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QUALITY OF INFORMATION DISCLOSED IN INTEGRATED REPORTS, IN THE EXTRACTING SECTOR: INSIGHTS FROM EUROPE

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Abstract: The study explores to what extent are extracting organizations from the European region, disclosing relevant information about social and environmental practices. To pursue the current exploratory study, a qualitative approach composed of two steps is performed. The first is a content analysis of 15 oil & gas and mining organizations integrated reports proposing a compliance exercise toward the International Integrated Reporting Framework. Then in the second one, the integrated reports of our sample are analyzed using MAXQDA, with the extent to which social and environmental references are positive, neutral, or negative. Thus, the present paper represents the first attempt in qualitative studies in Integrated Reporting with a specific focus on extracting sector. Our results demonstrate that the analyzed sample discloses more information related to the environment than social disclosure.

Keywords: Oil & Gas, Integrated Reporting, Europe, Qualitative Content Analysis
JEL classification: M40.

1. Introduction

The fast-economic development that occurred since the industrial revolution and the population growth can be considered responsible for the increase in greenhouse gas (GHG) emissions. Fossil fuels contributed with almost 80% of the total GHG released into our atmosphere from 1970 to 2010, leading to the so-called phenomenon of global warming (IPCC, 2014).

Increased worldwide awareness about climate change, the global community agreed to adopt the Kyoto Protocol, from 1997, which aimed to introduce legally binding emission reduction targets for developed countries; and the Paris Agreement, from 2015, that sought to limit the global warming "well below" 2°C (ECCEU, 2017).

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Consequently, firms worldwide began to consider their role in society and the environment; nowadays, non-financial reports such as Sustainability Reports (SR) are a normal characteristic in high profile businesses (Cho et al., 2015). Especially extractive industries, as the *mining* and *oil & gas* industries, have been giving particular attention to Corporate Social Responsibility (CSR) and SR (Cowell et al., 1999; Guenther, 2007; Frynas, 2009; Spence, 2011). The extracting sector has the highest reporting rate compared to other industries (Halme & Huse, 1997); as in these organizations, the environmental impact of their activity is significant (Ali & O'Faircheallaigh, 2007).

Furthermore, other authors find that extracting companies disclose information about social and environmental aspects seeking approval from their stakeholders (Yongvanich & Guthrie, 2005).

Therefore, extracting companies are embracing a relative new type of report which has been gaining momentum in the recent period: Integrated Reporting (IR); considered to be the evolution of the SR (Mio & Fasan, 2016), it aims to include financial and non-financial information relevant to the company in a single connected report (Eccles R.G., Krzus M.P., 2010; Eccles R.G., Saltzman D., 2011; Paternostro S. 2016). According to the International Integrated Reporting Council (IIRC), IR aims to "promote a more cohesive and efficient approach to corporate reporting that draws on different reporting strands and communicates the full range of factors that materially affect the ability of an organization to create value over time" (IIRC, 2013; p. 2). Accordingly, longitudinal studies focusing on only one sector of activity are still scant and the use of the Integrated Reporitng framework is yet underinvestigated.

Thus, the present paper has two main aims: first to analyze the compliance of extracting organizations toward the International Integrated Reporting and then to investigate which type of social-environmental information is disclosing such organizations. To achieve the proposed aims, a qualitative approach in two steps was performed: analyzing the level of compliance of European extracting organizations' integrated reports toward the International Integrated Reporting Framework (IIRF) based on the Framework proposed by Zhou et al. (2017). The second step is to analyze to what extent are extracting sector companies, in particular, those from the European region, disclosing information on their integrated report about their activity, with a specific focus on social and environmental issues, as classified by Hackston and Milne (1996) and Dong (2010), divided into categories *positive*, *negative* and *neutral*, with the compliance toward the IIRF.

The sample of organizations has been gathered from the IIRC official database for the European zone (examples.integratedreporting.org); considering this a preliminary research, the present paper focuses on 15 organizations incorporate by the IIRC database under the region "Europe." The reports are collected from the official sites of the undertakings; content analysis is pursued to obtain information and classified through MAXQDA, a software for the qualitative analysis.

The following research sets the ground for further qualitative studies in the sphere of IR.

The present paper unfolds as follows: the second section provides a brief overview of relevant literature on extracting companies and social and environment disclosures and the concept of Integrated Reporting, the third section outlines the methodology employed to pursue the present research, the fourth section provide the results of the study and conclusions are made in the last section.

2. Literature Review

Environmental awareness has been growing worldwide, resulting in countries' regulations (e.g., Paris Agreement, 2015, United Nations Climate Change). While for organizations, regulation happens in different countries. The most noticeable regulation appeared in South-African, in the Johannesburg Stock Exchange (JSE) with the release of the KING I code in 1994, followed by King II 2002 and in 2009 King III and finally when the KING IV was released in 2016. These regulations aimed to direct companies listed on JSE to more sustainable environmental, social and economic performances. At the same time, the regulations gave birth to the Integrated Reporting (IR), which later became a global movement known today all over the world, but still voluntarily, under the supervision of the IIRC. In addition, other regulations recently appeared inside the European region through the European Directive on non-financial information 2014/95/EU, entering into force in 2017 (2014/95/EU), to regulate the increasing volume of non-financial reports.

But, whether regulations strived to appear on the international level, multinational companies and visible companies have seen a noticeable spreading of sustainability reporting practices (Cho, 2015). The possibility to respond to stakeholder increased requirements through the publication of the Corporate Social Responsibility (CSR) report and Sustainability Report (SR) brought wide dissemination of such reports (Kolk, 2001; Kolk, 2003). As the stakeholder expectations can be satisfied by organizations' activity exposed in CSR reports, SR appears to improve employee satisfaction (Dean, 2003), as well as community satisfaction (Gray, 2001; Dean, 2003) and consumer opinion (Verschoor, 2006).

Furthermore, undertakings belonging to the extractive sector, such as mining and oil & gas sectors (Guenther, 2007), has the highest reporting rate compared to other industries (Halme and Huse, 1997); mainly due to their activities impact on the environment (Ali & O'Faircheallaigh, 2007) extracting undertakings are responding to social pressure through the issuance of CSR and SR.

To this extent, mining and oil & gas sectors are developing their SR faster than other sectors (Halme and Huse, 1997), attracting academics' interests, which analyzed reports belonging to extracting companies.

In particular, academics demonstrate an increase in the number of annual reports, in the case of South-African mining industries, from 1999 to 2002 (de Villiers & van Staden, 2006) and development in sustainability reports for what concerns forms, comprehensiveness in the case of oil & gas industries (Perez, 2009). Other scholars analyzed trends and issues in the mining sector, outlining an increasing sophistication of information disclosed and inhomogeneous level of maturity in the report's contents. Also, the author developed a classification of "leaders" and "laggards" (Jenkins & Yakovela, 2006).

Furthermore, academics analyzed the content of sustainability reports in the oil & gas industry in the case of the Australian oil & gas sector, outlining different aspects disclosing a high quantity of information for social and environmental matters, including employees' safety and health programs. In contrast, the author outlines the lack of quantitative data for readers about their outcomes (Dong, 2010).

Moreover, authors try to offer a framework for sustainable development of mining companies with the extent to standardize corporate reports in line with Global Reporting Initiative (GRI) requirements (Azapagic, 2004); while, others demonstrate

CSR is likely to address critical environmental challenges (Frynas, 2009) while does not address sufficiently to governance issues and community development (Frynas, 2009; Frynas, 2010).

Based on the lacks mentioned above, a new type of corporate reports appeared among the years following the evolution of the stakeholder requirements, beginning from 1997 GRI attracted the attention of multinational and national companies and scholars; during the years, plenty of studies examined the compliance level of corporate social report and SR, based on GRI guidelines, in different countries such as Australia (Guthrie & Farneti, 2008), Japan (Suzuki & Tanimoto, 2005), North America (Vigneau et al., 2015), Greece (Skouloudis et al., 2009), Romania (Berinde & Andreescu, 2015), Hungary (Demeny, 2015) and Sweden (Hedberg and von Malmborg, 2003).

In particular, a relatively new report appeared on the international horizon which aims to "Enhance accountability and stewardship for the broad base of capitals (…) and promote understanding of their interdependencies" (IIRC, 2013; p.2), spreading from the South African experience the: "Integrated Reporting" (Eccles and Krusz 2010; Solomon and Maroun, 2012; Churet and Eccles, 2014). IR can be considered "the best way to communicate the company's overall performance to stakeholders" (Sierra-Garcia, 2015; p. 287).

IR is recognized to be the evolution of the SR (Mio & Fasan, 2016), and although traditional reports are based on GRI guidelines, issued the first time in 1997 and recently updated, usually disclose information about social, environmental, and governance information in a disconnected manner, without giving stakeholder the clear picture of the entity (Solomon and Maroun, 2012; Marx and Mohammadali, 2014; de Villiers et al., 2017). Other authors consider that "*companies are expected to achieve integration of sustainability and governance information within the annual report. Such integration is deemed essential if businesses are to embed stakeholder accountability into the heart of their operations in a meaningful way*" (Maroun, 2012; p. 2016). However, Flower (2015) provided a significant critique to the movement, which considers IIRC abandoned its stimulation of sustainability accounting exchanging toward investors' needs rather than social needs.

Furthermore, authors have been focusing on the level of compliance of IR reporters toward the IIRF. Wild and van Staden (2013) analyzed a sample of 58 organizations issuing IR included in the IIRC database in 2013, outlining that early adopters, in general, failed to comply with the guiding principle of conciseness; still, authors are demonstrating that in South Africa on a sample of 40 companies listed in JSE are not in line with the requirement of the IIRF (Marx & Mohammadali-Haji, 2014).

On the other hand, other authors outlined a change after the regulation of IR comparing annual reports from 2009-2010 to 2011-2012, information disclosed in reports increased after the regulation are: *human, social and relational, natural* and *intellectual capital* (Setia et al., 2015).

Sofian and Dumitru (2017) investigated a small sample belonging to the financial sector, including only eight European companies, for 2015; authors find that each sampled company disclosed content related to the strategic objectives and strategies to achieve them achieved the maximum level of compliance; while the governance category obtained the lowest compliance.

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In particular, studies regarding IR in the case of extracting organizations studies are scarce. However, a first attempt has been made in the Nigerian oil & gas industry, demonstrating that Nigerian companies are disclosing information in a non-integrated way duplicating the info over the report and disclosed in a distorted form (Ayoola & Olasanmi, 2013).

In this vein, Lai et al. (2016) focused on the influence of ESG disclosure level, firm size, leverage, profitability and environmental sensitivity on IR adoption. The sample used was composed of companies that were members of the IIRC pilot programme at the end of March 2013. However, they had to eliminate a total of 33 organisations that were not listed and did not have available ESG data. The authors, in order to demonstrate if IR adoption was a response to bad ratings, applied a logistic regression model using panel data for 2009–2011. Their results demonstrated that IR adoption is not used in order to repair bad sustainability ratings, as organisations adopting IR did not have lower ESG disclosure than non-adopters.

Moreover, Lai et al. (2016) focused on the influence of ESG disclosure level, firm size, leverage, profitability and environmental sensitivity on IR adoption. The sample used was composed of companies that were members of the IIRC pilot programme at the end of March 2013. However, they had to eliminate a total of 33 organisations that were not listed and did not have available ESG data. The authors, in order to demonstrate if IR adoption was a response to bad ratings, applied a logistic regression model using panel data for 2009–2011. Their results demonstrated that IR adoption is not used in order to repair bad sustainability ratings, as organisations adopting IR did not have lower ESG disclosure than non-adopters. Furthermore, García-Sánchez et al. (2019), using a sample of 956 companies, investigated the effects of managerial discretion in munificent contexts and the board of directors' strength. The results demonstrated that IR adoption is not associated with the munificent context, while the strength of the board and investor protection levels moderate the relationship between munificence and IR adoption (García-Sánchez et al., 2019).

As mentioned in the introduction, based on the authors' knowledge, there are only few qualitative studies focused on the oil and gas sector.

Thus, as outlined above, this research proposes an exploratory qualitative analysis about the information disclosed in the IR of oil & gas companies members of the IIRC database to assess which types of data are being disclosed to the stakeholder and if the compliance toward the IIRF can be related to higher disclosure of qualitative information.

3. Theoretical Framework

The paper ground its theoretical Framework on the *Legitimacy theory,* which is "important in analyzing the relationships between organizations and their environments. Legitimacy provides a linkage between the organizational and societal levels of analysis. Legitimacy and social norms and values constrain the actions taken by individual organizations" (Pfeffer & Dowling, 1975; p. 131).

In particular, Lindblom (1994) describes four strategies by which companies can gain legitimacy in their environment; first, organizations should try to keep up-to-date information regarding performances and activities for its stakeholder; then, influencing their perceptions without changing their behavior. As a third move,

companies can try to manipulate stakeholder's perception moving their attention toward favorable facts; fourth, organizations can try to shape and influence the external expectations of their performance (Guthrie et al., 2006).

According to Guthrie (2006), the existence of a "*social contract"* between the organization and the environment in which it operates sets the ground for the existence of legitimacy theory.

Moreover, several authors demonstrate how environmental and social disclosures are relevant for organizations to maintain their legitimacy (Hakston & Milne, 1996; Guthrie et al., 2006; Dong, 2010; Garcia-Sanchez, 2013; Setia et al., 2015).

Thus, since the IR movement is still adopted voluntarily, besides South Africa, the information analyzed in the present research refers to the social and environmental aspects; legitimacy theory has been considered the ideal Framework for this paper.

4. Methodology

4.1. Sample Composition

The research is based on a sample of 15 companies involved in the oil & gas and mining sector, gathered from the official database of the IIRC for the European region. Reports are collected from the official site of the organizations for the year 2019, as all organizations have reports available on their sites for the mentioned year. Reports are considered for their high credibility (Guthrie & Parker, 1989; Willmshurst & Frost, 2000).

Companies included in the present exploratory study belongs to the extracting sector and are presented below:

Country	Total Assets (€)	Total Revenue (€)	Net Income (€)	Total Employees (#)	N° of Companies	State-Owned Enterprises
Italy	58.100	58.263	-603	36.369	2	2
Poland	12.001	9.195	-770	23.154	2	2
Russia	35.712	67.717	2.457	295.800	1	1
Spain	9.182	1.188	417	1.337	1	-
Sweden	5.627	4.261	448	5.477	1	-
Switzerland	118.520	138.282	1.247	154.832	1	-
UK	513.531	247.691	-435	187.185	6	-
Ukraine[1]	214.816	58.770	686	74.765	1	1
Total	968.844	587.090	3.834	782.798	15	6

Table 4.1: Sample's financial and ownership data from Thomson Reuters EIKON, for 2016

[1] Data for Ukraine's company have been collected from the official report of the organization, as data are unavailable on Thomson Reuters EIKON;

The IIRC Database included one organization headquartered in Mexico in the European region. However, as the present study concerns European organizations, the Mexican company has been removed from the sample, obtaining a final sample of 15 organizations.

4.2. Research Analysis

The study of the report has been pursued through content analysis which is: "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 1980; p. 18). As the primary aim of the paper is to study the level of compliance, the mentioned methodology has been used mainly for similar studies that aimed to analyze the compliance of IR and the risk disclosure in South Africa (Marx and Mohammadali Haji, 2014; Setia et al., 2015; Enslin et al., 2015). Also, for research about corporate social responsibility and environmental disclosure (Kilian, 2014) and other empirical studies (Guse et al., 2016; Matuszak and Rózanska, 2017; Venturelli et al., 2017).

To measure the level of compliance toward the IIRF, the reports have been manually analyzed employing the Framework given by Zhou et al. (2017). In this vein, a dichotomous coding system has been applied, with the attribution of scores for the presence (1) and absence (0) (Guse et al., 2016; Venturelli et al., 2017) per 8 categories which includes 31 elements of the IIRF given in the Zhou et al. (2017) framework.

Coding Framework based on Zhou et al. (2017)

Category	Elements	Scoring Schemes	
		Minimum Score	Maximum Score
Organizational overview and operating context	*Reporting boundary*	*0*	*1*
	Mission and value	*0*	*1*
	Business overview	*0*	*1*
	Operational Context	*0*	*1*
	Summary Statistics	*0*	*1*
Governance	*Governance Structure*	*0*	*1*
	Governance Strategy	*0*	*1*
	Remuneration and Performance	*0*	*1*
	Governance and Others	*0*	*1*
Risks Opportunities	*Risks*	*0*	*1*
	Opportunities	*0*	*1*
	Strategic Objectives	*0*	*1*
Strategy and Resource Allocation	*Links Between strategy and Other Elements*	*0*	*1*
	Competitive Advantage	*0*	*1*
	Stakeholder Consultations	*0*	*1*
Business Model	*Business Model Description*	*0*	*1*
	Links between Business Model and Others	*0*	*1*

Category	Elements	Scoring Schemes	
		Minimum Score	Maximum Score
	Stakeholder Depenceniesc	*0*	*1*
	KPIs against Strategy	*0*	*1*
	Explanation of KPIs	*0*	*1*
	Stakeholder Relationship	*0*	*1*
Performance and Outcomes	*Past, Current, and Future Performance*	*0*	*1*
	Financial Implications of Other Capitals	*0*	*1*
	Supply Chain Performance	*0*	*1*
	The quality of Quantitative Indicators	*0*	*1*
Future Outlook	*Anticipated Changes*	*0*	*1*
	Potential Changes	*0*	*1*
	Estimates	*0*	*1*
	Conciseness and Link	*0*	*1*
Other Elements	*Materiality Determination Process*	*0*	*1*
	The Board Sign-Off	*0*	*1*

Table 4.2: Content employed for the compliance exercise

Results per category are calculated based on the average of each element contained in the referred category. Thus, the number of elements per category does not influence the weight of the respective type. This gives an unweighted approach for the final average calculation.

Moreover, to pursue the second aim of the present study bases its analytical Framework on the previous studies of Hackston and Milne (1996) and Dong (2010).

Information is categorized as *positive, neutral* and *harmful* for the following categories: *employee, environment, community, product, energy, general*[2].

The categories are further included in two macro-categories exposed below:

Further Categorization of Researched Sentences

Social	Environmental
Employee, Community, General	Environment, Energy, Product

Table 4.3: Categorization proposed with the extent to summarize results

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[2] As in Dong (2010) the general category refers to corporate commitment, objectives to be socially responsible

The analysis has been carried on through the adoption of MAXQDA software. Qualitative software is not new for researchers as these have been used since the 1980s and allow users to process word and pdf files, making the research of words and sentences quicker. Such software has been used for investigations regarding legitimization of negative aspects (Hahn, 2014), changes in SR in automotive industries (Sukitsch, 2015), or for empirical studies regarding approaches of organizational learning (Siebenhuner, 2007).

Therefore, after the compliance exercise, sentences have been categorized as positive, neutral, and common negative aspects resulting from the process are going to be outlined in the fourth section after statistical details regarding the findings, including categorization of common items disclosed in integrated reports, as exposed by Dong (2010).

5. Results & Discussion

5.1. Results

Organizations analyzed in the present study are divided equally per region: western and eastern, while public ownership is prevailing among the used sample, with three organizations being public and one being private. Sample better explained below:

Sample Region and Ownership Presentation

	Eastern
Ukraine (1), Russia (1), Poland (2),	
Public	*Private*
Italy (2)	**Spain (1), Sweden (1), Switzerland (1), UK (6)**
	Western

Table 5.1: sample presentation of region and ownership

Regarding ownership, the predominant public ownership is in eastern countries, ex-communist countries, being transitional economics from ex-communist countries (Tan, 2005).

The outcome of the content analysis is presented below, primarily outlining the compliance of extracting companies toward the IIRF, based on Zhou et al. (2017) and secondarily exposing the results of the qualitative content analysis, a simple descriptive statistic is provided as aggregate and as single category following Hakston and Milne (1996) and Dong (2010).

The first exercise demonstrates, in general, a high level of compliance toward the IIRF with the following results:

Compliance Analysis Results

	Organizational Overview	Governance	Opportunities and Risks	Strategy and Resource Allocation Plans	Business Model	Performance and Outcomes	Future Outlook	Other Elements	Average Per Country
ITALY	0,75	0,88	0,75	0,63	1,00	0,71	0,67	0,50	**0,74**
POLAND	0,75	0,88	1,00	0,88	1,00	0,50	0,50	0,75	**0,78**
RUSSIA	0,75	1,00	1,00	1,00	1,00	0,86	0,67	1,00	**0,91**
SPAIN	0,75	1,00	1,00	0,75	1,00	0,86	0,67	1,00	**0,88**
SWEDEN	0,75	1,00	1,00	0,75	1,00	0,57	1,00	1,00	**0,88**
SWITZERLAND	0,75	1,00	1,00	0,75	1,00	0,71	0,33	1,00	**0,82**
UK	0,79	0,96	1,00	0,54	0,83	0,71	0,83	1,00	**0,83**
UKRAINE	1,00	1,00	1,00	0,50	0,67	0,43	0,67	0,50	**0,72**
Average Per Category	**0,80**	**0,95**	**0,97**	**0,69**	**0,90**	**0,68**	**0,71**	**0,88**	**0,82**

Table 5.2: Compliance results from the analysis based on Zhou et al. (2017), per country and category

As explained in the methodology, results have been given based on the presence or absence of the content. An example is shown below:

> *"[…] business model targets long-term value creation by delivering on profitability and growth, efficiency, operational excellence and handling operational risks of its businesses. Eni identifies as the main challenge of the energy industry the balance between the maximization of the access to energy and the fight against the climate change, which necessarily involves a change in the energy mix, through the reduction of carbon footprint."*
>
> *Italian, Oil & Gas entity definition of Business Model*

The higher results obtained concern the "*Governance*," "*Opportunities and Risks*," and "*Business Model*." Other authors have outlined similar results (Guse et al., 2016; Manes et al., 2018). Considering that the sample is composed of six State-Owned Enterprises (SOE), which are "enterprises where the state, regional governments or cities have significant control, through full, majority, or significant minority ownership" (OECD, 2011; PwC, 2015) and as these entities "have a civic responsibility to properly manage public goods, resources and/or facilities in a way

that supports sustainable development objectives and promotes the public interest" (GRI, 2005; p.7-8); "Public sector organizations are central to the delivery of sustainable development. Every aspect of their role – from education to environmental services, and from planning to social care – shapes how people live their lives" (Birney et al., 2010, p. 3), as "accountability expectations and obligations are higher for public enterprises due to public ownership and objectives associated with the public mission" (Greiling & Grub, 2014; p. 210). Despite the premises mentioned above, higher compliance results were expected for Italy, Poland, and Ukraine as organizations belonging to these three countries are all SOEs, but the three countries on average got the lowest results respectively 0,74; 0,78; 0,72.

The analyzed sample disclosed a number of 2949 coded sentences, including all categories, with a maximum of 1286 coded sentences in the *environment* category and a minimum of 1 regarding general references to the corporate commitment of being socially responsible.

General Descriptive Statistics

	Number of sentences
Total	2.949
Average	368
Min	131
Max	1.286

Table 5.3: quantity of sentences disclosed by sample companies, per country

The majority of sentences recognized mostly come from UK organizations, while the minimum recognized comes from Switzerland. Further on, to present results clearer, below exposed coded sentences per category obtained per country, including total per category studied and the average of the references.

References per Country

Categories	UK	Sweden	Poland	Ukraine	Russia	Switzerland	Italy	Spain	Total Coded Sentences	Average Coded Sentences
Community\Negative	3	0	0	1	0	4	2	0	10	1
Community\Neutral	14		0	7	0	4	2	2	29	4
Community\Positive	95	21	9	12	0	11	14	15	177	22
Total Community	**112**	**21**	**9**	**20**	**0**	**19**	**18**	**17**	**216**	**27**
Employees\Negative	15	1	1	2	0	0	2	0	21	3
Employees\Neutral	110	17	12	9	16	15	17	5	201	25
Employees\Positive	236	45	115	45	63	15	13	40	572	72
Total Employees	**361**	**63**	**128**	**56**	**79**	**30**	**32**	**45**	**794**	**99**

Categories	UK	Sweden	Poland	Ukraine	Russia	Switzerland	Italy	Spain	Total Coded Sentences	Average Coded Sentences
Energy\Negative	11	1	2	8	3	0	2	0	27	3
Energy\Neutral	95	11	2	23	6	12	39	9	197	25
Energy\Positive	174	30	74	42	22	29	45	39	455	57
Total Energy	**280**	**42**	**78**	**73**	**31**	**41**	**86**	**48**	**679**	**85**
Environment\Negative	22	0	0	0	0	0	9	0	31	4
Environment\Neutral	92	8	7	6	5	8	72	14	212	27
Environment\Positive	238	45	160	43	50	14	60	38	648	81
Total Environment	**352**	**53**	**167**	**49**	**55**	**22**	**141**	**52**	**891**	**111**
General\Negative	2	0	0	0	0	0	0	0	2	0
General\Neutral	5	0	0	0	0	0	2	1	8	1
General\Positive	33	2	21	1	6	3	1	12	79	10
Total General	**40**	**2**	**21**	**1**	**6**	**3**	**3**	**13**	**89**	**11**
Product\Negative	12	1	0	1	2	1	1	2	20	3
Product\Neutral	68	9	1	4	7	8	5	4	106	13
Product\Positive	61	11	26	1	24	7	6	18	154	19
Total Product	**141**	**21**	**27**	**6**	**33**	**16**	**12**	**24**	**280**	**35**
Total Coded Sentences per Country	*1286*	*202*	*430*	*205*	*204*	*131*	*292*	*199*	*2949*	*655*
Average Coded Sentence per Organization per Country	*214*	*202*	*215*	*205*	*204*	*131*	*146*	*199*	*190*	*190*

Table 5.4: quantity of sentences disclosed by sample companies

Few examples of coded sentences are given below to demonstrate how the selection has been made:

"*The extent and cost of future environmental restoration, remediation and abatement programs are inherently difficult to estimate...*"

Environmental/Negative Statement

"*Community investments are our contributions to, and financial support of, the broader communities in the regions where we operate.*"

Community/Neutral Statement

"In 2016, 788 employees of the Company improved their housing conditions through a long-term mortgage lending program."

Employees/Positive Statement

Poland obtained the highest number of references per organization differentiating with one reference more than the UK, which has the highest number of organizations in the sample. In contrast, Switzerland obtained the lowest number of references, with one organization obtained 131 references.

Negative sentences obtained a low score in all the analyzed categories, which demonstrate that companies are not inclined to disclosed information about negative aspects of their activity; confirming that "most environmental reports have a high propensity to disclose favorable information, such as environmental management efforts, innovation, and development of new products, environmental targets and environmental commitments, rather than negative information" (Dong, 2010; p. 110). Most of the negative aspects concern environmental disaster incurred during the financial year of reporting and refer to the damages, losses, fines, and further contribution to reestablish the environment. While dominant sentences were positive, they were disclosed in all the categories.

In particular, being extracting organizations operating in a sensible sector of activity, the category which obtained the highest positive references is the one related to the *environment*, with 891 references similar results have been received by Dong (2010), who considered that organizations operating in Australian oil & gas in the sector are seeking to modify the view of their reputation by society; confirming other authors that obtained similar results (Hackston and Milne, 1996; Deegan and Gordon, 1996; Guthrie et al., 2008), this means that these organizations are respecting the "social contract" signed with the stakeholder so trying to legitimize their activity.

Moreover, the second category with the highest references belongs to employees, with 97 fewer references in comparison with environmental, Dong (2010) obtained similar results having employees in the first place with more references and second environment; however, the present study confirms noticeable attention given by these organization toward its employees, proved by the presence of different references of employees training, health care, holidays programs and long term mortgage for employees as also outlined by Hakston and Milne (1996).

Unfortunately, evidence from the analysis demonstrates that for state-owned organizations, one of the categories with the lowest results in *general* and *community* is strictly related to the organization's activity in their working environment with society.

Furthermore, a comparison between western and eastern organizations comes naturally, and the insights provided by the analysis demonstrate that eastern companies disclose more *positive* information than western companies. While *negative* and *neutral* aspects are disclosed more in western companies rather than eastern organizations. A similar comparison has been attempted by comparing CSR reports from Central Eastern Europe (CEE) and western countries; findings demonstrate that in the CEE region, such reports are not widespread and rarely follow GRI guidelines (Steurer & Konrad, 2009); on this statement, further researches are required to define whether the western company is being truly demonstrating their commitment of being socially responsible.

5.2. Discussion

The compliance analysis demonstrate a fair level of disclosure in line with previous studies (Sofian & Dumitru, 2017). Although, the analysed organizations have a better understanding of the IR framework in comparison to early adopters (Wild & van Staden, 2013). Noteworthy to mention, is the high results obtained by all organizations in specific contents of the IR, such as: "Business Model", "Organizational Overview" and "Governance" which contribute to the communication and legitimization of the organization toward stakeholders. In this perspective, results have been higher than all the analyzed literature (Sofian & Dumitru, 2017; Wild & van Staden, 2013; Setia et al., 2015).

Additionally, the present research outlines similar items disclosed by organizations that emerged from the classification. As the analysis shows, all the companies in the sample disclosed positive information regarding the environmental matter related to improvements of assets, reliability of assets, energy efficiency, and ecological performance programs. At the same time, common patterns regarding employees concern employees' health and safety, a significant investment for developing new skills and competencies, including safety. Moreover, positive categories regarding *community* and *public* disclosure obtained a low score. For instance, declarations about the willingness to create a sustainable impact for the society in these organizations are operating.

Regarding negative aspects, which are hardly present in the analyzed reports, the category that obtained the highest score was environmental, due to a recent scandal regarding oil extraction that affected two UK organizations and trials. Negative aspects have been generally disclosed by western organizations demonstrating a higher degree of transparency. Other remarkable negative aspects are related to the *product* category. Due to the instability of the raw materials markets presented in the reports, companies disclosed information about decreasing revenue due to market volatility. However, the organization rarely disclosed negative news, as also outlined by Hahn (2014).

Furthermore, the present research correlates the results from the compliance exercise with the Framework proposed by Dong (2011). Thus, the correlation seems forced. IR contains requirements regarding the aspects presented in Dong's Framework. Therefore, the correlation between the compliance analysis and the study based on Dong (2011) framework does not offer relevant results, as the countries with the highest compliance results (Russia, UK, Spain, Sweden) have a similar number of references as the country with the lowest compliance result (Ukraine).

Compliance Results and Average References

	Average Per Country	Average Reference per Organization	Average Reference Social	Average Reference Environmental
Italy	0,74	146	27	120
Poland	0,78	215	79	136
Russia	0,91	204	85	119
Spain	0,88	199	75	124
Sweden	0,88	202	86	116
Switzerland	0,82	131	52	79
Uk	0,83	214	86	129
Ukraine	0,72	205	77	128
Total Average	**0,82**	**190**	**71**	**120**

Table 5.5: level of compliance and n.° of sentences disclosed by the analyzed companies

Moreover, Switzerland, with a compliance level of 0,88, obtained the lowest results in the second analysis with only 131, closer to Italy with a compliance score of 0,74 than Russia, which received the highest compliance result of 0,91.

6. Conclusion

In conclusion, the present exploratory study demonstrates that extracting organizations have, on average, high compliance toward the IIRF, demonstrating a low level of compliance by SOEs, and a higher level of compliance is provided by western organizations rather than eastern companies. Moreover, organizations disclose the most information regarding environmental and employee matters, providing an increased number of information about the mentioned categories. However, two categories are ignored by the sample, *general* and *community*; even if the environmental impact of their activity is significant (Ali & O'Faircheallaigh, 2007), extracting organizations are not disclosing information concerning their activities for the communities in which are involved, as they are doing with environmental and employees; the same results has been outlined by Dong (2010).

Although different reports have been analyzed from the study of Dong (2010), comparing the results, there is an increased number of references for what concern negative aspects of the organizations' activity, which requires further research similar to Hahn (2014) with the extent to examine how these organizations are legitimizing their negative aspects.

The paper contributes to the existing literature as it focuses on only one sector of activity on a longitudinal horizon adding to the literature information related to the compliance evolution toward the IIRF in the case of Oil & Gas organizaitons.

As a practical implication, extracting companies need to improve their disclosure regarding their activities as corporate citizens or their commitment to being socially responsible. While eastern organizations are recommended to disclose adverse information about their activities as happen in western companies.

Findings can be considered consistent with prior studies on other corporate reports and in different areas such as New Zealand (Hakston & Milne, 1996) and Australia (Dong, 2010), although the present analysis provides a slightly different result from the mentioned studies.

To this extent, further studies must be conducted in the sphere of qualitative analysis of Integrated Report considering that until now, studies on IR are related to compliance toward the IIRF (Wild & van Staden, 2013; Marx & Mohammadali-Haji, 2014; Setia et al., 2015; Sofian & Dumitru 2017).

Significant limitations of the present study rely upon the restricted sample that comprehends only 15 organizations as further research guidelines are recommended to consider more organizations, different geographical areas with the extent to analyze similar behavior in other regions.

As further development of the present study, a comparison between countries member of the European Union vs. Non-EU members. To analyze to what extent the non-financial information is developing inside the EU as it began to regulate non-financial information flux through the EU Directive 2014/95/EU, which have been already regulated in England, Netherland, and Spain. Moreover, other sectors can be included for similar and further qualitative studies, as Integrated Reported has not yet been studied under a similar lens.

Finally, the present study represents the first attempt in qualitative analysis of IR; further qualitative analysis research must be conducted in the Integrated Reporting horizon.

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NATIONAL INDUSTRY 4.0 PLATFORMS IN THE VISEGRAD 4 COUNTRIES – A COMPARISON WITH THE FRONTRUNNER DIGITAL ECONOMIES IN EUROPE

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Abstract: Based on the international digitization indexes, the development level of digitalization in the Visegrad Four (V4) countries is similar in many respects. The status of the recent digital developments is comparable in results and in deficits also. These economies have similar inescapable paths in the past and further development opportunities in the future. The economic success of these four countries greatly depends on the transformation of their economic structures, mainly by utilizing digitalization. This study compares the approaches, activities and initiatives of the national Industry 4.0 platforms of the V4 countries that promote and support the digital transformation on the national strategic level. The study also highlights the results that have already been achieved by the members of the European Quartet. These four countries have reached good results in digital infrastructure investments. Meanwhile, they are left behind in skillsets, education and adoption of companies, regarding their digital transformation. Beside the direct comparison of the four Industry 4.0 platforms, the study extends the research to three of the Frontrunner countries of the EU in digitalization, namely to Austria, Germany, Sweden, to understand the best practices they use and actions they take regarding the digitalization. The paper formulates guidelines for defining competitive policies and techniques for accelerating the digitalization of the V4 economies. The study lists the pain points of the V4 digitalization and makes suggestions on recoveries, mainly on the field of the potential involvement of companies and the financing of the national I40 platforms.

Keywords: Visegrad Four; digital transformation; digitalization; Industry 4.0
JEL classification: O11, O14, O23, O38, O33, D83.

1. Introduction

Digital transformation impacts every segment of the economy and society. Added value, trained workforce and relocated industry become the most important benchmarks in the competition between nations. New technologies will result in new business structures, new products, new operating models and digital networks at the micro level in the next two decades, coupled with efficient paperless states, shifting status quos and changing economic rules applicable in the macro economy

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(Kagermann et al. 2013; Klitou et al. 2017c; Morrar et al. 2017; Blanchet et al. 2014; Giesbauer et al. 2016). Just like all other European states and the top bodies of the European Union, the Visegrad Four (V4) countries respond to this challenge as it is represented by the Digital Transformation Monitor (DTM) published by the European Committee (EC) (Klitou et al. 2018a; Klitou et al. 2017b; Klitou et al. 2017a; Klitou et al. 2018b). Digitalization, as a complex multi-dimensional and multi-disciplinary issue, is regarded as one of the most important economic policy and geopolitical issues (Kagermann et al. 2016).

The study uses word "digitalization" in the meaning of national digital developments for rising efficiency on macroeconomic level, meanwhile word "digital transformation" or Industry 4.0 (I40) will be used on the corporate level referring to the process reengineering achievements by the digital technologies.

For having an impulse on the readiness level of a specific country, digitalization indexes are considered important sources. These scales make the detailed evaluation and the comparative analysis possible. The V4 countries – Czech Republic, Hungary, Poland, Slovakia - have reached similar results and faced with similar constraints regarding digitalization. The countries are at a pretty similar digitalization level according to the DESI (Digital Economy and Society Index) rankings, although placed at the inglorious last third segment of the lists (EC 2020d). The relevant indexes and their scorings will be presented in the first half of the study as well as the specific digitalization context of the V4 countries and their economies, showing the structural issues regarding digitalization they have to deal with financing, education, knowledge transfer, legislation, and innovation (Grzyb 2019; Mattauch 2017; Grencikova et al. 2020; Johanesova et al. 2019; Nick et al. 2017).

The second part of the study is about the national I40 platforms (frameworks) that represent the strategic and economic policies of the industrial digital transformation. The national I40 platforms have an intermediary role. These institutions link the policy makers and the company segment by initiatives, fundings, professional services, consultancy services, expertise, promotions, and support for digital developments. These platforms take part in training SMEs, bringing together stakeholders, and opening labs (Probst et al 2017). The national I40 platforms have a direct role to support the digital transition, solving the structural issues of the national economies and accelerate adoption of digital transformation at the corporate level.

The study makes a comparative analysis of the I40 platforms of the V4 countries. The analysis is extended by three of the Frontrunner countries of the EU – Austria, Germany, and Sweden - in the field of digitalization as well (Nick et al. 2019b). The comparison leads to the main findings of the paper, based on the similarities and differences of the policies applied, highlighted the lessons to be learned from the Frontrunners. Ideas will be added for finetuning the set of policies, initiatives and actions of the national I40 platforms in the V4 countries in the closing chapters, for further discussions.

2. Literature review

The idea of comparative analysis of contuntries along with international rankings, and EU level statistics already resulted relevant scientific findings regarding the CEE region.

Moroz (2017), for instance, visualized the DESI sub-categories by putting the layers on each other, and making a comparison of five EU countries including Poland, Slovakia, Germany, Lithuania, Italy. Moroz (2017) urged immediate actions for Poland to boost the ICT impact on the economy, seeing the gap between the achievements of digital transformation of the revised set of countries and Poland.

Grzyb compared Polish companies with the EU average, and the EU digital leaders referring to the adopted I40 technologies. The study also emphasized the Polish backlogs in values (Grzyb 2019).

Papula et al. (2017) show a comparison by industry segments, comparing the Slovak I40 preparations with the Austrian, German and Swiss achievements. The research presented significant level of backlog on one hand, and rapid development on the other. Slovakia has made huge steps in digital development, mainly on the backbone level infrastructure on a yearly basis, and has faced the lack of relevant competences and human resources (Papula et al. 2017).

Ulewicz et al. (2019) carried out the research on Poland and Slovakia, demonstrating that providing financial support for SMEs was crucial to achieve results in penetration of the digital transformation.

The study aims to make a comparative analysis that is different compared to the ones mentioned above, mainly in its approach. The comparison of the paper is based on the national I40 platforms specifically, expecting new, jet unrevealed conclusions.

3. Research methodology and hypotesises

The methodology of the research is based on the EU level DTM publications on the national I40 platforms (Klitou et al. 2018a; Klitou et al. 2017b; Klitou et al. 2017a; Klitou et al. 2018b). During the research work the most important attributes of the national I40 platforms were put next to each other by the country reports of the V4 and the Frontrunner countries. The aggregation and the comparison of the data led to a new set of information and the conclusions. The idea of the extraction of data from the DTM publications was activity led. It means that activities executed and planned by the national I40 platforms were put into the comparison tables. The selection covers different levels of fields of activities, 11 segments in total.

The resulting table involves strategic planning activities, policies, initiatives as well as direct tasks (ie. I40 campaigns, exhibitions, education). The table makes possible of grouping along with different views. One of the views applied refers to the V4 countries as a group, and the Frontrunners as another.

The hypothesis formulated is (H1): Good practices applied by the Frontrunner countries regarding digitalization differ from the practices of the national I40 platforms of the V4 countries. The expectation is to reveal explanatory differences that need to be taken into consideration by the V4 countries, regardless of the other relevant economic conditions.

The second hypothesis (H2) is: The V4 countries apply similar toolset of I40 policies. The expectation is to reveal relevant similarities due to their homologous status of digitalization and digital transformation.

4. I40 readiness and the Digitalization status of the V4 countries

Since the last decade, the V4 countries have reached a significant economic growth and a substantial industrial development. The average annual GDP growth of the four economies is between 3.0% and 4.8%, with a high contribution of the industry sector of approximately 30%. The highest added value has been achieved by the Czech industry. The GDP growth is driven by the export and also by domestic consumption. There is a strong dominance of SMEs in all of the examined industries even in the priority manufacturing sectors, such as the 1. car industry, 2. electronics, 3. pharmaceuticals, 4. IT&C. However, the level of labour efficiency is low in all of the four industries. The labour market shows the symptoms of saturation, with growing wages, while growth is coupled with the increase of imports (EC 2019a; EC 2019b; EC 2019c; EC 2019d; Adamek 2018; Mattauch 2017; Nick et al. 2019a).

The V4 countries (except Poland) constitute a characteristic group representing Traditional Industry by categorization of Roland Berger international consulting firm, regarding the I40 readiness (Hoff 2016). These countries are characterized by a significant level of industrial activities, however, their technological and digitalization level is considered underdeveloped. The industrial structure is based on assembling activity with low level of added value, limited innovation, and low-rate research and development. By way of contrast, Frontrunners are characterized by a high technological level, high added value and high-rate industrial output.
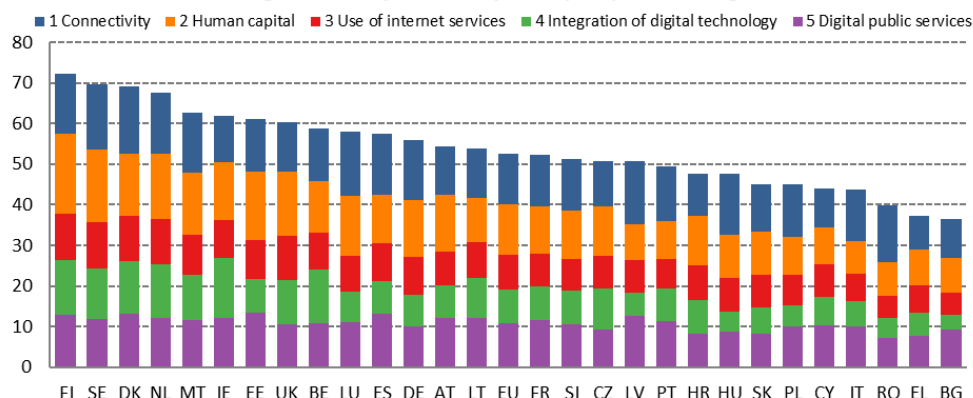
At the same time, the industrial tradition in these countries is significant and long-standing. Therefore, it is no coincidence that this region, following the change of regime, has been strongly linked to automotive manufacturing, the number one industrial supply and production chain of our time, making use of the advantage provided by the wage arbitrage. Nowadays, the V4 countries have strong ties with the German multinational car manufacturing holdings (Csíki et al. 2019).

The EC (the European Commission) ranks the digital readiness of the countries within the EU on the basis of the DESI Index. The DESI Index is a composite index, suitable for quantification of the digital readiness of the countries. The index analyses five strategic areas: 1. Connectivity – access to broadband; 2. Human capital / Digital skills; 3. Use of Internet services (population); 4. Integration of digital technology (business); 5. Digital public services.[1] The DESI index monitors the elements and the rate of development (EC 2017). The DESI index, measures digitalization as a social challenge for business as a whole, cumulatively. The DESI index is published by the EU annually (Losonczi et al. 2019).

The rankings of the V4 countries are close to each other on the basis of the DESI index, meaning that the four countries have a very similar level of development in digitalization, see Figure 1 (EC 2020d). Nevertheless, all the four countries are located in the last third of the list. Their results at the measured individual strategical areas are typically attain below the average or spread evenly through the EU average values.

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[1] https://ec.europa.eu/digital-single-market/en/news/digital-economy-and-society-index-desi-2020

Fig. 2: DESI index 2020 ranking

Legend: ■ 1 Connectivity ■ 2 Human capital ■ 3 Use of internet services ■ 4 Integration of digital technology ■ 5 Digital public services

Source: DESI Country Report Hungary 2020 (EC 2020d)

It is interesting to observe that the Frontrunners of the Roland Berger classification method have different rankings compared to DESI, due to the different contexts of the measured elements. The German and the Austrian economies are positioned in the middle of the field, while Sweden achieved the top ranking in this comparison. The summary of the ranking (Table 1), made based on the 2014-2020 DESI index, demonstrates the traces of competition among the countries through the changes in their ranking. Of the V4 countries, the Czech Republic boasts the most developed digitalization status, overtaking the other three countries by 2-3 places. The Czech Republic can be found above the EU average values in the majority of the reviewed aspects, while the other V4 countries are slightly lagging behind (EC 2017, EC 2018a, EC 2019a, EC2020a EC 2020a, EC2020b, EC 2020c, EC 2020d).

Table 1: Position of selected countries in DESI, 2014-2020

No.	2014	No.	2017	No.	2018	No.	2019	No.	2020
1	Denmark	1	Denmark	1	**Sweden**	1	Finland	1	Finland
2	**Sweden**	2	Finland	2	Finland	2	**Sweden**	2	**Sweden**
3	Finland	3	**Sweden**	3	Denmark	3	Dánia	3	Denmark
10	**Germany**	11	**Austria**	13	**Austria**	13	**Germany**	12	**Germany**
11	**Austria**	14	**Germany**	14	**Germany**	14	**Austria**	13	**Austria**
19	**Czech Republic**	17	**Czech Republic**	19	**Czech Republic**	18	**Czech Republic**	17	**Czech Republic**
20	**Slovakia**	20	**Slovakia**	20	**Slovakia**	21	**Slovakia**	21	**Hungary**
21	**Hungary**	22	**Hungary**	22	**Hungary**	22	**Hungary**	22	**Slovakia**
22	**Poland**	24	**Poland**	24	**Poland**	25	**Poland**	23	**Poland**
28	Romania	28	Romania	28	Greece	28	Bulgaria	28	Bulgaria

Source: Own compilation, based on DESI database reports and DESI country reports 2014-2020 (EC 2017, EC 2018a, EC 2019a, EC2020a EC 2020a, EC2020b, EC 2020c, EC 2020d)

It seems that the V4 countries stick together not only on the geopolitical level, but on the economic development level as well. They follow a fairly similar digitalization path.

5. Four countries, four different level of digitalization achieved

5.1. Czech Republic

According to the DESI index, the Czech Republic is ahead of the other V4 countries in digital development, and belongs to the moderately developed countries on the basis of several factors, reaching or going above the EU28 averages (DESI 2018a).

The presence of I40 in businesses varies significantly. It is the highest in the automotive industry, electrical engineering and pharmaceutical industry. Strategic priorities are outlined in the Czech Digital Agenda / Digital Czech Republic (2018) framework: 1. Supporting digital and technological innovation, 2. Stimulating entrepreneurship, 3. Providing easier conditions for access to capital, 4. Adopting future-proof regulations, 5. Building the competences and skills of the future. The Society 4.0 initiative is also present in the policies, putting emphasis on surveying and managing the impacts of I40 not only in the strictly interpreted industrial production, but also in education, in the labour market and in other segments (Adamek 2018). The Digital Czech Republic is linked with the Industry 4.0 Strategy, launched in 2016.

Based on the research carried out by Vrchota and Pech, 62% of the companies in the Czech Republic consider themselves to be impacted by the I40 paradigm, and this confirms the 65% rate measured by the Czech Chamber of Industry. The degree of awareness-raising and the importance of digital transformation, together with the statistically detectable adaptation readiness level, increases in line with the size of the company (Vrchota - Pech 2019).

5.2. Hungary

Regarding its digitalization readiness level, Hungary, based on the DESI index, also belongs to the last third of the EU28 countries. Hungary has shown a developing trend in recent years, catching up with a development rate above the EU average. (EC 2020d). The highest scores are achieved in the broadband internet access, while the country underperforms in the fields of digital public services and the integration of digital technologies.

Strengthening the technological adaptation and accelerating the digitalization is an important task for the future competitiveness of Hungary. Regarding the latter, it is indispensable to employ skilled workforce and to change the economic model accordingly: to switch to an economy which focuses on added value (Losonci et al. 2019). Hungary's digitalization strategy is the Digital Welfare Program (2015) which, in addition to the possibility of applying new technologies, defines specific strategic orientations for education, start-up businesses and various branches of industry (EC 2019d).

The level of digitalization of SMEs in the business sector is low due to the limited capital available for them for the implementation of developments (EC 2019d), while the lack of skills is also a significant deficit (Nick et al. 2017).

Companies in Hungary are open to meet the requirements of digital transformation: 71% of the companies consider I40 important from the point of view of their competitiveness, however, the majority of them 1. do not have a suitable strategy, 2. do not consider vertical integration important, 3. have poor innovation related experience, and 4. have only limited real-life experience (Nick et al. 2017).

Based on the preliminary results of an already not published scientific research of the authors own, further interesting conclusions can be added to the knowledge about the digitalization awareness of the corporate sector in Hungary. The country wide primer research was addressed 3000 mainly SME companies and resulted 100+ fully filled forms answering the 71 questions total. The questionnaire was carried out at the turn of 2020-2021. See highlighted results relevant in the followings: 1. 41% of companies consider it particularly important to prepare for the digital transformation, with the contradiction, however, that 2.) 54% of companies believe that the pressure of digital transformation is less valid for them. 3.) 50% of respondents believe that they will be ready for the challenges of digital transformation in 2-3 years (as compared to the current 25%).

5.3. Poland

Significant developments have been carried out by the country to facilitate the digitization transition, primarily in building a broadband internet infrastructure (EC 2019b). However, the integration of efficiency-increasing technologies is below the EU average (Weresa - Kowalsky 2019). Poland has been developing continuously, both in terms of Internet technologies and human resources (EC 2018b). Nevertheless, the digitization level of the companies continues to be low, with 60% having a low digitization value (EC 2019b).

The digitization strategy of the country is the Responsible Development Program which sets the target of re-industrializing the country within the framework of several sub-programs (including the Future Industry Program, the sub-program of which is Industry 4.0 / Przemysl 4.0, see later). The program is a 25-year strategy intended to re-position the country (Morawiecki plan). The Smart Growth Program, aimed at strengthening innovation, research and competitiveness, also supports digitalization (EC 2019b).

The country is intentionally digitalizing public administration (Paperless Poland), occasionally applying blockchain and AI technologies. Another positive development is the increase in the number of start-up businesses (+4% - 2016-2017).

For the Polish companies, transfer of the I40 knowledge seems really important, ensuring that the investments they launched provide adequate returns (Grzyb 2019). It also appears from Grzyb's research that among Polish companies the highest demand for I40 solutions can be detected predominantly in the following branches of industry: vehicle industry (93%), manufacturing industry (45%) and pharmaceuticals (35%). SMEs are seemingly excluded from the transformation process; only 42% of the participants in the research gave the response that they are addressing the issue of digital transformation. I40 is considered by the vast majority of the interviewed companies as a tool for improving efficiency, and 48% thought that it can also be applied as a customer satisfaction improvement tool (Grzyb 2019). 40% of the Polish companies see business possibilities in disseminating digital transformation as a paradigm, and 87% stated that a slightly increasing demand could be witnessed in the market for smart products, as compared to past years (Grzyb 2019).

5.4. Slovakia

Slovakia also underperforms in terms of its level of digitalization, similarly to the other V4 countries. For Slovakia, it is access to broadband Internet and digital public services (EC 2019a). Based on the DESI index, access to broadband Internet

and the 4G access are below the EU average, just as the digital skills of the population. Slovakia did not present any significant development in digitalization, according to the DESI index (EC 2020a).

The Slovak companies underperform in research and development. This constitutes a barrier to activities with higher added value. Therefore, it is essential for education to meet the demand coming from the fields of ICT and engineering.

The Slovak Smart Industry / Industry 4.0 strategy was launched in 2016, taking into account 35 aspects. Key points of the strategy are embedding the key branches of industry, promoting the economy via research, development and sciences, building an innovative society and developing skilled human resources (EC 2019a). The digital transformation is hindered by the lack of regulation, governmental guidance and subsidies. However, there are a number of initiatives providing assistance in inter-company cooperation (EC 2019a).

In 2018, 50% of the companies in Slovakia started to apply the I40 concept and that of smart technologies, according to the research conducted by Grencikova et al. (2020). However, there was a big leap in 2019: a positive response was given to this question by 84.5% of large corporations and 71% of medium-sized companies, while 62.4% of small companies and 39% of family businesses did not give a positive response to the question. I40 for the Slovak companies will first of all result in improving efficiency and reducing costs (Grencikova et al. 2020).

6. National strategies and I40 platforms for the digitalization and the digital transformation of the industres

In this chapter the importance of the national I40 platforms will be introduced. The national digitalization strategies and the national I40 platform initiatives will be examined more thoroughly.

The national I40 platforms are strongly connected to the EU2020 Strategy thorough several layers of EU and national level policy making bodies, initiatives and actions. Top-down and bottom-up effects must be parallelly and simultaneously maintained for strategic, harmonization and bureaucratic reasons. "A pyramid-model emerges by layering the initiatives, well representing the successive programs and their connections" (Nick et al. 2019a 35-36).

The "Europe 2020" strategy can be found at the very top of the system. The strategy intends to provide long-term, sustainable answers to the changes in the global economy, in accordance with the following fundamental criteria: 1. employment, 2. R&D, 3. energy/climate, 4. education and 5. decrease of poverty. This will be built up and supplemented by "Seven Flagship Initiatives" from the viewpoint of economic development and competitiveness.

In 2015, the European Union launched the Digital Single Market (DSM) initiative aimed to remove the online barriers in the EU28 countries and create the Single Market. The targets of the initiative included the following: 1. fast connectivity, 2. protection of the private sector, 3. building and securing new internet access modes. The initiative intends to build an adequate digital environment for SMEs and to create the opportunity for the population to develop the necessary new skills. "DSM examines the strategic break-out points of digitalization. The EC priorities are tangible economic aspects, and thus strengthening competitiveness, encouraging innovation and popularising sustainable business models are considered important factors. Great emphasis is placed on provision of resources to companies in terms of finances, skilled workforce, energy and raw materials" (Nick et al. 2019a 36).

The Digitising Europe Industry (DEI) strategy, the first initiative focusing on industry, was introduced in 2016 under the umbrella of the DSM. In a way that complements national digitalization strategies, the DEI focuses on increasing the competitiveness of the EU and realizing the advantages of the I40. The DEI is built on five pillars. The pillars comprise comprehensive programs, initiatives, actions and workflows with a multi-disciplinary and comprehensive approach: 1. European platform of national initiatives in digital industry: 2. Digital Innovation Hubs; 3. regulatory framework suitable for the digital age, 4. preparing Europeans for the digital future and 5. strengthening leadership through partnerships and industrial platforms (EC 2017).

Digitalization of the continent is coordinated by the EC in accordance with the above strategies which extend to the community and national initiatives and serve as the catalysis of cooperation of governments driven by the EC policies (CENFIM 2018). National platforms join the strategic platforms from below (Buica 2016). These programs involve financing applications, awareness-raising initiatives and regional programs, focusing mainly on coordination and support of the digital transformation of industry (I40), as one of the many areas of digital transformation. The toolsets of the I40 platforms (or frameworks) have an enormous impact on the moods and results of the national digital transformations.

7. The national I40 platforms of the V4 countries

7.1. Czech Republic (Industry 4.0)

The Czech Republic I40 initiative's vision is a fully digitalized industry. Innovation, scientific activity and support of research and development have a strong focus among the programs, including through financing of clusters, innovation centres and incubators. Companies can submit applications for building data centres and implementing software developments. Skills upgrading (Education 4.0) and applied research are in the focus of the program (Klitou et al. 2017a). Strategic priorities are outlined in the Czech Digital Agenda / Digital Czech Republic (2018) framework: 1. supporting digital and technological innovation, 2. stimulating entrepreneurship, 3. providing easier conditions for access to capital, 4. adopting future-proof regulations, 5. building the competences and skills of the future. The Society 4.0 initiative is also present in the policies, giving emphasis to surveying and managing the impacts of I40 not only in strictly interpreted industrial production, but also in education, in the labour market and in other segments (Adamek 2018). The Digital Czech Republic is linked with the Industry 4.0 Strategy, launched in 2016. Among strategic documents, it is also worth mentioning the Innovation Strategy and the Smart Specialisation Strategy. Central elements of the documents are innovation, R&D, and efficiency (EC 2020c).

7.2. Hungary (Industry 4.0 National Platform)

The targets of the Industry 4.0 National Platform include 1. increasing industrial output, 2. promotion of R&D, 3. innovation and 4. exports for domestic companies, 5. decreasing work activities that are performed by low-skilled workforce and dissemination of activities that require high qualifications. The strategic document aimed at following the methodology of the German Industry 4.0 initiative seeks to establish a balance between private and state actors regarding financing and involvement. Seven working groups have been formed within the framework of the

platform with the aim of putting forward proposals for turning the principles into practical steps. The platform envisages strengthening the competitiveness of the country and increasing individual values of the companies by the implementation of digitalization and the I40 technologies. The initiative supports and emphasizes the importance of cooperation between stakeholders (Klitou et al. 2018a).

7.3. Poland (Industry of the Future Platform)

The Industry of the Future program plays the role of accelerator in industrial digitalization, supporting coordination between stakeholders. The ideas of the platform stem from the corporate sector. The primary aim is increasing the country's competitiveness. In the interest of this aim, the platform has created, among others, 1. a framework system related to professional skills, 2. promotion of the shift in paradigm has been started, 3. new business models have been drawn up and 4. integrated hw-sw solutions presented. Financing is provided by the state. The established working groups are involved in developing standards, substantiating the legal background and participating in educational and training issues, as well as in the promotion of developing I40 solutions (Klitou et al. 2017b).

7.4. Slovakia (Smart industry)

The primary promoter of the Slovak Smart Industry Initiative is the government of Slovakia. The aim of the initiative is catalysation of the digital development, predominantly on a technological basis, reacting simultaneously to the challenges of R&D, the labour market and education. The initiative does not anticipate a decrease of labour in the industry, but it does anticipate a transformation of expected competences. 1. Knowledge transfer, 2. development of production and 3. availability of financing play an important role as well. The Slovak I40 digitalization model also significantly relies on participation and cooperation of stakeholders. In addition to developing the priorities of digitalization, the platform is involved in working out and implementing action plans (Klitou et al. 2018b). The Slovak Smart Industry / Industry 4.0 strategy was launched in 2016, taking into account 35 aspects. Key points of the strategy are embedding the key branches of industry, promoting the economy via research, development and sciences, building an innovative society and developing skilled human resources (EC 2019a). The transformation is hindered by the lack of regulation, governmental guidance and subsidies. However, there is a number of initiatives providing assistance in inter-company cooperation (EC 2019a).

8. Comparison of the digitalization platform initiatives

In order to make a detailed analysis of the I40 platforms, the DTM Country Monitor publications were compared during the research. The DTM specifies twelve aspects for the direct characterisation of the national I40 strategies and platforms, of which seven have been organised in a chart (1-7) in Table 2, while further four dimensions have been selected and highlighted by the author within the research activities, based on the reports. The table contains the characterisation of the three Frontrunner countries according to Roland Berger's I40 (Austria, Germany and Sweden) next to the V4 countries, focusing on industrial digitalization, governmental and national I40 approaches, principal directions, actions and deficits.

Table 2. Extract of national I40 platform policies, based on the DTM country reports

	NATIONAL I40 STRATEGIES AND PLATFORMS						
ASPECTS	GERMANY Industrie 4.0 (2011)	AUSTRIA Industrie 4.0 Österreich (2014)	SWEDEN Produktion2030 (2013)	HUNGARY Industry 4.0 National Technological Platform (2016)	POLAND przemystu 4.0 (2016)	CZECH REPUBLIC Prumysl 4.0 (2016)	SLOVAKIA Smart Industry (2016)
1. FINANCING	Mixed financing; rate of state subsidy: 2to1; 5to1	Mixed private and state financing in equal ratio; three-level membership fee: for large companies, start-ups and research organizations	Mixed financing 50–50%	Mixed financing	Community / state financing is dominant	Community / state financing is dominant	Community / state financing is dominant
2. TARGET GROUP	Manufacturing companies; SMEs; economic policy makers	Companies, research organizations, universities, economic policy makers (regional, national), trade unions	Research organizations, SMEs	Political actors, private sector, R&D organizations, industrial associations, universities, business, social circles	Stakeholders from every segment of transformation of industry; amongst these: a significant rate of SMEs and domestic I40 solution suppliers.	Stakeholders; Political actors, private sector, R&D organizations, industrial associations, universities	Industry, SMEs, R&D organizations, universities and non-governmental organisations.
3. FOCUS POINTS	Digital innovation and the ICT market; business models / transformation of products / services	Norms-standards, R&D&I, Abilities-skills, Regional strategies, Human resources, Smart logistics	Sustainable, flexible production and transport; integrated, human-centred production and development	Strengthening knowledge economy within sectoral strategies.	Building competences, transferring knowledge, developing infrastructure, promoting SMEs, catalysing cooperation.	Developing a flexible education system for appropriately timed market responses.	Encouraging awareness raising, cooperation, financing, labour market, education, regulatory framework, innovation
4. MAJOR OBSTACLES	Competition between ICT companies; lack of practical approach	Multiplicity of approaches providing solutions for the problems; time-consuming definition of topics and strategies	Variable approach patterns and priorities and SME involvement	Low level of stakeholder involvement	Lack of knowledge of SMEs, slow development of the support and financing processes to SMEs.	Lack of knowledge, resistance to the changes, infrastructural shortages in some regions of the country	Delayed initiative, tight schedules, financing structures not selected.

NATIONAL I40 STRATEGIES AND PLATFORMS

ASPECTS	GERMANY Industrie 4.0 (2011)	AUSTRIA Industrie 4.0 Österreich (2014)	SWEDEN Produktion2030 (2013)	HUNGARY Industry 4.0 National Technological Platform (2016)	POLAND przemystu 4.0 (2016)	CZECH REPUBLIC Prumysl 4.0 (2016)	SLOVAKIA Smart Industry (2016)
6.I40 APPROACH	Top-down	Bottom-up	Bottom-up	Bottom-up	Bottom-up	Bottom-up	Top-down
7.APPROACH BASIS	Emphasis on technological approach	Balanced technology and capability approach	Emphasis on capabilities	Balanced technology, based on capabilities and infrastructure	Balanced technology, based on capabilities and infrastructure	Emphasis on capabilities	Emphasis on technology
8. TARGETS	Maintaining Germany's leading position in engineering; decreasing the segregation of industry; developing industrial networks; involvement of SMEs and manufacturing companies for practical transformation	Relocating knowledge-based production to Europe	Putting Sweden at the global forefront with respect to investments aimed at sustainable production by the year 2030	Preparing the industry for accepting I40 and increasing the competitiveness of the country.	Providing adequate financing for re-industrialization, export orientation and regional development in the course of the 25-year span of the program.	Preparing Czech companies to join international supply chains; increasing efficiency, developing marketable I40 solutions.	Strengthening the industry of Slovakia through I40, paying particular attention to SMEs.
9.STRENGTHS	Bipolar strategy: Germany intends to simultaneously be the supplier of I40 solutions and the creator of I40-based market	Knowledge transfer, technological innovation, new business models, social embedding of digitalization	Sustainable production, flexible manufacturing processes, virtual production, human-centred production, product and production-based services,	Government initiation, support and financing of the program, involvement of the private sector.	The initiative contains both regulatory steps and practical business approaches.	Cooperation, multi-disciplinary approach, stakeholder involvement.	Primary aim is to change the way of thinking.

NATIONAL I40 STRATEGIES AND PLATFORMS							
ASPECTS	GERMANY Industrie 4.0 (2011)	AUSTRIA Industrie 4.0 Österreich (2014)	SWEDEN Produktion2030 (2013)	HUNGARY Industry 4.0 National Technological Platform (2016)	POLAND przemystu 4.0 (2016)	CZECH REPUBLIC Prumysl 4.0 (2016)	SLOVAKIA Smart Industry (2016)
10. I40 PLATFORM DUTIES	Strategic planning, action plans, preparing High-Tech strategy, implementing programs	Working out standards; preparing catalogues on services and service providers; recording best practises; providing access to knowledge, defining action plans, preparing strategy, launching working groups, searching for synergies.	Five key areas: project financing, knowledge transfer, education, establishing mobility of human resources, validating international aspects; integrated product and production development	Strengthening exchange of information and cooperation between stakeholders, accelerating innovation, promoting industry in innovative adaptation, creating the capability of prompt reaction to challenges, supporting brave innovation steps.	Promoting digital transformation: awareness raising, surveying market needs, integrating technological solutions, promoting I40, transferring knowledge.	Promoting digital transformation: awareness raising, increasing the ability to change, strategy implementing, preparing the society for the change.	Designating priorities, strengthening cooperation, implementing special monitoring for the branches of industry.
11. INVOLVEMENT OF SMEs	Integration of SMEs in the I40 value chain has top priority, since they are less prepared for the technological change, in the absence of a trained workforce	The government prepared dedicated programs for financing SMEs.	Collaboration is the key in the course of involving SMEs.	NA	Supporting SMEs is to be regarded as a key area of digital transformation.	NA	Developing the innovative character of SMEs has top priority.

Source: Own compilation (based on Klitou et al. 2018a; Klitou et al. 2017b; Klitou et al. 2017a; Klitou et al. 2018b; Nick et al. 2019b)

9. Discussion and lessons learned

Nick et al. (2019b: 48) contained a detailed analysis of the national I40 platforms of the three selected Frontrunner countries (Austria, Germany, Sweden). The summary of the similarities is shown below. "The factors assessed at strategic level show clear-cut similarities:

- Community / mixed financing on the part of the state / entrepreneurs,
- Targeted development and involvement of SMEs,
- Strengthening R&D&I,
- Cooperation of the state and the entrepreneur/academic sectors,
- Developing digital capabilities,
- Bottom-up "build-up",
- Innovative market initiatives for establishing faster and more efficient implementation and raising interest."

Along with the current research the comparative analysis is performed for the V4 countries also.

Regarding the national I40 platforms of the V4 countries, the following observations can be made, adding a counterpoint to the Frontrunners, where relevant:

- Financing is based on community (state) resources in all four countries, in contrast with the mixed financing of the Frontrunners;
- There is a need for the presence and development of knowledge and competence, similarly to the Frontrunners;
- There is a typical bottom-up structure in the V4 countries, similarly to the Frontrunners;
- The approach of digitalization is based on technology and capability, in a balanced manner (although to a different extent in the altogether seven analysed countries);
- The targets are consistent: 1. relocating industry, 2. increasing added value, 3. strengthening competitiveness, 4. cooperation of stakeholders, and the 5. need for R&D. These are given priorities in each country, Frontrunners and V4 countries alike;
- The involvement of SMEs in the national digitalization is detected as high priority endeavour to all of the V4 countries, just like the Frontrunners.

Having the answers to the key questions of the study, we can state that there are similarities in the national I40 platforms of the V4 countries. Most of the territories of the frameworks are managed similarly, inclusive financing, structuring, and approaching, as detailed above – justifying H2.

As for the key differences, compared to the Frontrunner countries, the way of financing can be mentioned. Meanwhile the community (state) financing is typical in the V4 countries, the mixed financing is available in the Frontrunner ones - justifying H1.

The results may explain the findings of the authors referred within the literature review (Moroz 2017; Grzyb 2019; Papula et al.; 2017 Ulewicz et al. 2019). They detect the low level of progress and involvement of the companies, regarding the I40 in the V4 countries. It seems that the community / state financing of the national I40 platforms and initiatives does not foster the company level digital transformation

buy-in well enough. Mixed financing – on the other hand - may power the involvement and the commitment of companies (including SMEs) in many ways. It might be a valid proposal for companies to take part in financing of the national I40 platform also, at least at an indirect way, for example purchasing relevant services.

The companies in the V4 countries see inadequate their 1. financial possibilities, 2. skilled competences, 3. level of involvement, and 4. level of awareness (Mattauch 2017; Johanesova et al. 2019; Grzyb 2019). They also face with other constraints: 1. weak start-up ecosystem, 2. weak productivity, 3. low-level personal skills, 4. slow adaptation, 5. low-level demand for learning, 6. effects of the brain-drain, 7. low level of automation, 8. low-rate ICT investments, 9. barriers to international growth, 10. lack of regional cooperation, 11. weak innovation, 12. low level of digital public services (Novak et al., 2018, a, b, c).

The national I40 platforms should put a bigger emphasis on attracting and addressing companies, by answering their constraints above. The bottom-up need for company level digital transformation must be invoked, and the cooperation with the governmental bodies should be strengthened. Fulfilling that need, additional direct actions should be formed, based on mixed financing:

- Dedicated promotions are needed
- Dedicated financial programs are needed
- Knowledge transfer should be available
- Champions program are welcome
- ICT and start-up programs should be linked to the I40 programs
- Learning paths are welcome
- Bottom-up surveys should be designed and published
- RnD and innovation must be emphasized
- I40 consultancy services should be addressed
- Crowdfundig Platform may be useful
- Shared licensing, shared know-how may help investments

Conclusion

The real risk for the V4 countries is that they will lose ground in the digital transformation. Their economies which are based on low labour costs are becoming less attractive to developed countries day-by-day. The I40 solutions of the developed countries result in increased efficiency, therefore developing economies are indirectly devalued and they are marginalised compared to the developed ones (Ulewicz et al. 2019). The danger of marginalisation derives from the basic philosophy of I40 itself: in the long run, machines will perform repetitive activities instead of humans. Therefore, the companies of the V4 countries have to move towards higher added value. This, however, first of all requires skills and competences and, naturally, a large number of other digital transformation related external and internal technology, business, government and regulations related factors (Ulewicz et al. 2019).

The digitalization status of the V4 countries is fairly similar. Regarding the level of digitalization development, all four countries are members of the group of followers, lagging behind, according to DESI. This is certainly explained by the 1. similar industrial, 2. cultural and political heritage, 3. the similarity of the sizes and 4. the open

nature of their economies and evidently the 5. unification impact of EU strategies, programs and financing structures.

Naturally, the V4 countries are not identical indeed in terms of their digitalization level and set of features. The acceptance of digitalization becomes stronger in all four countries year-to-year, the number of company-level projects is increasing and the development of the countries can be detected in most measured aspects (EC 2018a; EC 2018b; EC 2019a; EC2019b).

Having a focus on the national I40 platform initiatives of the V4 countries, we can make a conclusion that the I40 platform initiatives are based on similar structures and policies – answering to H2 of the study. The state finance occurs in all the four countries that differ from the national I40 platform initiatives of the Frontrunner countries. Frontrunners have a mixed financing that catalyses adaption, involvement and commitment of the companies - answering to H1 of the study.

Making a comparison with the obstacles of the Frontrunners, it seems that the actual bottlenecks in the Frontrunner countries are more sophisticated, higher-level and more indirect, as a result of their existing status of development. The issues that the V4 countries face with present the core of the digitalization and digital transformation. Lack of financing, knowledge, resources, awareness is detected as deficit.

Summarizing the findings of the research, relevant efforts should be put on promotion of the government programs, national digitalization strategies and national I40 platforms, thereby strengthening the innovation and digitalization level of the national economies. Catalysation and acceleration of digital transformation is a complex duty of the governmental bodies and the national I40 platforms, which they must break down to direct actions. The leaders of the countries should apply a mix of direct initiatives and policies, making it possible to catch up in the long term. The used policies should be attractive, supportive and also business-oriented (Ignatov, 2019). The Frontrunner countries in digitalization may provide good examples and practices for implementation.

The study definitely has limitations in a 360° degrees economic overview of the national I40 environments. The paper focuses solely on the national I40 platform initiatives. The conclusions though, bring a specific view that could become a target of further research. The possible effects of modifying the financial policy of the national I40 platforms would worth additional scientific investigations.

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THE NEXUS BETWEEN HEDGE FUND SIZE AND RISK-ADJUSTED PERFORMANCE

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Abstract: This paper explores the relationship between hedge fund size and risk-adjusted performance employing a data sample of 245 US hedge funds classified into eight different investment strategies. The studied period spans from January 2005 to February 2021, with calculations performed both on the whole coverage period as well as three sub-periods, to isolate the pre-crisis, crisis, and post-crisis funds' behavior. Similar to previous evidence found in the literature, the results reveal an inverse relationship between hedge fund size and risk-adjusted performance (as measured by the Sharpe, Treynor and Black-Treynor ratios) in most of the cases.

Keywords: hedge funds, risk-adjusted performance, fund size, fund performance
JEL classification: G11**,** G23, G32.

1. Introduction

Starting from the first "market-neutral" portfolio created by Alfred Winslow back in 1949, that could be deemed as the departing point in the development of the vast asset class that we know today, the hedge fund industry witnessed a remarkable increase in total assets, that according to Barclays is estimated to reach an impressive figure of approximately USD 4.5 trillion by the end of 2021. Barth et al. (2021) merged a set of seven public hedge fund data vendors and estimate an even bigger value of worldwide net assets under management (AuM) of USD 5 trillion, and gross assets under management of USD 8.3-8.5 trillion, underlying even more the importance of this asset class and its big "footprint" in the financial markets.

Surviving many recessions along the way, the hedge fund industry benefited from a largely unregulated market, coupled with an expanded use of leverage and various developments in investment strategies. Even now, in the context of the COVID-19 pandemics, hedge fund assets reached record high levels amid investors' hopes for the rebound of the economy as well as increased government spending to support its reboot. In their pursuit of above-average returns, hedge funds usually face a trade-off between prediction accuracy and reaction speed that can be best observed during periods of market turmoil (Dragomirescu – Gaina et. al, 2021).

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Basile (2016) defines hedge funds as "collective investment vehicles (CIVs) which, through active investment techniques and often with high financial leverage, aim to achieve positive risk-adjusted returns, irrespective of the trends of the target markets". A particular characteristic of hedge fund managers is the wide margin of discretion in the adoption of hedging or investment strategies that are regarded to be suitable to the followed objectives. This enables hedge fund managers to deliver above-average returns, that in turn, draws interest from a broad and increasingly sophisticated set of investors. Being aware of the operational and regulatory leeway benefiting hedge funds, lately, investors have been seeking more transparency from the funds they choose to invest in, and thus, industry regulation has moved into the public's attention. This goes hand in hand with the investors' appreciation and curiosity towards hedge funds' characteristics that should be analyzed prior to investing. While choosing a certain fund, one of the first dimensions being examined is its size, along with the return and risk attributes.

When it comes to the valuation models for explaining hedge funds returns, Lhabitant (2004) identifies two broad categories: absolute pricing models that include equilibrium models in conjunction with several macro-economic models, and relative value models, that price hedge funds relative to market or any other risk factors. The latter category could be further classified into several distinct components based on the factors used to explain the hedge fund returns, namely: explicit macro factors, explicit index factor models, explicit micro factor models, and implicit factor models (Amenc et al., 2003). A similar classification is suggested by Connor (1995), by identifying three broad factor categories, namely: macroeconomic factor models, fundamental factor models, and statistical factor models. Explicit micro-factor models are several factors that refer to fund specific features, such as age, size, fund manager tenure and performance fees (Stafylas et al., 2016). As it is presented below (Literature review section), there are a handful of studies that deal with this issue (e.g. Gregoriou and Rouah, 2002, Goetzmann, Ingersoll, and Ross, 2003, Harri and Brorsen, 2004, Getmansky, 2004, Jones, 2007, Clare et al., 2015).

The relationship between hedge fund size and its risk-adjusted performance has been a topic of growing concern for practitioners and academics alike. Although, the common belief might suggest that a larger size entails better performance and hence might pose a more attractive proposition, with investors being frequently lured by the growing asset base statistics, that are pompously advocated in funds' promotion materials, the academic studies on the matter are rather contradictory. The majority of studies analyzing the relationship between the size and performance conclude that there is a negative relationship, with smaller funds outperforming their larger peers (e.g. Schneeweis et al. 2002, Harri and Brorsen, 2004, Agarwal et al., 2004, Ammann and Moerth, 2005). Nevertheless, there are some studies that point towards a non-negative or even positive relationship between size and performance (e.g. Gregoriou and Rouah, 2002, Koh et al., 2003, Amenc and Martellini, 2003, Getmansky, 2004). The issue discussed here bears at least a twofold dimension.

On the one hand, it could be argued that investment opportunities narrow as assets increase, confining managers to choose among positions with high liquidity. Thus, they shun away from small-capitalization stocks that quite often offer the prospective of finding little-known companies with great upside potential, as these tend to be less covered by professional equity research analysts. This limitation curbs hedge fund performance once its asset base expands. Another argument

supporting the underperformance of large funds in comparison to their smaller peers is the one related to transaction costs, that inevitably increase, as a higher number of orders must be executed. This gives rise to the so-called diseconomies of scale, that is a phenomenon encountered not only across the asset management business, but across most industries, occurring when a firm experiences increasing marginal costs per additional unit of output. On the other hand, the structure of the performance fee as well as the management fees, might provide the incentive for better discipline while the asset base expands. Here it's worth mentioning that studies have revealed that hedge funds' compensation structures often fail to align managers' incentives with investors' interests as management fees tend to comprise a larger portion of total compensation for fund managers as their company grows (Kouwenberg et al., 2007, Broeders et al., 2019, Escobar-Anel et al., 2020). In other words, as funds grow, managers may have fewer incentives to improve fund performance because most of their compensation comes from the asset-based management fee (Gao et al., 2020).

At the same time, larger funds often benefit from operational synergies, as more resources are invested in the development of technology, regulation, and compliance areas. Moreover, besides fees, liquidity and a smaller universe of available stocks to invest in, the investing style of the fund can also make a difference. A fund with high turnover will be more adversely affected by liquidity issues than a fund with a long-term or hold strategy.

This curious combination of variables affecting the performance of one of the most intriguing asset management branches, has spurred my interest to research the topic and analyze more closely the relationship between the size and the risk-adjusted performance of hedge funds. Hence, this paper contributes to the existing strand of literature of hedge funds' performance analysis by studying the size impact on hedge funds' risk-adjusted returns on a more recent period compared to the studies that already exist on the subject, as well as three-sub-periods, one of them comprising a part of the COVID-19 crisis.

The size impact on the risk-adjusted performance is tested on a database comprised of 245 US hedge funds, classified into eight different investment strategies covering the period of January 2005 - February 2021. To isolate the pre-crisis, crisis, and post-crisis periods, the testing is also performed on three sub-periods. The latest studied sub-period (April 2009 – February 2021) also comprises a part of the COVID-19 crisis, hence making it possible to test the relationship during the latest pandemic that affected the global economy and financial markets in an unprecedented manner.

To highlight the size influence, the hedge funds are divided into quartiles based on their AuM level. The results confirm the conclusions from the literature (e.g.: Schneeweis et al. 2002, Harri and Brorsen, 2004, Agarwal et al., 2004, Ammann and Moerth, 2005), namely, an inverse relationship between size and risk-adjusted performance, for most of the cases. The portfolio that was constructed in the first quartile, delivered the highest return levels and the highest risk-adjusted performance values, in most of the cases. While the portfolio that was constructed in the fourth quartile, delivered, mostly, the lowest values for the risk-adjusted performance measures.

2. Literature review

The analysis of the relationship between size and hedge fund performance can have two possible implications. From the investor perspective, it is a decision factor that must be carefully weighted in before the investment action. Meanwhile, from the fund manager's viewpoint, the degree to which size impacts performance is relevant when deciding the optimal fund size to be chosen. A vast strand of literature documents that funds (both of mutual and hedge type) that are too large cannot be effectively managed (Liang, 1999, Indro et al., 1999, Chen et al., 2004, Pollet et al., 2008). This argument can also be traced to events from the hedge fund industry noticed along its history. For example, in 1998 the two largest hedge funds were the Quantum Fund and the Tiger Fund, and both experienced lackluster performance in 1998 and 1999. More than that, Tiger Management closed down in March 2000, further justifying the inverse relationship between size and performance.

Gregoriou and Rouah (2002) studied the relationship between size (defined as the total AuM at the start of the calculation period) of hedge funds and their performance by employing the Pearson's correlation coefficient and Spearman's rank correlation, from January 1994 to December 1999 and found no statistical significance. Thus, authors concluded that the size of a hedge fund (and of a fund of hedge funds) has no impact on its performance. Similar results were observed for the Asian hedge funds (Koh et al., 2003).

During the same year, an interesting study conducted by Hedges (2003) revealed slightly different results. The study covered the period of 1995-2002 and used three equally-weighted size-mimicking portfolios of monthly returns. The hedge funds were classified by size level into three distinct buckets: small, medium and large. The author showed that smaller funds performed better than larger funds. However, mid-sized funds reported the worst results. This finding suggested the notion of 'mid-life crises' for hedge fund managers as mid-size firms tend to be inefficient in terms of exploiting opportunities and processes to reach optimum performance (Stafylas et al., 2015).

On the other hand, Harri and Brorsen (2004) find a strong negative relationship between hedge fund size, measured as the logarithm of the market capitalization and fund returns. Authors test the hypothesis that the source of hedge fund returns comes from the existence and exploitation of the inefficiencies in asset pricing on the debt, equity, currency, and commodities markets. Since these inefficiencies have a fixed size, allocating more money to exploit a particular inefficiency would cause a decrease in returns. This hypothesis is also supported by the fact that some funds are closed to new investment.

Getmansky (2004) performs a regression on the TASS database that includes the size squared as a factor and finds a positive and concave relationship between current performance and past asset size is found. This suggests that an investor should select hedge funds that are near their optimal size. Agarwal, Daniel and Naik (2006), and Goetzmann, Ingersoll, and Ross (2003) find a similar relationship.

Moreover, Gregoriou et al. (2005) point that a hedge fund's risks increase proportionately with its AuM due to the use of specialized strategies that naturally impose a certain optimal size level beyond which it becomes increasingly challenging

to keep the same strategy or have the same opportunities for execution. As managers are aware of the trade-off between size and performance, they are inclined to close their funds for further investments as soon as a target size is reached.

Furthermore, Jones (2007) used simple returns to gauge performance and discovered that smaller, younger funds tend to outperform larger, older hedge funds. The results were obtained by creating three size-based hedge fund indices by combining the hedge fund performance records from the Hedge Fund Research, HedgeFund.net, Morningstar's Altvest, and Barclays Global HedgeSource databases. The author computed monthly returns and size levels for each fund from the database from January 1996 through December 2007 and grouped the funds based on their current size, hence constructing the three indices representative of the AuM level. The annualized return for the studied period for the small funds was of 16.01%, while for the largest funds was of 11.50%.

The argument that small hedge funds are more likely to outperform large funds has also been supported by the results of Gao et al. (2019). The authors employed data from the Lipper TASS and HFR databases and separated the hedge funds into three size groups: less than $10 million of AuM (small), $10 million to $100 million (medium), and more than $100 million (large). Their sample included performance data from January 1994 to December 2016. Although the study found that younger funds are inclined to outperform their older peers, age is not so relevant for smaller hedge funds.

Evidence shows that smaller hedge funds keep outpacing their larger peers even during times of crisis. Clare et al. (2015) studies the relationship between the hedge fund performance and size using a sample of over 7,200 funds during the period of 1995 to 2014 and discover a strong, negative relationship between hedge fund performance and size. More than that, authors also find that rather than dissipating during the two recent periods of financial crisis (the early 2000s' post-dotcom bubble and the Global Financial Crisis), other things equal, investors would have been better off with smaller hedge funds than with large ones during these crisis periods.

Yin (2012) explores the impact of the standard compensation contract in the hedge fund industry in aligning managers' incentives with investors' interests and proves empirically that managers' compensation increases as fund assets grow, even when diseconomies of scale in fund performance exist. Under this framework, managers' compensation is maximized at a much larger fund size than is optimal for fund performance. Yet to avoid capital outflows, managers are also incentivized to hinder fund growth to sustain style-average performance.

3. Methodology

The departing point of the research methodology used in this paper is the concept of the market model. The underlying idea behind the market model is that the rate of return "surprise" of any security is proportional to the return "surprise" of the market index portfolio, and the extent of the security's responsiveness to market changes, as measured by β, plus a firm-specific surprise. The market model equation divides returns into firm-specific and systematic components. The market model is often used inter-changeably with the single-index model. First suggested

by Sharpe (1966), the index model offers insight into portfolio diversification. The excess return on the portfolio of stocks could be written as:

$$r_p = \alpha_p + \beta_p r_M + \varepsilon_p, \qquad (1)$$

where r_p – excess return of the portfolio,
β_p – Beta of the portfolio p,
r_M – excess return of the market.

The index model is estimated by applying regression analysis to excess rates of return. The slope of the regression curve represents the beta of an asset, whereas the intercept is the asset's alpha during the sample period. The regression line is also called the security characteristic line (SCL). The regression beta is equivalent to the CAPM beta, except that the regression uses actual returns and the CAPM is specified in terms of expected returns (Bodie et al., 2011).

$$E(R_i) = R_f + \beta_i \left[E(R_M) - R(_f)\right] \qquad (2)$$

where, $E(R_i)$ – expected return of individual security i.

The expected return–beta relationship can be portrayed graphically as the security market line (SML). The SML offers a benchmark for the evaluation of investment performance. Given the risk of an investment, measured by its beta, the SML provides the required rate of return necessary to compensate investors for both risk as well as the time value of money. Therefore, in market equilibrium, the "fairly priced" assets should lie on the SML. If a stock is underpriced, it will provide an expected return in excess of the fair return given by the SML. Underpriced stocks therefore plot above the SML. In contrast, overpriced stocks plot below the SML. The difference between the fair and expected rates of return on a stock is reflected in the stock's alpha (α).

Furthermore, one category of risk-adjusted performance measures comes from the differential return developed by Michael Jensen (1968). The scope of this technique is to compare the return expected by the CAPM and the actual realized return.

$$\alpha_p = R_p - R_p^{CAPM} \qquad (3)$$

In addition, Jensen has also developed a method to determine whether the differential return had appeared by chance or if it has a statistical significance by running the following regression:

$$R_p - R_f = \alpha_p + \beta_p(R_M - R_f) + \varepsilon \qquad (4)$$

The error term shows how well the regression fits the data - a low error indicates a strong relationship, while a high error indicates a weak relationship. The intercept term (α_p) indicates whether the evaluated portfolio has an above-average or below-average performance. If α_p is positive, the portfolio has an above-average performance, respectively if it is negative, then the performance is below-average.

Note that we cannot classify portfolios based solely on the alpha measure, because a risk measure needs to be included as well. Black-Treynor's ratio divides Jensen's α to the systematic risk and offers a measure to evaluate portfolio managers based on their stock-picking ability:

$$R_{BT} = \frac{\alpha_p}{\beta_p} \tag{5}$$

The second category of risk-adjusted performance measures could be classified as the returns per unit of risk ratios. The return per unit of risk method was simultaneously developed with the CAPM. Jack Treynor (1965) and William Sharpe (1966) have used the implications of the CAPM for rating performance managers.

The Sharpe ratio, also known as the reward-to-variability ratio divides the realized portfolio return ($\bar{R}_p$) in excess of the risk-free rate ($\bar{R}_f$) to the variability of return measured by the standard deviation (σ_p).

$$SR = \frac{\bar{R}_p - \bar{R}_f}{\sigma_p} \tag{6}$$

As the standard deviation is a measure of total risk, Sharpe Ratio should be used when evaluating portfolios that include the majority of the manager's invested assets. On the other hand, if we want to evaluate portfolios that represent just a fraction of the invested funds, a better risk measure is the beta coefficient.

The Treynor ratio or ratio of reward divides the realized portfolio return in excess of the risk-free rate to the volatility of return measured by the portfolio beta.

$$TR = \frac{\bar{R}_p - \bar{R}_f}{\beta_p} \tag{7}$$

The greater the Sharpe and Treynor ratio is, the more performant is the portfolio. However, managers should be careful when selecting the appropriate benchmark index for the evaluated portfolio, as in a well-known study by Roll (1977) it proved to affect the risk-adjusted ratios.

In addition to the risk-adjusted performance measures that were computed for the employed data sample, the monthly, annualized return, standard deviation, and variance, as well as Beta level was calculated:

$$R_p = E(R_p) = \sum_{i=1}^{n} w_i \, E(R_i), \tag{8}$$

$$R_{ann} = (1 + R_p)^{12} - 1, \tag{9}$$

$$V(R_p) = \sum_{i=1}^{N} w_i^2 \, V(R_i) + \sum_{i=1}^{N} \sum_{j=1}^{N} w_i w_j Cov \, (R_i R_j), \tag{10}$$
$$i \neq j$$

$$\sigma_p = \sqrt{V(R_p)}, \tag{11}$$

$$\beta_p = \frac{Cov(R_p R_m)}{Var(R_m)}, \tag{12}$$

where
w_i – weight of individual security i,
R_p – average return of the portfolio,
$E(R_i)$ – expected return of individual security i,

R_{ann} – annualized return,
$Var(R_i)$ – variance of individual security i,
$Var(R_m)$ – variance of market return,
$Cov(R_iR_j)$ – covariance between the return of security i and the return of security j,
$Cov(R_pR_m)$ – covariance between the portfolio return and market return,
σ_p – standard deviation of the portfolio,
β_p - Beta of the portfolio.

Moreover, to study the size effect on the hedge funds' risk-adjusted performance, the dataset was split into quartiles by Assets-under-Management (AuM), as of the latest available data levels (reported in February 2021).The calculations were performed for the whole studied period, namely: January 2005 – February 2021, as well as for the following sub-periods: January 2005 – July 2007 (to isolate the funds' performance during the pre-crisis period), August 2007 – March 2009 (to isolate the funds' performance during the crisis period), and April 2009 – February 2021 (to isolate the funds' performance during the post-crisis period). After grouping the funds in accordance with their size level, equal-weighted portfolios have been constructed inside each quartile, which were evaluated from a risk-adjusted performance using the measures that were described above.

4. Data and descriptive statistics

The hedge fund sample used in this study is from the eVestment database. A Nasdaq platform, eVestment provides traditional and hedge fund data for public and private markets. The database used for this study consists of net-of-fee monthly returns for 245 hedge funds from the United States. The sample period spans from January 2005 to February 2021. Starting from the US hedge fund universe, as classified in the eVestment database, several filters were applied to arrive at the final studied database, namely: the selected funds should have at least a 5-year period of reported financial history, which among other characteristics, should also comprise the incentive and management fees. The selected hedge funds can be classified into eight categories, as per the pursued investment strategy, specifically: Relative Value, Fundamental Long/Short Equity, Fundamental Long Only Equity, Macro-Quantitative, Managed Futures Quantitative, Fund of Funds, Event-Driven, and Multi-Strategy. The data sample also contains the monthly net asset value and the maximum Drawdown values.

Table 1 – *Strategies' definitions*

Investment Strategy	Definition (eVestment)
Relative Value	Hedge funds that expect returns that compare to a preferred benchmark.
Fundamental Long/Short Equity	Alternative direct funds and replication funds that measure an equity security's intrinsic value by examining related economic, financial and other qualitative and quantitative factors, and then make long and short trades based on those assessments.

Investment Strategy	Definition (eVestment)
Fundamental Long Only Equity	Alternative direct funds and replication funds that measure an equity security's intrinsic value by examining related economic, financial and other qualitative and quantitative factors, and then make long only trades based on those assessments.
Macro-Quantitative	Alternative direct funds that use mathematical and technical models to identify opportunities in markets showing trends or momentum across asset classes or individual securities.
Managed Futures Quantitative	Alternative direct funds that use mathematical and technical models to identify opportunities in broad financial derivatives, commodities, commodity derivatives and FX.
Fund of Funds	Alternative fund of funds hold a portfolio of alternative funds rather than investing directly in shares, bonds or other securities.
Event-Driven	Alternative direct funds and replication funds that take positions in securities with the expectation of specific events to realize the value of their current positions.
Multi-Strategy	Alternative direct funds and replication funds that run several different strategies in-house that contribute to the total performance of the fund.

Source: eVestment database (Universes and Definitions Guidebook).

Table 2 summarizes the monthly net-of-fee returns for the data sample and its associated summary statistics. From January 2005 to February 2021, all hedge funds included in the sample earned an average net-of-fee return of 0.92% per month. In terms of the mean fund age, the hedge funds included in the data set had, on average, 322 months, or 26.8 years, while the funds belonging to the 90th percentile reached 565.2 months, or 47 years. The management fee, which is an annual fee charged by the manager to cover the operating costs of the investment vehicle and is applied to the net asset value, was on average 1.54%, stretching to 2% in the 90th percentile. Meanwhile, the incentive fee, also known as the performance fee, which is viewed as a reward for positive returns, reached, on average, 15% applied to the fund's profits.

Table 2 – *Descriptive statistics*

	Mean	STD	10%	25%	Median	75%	90%
Fund monthly return, %	0.92	4.80	-3.41	-0.84	0.73	2.56	5.37
Fund size ($,m)	83,736	624,040	63	223	762	4,649	36,341
Fund age (month)	321.66	235.48	120.0	168.0	264.0	384.0	565.2
Management fee (%)	1.54	1.81	0.90	1.00	1.50	1.75	2.00
Incentive fee (%)	15.41	7.69	0.00	10.00	20.00	20.00	20.00

Source: Author's computations based on eVestment data.

When it comes to the AuM level, the average hedge fund reported an asset base of USD 83.7 billion, while the median size level was of USD 0.76 billion. As it can be observed, the distribution of the AuM size is heavily skewed to the right, as there are a few, very large hedge funds, boasting an asset-base of over USD 1 trillion such as, Wellington Management Company, J.P. Morgan Investment Management Inc. and BlackRock. As a matter of fact, the latter is the world's largest asset manager with total assets under management of $9.46 trillion as of September 30, 2021. Table 3 summaries the size intervals obtained after dividing the dataset into quartiles by AuM.

Table 3 – *AuM Quartiles*

Quartile	1 – Small	2 - Moderate	3 - Expanded	4 - Large
AuM intervals	Less than $225 million	$225 million to $762 million	$762 million to $4.6 billion	$4.6 billion to $9 trillion

Source: Author's computations based on eVestment data.

Furthermore, the S&P500 was used as a proxy for the market return, with an average value for the analyzed period (January 2005 – February 2021) of 0.86%, while the ML 3-month T-Bills was used as a proxy for the return on the risk-free rate asset, reporting an average value of 0.11% for the sample period.

5. Results

Table 4a presents the traditional performance metrics for the four portfolios representative of the size quartiles during the whole analyzed period, namely January 2005 – February 2021. As it can be noticed, the average portfolio return reached the highest value, of 0.75% in the case of the lowest (*SMALL*) quartile, hence validating the inverse relationship between fund size and return. The same could be said about the funds' registered cumulative return. From January 2005 to February 2021, hedge funds from the first quartile earned 310.6% in net return, more than doubling the returns from the fourth quartile. It's important to note, that while the returns decreased as asset-base grew, the risk, measured as standard deviation and β, decreased. Thus, while smaller funds deliver better returns, they also pose a higher level of risk. It's interesting to observe that this is not the case for the *MODERATE* vs. *EXPANDED* portfolios, which are the second and the third quartile, respectively. The portfolio formed from the funds in the second quartile provides higher return and lower risk compared to the third quartile.

Table 4a – *Performance metrics. January 2005 – February 2021*

Quartile	Size	Average port-folio return	Standard deviation	Cumulative Return	β
SMALL	Less than $225 million	0.75%	2.16%	310.63%	0.42
MODERATE	$225 million to $762 million	0.64%	1.62%	235.05%	0.31

Quartile	Size	Average portfolio return	Standard deviation	Cumulative Return	β
EXPANDED	$762 million to $4.6 billion	0.63%	1.93%	225.76%	0.40
LARGE	$4.6 billion to $9 trillion	0.42%	1.28%	121.89%	0.26
Average		0.61%	1.75%	223.33%	0.35

Table 4b presents the risk-adjusted performance for the four portfolios representative of the size quartile during the whole analyzed period, namely January 2005 – February 2021. One can observe that the *SMALL* portfolio offered the highest alpha level. When it comes to the Sharpe, Treynor, and Black-Treynor ratios, the *MODERATE* portfolio leads the group. The *LARGE* portfolio, which comprises the funds with the highest level of AuM, delivered the lowest risk-adjusted results and registered the lowest alpha level.

Table 4b – *Risk-adjusted metrics. Period: January 2005 – February 2021*

Quartile	Alpha	Sharpe ratio	Treynor ratio	Black-Treynor
SMALL	0.33%	0.30	1.54%	0.79%
MODERATE	0.29%	0.33	1.69%	0.94%
EXPANDED	0.22%	0.27	1.30%	0.55%
LARGE	0.12%	0.24	1.20%	0.46%
Average	0.24%	0.28	1.43%	0.69%

Furthermore, the performance of the four portfolios was also analyzed by sub-periods in order to isolate the pre-crisis, crisis, and post-crisis behavior. During the pre-crisis period (January 2005 – July 2007), the average monthly portfolios' return was of 0.38%. Just as in the previous analysis that comprised the whole sample period, the *SMALL* portfolio is still placed at the top of the group, with a monthly return of 0.50%, followed by the *EXPANDED* portfolio delivering a return of 0.39%. The cumulative performance also follows a similar ranking, with the SMALL portfolio, scoring a 16.69% return. We can notice that, as expected, risk level decreases as asset base grows, with the *SMALL* portfolio, being the most risky asset, if we were to measure it by its standard deviation and Beta level, while the LARGE portfolio bears the smallest level of risk. These results are presented in the Table 5a.

Table 5a – *Performance metrics. Pre-crisis period: January 2005 – July 2007*

Quartile	Size	Average portfolio return	Standard deviation	Cumulative Return	β
SMALL	Less than $225 million	0.50%	0.99%	16.69%	0.33
MODERATE	$225 million to $762 million	0.37%	0.52%	12.11%	0.18
EXPANDED	$762 million to $4.6 billion	0.39%	0.46%	12.85%	0.17
LARGE	$4.6 billion to $9 trillion	0.25%	0.23%	8.13%	0.08
Average		0.38%	0.55%	12.45%	0.19

Source: Author's computations based on eVestment data.

Additionally, Table 5b represents the risk-adjusted performance for the four portfolios during the pre-crisis period. The *SMALL* portfolio is the only one that manages to deliver a positive alpha, albeit it is very close to zero, while the other portfolios register negative alpha values. The Sharpe, Treynor, and Black-Treynor ratios also have the highest values for the *SMALL* portfolio.

Table 5b – *Risk-adjusted metrics. Pre-crisis period: January 2005 – July 2007*

Quartile	Alpha	Sharpe ratio	Treynor ratio	Black-Treynor
SMALL	0.02%	0.16	0.49%	0.06%
MODERATE	-0.05%	0.05	0.15%	-0.28%
EXPANDED	-0.03%	0.10	0.27%	-0.15%
LARGE	-0.12%	-0.41	-1.21%	-1.63%
Average	-0.04%	-0.02	-0.07%	-0.50%

Source: Author's computations based on eVestment data.

In the case of the Great Financial Crisis period, the only portfolio that managed to not enter in the negative territory was the MODERATE portfolio. It also recorded the smallest value of standard deviation and Beta level, as it is represented in the Table 6a.

Table 6a – *Performance metrics. GFC period: August 2007 – March 2009*

Quartile	Size	Average portfolio return	Standard deviation	Cumulative Return	β
SMALL	Less than $225 million	-0.03%	1.80%	-0.97%	0.24
MODERATE	$225 million to $762 million	0.03%	1.09%	0.47%	0.15
EXPANDED	$762 million to $4.6 billion	-0.49%	1.88%	-9.66%	0.27
LARGE	$4.6 billion to $9 trillion	-0.18%	1.13%	-3.59%	0.16
Average		0.38%	-0.17%	1.47%	-3.4%

Source: Author's computations based on eVestment data.

In the Table 6b, it could be observed that the Sharpe and Treynor ratios had negative values for all of the portfolios, yet the smallest negative value was registered by the *SMALL* portfolio. It also managed to deliver the highest monthly alpha of 0.43% and the highest Black-Treynor ratio of 1.79%.

Table 6b – *Risk-adjusted metrics. GFC period: August 2007 – March 2009*

Quartile	Alpha	Sharpe ratio	Treynor ratio	Black-Treynor
SMALL	0.43%	-0.13	-0.99%	1.79%
MODERATE	0.24%	-0.16	-1.18%	1.60%
EXPANDED	0.07%	-0.37	-2.52%	0.26%
LARGE	0.07%	-0.34	-2.34%	0.44%
Average	0.20%	-0.25	-1.76%	1.02%

Source: Author's computations based on eVestment data.

Following the GFC, it was interesting to analyze how the hedge funds performed in the post-crisis period and whether larger funds started to provide better results in comparison to smaller funds. In terms of the average portfolio return, the situation hasn't changed much, with the *SMALL* portfolio still earning more than its larger-sized peers. It also displayed the highest amount of risk. Thus, it could be said that returns diminish as asset base increases, with the exception noticed for the *EXPANDED* vs. the *MODERATE* portfolio (0.84% vs. 0.78%, respectively), as it can be noticed in the Table 7a.

Table 7a – *Performance metrics. Post-crisis period: April 2009 – February 2021*

Quartile	Size	Average portfolio return	Standard deviation	Cumulative Return	β
SMALL	Less than $225 million	0.92%	2.35%	255.34%	0.50
MODERATE	$225 million to $762 million	0.78%	1.80%	197.48%	0.39
EXPANDED	$762 million to $4.6 billion	0.84%	2.07%	219.54%	0.46
LARGE	$4.6 billion to $9 trillion	0.54%	1.40%	112.85%	0.31
Average		0.77%	1.91%	196.30%	0.41

Source: Author's computations based on eVestment data.

The last table displays the risk-adjusted performance for the four portfolios during the post-crisis periods. *SMALL* and *MODERATE* achieved very similar levels of alpha, of 0.22% and 0.23%, respectively. Sharpe, Treynor and Black-Treynor ratios were the highest for the *MODERATE* portfolio, followed by the *EXPANDED* and *SMALL* portfolios.

Table 7b – *Risk-adjusted metrics. Post-crisis period: April 2009 – February 2021*

Quartile	Alpha	Sharpe ratio	Treynor ratio	Black-Treynor
SMALL	0.22%	0.37	1.75%	0.44%
MODERATE	0.23%	0.41	1.90%	0.59%
EXPANDED	0.19%	0.38	1.72%	0.42%
LARGE	0.09%	0.35	1.61%	0.30%
Average	0.18%	0.38	1.75%	0.44%

Source: Author's computations based on eVestment data.

6. Conclusions and discussions

This paper analyzes the relationship between hedge fund size and its risk-adjusted performance. Given the importance of this asset class in the context of the global financial markets and the investors' increasing interest towards the underlying investments of hedge funds and the main determinants of their performance, it is essential to understand what drives performance for these investment vehicles.

Whether size impacts risk-adjusted performance has been the topic of a long-standing debate among both practitioners and academia, with the latter tilting towards an inverse relationship between size and performance (e.g.: Schneeweis et al. 2002, Harri and Brorsen, 2004, Agarwal et al., 2004, Ammann and Moerth, 2005).

Yet there are studies that document a non-negative or even positive relationship between hedge fund size and performance (e.g.: Gregoriou and Rouah, 2002, Koh et al., 2003, Getmansky, 2004).

The negative relationship between asset size and performance is backed by several arguments, such as: the manager's stock picking ability is hindered once the fund's asset base grows, as the universe is confined to the most liquid assets, hence limiting the exposure of small-capitalization stocks in the investment process; the increase of transaction fees, as more orders have to be executed; the failure of fees to align investors' interests with managers' ones, as a great portion of the management's fee is attributed to the size of the managed asset base (Kouwenberg et al., 2007, Broeders et al., 2019, Escobar-Anel et al., 2020).

On the other hand, there are also arguments for the positive relationship between size and performance, namely, as the hedge fund's asset base increases, synergies may appear among its various departments, thus, improving the overall fund's performance.

Given the theoretical and empirical debate around this issue, this paper contributes to the existing literature by testing the impact of size on the risk-adjusted performance on 245 US hedge funds, classified into eight different investment strategies. The analyzed period spanned from January 2005 to February 2021, as well as three sub-periods to isolate the pre-crisis, crisis, and post-crisis periods. The results fall in line with the previous evidence from the literature (e.g.: Schneeweis et al. 2002, Harri and Brorsen, 2004, Agarwal et al., 2004, Ammann and Moerth, 2005), namely, validating an inverse relationship between size and risk-adjusted performance, for most of the cases.

The portfolio that was constructed in the first quartile, delivered the highest return levels and the highest risk-adjusted performance values, in most of the cases. While the portfolio that was constructed in the fourth quartile, delivered, mostly, the lowest values for the risk-adjusted performance measures. For the whole analyzed period, the average portfolio return reached the highest value, of 0.75% in the case of the lowest (*SMALL*) quartile, hence validating the inverse relationship between fund size and return. The same could be said about the funds' registered cumulative return. From January 2005 to February 2021, hedge funds from the first quartile earned 310.6% in net return, more than doubling the returns from the fourth quartile. When it comes to returns on a risk-adjusted basis, the *SMALL* portfolio offered the highest alpha level, while the *MODERATE* portfolio scored the highest Sharpe, Treynor, and Black-Treynor ratios. The *LARGE* portfolio, which comprises the funds with the highest level of AuM, delivered the lowest risk-adjusted results and registered the lowest alpha level. Similar results were observed for the sub-periods. Thus, it could be concluded that as assets grow, risk-adjusted performance diminishes. Nevertheless, given the complexity of the interaction of all the variables affecting hedge funds' performance, investors should be prudent when choosing the funds to invest in, rather than relying solely on the size characteristics.

Furthermore, an analysis of all the hedge fund's fundamental characteristics, such as size, fees, strategies and age along with their subsequent impact on the risk-adjusted performance could be considered as a future research direction. Also, one aspect that could be deemed as a limitation of my methodology is that the AuM level was taken from the latest date available (reported in February 2021), similar to the method proposed by Gregoriou and Rouah (2002), while the majority of studies

take into account the average AuM level. This could also be considered as a future research direction together with splitting the database by deciles, instead of quartiles, to analyze how and whether the results will adjust.

To conclude, given the magnitude of the hedge fund industry in the context of the global financial markets, this paper has practical implications as well, as it contributes to the research efforts in the direction of guiding investors in taking the right decision and distributes capital towards the best-performing funds.

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GREEN BRAND POSITIONING FOR ORGANIC FOOD: A CONTENT ANALYSIS OF CORPORATE WEBSITES

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Abstract: The purpose of this paper is to provide a perspective on the positioning bases of the green brands present on the organic food market. The research method is the content analysis of secondary data sources. The study was based on the analysis of the informational content available on the corporate websites of green brands in the portfolio of processing companies present on the Romanian market. This study identified 18 positioning bases for the investigated green brands. The positioning bases belong mainly to the category of attributes, these being in particular specific characteristics of organic food. The study notes the existence of specific positioning bases for organic food brands. The results can help practitioners to communicate brand positioning in the online environment by developing appropriate strategies.

Keywords: green brand positioning, online environment, content analysis, organic food.
JEL classification: M31, Q57, M10.

1. Introduction

Consumer preferences and government policies increasingly favor a balanced approach by companies regarding the environment, with managers paying more attention to strategic decisions that may have an impact on environmental issues (Hollensen, 2011; Zameer et al., 2020). In addition to government and stakeholder pressure, many companies are adopting a green marketing strategy due to the actions of the competition (Leonidou et al., 2015; Iyer et al., 2019; Taherdangkoo et al., 2019; Tjahjadi et al., 2020), the high costs of disposing of environmentally harmful products or waste (Mishra and Sharma, 2010), or even in order to apply their business philosophy.

This way, Ginsberg and Bloom (2004) argue that there is no marketing strategy that is right for every company. Therefore, strategies should be adapted to the particularities of the market, the intensity of competition and the level of

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concern for the environment of consumers. In the case of the organic market, as is the case of other markets, a particular approach to marketing strategies is needed.

By approaching green marketing, companies have the opportunity to capitalize on environmental concerns in order to position their brands with the purpose of gaining new competitive advantages on new markets. Consequently, the ideas and values specific to green marketing can become a new way of positioning a brand, which also requires adapting the concept to the issues and particularities of the green market.

The topic of green brand positioning has drawn the attention of researchers (Hartmann et al., 2004; Hartmann and Ibanez, 2005; Haung et al, 2014; Suki, 2016; Wang, 2016; Gong et al., 2020; Lin and Zhou, 2020; Bursan et al., 2021), some specialists even considering that brand positioning is the most tangible discrepancy between green and conventional marketing (Rex and Baumann, 2007).

One of the most competitive areas in which green brands enjoy consumer appreciation and recognition is the organic food area. From a niche market to an autonomous sector, the organic food market is constantly growing (Willer and Lernoud, 2019), which has led to the expansion of the number of organic products and, implicitly, the number of green brands. Even in these conditions, the subject of the positioning of organic food brands has not been widely exploited in research (Zanoli and Naspetti, 2006; Padel and Gössinger, 2008; Barrena and Sánchez, 2010; Zander et al., 2010; Ćirić and Prodanović, 2013; von Meyer-Höfer et al., 2013, 2015; Vlahović and Šojić, 2017).

Zanoli and Naspetti (2006) state that the green brand positioning is mainly based on product attributes. von Meyer-Höfer et al. (2015) also have an approach based on the attributes of the products, starting from the attributes that result from the observance of the legislative norms. Because organic food is primarily characterized by credentials, organic certification is essential and supports brand positioning (Zanoli and Naspetti, 2006; Janssen and Hamm, 2011; von Meyer-Höfer et al., 2015). Instead, the benefits are not so widely studied in the field of organic food, especially the emotional and symbolic benefits. By comparison, the rational benefits are more frequently analyzed due to the close connection with the specific attributes and characteristics of organic food (Wright and McCrea, 2007; Naspetti and Zanoli, 2009). However, in the literature, there is no extended vision on how specific positioning bases are used, as well as on their importance in defining the brand positioning. The relationship between attributes, benefits, values or other possible associations and brand positioning is still poorly highlighted in the literature.

This paper aims to investigate the positioning bases that organic food brands communicate through corporate websites. Starting from the studies conducted by Wang (2016, 2017) in the field of green brand positioning in the online environment, and by deepening the typologies of the researched positioning strategies (Hartmann et al., 2004, 2005), the paper intends to identify a number of alternatives used in the online environment by green brands.

The topic of green brand positioning was studied on the market of organic food in Romania. Still needing efforts to make marketing more efficient and more adapted to the specifics of the market, but also to educate and attract consumers to adopt a pro-ecological behavior (Stoica et al., 2020), Romania has made obvious progress in this direction, especially due to the EU's contribution to the development of

this sector. The research was conducted among organic food processors, due to their concerns in the direction of building their own brands.

This study contributes to the research of the positioning of green brands in the dynamic field of organic food. The study notes the existence of specific positioning bases for the brands present in this market, offering a series of solutions for companies that want to develop a brand that stands out in the multitude of green brands. Also, by exploring the online environment, the study provides directions for communicating brand positioning through this channel, which has become essential nowadays.

2. Literature review

Green brand positioning

Having as a starting point the approach offered by classic marketing (Ries and Trout, 2001), the concept of green brand positioning has been enriched with specific values and principles of green marketing, integrating the preoccupation for the environment and for the needs of current and future generations of consumers.

This concept is often presented as having strong implications in the field of marketing communication. From this perspective, green brand positioning implies an active communication and entails the differentiation of the brand by highlighting its environmental attributes (Hartmann et al., 2005). Moreover, Suki (2016) considers that the green brand positioning is achieved through green attributes being integrated into active communication campaigns, which could induce a more positive perception of green brands amongst consumers. These views are in line with the theories of those experts who argue that positioning emphasizes brand communication (Ries and Trout, 2001; Kapferer, 2008). In this regard, the role of a green brand is exploited to help consumers differentiate them from other similar brands with the same functions (Rahbar and Wahid, 2011).

However, some authors (Saha and Darnton, 2005) believe that the position of a green brand should be considered from the perspective of the perception on its ecological reputation, rather than how it compares to competing brands. This is because a brand may be ecologically superior, but it may not have the ability to convey green attributes and benefits as well as competing brands. Therefore, establishing a position in relation to competition requires paying special attention to the elements of the marketing mix, especially the communication strategy.

Nevertheless, the opinions presented above do not capture the full complexity of the issue of green brand positioning, with particular emphasis on marketing communication, which is important only after establishing the brand positioning, as well as other elements of the marketing mix (Wilson and Gilligan, 2005). The importance of positioning strategy derives from the fact that it is considered the essence of the marketing mix (Schiffman and Kanuk, 2007).

In terms of the impact on the elements of the marketing mix, the green brand positioning is a critical strategy for a brand (Huang et al., 2014), which has the role of influencing the perceptions of the consumers targeted by the green brand initiatives, providing an essential basis for differentiating the green brand from its competitors.

The consumer is particularly important in the process of positioning, and it is necessary to constantly refer to it in order to choose and maintain the desired green position. In this sense, all actions of an organization that wants to position itself

as environmentally friendly must meet consumer expectations (Polonsky and Rosenberger III, 2001). Consequently, the incorporation of environmental aspects in the brand positioning strategy must take into account the target consumer segment. For example, Belz and Schmidt-Riediger (2009) consider that organizations that are positioned in the price and/or premium quality segment are more inclined to adopt green marketing strategies than those that try to differentiate by price.

Starting from a series of well-known opinions in the field of brand positioning (Ries and Trout, 2001; Kapferer, 2008), Huang et al. (2014) considers the green brand positioning part of the brand identity and the value proposition regarding green attributes, which must be actively communicated to the target audience. Thus, in order to gain the desired position for a green brand, marketing communication must be used to create a distinct identity in the minds of consumers. In addition to providing the attributes and functional benefits desired by consumers, green brand positioning also implies satisfying emotional needs and building an affective relationship with the customer (Coddington, 1993, cited in Hartmann et al., 2005). Therefore, green brand positioning can be considered a subset of attributes, benefits and environmental values that have the ability to convince green customers to be loyal to green products and brands (Hartmann et al., 2005; Amin et al., 2015).

However, it is not only the green elements that are important in establishing the positioning of a green brand. It is also necessary to establish the degree to which green attributes are used to communicate to the market how the product/brand differs from existing ones (Driessen et al., 2013). Thus, some specialists (Mera, 2003; Belz and Karstens, 2005; Driessen et al., 2013) consider that this decision entails establishing the need to position the green brand on the basis of the combination between green attributes and traditional attributes, specific to conventional products, and the determination of which of the two attribute categories is the dominant one.

In conclusion, a well-implemented green brand positioning strategy can, overall, lead to a more favorable perception of the brand, thus providing support for the overall marketing approach (Hartmann et al., 2005). Positioning must give to a green brand a position to convey its ability to reduce the negative impact on the environment and human health, while not forgetting to best meet the basic needs of consumers.

Green brand positioning in the field of organic food

While organic food markets are still considered a relatively small niche, opportunities to position organic products are found in a wide range of approaches. The key to understanding the nature of these alternatives is to know the value created by offering eco-friendly products to the customer and by including them in a company's value proposition (Dean and Pacheco, 2014).

Companies present on the organic food market can focus primarily on the characteristics of the product, having the opportunity to highlight the organic or natural composition of the product and the fact that it does not contain food additives. Also, if we refer to intangible attributes, the corporate/brand identity is communicated and the philosophy or nature of the production process can be highlighted: the fact that food is traditionally manufactured by a family company, which is focused on animal and environmental welfare (Brüggenwirth, 2006). If some or most of the attributes are of a superior level, the organization may want to position its brand as superior or as a technological leader.

Zanoli and Naspetti (2006) state that the green brand positioning is mainly based on certain attributes of products, either positive (better taste, authentic, natural etc.) or negative (without chemicals, non-GMOs, no artificial flavors, no preservatives, etc.). At EU level, brands choose to position themselves through attributes which are also regulated by the legislation in the field. These specific attributes of organic products were analyzed by von Meyer-Höfer et al. (2015). Often, these attributes are held by all certified organic products, therefore they can represent points of differentiation only in a few cases. Instead, they often need to be associated with other attributes or other positioning bases. Also, in the case of the attributes regulated by EU legislation, it is very important how they are represented through the marketing mix, as they can be put in an unique light, especially through the way the communication strategy is implemented.

By studying the literature, other attributes were identified, compared to those included in EU regulations, which are often used to position brands of organic products. Among these green attributes we mention: good/authentic/ intense/natural taste (Fillion and Arazi, 2002; Naspetti and Zanoli, 2009; Asioli et al., 2014; von Meyer-Höfer et al., 2015; Hemmerling et al., 2016; Sidali et al., 2016), high nutritional content (Naspetti and Zanoli, 2009; Sidali et al., 2016); ecological packaging (Magnier et al., 2016; Steenis, 2019); local/regional production (Zander and Hamm, 2010; Roosen et al., 2012; Sidali et al., 2016).

On the other hand, positioning through benefits is one of the most natural alternatives that a brand can use to gain a certain position in the minds of consumers. Therefore, studying the reasons for buying and the benefits desired by consumers could support the brand in choosing a successful position on this market. Research has found that occasional consumers have become loyal buyers of organic products only when they were convinced of the positive benefits for health, environment and animal welfare (Wright and McCrea, 2007).

We must also not forget the food safety guaranteed by organic products. Food safety is linked to the risks perceived by consumers regarding the ingestion of "harmful substances" through their diet (Naspetti and Zanoli, 2009). Organic food should be positioned is such a way as to ensure food safety for those prevention-focused consumers who want safe, pesticide free food and consistent quality. Conversely, promotion focused consumers are trying to attain two consequences: one is the egoistic goal of individual health, a cheerful life and classic or old-fashioned aesthetics, and the other is related to altruism or an interdependence-others orientation (Chen et al., 2015). Finally, it can be difficult to distinguish whether buyers are behaving out of altruism, as a result of a sense of individual responsibility or a desire to signal a certain social status, because motivations are likely to be interrelated (Dean and Pacheco, 2014).

Due to the fact that organic products favor a strong emotional involvement (Zanoli and Naspetti, 2006), compared to other food products, green brands may choose to be associated with emotional/symbolic benefits. Marketers could successfully position organic products based on emotional and symbolic benefits, related to the sensory pleasure of consuming organic food and feelings of security, satisfaction and pride derived from improving health for themselves and their family (Bozga and Cristea, 2016).

An essential feature of organic products is related to the organic certification scheme that can be associated with the brand. Thus, being symbolic products that

consumers perceive mainly on the basis of credentials, such as the logo specific to the certification body (eco-label), it is extremely important that the product be positioned in terms of terminal value (Zanoli and Naspetti, 2006).

These tools give consumers the opportunity to choose between products with similar visual elements, differentiating between them. Mentioned among extrinsic quality indices, they serve as signs of quality before any other experience. They act as trusted creators and are linked to the level of consumer experience (Bredhal, 2003, cited in Naspetti and Zanoli, 2005). Using other logos specific to different certification schemes in addition to the mandatory logo can be an effective strategy if consumers associate added value to the additional logo, such as stricter standards, higher food security or any other aspect of perceived quality (Janssen and Hamm, 2011; von Meyer-Höfer et al., 2015).

3. Research methodology

The purpose of this exploratory research is to study the content of the positioning communicated for organic food brands that are in the portfolio of certified organic food processors in Romania. The study aims to identify the bases of green brand positioning, as well as their importance in terms of communicating the brand's position in the online environment.

Research method

The research method is the content analysis of secondary data sources in the online environment. During the process of data collection and analysis, an exploratory study was conducted to identify, analyze and describe the positioning bases used by the identified brands. The study was based on the analysis of the informational content available on corporate websites.

Defining the target population and the sampling frame

The target population consists of Romanian companies that hold an organic certification granted by an accredited certification body. Among the operators registered in organic farming (producer, processor, trader, importer, exporter, operator in spontaneous flora, operator in aquaculture), the most susceptible economic agents concerned with the development of organic brands are processors. Thus, the target population consists of all processing companies for which the organic certificate is published on the official website of the Ministry of Agriculture and Regional Development (MADR, 2018).

In addition to holding an organic certification and to being included in the category of processors, additional selection criteria were established so that the companies included in the sampling frame would meet the purpose of the research:

a. The company must have an official website;
b. The company must process and/or package organic products under its brand;
c. The offer available on the official website must include organic food products;
d. Products sold under their brand must be addressed to individual customers.

The fulfillment by the companies of the last three selection criteria was verified exclusively on the basis of the information presented on the website. In the absence of this information, the company is excluded from the sampling frame.

Collecting data on the target population and establishing the sampling frame

In order to identify the companies processing organic products that meet the criteria mentioned above, between February 9 and 17, 2020, the MADR website was accessed in order to select processors that have an organic certificate issued in 2018. Analyzing the data published by the certification bodies, 148 processing enterprises registered in organic farming in 2018 were identified (one of the companies was eliminated because it was present twice).

For the 147 processing companies, the existence or non-existence of an official website was identified. In this sense, between April 7 and 10, 2020, the Google search engine was used to identify the websites. It was intended that the identified website should clearly specify the name of the company in one of the sections of the website (usually, the name of the company was identified in the sections "Terms and Conditions" or "Contact"). Following this stage, in the case of 54 companies an official website has not been identified, while in the case of another 6 companies it was found that the website is under maintenance, under construction or currently unavailable. After this stage, the other three criteria (b, c and d) were applied, as we can observe in Table 1.

Table 1. Selection of the sampling frame

Selection criteria	Variables investigated	N
	Target population	**147**
A	>Companies for which an official website has not been identified	54
A	>Companies whose website is in maintenance, in construction or currently unavailable	6
A	**>Companies for which an official website has been identified, of which:**	**87**
B	>>Companies that do not offer food products	3
B	**>>Companies that offer food products, of which:**	**84**
C	>>>Companies for which no organic products have been identified	14
C	**>>>Companies for which organic products have been identified, of which:**	**69**
D	>>>>Companies for which it has not been identified on the website that sell their products to individual customers	10
D	**>>>>Companies for which it has been identified on the website that sell their products to individual customers**	**59**
	Sampling frame	**59**

Finally, 59 organic certified processing companies remained in the investigated group, whose website was analyzed.

Data collection and analysis

Each of the 59 corporate websites was accessed and viewed in order to determine what information is related to the green orientation of the company and the brand and what information is related to organic products. The entire content (in the form of text) present on the website was analyzed, but particular attention was paid to the elements that could represent evidence of the use of positioning bases in order to communicate the chosen positioning strategy. The gathering of information from the websites took place between April 7 and 30, 2020.

Content analysis was performed using nVivo 12 software, which facilitated the analysis of information extracted manually from corporate websites. The selected information was considered the main data for analysis. The importance of using nVivo software in conducting exploratory research has been pointed out in numerous papers. Also, a wide variety of research questions can be answered by exploring communication in the online environment (Jackson and Bazeley, 2019).

Content analysis was used to classify the categories and concepts that appeared in the collected data. The research was based on codes created by the researcher, based on the topics and themes identified in the selected text on corporate websites. At a first analysis of the selected text, 47 codes were created. After that, the text was read for the second time, and the codes were refined, being grouped into more general categories, which could better represent the content identified on all websites analyzed. Thus, in the end, 18 codes resulted. The nVivo software was used to help encode. Examples of codes can be found in Table 2.

Table 2. Examples of codes built on the bases used to position an organic food brand

Code name	Content identified on the website
Raw food	*"This raw vegan product, obtained by concentrating in vacuum at a temperature of max 42°C, without pasteurization, has a high content of natural fruit sugars, rich in vitamins and antioxidants, without added sugar, preservatives, additives or dyes. The manufacturing process ensures the preservation of nutrients, phytonutrients and aromas of grapes"* (RAW-E) (Phenalex, 2020)
Maintaining or regaining health and adopting a healthy lifestyle	*"In order to grow up beautiful and harmonious, the child must have a healthy base structure, which will allow him to enjoy all the special moments of childhood. 1BIO3 milk is enriched with 21 vitamins and minerals, for the balanced development of the little ones"* (OLYMPUS 1BIO3) (Fabrica de Lapte Brașov, 2020)
Naturalness and purity	*"In obtaining the wines from this range, we used only what Mother Nature offered us to the fullest: earth, air, water, sun. These are the only ingredients, used naturally to get the most out of each grape"* (BUDUREASCA ORGANIC) (Viile Budureasca, 2020)
Local/regional production	*"The factory continues the local tradition of trout processing by smoking. Valeputna, the Premium brand under which we sell our products, is a tribute to the first trout farm in Romania - founded here in 1896 under the name of "Valeputna Fischbruthutte" - and to the artisans to whom we owe the secrets of the recipe for smoking. In Putna Valley was invented the local delicacy known as Cobza, smoked trout with fir cones and beechwood, dressed in fir-tree branches and tied in hazel twigs"* (VALE PUTNA) (Quality Natural, 2020)
Product safety	*"Organic milk is carefully tested and verified at each factory reception. The tests monitor both milk quality (fat, protein, density) and microbiological safety (germ loading, accidental contamination)"* (ZUZU BIO) (Albalact, 2020)

4. Research results

Positioning bases used for organic food brands

Based on the content analysis, there were 18 elements (codes) that can be positioning bases for green brands (see Table 3). Also, in the elaboration of the codes, the studies carried out on this subject were taken into account (Hartmann et al., 2005; Naspetti and Zanoli, 2009; Zander and Hamm, 2010; Insch, 2011; Juwaheer et al., 2012; Ćirić and Prodanović, 2013; Driessen et al., 2013; Haryanto and Budiman, 2014; Huang et al., 2014; Matthes et al., 2014; Amin et al., 2015; von Meyer-Höfer et al., 2015; Wang, 2016, 2017; Vlahović and Šojić, 2017), specifying that the subject of positioning the brands present on the market of organic food products is weakly highlighted in the literature.

Table 3. The results of the content analysis

No.	Elements (n=18)	Concepts involved
1.	**Absence of chemical pesticides and mineral fertilizers**	without the presence of pesticides, insecticides, synthetic fertilizers or other chemicals; natural fertilizers; natural processes for nutrients and pests, diseases or weed control; natural methods of soil care;
2.	**Animal welfare**	protection of habitats and natural living conditions; animals raised freely in clean areas with natural food sources; animals fed and bred according to the standards imposed by EU regulations;
3.	**Brand/product exclusivity**	limited series; locally/worldwide unique product; premium/super-premium brand;
4.	**Contact with nature**	care for nature; in harmony with nature; natural environment (open-air, pastures, mountain landscape etc.);
5.	**Environment protection**	protected natural area; ecosystem; preserving the quality of the environment; ecologically sustainable system; sustainable development; low impact on the environment; environmental management sustainability; crop rotation; protects the soil and ecosystems;
6.	**Freshness**	make-to-order production; short time interval between harvesting and delivery to the customer; product made from fresh raw materials; storage system; packaging methods; short supply chains;
7.	**Local/regional production**	local product/ingredient; short supply chains; tradition/Romanian traditions; local varieties; local processing tradition; local resources; manufactured in Romania; authentic Romanian taste; rural environment; full Romanian capital/Romanian company; 100% Romanian product/brand; sustainable development of the village and the country; local/small farms; original/authentic products; products "like at my mother's house"; old/local recipes, collected and passed down from generation to generation; rural tradition; Romanian cuisine;
8.	**Low number of chemicals and non-GMOs**	without food additives, enhancers, stabilizers, GMOs, artificial sweeteners, emulsifiers, preservatives, dyes, artificial flavors, thickening/ growth agents etc.; products as close as possible to the natural state; do not contain traces of antibiotics, insecticides etc.;

No.	Elements (n=18)	Concepts involved
9.	**Low resource consumption and use of renewable energy**	use of by-products; separate collection of rainwater; alternative energy sources (vegetable oil, solar panels etc.); control of energy consumption; CO_2 absorption; renewable resources; food waste reduction;
10.	**Maintaining or regaining health and adopting a healthy lifestyle**	healthy lifestyle; healthy product; diet; immunity; nutrition; balanced diet; beneficial effects on the body (increased immunity, energy supply etc.); healthy diet; physical well-being; vegan/vegetarian diet;
11.	**Manufacturing technology and production/processing process**	meticulous processing; minimal processing; traditional methods; delicate pressing; natural fermentation process; artisanal methods; without heat treatment; cold pressing; slow grinding; modern equipment and automation; production laboratories; technological system;
12.	**Naturalness and purity**	natural product; pure product/ingredient; 100% natural; intact natural properties; virgin soils; non-counterfeit products; undetectable levels of residues; simplicity;
13.	**Nutritional and sanitary values**	rich content of minerals, antioxidants, fiber, vitamins, proteins, polyunsaturated fatty acids, macro and micro nutrients and phytonutrients etc.; low acidity; vegetable source of protein, fiber etc.; product of high nutritional value; superfood; minimum fruit content; food with integral value; whole product;
14.	**Positive emotions and feelings**	good feeling; positivity; harmony; inner peace; calm state; relaxation; the joy of life;
15.	**Quality**	quality product/ingredient; quality standards (ISO 9001, ISO 22000, FSSC 22000, etc.); premium/super-premium quality; superior quality compared to conventional products; exceptional varieties; verified/selected raw material suppliers; integrated quality system; quality assurance; certified quality; quality control in the supply chain; qualitative selection; quality assurance; total quality assurance; permanently controlled quality;
16.	**Raw food**	not processed by temperatures above 42°C; raw food; minimally processed items; preserving everything that is best from nature (nutrients, phytonutrients, flavors etc.); raw vegan product; without pasteurization;
17.	**Safety**	own laboratory; food safety; laboratory analyzes: physical-chemical, microbiological and contamination; analysis bulletins; checking the quality of the raw material and the finished product; internal and external analysis plan; certified and accredited laboratory; control system; traceability; health rules;
18.	**Taste**	savory taste; delicious taste; distinctive taste; maximum flavor; retains primary/natural flavors; pure taste; better taste; authentic taste; intense taste; delight for the senses/explosion of delight for the taste buds; fine taste; real fruit taste; perfect taste; fruity taste;

As we can see, most of the elements identified based on content analysis are characteristic of the products that represent the brand, being largely their attributes. We can identify both attributes that are rather specific to organic food, such as: "absence of chemical pesticides and mineral fertilizers" or "low number of chemicals and non-GMOs", as well as attributes that can be representative of any product food: "taste", "quality", "freshness" or "local/regional production". Also, the variables in the category of benefits are lower in number compared to those in the category of attributes.

Frequency of the positioning bases used to communicate the positioning strategy for organic food brands

Table 4 shows the frequency of occurrence of the codes, as well as the number of references for each code. Also, the share of these codes among the analyzed companies was established.

More than half of the brands choose to communicate elements related to the quality of organic products through the official website. This is not necessarily an attribute that can be associated exclusively with organic products (differentiation point), but can be considered an important positioning base for a green brand, as they usually choose to position themselves on the premium or super-premium segment. Also, an equally important variable is "maintaining or regaining health and adopting a healthy lifestyle", this being identified on 54% of the websites. The benefits of organic food for the body and general health, as well as the contribution to a healthy lifestyle and a balanced diet, are among the elements that the brands present on their websites.

Table 4. Frequency of codes and references among companies included in the investigated group

No.	Code/concept name	No. of companies for which the code has been assigned	No. of references made on each code	Share of the no. of companies for which the code was assigned in the total no. of companies
1	Absence of chemical pesticides and mineral fertilizers	5	9	8%
2	Animal welfare	3	3	5%
3	Brand/product exclusivity	9	12	15%
4	Contact with nature	8	9	14%
5	Environment protection	11	19	19%
6	Freshness	9	11	15%
7	Local/regional production	26	53	44%
8	Low number of additives and non-GMOs	10	13	17%
9	Low resource consumption and use of renewable energy	7	9	12%
10	Maintaining or regaining health and adopting a healthy lifestyle	32	74	54%
11	Manufacturing technology and production/processing process	24	52	41%
12	Naturalness and purity	15	23	25%
13	Nutritional and sanitary values	17	28	29%
14	Positive emotions and feelings	9	14	15%
15	Quality	35	75	59%
16	Raw food	7	11	12%
17	Safety	10	13	17%
18	Taste	22	34	37%
Number of companies included in the investigated group		**59**	-	-

Due to the fact that the investigated group of companies includes only processors of organic products, 44% of enterprises highlight on their websites that production/processing is done locally, the products being promoted as Romanian/ local/traditional. The quality of the products, the main positioning bases identified, is supported by the manufacturing technology and the production/ processing process, a variable that is found in the content retrieved from the websites of 41% of the analyzed companies.

As a result of the fact that the analysis is carried out for organic food brands, it is understandable why the variable "taste" is among the variables frequently communicated by the analyzed websites. Other variables that may be specific to the brands present on this market are those related to the nutritional and sanitary values of organic products, as well as the promotion of naturalness and purity of the product, occupying the following places as importance in terms of content identified on the analyzed websites.

It should be noted that 12 of the identified variables are found in less than 20% of the analyzed companies. This category includes most variables that can be linked to providing benefits to consumers (with the exception of the variable "maintaining or regaining health and adopting a healthy lifestyle"), namely: "environmental protection", "safety", "product/brand exclusivity", "positive emotions and feelings", "contact with nature" and "animal welfare". On the other hand, the variable "freshness" is more difficult to use, given that most companies process the food they sell under their own brand. Also, a small number of companies have the opportunity to manufacture organic food through thermal processing at low temperatures (below 42°C), which is why the variable "raw food" is so poorly highlighted in the content on the website.

The absence of chemical pesticides and mineral fertilizers (8%), as well as the low number of additives and the lack of genetically modified organisms (17%), were not so frequently identified in the content collected on the websites. It is also noted that efforts to produce low-resource or renewable energy products are not a priority for the companies included in the analysis or do not consider this to be so important and relevant for brand positioning, so as to communicate it to the public.

5. Discussions

This study identified 18 positioning bases for the investigated green brands, as they resulted from the analysis of the content identified on the corporate websites. The identified positioning bases are both attributes that are rather specific to organic food, as well as attributes that can be representative for any food. This approach may also be used for identified benefits, which are fewer in number. These results support the existence of a balanced strategy, which in the opinion of some specialists (Hartmann et al., 2005) has the most important results in generating a positive attitude towards the green brand.

In the case of a balanced positioning strategy, the socio-ecological dimension is approached with the same intensity as other bases specific of conventional products (Belz and Karstens, 2005). Choosing a combination of primary and green attributes and benefits leads to avoiding the myopia of green marketing (Ottman et al, 2006). Also, Mera (2003) considers that positioning only by using the green attribute is not usually effective, because this attribute is not the only one, nor the main attribute that the consumer requests at the time of the purchase decision.

The current study investigates brands that represent food, leading to the emergence of specific attributes that may represent potential positioning bases. Thus, variables such as: "taste", "raw food", "low number of chemicals and GMOs", "freshness", "nutritional and sanitary values" are representative for these brands. Some of these attributes were conceptualized by von Meyer-Höfer et al. (2015), starting from EC Regulation 834/07. Regarding the benefits, one of the functional benefits can be directly associated with the category of organic food, namely "maintaining or regaining health and adopting a healthy lifestyle".

Regarding the importance of the positioning bases identified in the content presented on the analyzed websites, the most frequently used by the analyzed brands were: "quality", "maintaining or regaining health and adopting a healthy lifestyle" and "local/regional production". On the other hand, some bases signal concern for environmental protection ("absence of chemical pesticides and mineral fertilizers", "low resource consumption and use of renewable energy").

These results are in compatibility with the reasons for buying organic products declared by Romanian consumers. Numerous studies have shown that consumers are more motivated by personal benefits than by concerns for the well-being of society and care for the environment (Stoica, 2020). The main reason identified in most studies is related to health (Roman et al., 2015; Vietoris et al., 2016; Petrescu et al., 2017), followed by high quality and better taste of organic products (Bozga, 2015). In contrast, care for the environment is not the main reason stated by consumers (Bozga, 2015; Voicu and Iliescu, 2015; Roman et al., 2015; Petrescu et al., 2017). In this regard, Bozga and Cristea (2016) consider that vegan products could be positioned based on their purity, expressed by the lack of chemical fertilizers, growth stimulants, herbicides, pesticides, insecticides etc., while in the case of processed products, a point of differentiation is the lack of food additives.

Compared to similar conventional products, in the case of green products, a strategy of qualitative differentiation is certainly recommended. Such an approach is based on both the intrinsic qualities of organic products and the consumer's perception on organic products. In principle, belonging to the category of organic products itself is a strong distinguishing feature from conventional products. This qualitative differentiation is also made by Romanian consumers, as indicated by the research conducted by Petrescu and Petrescu-Mag (2015). This positive image of organic food is due, as indicated by the results of research conducted by Voinea and colleagues (2015), to the following factors involved: origin in organic farming, additional input of nutrients with a positive impact on health, but also reduced quantity of substances with a negative impact on it, high food safety and superior organoleptic characteristics. However, given the low level of information and the unclear image that Romanian consumers have about organic products, highlighting some attributes (points of differentiation) can be extremely useful for the success of a green brand (Bozgă, 2017).

Theoretical implications

This study contributes to the research on the positioning of green brands. Compared to previous research (Hartmann et al., 2005; Haung et al., 2008; Wang, 2016; Wang, 2017), this study serves as a first attempt to develop the topic of

positioning existing brands in the organic food market. Therefore, the study notes the existence of specific positioning bases for the brands present in this market. The identified positioning bases refer mainly to the category of attributes, these being mainly specific characteristics of organic products.

The study contributes to the research on green brand positioning in the online environment. Also, the research studies the positioning bases communicated at the level of a single category of partners in the organic supply chain, namely organic food processors.

Managerial implications

The obtained results can provide a series of solutions for practitioners who wish to develop a brand that would be representative for their green offer, which will differentiate itself from the rest of the brands present in this market. The study offers a series of positioning bases specific to the brands on the organic food market, presenting in detail the concepts involved in all bases as well as the relationships between them. Consequently, managers have the opportunity to create a mix between them, in order to outline a balanced positioning strategy.

The results can help practitioners to communicate brand positioning in the online environment by developing appropriate strategies. Corporate websites should be seen as a tool that plays a key role in transmitting and supporting brand positioning, as well as in increasing its value. The communication of the attributes and/or benefits that describe the desired positioning must be done in a clear and consistent manner, in order to ensure that the communicated positioning coincides as closely as possible with the desired positioning.

Conclusions

This article paves the way for research into the field of green brands in the organic food market, offering a number of specific positioning bases. The study is the first that analyzes the topic of brand positioning on the organic food market in Romania. This topic is of interest to companies that are struggling in finding a distinctive place in this market.

In order to provide a realistic basis for evaluating the results of exploratory research, it is important to specify the main limitations of this study. They can be used to develop future studies that aim to deepen the topic of positioning for a green brand in the online environment.

The analysis of secondary data did not include all the enterprises that sell under their own brand organic food on the Romanian market. The research was conducted among organic food processors, but there are other categories of certified economic operators (agricultural producers, traders). Research that would include all types of certified economic operators could provide an overview of the content of positioning communicated on companies' websites and could help to identify differences in the positioning alternatives chosen for the brand.

The application of the selection criteria for the composition of the investigated group was made mainly based on the analysis of the information present on the identified websites. Although there is a certainty that all enterprises

included in the target population are processors of organic products, in terms of compliance with the other selection criteria, the results obtained may be affected by a number of elements: lack of information on the website, incomplete presentation of information, the existence of outdated information regarding the current activity of the company, omission of information or misinterpretation by the researcher.

The research is based only on the content taken from the official websites, which cannot represent a complete picture even on the positioning disseminated by the company regarding the brand in the online environment. All the communication media used has the role of disseminating the positioning for the brand. In addition, only the content in the form of text was extracted from the websites, but it should be noted that the images, the design, the graphics of the website etc., have a role in shaping the brand positioning and influence consumer perception.

We must specify that only one researcher was involved in the creation of the codes, therefore the replicability (Krippendorff, 2013) of the codes analyzed in this paper cannot be ensured. This was possible by hiring a second researcher to work independently and apply the same coding instructions to the same units of analysis (Wang, 2016).

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THE FOURTH INDUSTRIAL REVOLUTION: EXPLORING THE DETERMINANTS OF INTERNET ACCESS IN EMERGING ECONOMIES

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Abstract: With the rapid developments and changes in technology in the Fourth Industrial Revolution being witnessed everywhere, this study aimed to investigate the factors that influence access to the internet by households in emerging economies with a direct focus on South Africa one of the countries in Sub-Saharan Africa. Access to broadband facilities by individuals, households and consumers is one of the critical components of the economic growth and prosperity of a country. It is generally believed that the access to broadband technologies by a community or nation helps to increase productivity which assists a lot in fueling economic growth which will have an impact on the levels of poverty. Using the logistic regression, the study found out that race, access to telephone landline, access to a cellular cellphone, access to electricity, owning a house, gender, age of the household head, net household income per month, and household expenditure were the significant variables in influencing the demand for internet access by households in emerging economies. The factors that were more important in the influence on access to the internet were the availability of electricity and access to a cellphone. Therefore, the study concludes that to improve the quality of life of the people, it is imperative that the governments across the world, do invest more in improving access to quality internet, but one of the prerequisites is that households should have a stable electricity supply and they have access to cellphones.

Keywords: access, determinants, the fourth industrial revolution, internet access, South Africa
JEL Classification: L8, M15.

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1. Introduction

The Fourth Industrial Revolution (4IR) is becoming more and more real to humanity. One of the factors that cause people to be anxious about the developments is the fact that 4IR is associated with the potential of raising global incomes which will help in the improvement of the quality of life of the people (Mhlanga & Moloi, 2020). However, it is also believed that the 4IR will come with disruptions in almost all the sectors of the economy (Schwab, 2017). There is a general belief that 4IR will be greatly associated with greater inequality, severe job losses, climate change risks such as heatwave and the rising of oceans. The 4IR is characterized by the fusion of technologies that is blurring the lines between the physical, digital, and biological worlds (Xu et al., 2018)

Scholars believe that the 4IR is building its strength on the capabilities of the third industrial revolution and it is characterized by various technologies such as mobile supercomputing, intelligent robots, self-driving cars among other notable technologies (Schwab, 2017). Schwab (2017) went on to argue that with the potential of the 4IR the world has a lot of potentials to connect billions of people to digital networks which will improve the efficiency of organizations. Schwab (2017) also asserted that the ability to connect the world can also assist in the management of assets in ways that can help in regenerating the natural environment which can go on to undo the damage of the past revolutions. Without proper, affordable, reliable, and efficient internet connectivity it will be very difficult for a community or a government to be able to realize the benefits associated with the 4IR let alone to be able to hedge against the potential problems associated with this revolution (Lee et al., 2018). This was supported by Schwab (2017) who argued that with the rapid changes in technology governments may fail to adapt, employ, and regulate new technologies to be able to effectively capture their benefits.

All this points to the fact that internet connectivity, the issue of the digital divide by some of the central technology that should be available to the people (Lee et al., 2018; Schwab, 2017).

The changes over the years in internet access technology, from dial-up to broadband, have caused a considerable debate on the digital divide (Flamm & Chaudhuri, 2007; Lembani et al., 2020). Currently, much focus is on ubiquitous broadband and high speed city-wide wireless access (Flamm & Chaudhuri, 2007; Lembani et al., 2020). Access to broadband facilities by individuals, households and consumers is one of the critical components of the economic growth and prosperity of a country. It is generally believed that access to broadband technologies by a community or nation helps to increase productivity which assists a lot in fueling economic growth which will have an impact on the levels of poverty (Grosso, 2006; Lembani et al., 2020). The emergence of bandwidth-intensive technologies such as video communication, 5th generation network and various applications has reinforced the importance of access to broadband and its importance in the development of a community, region and even continent (Drake et al., 2019; Grosso, 2006). Kekana (2013) also argued that broadband access can come with many benefits on productivity, education, health, internet inclusion economic growth and development. The argument by Kekana (2013) was that to achieve substantial progress in health care, education, business, and government access to speed and stable internet are some of the prerequisites. This was also supported by Ang et al. (2020) who argued that internet use becoming

a necessity, yet older adults may not use the internet due to health and non-health reasons like lack of digital literacy or visual impairment and sometimes movement difficulties.

The World Bank (2020a) also supports the view that broadband access has a strong economic value for the government and the citizens. It is argued that internet access is a necessity for economic and human development in both developed and developing countries (The World Bank, 2020a). The World Bank (2020a) went on to argue that internet access is a powerful tool for delivering essential services like education and healthcare, increasing the opportunities for women's empowerment and environment sustainability, and contributing to enhanced government transparency and accountability. There is also an argument that internet access helps to foster the social development of communities. Various other studies documented the factors that influence households' access to broadband. Flamm & Chaudhuri (2007) analyzed the impact of the various socio-economic factors on the decision by households to subscribe to dial-up internet access.

The authors discovered that the price of broadband has an impact on access to broadband. Another study by Lera-López et al., (2009) assessed the impact of socioeconomic and demographic factors in influencing internet use and the frequency of use by individuals in Spain. Through employing binomial and ordered logit models the authors discovered that internet use was influenced by the level of education, age, occupation, employment in the service sector, the nationality of the individual, location that is where an induvial resides in urban areas and regional gross domestic product. The study also discovered that frequency is positively influenced by the level of education, gender, and the size of the population Lera-López et al. (2009).

Another study was done by Al-Hammadany & Heshmati (2011) discovered that the internet is one of the advanced technologies that are critical in facilitating communication and trade. In the same study Al-Hammadany & Heshmati (2011) conceded that from its inception in the 1960s, the internet has been so influential in the creation of opportunities and favorable conditions for growth in developing and developed nations. Al-Hammadany & Heshmati (2011) also highlighted that factors such as "*lack of adequate resources, insufficient incentives and encouragement from the government, and social inhibitions*" were the factors that were affecting the effective adoption of the internet in Iraq. Motivated by these findings the study intends to investigate the factors that influence internet demand by households in Sub-Saharan Africa with a specific focus on South Africa.
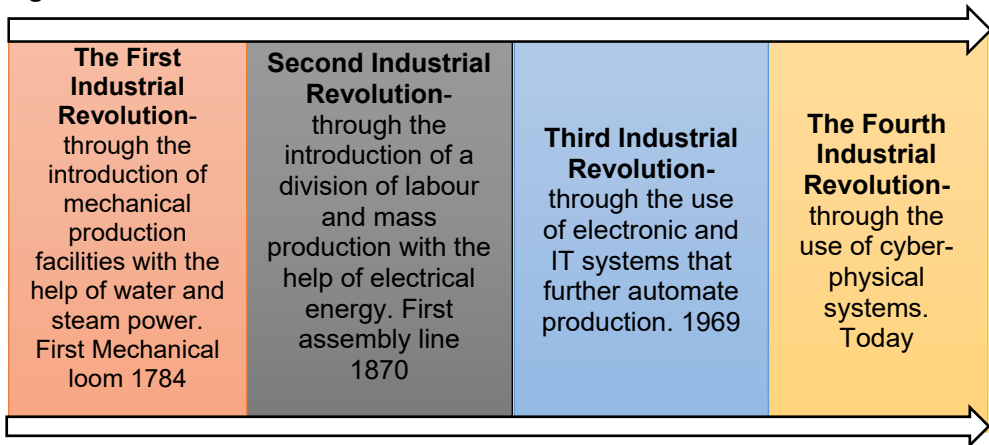
2. The Fourth Industrial Revolution

The world went through major technological advances termed the First Industrial Revolution, the Second Industrial Revolution, Third Industrial Revolution, and the Fourth Industrial Revolution (Li et al., 2017). The first industrial Revolution is argued to be started in Great Britain with the introduction of hydraulic and stream engine (Li et al., 2017; Schwab, 2017). The Second Industrial Revolution attained the separation of components and assembly of products based on specialization and division of labour (Lee et al., 2018; Mhlanga, 2020b). The Third Industrial Revolution is associated with a wide application of the electronic and information technology automation of manufacturing processes (Li et al., 2017). Currently, the world is going

through another wave popularly known as the Fourth Industrial Revolution characterized by the application of cyber-physical systems in the manufacturing environment (Mhlanga, 2020; Schwab, 2017).

The Fourth Industrial Revolution is creating hyper-connectivity based on monitoring, analyzing and digitizing with an impact on how human and machine, human and human, machine and machine (Park, 2018). Hyperconnectivity is making communication to be universal, global and to be instant communication (Park, 2018). The Fourth Industrial Revolution is also characterized by wider application of artificial intelligence (AI) which is enabling data massive data processing including issues related to language processing and images which computers are not able to fathom (Park, 2018). Figure 1 is showing the fourth industrial revolutions.

Figure 1: Industrial Revolutions

| The First Industrial Revolution- through the introduction of mechanical production facilities with the help of water and steam power. First Mechanical loom 1784 | Second Industrial Revolution- through the introduction of a division of labour and mass production with the help of electrical energy. First assembly line 1870 | Third Industrial Revolution- through the use of electronic and IT systems that further automate production. 1969 | The Fourth Industrial Revolution- through the use of cyber-physical systems. Today |

Source Author's Analysis

The figure above shows the four industrial revolutions, the First Industrial Revolution, the Second Industrial Revolution, the Third Industrial Revolution and Mhlanga (2020a) stated that the impact of the Fourth Industrial Revolution on humanity will not only result in job losses but will also have an impact on how public and private goods are delivered. Chung & Kim, (2016) also believe that the Fourth Industrial Revolution is not only changing the "what" and "how" we do things, but also "who" we are.

3. A Brief Background of Internet Access

According to Statista (2020) as of July 2020, approximately 4.57 billion people were active internet users, which is 59 per cent of the global population. Countries such as the United States of America, China and India were ahead of many countries in terms of internet use (Statista, 2020). Globally online penetration was 59 per cent with Northern Europe being the first with a 95 per cent internet penetration rate among the population (Statista, 2020). United Arab Emirates (UAE), Denmark and South Korea were the nations with the highest internet penetration while North Korea was the country with the lowest internet penetration with virtually

no online usage penetration (Statista, 2020). For the period ending 2018, Asia was the region with the largest number of online users which were over 2 billion with Europe being the second with 705 million internet users (Seymour & Naidoo, 2020).

In developing nations, only 35 per cent of the population has access to the internet versus an average of 80 per cent in developed nations. Broadband is also becoming the basis for smart infrastructure for example intelligent transport systems and smart electric grids. These smart technologies are facilitated by new wireless technologies (The World Bank, 2020a). It is believed that internet access can help in the creation of jobs. The World Bank (2020a) stated that raising internet penetration in developing countries can transform the economies in a great way. For instance, The World Bank (2020a) indicated that if the internet penetration increases to 75 % of the population in all developing countries from the current 35% can help to add approximately US$ 2 trillion to the collective gross domestic product and subsequently create 140 million jobs around the world.

3.1. Internet Access in South Africa

Internet access in South Africa rose from 2.4 million which was 5.35 per cent in 2000 to approximately 5 million which was 8.43 per cent in 2008. The numbers further increased to 12.3 million which was 29.3 per cent in 2012 and 2016 the number of internet users rose to 29.3 million, this was 54 per cent of the population in South Africa (Stats SA, 2018). South Africa's internet penetration was the highest for the African continent which was 19.9 per cent. The total number of wireless broadband users in South Africa was more than that of fixed broadband users in 2007 and in 2012, the number of fixed broadband users was approximately 12.7 million while fixed-line broadband users were 1.1 million. Figure 2 shows a summary of internet users in South Africa in 2018 per province in South Africa.

Figure 2: Summary of Internet broadband users in South Africa
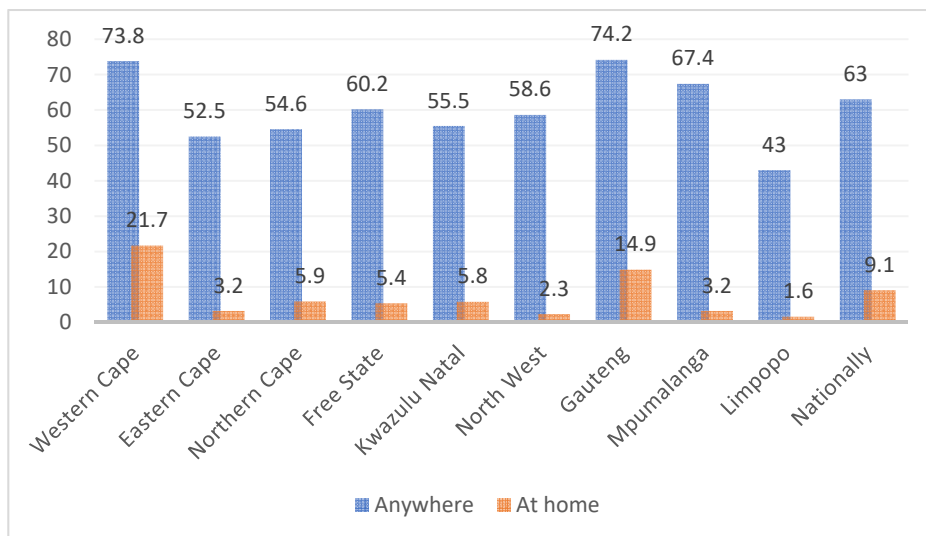
Source: Author's Analysis Stats SA (2019) data

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Figure 2 indicates that in South Africa, 63 per cent of households in South Africa had at least one member with access to or used the internet at home, internet cafes, place of work or place of study. The province with the highest use of the internet was Gauteng with 74.2 per cent followed by Western Cape with 73.8 per cent. Mpumalanga Province was the third province concerning internet use, with 67.4 per cent while Limpopo province was the lowest province concerning internet usage with 43 per cent. The table also showed that in South Africa Internet access at home was marginally about 9.4 per cent. The province with the highest internet access at home was Western Cape with 21.7 per cent followed by Gauteng with 14.9 per cent and the lowest was Limpopo with 1.6 per cent and North-West with 3 per cent (Stats SA, 2019). Figure 3 is showing individuals using the internet percentage of the population in South Africa.

Figure 3: Individuals Using the Internet (% of Population) in South Africa from 1996-2019
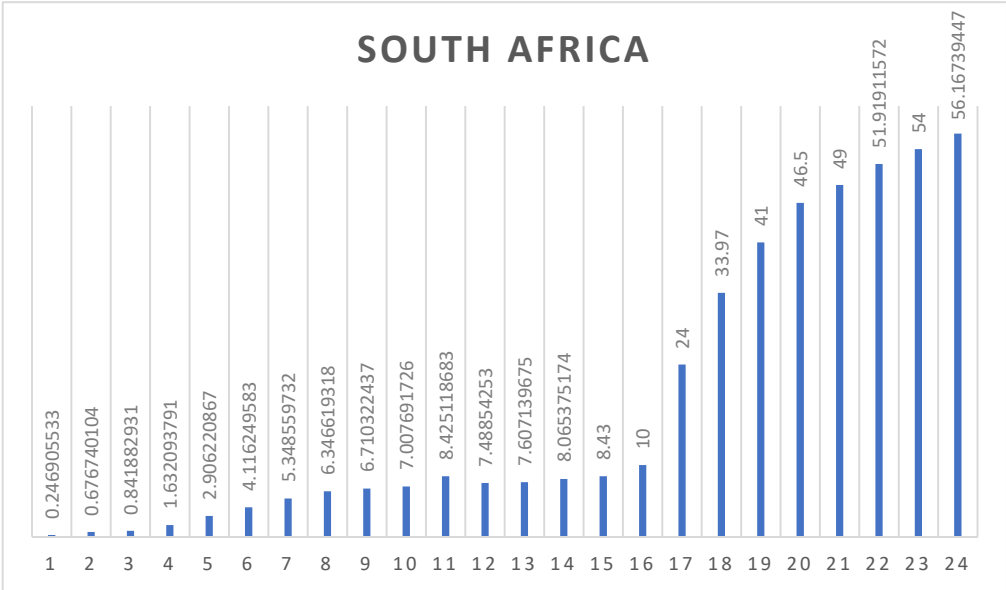
Source: The World Bank (2020b)

Figure 3 shows the individuals who are using the internet as a percentage of the population from 1996 to 2019. The information from the World Bank (2020b) was not different from the information given by Stats SA (2018). The information from the World Bank shows that Internet use in South Africa has been increasing over the years. In 2019, internet use as a percentage of the population was at 56 %. Figure 4 is comparing internet use in South Africa as a percentage of the population with other African countries, which are Zimbabwe, Zambia, Tanzania, and Uganda.

Figure 4: Individuals Using the Internet % of Population in selected African countries from 1996-2019
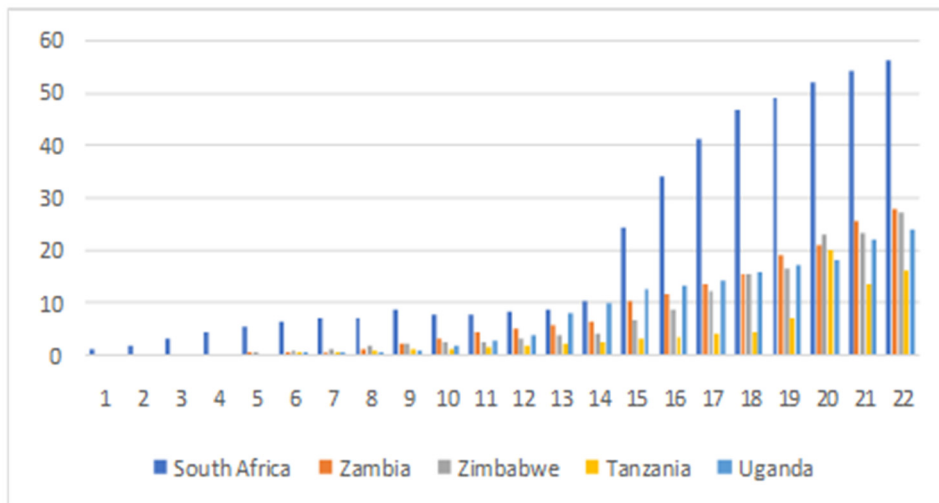
Source: Author's Analysis the World Bank (2020b)

Figure 4 shows that South Africa is at the top of the use of the internet as a percentage of the population compared to other African countries. From 1996 to 1999, no country was using the internet from the selected nations, Zimbabwe, Zambia, Tanzania, and Uganda. Internet use has been increasing in South Africa since 1996. Among the selected nations, Zambia was the next country with more people using the internet followed by Zimbabwe, Uganda, and Tanzania.

4. Literature Review

4.1. Brief Background and History of the Internet

The internet is generally defined as a global network of computers that operate in the same way as the postal system, but only at sub-second speeds (Chaudhuri et al., 2005; Trudel, 2019). The BBC-Web Wise (2012) went on to state that the internet works in the same way as the postal system as it permits people to send envelopes with messages and packets of digital data. For the internet to work, a common language is used called the transmission control protocol/internet protocol (TCP/IP). In this way, the IP address helps people to be connected to the internet. The origins of the internet are credited to the ARPnet that was created by the US defense department's advanced research project agency in the 1960s (BBC-WebWise, 2012). Many different networks were then created by private commercial companies, in different countries. The only problem was that these networks could not connect. The TCP/IP was developed by Vint Cerf and Bob Kahn in 1974 and it came forth with a protocol for packet network interconnection. As a result, the internet became a network of networks although the IP dominated (BBC-WebWise, 2012).

4.2. Empirical Literature Review

Empirical research on the determinants of internet access is available, for example, Flamm & Chaudhuri (2007, 2011), Grosso (2006), Nishijima et al. (2017) among others. Chaudhuri et al. (2005) analyzed the impact of various socio-economic on the decision of households in America on the decision to pay for basic internet access using a discrete choice framework. The study discovered that the level of education and income were strong variables that influenced the households' decision to pay for basic internet access. The study also discovered that the decision to pay for internet services was moderately sensitive to the price which motivated the authors to believe that access subsidies for basic access can help deal with the problem of the digital divide. Also, Chaudhuri et al. (2005) also extended the analysis of the impacts of socio-economic factors on a household's decision to subscribe to dial-up internet access. A cumulative utility ordered logit model was used in the analysis since demand cannot be expressed directly. It was observed that the decision to purchase was influenced by its own price elasticity broadband demand and the cross-price sensitivity of broadband concerning dialup price.

Grosso (2006) investigated the factors that influence broadband penetration in the OECD nations. Using the generalized least squares multiple regression analysis, the study discovered that competition among the various network providers increases broadband penetration. Flamm & Chaudhuri (2007) also extended analysis of the impact of socioeconomic factors on the decision made by households to subscribe to broadband, the study also discovered that own-price elasticity of broadband demand and cross-price elasticity of demand were the variables that were statistically significant in influencing the decision by households to subscribe to broadband. Al-Hammadany & Heshmati (2011) also discovered that the internet is one of the emerging technologies which helped create opportunities and conditions for progress. In explaining the determinants of internet use in Iraq, the results revealed that lack of adequate resources, insufficient incentives, and motivation from the government as well as social inhibitions was among the determinants of internet access by households.

Jakopin & Klein (2018) also investigated the drivers of broadband take-up that helps to outline and evaluate the diffusion situation of a country. The study was mainly focused on worldwide broadband access, the results indicated that broadband internet take-up is important for economic growth and prosperity. Nishijima et al. (2017) also discovered that the widespread growth of information and communication technology made it possible for people to be able to participate in the social-political and economic dimensions of their daily lives. Using various inequality indexes, the study discovered that the digital divide among the people in Brazil has been decreasing over time. The study also discovered that lack of education was one of the main determinants of the digital divide in Brazil, especially among elderly people.

5. Research methodology

This study used the data from Stas SA (2018), General Household data (GHS). Relevant variables were extracted from the data with a total sample of 20908 distributed across all the provinces in South Africa (Stats SA, 2018). The GHS was

introduced in 2002 to track the progress of development in South Africa. The GHS report of 2018 is showing how far South Africa progressed over the past 17 years. The target population of the survey consists of all private households in all nine provinces of South Africa and residents in workers' hostels. Collective living quarters such as old age homes student hostels, hospitals, prisons, and military barracks were not part of the survey. The survey is representative of non-institutionalised and non-military persons or households in South Africa.

5.1. Dependent Variable

The dependent variable was drawn from a question which was asking households to state whether the members of the household use internet services at home. The dependent variable data was recorded to appear in a binary form wherein circumstances where the household had access to internet services the variable assumed the value of 1, while in circumstances where the household had no access to the internet the dependent variable assumed the value of 0. The independent variables are explained in the table below.

5.2. Independent variables

Table 1: The independent variables used in this study

Independent variable	Description of the Variables
Race	This variable assumes the following variables 1=African Black, 2= Coloured, 3=Indian/Asian, 4=White. Apriori expectation is -/+, this depends on the reference category.
Gender	This variable is a dummy variable where 1= male and 0 otherwise. The apriori expectation is +/- depending on the reference category.
Age	The number of years of an individual. The variable is expected to have a positive influence on access to the internet.
Household expenditure	This is the total expenditure of the household per month. The apriori expectation for the variable is +/-.
Net household income	Net household income is the income received by the household. The apriori expectation is +/- influence on access to the internet
Telephone	This variable is a dummy variable that assumes two variables o and 1. The apriori expectation of the variable is +/- depending on the reference category.
Cell phone/Smartphone	This is a dummy variable that takes two values 0 and 1. It is expected to have a +/- depending on the reference category.
Access to electricity	This is a dummy variable that also takes two values 0 and 1. It is expected to have a +/- influence depending on the reference category
House ownership	This variable is a dummy variable that takes two values 0 and 1 and it is expected to have a +/- influence on access to the internet.

Source: Authors Analysis

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5.3. Empirical Model: The Logit Model

The dependent variable, in this case, is dichotomous which motivated the use of the logistic regression analysis. The equation of the logit model transforms the log-odds of success to a linear component as shown below:

$$\log\left(\frac{\pi_i}{1-\pi_i}\right) = \sum_{k=0}^{K} x_{ik}\,\beta_k \quad i = 1, 2, \dots, N \tag{1}$$

In equation one, to find parameters where the probability of the observed data is the greatest, we should use maximum likelihood estimation. To proceed with the estimation of the logit model, the first thing is to state the probability that $Y = 1$. The probability $Y = 0$ is written as $1 - \hat{P}$. Where $\hat{P}$ is the probability? $Y = 1$ and $Y = 0$ only show whether the household has access to the internet or not. $Y = 1$ when a household has access to the internet and $Y = 0$ is when a household does not have internet access. This will drive lead to the following equation:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \beta_1 X \tag{2}$$

To find the expected probability that Y=1 for all the values of X is calculated as shown in equation 3:

$$\hat{P} = \frac{\exp(\beta_0 + \beta_1 X)}{1 + \exp(\beta_0 + \beta_1 X)} = \frac{e^{\beta_0 + \beta_1 X}}{1 + e^{\beta_0 + \beta_1 X}} \tag{3}$$

The model with the variables used as the factors influencing the demand for the internet will be expressed as:

$$\ln\left(\frac{P}{1-P}\right) = \beta_0 + \sum_{i}^{n} \emptyset_i + \sum_{j}^{n} \emptyset_j + \varepsilon \tag{4}$$

Equation 4 above $\sum_{i}^{n} \emptyset_i$ represents all the factors in the model, while all the covariates are shown as $\sum_{j}^{n} \emptyset_j$. Substitution the above equation with Z will make the equation appear as follows:

$$Z = \beta_0 + \emptyset_1 Race + \emptyset_2 Age + \emptyset_3 Household\ Expenditure + \\ \emptyset_4 Net\ household\ income + \emptyset_5 Gender + \emptyset_6 Cellphone + \emptyset_7 Telephone + \\ \emptyset_8 Acess\ to\ electricity + \emptyset_9 House\ Onwership + \varepsilon \tag{5}$$

6. Results and Discussion

6.1. Descriptive Statistics

6.1.1 Sample

The sample comprised of all the population groups in South Africa, Black African, Coloured, Indian, and White. The distribution of the sample is shown in Table 2.

Table 2. Study of population distribution

Race	Count out of 20908	Percentage
Blacks African	17361	80.9%
Coloured	1659	7.1%
Indian	391	2.4%
White	1497	9.5%

Source: Author's calculations GHS data

Table 2 shows that 17361 (80.9%) of that sample were Blacks while the remaining 19.1 per cent was shared among the Whites (9.5%), Coloureds (7.1%) and Indian (2.4%). Table 2 indicates the gender distribution of the population.

Table 3. Gender distribution of the study

Study's gender distribution		
Gender	Frequency	Percentage
Male Headed Households	11948	58.4%
Female-Headed Households	8960	41.6%
Total	20908	100

Source: Author's Analysis GHS data

The logistic regression results are presented in Table 4 below.

Table 4. Logistic regression results

Variables	B	S.E.	Wald	Df	Sig.	Exp(B)
Race			1176.068	3	0.00	
Colored (1)	-1.05	0.095	121.604	1	0.00	0.35
Indian (2)	0.226	0.154	2.155	1	0.142	1.253
White (3)	1.636	0.101	261.38	1	0.00	5.136
Telephone (1)	1.732	0.084	427.629	1	0.00	5.65
Cellphone (1)	3.044	0.712	18.291	1	0.00	20.997
Access to electricity (1)	3.701	1.002	13.648	1	0.00	40.484
House ownership (1)	0.428	0.067	40.449	1	0.00	1.535
Gender (1)	0.595	0.07	72.166	1	0.00	1.812
Age of household head	-0.017	0.002	52.707	1	0.00	0.983
Net household income per month in Rand	0.00	0.00	2.457	1	0.117	1.00
Household expenditure	0.024	0.004	47.728	1	0.00	1.025
Constant	-9.01	1.236	53.145	1	0.00	0.00

Variables Race, Telephone, Cellphone, Access, House ownership, Gender, Age of household head, Net household income per month in Rand, Household expenditure Omnibus Tests of Model Coefficients Chi-square Step 3380.448, Block 3380.448, Model 3380.448 df 11, Sig..000. Model Summary -2 Log-likelihood, 7970.975a, Cox & Snell R Square, .151, Nagelkerke R .357.

Source: Author's calculations GHS data

The results from the logistic regression analysis in the table above indicated that variables race, access to telephone landline, access to a cellular cellphone, access to electricity, owning a house, gender, age of the household head, net household per month, and household expenditure were the significant variables in influencing the demand for internet access by household in South Africa. The variables age and being Coloured were the variables that had a negative influence on the demand for the internet. The results indicate that being Coloured in South Africa reduces the probability of the household having access to the internet. The odds of demand for the internet declines by 0.35 for Coloured people compared to Black Africans. The results also indicated that being Indian in South Africa increases the probability of the household having access to the internet. The variable had a positive influence on access to the internet with an odds ratio of 1.253. This means that the probability of demand for internet services increases by 1.253 for Indians compared to Black Africans.

Amongst the three racial groups in South Africa, White had a higher probability of having access to the internet compared to all the other races. The variable White had a positive influence on the demand for internet with an odds ratio of 5.136. This means that the probability of demand for the internet increases by 5.136 for the White population compared to Black Africa the reference category. These results were supported by scholars such as Ono & Zavodny (2003), Banerj & Hodge (2007), Kamalu (2012). These scholars discovered the White population had been exposed to the use of internet services for a long time. As a result, they generally dominate its use compared to other races like Blacks, Indians, and Hispanics. Also, the results indicated that access to the telephone increases the probability of a household having access to internet services. The variable had a positive influence on access to internet services. The odds of demand for internet services by households with telephone access at home was 5.65. This means that the probability of demand for internet increases by 5.65 for households with telephone access compared to households without access to a telephone at home. These results imply that it is easy for households with the telephone at home to subscribe to internet services compared to households without internet access.

Again, the results revealed that access to a cellphone increases the probability of a household having internet access. The result was significant at a 1 per cent level of significance with an odds ratio of 20.997. The probability of a household increases by 20.997 for households with cellphones compared to households without a cellphone. This variable was significant at a 1 per cent level of significance. The results imply that owning a cellphone in South Africa motivated households to subscribe to internet services compared to circumstances where individuals had no access to a cellphone. These findings were supported by various scholars, for instance, Statistics South Africa (2020) and Siaw et al. (2020) discovered that many internet users in South Africa make use of their telephone and cell phones to have internet access. The World Bank (2020a) also reported that an increase in cell phone and telephone ownership increases internet usage.

The results also indicated that access to electricity had a positive influence on access to internet services. The variable was significant at a 1 per cent level of significance with an odds ratio of 40.484. Households with access to electricity had more probability of having access to electricity compared to households without electricity. The probability of access to the internet increases by 40.484 compared to

households without electricity. This means that to increase access to the internet in South Africa, it is imperative to increase access to electricity by households. These findings agreed with the findings of Armey and Laura (2015) and McKeown et al. (2007) who discovered a positive relationship between access to electricity and internet usage. The argument from these studies was that access to electricity increases the chances of a household to access the internet in developed countries which can be the case in developing nations.

Also, the results indicated that households with their property had a higher probability of having access to the internet compared to households without a house. The variable house ownership was significant at 1 per cent with an odds ratio of 1.535. This implies that the probability of access to electricity increases by 1.535 for households with their own houses compared to households without houses. The variable gender was also significant in influencing access to the internet by households in South Africa. The variable was significant at a 1 per cent level of significance with an odds ratio of 1.812. This means that the probability of access to the internet increases by 1.535 for males compared to females. Males had a higher probability of access to internet services compared to females. This might be due to the different chances of access to income by females and males.

Also, the results indicated that the age of the household head had a negative influence on access to the internet by households in South Africa. The variable was significant at a 1 per cent level of significance (P-value, 0.00) and the odds ratio of 0.983. The variable implies that a unit change in the age of the household head will lead to a decline in the demand for internet by approximately 0.983. This may be because when a person grows older, their income stream declines which may affect their demand for internet broadband. The variable net household income was also significant at a 10 per cent level of significance in influencing access to broadband with a P-value of 0.117 and an odds ratio of 1.00. The variable net household income had a small coefficient, and this may be the reason why the variable had a small coefficient. On the other hand, the variable net household expenditure was also significant in influencing access to internet services. The variable was significant at a 1 per cent level of significance with a P-value of 0.000 and an odds ratio of 1.025. The probability of access to internet services increases by approximately 1.025 when the household increases its expenditure. The studies by Chaudhuri et al. (2005) and Hargittai (2003) found age to have an inverse relationship with the use internet, the scholars argued that young age has access to internet use compared to old age because young age has more access to computers and electrical gadgets that use the internet. Billon et al. (2009) further argued that most of the population in developing countries includes young people and the probability of them using the internet is higher compared to old age. Another possible explanation is that young age does not have intense household expenditure compared to old people, therefore, they spend most of their expenses on the internet (Billon et al., 2017; Smith & Graham, 2012).

7. Conclusion and Policy Recommendation

This study aimed to investigate the factors that influence access to the internet by households in South Africa. Access to broadband facilities by individuals, households and consumers is one of the critical components of the economic growth

and prosperity of a country. It is generally believed that the access to broadband technologies by a community or nation helps to increase productivity which assists a lot in fueling economic growth which will have an impact on the levels of poverty. Using the logistic regression, the study discovered that variables race, access to telephone landline, access to a cellular cellphone, Access to electricity, owning a house, gender, age of the household head, net household per month, and household expenditure were the significant variables in influencing the demand for internet access by household in South Africa. The variables age and being Coloured were the variables that had a negative influence on the demand for the internet. For instance, the results indicate that being Coloured in South Africa reduces the probability of the household having access to the internet. The odds of demand for the internet declines by 0.35 for Coloured people compared to Black Africans. Variables that were outstanding in influencing access to internet services were availability of electricity in the home, access to a cellphone, telephone and being White. The study recommends that in the quest to uplift the lives of the people, the government should try and improve access to electricity.

The current study investigates the factors that influence internet demand by households in Sub-Saharan Africa. Data accessibility and availability influenced the variables used to carry out the investigation which are Race, Age, Household Expenditure, Net household income, Gender, Cellphone, Telephone, Access to electricity, House Ownership. Future research must consider other variables such as the level of education and distance to the nearest service provider among many variables.

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