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Mobbing in Slovenia: Prevalence, mobbing victim characteristics, and the connection with post-traumatic stress disorder

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Abstract

An increasing number of organizations face the problem of mobbing, which represents a serious, widespread problem with numerous consequences for victims, organizations, and society. We also recognize the connection this phenomenon has with the emergence of post-traumatic stress disorder (PTSD). PTSD poses one of the most critical consequences for victims of mobbing, who mostly consist of employees at lower organizational levels. Our research focuses on the prevalence of mobbing in Slovenia, its correlation to PTSD, and some differences in the subjective and objective assessments of being exposed to mobbing. We found that the prevalence of mobbing in Slovenia can be compared to some previous assessments as well as data from other countries. Among the study's participants, 24% could be classified as regular victims of mobbing. For the first time, we link mobbing with PTSD using a Slovenian sample. We also recorded some interesting differences between subjective and objective assessments of mobbing, thereby indicating the importance of subjective conceptualizations of mobbing acts, which should be investigated in greater detail in future research.

Keywords: Mobbing, post-traumatic stress disorder, prevalence, subjective and objective assessment, workplace health.

1 Introduction

The modern workplace is changing: The pace of work is accelerating while work efficiency and performance depend on social interaction more than ever. New ways of doing business lead to increased competition and rivalry between coworkers. In addition to difficult interpersonal relationships and increasing

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stress, the phenomenon of mobbing is becoming increasingly noticeable. Mobbing is a sophisticated form of terror in the workplace that can be used to disable a coworker emotionally, mentally, socially, and economically (Bakovnik, 2006).

Several studies have confirmed that mobbing is an issue. Researchers estimate that the prevalence of mobbing ranges anywhere from 1% to 53% among various occupations and countries (Bentley et al., 2012; Cowie et al., 2000; Leymann, 1996; Lutgen-Sandvik, Tracy, & Alberts, 2007; Mikkelsen & Einarsen, 2001; Vartia, 1996; Zapf, Einarsen, Hoel, & Vartia, 2003). Data for Slovenia also vary. The fourth European Working Condition Survey revealed a 7.4% prevalence (Parent-Thirion, Macias, Hurley, & Vermeylen, 2007) whereas the Slovenian Banking Union' research recorded a 15.1% prevalence (Robnik & Milanovič, 2008). Mobbing most often affects subordinates in organizations (Brinkmann, 1995; Zapf et al., 2003), which includes several other groups that are even more exposed, such as the elderly, people who are often absent, and women (Brečko, 2010). Kostelić-Martić (2007) pointed out that minorities—from religious and ideological minorities to homosexuals—are also victims of mobbing.

Yet we must emphasize that not every insolence or ordinary work requirement should be seen as an act of mobbing. Vie, Glasø, and Einarsen (2010) suggested that the term *mobbing* should be treated within the individual's experience of a certain act that is caused by others. Some people might interpret an action as a harmless joke, while others might see the same action as an act of mobbing. In any case, subjective assessments often differ from the results of objective measurements, although some coherency is also observed (Notelaers, Einarsen, De Witte, & Vermunt, 2006; Zapf et al., 2003).

The consequences of mobbing include a wide range of problems that affect the victims as well as co-workers (Brečko, 2010; Tkalec, 2001; Vartia, 2001), the organization (Brečko, 2006; Di Martino, Vittorio, Hoel, & Cooper, 2003; Tkalec, 2006), and society (Brečko, 2010; Di Martino et al., 2003). Nevertheless, mobbing affects victims the most because it impacts various aspects of their lives: mental and physical functions, interpersonal relationships and interactions, and economic stability. The most severe cases of mobbing lead to the emergence of post-traumatic stress disorder (PTSD)—a complex, usually chronic, and tiring mental disorder caused by surviving an extremely severe event or trauma (Weathers, Keane, & Foa, 2009). Di Martino et al. (2003) reported that the rate of PTSD in victims of mobbing exceeds those of people who experienced traumatic accidents. Furthermore, Brečko (2006) noted that the level of risk for developing PTSD in victims of mobbing (25%–50%) resembles the risks in survivors of aircraft accidents (25%), war veterans (25%–50%), and survivors of car accidents (20%).

The fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM-IV-TR*; American Psychiatric Association, 2000) provides the most commonly used definition of PTSD, categorizing it as an anxiety disorder. It involves the following diagnostic criteria: (1) reliving symptoms (e.g., remembering the trauma), (2) demonstrating avoidance symptoms (e.g., avoiding thoughts and feelings associated with the traumatic event), and (3) experiencing symptoms of increased arousal (e.g., irritability, lack of concentration). The diagnosis is justified when at least one symptom of reliving, three avoidance symptoms, and two arousal symptoms occur at least one month. The symptoms typically also interfere with the individuals' ability to function in social, professional, or other fields of human activity (American Psychiatric Association, 2000).

In addition, formal diagnosis requires an experience of a death threat or threats of serious injury to the individual or to others. Mobbing victims usually do not meet this criterion (Rodriguez-Muñoz, Moreno-Jiménez, Sanz Vergel, & Garrosa Hernández, 2010). Many authors have discussed this dilemma (Arias & Pape, 1999; Gold, Marx, Soler-Baillo, & Sloan, 2005; Ravin & Boal, 1989), noting that PTSD can occur in the absence of a traumatic event. For example, Long et al. (2008) showed that an even higher rate of PTSD and severity of symptoms occurred when the criterion of traumatic experience was not present.

Numerous researchers have repeatedly confirmed a positive relationship between mobbing and PTSD. Leymann and Gustafson (1996) identified 59 participants, within a 64-person sample, who demonstrated PTSD symptoms. Mikkelsen and Einarsen (2002) found a positive correlation between mobbing and PTSD (r = 0.34), and 76% of the studied 118 mobbing victims displayed severe symptoms of PTSD. Moreover, Nielsen, Matthiesen, and Einarsen (2005) determined that 84% of victims of mobbing had PTSD. The same authors made no observations about gender differences in the prevalence of PTSD among victims of mobbing. In general, however, PTSD is more prevalent among women than men (Breslau, Davis, Andreski, Paterson, & Schultz, 1997; Christiansen & Elklit, 2012; Schüffel, Schade, & Schunk, 2004).

In Slovenia, the limited amount of research that exists in the field of mobbing often focuses on its prevalence and the characteristics of people involved. In the present study, we wanted to reexamine the prevalence of mobbing in Slovenia as well as gender differences, differences between age groups, and organizational levels in terms of exposure

to mobbing. In the second part of the present study, we explored the link between mobbing and PTSD, which has not yet been studied in Slovenia. We also wanted to observe potential differences between subjective and objectives measures of mobbing exposure and differences in the incidence of PTSD among male and female victims of mobbing.

2 Method

2.1 Sample

The research sample consisted of 150 participants (females = 81) who had been employed for at least six months. In terms of the organizational structure, the sample includes 62% workers/contractors, 20% employees in lower management, 12% in middle management, and 6% in upper management. Table 1 shows participants' age structure.

2.2 Instruments

We collected data using a structured questionnaire that consisted of three parts:

(1) A set of demographic questions included questions about gender, age group, and the organizational level at which the participant was employed.

(2) The Negative Acts Questionnaire (NAQ; Einarsen, Raknes, Matthiesen, & Hellesøy, 1994) consists of 22 negative behaviors (e.g., "Someone withholding information that affects your performance") that are valued by respondents using a 5-point scale (1 = never; 5 = daily). According to the responses, respondents were classified into three groups: (a) respondents who are not victims of mobbing; (b) respondents who are occasionally victims of mobbing; and (c) respondents who are regular victims of mobbing. For this classification, we used the following key:
   - *Not a victim of mobbing:* respondents who marked all items with 1 (never) and thus had not been victims of negative acts in the preceding six months.
   - *Occasional victim of mobbing:* respondents who had been victims of at least one negative act occasionally or monthly.
   - *Regular victim of mobbing:* respondents who had been victims of at least two negative acts weekly or more often.

Subjective assessments of exposure to mobbing were collected with the following question: "Are you a victim of workplace mobbing?" Participants assessed their answer (taking into account the given definition of mobbing) on a scale ranging from 1 (not a victim of mobbing) to 5 (yes, almost daily, I am a victim of mobbing).

The post-traumatic symptom scale–10 items (PTSS-10; Raphael, Lundin, & Wisæth, 1989) was translated and adapted for Slovenian researchers by Jan (2011). It consists of 10 symptoms of PTSD (e.g., "I have trouble sleeping"; "I'm having nightmares"). Respondents assess their frequency on a scale ranging from 1 (never) to 7 (always). The respondent's level of PTSD equals the overall score on the scale. In the current study, participants whose total score was 35 points or more were considered victims of PTSD; those whose scores fell between 27 and 35 points were considered potential victims of PTSD (Boer et al., 2007).

Both questionnaires used have been proven to be very reliable. The analysis of internal consistency of the NAQ revealed a Cronbach's α of 0.94 whereas the analysis of PTSS-10 showed a Cronbach's α of 0.93.

3 Results

We analyzed the responses to the NAQ and found that 63% of the participants fall into the category of occasional victims of mobbing, 24% of participants fall into the category of regular victims of mobbing, and only 13 % of respondents reported no exposure to negative acts in their workplace.

The subjective assessment provided a different picture: 59% of the participants believed that they are not victims of mobbing, 36% saw themselves as occasional victims, and 5% considered themselves as regular victims of mobbing.

We present the crosstabs of the NAQ results and the subjective assessment of mobbing exposure in Table 2. We can see that the subjective measure rarely fits (in 37% of respondents) the results of the NAQ. Notably, the subjective rating was typically lower.

Table 1 Participants' Age Structure

Age (years)	⩽ 25	26 ⩽ 30	31 ⩽ 35	36 ⩽ 40	41 ⩽ 45	46 ⩽ 50	51 ⩽ 55	⩾ 56
Frequency	12	56	25	14	17	14	9	3
%	8.0	37.3	16.7	9.3	11.3	9.3	6.0	2.0

The highest scores on the NAQ were achieved by participants from the 36- to 40-year-old group (M = 44.4; SD = 16.75), participants who work in lower management (M = 36.8; SD = 13.80), and workers/contractors (M = 36.5; SD = 14.47). Men's and women's responses on the NAQ showed no statistically significant difference tested with Mann-Whitney's test (U = 2758.0; p < 0.05). Individuals from 26- to 30-year-old group (49%) and individuals who work as workers/contractors (68%) represent the majority of regular mobbing victims. We did not, however, record any gender differences in our sample of regular mobbing victims.

Table 2 Crosstabs Analysis of NAQ Results and Subjective Measures of Mobbing Exposure

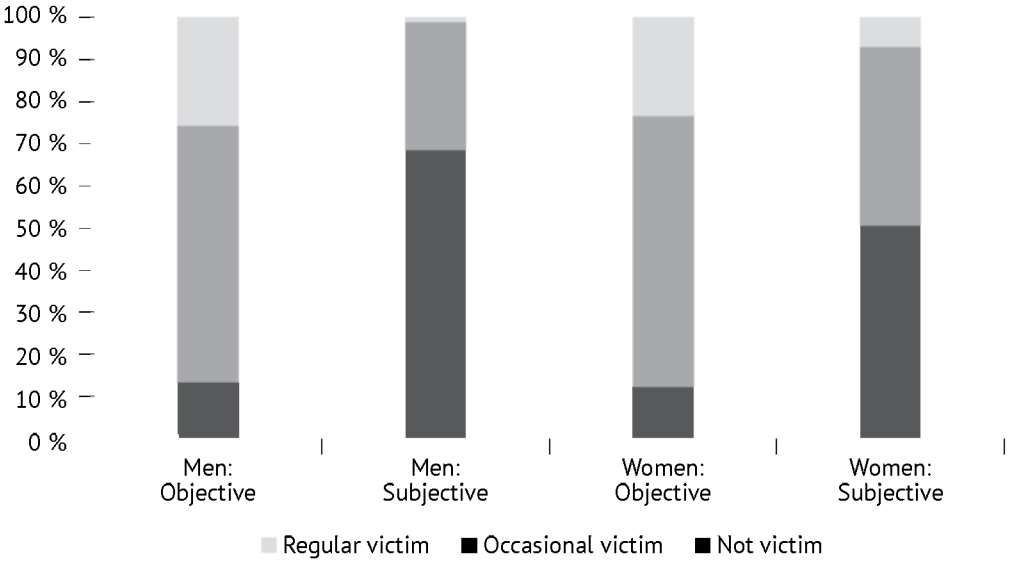
		NAQ			
		Not victim	Occasional victim	Regular victim	Total
Subjective measure	Not victim	18	61	9	88
	Occasional victim	1	32	22	55
	Regular victim	0	1	6	7
	Total	19	94	37	150

Table 3 Average Estimates for the Occurrence of Individual Symptoms in PTSS-10

	M	*SD*	*Me*
Irritability	**2.81**	1.51	2.5
Jumpiness	**2.73**	1.55	2
Sleep problems	**2.72**	1.63	2
Frequent mood swings	**2.71**	1.56	2
The need to withdraw from others	2.54	1.61	2
Depression (I feel dejected/down-trodden)	2.34	1.56	2
Muscular tension	2.15	1.56	2
A bad conscience, blame myself, have guilty feelings	2.13	1.35	2
Nightmares	1.97	1.31	1.5
Fear of places and situations that remind me of negative acts in the workplace	1.77	1.32	1

Note. Estimates were given on a 5-point scale for each item; *M*: mean; *SD*: standard deviation; *Me*: median.

Figure 1: Comparison of subjective ratings of mobbing exposure and results of the NAQ based on participants' gender



The results of the NAQ do not suggest any gender differences in exposure to mobbing. On the contrary, the subjective measures present a slightly different picture. A comparison of the objective and subjective exposure assessments of mobbing by participants' gender are presented in Figure 1. The difference between the ratings was significantly higher in men ($U = 2139.00$; $p < 0.05$).

On the PTSS-10, respondents on average reached 23.9 points ($SD = 11.63$). Table 3 provides the average estimates of the frequency of occurrence for individual symptoms, as assessed by the participants on a 5-point scale.

The groups most exposed to PTSD are workers/contractors ($M = 24.5$; $SD = 12.13$), followed by middle management ($M = 24.1$; $SD = 11.14$), lower management ($M = 23.2$; $SD = 11.15$), and lastly higher management ($M = 19.7$; $SD = 9.81$). Based on age-group classifications, the results show that 36- to 40-year-olds are the most exposed to PTSD ($M = 32.4$; $SD = 11.99$) while 41- to 45-year-olds were the least exposed ($M = 16.9$; $SD = 6.39$). Focusing on gender differences, we see that women, on average ($M = 25.7$; $SD = 12.15$), achieved typically higher scores ($U = 2181.0$; $p < 0.05$) compared to men ($M = 21.7$; $SD = 12.15$).

We also compared the scores on the PTSS-10 between men and women on the level of mobbing exposure measured with the NAQ. The comparison of average scores is illustrated in Figure 2.

Analysis using the Mann-Whitney test for two independent samples showed that statistically significant differences between the sexes was found only in the group of occasional victims of mobbing ($U = 734.00$; $p < 0.01$).

We tested the correlation between the scores on the NAQ, subjective measurement of mobbing exposure, and the test results on the PTSS-10 using the Spearman's rho correlation. We present our findings in Table 4, which shows that all correlations are statistically significant.

We were also interested in whether the level of PTSD differed for people who fall into the selected category of mobbing according to the subjective estimates and the test

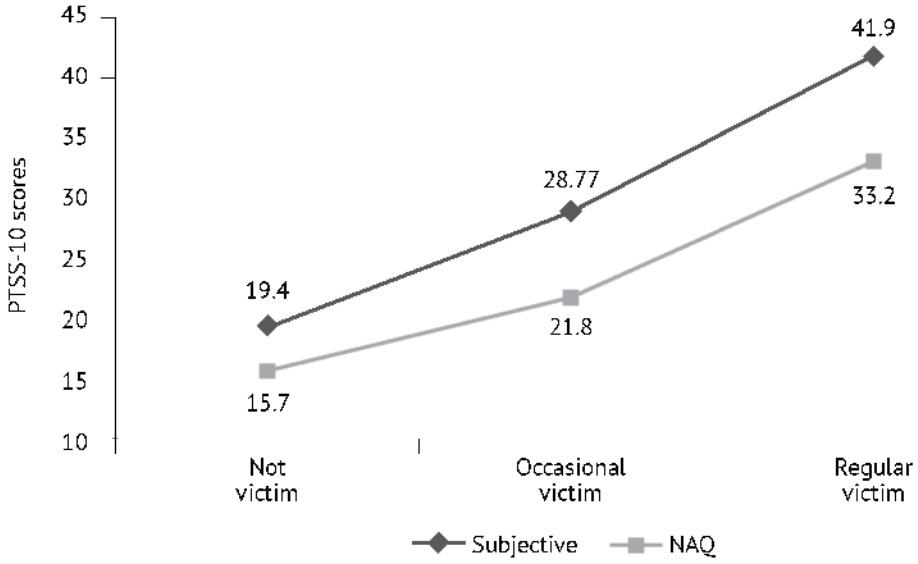
Table 4 Results of Spearman's Correlation Test among Scores on the NAQ, the PTSS-10, and Subjective Measure of Mobbing Exposure

		NAQ	PTSS-10	Subjective measure
Spearman's rho	NAQ	1	-	-
	PTSS-10	0.59**	1	-
	Subjective measure	0.67**	0.48**	1

**$p < 0,01$ (one-tailed tests)

Figure 2: Comparison of average PTSS-10 scores between men and women according to the NAO results of exposure to mobbing

Figure 3: Comparison of assessments on the PTSS-10 based on objective and subjective measures of exposure to mobbing



results of the NAQ. Figure 3 illustrates the test results of the PTSS-10 with respect to these conditions.

Figure 3 clarifies that the participants, who were arranged in their respective groups according to the subjective measure, scored higher on the PTSS-10, compared to those classified based on the NAQ scores.

Discussion

Our findings reaffirm the troublesome prevalence of mobbing among Slovenian employees. The findings also reveal significant differences between the subjective assessments of exposure to mobbing and estimates obtained by an objective method. Furthermore, we confirmed with a Slovenian sample that exposure to mobbing significantly correlates with the emergence of PTSD.

Our findings deviate from previous research in the percentage of mobbed individuals (Parent-Thirion et al., 2007; Robnik & Milanović, 2008). The NAQ test results indicate that 24% of participants are regular victims of mobbing, whereas 68% of participants reported being occasional victims of mobbing. These results fit the data for other countries, which as noted, range from a 1% to a 53% prevalence (Bentley et al., 2012; Cowie et al., 2000; Leymann, 1996; Lutgen-Sandvik et al., 2007; Mikkelsen & Einarsen, 2001; Vartia, 1996; Zapf et al., 2003). Our results show that victims of mobbing are usually 26 to 30 years old (49%) and at the organizational level of workers/contractors (68%). These findings are consistent with the findings of other studies (Brinkmann, 1995; Zapf, 2000). On the other hand, we did not find any gender differences in exposure to mobbing, which is contrary to some previous claims (Brečko, 2010), although such results are not unique (Einarsen et al., 1994; Hoel et al., 2001; Rayner, Hoel, & Cooper, 2002).

Subjective estimates of mobbing exposure were considerably lower. According to the data, 36% of the present study's participants categorize as occasional victims and 5% fall in the category of regular mobbing victims. Other researchers have reported such differences between subjective and objective assessments of mobbing exposure (Notelaers et al., 2006; Zapf et al., 2003). Differences of this type occurred more often in men, which raises questions about the importance of the subjective conceptualization of acts of mobbing. Escartin, Salin, and Rodriguez-Carballeira (2011) provided some answers that drew attention to higher sensitivity in evaluating mobbing in women. Nevertheless, this remains an under-researched area with considerable potential.

One of the main goals of the present research was to explore the link between exposure to mobbing and PTSD. Our findings show a statistically significant positive correlation between PTSD and the results of the NAQ ($p = 0.59$) as well as the results of the subjective assessment ($p = 0.48$). Using a Slovenian sample, this connection was confirmed for the first time, although it had already been detected in previous research on foreign samples (Mikkelsen & Einarsen, 2002; Nielsen et al., 2005). The descriptive analysis of our results also suggests such a connection. We found that workers/contractors are the most at-risk of PTSD and are the most exposed to mobbing (Brinkmann, 1995; Zapf et al., 2003).

Our analysis also shows that women scored significantly higher on the PTSS-10 scale than men in the entire sample.

Such data are consistent with general estimates of the prevalence of PTSD (Breslau et al., 1997; Christiansen & Elklit, 2012; Schuffel et al., 2004). However, among the regular victims of mobbing, no significant gender differences were found in the PTSS-10 scores.

The findings of the present study should be viewed in light of its limitations, which are derived primarily from the characteristics of our sample. The number of study participants deviated across age groups and organizational levels and was relatively low. In addition, we chose to divide the methods into subjective and objective assessments of mobbing exposure. We used a questionnaire, the NAQ, as an objective measure; despite its reasonably good psychometric characteristics, it is still based on self-report. Interestingly, according to this limitation, we would expect more consistent results when comparing the subjective and objective measures, which was not the case. Finally, although we chose the PTSS-10 scale for its promising psychometric characteristics, it is still one of the many instruments used to evaluate PTSD. Finally, we must also note that the PTSS-10 is more of a research tool than it is diagnostic.

Conclusions

Our research deepens the understanding of mobbing in our country. We have confirmed its prevalence and relevance among Slovenian employees and, for the first time, have also confirmed its connection with PTSD in a Slovenian sample. Our findings unravel the seriousness of the problem of mobbing in Slovenia. The problem has been explored to some extent by several prior studies, although we are still waiting for a larger research project in this area. Furthermore, future research should focus on detecting specific features of mobbing conceptualizations by individuals. The present findings show that men identify mobbing to a lesser extent compared to women. Escartín et al. (2011) suggested that such differences stem from women's higher sensitivity to acts of mobbing, although we assume that other variables could be important as well. Vie et al. (2010), for example, highlighted the importance of personal characteristics; meanwhile, Ireland (2006) studied the effect of organizational context, Lewis (2001) the role of media, and Escartín, Zapf, Arrietta, and Rodríguez-Carballeira (2011) the moderating effect of the national context.

The current situation clarifies that society fails to view mobbing as a wider social phenomenon and treats it with a lack of urgency. Slovenian legislation of this field remains highly problematic. No specific law prevents mobbing, which makes it difficult to prove mobbing legally. However, we have several regulations that indirectly govern procedures in cases of mobbing and sanctioning employers where mobbing actions occur. For example, the Employment Relationship Act (2009), the Civil Servants Act (2012), and the Occupational Health and Safety Act (2011) all address mobbing.

However, there are some solutions for addressing workplace mobbing, which can be adopted by managers, employees, and even the victims. Niedl (1996) suggested that detection of negative acts is possible in an early stage, thereby enhancing the possibility for their prevention. Generally, these solutions focus on eliminating tolerance for bullying and mobbing through surveillance, policy development, training, coaching, mediation, and different reward systems that motivate collaborative behavior at work (Ferris, 2009). The victims are usually encouraged to seek help that integrates the individual, organization, and psychotherapy (Duffy & Sperry, 2012).

Yet mobbing is still not recognized as a social problem, and it is high time for some organized preventive-oriented efforts to fight against it. On the one hand, we must educate and inform; on the other hand, we must introduce more precise legal regulations in this area.

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Mobing v Sloveniji: razširjenost, značilnosti žrtev mobinga in povezava s posttravmatsko stresno motnjo

Izvleček

Organizacije se vse pogosteje soočajo z mobingom. To je resen in predvsem razširjen problem. Že dolgo poznamo tudi njegovo povezavo s posttravmatsko stresno motnjo. Za žrtve mobinga, med katerimi so najpogosteje zaposleni na nižji organizacijski ravni, je ta motnja je ena najresnejših težav. Z raziskavo smo želeli ugotoviti razširjenost mobinga v Sloveniji, raziskati njegovo povezanost s posttravmatsko stresno motnjo ter proučiti razlike med subjektivnimi in objektivnimi ocenami izpostavljenosti mobingu. Naše ugotovitve kažejo, da je prevalenca mobinga v Sloveniji primerljiva s podatki iz prejšnjih merjenj pa tudi s podatki za druge države. Med udeleženci raziskave je kar 24 % takih, ki se uvrščajo v skupino rednih žrtev mobinga. Prvič potrjujemo njegovo povezavo s posttravmatsko stresno motnjo na slovenskem vzorcu. Zabeležili smo tudi zanimive razlike med subjektivnimi in objektivnimi ocenami, ki kažejo na pomen subjektivne konceptualizacije dejanj mobinga.

Ključne besede: mobing, posttravmatska stresna motnja, prevalenca, subjektivno in objektivno ocenjevanje, zdravje na delovnem mestu

Examining Determinants of Leadership Style among Montenegrin Managers

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Abstract

As a leader's behavior can have a strong impact on different employee work-related outcomes, various approaches have been put forth in an effort to determine the most effective form of leadership and determinants of individuals' choice of leadership style. This paper analyzed whether one's choice of leadership style is due more to personal or organizational characteristics. We used survey data to investigate the determinants of leadership style among Montenegrin managers. Our analysis showed that, although demographic characteristics such as gender, age, and education do not influence the choice of leadership style, internal organizational characteristics such as hierarchical level, managerial orientation to tasks/people, and decision-making characteristics such as decision-making style and decision-making environment are positively associated with the choice of democratic leadership style. This contributes to recent research in leadership that shows how some personal characteristics are considered to be less important in developing certain styles and that the choice of style is more dependent and contingent on external influences and situations.

Keywords: decision-making characteristics, demographic characteristics, internal organizational characteristics, leadership style, Montenegro

1 Introduction

Research on leadership and leadership style has been present in scientific research for decades, yet despite its strongly recognized importance it remains an elusive

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concept (Singh, Nadim, & Ezzedeen, 2012) and an object of interest for many researchers. According to Bhatti, Maitlo, Shaikh, Hashmi, and Shaikh (2012, p. 192) leadership can be defined as

> a social influence process in which the leader seeks the voluntary participation of subordinates in an effort to reach organization goals. It is a process whereby one person exerts social influence over other members of the group and a process of influencing the activities of an individual or a group of individuals in an effort towards goal achievement in given situations.

Because of its strong influence not only on the employee's motivation, job satisfaction, and other work-related outcomes, but also on the overall organizational performance, various approaches have emerged in attempts to give an answer to the most effective form of leadership and leadership style. Different theories and assumptions, based on personality, behaviorist, and contingency theories, have been used to establish the traits and behaviors that determine effective leadership and leadership style (Jonsen, Maznevski, & Schneider, 2010). Leadership style can be defined as a set of behaviors, beliefs, and focus of power that a manager adopts toward its subordinate staff (i.e., the way in which the manager typically behaves toward members of the group; Mullins, 2005). Looking at the continuum or range of possible leadership behavior based on manager and non-manager power, influence, and freedom (Tannenbauem & Schmidt, 1973), one of the most accepted distinctions is between autocratic and democratic leadership styles. The notions of autocracy and democracy have been used to distinguish these two styles (Choi, 2007). Democratic leadership is defined as the performance of three functions: distributing responsibility among the membership, empowering group members, and aiding the group's decision-making process (Gastil, 1994). On the other side, an autocratic leader maintains a high level of individual control over all decisions, defines all the activities, and seeks no participation from group members.

The style that a leader adopts is based on a combination of their beliefs, ideas, norms, and values (Iqbal, Inayat, Ijaz, & Zahid, 2012). It is a permutation of various personal traits and characteristics, attributes, and qualities that influence group members for the accomplishment of the targets (Ansari & Naeem, 2010). In that sense, various demographic characteristics were investigated to determine their relevance to a leadership style. Demographic characteristics of the workforce in the management of an organization have received increased attention among researchers in recent years because of its importance in predicting workers' behavioral outcomes, such as efficiency and effectiveness (Shadare, 2011).

Therefore, this study collects and analyzes different data on a number of demographic as well as organizational and decision-making characteristics that can be considered important in explaining leadership styles. The characteristics analyzed age, gender, and educational level (demographic); hierarchical level and managerial characteristics (organizational); and decision-making style and decision-making environment (decision making). The objective of the study is to examine whether these characteristics can be seen as determinants of leadership style. As Oshagbemi (2008) stated, although a significant amount of existing research on leadership styles has focused on only one personal dimension or one organizational aspect and its impact on leadership, it is believed that a better approach would be to examine both various personal and organizational dimensions as determinants of leadership style. Thus, this paper attempts to give a broader picture of the influence of not only demographic, but also organizational and decision-making characteristics on leadership style. Thus, this paper conducts an empirical study of the sample of 105 managers from 96 organizations in Montenegro.

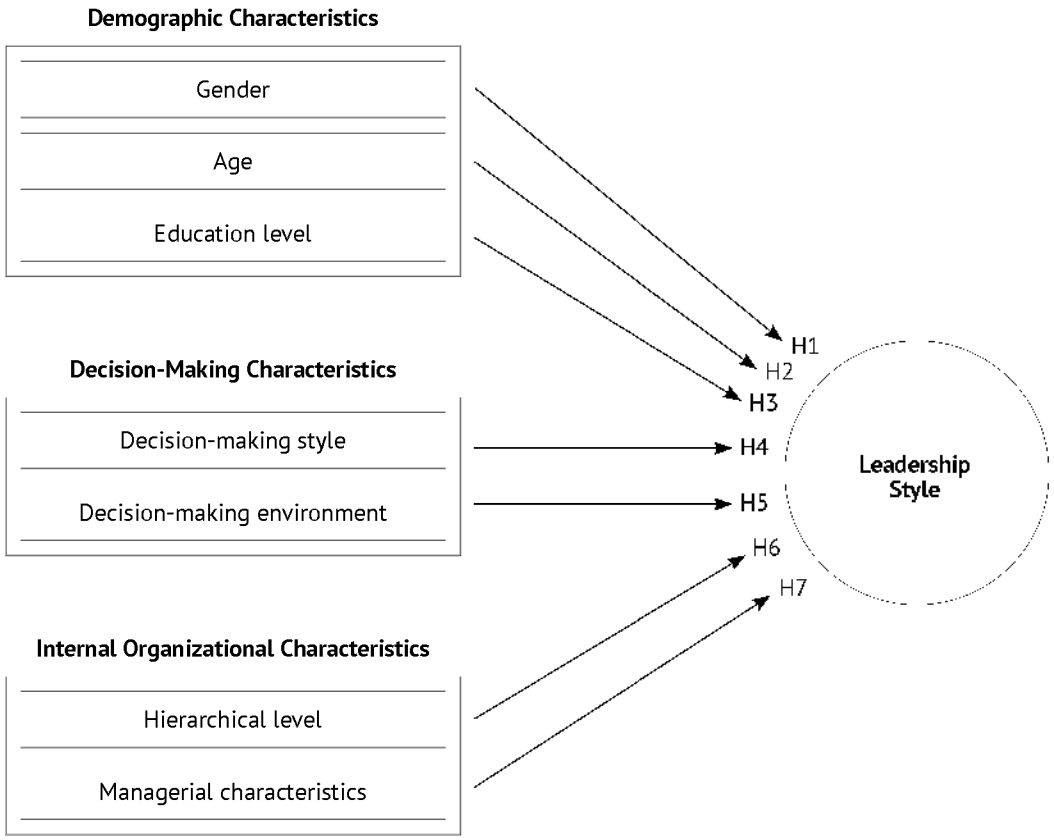
The remainder of this paper is structured as follows. In the next section, we provide a theoretical and conceptual framework of the influence of different demographic, organizational, and decision-making characteristics on leadership style. The third section presents data and methods employed. Section four analyzes the results. Concluding remarks as well as limitations of the study are presented in the final section.

2 Related Literature and Hypotheses

From an economic and management viewpoint, the managers' decision to adopt a certain leadership style can be explored in the context of a discrete choice model, where the rational manager chooses the alternative (one of the leadership styles) that maximizes the net expected benefits. Different variables are considered to determine the choice of one's leadership style. Previous research has explored several of these factors and those usually include personal characteristics (i.e., demographic factors such as gender, age, educational level, ethical background, nationality, work experience) (e.g., Eagly & Carli, 2003; Eagly & Johnson, 1990; Kabacoff, 2002; Merchant, 2012; Posner, 1992; Toren et al., 1997; van Engen, van der Leeden, & Willemsen, 2001), organizational position (e.g. Manning, 2002; Yukl, 2002) managerial orientation (e.g., van Engen & Willemsen, 2000), and decision-making characteristics (e.g., Puffer, 1990; Snowden & Boone, 2007).

In accordance with these studies, it is possible to see that individuals' choice of leadership style can depend on their demographic, organizational, and managerial characteristics

Figure 1: Research framework



as well as their decision-making situation based on different decision-making variables. Following these approaches of previous research and the literature review, we formulate several hypotheses regarding the determinants of leadership style structured along the following lines: (1) demographic characteristics (gender, age, and education); (2) internal organizational characteristics (hierarchical level and managerial orientation to tasks/people and change); and (3) decision-making characteristics (decision-making style and decision-making environment). With this approach, we try to integrate these three groups of characteristics to determine which leadership style should be used. Figure 1 illustrates the research framework.

2.1 Demographic Characteristics

Gender

Traditionally, studies relating to gender and leadership have used masculine norms as the standards for behaviors, leading to conclusions that men are often viewed as better leaders while women often adopt masculine behaviors to fit into male-dominated hierarchical structures and systems (Gutek, 1985). Moreover, as indicated by Barbuto, Fritz, Matkin, and Marx (2007), women are expected to behave like leaders (authoritative, confident) while simultaneously being feminine (friendly, kind, etc.). The literature presents conflicting arguments concerning the impact of gender on leadership style. Although one group of researchers finds that differences in leadership behaviors are based on gender (e.g., Collard, 2001; Druskat, 1994; Eagly & Johnson, 1990; Taylor, 1998; Vikenburg et al., 2011), another group has found no effect (e.g., Komives, 1991; Oshagbemi, 2008; van Engen et al., 2001). For instance, using a meta-analysis based on 162 reports, Eagly and Johnson (1990) found significant gender differences in the reported use of democratic or participatory styles of leadership. More precisely, the authors indicated that men were more likely than women to use autocratic, or direct, controlling styles. Gender was also found to have an effect on the process of the creation of leadership and interface between the leader and his or her followers (Bartkus, Kaminskas, & Grunda, 2012). In contrast to these findings, several authors have rejected the relationship between gender and leadership style. In this sense, Komives (1991), Oshagbemi (2008), and Yammarino Dubinsky, Comer, and Jolson (1997) found no effect of gender on leadership style. In order to further examine

the relationship between leadership style and gender, we propose the following hypothesis:

H1: The leadership style is associated with the manager's gender.

Age and educational level

Studies of age and educational level as predictors of leadership style are nearly absent from the research literature. As Barbuto et al. (2007) emphasized, the very few studies that have examined age and leadership have been limited to retirement or adolescence factors. Even fewer of them have studied the relationship between leadership and educational level. However, age serves as an important factor that influences leadership style as there are important differences in attitudes and behavior between different generations. In this sense, it is argued that younger workers are more adoptable in fast-changing environments, take risks, consider new approaches, etc. (Kabacoff, 2002; Kabacoff & Stoffey, 2001; Oshagbemi, 2008). Moreover, using a sample of Ohio AmeriCorps members, Kazan (2000) found that age influences the self-leadership style. Similar results were obtained by Payden (1997), Taylor (1998), and Thomas (1996).

The leader's level of education can produce a significant effect on followers' perceptions of leadership behaviors. Barbuto et al. (2007) found significant differences among educational level groups, and additional research done by Ali and Ali (2011), Kao (2006), and Nayak (2011) confirmed the significant positive relationships between leadership style and educational level. Consistent with these findings, Shadare (2011) found that a manager with higher education tends to be more efficient on the job than one with a lower educational achievement. In light of these arguments, the following hypotheses can be tested:

H2: The leadership style is associated with the manager's age.

H3: The leadership style is associated with the manager's educational level.

2.2 Decision-Making Characteristics: Decision-making style and decision-making environment

Decision-making style

Each leadership style is characterized by a specific decision-making style. These decision-making styles can differ with respect to the number of alternatives used, amount of information, and the extent to which they coordinate different resources of input (Driver & Brousseau, 1990, as cited in Rehman & Waheed, 2012). Puffer's (1990) research showed that decision style, decision outcome, and organizational role of the observer have a significant impact on attributions of the charismatic leadership style. Similar results were identified by Kedia and Nordvedt (2002, as cited in Rehman & Waheed, 2012), whose study showed a relationship between leadership styles and decision-making styles. These researchers argued that transformational leaders use a more comprehensive style (a high number of alternatives used, a large amount of information, and a high coordination of different resources of input) of decision making. Therefore, we argue:

H4: Leadership style is associated with the decision-making style.

Decision-making environment

Different aspects of the decision-making environment also determine leadership style. In situations of an unstable and turbulent environment, leadership style would be characterized by a very direct top-down communication (Snowden & Boone, 2007), which is seen as a characteristic of an autocratic leadership style. Decisions are made in a political manner based on the relative power of those involved and without any particular pattern characterizing the criteria used (Smart et al., 1997, as cited in Hassan, Shah, Zaman, Ikramullah, & Ali Shah, 2011). In a more stable environment, more information is available, decisions can be easily delegated, and a more democratic leadership style can be applied. In this sense, we propose the following hypothesis:

H5: Leadership style is associated with the decision-making environment.

2.3 Internal Organizational Characteristics: Hierarchical level and managerial characteristics

Hierarchical level

According to Hunt (1971), the research has increasingly emphasized the possible differences in leadership requirements at different managerial levels, yet very few empirical studies have been conducted. Yukl (2002) suggested that differences in job requirements and discretion exist across levels in organizations and that hierarchy is one of the determinants of leadership style. Although Eagly and Johnson (1990) found that organizational level had little impact on the effect sizes of autocratic versus democratic leadership styles, strong evidence does suggest that there are distinct

patterns of behavior across different hierarchical levels in organizations (e.g., Edwards & Gill, 2012). Kabacoff (1999) found differences in the leadership styles and practices of individuals in terms of both organizational level and function. Specifically analyzing different organizational levels indicates that middle-level leadership styles differs significantly from either senior or lower-level leaders. Ansari and Naeem (2010) showed that lower management applied a significantly higher degree of autocratic style than middle management. However, Oshagbemi and Gill (2004) found that a significant difference exists between the senior and first-level managers' leadership styles, but not between senior and middle-level managers or middle- and first-level managers. Thus, we formulated the following hypothesis:

H6: The leadership style is associated with the manager's hierarchical level.

Managerial characteristics

As previously mentioned, various classifications of leadership styles have been used in research practice. A widely accepted classification is the dimensions of autocratic and democratic leadership styles, emphasizing a strong distinction between managers oriented toward directive and participative or job-centered versus employee-centered leadership (van Engen & Willemsen, 2000). A democratic leader encourages employee participation by creating a sense of ownership among the employees an environment in which all employees feel at ease working. Employees and team members feel in control of their own destiny and are motivated to work hard by more than just a financial rewards (Bhatti et al., 2012). In addition, democratic leaders communicate regularly with employees about the organization's purpose, goals, and mission. They treat each worker as an individual, transmitting their values and ethical principles, providing challenging goals and communicating a vision of the future while encouraging strategy making, group synergy, innovation, change, and creativity (Ansari & Naeem, 2010). On the other hand, the autocratic leadership style is characterized by one's strong orientation to tasks, results, procedures, and rules, along with a strong emphasis on high standards for performance and making leaders' and subordinates' roles explicit (Eagly & Johnson, 1990). With respect to the identified factors, we plan to test to determine if a manager who chooses the democratic leadership style also has managerial characteristics that include a people orientation and affinity toward the implementation of changes. Thus, the following hypothesis is set:

H7: The democratic leadership style is associated with a people orientation and the implementation of changes.

3 Data and Model Specification

The data presented in this study were collected as part of a larger study conducted among all business organizations in Montenegro, with the aim of making a comparative analysis of management functions in Montenegro. To this end, a questionnaire survey was conducted; it consisted of 11 sections, where nine sections covered some different aspects of management behavior and two sections covered basic questions regarding organizational and personal characteristics.

In this paper, we present and analyze data concerned with various characteristics of Montenegrin managers as leaders as well as their preferred leadership and decision-making styles. The survey was conducted by a professional agency from June to September 2007. We obtained a sample of 105 managers from 96 organizations in Montenegro. Although they are usually used as control variables, the variables of age, gender, and educational and hierarchical levels are used as independent variables in this study; only size and the sector in which organizations act are used as control variables. The democratic leadership style was used as a dependent variable.

Explanatory variables

To operationalize hypothesis H1 (gender), we used a dummy variable (*GENDER*) that has a value of 1 if the employee is a man. The second hypothesis, H2 (age), is tested using two dummy variables: *AGE 1* has value of 1 if the employee is between 18 and 40 years old and *AGE 2* has a value of 1 if the employee is more than 41 years old. *AGE 2* was also a reference category. The effect of education on leadership style in hypothesis H3 was measured using two dummy variables: *EDUCATION1* has a value of 1 if the employee has a doctorate, master's degree, or university degree; *EDUCATION2* has a value of 1 if the employee has two years of higher education, a high school degree, or a primary school degree. This was also a reference category. Hypothesis H4 (decision-making style) was tested using three dummy variables (i.e., rarely, often, always): *DECISION-MAKING STYLE* equals 1 if the employee rarely, often, or always makes decisions with his colleagues. To test how the decision-making environment affects the leadership style (H5), we used a continuous variable representing the percentage of people who make decisions in a stable or unstable environment. Hypothesis H6 (hierarchical level) was tested using three dummy variables: *HIERARCHICAL LEVEL* equals 1 if the employee's position is at the top level, middle level, or low level. To test hypothesis H7 (managerial characteristics), we used three dummy variables: *CHARACTERISTIC1* has a value of 1 if the employee is more oriented to reaching the objective than to following the leader, *CHARACTERISTIC2* has value of 1

if the employee is more oriented to procedures and results than to interaction between employees, and *CHARACTERISTIC3* that has a value of 1 if the employee is more oriented to results than to the implementation of changes.

The dependent variable, denoted as *DEMOCRATIC LEADERSHIP STYLE*, is a binary variable equal to 1 if the employee chooses the democratic leadership style rather than a mixed (between democratic and autocratic leadership styles) or autocratic style (looking at the continuum of the democratic–autocratic leadership style, from pure democratic to pure autocratic style).

Dummy variables were used to compile data into mutually exclusive categories (Gujrati, 2003). In this way, we could clearly analyze differences among the analyzed categories. As mentioned, we used sector and size as the control variables. We used three sectors of activity: manufacturing, service, and trade. In terms of size, we used three groups of organizational size: Size 1 (1 to 10 employees), Size 2 (11 to 50 employees), and Size 3 (more than 50 employees). The definition of variables and sample statistics are given in Table 1. By using adequate statistical methods, no problem of multicollinearity was detected.

The Empirical Model

We used a linear model for the underlying latent variable driving certification:

$$Y_i^* = \alpha + \sum_{i=1}^{10} \beta_i x_i + \mu_i, \quad i = 1,2,...,N. \tag{1}$$

Table 1 Definition of Variables and Sample Statistics

Variable	Description	Mean	SD	Min	Max
Dependent variable					
Democratic Leadership Style	The employee uses democratic rather than a mixed (between democratic and autocratic or pure autocratic) leadership style Dummy variable (= 1 if yes)	0.40	0.49	0.00	1.00
Independent variables					
SECTOR	Manufacturing	0.25	0.43	0.00	1.00
	Service	0.31	0.47	0.00	1.00
	Trade ***(ref)***	0.44	0.50	0.00	1.00
SIZE	Size1 (1 to 10 employees) ***(ref)***	0.29	0.45	0.00	1.00
	Size2 (11 to 50 employees)	0.34	0.48	0.00	1.00
	Size3 (more than 51 employees)	0.37	0.48	0.00	1.00
GENDER	The employee is a man Dummy variable (= 1 if yes)	0.75	0.44	0.00	1.00
AGE	AGE1 (between 18 and 40 years old)	0.52	0.50	0.00	1.00
	AGE2 (more than 40 years old) ***(ref)***	0.48	0.50	0.00	1.00
EDUCATION	EDUCATION1 (Ph.D., master, or university degree)	0.44	0.50	0.00	1.00
	EDUCATION2 (two years of superior education, high school degree, primary school degree) ***(ref)***	0.56	0.50	0.00	1.00
HIERARCHICAL LEVEL	Top level	0.55	0.50	0.00	1.00
	Middle level	0.32	0.47	0.00	1.00
	Low level ***(ref)***	0.13	0.34	0.00	1.00
CHARACTERISTIC1	The employee is more oriented to reaching the objective than to following the leader Dummy variable (= 1 if yes)	0.84	0.37	0.00	1.00
CHARACTERISTIC2	The employee is more oriented to procedures and results than to interactions between employees Dummy variable (= 1 if yes)	0.53	0.50	0.00	1.00
CHARACTERISTIC3	The employee is more oriented to results than to the implementation of changes Dummy variable (= 1 if yes)	0.61	0.49	0.00	1.00
DECISION-MAKING ENVIRONMENT	Stable environment	52.32	25.06	0.00	100.00
	Unstable environment	43.39	24.39	0.00	100.00
DECISION-MAKING STYLE (participation)	Rarely ***(ref)***	0.19	0.39	0.00	1.00
	Often	0.50	0.50	0.00	1.00
	Always	0.26	0.44	0.00	1.00

where X_i represents the vector of variables for leadership style (*SECTOR, SIZE, GENDER, AGE, EDUCATION, HIERARCHICAL LEVEL, MANAGERIAL CHARACTERISTICS, DECISION-MAKING ENVIRONMENT,* and *DECISION-MAKING STYLE)*; β_1–β_{10} are the slope coefficients to be estimated; and α and μ are the intercept and the disturbance term, respectively.

The model of the employee's leadership style was a discrete-choice model, with the dummy variables indicating *DEMOCRATIC LEADERSHIP STYLE* as the dependent variable Y_i:

$$Y_i = 1 \quad if \quad Y_i^* > 0, \qquad Y_i = 0 \quad otherwise. \tag{2}$$

We specified logistic distributions for μ and maximized the log-likelihood of the logit models (Greene, 2000) to estimate the model's parameters up to a positive constant.

4 Results and discussion

The results of the multinomial regression regarding determinants of leadership style are presented in Table 2. According to the results, R2 is 0.30, indicating that the model fits the data adequately. The following paragraphs present the validity of each hypothesis based on the statistical significance of associated parameters.

Our first hypothesis (H1)—the leadership style is associated with the manager's gender—was not supported in the model. The results show that no effect of gender exists when using the democratic leadership style, indicating that men and women equally use this style. This is, as mentioned in the literature review, in line with Komives' (1991), Oshagbemi's (2008), and Yammarino et al.'s (1997) results, which indicated that gender had no effect on leadership style. In addition, overviews of studies of sex differences in cognition demonstrate that these differences have become

Table 2 Determinants of Leadership Style

		Democratic Leadership Style	
Variables		Estimate	Standard Error
Intercept		-2.48*	1.34
SECTOR	MANUFACTURING	0.17	0.52
	SERVICE	0.17	0.44
SIZE	SIZE1	1.04***	0.49
	SIZE2	1.27***	0.58
GENDER		0.33	0.43
AGE1		0.26	0.39
EDUCATION1		-0.16	0.42
HIERARCHICAL LEVEL	TOP	1.51***	0.57
	MIDDLE	1.72***	0.59
MANAGERIAL CHARACTERISTICS	CHARACTERISTIC1	-0.82	0.55
	CHARACTERISTIC2	0.66*	0.39
	CHARACTERISTIC3	-0.06	0.38
DECISION-MAKING ENVIRONMENT	STABLE	0.00	0.01
	UNSTABLE	0.02***	0.01
DECISION-MAKING STYLE	OFTEN	-0.02	0.48
	ALWAYS	-1.09**	0.52
Max Rescaled R2		0.30	
-2 log L		194.293	
-2 log L (Intercept only)		238.407	
Likelihood ratio		44.11	
Percent concordant		76.9	
Number of observations		177	

Note: (*), (**), and (***) stand for parameter significance at the 10%, 5%, and 1% levels, respectively.

considerably smaller or have even vanished within the last 30 or 40 years (van Engen & Willemsen, 2000). One potential reason for these results might be the changed roles and characteristics of women as business leaders. As Jonsen et al. (2010) stated, there is an evident trend in increasing similarities in the styles of men and women as a result of the changed roles and self-perceptions of women in industrialized countries and the appearance of women in formerly all-male occupations. Thus, according to our results, we can conclude that male and female Montenegrin managers use similar leadership styles and gender cannot be seen as a determinant of leadership style used. More and more research has shown that the differences in leadership styles between men and women are slowly vanishing; our research contributes to this line of thinking.

Hypotheses H2 (the leadership style is associated with the manager's age) and H3 (the leadership style is associated with the manager's educational level) were also note supported in our model. Previous research does indicate that the older the manager, *ceteris paribus*, the more likely it is for consultative and participative leadership styles to be used. In other words, older leaders prefer more collective decisions compared to younger managers, who prefer making decisions that might not necessarily get the approval of the majority of workers (Oshagbemi, 2008). However, our results show no significant difference between young workers (between 18 and 40 years old) and older workers (more than 40 years old) when using the democratic leadership style. This suggests that, for the managers in Montenegrin organizations, age does not represent a significant determinant or predictor of the use of the democratic leadership style. This is in line with research of Ekaterini (2010), who explained such a result as the intention of older workers to not necessarily make decisions with their colleagues as they can draw on their years of experience to make decisions with a greater degree of confidence, which younger workers usually do not have. In addition, for Montenegrin managers, education cannot be seen as associated with the democratic leadership style as our results show no difference among employees with a doctorate, master's degree, or university degree and employees having two years of higher education, a high school degree, or a primary degree. Although, as mentioned, the level of education influences people's values, wants, and needs, our results suggest that this factor is not connected with the leadership style used, but presumably more with different expectations and motivation in the workplace.

Hypothesis H4 tested whether leadership style is associated with the decision-making process. The results suggest a significant and positive relationship exists between the democratic leadership style and managers' decision making when the manager always makes decisions with his colleagues. The results suggest that the democratic leader always tries to create such an environment in which all employees feel at ease working and are asked to participate in decision making in the organization. This creates a sense of ownership among the employees, and they work more enthusiastically (Bhatti et al., 2012). Montenegrin managers encourage their colleagues' participation, which can be seen as being associated with the democratic leadership style. Moving toward this highly participative decision-making style, as Vroom (2000) emphasized, can contribute to the organization by (1) developing individual members' knowledge and competencies by providing them with the opportunities to work through problems and decisions usually happening at higher organizational levels; (2) increasing teamwork and collaboration by providing individuals with the opportunities to solve the problems as part of the team; and (3) helping in increasing individual identification with organizational goals.

Hypothesis H% tested whether the leadership style is associated with the decision-making environment. The results confirmed that the democratic leadership style is associated with the unstable decision-making environment. This is interesting to see because it was expected that the democratic leadership style would be more of a characteristic of a stable environment, where the leader has enough time to take into consideration all of the alternatives and resources while encouraging employees' participation and exchanges of information. In a more unstable environment, decisions have to be made quickly and with a minimum of costs, so it is surprising and rather unusual to see that Montenegrin managers use the democratic style in an unstable environment. This result might suggest that they are more oriented to getting the right and appropriate decision instead of making a risky but not necessarily right and, in the long-term, satisfactory decision.

The hypothesis that leadership style is associated with the manager's hierarchical level (H6) was strongly supported by our research for top and middle management levels. Our results indicated that strong differences in leadership style exist between top and middle management compared to lower management, but no difference exists between top and middle management. This is a somewhat expected result as the work itself and job responsibilities and requirements at different organizational levels call for a higher or lower level of democratic or autocratic leadership style. First-level management is more oriented to tasks, procedures and results, and day-to-day activities, where a more autocratic or mixed leadership style is suitable, while higher organizational levels tend to use more democratic ones as higher organizational levels are more strategic and change oriented, motivating and encouraging people to do more than they initially thought possible (Oshagbemi, 2008).

The results of our final hypothesis, H7 (democratic leadership style is associated with people orientation and

implementation of changes), were somewhat expected. The results strongly confirmed that orientation to people is associated with one's choice of democratic leadership style, but they did not confirm that the democratic leadership style is associated with following the leader and the implementation of changes. These findings suggest that Montenegrin managers—although oriented to people—still have to develop their abilities for inspiring employees to follow them, create, innovate, and change.

Finally, regarding the sector activity and size that we used as control variables, the results showed no support for the differences in democratic leadership style in organizations regarding their sector activity, but they did support that certain organizations—according to their size—are more sensitive to the democratic leadership style than others. For instance, the results show that the democratic leadership style is associated with smaller organizations—concretely, with organizations with 1 to 10 employees or with 11 to 50 employees. Larger organizations usually require more control mechanisms, rules, and procedures; thus, it is possible that the autocratic or mixed leadership style is more present in larger organizations.

5 Conclusion

In this study, our aim was to analyze and examine various variables that seem to contribute to and determine one's choice of its leadership style. As most of the previous studies counted for only one or several closely interlinked variables, our goal was to examine several demographic, organizational, and decision-making characteristics that could be seen as determinants of leadership style. According to the literature review, we proposed several hypotheses that were tested on a sample of managers in Montenegrin organizations.

Our results yielded several interesting outcomes that can help us better understand the effect of demographic, organizational, and decision-making characteristics on leadership style. The results have shown that there is no significant difference regarding leadership style among men and women or according to age and education level. This leads to the conclusion that leadership style could be under a greater influence of different situational characteristics and contingencies that are not a direct characteristic of a manager, but conditions in which the manager works (e.g., hierarchical level or organizational characteristics) that surround the leader.

The results also confirm that the democratic leadership style is more people oriented and transformational and encourages participation more. As such, it is not surprising that our results confirm that the democratic leadership style is associated with interactions with people and an orientation to people.

There are three limitations of our study that future work might seek to address. First, we used a rather small sample of Montenegrin managers. Our analysis is restricted by the choice of this sample. Thus, future research should include a larger sample in order to gain a deeper understanding of the issues examined. It would be interesting to examine these issues in other countries to determine whether national culture also plays a significant determinant of leadership style. Second, further research should analyze the combined effects of various characteristics of leadership style. It would also be useful and interesting to consider and analyze how and if these differences can produce differences in the effectiveness of leaders. This is a complex question that future research should address by considering different measures of organizational outcomes in line with different measures of leadership style and its determinants.

The findings of this study could be useful for theory and practice in understanding different influences on one's choice of leadership style. The research is also a way of enhancing existing research as previous management literature has not provided a similar approach to researching at the same time various personal as well as organizational factors. This is especially interesting in the context of Montenegro as, together with the broader results of the study, this research helped develop a deeper understanding of management practice in Montenegro and, more specifically, leadership characteristics and determinants of leadership styles in Montenegrin organizations.

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Proučevanje dejavnikov stila vodenja med črnogorskimi menedžerji

Izvleček

Obnašanje vodje ima lahko močan vpliv na različne izide, povezane z delom zaposlenega, zato so bili razviti različni pristopi za najučinkovitejši stil vodenja in dejavnikov za izbiro stila vodenja. Namen prispevka je analizirati, ali na izbiro stila vodenja vplivajo bolj osebni ali bolj organizacijski dejavniki. Pri proučevanju dejavnikov stila vodenja med črnogorskimi menedžerji je analiza podatkov iz raziskave pokazala naslednje: demografski podatki, kot so spol, starost in izobrazba, ne vplivajo na izbiro stila vodenja, interne organizacijske značilnosti, kot sta hierarhična raven in menedžerska usmeritev k nalogam/ljudem, in značilnosti odločanja, kot sta stil odločanja in odločevalsko okolje, pa so pozitivno povezane z izbiro demokratičnega stila vodenja. Ta prispevek k novejšim raziskavam o vodenju kaže, da so nekatere osebne značilnosti upoštevane kot manj pomembne pri razvoju določenega stila in da je izbira stila bolj odvisna od zunanjih vplivov in razmer.

Ključne besede: značilnosti odločanja, demografske značilnosti, interne organizacijske značilnosti, stil vodenja, Črna gora

Measuring efficiency of nations in Multi Sport Events: A case of Commonwealth Games XIX

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Abstract

This paper used a data envelopment analysis (DEA) to measure the performance of the nations participating in the Commonwealth Games. To increase the consistency of the research, multiple models were employed to validate the result, but the nature of the input and output remained same throughout the paper. The objective of this study was to establish some realistic targets in terms of number of players for all participant countries and evaluations of their performance as well as benchmarks against the most efficient country. This study would help the nations optimize the size of their players to maximize the outcome in terms of the number of medals won in sporting events.

Key words: Performance measurement, data envelopment analysis, efficiency, Commonwealth Games.

1 Introduction

The XIX Commonwealth Games 2010 (CWG 2010), held in Delhi on October 2 through 14, were a major success. The games attracted the participation of 71 nations who are part of the Commonwealth Games Associations (CGAs), representing one-third of the world's population. Approximately 6,500 athletes and team officials competed in 17 sports and four para-sports in 290 sessions. In the end, two new world records (power lifting and athletics) and 108 new Commonwealth records were established.

In general, athletes compete on behalf of the nation, and ranking is based on the total number of gold medals won by each country. Usually the gold medals are worth more than silver ones, which are worth more than bronze ones. At the end of the games, the sum of the medals is computed and used for ranking the participating countries.

2 The Commonwealth Games

The Commonwealth is an alliance of 53 nations across the globe. Although there are 53 Commonwealth nations, presently 71 CGAs can enter a team in the

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Commonwealth Games, as one nation can have multiple CGAs. For example, the United Kingdom is a single Commonwealth nation that consists of seven CGAs: Scotland, Wales, England, Guernsey, Isle of Man, Jersey, and Northern Ireland. The Commonwealth Games are also known as the Friendly Games as they are held between a family of nations that share a common history. Her Majesty Queen Elizabeth II is the head of the Commonwealth and patron of the Commonwealth Games Federation (CGF). Prince Edward, HRH the Earl of Wessex KCVO, is the vice patron.

The first edition of these prestigious games took place in Hamilton, Canada, in 1930, with 11 countries and 400 athletes competing six sports. Since then, 19 games have been held, being scheduled every four years (except for 1942 and 1946 due to World War II). From 1930 to 1950, the games were known as the British Empire Games, from 1954 to 1966 they were the British Empire and Commonwealth Games, and in 1970 and 1974 they were known as the British Commonwealth Games. Finally, in 1978, in Edmonton (Canada), the name of the games were changed to the Commonwealth Games, a name that remains to today (http://www.thecgf.com/games/story.asp)

The number of teams competing in the Commonwealth Games depends on the number of nations in the Commonwealth itself as, from year to year, nations are admitted and suspended for various reasons. Since 2002, there has been an increase in attendance as all Commonwealth nations have been represented in all editions of these prestigious games. As the number of nations taking part has increased, so too have the number of athletes participating, sports included, and events held.

Although various multi-sport events are held globally, the Commonwealth Games are a unique, world-class, multi-sport events held once every four years. Table 1 summarizes a few of the most popular multi-sport events along with their descriptions.

There is still great diversity in the relative performance of athletes, as indicated by nations' rankings, which makes it difficult to understand how and where to improve. This article employs a data envelopment analysis (DEA) to compare the relative efficiency of the utilization of resources (i.e., players) by nations who have won medals in the XIX Commonwealth Games 2010 in Delhi. In an attempt to find new ways to establish alternative performance rankings, this paper uses the DEA model with an output orientation. The total number of players from each country is used as an input, whereas the outputs are the total number of medals (gold, silver, and bronze). The unit of analysis is all countries that won at least one medal.

The objective of the paper is twofold. In the first stage, the paper ranks the nations in terms of all medals won and gold medals won by calculating their relative efficiency. In the second stage, the paper decides the optimal number of players to be sent to win medals in the CWG. To achieve the second objective, a DEA model with input orientation is used.

The paper is organized as follows: Section 2 discusses the DEA models used for evaluating the performance of the participating countries. Section 3 presents an empirical study using different DEA models. Section 4 presents the methodology, while Section presents the findings. Section 6 contains conclusions and discussions.

Table 1 Major International Multi-sporting Events and Descriptions

Event	Description
Summer Olympics	The world's premier multi-sport and multi-country sporting competition, held every four years.
Winter Olympics	The winter sports version of the Olympic Games, held every four years, two years after the Summer Olympics.
Paralympic Games	A major event for athletes with disabilities, now run in conjunction with the Summer Olympic Games, every four years.
Commonwealth Games	Held every four years, most recently held in Glasgow in 2014.
Asian Games	The Asian Games, officially known as Asiad, is a multi-sport event along the lines of the Olympics, though only for Asian countries. They were first held in 1951.
Gay Games	The Gay Games, held every 4 years, is open to all who wish to participate, without regard to sexual orientation.
Military World Games	For military athletes from more than 100 countries.
European Games	A multi-sport event along the lines of the Summer Olympic Games, though limited to athletes from European nations.
Youth Olympics	The Youth Olympic Games is an international multi-sport event, held every four years for athletes aged 14 to 18.

Source: Wood 2010

3 Data Envelopment Analysis

DEA is a non-parametric approach developed by Farrel (1957). Charnes, Cooper and Rhodes (1978) subsequently made a major breakthrough in the same field. Since then, DEA has been widely accepted, particularly in its application to public sector operations, such as education and healthcare, where the policy objectives are vaguely defined as a functional form of input–output relationships. DEA is a non-parametric technique for assessing the relative performance of a set of similar units. Each decision making unit (DMU) has a certain number of inputs and produces a certain number of outputs. In this case, the countries that won at least one medal are considered DMUs. The aim is to identify which country is operating efficiently in converting the inputs into outputs in an optimum way, indicating that it belongs to the efficiency frontier, and which DMUs do not operate efficiently (i.e., not able to convert the inputs to outputs) and therefore should make appropriate adjustments in their input and/or output in order to attain efficiency.

DEA has been applied in a number of different areas, such as hospitality, healthcare (hospitals, doctors), education (schools, universities), banks, manufacturing, benchmarking, management evaluation, energy efficiency, fast food restaurants, and retail stores (Cooper, Seiford, & Tone, 2004; Cooper, Thompson, & Thrall, 1996; Debnath & Shankar, 2009; Debnath & Shankar, 2013; Fare, Grosskopf, & Lovell, 1994; Rhode & Southwick, 1993; Sinauny-Stern, Mehrez, & Barboy, 1994; Thenassoulis & Dunstan, 1994; Tomkins & Green, 1988). Anderson (1995) compiled more than 360 papers on the application of DEA, and there has been a constant increase in the number of DEA applications reported on Portland State University's website. DEA is used to compute a score that defines the relative efficiency of a particular DMU versus all other DMUs observed in the sample. The various inputs and outputs are assigned optimal weights by which the output can be maximized.

The two most frequently applied models used in DEA are the CCR model, named after Charnes et al. (1978), and the BCC model, named after Banker, Charnes, and Cooper (1984). The basic difference between these two models is the returns to scale (RTS). Whereas the latter takes into account the effect of variable RTS (VRTS), the former restricts DMUs to operate with constant RTS (CRTS). Charnes et al. (1978) developed DEA to evaluate the efficiency of public sector non-profit organizations. DEA aims to measure how efficiently a DMU uses the resources available to generate a set of outputs. DMUs can include manufacturing units, departments of big organizations (e.g., universities, schools, bank branches, hospitals, power plants, police stations, tax offices, defense bases), a set of firms, and even practicing individuals like medical practitioners.

Efficiency measurement is a commonly used tool to measure the performance of any DMU and estimate the relative efficiency of the DMUs. Generally speaking, simple efficiency can be calculated using a ratio of outputs to inputs, as given in Equation 1.

$$\text{Efficiency} = \text{Outputs} / \text{Inputs} \tag{1}$$

However, in DEA, multiple inputs and outputs are linearly aggregated using weights. Therefore, the efficiency is measured as a ratio of:

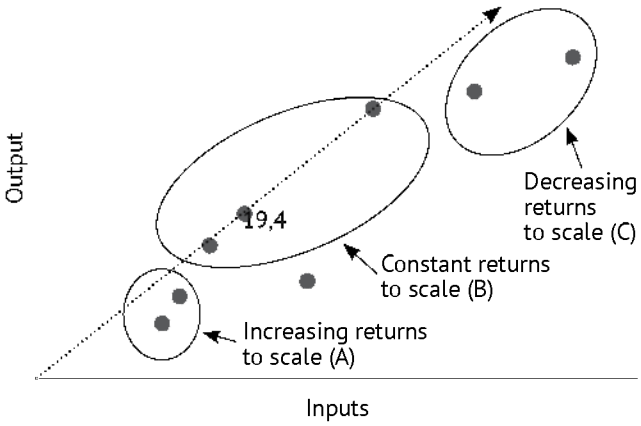
$$\text{Efficiency} = \frac{\text{Weighted Sum of Outputs}}{\text{Weighted Sum of Inputs}} \tag{2}$$

$$\text{Efficiency} = \frac{\sum_{j=1}^{J} v_j y_j}{\sum_{i=1}^{I} u_i x_i} \tag{3}$$

where u_i is the weight assigned to input x_i and v_j the weight assigned to output y_j as given in Equation 3.

DEA models assume CRTS and VRTS. In a CRTS, the change in the output is proportionate to the change in the input. However, in a VRTS, the change in output is not proportional to the change in the input. Figure 1 shows various types of RTS.

Figure 1: Various returns to scale in DEA



Point A represents the units present in the region of increasing RTS. If we assume that an increase in inputs will increase outputs above the dashed line that would result in a greater than proportionate increase in outputs. If the units increase their inputs, the ratio of inputs to outputs will change so that the unit moves along the efficiency horizon and the unit will move into the region of CRTS. Point B falls into a CRTS.

Point C falls in the region of decreasing RTS or non-increasing RTS. This implies that increases in inputs will result in a ratio of inputs to outputs that continue to fall along the frontier. If that assumption holds, increases in inputs will result in proportionately smaller increases in output. The only point not identified by any region is an inefficient unit.

4 DEA and Sports

The existing literature shows that researchers have used diverse mathematical models to study the results of multi-sport games. Lozano, Villa, Guerrero, and Cortes (2002) and Estellita Lins, Gomes, Soares de Mello, and Soares de Mello (2003) analyzed the relative efficiency of the participating countries that won at least one medal in Olympic Games in relation to their available resources, where inputs were the country's population and gross domestic product (GDP) and outputs were the numbers of gold, silver, and bronze medals.

Benicio, Bergiante, and Soares (2013) applied the free disposal hull (FDH) model to measure the efficiency of the Winter Olympic Games held in 2010. The authors used the BCC input-oriented model, where the number of athletes was considered as an input and the number of gold, silver and bronze medals was considered as output parameters. Meanwhile, Lozano et al. (2002) measured the performance of the nations at the Summer Olympics Games using DEA, where the gross national product (GNP) and population of the participating countries were input variables while the output variables were the number of gold, silver, and bronze medals. Zhang, Li, Meng, and Liu (2009) used DEA to measure the performance of nations of the Olympic Games. However, the authors used lexicographic preference in the DEA. Churilov and Flitman (2006) used several social economics variables—not only GDP and population, but also the DEL index and IECS index—to evaluate the performance and rank the participating nations in the Sydney Olympics held in 2000. Cesaroni (2011) used the FDH model to analyze the efficiency of Italian drivers and vehicle agencies. Other important European leagues have been investigated using the DEA model as well, such as the Spanish league (Gonzalez-Gomez & Picazo-Tadeo, 2010), the Italian Serie A (Bosca, Liern, Martínez, & Sala, 2009), the German Bundesliga (Haas, Kocher, & Sutter, 2004), and the French Ligue 1 (Jardin, 2009). Sexton and Lewis (2003) applied the two-stage DEA model to baseball and an apportion of the duties of a typical baseball club among the two operating units.

Dawson, Dobson, and Gerrard (2000a, 2000b) applied stochastic frontier analysis to investigate managerial efficiency in English soccer. A similar approach was used by Carmichael, Thomas, and Ward (2001) to investigate the production function in English association football. Haas (2003a, 2003b) used the DEA model to analyze the efficiency of the English Premier League and applied the DEA model to Major League Soccer. Barros and Garcia-del-Barrio (2008) estimated a stochastic frontier latent class model to analyze cost efficiency. Anderson and Sharp (1997) used deterministic non-parametric frontier to create a new measurement to evaluate the batsmen in baseball games. Carmichael, Thomas, and Ward (2000) applied DEA to formulate the production function in rugby games. Fezel and D'Itri (1997) also used deterministic non-parametric frontier to measure coaches' efficiency in basketball. The authors concluded that the results would help replace coaches and enhance teams' performance. Hadley, Poitras, Ruggiero, and Knowles (2000) used DEA in American football to evaluate the team's performance with respect to its potential. Scully (1994) applied stochastic frontier and deterministic frontier in American football and baseball, respectively, to study the relationship between coaches' performance in terms of the team and efficiency of its management.

5 Research Methodology

5.1 Model Selection

As the objective of the study is to optimize the number of players participating in the international games to maximize the efficiency of the team in terms of winning medals, an output-oriented model was selected for the same purpose. The BCC model was chosen as the change in the input does not guarantee a proportionate increase in the output. As previously discussed, the BCC model would have VRTS. The change in the number of medals (output) cannot be proportional to the number of players (input) in our case.

5.2 Data Collection

The data were collected from the CWG office in New Delhi, India. In total, 71 countries participated in the games, representing various region of the world, including the Caribbean, Asia, Oceania, Africa, Europe, and America. Approximately 4400 players participated, including 1700 females. The participating countries won 762 medals, which were nearly equally distributed among gold, silver, and bronze medals. Table 2 shows that, of the 71 participating countries, only 34 (approximately 47%) won medals in international sports events; of these, 23 countries (67%) won gold medals.

6 Findings

This paper performed an independent DEA of the 2010 Commonwealth Games held in India. In the DEA, the DMUs are considered to correspond to the participating nations that won at least one medal. Two models were used to analyze the performance of the medal-winning nations. In the first model, three output variables were considered: he number

Table 2 Highlights of Participating Nations and Medals Won

CODE	COUNTRY	REGION	GOLD	SILVER	BRONZE	TOTAL
AIA	Anguilla	Caribbean				0
ANT	Antigua and Barbuda	Caribbean				0
AUS	Australia	Oceania	74	55	48	177
BAH	Bahamas	Caribbean	1	1	4	6
BAN	Bangladesh	Asia			1	1
BAR	Barbados	Caribbean				0
BER	Bermuda	Americas				0
BIZ	Belize	Americas				0
BOT	Botswana	Africa	1		3	4
BRU	Brunei Darussalam	Asia				0
CAN	Canada	Americas	26	17	33	17
CAY	Cayman Islands	Caribbean	1			1
CMR	Cameroon	Africa		2	4	6
COK	Cook Islands	Oceania				0
CYP	Cyprus	Europe	4	3	5	12
DMA	Dominica	Caribbean				0
ENG	England	Europe	37	60	45	142
FLK	Falkland Islands	Americas				0
GAM	Gambia	Africa				0
GGY	Guernsey	Europe				0
GHA	Ghana	Africa		1	3	4
GIB	Gibraltar	Europe				0
GRN	Grenada	Caribbean				0
GUY	Guyana	Americas		1		1
IND	India	Asia	38	27	36	101
IOM	Isle of Man	Europe			2	2
IVB	British Virgin Islands	Caribbean				0
JAM	Jamaica	Caribbean	2	4	1	7
JEY	Jersey	Europe				0
KEN	Kenya	Africa	12	11	9	32
KIR	Kiribati	Oceania				0
LCA	St. Lucia	Caribbean			1	1
LES	Lesotho	Africa				0
MAS	Malaysia	Asia	12	10	13	35
MAW	Malawi	Africa				0
MDV	Maldives	Asia				0
MLT	Malta	Europe				0
MOZ	Mozambique	Africa				0
MRI	Mauritius	Africa			2	2
MSR	Montserrat	Caribbean				0
NAM	Namibia	Africa		1	2	3
NFK	Norfolk Island	Oceania				0
NGR	Nigeria	Africa	11	8	14	33
NIR	Northern Ireland	Europe	3	3	4	10
NIU	Niue	Oceania				0
NRU	Nauru	Oceania	1	1		2
NZL	New Zealand	Oceania	6	22	8	36
PAK	Pakistan	Asia	2	1	2	5
PNG	Papua New Guinea	Oceania		1		1
RSA	South Africa	Africa	12	11	10	33
RWA	Rwanda	Africa				0
SAM	Samoa	Oceania	3		1	4
SCO	Scotland	Europe	9	10	7	26
SEY	Seychelles	Africa		1	0	1
SHN	St. Helena	Americas				0
SIN	Singapore	Asia	11	11	9	31
SKN	St. Kitts and Nevis	Caribbean				0
SLE	Sierra Leone	Africa				0
SOL	Solomon Islands	Oceania				0
SRI	Sri Lanka	Asia	1	1	1	3
SVG	St. Vincent and The Grenadines	Caribbean				0
SWZ	Swaziland	Africa				0
TAN	Tanzania	Africa				0
TCA	Turks and Caicos Islands	Caribbean				0
TON	Tonga	Oceania			2	2
TRI	Trinidad and Tobago	Caribbean				0
TUV	Tuvalu	Oceania				0
UGA	Uganda	Africa	2			2
VAN	Vanuatu	Oceania				0
WAL	Wales	Europe	2	7	10	19
ZAM	Zambia	Africa				0

of gold, silver, and bronze medals won by a country in the CWG 2010. The DEA output is summarized in Table 3. The input variable was the total number of players representing a country across chosen sports events. In the second model, only one output variable was considered in terms of the number of gold medals won by the nations. The analysis of this model is presented in Table 4. The data set is heterogeneous in terms of the size of the nations and the GDP as the data set represents both poor and rich countries. India is the most populous country that participated in the game, while the Cayman Islands and Nauru are the least populated countries; their GDP is also small compared to India. The analysis primarily computes the relative efficiency of the nations participating in the game, irrespective of their size and economy. Both models are BCC output oriented, where the output (number of medals) is maximized under at most

Table 3 DEA Results Considering Three Outputs

No.	DMU	Score	Rank	Reference set (lambda)								
1	Australia	1	1	Australia	1							
2	Bahamas	1	1	Bahamas	1							
3	Bangladesh	0.175799	31	Bahamas	0.831169	Nigeria	0.168831					
4	Botswana	0.611111	14	Bahamas	0.909091	Nigeria	9.09E-02					
5	Canada	1	1	Canada	1							
6	Cayman Islands	0.430323	19	Australia	1.81E-02	Nauru	0.981865					
7	Cameroon	1	1	Cameroon	1							
8	Cyprus	0.618182	13	Bahamas	0.452941	Nigeria	0.270588	Singapore	0.276471			
9	England	1	1	England	1							
10	Ghana	0.356481	23	Bahamas	0.558442	Nigeria	0.441558					
11	Guyana	0.208633	30	Nauru	0.62069	Singapore	0.37931					
12	India	0.75	10	Australia	1							
13	Isle of Man	0.386935	21	Bahamas	0.883117	Nigeria	0.116883					
14	Jamaica	0.30529	26	England	4.29E-02	Singapore	0.957096					
15	Kenya	0.466896	17	Australia	0.202689	England	7.43E-02	Singapore	0.722994			
16	St. Lucia	1	1	St. Lucia	1							
17	Malaysia	0.501869	16	Australia	9.33E-02	Canada	0.310652	England	9.12E-02	Nigeria	0.504805	
18	Mauritius	0.249191	28	Bahamas	0.597403	Nigeria	0.402597					
19	Namibia	0.426952	20	Bahamas	0.865169	Nigeria	2.04E-03	Singapore	0.132789			
20	Nigeria	1	1	Nigeria	1							
21	Northern Ireland	0.358951	22	Bahamas	0.104322	Nigeria	0.533035	Singapore	0.362643			
22	Nauru	1	1	Nauru	1							
23	New Zealand	0.7048	11	England	0.412541	Singapore	0.587459					
24	Pakistan	0.288394	27	Bahamas	0.398374	Nauru	8.13E-03	Singapore	0.593496			
25	Papua New Guinea	7.93E-02	34	England	3.30E-02	Singapore	0.966997					
26	South Africa	0.533079	15	Australia	0.152079	England	7.42E-02	Nigeria	0.231174	Singapore	0.542525	
27	Samoa	0.335458	25	Australia	0.108808	Nauru	0.891192					
28	Scotland	0.336404	24	Australia	0.146703	England	0.250434	Singapore	0.602863			
29	Seychelles	0.243697	29	Nauru	0.689655	Singapore	0.310345					
30	Singapore	1	1	Singapore	1							
31	Sri Lanka	8.20E-02	33	Australia	1.31E-03	England	4.29E-02	Nigeria	0.320506	Singapore	0.6353	
32	Tonga	0.628571	12	Bahamas	0.727273	St. Lucia	0.272727					
33	Uganda	0.169782	32	Australia	0.147668	Nauru	0.852332					
34	Wales	0.461319	18	Canada	0.249382	England	9.48E-02	Nigeria	0.655821			

the present input (number of players) consumption. Table 3 shows that countries like Australia, Bahamas, Canada, Cameroon, England, St. Lucia, Nigeria, Nauru, and Singapore were fully efficient countries in terms of winning medals, even though these countries differ in terms of their size and economic conditions.

VRTS is assumed to hold. The inputs represent the number of players representing their respective countries, which can be controlled by the countries. As this paper also measures the efficiency of countries in winning medals, the BCC output (O)-oriented model was considered for the analysis.

As Table 3 suggests, very few countries were fully efficient in terms of winning at least one medal in the game. For instance, Australia, Bahamas, Canada, Cameroon, England, Nigeria, Nauru, and Singapore are fully efficient countries (efficiency = 100%).

Table 4 presents the BCC (O)-oriented model, where the number of players are used as the input variable and the only output variable is the number of gold medals won by the participated nations in CWG 2010. Compared to the earlier analysis, a drastic change can be seen as the number of fully efficient countries dropped to three—namely, Australia, India, and Nauru.

Table 5 shows the benchmark of the inefficient countries under the BCC (O)-oriented models. This table summarizes the information from Tables 3 and 4, where Table 3 represents the model (called model 1) with three outputs and Table 4 represents one output (called model 2). In model 1, the numbers of output variables are the number of gold, silver, and bronze medals; model 2 has one output variable—namely, the number of gold medals won in the CWG 2010. The inferences have been drawn heavily from peer group analysis that plays a significant role in DEA modeling. The result is particularly significant for inefficient countries to improve their efficiency by referring to the peer group located on an efficient frontier. For instance, countries like Canada and Singapore are fully efficient countries in model 1 (efficiency = 100%; Table 3), which means these countries

Table 4 DEA Results Considering One Output (Gold Medal)

No.	DMU	Score	Rank	Reference set (lambda)		
1	Australia	1	1	Australia	1	
2	Bahamas	0.274148	14	Australia	3.63E-02	Nauru 0.963731
3	Botswana	0.201146	18	Australia	5.44E-02	Nauru 0.945596
4	Canada	0.549286	5	Australia	0.634715	Nauru 0.365285
5	Cayman Islands	0.430323	9	Australia	1.81E-02	Nauru 0.981865
6	Cyprus	0.404506	11	Australia	0.121762	Nauru 0.878238
7	England	0.534126	6	Australia	0.935233	Nauru 6.48E-02
8	India	0.513514	7	Australia	1	
9	Jamaica	0.138625	21	Australia	0.183938	Nauru 0.816062
10	Kenya	0.416659	10	Australia	0.380829	Nauru 0.619171
11	Malaysia	0.323261	13	Australia	0.494819	Nauru 0.505181
12	Nigeria	0.604069	4	Australia	0.235751	Nauru 0.764249
13	Northern Ireland	0.207937	17	Australia	0.183938	Nauru 0.816062
14	Nauru	1	1	Nauru	1	
15	New Zealand	0.168498	20	Australia	0.474093	Nauru 0.525907
16	Pakistan	0.233515	16	Australia	0.103627	Nauru 0.896373
17	South Africa	0.44283	8	Australia	0.357513	Nauru 0.642487
18	Samoa	0.335458	12	Australia	0.108808	Nauru 0.891192
19	Scotland	0.254096	15	Australia	0.471503	Nauru 0.528497
20	Singapore	0.919048	3	Australia	0.150259	Nauru 0.849741
21	Sri Lanka	6.06E-02	23	Australia	0.212435	Nauru 0.787565
22	Uganda	0.169782	19	Australia	0.147668	Nauru 0.852332
23	Wales	6.60E-02	22	Australia	0.401554	Nauru 0.598446

are able to use their resources (capability of the players) to win at least one medal. However, they are inefficient in model 2, as shown in Table 4, in terms of winning gold medals. Their efficiency scores are 0.549268 and 0.919048, respectively (see Table 4). Furthermore, if these two countries want to improve their performance, they need to refer to their peer group. Although the peers for Canada are Australia and Nauru (5th and 7th column of Table 4), Australia has more weightage (0.634715) than Nauru (0.365285). Hence, the most appropriate peer for Canada would be Australia in terms of improving the efficiency in winning gold medals. Similarly, for Singapore, the peers are Australia (0.150259

Table 5 Benchmarks According to Both Models

Sr. No	Country	Model 1 (Gold+ Silver+Bronze)	Model 2 (Gold Medal)
1.	Anguilla	N/A	N/A
2.	Antigua and Barbuda	N/A	N/A
3.	Australia	Australia	Australia
4.	Bahamas	Bahamas	Nauru
5.	Bangladesh	Bahamas	N/A
6.	Barbados	N/A	N/A
7.	Bermuda	N/A	N/A
8.	Belize	N/A	N/A
9.	Botswana	Bahamas	Nauru
10.	Brunei Darussalam	N/A	N/A
11.	Canada	Canada	Nauru
12.	Cayman Islands	Nauru	Nauru
13.	Cameroon	Cameroon	N/A
14.	Cook Islands	N/A	N/A
15.	Cyprus	Bahamas	Nauru
16.	Dominica		
17.	England	England	Nauru
18.	Falkland Islands	N/A	N/A
19.	Gambia	N/A	N/A
20.	Guernsey	N/A	N/A
21.	Ghana	Bahamas	N/A
22.	Gibraltar	N/A	N/A
23.	Grenada	N/A	N/A
24.	Guyana	Nauru	N/A
25.	India	Australia	Australia
26.	Isle of Man	Bahamas	N/A
27.	British Virgin Islands	N/A	N/A
28.	Jamaica	Singapore	Nauru
29.	Jersey	N/A	N/A
30.	Kenya	Singapore	Nauru
31.	Kiribati	N/A	N/A
32.	St Lucia	St Lucia	N/A
33.	Lesotho	N/A	N/A
34.	Malaysia	Nigeria	Nauru
35.	Malawi	N/A	N/A
36.	Maldives	N/A	N/A
37.	Malta	N/A	N/A
38.	Mozambique	N/A	N/A
39.	Mauritius	Bahamas	N/A
40.	Montserrat	N/A	N/A
41.	Namibia	Bahamas	N/A
42.	Norfolk Island	N/A	N/A
43.	Nigeria	Nigeria	Nauru
44.	Northern Ireland	Nigeria	Nauru
45.	Niue	N/A	N/A
46.	Nauru	Nauru	Nauru
47.	New Zealand	Singapore	Nauru
48.	Pakistan	Singapore	Nauru
49.	Papua New Guinea	Singapore	N/A
50.	South Africa	Singapore	Nauru
51.	Rwanda	N/A	
52.	Samoa	Nauru	Nauru
53.	Scotland	Singapore	Nauru
54.	Seychelles	Nauru	N/A
55.	St. Helena	N/A	N/A
56.	Singapore	Singapore	Nauru
57.	St. Kitts and Nevis	N/A	N/A
58.	Sierra Leone	N/A	N/A
59.	Solomon Islands	N/A	N/A
60.	Sri Lanka	Singapore	Nauru
61.	St. Vincent and The Grenadines	N/A	N/A
62.	Swaziland	N/A	N/A
63.	Tanzania	N/A	N/A
64.	Turks and Caicos Islands	N/A	N/A
65.	Tonga	Bahamas	N/A
66.	Trinidad and Tobago	N/A	N/A
67.	Tuvalu	N/A	N/A
68.	Uganda	Nauru	Nauru
69.	Vanuatu	N/A	N/A
70.	Wales	Nigeria	Nauru
71.	Zambia	N/A	N/A

Table 6 Ideal Number of Players in Two Situations (BCC input-oriented model)

Sr. No.	Country	Actual number of players	Ideal number of players under Model 1 (Gold+Silver+Bronze)	Ideal number of players under Model 2 (Gold Medal)
1.	Anguilla		N/A	N/A
2.	Antigua and Barbuda		N/A	N/A
3.	Australia	396	396*	396*
4.	Bahamas	24	24*	10
5.	Bangladesh	37	13	
6.	Barbados			
7.	Bermuda		N/A	N/A
8.	Belize		N/A	N/A
9.	Botswana	31	21	10
10.	Brunei Darussalam		N/A	N/A
11.	Canada	255	255*	143
12.	Cayman Islands	17	10	10
13.	Cameroon	25	25*	N/A
14.	Cook Islands		N/A	N/A
15.	Cyprus	57	36	25
16.	Dominica			
17.	England	371	371*	201
18.	Falkland Islands		N/A	N/A
19.	Gambia		N/A	N/A
20.	Guernsey		N/A	N/A
21.	Ghana	58	21	N/A
22.	Gibraltar		N/A	N/A
23.	Grenada		N/A	N/A
24.	Guyana	32	10	N/A
25.	India	407	285	206
26.	Isle of Man	33	17	N/A
27.	British Virgin Islands		N/A	N/A
28.	Jamaica	81	28	16
29.	Jersey		N/A	N/A
30.	Kenya	157	72	69
31.	Kiribati		N/A	N/A
32.	St. Lucia	13	13*	N/A
33.	Lesotho		N/A	N/A
34.	Malaysia	201	96	69
35.	Malawi		N/A	N/A
36.	Maldives		N/A	N/A
37.	Malta		N/A	N/A
38.	Mozambique		N/A	N/A
39.	Mauritius	55	17	N/A
40.	Montserrat		N/A	N/A
41.	Namibia	30	17	
42.	Norfolk Island		N/A	N/A
43.	Nigeria	101	101*	63
44.	Northern Ireland	81	30	21
45.	Niue		N/A	N/A
46.	Nauru	10	10*	10*
47.	New Zealand	193	137	37
48.	Pakistan	50	20	16
49.	Papua New Guinea	78	10	N/A
50.	South Africa	148	76	69
51.	Rwanda			
52.	Samoa	52	21	21
53.	Scotland	192	63	53
54.	Seychelles	28	10	N/A
55.	St. Helena		N/A	N/A
56.	Singapore	68	68*	63
57.	St. Kitts and Nevis		N/A	N/A
58.	Sierra Leone		N/A	N/A
59.	Solomon Islands		N/A	N/A
60.	Sri Lanka	92	14	10
61.	St. Vincent and The Grenadines		N/A	N/A
62.	Swaziland		N/A	N/A
63.	Tanzania		N/A	N/A
64.	Turks and Caicos Islands		N/A	N/A
65.	Tonga	21	17	N/A
66.	Trinidad and Tobago		N/A	N/A
67.	Tuvalu		N/A	N/A
68.	Uganda	67	16	16
69.	Vanuatu		N/A	N/A
70.	Wales	165	72	16
71.	Zambia		N/A	N/A

weightage) and Nauru (0.849741 weightage), as depicted in Table 4. Nauru has greater weightage (0.849741 > 0.150259), making it a role model for Singapore to improve its efficiency. Nauru only participated in weight lifting and won medals in that. Similarly, India—being an inefficient DMU in model 1 (Table 3) with only 75% efficiency and 51% efficiency in model 2 (Table 4)—has to follow Australia if it wants to win at least a medal in the game or a gold medal. On a similar note, according to Tables 3 and 4, countries like Sri Lanka, Scotland, and Pakistan should follow Singapore's example to win at least a medal. Surprisingly, when comparing Tables 3 and 4, Nigeria is a fully efficient country in terms of winning at least one medal; however, it needs to follow the strategy adopted by Nauru in order to win a gold medal.

As one of our objectives is to estimate the ideal number of athletes that a country should select to represent in multi-sports events like the CWG in order to win at least a medal or only gold medal, an input-oriented model was also run to analyze the performance of the medal-winning nations. For this purpose, the BCC input-oriented model was selected for both situations—the first for the three output variables (model 1) and the second for one output variable (model 2). In this input-oriented model, which aims to reduce the input amounts by as much as possible while keeping at least the present output levels, the number of athletes was considered as an input variable. Table 6 represents the ideal number of athletes under two different situations: when three outputs (model 1) compared to only one output is considered (model 2). In model 1, the output is the number of gold, silver, and bronze medals won by the nations; in model 2, the number of gold medals won is considered an output variable. Numbers with an asterisk (*)represent an optimum number of players to win at least a medal or a gold medal.

The optimum number of players for a country to win at least a medal is given in the fourth and fifth columns of Table 6. As an explanation, Kenya should be represented by only 72 instead of 157 to win at least a medal, and it requires only 69 to win a gold medal. Similarly, India should represent only 285 and 206 players to win at least a medal and a gold medal, respectively. Scotland was represented by 192 players but it needs only 53 to win a gold medal or 63 players to win at least a medal. South Africa needs only 69 to win a gold medal and 76 to win at least a medal. This analysis is useful for those countries represented by a huge number of players, but not able to compete with the participants of other countries. Therefore, a good strategy could be to select players in such a combination that the players are able to win in the international games. The reputation of a country also depends on success in international games like CWG.

7 Conclusion and Discussion

The present study discussed DEA models with a various combination of input and output variables for the evaluation of the relative efficiency of nations that won medals at CWG held in India in 2010. The findings are interesting and insightful too. In an international sports event, the primary objective of any nation is to show its superiority over other participating nations by winning a maximum number of medals, especially gold medals, in multi-sports events. However, it is also usual practice among many nations to represent the country in multiple sports without any expertise. This leads to a huge participation in terms of the number of players, delegations, and officials without winning any laurels for the country. This is obviously not a desirable situation as it causes embarrassment for the participating nation. Given that one of the contributions of this study is to optimize the number of players to maximize efficiency in terms of medals won in international sports events, DEA modeling has been used. The different DEA models show different results as the number of DMUs (countries in our case) changed when the numbers of output parameters were used as a variable. The result is essentially useful for the policymakers of the international sports events who decide the number of players to represent their country in the international sports arena. The result of the present study would help them strategize the number of players to maximize the probability of winning medals in various sports.

An interesting aspect of this paper was the effort to identify the trend among participating nations in CWG 2010 in terms of representing the ideal number of players. The countries with fewer players were found to be more efficient in terms of their performance than countries with more players in CWG 2010. Indeed, Nauru, with the fewest participating players (only 10), was able to win a gold and silver medal, whereas Sri Lanka won one medal in each category with 92 participating players. Although there is pride in taking part in international sports events and national pride has its own significance, in terms of performance efficiency, the number of medals matter to a great extent.

As per the results, only a handful of nations have been identified as being completely efficient, whether in terms of sending an appropriate number of players to represent the country or to win a medal. Most countries exhibit more of a disappointment and only modest success.

Future research should consider analyzing the same countries for the CWG recently concluded in Glasgow in 2014. As the number of countries remains the same, the efficiency of these countries can be observed with a different number of players in different sports activities.

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Merjenje učinkovitosti nacij pri večšportnih dogodkih: primer XIX. iger Commonwealtha

Izvleček

V prispevku je bila za merjenje uspešnosti nacij, sodelujočih na igrah Commonwealtha, uporabljena analiza podatkovne ovojnice. Da bi lahko preiskali veljavnost rezultatov, smo za povečanje doslednosti raziskave uporabili več modelov, vendar je narava vložkov in izložkov ostala nespremenjena.

Namen raziskave je ugotoviti najbolj smiselno število udeleženih športnikov iz vseh sodelujočih držav ter oceniti njihovo uspešnost glede na najučinkovitejšo državo. Raziskava je lahko v pomoč nacijam pri optimizaciji števila udeleženih igralcev, da bi maksimizirali izide, tj. število medalj, dobljenih na športnih dogodkih.

Ključne besede: merjenje uspešnosti, analiza podatkovne ovojnice, učinkovitost, igre Commonwealtha

The Effect of the Combination of Different Methods of Stock Analysis on Portfolio Performance

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Abstract

The literature that examines the stock analysis is often faced with the same questions: Which stock analyses should be chosen and which indicators of individual stock analyses give the best information on whether a particular stock should be included in the portfolio? How many indicators and which combination of indicators should you choose to forecast future stock prices as accurately as possible? Can investors use stock analyses to create such a portfolio to meet the investment expectations? The main purpose of this article is to use theoretical methodology to determine whether the use of a combination of indicators from different stock analyses has a positive impact on the profitability of the portfolio.

Keywords: Portfolio, stock analysis, portfolio manager, indicators, investment decisions, stock prices

1 Introduction

Future movements in stock prices can be assessed using a variety of methods and indicators. In the literature, the most commonly represented methods are the fundamental and the technical analyses of stocks. The job of stock market analysts and portfolio managers is to try to find the best method or the best model to forecast future stock prices in a certain period of time as the aforementioned methods and models are constantly updated and supplemented. Of course, it would be irrational if stock analysts continuously used only the current "safest" methods. Unfortunately, the use of graphic examples of stock price movements or the indicators of the fundamental analysis of stocks only does not suffice for a sound method, which could be used to forecast the future stock price movements. However, the results of both simulations shown in this contribution demonstrate that it is the best for using the combination of both types of stock analyses.

2 Overview of the Theoretical Basis of Fundamental and Technical Analysis of Stocks

A fundamental analysis argues that the stock price is influenced by many factors, such as the company's profit, the company's reputation, risk degree, the impact of monetary policies, fiscal policies, the impact of macroeconomic aggregates, and the economic cycle phase of the global economy. All of these factors represent basic information for a fundamental analysis of stocks, which does not relate only to the company, but also to the industry and the overall economy. With the data

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collected, we can estimate what will happen with regard to the prices of stocks in the future. A fundamental analysis requires a lot of time, as it includes a number of indicators for the analysis of a relatively small number of stocks (Baker, 2010; Braun, 2007; Goldberg & von Nitzsche, 2000).

The price-to-earnings ratio (P/E ratio) indicator represents the ratio between the market price per stock and net income (earnings) per stock. It is the most frequently used indicator among investors making investment decisions (Kleindienst, 2001; Madura, 2011). By comparing the earnings per stock and dividend per stock, we can also calculate the stock of payments to companies or the payout ratio, which represents the ratio of dividends paid in comparison to the entire net income of the company. Another indicator is the price-to-book ratio (P/B ratio), representing the ratio between the stock price and its book value. Analysts can also use the price-to-sales ratio (P/S ratio), which represents the ratio between the stock price and turnover of the company, to assess the current stock value per stock (Matschke & Brösel, 2013; Pernsteiner, 2008). The expected success of a company and the expected growth of a company's stock value in the future can also be determined by using indicators such as EBIT and EBITDA[1] (Born, 2009; Mattern, 2005).

In addition to the fundamental analysis of stocks, financial markets analyses use a slightly newer stocks analysis—namely, the technical analysis of stocks—which, with respect to their observations and forecasts, can sometimes surpass even the fundamental analysis of stocks. The technical analysis uses past prices and other past data to predict future market movements. In practice, all major portfolio managers publish technical commentaries on the market, and many of the advisory services are based on technical analyses (Han, Yang & Zhou, 2013). Their approach assumes that stock prices move cyclically and that all the facts and the relevant stock price data reflect fluctuations in stock prices. By estimating the movements in stock prices in the past, we can predict future stock market trends. We can presumably use certain information to predict the changes in trends and their continuity. To analyze the formations and trends, the most commonly used techniques are the line, bar, and point and figure charts as well as the Japanese candlestick approach (Nison, 2001; Welcker, 1994), which is why this analysis is also called a chart analysis as it assumes that the purchase signals of individual stocks in the graph can be significantly faster read than through the information available via the use of the fundamental analysis.

The challenge or the art of forecasting price movements of stocks in the future stems from the reliability of chart-reading systems in the close monitoring and assessing of exchange rate "oscillations." Several tools can be used for these purposes: the trend line and the formations signaling recommendations about buying or selling stocks. The next most commonly used indicator is the moment at which we measure the degree of variability in stocks' trends (Knight, 2007). Another important technical indicator is the relative strength index, an oscillator that compares the output rate at a given moment with the output rate in the past. MACD is an oscillator that measures the relationship between two moving averages of the rate. It shows the difference between 26-day and 12-day exponential moving average rates (Knight, 2007; Steiner & Bruns, 2008).

Equity analysts and portfolio managers are important information intermediaries (Ellmann, 2006) on the capital market. Their primary role is that, by actively managing investments, they achieve additional value for an investor (Budelmann, 2013). This is why the experts favoring the fundamental analysis underscore the view that, before deciding to purchase stocks, the investor's priority task is to take into consideration the psychological aspects of stock market participants in addition to indicators of fundamental analysis, as this consideration, in their opinion, makes it possible to gather a large amount of relevant data.

In contrast, technical analysts do not deal with the fundamental data of each stock. For each stock, they can accurately describe its position and possible future trends of a corporation, but they do not consider that the movement of the stock price largely depends on the subjective assessments of the investor and stock market participants (Bazdan, 2010; Steiner & Bruns, 2008). Heese (2011) argued that the comprehensive analysis of stocks necessarily involves the use of indicators from both analyses.

3 Hypothesis

Based on the previous discussion, the portfolio manager's decisions about which stocks will be included in the portfolio depend upon a wide range of factors, which are dealt with in detail by the stocks analysis methods already described. When studying the stock analyses, we can argue that both analyses have their strengths and weaknesses; thus, none can be described as "better.,. From our starting point, and given the fact that selecting the right portfolio is a delicate act that plays a decisive role in determining whether we will achieve the desired return or not, this study focuses on verifying the following hypothesis: When we combine the indicators from various stock analyses to include stocks in a portfolio, there is a greater likelihood that the portfolio will be more profitable. The verification of the hypothesis is connected with the risk of obtaining different results when

[1] Earning Before Interest, Taxes, Depreciation and Amortization

other types of stocks are selected—namely, the final result is dependent on the selection of indicators, the chosen time period, stock selection for joint portfolio for the purpose of stock selection, and some additional factors.

4 Research Methodology

To test the hypothesis, we used three simulations comprising 20 randomly selected stocks that were monitored for 10 years; next, another three simulations comprising 26 stocks were monitored for a year. The stocks were selected based on various criteria. A statistical analysis was carried out using the SPSS 21.0 program. Two versions of the analyses were used: a one-way ANOVA and a *t*-test for independent samples. The stocks categorized into the three simulations were identified, and portfolios A, B, and C were designed based on the selected stocks' analyses.

5 Limitations and Calculations

Due to its usefulness and transparency, the New York Stock Exchange (NYSE, 2013) database was used for data collection. Randomly selected stocks corresponding to the set filters were used; the movements of their prices were observed and then categorized into portfolios using the analytical methods.

Portfolio A comprises stocks selected based on the fundamental analysis indicators. The filters or selection criteria are the indexes of the fundamental analysis: P/E < 26.26, P/B < 3.40, P/S < 1.71. The values represent the average of fundamental indicators of the S&P 500 index on January 25, 2002. The numbers correspond to the current average of the S&P index according to the Bloomberg filter.

Information from the database was considered from January 25, 2002, to December 31, 2012, as a long-term average.

Table 1 Selection of Stocks according to Fundamental Indicators

Stock code (NYSE)	P/E	P/B	P/S	Price on 25/1/2002	Price on 31/12/2012
AEP-American Electric Power Company Inc.	12.62	1.62	0.55	41.55	42.68
ALL-The Allstate Corp.	16.11	1.34	0.80	32.40	40.17
CR-Crane Co.	14.20	2.18	0.89	23.86	46.28
D-Dominion Resources, Inc.	13.97	1.84	1.38	29.20	51.80
DUK-Duke Energy Corp.	8.03	1.28	0.88	108.12	63.80
DVN-Devon Energy Corp.	7.73	1.51	1.66	19.29	52.04
ETR-Entergy Corp.	12.52	1.19	0.92	40.45	63.75
FMC-FMC Corp.	11.25	2.94	0.55	8.64	58.52
HAL-Halliburton Company	11.20	1.30	0.47	7.17	34.69
JCI-Johnson Controls, Inc.	15.05	2.28	0.36	13.24	30.67
M-Macy's, Inc.	11.20	1.34	0.49	20.20	39.02
NEE-NextEra Energy, Inc.	11.34	1.63	1.12	26.81	69.19
NOC-Northrop Grumman Corp.	15.89	1.39	0.61	52.40	67.58
PNW-Pinnacle West Capital Corp.	10.62	1.43	0.91	42.50	50.98
PPL-PPL Corp.	8.09	2.65	0.88	16.80	28.63
R-Ryder System, Inc.	15.52	1.18	0.28	23.91	49.93
SVU-Supervalu, Inc.	13.85	1.63	0.14	23.55	2.47
TAP-Molson Coors Brewing Company	16.03	1.98	0.79	26.29	42.79
TE-TECO Energy, Inc.	11.41	1.72	1.29	24.43	16.76
WMB-Williams Companies, Inc.	9.81	1.72	0.43	24.77	32.74

Source: S&P 500, Bloomberg, NKBM

Table 2 Selection of Stocks according to Technical Indicators

Stock code (NYSE)	MACD on 25/1/2002	Price on 25/1/2002	Price on 31/12/2012
AP-Ampco-Pittsburgh Corp.	0.05	11.11	19.98
BAX-Baxter International, Inc.	0.96	52.52	66.66
BHLB-Berkshire Hills Bancorp, Inc.	0.71	21.59	23.86
CEC-CEC Entertainment, Inc.	1.03	28.40	33.19
CI-CIGNA Corp.	0.08	31.10	53.46
CRT-Cross Timbers Royalty Trust	0.45	18.70	26.92
EBF-Ennis, Inc.	0.31	9.67	15.47
ETR-Entergy Corp.	0.54	40.45	63.75
FNFG-First Niagara Fin. Group, Inc.	0.25	6.90	7.93
GAS-AGL Resources, Inc.	1.42	45.55	39.97
GSH-Guangshen Railway Co., Ltd.	0.22	8.90	19.74
IDA-IDACORP, Inc.	0.28	38.43	43.35
LMT-Lockheed Martin Corporation	2.22	50.00	92.29
MRF-American Income Fund, Inc.	0.04	8.71	8.37
MSB-Mesabi Trust	0.03	3.14	25.45
PRE-Partnerre, Ltd.	0.19	51.52	80.49
RCI-Rogers Communications, Inc.	0.18	7.98	45.40
SCG-SCANA Corporation	0.16	27.59	45.64
SQM-Sociedad Quimica y Minera de Chile	0.08	2.18	57.64
WMT-Wal-Mart Stores, Inc.	1.67	58.40	68.23

Source: S&P 500, Bloomberg, NKBM

The same source of information was used to select stocks for portfolio B, which consists of stocks analyzed using the technical analysis indicators of which only the following will be applied: MACD > 0, RSI < 50, Stochastic Buy Signal < 30 days. These values are set theoretically according to Bloomberg. The relative strength index (RSI) is one of the most well-known technical indicators, which is why it was included in the criteria for selecting stocks for portfolio B. RSI focuses on the movement of the stock price and measures the ratio between the average surge and drop in the price of a stock. The stochastic oscillator compares the final price of the stock in relation to the interval of the stock's movement within a specified period of time. The MACD indicator, which proved to be the best indicator of the purchase or sale of stocks (Trančar, 2000), was chosen as the primary criterion. Whenever a signal line intersects the value 0 from the bottom to the top, it is time to buy the stock as it is expected that its value will go up in the future and vice versa. Based on this information, stocks whose MACD indicator value was either positive or close to zero and showed a rising value were included in portfolio B. The value of the MACD indicator for individual stocks was chosen on January 25, 2002, and the prices of all stocks were subsequently monitored.

Portfolio C consists of the best stocks of portfolios A and B. The primary criteria used were the MACD in the technical analysis and the P/E in the fundamental analysis. thus, portfolio C represented the selection of stocks based on both fundamental and technical analyses. So as not to neglect any of them, we chose exactly one half of portfolio A and one half of portfolio B stocks. The first and the second simulations comprise portfolios of 10 stocks, while the third includes portfolios of 20 stocks.

After setting filters and selecting stocks for all three simulations, monthly stock prices were monitored from January 25, 2002, to December 31, 2012, for the first part and from January 27,2012, to December 12, 2012, for the second part.

Based on the hypotheses, we expected portfolio C to be more profitable in all simulations than portfolios A and B as portfolio C comprises portfolio A's stocks with the lowest P/E index and portfolio B's stocks where the MACD index is positive and close to zero. Table 1 summarizes the selection of the stocks; the values in all tables are expressed in U.S. dollars.

The results of monitoring all three simulations representing the three portfolios were based on different criteria. The first

simulation represents the movement of the individual portfolios' values: portfolio A (10 stocks), selected using fundamental indicators; portfolio B (10 stocks), selected using technical indicators; and portfolio C (20 stocks), selected according to the combination of fundamental and technical analyses. The second simulation also comprises three portfolios consisting the second half of the chosen stocks. Using the same principle, the third simulation was designed, except the portfolios comprise the whole group of stocks. However, the portfolio always covers only one stock from an individual joint-stock company.

For portfolio A:

$$A_t = P_{1_t} + P_{2_t} + \ldots + P_{n_t} = \sum_{i=1}^{n} P_{i_t} \quad (1)$$

where,
A_t = value of portfolio A at time t
i = {1, 2, 3, …, n}
n = number of stocks included in portfolio A
P_{i_t} = value of stock i at time t
t = time

What follows is the calculation of the profitability rate of portfolio A.

$$\%\ \mathrm{A} = \left(\frac{A_t - A_{t-1}}{A_{t-1}} \right) * 100 \ \text{ in } \% \quad (2)$$

where,
% A = profitability rate of portfolio A (in %)
A_t = value of portfolio A at time t
A_{t-1} = value of portfolio A at time t-1

Supposing that we ennoble our capital for 10 years and do not change portfolios A, B, or C, the variable will be t-1 = 25/1/2002, t = 31/12/2012. The same methodology is used to calculate the value and profitability of portfolios B and C. Because we wanted to acquire realistic results of our simulations, we monitored the movement of stock prices for a period of 10 years, at the end of which the profitability of each portfolio was determined.

6 Analysis and Results

Table 3 shows the values (in U.S. dollars) and profitability of individual portfolios in each simulation.

Using the same methodology, 26 stocks were chosen for the three simulations from January 27, 2012, to December 27, 2012. If we ennoble our capital for only one year and do not change portfolios A, B, and C, the variable is t-1 = 27/1/2012, t = 27/12/2012. The same methodology was used to calculate the value and profitability of portfolios A, B, and C. Portfolio A comprises stocks selected using the fundamental analysis indicators: P/E < 13.35, P/B < 2.15, P/S < 1.29. The values represent the average of fundamental indicators of the S&P 500 index on January 27, 2012. The same methodology was used to calculate the value and profitability of portfolios A, B, and C. The values in Table 4 are expressed in U.S. dollars.

In addition, the statistical analysis carried out with the SPSS 21.0 program proved our hypothesis. Two versions of analyses were presented, with the results being the same in both of them. In the first version the one-way ANOVA (one-way analysis of version) was used; a t-test for independent samples was used in the second version.

Table 3 *Value and Profitability of Portfolios of Individual Simulations (10 years)*

SIMULATION 1 / PORTFOLIO A			SIMULATION 1 / PORTFOLIO B			SIMULATION 1 / PORTFOLIO C		
Stock code	25/1/2002	31/12/2012	Stock code	25/1/2002	31/12/2012	Stock code	25/1/2002	31/12/12
AEP	41.55	42.68	AP	11.11	19.98	DVN	19.29	52.04
ALL	32.40	40.17	BAX	52.52	66.66	DUK	108.12	63.8
CR	23.86	46.28	BHLB	21.59	23.86	HAL	7.17	34.69
D	29.20	51.80	CEC	28.40	33.19	FMC	8.64	58.52
DUK	108.12	63.80	CI	31.10	53.46	ETR	40.45	63.75
DVN	19.29	52.04	CRT	18.70	26.92	AP	11.11	19.98
ETR	40.45	63.75	EBF	9.67	15.47	CI	31.1	53.46
FMC	8.64	58.52	ETR	40.45	63.75	FNFG	6.9	7.93
HAL	7.17	34.69	FNFG	6.90	7.93	EBF	9.67	15.47
JCI	13.24	30.67	GAS	45.55	39.97	CRT	18.7	26.92
Value of portfolio	323.92	484.40	Value of portfolio	265.99	351.19	Value of portfolio	261.15	396.56
Profitability		49.50%	Profitability		32.00%	Profitability		51.85%
SIMULATION 2 / PORTFOLIO A			SIMULATION 2 / PORTFOLIO B			SIMULATION 2 / PORTFOLIO C		
M	20.20	39.02	GSH	8.90	19.74	PPL	16.80	28.63
NEE	26.81	69.19	IDA	38.43	43.35	WMB	41.55	42.68
NOC	52.40	67.58	LMT	50.00	92.29	PNW	42.50	50.98
PNW	42.50	50.98	MRF	8.71	8.37	M	20.20	39.02
PPL	16.80	28.63	MSB	3.14	25.45	NEE	26.81	69.19
R	23.91	49.93	PRE	51.52	80.49	MSB	3.14	25.45
SVU	23.55	2.47	RCI	7.98	45.40	MRF	8.71	8.37
TAP	26.29	42.79	SCG	27.59	45.64	SOM	2.18	57.64
TE	24.43	16.76	SOM	2.18	57.64	SCG	27.59	45.64
WMB	24.77	32.74	WMT	58.40	68.23	RCI	7.98	45.40
Value of portfolio	281.66	400.09	Value of portfolio	256.85	486.60	Value of portfolio	197.46	413.00
Profitability		42.00%	Profitability		89.40%	Profitability		109.16%
SIMULATION 3 / PORTFOLIO A			SIMULATION 3 / PORTFOLIO B			SIMULATION 3 / PORTFOLIO C		
AEP	41.55	42.68	AP	11.11	19.98	DVN	19.29	52.04
ALL	32.40	40.17	BAX	52.52	66.66	DUK	108.12	63.8
CR	23.86	46.28	BHLB	21.59	23.86	PPL	16.8	28.63
D	29.20	51.80	CEC	28.40	33.19	WMB	41.55	42.68
DUK	108.12	63.80	CI	31.10	53.46	PNW	42.5	50.98
DVN	19.29	52.04	CRT	18.70	26.92	HAL	7.17	34.69
ETR	40.45	63.75	EBF	9.67	15.47	M	20.2	39.02
FMC	8.64	58.52	ETR	40.45	63.75	FM	8.64	58.52
HAL	7.17	34.69	FNFG	6.90	7.93	TE	24.43	16.76
JCI	13.24	30.67	GAS	45.55	39.97	NEE	26.81	69.19
M	20.20	39.02	GSH	8.90	19.74	MSB	3.14	25.45
NEE	26.81	69.19	IDA	38.43	43.35	MRF	8.71	8.37
NOC	52.40	67.58	LMT	50.00	92.29	AP	11.11	19.98
PNW	42.50	50.98	MRF	8.71	8.37	CI	31.1	53.46
PPL	16.80	28.63	MSB	3.14	25.45	SOM	2.18	57.64
R	23.91	49.93	PRE	51.52	80.49	SCG	27.59	45.64

SIMULATION 3 / PORTFOLIO A			SIMULATION 3 / PORTFOLIO B			SIMULATION 3 / PORTFOLIO C		
Stock code	25/1/2002	31/12/2012	Stock code	25/1/2002	31/12/2012	Stock code	25/1/2002	31/12/12
SVU	23.55	2.47	RCI	7.98	45.40	PRE	51.52	80.49
TAP	26.29	42.79	SCG	27.59	45.64	RCI	7.98	45.4
TE	24.43	16.76	SQM	2.18	57.64	GSH	8.9	19.74
WMB	24.77	32.74	WMT	58.40	68.23	FNFG	6.9	7.93
Value of portfolio	605.58	884.49	Value of portfolio	522.84	837.79	Value of portfolio	474.64	820.41
Profitability		46.00%	Profitability		60.20%	Profitability		72.85%

Source: NYSE, NKBM, author's calculations

Table 4 Value and Profitability of Portfolios of Individual Simulations (one year)

SIMULATION 1 / PORTFOLIO A			SIMULATION 1 / PORTFOLIO B			SIMULATION 1 / PORTFOLIO C		
Stock code	27/1/2012	27/12/2012	Stock code	27/1/2012	27/12/2012	Stock code	27/1/2012	27/12/2012
ADM	29.82	27.49	AA	10.43	8.62	BAC	7.29	11.47
AET	43.43	46.24	ACE	69.46	79.62	ADM	29.82	27.49
AFL	49.04	53.01	AET	43.43	46.24	AFL	49.04	53.01
BAC	7.29	11.47	AMGN	68.34	86.15	CVX	103.96	108.52
C	30.87	39.25	AMT	63.01	76.29	COP	52.9	57.9
CHK	22.05	16.86	APD	88.19	84.80	C	30.87	39.25
CI	45.18	53.66	BDX	79.09	78.28	AET	43.43	46.24
COP	52.90	57.90	BMY	32.29	32.14	AMT	63.01	76.29
CVX	103.96	108.52	BXP	104.24	105.67	AA	10.43	8.62
ETN	49.57	53.63	CAT	111.28	87.66	AMGN	68.34	86.15
FE	42.26	41.65	EMR	51.67	52.67	BDX	79.09	78.28
GD	70.35	69.02	FDX	92.95	91.50	HNZ	51.73	57.86
HES	55.26	52.45	FLR	57.23	58.20	BMY	32.29	32.14
HUM	88.26	68.00	HNZ	51.73	57.86	EMR	51.67	52.67
Value of portfolio	690.25	699.15	Value of portfolio	923.34	945.70	Value of portfolio	673.87	735.89
Profitability		1.29%	Profitability		2.42%	Profitability		9.20%
SIMULATION 2 / PORTFOLIO A			SIMULATION 2 / PORTFOLIO B			SIMULATION 2 / PORTFOLIO C		
MET	35.52	32.88	INTU	57.35	60.34	VLO	24.12	33.83
MRO	31.24	30.32	KSS	46.69	42.54	MET	35.52	32.88
MUR	61.42	59.47	MDLZ	25.17	25.36	NOC	58.71	67.74
NOC	58.71	67.74	MON	80.53	93.99	RTN	48.64	57.8
PCG	40.83	40.02	NOV	77.40	66.97	XRX	7.88	6.79
PRU	57.22	53.05	NUE	44.50	43.15	WLP	65.42	60.48
RTN	48.64	57.80	PXD	97.42	104.95	NUE	44.5	43.15
TEL	34.30	36.93	ROK	76.90	82.74	MDLZ	25.17	25.36
UNH	51.02	54.44	SNDK	46.70	43.22	SWN	32.04	33.13
VLO	24.12	33.83	SWN	32.04	33.13	KSS	46.69	42.54
WLP	65.42	60.48	TEL	34.30	36.93	MON	80.53	93.99
XRX	7.88	6.79	XOM	85.83	86.86	PXD	97.42	104.95
Value of portfolio	516.32	533.75	Value of portfolio	704.83	720.18	Value of portfolio	566.64	602.64
Profitability		3.37%	Profitability		2.17%	Profitability		6.30%

SIMULATION 3 / PORTFOLIO A			SIMULATION 3 / PORTFOLIO B			SIMULATION 3 / PORTFOLIO C		
ADM	29.82	27.49	AA	10.43	8.62	VLO	24.12	33.83
AET	43.43	46.24	ACE	69.46	79.62	BAC	7.29	11.47
AFL	49.04	53.01	AET	43.43	46.24	ADM	29.82	27.49
BAC	7.29	11.47	AMGN	68.34	86.15	AFL	49.04	53.01
C	30.87	39.25	AMT	63.01	76.29	CVX	103.96	108.52
CHK	22.05	16.86	APD	88.19	84.80	COP	52.9	57.9
CI	45.18	53.66	BDX	79.09	78.28	MET	35.52	32.88
COP	52.90	57.90	BMY	32.29	32.14	C	30.87	39.25
CVX	103.96	108.52	BXP	104.24	105.67	NOC	58.71	67.74
ETN	49.57	53.63	CAT	111.28	87.66	AET	43.43	46.24
FE	42.26	41.65	EMR	51.67	52.67	CI	45.18	53.66
GD	70.35	69.02	FDX	92.95	91.50	RTN	48.64	57.8
HES	55.26	52.45	FLR	57.23	58.20	XRX	7.88	6.79
HUM	88.26	68.00	HNZ	51.73	57.86	NUE	44.5	43.15
MET	35.52	32.88	INTU	57.35	60.34	AMT	63.01	76.29
MRO	31.24	30.32	KSS	46.69	42.54	AA	10.43	8.62
MUR	61.42	59.47	MDLZ	25.17	25.36	MDLZ	25.17	25.36
NOC	58.71	67.74	MON	80.53	93.99	SWN	32.04	33.13
PCG	40.83	40.02	NOV	77.40	66.97	KSS	46.69	42.54
PRU	57.22	53.05	NUE	44.50	43.15	AMGN	68.34	86.15
RTN	48.64	57.80	PXD	97.42	104.95	MON	80.53	93.99
TEL	34.30	36.93	ROK	76.90	82.74	BDX	79.09	78.28
UNH	51.02	54.44	SNDK	46.70	43.22	PXD	97.42	104.95
VLO	24.12	33.83	SWN	32.04	33.13	HNZ	51.73	57.86
WLP	65.42	60.48	TEL	34.30	36.93	BMY	32.29	32.14
XRX	7.88	6.79	XOM	85.83	86.86	XOM	85.83	86.86
Value of portfolio	1206.57	1232.90	Value of portfolio	1628.17	1665.88	Value of portfolio	1254.43	1365.9
Profitability		2.12%	Profitability		2.31%	Profitability		8.88%

Source: NYSE, NKBM, author's calculations

Table 5 ANOVA[a]

Descriptives[a] in %								
a-10 years	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A	3	45.8333	3.75278	2.16667	36.5109	55.1557	42.00	49.50
B	3	60.5333	28.70145	16.57079	-10.7650	131.8317	32.00	89.40
C	3	77.9533	28.99383	16.73959	5.9287	149.9780	51.85	109.16
Total	9	61.4400	24.76953	8.25651	42.4005	80.4795	32.00	109.16

ANOVA[a] in %					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1551.241	2	775.620	1.386	0.320
Within Groups	3356.997	6	559.500		
Total	4908.238	8			

Table 6 Post Hoc Tests

a-10 years	Multiple Comparisons[a]					
Dependent Variable: in %						
Bonferroni						
(I) portfolio	(J) portfolio	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-14.70000	19.31320	1.000	-78.1913	48.7913
	C	-32.12000	19.31320	0.442	-95.6113	31.3713
B	A	14.70000	19.31320	1.000	-48.7913	78.1913
	C	-17.42000	19.31320	1.000	-80.9113	46.0713
C	A	32.12000	19.31320	0.442	-31.3713	95.6113
	B	17.42000	19.31320	1.000	-46.0713	80.9113

*. The mean difference is significant at the 0.05 level.

Table 7 Independent Samples Test[a] A–C

Independent Samples Test[a] in %									
a-10 years	Levene's Test for Equality of Variances		*t*-test for Equality of Means						
	F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	5.105	0.087	-1.903	4	0.130	-32.12000	16.87923	-78.98426	14.74426
Equal variances not assumed			-1.903	2.067	0.193	-32.12000	16.87923	-102.53577	38.29577

Table 8 Independent Samples Test[a] B–C

Independent Samples Test[a]									
a-10 years	Levene's Test for Equality of Variances		*t*-test for Equality of Means						
	F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	0.016	0.906	-0.740	4	0.501	-17.42000	23.55430	-82.81723	47.97723
Equal variances not assumed			-0.740	4.000	0.501	-17.42000	23.55430	-82.81987	47.97987

As Tables 5 through 8 demonstrate, among the three portfolios, no statistically significant differences occur at the 0.05 level of significance, which means that the differences are not statistically important. Nevertheless, the profitability of portfolio C is, on average, 32.12% greater than the profitability of portfolio A over 10 years (i.e., 3.21% a year) 17.42% greater than the profitability of portfolio B (i.e., 1.74% a year).

Tables 9 through 12 summarize the results of the statistical analyses of stocks' profitability when held for only one year.

Table 9 ANOVA[a]

Descriptives[a] in %								
a-One year	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A	3	2.2600	1.04704	0.60451	-0.3410	4.8610	1.29	3.37
B	3	2.3000	0.12530	0.07234	1.9887	2.6113	2.17	2.42
C	3	8.1267	1.59001	0.91799	4.1769	12.0765	6.30	9.20
Total	9	4.2289	3.07510	1.02503	1.8652	6.5926	1.29	9.20

ANOVA[a] in %					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	68.369	2	34.185	28.173	0.001
Within Groups	7.280	6	1.213		
Total	75.650	8			

Table 10 *P*ost Hoc Testsa

a-One year	Multiple Comparisons[a]					
Dependent Variable: in %						
Bonferroni						
(I) portfolio	(J) portfolio	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	-0.04000	0.89940	1.000	-2.9967	2.9167
	C	-5.86667*	0.89940	0.002	-8.8234	-2.9099
B	A	0.04000	0.89940	1.000	-2.9167	2.9967
	C	-5.82667*	0.89940	0.002	-8.7834	-2.8699
C	A	5.86667*	0.89940	0.002	2.9099	8.8234
	B	5.82667*	0.89940	0.002	2.8699	8.7834

* The mean difference is significant at the 0.05 level.

Table 11 Independent Samples Test[a] A–C

Independent Samples Test[a] in %									
a-One year	Levene's Test for Equality of Variances		*t*-test for Equality of Means						
	F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	1.184	0.338	-5.337	4	0.006	-5.86667	1.09916	-8.91841	-2.81492
Equal variances not assumed			-5.337	3.460	0.009	-5.86667	1.09916	-9.11574	-2.61759

Table 12 Independent Samples Test[a] B–C

a-One year	Levene's Test for Equality of Variances		*t*-test for Equality of Means						
	F	Sig.	*t*	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	12.458	0.024	-6.328	4	0.003	-5.82667	0.92084	-8.38333	-3.27001
Equal variances not assumed			-6.328	2.025	0.023	-5.82667	0.92084	-9.74250	-1.91083

According to Tables 9 through 12, among the three portfolios, there are statistically significant differences at the 0.001 level of significance. The profitability of portfolio C is on average statistically significantly bigger than the profitability of portfolio A (i.e., by 5.87%) and the profitability of portfolio B (i.e., by 5.83%). In addition, the statistical results show that, in terms of the stock analysis, it is reasonable to use and choose the right combination of indicators of both types of stock analysis—fundamental and technical—as doing so enables the reduction of risks in asset management.

Nevertheless, we are aware of the fact that the verification of the hypothesis is connected with the risk of obtaining different results as the result is dependent on the selection of indicators, the chosen time period, stock selection for joint portfolios, and other factors.

7 Conclusions

Regarding the design of investment portfolios, the most frequently used methods of stock analysis are fundamental and technical analyses, which analyze economic, structural, and political factors influencing the development of market capital. The main focus of this view is analyzing the numerous data of a conjunctive nature as well as the indicators of economic trends, structural factors, the effects of labor market flexibility, political decisions, and the like. Although the latter focuses mainly on the history of the monitored stocks' value, it favors methodology that indicates that it is possible to predict the stock movement in the future with the help of its past graphical forms. The flexibility of the stock analyses, indicators, and principles used is mainly dependent on the model chosen by the analyst or portfolio manager. In principle, each analytical method is only as flexible as its analyst or portfolio manager, who is definitely aware of the fact that both analyses have positive and negative sides and therefore should be combined by using the former to determine which stock to choose and the latter to determine when it is the right time to buy.

However, we still have not answered the questions of how many and which indicators to choose for individual stock analyses. If many false indicators are used, the model for predicting the stock's movement will also be false. Even a very skilled investor is not capable of indefinitely studying a great number of indicators.

The point of designing a model is to define not only the right number of chosen indicators, but also the right ones. If we choose too many indicators, the model will not bring the wanted synergetic effects as individual indicators can interfere with each other. This results in the phenomenon where each individual indicator shows a better prognosis of stock price movement than all the indicators together. Therefore, it is incorrect to monitor individual indicators in isolation as it leads to one indicator's weakness equaling the potential power of predicting the stock price movement of another one (Heese, 2011). For this reason, portfolio managers' analysts should find an appropriate set of complementary indicators that can then be used to design a valid model. The accuracy of predicting the stock price movement will increase; consequently, the probability of portfolio outcomes coming true will also increase.

In conclusion, let us briefly review the empirical conclusions from the research, which was based on three simulations, comprising portfolios A, B, and C. The average of fundamental indicators for S&P 500 index on a specific day's filters was the basis for selecting stock according to the primary criteria. Among the known criteria (i.e., P/E, P/S, and P/B), P/E was selected as the primary filter for the selection of stocks for portfolios A and C.

Regarding technical indicators, our choice was limited to MACD, RSI, and stochastic buy signal. The MACD index was chosen for the categorization of portfolios B and C.

Due to its usefulness and transparency, the NYSE database was used for the data collection. Randomly selected stocks corresponding to the set filters were used; movements of the prices were observed and then categorized into portfolios with the help of analytical methods.

The results of the portfolios' analysis led to the following conclusions. The profitability of portfolio A (comprised stocks selected based on fundamental indicators) and B (designed with the help of technical analysis criteria) was in all simulations lower than the profitability of portfolio C. Due to the combinations of both stocks' analyses, a better filter was chosen for the selection of stocks for portfolio C than for portfolios A and B. It is possible that the combination of different indicators from the fundamental and technical analyses had an influence on the profitability of the portfolio. The combined use of indicators from both technical and fundamental analyses of stocks had a positive impact on the profitability of the portfolio.

The answer to the question as to whether such results can be expected on other stock markets as well as would be affirmative as the profitability of the portfolio is more dependent on a positive economic situation, macro and micro economic factors, investment period, investment dispersion, and similar location as the market in which we invested.

Yet compared to the European market, the American market has by its nature a larger number of business operations, greater liquidity, and a broader choice of investment products (Mai, 2004). A better allocation of capital is ensured by unified business conditions, which enable the investors to invest their capital into the investments that they expect to yield the best results (Baele et al., 2004). A concentration of capital markets ends up in de facto unified national regulations and supervision. In addition, the market capitalization of American stock markets is twice as large as all European stock markets combined. Thus, dealing with stocks on various national stock exchanges on the European market causes bigger transaction costs, which leads investors to concentrate primarily on home securities (Mai, 2004). In addition, Jensen (1978) stressed the importance of trading profitability in assessing market efficiency. He further highlighted the importance of transactions costs and other market microstructure issues for defining market efficiency (Schwert, 2002).

All of these considerations lead to the assumption that the American capital market is more effective, which is not true according to Fama (1970; 1991), whose hypothesis of an effective market is based on the presumption that the prices of securities contain all the available and relevant information and that all participants on the market—buyers as well as sellers—act rationally. Thus, all market information is at any time reflected in the rates. According to the theory of market efficiency, no market participant can, in the long-term, outrun the market (Fama, 1970). Our model of portfolio formation rejects all three major components of Fama's hypothesis of weak efficiency, which states that we cannot draw conclusions about the future of stock rates from past rate movements (Steiner & Bruns, 2000). The technical analysis of stocks is mostly based on the past movements of stock rates, which—according to defenders of this approach—gives good results in terms of moderate efficiency, which claims that all markets' important and public information is incorporated into the actual rate itself. Fama (1970) concluded that the basic analysis is useless, as all public information is already included into the actual rate itself (Scheufele & Haas, 2008). Meanwhile, high efficiency refers to the claim that all markets' relevant public and internal information is reflected in the rate; thus, the use of insider information on the financial market—especially in stock exchange business—is useless. The fact that doing business on the stock exchange using insider information is lucrative in the short term also rejects this hypothesis (Scheufele & Haas, 2008; Steiner & Bruns, 2000), just as it is rejected by our model of portfolio selection.

Ultimately, the chosen stock selection model can be used for the American or any other capital market. It is essential that the basic data reflect the actual state of the company and the economy as a whole, especially as there are as many portfolio formation models as there are portfolio managers and investors creating their own models.

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Vpliv kombinacije različnih metod analiz delnic na donosnost portfelja

Izvleček

V literaturi, v kateri so bile proučevane analize delnic, se pogosto srečujemo z istimi vprašanji: Katero od naštetih analiz delnic izbrati, kateri kazalniki posamezne analize delnic dajejo najboljše informacije o tem, ali določeno delnico vključiti v portfelj ali ne? Koliko kazalnikov in katero kombinacijo med njimi izbrati, da bodo napovedi prihodnjega gibanja cen delnic čim bolj natančne? Ali lahko investitorji z analizami delnic oblikujejo takšen portfelj, da bo izpolnil njihova naložbena pričakovanja? Glavni namen članka je, da z metodologijo, ki smo jo predstavili v teoretičnem delu, preverimo, ali uporaba kombinacije kazalnikov različnih analiz delnic pozitivno vpliva na donosnost portfelja ali ne.

Ključne besede: portfelj, analiza portfelja delnic, upravljavec portfelja, kazalniki analiz delnic, investicijsko odločanje, cena delnice

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