Soltwisch 2015). As a result, banks continued to lend to unqualified borrowers despite the growing mortgage delinquencies and foreclosures, ultimately leading to one of the worst financial crashes since the great depression and a global recession (Davis 2009).

Although there are clear dangers associated with being complacent, there is little advice available to mangers on how to identify sources of complacency in their business, and what they can do to prevent it. There-

fore, the purpose of this article is to identify key indicators of complacency in four areas: process, people, structure, and culture. In addition, we develop a framework for assessing the need for environmental scanning based on the complexity and frequency of change in the environment. Finally, we explore the decision making processes involved with contentment and use market examples to provide managers with advice on how to identify and react to complacency in their organizations.

Sources of Complacency

The cure for organizational complacency is not a one-size-fits-all solution; it is essential for organizations to analyze their competitive posture and propensity for change before identifying and implementing a necessary transformation relative to their circumstances. Organizations need to routinely address their internal and external factors to gauge their competitiveness to calibrate their environmental factors, decision making processes, and corporate culture. Such calibration must critically examine the processes, people, structure and culture (see table 1). Individuals in key positions within the organization must embrace and ignite the necessity to be agile and constantly add value to their stakeholders; if the leaders within the institution are complacent, organizational complacency will ensue. Moreover, an organization needs to analyze and demand the level of accountability that is expected from the board of directors, executive team, and other management levels to ensure the company is reaching its full potential.

Complacency can be identified in four key areas: processes, people, structure, and culture. Processes become routine over time in order to make work more efficient. For example, lending to unqualified borrowers with little or no credit and no money down was common practice in the time period leading up to the financial crisis (Davis 2009). As this activity became more routine, lenders became less concerned about the ability of borrowers to afford the loans they were issuing, even though there were clear indicators suggesting that the housing bubble had begun to collapse. For example, between 2005 and late 2007 banks continued to issue risky loans despite clear signs that housing prices were falling (Phillips and Yu 2011). One of the key process changes leading to complacency was that banks could sell their loans on the secondary market as mortgage backed securities, thus removing the debt from their books (Soltwisch 2015). This transfer of risk was a clear process change that allowed banks to continue to ignore changes in the market. Routines developed over time are likely

to remain intact as long as they remain profitable (Nelson and Winter 2002). Because of this, processes developed around revenue generating activities may become a significant source of complacency.

There was a clear sense of overconfidence among top managers in the banking industry during the housing bubble, allowing them to become complacent in their decision making. Research suggests that top management teams are more likely to keep the same members and stay together longer when the company is doing well (Finkelstein and Hambrick 1990). These highly cohesive teams are more likely to encounter groupthink (Janis 1972), reducing the evaluative capabilities of the members. A long standing set of top managers may indicate a sign of complacency. Outsiders should be brought in to stimulate new perspectives. In addition, employees should be trained and incentivized to provide new ideas for product and process improvements.

Cultural and political elements may also lend to complacency within companies. Although success is often revered by other organizational members, failure may be socially unacceptable. Because of this, maintaining the status quo is often politically less risky than going out on a limb to identify and react to problems. For example, loan officers in the financial service industry were admired within their institutions as loans remained profitable sources of revenue during the housing bubble. The reward structure also encouraged complacency as they were often a given a commission based on the amount of loans they originated (Kane 2009). The social and political pressures were in favour of maintaining the status quo, making it difficult for individuals to speak out about the risky mortgages. As a result, banks continued to lend to questionable borrowers despite clear red flags in the market.

Finally, structural changes can make a company less likely to identify changes in their environment. Centralized decision making structures make firms less agile as decisions have to work their way up the chain of command. In a study of the newspaper industry, Gilbert (2005) showed that US newspapers companies were very slow to react to competition from online news sources because local level managers were required to adhere to strict procedures laid out by headquarters. All decisions had to be approved by the CEO, causing the local managers to be less likely to consider alternative news sources (Gilbert 2005).

As companies make large investments in new plants, property, and equipment, they will have a reduced capacity to meet changing market conditions do to structural inertia (Hannan and Freeman 1984). The supply chain may also become an impediment to change. Supply relation-

TABLE 1 Organizational Complacency Effect on Organizational Components

Processes	• Insufficient environmental scanning • Unable to react to external changes • Inadequate decision making processes in place
People	• Little accountability held among organizational players • Justification for retaining unsuitable leadership
Structure	• Subject to organizational atrophy • Structure becomes combersome
Culture	• Culture of risk aversion and uncertainty avoidance • Culture dependent upon rules and procedures • No challenging processes, procedures, and standards

ships built up over long periods of time may limit managers' ability to identify new suppliers. As managers develop strategic partnerships with key suppliers, they become more dependent on those suppliers. Escalating commitment theory tells us that managers are more likely to continue with a failing course of action when they have significant sunk costs in a project (Arkes and Blumer 1985). As companies invest in new technologies and capabilities, they may become less apt to respond opportunities and threats in their environment. Therefore, structural changes associated with current business activities may become a source of complacency within the organization. Table 1 depicts these four major sources of complacency.

Once an organization selects a competitive strategy, it derives a set of critical tasks and objectives to accomplish through the use of processes, people, structure, and culture (O'Reilly 2008). Complacency stems from minimal and inconsistent critical analysis of each of these factors within an organization. The likelihood that an organization is subject to complacency increases correspondingly with organizational atrophy. As an organization matures, the corporate self-awareness and purpose within its processes and structure decrease often resulting in excess administrative and support staff, cumbersome procedures, reduced communication and coordination, and reliance upon outdated business models (Daft 2013). An organization that neglects to conduct regular critical analyses of its processes, people, structure, and culture fails to perform regular environmental scans, utilizes poor decision making processes, justifies its current position, hires and retains ineffective leadership team, and relinquishes accountability within the organization. The failures of Blackberry, Kodak, Blockbuster, Borders, and Circuit City exhibit many of these complacent characteristics. The solution to organizational com-

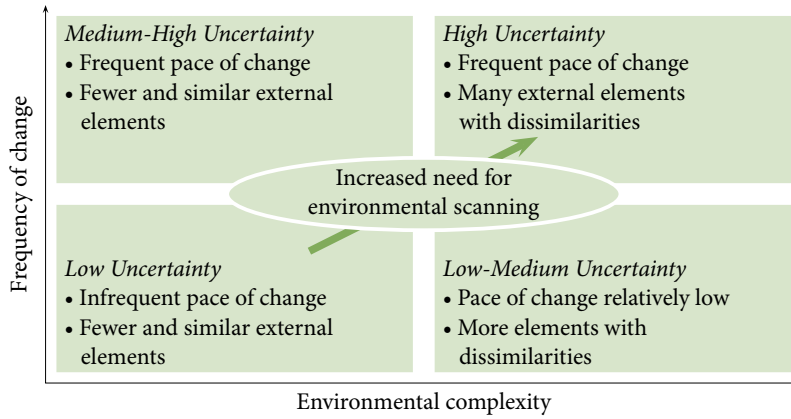

FIGURE 1 Framework for Assessing Need for Environmental Scanning

placency is to maintain a routinely investigative mechanism that examines the processes, people, structure, and culture to insure the required agility within the industry.

DESIRE FOR CONSTRUCTIVE CHANGE

To successfully ward off complacency, an organization must be more than willing to change; they must be proactively scanning, analyzing, and forecasting their ever-changing environment. The willingness to react to circumstances or adopt changes, while important, may not be enough for companies in a complex and unstable environment. Business model shelf-lives grow shorter and shorter as the pace of business and technological innovations increase. If an organization within a highly uncertain environment relies on a reactive-adaptation approach, it may fall behind its competitors. Organizations within these environments will need to increase the frequency of environmental analyses. Figure 1 displays the relationship of the frequency of change in an environment, the complexity within it, and the need for environmental scanning. Organizations must designate cross-functional teams to perform routine environmental scanning to determine the appropriate strategies relevant to their environmental uncertainty.

DECISION MAKING PROCESSES

Organizations have limited time to react to changes before their performance is hindered. Figure 2 depicts the stages an organization experiences once a change is introduced in their environment. The blinded

stage begins when an internal or external change threatens the longevity of the firm; often times, the organization does not recognize the signals introducing the decline and neglects to take prompt action (Daft 2013). Borders Group failed to react quickly to the introduction of online book retailing and its performance fell quickly behind Amazon. Borders' inaction eventually led to a faulty action; the company clung to its brick-and-mortar strategy as bookstore sells declined. The organization was deeply invested in an outdated business model, was unable to restructure, and filed for bankruptcy in 2011. The inability to identify change and incapacity to determine how to react to it are contributors to organizational complacency. Consequently, an organization must be able to analyze and forecast changes in the environment, as discussed above, but must also be able to identify and react to changes made by its competitors and appropriately adapt.

A factor that contributes to the capability of the firm to adopt change successfully is its ability to recognize the type of reactive-change necessary. Episodic change is characterized by low-level and managed disruptions and is usually a one-time occurrence such as a well-calculated merger; continuous change occurs when rates of change are higher and requires consistent technological and product innovation; lastly, disruptive change occurs with debilitating force that revolutionizes a process or an industry practice. An organization can better analyze the level of threat an episodic change poses and may choose to mimic the change. Continuous changes are much more predictable and can be anticipated with increased levels of technology; organizations are expected to seek out new and improved methods, equipment, and workflow processes (Daft 2013). The most complex type of change is disruptive; how does an organization know that a new trend will stick or how it should react to the trend? A constructive way for an organization to analyze the situation is by walking through a decision making process.

The following process adapts Henry Mintzberg's (Mintzberg, Raisinghani, and Théorêt 1976) Incremental Decision Model to the context of reactive change and adaption.

1. *Identification Phase.* This phase beings with an organization recognizing that an external change has occurred and then diagnosing the problem by gathering more information. Organizations can use environmental scanning and analysis to identify the following factors:
    - *Direct and indirect competitors.* Organizations should not only

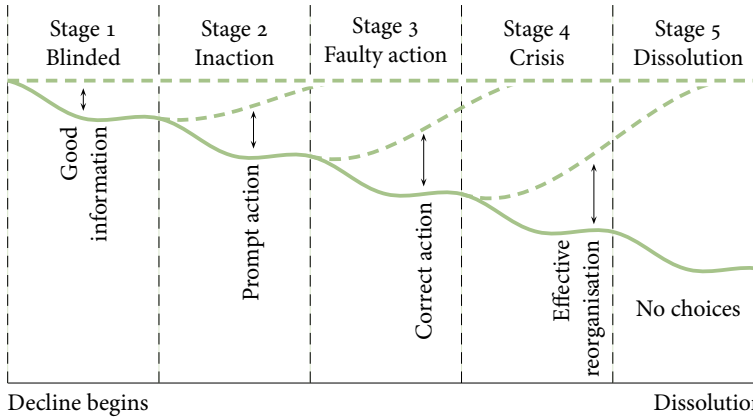

FIGURE 2 Stages of Decline and Widening Performance Gap (adapted from Weitzel and Jonsson 1989)

consider direct competitors but also institutions they do not compete with directly by identifying which products and services might be related to their own.

- *Types of change.* An organization should understand whether its competitors made a strategic or tactical change; is the competition launching a major product, service, process, or business-model innovation or is the company simply refining their current strategy (Dess et al. 2014). Is the change one that presents a nominal impact or could this be disruptive to the industry?
- *Hard and soft trends.* Organizations should look at both measureable trends and possible trends. The organization then must ascertain whether or not the change is attractive, resilient, attainable, and whether it creates value. There must be a need for the change for a period long enough to make the change worthwhile, the necessary technology must be available or reachable in the near future, and the adjustment should provide value to the consumer and/or the organization in some way.
- *Threats to organization.* It is important for organizations to consider how changes being made by competition will affect its target market, market share, cost structure, and overall strategy.

2. *Development Phase.* Organizations should identify possible reactions and capabilities to react by first searching its existing procedures and then resorting to a custom solution if it is faced with a non-programmed decision. An organization must then recognize

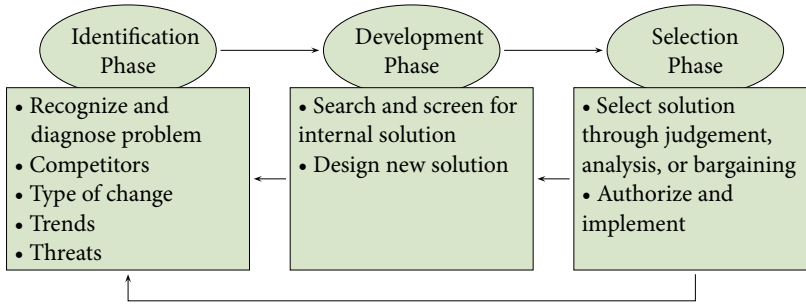

FIGURE 3 Incremental Decision Model and External Changes

whether or not it has the resources or ability to carry out the response and must be able to justify its actions. Often times, an organization's reaction will reflect the change made by the competition; i.e. strategic action by competitor will be combated with a strategic reaction by the organization. It is important to understand that an organization's competition may also react to its own decisions.

3. *Selection Phase.* This phase is when the solution is chosen. If the decision falls upon one decision maker, s/he may use judgement and experience to select a solution. Management can use scientific data in an analysis of alternatives but must realize it may not be as prominent in reacting to external changes. The Carnegie model of organizational decision making discusses formation of a coalition; an alliance among organization leaders that agree about the institutions goals and priorities (Cyert and March 1963). Often, before a coalition can be formed, members with differing opinions must debate on a goal oriented solution is found. To implement the new action, managers must authorize the change and sell it to employees; organizational culture contributes greatly to an organization's ability to embrace and carry out change.
4. *Dynamic Factors.* This decision making process is not a static step-by-step method. Often times, minor problems arise in the course of identifying, selecting, and implementing a problem and solution; these decision interruptions will cause the organization to loop back to earlier stages. Organizations should reflect upon the process and results of their decisions, learn from mistakes, and then continue to scan the environment for other possible threats.

Blockbuster, once America's dominant movie-rental chain, suffered

from organizational atrophy; the organization was unable to identify an effective reaction to Netflix's interruption in the movie-rental industry. The company lacked structure and processes that would have allowed it to identify environmental opportunities and threats demonstrated in hard trends by its direct and indirect competitors and find a solution. The incremental decision making process could have assisted Blockbuster in identifying the problem, understanding the impact on its operations, developing a solution, selecting the best alternative, and then implementing the solution. Kodak, Borders, Circuit City, and Blackberry all could have benefited from having this process in place.

ORGANIZATIONAL STRUCTURE AND CULTURE

One contributor to organizational complacency is the inherent desire for stability in human nature; people are naturally predisposed to be risk averse. Therefore, major fundamental changes can compromise the perceived validity of organizational decisions in the views of the public and shareholders (Hannan and Freeman 1989). In order to demonstrate legitimacy to stakeholders, a company must create a structure designed to embrace change and build a well communicated corporate culture to support it. The structure necessary to support change is contingent upon the organization's size, strategy, culture, and its focus on either manufacturing or service. Large organizations possessing the goal of efficient product manufacturing will require more of a mechanistic design (Daft 2013). It is important for these organizations to utilize organic designs within smaller departments whenever possible to increase the innovativeness of the firm. These hybrid organizations are ambidextrous: They have the ability to maintain efficiency in today's business operations while anticipating and preparing for predicted changes in the future. The organization can accomplish this through separating their exploitative operations from the exploratory operations and by maintaining a tightly integrated senior management team (O'Reilly and Tushman 2004).

Generally, organizations increase the number of positions within their structure as the external environment becomes more complex and harder to predict; while this enables companies to handle the increased uncertainty, it often leads to increased internal complexity (Daft 2013). Increased size and complexity in an organization may contribute to reluctance to change, or complacency, and lead a business to react only when its survival is in jeopardy. Many established firms wait too long to respond to external changes and when they do, it is often inadequate; this

may explain why change is often driven by new firms (McArdle 2012). In order to prevent this nature of complacency, the organization must establish a culture that supports and encourages essential changes. Whether it is the entire organization or the explorative leg of an ambidextrous organization, the culture should promote constant improvement. Google's culture, for example, is built around the idea that 'Great just isn't good enough' (Google n. d.). The company sets goals it knows it can't reach yet but that is what is expected of Google employees and stockholders.

A risk adverse culture breads complacency; organizations that react negatively to mistakes made by managers and employees will find themselves with a workforce trained to follow existing rules and procedures without question. To avoid complacency and achieve constant improvement in their business operations, organizations can develop a business-process-management culture that aligns all employees' efforts on adding value to the end consumer of their product or service (Zairi 1997). Therefore, an organization must consider the risk it is willing to undertake in its strategy and effectively communicate it with employees. This can occur through changes in policies and procedures as well as cultured manager/employee interactions. Organizations that accept feedback from employees working through processes can assess the purpose of business practices and make improvements. Managers' reactions to employee mistakes can either deter or encourage employee innovation and contribution. Organizations wishing to avoid organizational complacency should promote challenging processes and allow functionality without the fear of making mistakes.

JUSTIFICATION OF CURRENT POSITION

There are many justifications an organization may use to avoid change: Overconfidence in and reliance on past success may lead an organization to stick with an outdated strategy. Managers may demonstrate uncertainty avoidance resulting in justification of maintaining historically successful business models. Change is risky; it involves doing something that isn't already working (McArdle 2012). This is why culture and corporate accountability are key in ensuring the endurance and longevity of a firm.

A CEO, or other executive team member, with a history of success can become self-righteous and overconfident in his/her ability to make decisions. A leader with a successful past may be an attractive hire to an organization or may be retained by an organization for the wrong reasons; key

individuals in a corporation should be hired or retained based on their ability to provide ongoing and value to the company. If the individual with a successful track record is content with what he has accomplished in life, he may bring complacency into the organization. Certainly, the institution should analyze abilities based on past performance but should equally assess the individual based on his/her potential and desire to add value to the organization. The individual should be forward looking and motivated to help the organization achieve prominence in his/her industry. Google describes their culture as one where they target smart and determined people with ability over experience.

The same may occur for successful business models; organizations may cling to past successes and miss future opportunities. Richard Randall (2011), founder and president of management-consulting firm New Level Advisors, describes Kodak as complacent:

> Though Kodak was in on the ground floor of digital photography, its management was complacent for many years. Like so many other companies that have had a long run at the top, they either didn't spend the time or didn't have the imagination to see where digital photography might go and what it would do to their film-driven business model.

Kodak desperately wanted film to remain in-demand just as Borders and Blockbuster thought they could keep their brick-and-mortar business in competition with Amazon and Netflix. Business should not just be evaluating what they should do in the future, but should be evaluating what they should stop doing. Otherwise, consumers will make those decisions for them (Randall 2011).

CORPORATE ACCOUNTABILITY

Proper corporate governance will allow an organization to align the interests of the executive team and the owners of the organization but is simply not enough. Organizational complacency stems from lack of accountability within corporate governance players: the shareholders, board of directors (BOD), and executive management. These players should hold each other responsible for challenging their assumptions and rational; by questioning one's performance and validity of their current processes, the organization can achieve regular corporate self-analysis and avoid complacency.

Ideally, the shareholders of a company elect a BOD to operate in the best interests of the group; often times this relationship is complicated

with proxy votes and majority shareholders setting the stage for accountability to be disrupted. If a majority of shareholder(s) elect members to the board for reasons other than to effectively guide the company, such as friendship or familiarity, this can lead to reduced effectiveness and environmental awareness hampering constructive and timely change. One of the roles of the BOD is to select, evaluate, and plan succession for the organization's CEO. If the BOD is unwilling to exercise their fiduciary responsibility and replace the CEO when the individual becomes complacent or self-righteous, the organization will suffer and abdicate its competitive position. The BOD must also be held accountable for guiding and directing major strategies, objectives, and plans of the organization; if the BOD does not balance its focus on the past, present, and future and consist of individuals with suitable expertise and level of participation, the organization will lose its momentum.

The executive team should then, in turn, challenge middle managers on the expectations and standards they establish. Organizational complacency will sneak up on managers that are not challenging themselves and the employee's around them to achieve and improve organizational processes. This loops back to organizational culture; building accountability of achievement into the foundation of the organization's culture to allow the firm to extinguish complacency.

Conclusions, Limitations, and Discussion

Complacency trap, a stage that cripples the ability of organizations to effectively forecast and adapt to the environmental changes, is the source of downward spiral that results in demise of organizations. As our global markets are becoming more interconnected, complacency is not an option to remain competitive on an international scale. To avoid falling victim to ever-changing and ever-evolving markets, organizations must embrace agility and prompt adaptation to market trends and operational and strategic manoeuvres that competitors employ to gain competitive advantage. Aligning the appropriate culture with structure, people and processes to constantly remain vigilant and on guard is necessary to overcome organizational complacency.

Leadership must play a pivotal role in building agility by identifying areas of their organization that may be prone to complacency. We suggest that processes, people, culture, and structure may become important sources of complacency. Over time, processes are developed to make profitable activities more efficient. These procedures may hinder change

initiatives, however, as they are often cemented into the habits and routines of the organization (Becker 2004). For example, Borders Bookstores built a very sophisticated point of sale inventory management system to keep their stores stocked with merchandise. As they continued to invest in carrying the latest books and games, the world was rapidly changing around them. Books were becoming digitalized, making the one stop shop an antiquated business model in the book industry (Clay et al. 2002). Managers and employees should continually evaluate key processes in order to insure that they align with their competitive environment.

> The only thing of real importance that leaders do is to create and manage culture. If you do not manage culture, it manages you, and you may not even be aware of the extent to which this is happening.
>
> Edgar Schein (2010)

Building a culture that is equipped to identify and react to changing business practices requires a constant effort by organizational leaders. Employees should be encouraged and rewarded for taking risks. 3M does this through a program called 3M New Ventures. Employees are insured that they will get their old jobs back if they leave their current job to launch new products or invention. They are also compensated for their efforts by receiving a percentage of sales related to their project. Employees are often scared to identify problems or create solutions as they often believe they will be blamed if things don't work out. They may also feel social pressures to maintain the status quo. Leaders should be fostering a culture that encourages taking risks to solve important problems.

Structures can become highly complex and inert over time (Hannan and Freeman 1984). These structures may be slow to respond to environmental changes, leaving them vulnerable in the competitive market. A restricting may be a way for organizations to maintain dexterity. For example, Google has recently restructured into a holding company (Alphabet) in order to maintain flexibility in some of the smaller business units, such as Nest. With this new structure, Alphabet can give their businesses more autonomy to make their own decisions (Dougherty 2015).

Structure may also influence how leaders view their competitive landscape. Managers often view similarly structured companies as their main competitors (Porac, Thomas, and Baden-Fuller 1989); however, it is often just as important to look at indirect competitors to see where customers may find alternatives. For example, universities may use similar size schools in their region as a benchmark for their strategic plans. Be-

cause of this, many universities have overlooked competition from other sources, such as online education.

Although we have provided advice on how to identify and manage complacency, there are several limitations to the current study. Change is a challenging process, and may actually leave the company more vulnerable to market pressures while it is occurring. Organizations are subject to the liability of newness after a dramatic restructuring, increasing their probability of failure (Singh et al. 1986). In this article we have focusing on sources of complacency in order to help organizations identify when a change is necessary. However, organizations should take steps to prepare for a change effort before they jump in head first.

Building support from key organizational members early on can make a change much easier to implement. Restructuring can be a time consuming and expensive process, so the availability of resources should be carefully considered. Our decision making model may help managers understand the type of change needed to realign their business strategy. It should be noted that it is much easier to navigate an equilibrium rebalance at the early stages of decline rather than waiting for the performance gap to widen (Weitzel and Jonsson 1989). Future research could help identify when change is not an option for a company. In that case, managers may consider a divestiture strategy rather than a restructuring.

Our Framework for Assessing the Need for Environmental Scanning suggests that managers should look at both environmental complexity and frequency of change to understand how much environmental scanning is needed. We suggest that highly uncertain environments characterized by complexity and a high frequency of change have the greatest need for environmental scanning. Future research could investigate what how these environments may differ depending on the industry. For example, high-tech industries may be exceptionally dynamic, posing a higher risk for dramatic environmental shifts. Managers in these industries may need to spend additional resources scanning for new technologies that may reshape their industry.

Governing boards and top executive teams play a key role in creating a culture that embraces change. Future research could delve into this topic further to better understand how to increase dexterity in top management teams. Diversity and executive tenure may be important variables for reducing complacency.

National and organizational cultures may be additional contextual variables worth exploring. For example, cultures high in uncertainty

avoidance, such as South Korea, may be more prone to complacency as they tend to avoid taking risks.

This research provides an important framework to help managers identify and react to complacency within their organizations. As globalization becomes an increasing force in the 21st century, our complex and dynamic competitive environment creates new opportunities and challenges for business leaders. Managers need to contemplate both foreign and domestic threats in order to remain competitive on an international scale. In order to do this, they should be mindful of complacency and the impact it may have on their ability to effectively navigate the competitive landscape.

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Scenariji naftne industrije Hrvaške in regije: kvalitativni pristop

Radoslav Barišić

Naftna industrija je zgodovinsko obremenjena z različnimi turbulencami in pretresi, kar ima pomemben učinek na tržišče. Z namenom predvidevanja nepredvidenih in potencialno škodljivih situacij nekaj podjetij, kot del svojega dolgoročnega strateškega načrta, posveča pozornost scenarijskemu načrtovanju, kar je uporabna tehnika za pripravo primerne strategije in odzivov na potencialno nepredvidene nujne primere. Scenarijsko načrtovanje se uporablja za podrobno analizo trenutne situacije na tržišču in potencialnega prihodnjega razvoja, s čimer ustvarja raziskovalni okvir za ustvarjanje razvojnih scenarijev. Scenarijsko načrtovanje je še posebej poudarjeno v kontekstu naftne industrije, glede na to, da gre za tehniko, ki je dejansko nastala v tem poslu (uporabljala se je tudi v prejšnji vojaški doktrini), saj je zaradi scenarijskega načrtovanja nekaj naftnih podjetij profitiralo in pridobilo privilegiran položaj. Cilj članka je ponuditi vpogled v pomembnost in različne pristope pri uporabi scenarijskega načrtovanja danes ter razložiti potencialne dolgoročne scenarije naftne industrije na Hrvaškem in v regiji, pridobljene s pomočjo kvalitativne raziskave in poglobljenih intervjujev s številnimi strokovnjaki s področja naftne industrije.

Ključne besede: konkurenčna prednost, naftna industrija, scenarijsko načrtovanje
Klasifikacija JEL: L1
Managing Global Transitions 14 (4): 317–334

Kakovost korporativnega upravljanja v izbranih tranzicijskih državah

Danila Djokić in Mojca Duh

Pomembna vprašanja, ki zadevajo pojem dobrega korporativnega upravljanja, se osredotočajo na to, kaj dobro korporativno upravljanje je, kdo ima od njega koristi in kako se lahko meri njegova kvaliteta. Cilj naše študije je razširiti naše poznavanje vloge standardov in kodeksov dobrega korporativnega upravljanja pri izboljšavi upravljavskih praks. Ugotovili smo, da so pri merjenju in izboljšavah kvalitete korporativnega upravljanja pomembni ne le formalne regulacije, standardi in

upravljavski kodeksi – ki omogočajo oceno upravljalskih praks podjetja –, ampak tudi pokazatelji korporativnega upravljanja. Rezultati raziskave, izvedene na podlagi metodologije indeksa SEECGAN, so nakazali, da so imeli obvezne zahteve in prostovoljna priporočila visokih upravljavskih standardov pozitiven vpliv na prakse korporativnega upravljanja v Sloveniji.

Ključne besede: korporativno upravljanje, indeks, kakovost, tranzicijska država
Klasifikacija JEL: G34, P20
Managing Global Transitions 14 (4): 335–350

Privatizacija in optimalno dobrobitje v mednarodnem Cournotovem modelu

Fernanda A. Ferreira in Flávio Ferreira

V pričujočem članku analiziramo odnos med privatizacijo javnega podjetja in davčnimi prihodki domače vlade v pogojih mednarodne konkurence z uvoznimi tarifami vred. Razmišljamo o modelu duopoly, kjer domače javno podjetje in tuje zasebno podjetje tekmujeta na domačem trgu kot igalca Cournot. Poleg tega domača vlada nalaga tudi tarifo za regulacijo uvoženega blaga in so ji pri tem lahko bližje tarifni prihodki kot družbena blaginja. Izračunamo ravnovesje in pokažemo, da bo privatizacija (a) povečala dobiček tako domačih kot tujih podjetij, (b) povečala tarife, uvedene na uvožene dobrine, in (c) zmanjšala domačo blaginjo. Nadalje pokažemo da bo večji vladni interes za tarifne prihodke zvišal družbeno blaginjo tako v mešanih kot zasebnih modelih.

Ključne besede: teorija iger, industrijska organizacija, Cournotov model, privatizacija
Klasifikacija JEL: C72, L33
Managing Global Transitions 14 (4): 351–358

Optimizacijski problem na teoriji možnosti zasnovanega portfolia z nenatančnimi napovedmi

Massimiliano Kaucic in Roberto Daris

V članku predlagamo nov pristop intervalne optimizacije za izbiro portfolia, kadar so na voljo nenatančne napovedi. Razmislimo o izbiranju vlagateljev glede na teorijo možnosti, kjer so scenariji podani v obliki približnih številk. Dobljeni izsiljeni nelinearni intervalni optimizacijski problem je pretvorjen v dva nelinearna programska problema, z uporabo skupnega reda razmerja med intervali. Statična in dinamična analiza portfoliev, ki vključujejo sredstva iz hrvaškega trga, ponazori potencial metode z upoštevanjem standardnega postopka.

Ključne besede: teorija možnosti, naključni nizi, red intervala, hrvaški delniški trg
Klasifikacija JEL: C61, C63, G11, G15, G17
Managing Global Transitions 14 (4): 359–384

Predhodniki organizacijske samozadovoljnosti: identificiranje in preprečevanje samozadovoljnosti v delovnem okolju

Abe Harraf, Brandon Soltwisch in Kaitlyn Talbott

Današnje tekmovalno globalno okolje je bolj dinamično kot kadar koli poprej in v njem organizacije ne morejo sedeti križem rok. Finančna kriza v gospodarstvu Združenih držav postreže z živim primerom, kaj se lahko zgodi, ko se organizacijam ne uspe prilagoditi spremembam v njihovem okolju. Je pa malo znanega o razlogih za samozadovoljnost in o tem, kaj lahko managerji naredijo, da jo preprečijo. Ta članek identificira vire samozadovoljnosti na štirih večjih področjih: postopku, ljudeh, strukturi in kulturi. Nato razvijemo okvir za ocenjevanje potrebe po pregledovanju okolja, ki temelji na kompleksnosti in pogostosti spremembe v okolju. Na koncu uporabimo primere s tržišča z namenom oblikovanja koristnih nasvetov za managerje, kako identificirati in se odzvati na samozadovoljnost v njihovih organizacijah.

Ključne besede: organizacijska samozadovoljnost, strateška fleksibilnost, spremembe, prilagoditev, organizacijska kultura
Klasifikacija JEL: M12, M14
Managing Global Transitions 14 (4): 385–401