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CONTENTS

Technology Acceptance Model in an Environmental and Organizational Context (evidence from Kazakhstan)

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SUMMARY

The aim of this paper is to investigate the impact of the environmental and organizational moderators on farmers' e-commerce adoption behaviour. Data were collected from 384 wheat farmers in Kazakhstan. Descriptive analysis and multiple group analysis findings revealed that environmental (i.e. government) and organizational moderators had an insignificant effect on the relationship of the dependent variables (between behavioural intention and usage behaviour). However, there is a positive impact of the environmental (i.e. government) and organizational moderators on the relationship between the independent variables (Perceived Usefulness, Perceived Ease of Use, Social Influence, Facilititating Conditions, Compatibility) and dependent variable (behavioural intention).
Keywords: Government support; organizational support; moderator; farmers
Journal of Economic Literature (JEL) codes: O33; O38; Q16
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INTRODUCTION

The collapse of communism in the Soviet Union and Eastern Europe in the early 1990s was one of the most transformative events in economic history. After abandoning a centrally planned economic system, Kazakhstan has gone through a difficult path of reformations of the main sectors of economy, including agriculture. Nowadays, agriculture in Kazakhstan has overcome recovering from the major production decline that occurred during the phase of 1990s, which was at the phase of transferring the management mechanisms from the centrally planned economy to market economy. Since 1999, agricultural production and other related areas have been developing at a steady pace across all regions of the country. Adaptation of commodity producers to the new economic conditions, the development of other sectors of the national economy, and the increase in household income have all led to higher demand for the country's agricultural products and services and to the development of state-led agricultural policies. Kazakhstan traditionally has been an agroindustrial country for centuries and the development of virgin lands in the 1960s turned it into one of the largest producers of wheat and other types of grain in the world (Sikos & Meirmanova, 2020). Within the framework of digitalization, by 2021 at least 20 digital farms, which operate without human intervention, and 4000 advanced farms, partially automated farms, that use fuel consumption sensors, GPS trackers, meteorological stations, an electronic weed map and software for managing business processes were created, full automation of processes and public services were provided throughout the country (AKORDA, 2018). Digitalization measures have focused on farms and simplifying their activities. E-commerce is the activity of electronically buying or selling of products, and its integration is one of the most important parts of the digitalization programme in the agricultural policy of Kazakhstan. Experts claim that the development of e-commerce in agriculture helps farmers to escape the shackles of the supply

chain, particularly in selling unprocessed agricultural products, helping them to arrange the agricultural production structure and meeting the demands of supply-side reform. As a result, rural e-commerce is emerging as a new hub for the development of Kazakhstan's economy. This study aims to create a technology acceptance model that can demonstrate how environmental (i.e. government) and organizational moderators can have an impact on the farmers' e-commerce adoption behaviour in wheat growing farms of Kazakhstan. This contributes to the aim of accelerating the usage of e-commerce tools by farmers in farming operations and demonstrating to the consumers how the adoption of technologies provides a certain economic and social effect, creating the material prerequisites for effective management and production development policies.

LITERATURE REVIEW

Generally, there are some quantitative and qualitative studies on the adoption of information and communication technologies (ICT) by farmers. At the beginning farmers were frightened by the role of ICT; however, many farmers have overcome their skepticism towards ICT and related issues and have became at ease with ICT due to government policy frameworks were presented in the form of education and funded technology purchases (Machfud & Kartiwi, 2013). There is much hopefulness about the growth of e-commerce in the agricultural sector around the world. For instance, there is more optimism about German farmers' intentions to use e-commerce for business purposes in the future. Around 70% of German farmers are willing to sell and purchase electronically (RENTENBANK, 2015). E-Choupal, a conglomerate in India, encourages Indian farmers to create a direct marketing channel, and eliminate wasteful intermediation, thus reducing transaction costs and making logistics more efficient (Goyal, 2010).

Moreover, the literature shows some evidence that the adoption of e-commerce by farmers is based on the composition of rational, social deterministic, and behavioural reasons. From a rational point of approach, e-commerce incentives are rooted in business that leads to farmers' adoption of e-commerce strategies. From a social deterministic point of view, farmers from small and medium-sized farms rely on social reasons for making decisions on adoption of e-commerce strategies. Social determinism includes social constructs that play a substantial role in their decision-making. From the theory of behaviourism point of view, farmers' decisions on acceptance of e-commerce tools related to their environment are based on farmers' knowledge and experiences from farming. Researches show that e-commerce penetration in small and medium-sized farms was rare due to farmers' irrational reasons such as being too busy or feelings of intimidation (Machfud & Kartiwi, 2013). According to their findings, behavioural factors are the main determinants in defining farmers' perceptions on acceptance of e-commerce tools that can be assessed through different technology adoption models or theories.

Technology Acceptance Model, Theory of Planned Behaviour, Theory of Reasoned Action, Technology Acceptance Model, Unified Theory of Acceptance and Use of Technology are well-known technology adoption models that are being applied in different areas, specifically in information systems fields. Technology Acceptance Model (TAM) provides a theoretical basis to understand and evaluate the acceptance of new technologies by users, allowing the development and implementation of better systems. The model has been tested in many investigations, in various contexts and has proven to be a reliable tool to understand technology acceptance. TAM appears to be the most widely applied model/theory in technology acceptance studies of online commerce. Fedorko et al. (2018) examined methodically the effect of individual's experience factors on e-commerce site search and navigation through reconstructing TAM with other determinants. Fayad and Paper (2015) extended TAM by adding four exogenous variables, such as "process satisfaction", "outcome satisfaction", "expectations" and "e-commerce usage" in order to understand online consumer behaviour. Renko and Popović (2015) applied TAM in order to investigate electronic retailing adoption among Croatian consumers.

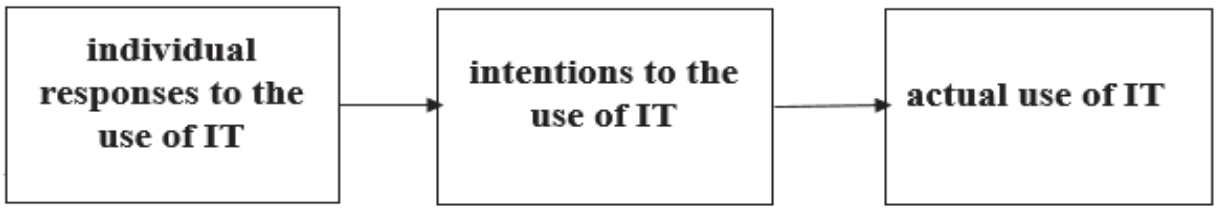
Integration of moderators into the technology acceptance models or theories leads to modification of the strength of the relation between an independent and a dependent variable (Imai et al., 2010). Kosar and Mehdi Raza Naqvi (2015) determined a moderator as the "variable that affects the direction and/or strength of the relation between independent or predictor variable and dependent criterion variable". Moderators can be applied within four well-known contexts: Technology Context, Individual Context, Organizational Context, Cultural Context (Han, 2003). Researchers should take into consideration these four contexts in order to explain the adoption or non-adoption of the certain technologies by individuals in a given environment and set of conditions. The impact of the contexts on behavioural beliefs will provide a solid basis on technology acceptance models. TAM does not include any moderators; however, incorporating environmental (i.e. government) and organizational factors as moderating variables into the

model might lead to a better prediction and explanation of behavioural beliefs towards e-commerce tools usage. There are a limited number of empirical studies where organizational and environmental factors have been applied. An analysis of the moderators might reveal where to concentrate effort and resources to implement technology adoption model by farmers appropriately.

The environmental (i.e. government) factor as a moderating variable was defined by Calantone et al. (2006) as "the extent to which government promotes facilitating conditions in order to accept new technologies". In their study, the organizational factor as a moderating variable has a positive impact on the behavioural beliefs with positive correlations. The authors incorporated environmental factors as moderating variables because: (1) Environmental changes (opportunities and threats) encourage businesses to operate efficiently and optimize their processes; (2) environmental forces can improve the organization in its services and products; (3) the environmental forces can cause desirable yields and improve their performance (Salavou et al., 2004; Damanpour et al., 2009). Organizational factor as a moderating variable strengthens other factors in order to optimize business performance (Deshpande & Farley, 2004). Leonard-Barton (1987) states that predicting technology acceptance behaviour will not be efficient without observing management support at a hierarchal level in an organization. Based on the abovementioned literature, I incorporated management moderators at a high level (i.e. government support (GS)) and at a low level (i.e. organizational support (OS)) into the original TAM.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

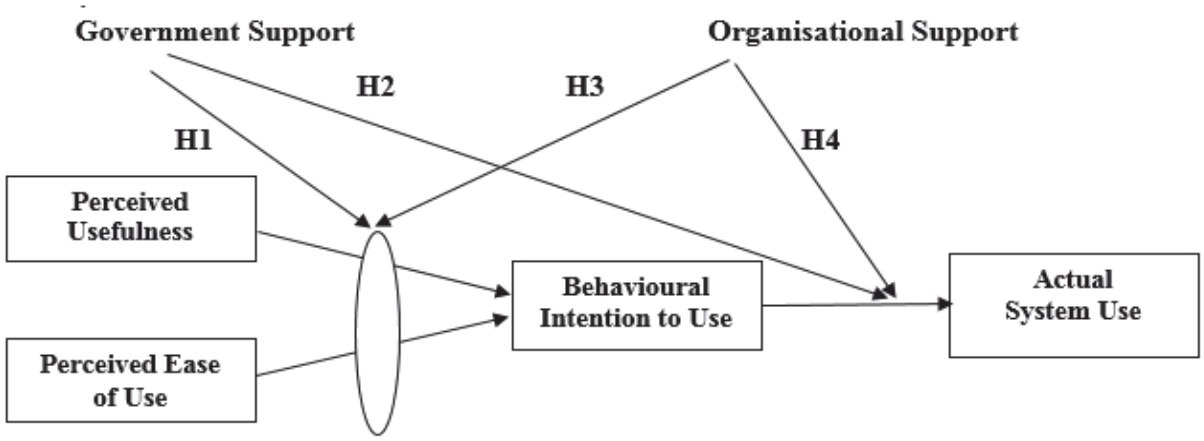
This research is a cross-sectional study due to the data being collected over a short period of time. Behavioural intention is one of the main dependent variables in order to predict actual usage of e-commerce tools in the future. Venkatesh et al. (2003) suggest that individual responses to use the information technology may influence the intentions to use the information technology and consequently, intentions to use the information technology may influence the actual use of the information technology, as shown in Figure 1.



Source: Venkatesh et al. (2003)

Figure 1. Basic concept underlying user acceptance models

The current article attempts to conceptualize TAM with the influence of management moderators at a high level (i.e. government support (GS)) and at a low level (i.e. organizational support (OS)) on the relationship between independent and dependent variables. Government support (GS) and organizational support (OS) moderators are expected to moderate the impact of exogenous variables on "behavioural intention" and moderate the impact of "behavioural intention" on "actual usage".



Source: Venkatesh et al. (2003)

Figure 2. The incorporation of moderators into TAM

As shown in Figure 2, the moderating hypotheses were established in the following way:

H1: The influence of exogenous variables (Perceived Usefulness, Perceived Ease of Use, Social Influence, Facilitating Conditions, Compatibility) towards behavioural intention is moderated by the Government Support moderator.

H2: The influence of behavioural intention on actual usage is moderated by the Government Support moderator.

H3: The influence of exogenous variables (Perceived Usefulness, Perceived Ease of Use, Social Inluence, Facilitating Conditions, Compatibility) towards behavioural intention is moderated by the Organizational Support moderator.

H4: The influence of behavioural intention on actual usage is moderated by the Organizational Support moderator.

DATA AND METHODS

The dataset used in the recent paper is same as the dataset that was used in an earlier paper of Meirmanova (2020), but the aim and the purpose of this paper is different. The researcher used multi-stage random sampling design in order to select the sample at every stage randomly. The population size is individuals (farmers) selected from wheat farms. There are approximately 190000 farms in Kazakhstan, of which 14813 grow mainly wheat. Krejcie and Morgan (1970) state that if the given population (N)=15000 then sample is required to be S=375. Therefore, the sample size of the present study is S=384 individuals (farmers) who were selected by their experience in using e-commerce tools and were considered as the representatives of the population for generalisability. The email questionnaires were distributed to farms which are scattered within Kazakhstan. The cutting edge technologies, such as Gmail, Whatsapp, Messenger were used to collect information from farmers in a short period of time due to Kazakhstan is the ninth largest territory in the world, it would be costly to distribute questionnaires through conventional type of mail services, e.g. letters. The questionnaires were distributed to 568 respondents on wheat farms of Kazakhstan by e-mail, where 452 questionnaires were received back with a response rate of 79% and only 384 valid questionnaires were processed for analysis. The self-administered survey questionnaire is adopted as the primary source of data collection with some supporting e-mailed surveys. Zikmund (2003) and Sekaran (2000) defined the rationales behind selecting the self-administered questionnaire method for data collection, which are that it (1) "embraces whole population and a large territory" – the targeted population are farmers in wheat farms in Kazakhstan, which are spread geographically across fifteen provinces (oblasts) of Kazakhstan. Therefore, to reach every farmer individually for an interview seems to be impractical; (2) "inexpensive and time-saving: much time and money can be saved in comparison with the interview method due to the researcher does not need to sit with the respondent and fill the data in by him/herself" - in order to save additional time due to the delay in the postal service, and the electronic format of the questionnaire is included for distribution due to the expensive costs of printing and travelling; (3) "respondent's convenience: unlike the interview method, with the self-administrated survey method (i.e., mail or e-mail) the respondent is free to think about their replies and complete it whenever a convenient time is available to him/her" - respondents

will not be biased by the researcher's opinion, or by time hassle requirements. The survey was conducted during June-August, 2018. A total of 384 valid questionnaires were obtained for further analysis after the researcher discarded incomplete questionnaires with missing values. The questionnaire was designed in order to avoid confusing, double-barrelled questions and to stimulate the farmers to respond in a short time and with little effort (Kothari, 2004). The developed questions used to measure the research model are based mostly on items used in measurements by Venkatesh et al. (2003) and Venkatesh and Davis (2000) (see Appendix A). Sekaran (2000) classified two main groups of scales, i.e. rating and ranking scales in order to measure individual's behaviour. As a scaling method, the items were chosen for different determinants in the present study (Likert, 1932). Likert scales were used, including seven classified answers, ranging from "strongly disagree" to "strongly agree".

METHODOLOGY

Multiple group analysis was applied in the current research. Two groups of hypotheses are tested by using AMOS' multiple group analysis in order to examine the influence of moderators on the relationship of constructs towards usage behaviour and behavioural intention. The objectives of comparing between or among groups are to investigate whether there are any significant differences between or among them.

Government support was split into two groups: low government support and high government support. There are 204 farmers who perceive that government support is low in e-commerce usage, while 180 farmers perceive that government support is high in e-commerce usage. The measurement model for the low government support group is [χ^2=168.42; df=129, χ^2/df=1.3055; GFI =.952; AGFI=.923; CFI=.987; RMSEA=.027; TLI=.983] and for the high government support group is [χ^2=201.57; df=148, χ^2/df=1.3620; GFI =.948; AGFI=.918; CFI=.985; RMSEA=.025; TLI=.981], thus indicating that the model fits the data very well. As shown in Table 1, Cronbach's alpha values were higher than 0.7 and consequently all factors have adequate reliability. The convergent validity is evaluated by using the average variance extracted (AVE). The discriminant validity is supported by maximum square variance (MSV). AVE for all constructs are higher than 0.5 and MSV for all constructs are less than AVE, thus indicating that the convergent and discriminant validities are considered satisfactory.

Table 1
Constructs' validity of low and high government support

	low government support			**high government support**		
Constructs	**Cronbach's α**	**AVE**	**MSV**	**Cronbach's α**	**AVE**	**MSV**
PU (perceived usefulness)	0.856	0.721	0.317	0.904	0.747	0.689
PEOU (perceived ease of use)	0.823	0.758	0.385	0.887	0.652	0.364
SI (social influence)	0.759	0.663	0.425	0.805	0.587	0.325
FC (facilitating conditions)	0.765	0.515	0.352	0.739	0.564	0.251
COMP (compatibility)	0.847	0.561	0.331	0.875	0.698	0.482
BI (behaviour intention)	0.929	0.528	0.282	0.729	0.574	0.394
BU (behaviour usage)	0.757	0.506	0.354	0.786	0.628	0.486

Source: Own calculations

There is a moderating effect of Government Support on the relationship between exogenous variables (PU, PEOU, SI, FC, COMP) and usage behaviour, while no moderating effect of Government Support was found on the relationship between usage behaviour and behavioural intention, as shown in Table 2, thus supporting Hypothesis 1 and rejecting Hypothesis 2.

Table 2
Summary of the moderating effect of Government Support

Hypotheses	Low GS		High GS		Z-score	Results
	R^2	Estimate	R^2	Estimate		
FARMTASK <---PU	42.1%	.254	48.1%	.115	-1.758*	Accepted
FARMTASK <---PEOU		.087		.258	1.694*	Accepted
FARMTASK <---SI		.224		.118	-1.627*	Accepted
FARMTASK <---FC		.312		.164	-2.043**	Accepted
FARMTASK <---COMP		.216		.112	-2.481**	Accepted
BIFARMTASK <---FARMTASK	55.7%	.248	51.3%	.305	0.569	Rejected
Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10						

Source: Own calculations

As shown in Table 3, Cronbach's alpha values were higher than 0.7 and consequently all factors have adequate reliability. AVE for all constructs are higher than 0.5 and MSV for all constructs are less than AVE, thus indicating the convergent and discriminant validities are considered satisfactory.

Table 3
Constructs' validity of low and high organizational support

	low organizational support			high organizational support		
Constructs	**Cronbach's α**	**AVE**	**MSV**	**Cronbach's α**	**AVE**	**MSV**
PU (perceived usefulness)	0.854	0.684	0.249	0.914	0.784	0.291
PEOU (perceived ease of use)	0.916	0.662	0.337	0.898	0.645	0.276
SI (social influence)	0.925	0.697	0.258	0.873	0.627	0.261
FC (facilitating conditions)	0.861	0.624	0.173	0.782	0.561	0.024
COMP (compatibility)	0.834	0.573	0.294	0.861	0.552	0.149
BI (behaviour intention)	0.759	0.724	0.268	0.734	0.637	0.308
BU (behaviour usage)	0.847	0.564	0.343	0.872	0.591	0.237

Source: Own calculations

Organizational support was split into two groups: low organizational support and high organizational support. There are 175 farmers who perceive that organizational support is low in e-commerce usage, while 209 farmers perceive that organizational support is high in e-commerce usage. There is a moderating effect of Organizational Support on the relationship between exogenous variables (PU, PEOU, FC, COMP) and usage behaviour, while no moderating effect of Organizational Support was

identified on the relationship between usage behaviour and behavioural intention, and no moderating effect of Organizational Support was found on the relationship between social influence (SI) and usage behaviour, as shown in Table 4, thus partially supporting Hypothesis 3 and rejecting Hypothesis 4.

Table 4
Summary of the moderating effect of Organizational Support

Hypotheses	Low OS		High OS		Z-score	Results
	R^2	Estimate	R^2	Estimate		
FARMTASK <---PU	44.8%	.275	39.2%	.114	-2.185**	Accepted
FARMTASK <---PEOU		.164		.045	-1.946**	Accepted
FARMTASK <---SI		.178		.152	-0.172	Rejected
FARMTASK <---FC		.234		.426	2.281**	Accepted
FARMTASK <---COMP		.118		.039	-2.374**	Accepted
BIFARMTASK <---FARMTASK	55.4%	.259	51.3%	.236	-0.581	Rejected
Notes: *** p-value < 0.01; ** p-value < 0.05; * p-value < 0.10						

Source: Own calculations

CONCLUSIONS

Table 5 summarizes the results of the moderating hypotheses. It has been found that the impact of government support and organizational support partially fitted the proposed model. These moderators significantly moderated the key relationships (such as the influence of the exogenous variables on usage behaviour). However, organizational support was insignificant in the influence of social influence (SI) on usage behaviour in farming. In addition government support and organizational support were insignificant in the influence of usage variable on the behavioural variable.

Table 5
Summary of Moderating Hypotheses

Ho	Exogenous Latent Constructs	Endogenous Latent Constructs	Moderator	Hypothesis results	Explanation
H1	Perceived Usefulness, Perceived Ease of Use, Social Influence, Facilitating Conditions, Compatibility	FARMTASK	Government Support	Accepted	Government Support significantly moderated the influence of predictors

H3	Perceived Usefulness, Perceived Ease of Use, Social Influence, Facilitating Conditions, Compatibility	FARMTASK	Organizational Support	Accepted (Partially rejected)	Organizational Support significantly moderated the influence of predictors
Ho	**Usage variable**	**Behavioural variable**	**Moderator**	**Hypothesis results**	**Explanation**
H2	FARMTASK	BIFARMTASK	Government Support	Rejected	Government Support insignificantly moderated the relationships
H4	FARMTASK	BIFARMTASK	Organizational Support	Rejected	Organizational Support insignificantly moderated the relationships

Source: Own calculations

From the theoretical point of view, the developed model provides a better understanding of the relationships between the core constructs and usage behaviour, as well as between the usage behaviour and behavioural intention; both of these relationships were moderated by Organizational support and Government support. The empirical findings derived from examining the key predictors by perceptions of high-level and low-level management support moderators within the one social group (e.g. farmers of wheat farms). The examination within one social group and the assessment of key predictors at management level help to extend behaviour acceptance research to a wide range of workplaces at the micro-level context. The integration of management level factors such as Organizational support and Government support between the independent variables and farmers' behavioural intention and farmers' usage behaviour in e-commerce applications usage.

The main contribution of the current study is the examination of the influence of moderators (perceived high-level and low-level management support) through Multiple Group Analysis (MGA) in order to analyze moderation effects. Previously there were few studies using MGA. Organizational characteristics significantly influenced e-commerce adoption. The results of the current research indicate that it would be a good idea to promote e-commerce technologies usage at organizational level and at government level. The second practical contribution is that farmers' perceptions of and attitudes towards the acceptance of new technology acceptance may play the the role of indicators in creating technology adoption frameworks by research institutions.

This study suggests recommendation for future research related to the adoption of e- commerce technologies and applications. The first suggestion is that the individual context, technological context, and cultural context dimensions should be considered in e-commerce technologies adoption, since the model of the present study was moderated in the organizational context dimensions.

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Appendix A

Section A: Perceived Usefulness and Perceived Ease of Use toward e-commerce usage: please rate the extent to which you agree with each statement (circle only one option)
1= Strongly Disagree 2= Quite Disagree 3= Slightly Disagree
4= Neutral 5= Slightly Agree 6= Quite Agree 7= Strongly Agree

A1. PERCEIVED USEFULNESS about the e-commerce usage.
1. Using e-commerce enables me to accomplish tasks more quickly: *1 2 3 4 5 6 7*
2. Using e-commerce improves the quality of my work: *1 2 3 4 5 6 7*
3. Using e-commerce makes it easier to do my work: *1 2 3 4 5 6 7*
4. I find e-commerce useful in my work: *1 2 3 4 5 6 7*
5. Using e-commerce gives me greater control over my work: *1 2 3 4 5 6 7*
A2. PERCEIVED EASES OF USE about the e-commerce usage.
1. Learning to use e-commerce is easy for me: *1 2 3 4 5 6 7*
2. I find it easy to use e-commerce to do what I want to do: *1 2 3 4 5 6 7*
3. I find it easy for me to become skilled in using e-commerce: *1 2 3 4 5 6 7*
4. I find e-commerce easy to use: *1 2 3 4 5 6 7*

Section B: Social Influence, Facilitating Conditions and Compatibility toward e-commerce usage: please rate the extent to which you agree with each statement (circle only one option)
1= Strongly Disagree 2= Quite Disagree 3= Slightly Disagree
4= Neutral 5= Slightly Agree 6= Quite Agree 7= Strongly Agree

B1. SOCIAL INFLUENCE about e-commerce usage.
1. Management of my organization thinks that I should use e-commerce: *1 2 3 4 5 6 7*
2. The opinion of my organizational management is important to me: *1 2 3 4 5 6 7*
3. Government management thinks that I should use e-commerce: *1 2 3 4 5 6 7*
4. The opinion of government management is important to me: *1 2 3 4 5 6 7*

B2. FACILITATING CONDITIONS about e-commerce usage.
1. The resources necessary (e.g. new computer hardware and software, internet etc.) are available for me to use e-commerce effectively: *1 2 3 4 5 6 7*
2. I can access e-commerce very quickly within my farm: *1 2 3 4 5 6 7*
3. Guidance is available to me to use e-commerce effectively: *1 2 3 4 5 6 7*
4. A specific person (or group) is available for assistance with e-commerce usage difficulties: *1 2 3 4 5 6 7*

B3. COMPATIBILITY about e-commerce usage.
1. Using e-commerce is compatible with all aspects of my work: *1 2 3 4 5 6 7*
2. I think that using e-commerce fits well with the way I like to work: *1 2 3 4 5 6 7*
3. Using e-commerce fits into my work style: *1 2 3 4 5 6 7*

Section C: individual's *BEHAVIOUR USAGE* and *BEHAVIOUR INTENTION* toward e-commerce usage: please rate the extent to which you agree with each statement (circle only one option)
1= Strongly Disagree 2= Quite Disagree 3= Slightly Disagree
4= Neutral 5= Slightly Agree 6= Quite Agree 7= Strongly Agree

C1. BEHAVIOUR INTENTION (BI)
1. I intend to use e-commerce in my farming tasks: *1 2 3 4 5 6 7*
2. I intend to use e-commerce in my non-farming tasks: *1 2 3 4 5 6 7*
3. If I had access to e-commerce, I predict that I would use it:
1 2 3 4 5 6 7
4. Whenever it will be possible for me, I plan to use e-commerce in my farming tasks: *1 2 3 4 5 6 7*
C2. BEHAVIOUR USAGE (BU)
1. I use e-commerce in my farming tasks: *1 2 3 4 5 6 7*

2. I use e-commerce in my non-farming tasks: *1 2 3 4 5 6 7*
3. If I had access to e-commerce, I would use it: *1 2 3 4 5 6 7*
4. Whenever it is possible for me, I use e-commerce in my farming tasks:
1 2 3 4 5 6 7

Section D: MANAGEMENT SUPPORT: please rate the extent to which you agree with each statement (circle only one option)

1= Strongly Disagree 2= Quite Disagree 3= Slightly Disagree
4= Neutral 5= Slightly Agree 6= Quite Agree 7= Strongly Agree

D1. Government Support (GS)
1. The government is committed to a vision of using e-commerce in farms: *1 2 3 4 5 6 7*
2. The government strongly encourages the use of e-commerce for farming purposes: *1 2 3 4 5 6 7*
3. The government strongly does not encourage the use of e-commerce for farming purposes: *1 2 3 4 5 6 7*
4. The government recognize farmers' efforts in using e-commerce for farming purposes: *1 2 3 4 5 6 7*
5. The government does not recognize farmer's efforts in using e-commerce for farming purposes: *1 2 3 4 5 6 7*

D2. Organizational Support (OS)
1. My organization is committed to a vision of using e-commerce in farming tasks: *1 2 3 4 5 6 7*
2. My organization strongly encourages the use of e-commerce for farming purposes: *1 2 3 4 5 6 7*
3. My organization does not encourage the use of e-commerce for farming purposes: *1 2 3 4 5 6 7*
4. My organization recognize farmers' efforts in using e-commerce for farming purposes: *1 2 3 4 5 6 7*
5. My organization does not recognize farmers' efforts in using e-commerce for farming purposes: *1 2 3 4 5 6 7*

Comparing Green Economy in Iran with OECD Asian Countries by Applying TOPSIS and GI Method

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SUMMARY

In this study, we tried to calculate Iran's green growth index and compare it with four selected OECD countries in the continent of Asia, Turkey, Japan, Korea, and Israel in 2015 by applying the Green Index, and Technique for Order of Preference by Similarity to Ideal Solution. Our research provides a new methodology to rank different countries based on green growth indicators. Applying both methods, Iran ranked fourth among the selected countries. Iran, in comparison to Turkey, Japan, and Korea, is behind in developing sustainability and green economy indices.
Keywords: Green Economy; TOPSIS; Green Index; Iran; OECD Asian Countries.
JEL classification: O13; D81; Q56.
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INTRODUCTION

Green economy concerns how to continue developing the economy without any damage to the environment. It is created to solve environmental challenges to have sustainable development in different aspects. All the important international organizations including the United Nation Environment Programme (UNEP), Organization for Economic Co-operation and Development (OECD), World Bank, and International Monetary Fund (IMF), and also most governments support and try to follow the concept of the green economy (Tóthné 2014). Accordingly, some researchers are dedicated to this vital and challenging topic.

What is a green economy? This is a question that researchers have tried to answer and most of them refer to UNEP's definition. According to UNEP, "a green economy is defined as low carbon, resource-efficient and socially inclusive". Moreover, "UNEP defines a green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities" (UNEP 2011, p. 2). Therefore, generally, it can be concluded that a green economy is an economy with the notable consideration of reducing environmental hazards in implementing policies. It does not mean that growth in the economy should not be considered. It means that growth should be in the context of ensuring mitigating damage to natural resources and the environment.

According to OECD (2017), being sustainable in the long-term is related to the ability to reduce dependence on natural resources, reduce pollution, and develop the quality of physical and human capital. However, in developing the living standards of people, the usage of natural resources and 'heavily polluting technology' increases. Reliance on these resources to increase the living standards can be effective in the short run. In the long-term, governments should find some new and sustainable

resources. Implementing a green economy can be costly in short term. Politicians mostly are not willing to spend on the short-term cost, although they know it will save general costs in the long term (Sachs 2010). However, according to Gupta et al. (2019) referred to Gharaei et al. (2019), Hao et al. (2018), and Rabbani et al. (2019), because of the knowledge and awareness of people and the world community about environmental issues and regulatory mandates, there is considerable pressure on private and public sectors to take a responsible look at environmental aspects of production and their supply chains.

The green economy's issues in Iran motivated us to seek the place of Iran in comparison with Asian OECD countries (Japan, South Korea, Turkey and Israel) based on green growth indices. In Iran, the general policies for developing and implementing green economy were that introduced in 2015 are focused on the following areas (Zistonline, 2019):

1. Low carbon industry, usage of clean energy, healthy and organic agriculture products, and the management of waste and effluents by utilizing economic, social, natural, and environmental capacities.
2. Modify the production pattern in various economic and social sectors and optimize the pattern of water, resources, food, materials, and energy consumption, especially promoting environmentally friendly fuels.
3. Development of green public transport, including electrical ones and generally increasing public transport, especially in metropolitan areas.

In the following of decisions to improve the environmental condition in Iran, in April 2016, the High Representative of the Union for Foreign Affairs and Security Policy and Vice-President (HRVP) Mogherini and Mohammad Javad Zarif (Iran's foreign minister) reached an agreement on closer cooperation of Iran and EU to develop Iran's green situation by supporting Iran in the areas of prosperity, planet, and people. Moreover, Iran's sixth national development plan (2016-2021) emphasizes market-based reforms and environmental issues to build a resilient economy (European Commission Statement 2016).

There are some challenges to solve or even improving the green economy situation in Iran, According to the Deputy of production and infrastructure research (2017), the challenges include:

1. The lack of environmental protection culture: environment protection is seen as a luxury and non-priority issue;
2. Policymaking is person-oriented: changing the approach to the environment by changing the policymakers;
3. Weakness and inefficiency of green civil society organizations: limited numbers and small role of social organizations;
4. High energy consumption and high pollution production: because of the energy subsidies, low-cost access to fuel may cause excessive consumption and produce pollution;
5. The cheap sale of foreign and domestic resources has fueled unnecessary consumption and destruction of natural resources;
6. The dependence of the economy on natural raw materials: the growth and cycle of economic activities in Iran have historically been based on the extraction of natural raw materials such as oil.

The goals of our study are, firstly, to compare Iran with selected OECD countries based on green growth indices in 2015 by using the green index (GI) method, and secondly, applying the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) as a practical method to rank the countries. In our study, we considered all the green growth indicators and sub-indicators to compare and rank the countries. Firstly, the countries are ranked based on the green index formula provided by Tóthné (2013; 2014). Then, TOPSIS, which is a form of Multi-Criteria Decision-Making technique (MCDM), is used to categorize the countries based on green growth indices. Although there are many different MCDM techniques, TOPSIS was chosen in this paper. In comparison to the other MCDM techniques like the Analytical Hierarchy Process, there is no restriction on the number of criteria and alternatives in TOPSIS. In this study, we considered more than 50 sub-criteria of green growth indices.

Calculation procedures in TOPSIS are rather similar to the green index formula except for two considerable differences. In TOPSIS the type (positive or negative) of criterion/index should be determined, while in the green index all the criteria/indices are considered the same type. Also, in TOPSIS the weight of each criterion/index will be calculated while in the green index criteria are not weighted. The weights

may influence the final results. We selected 2015 as the focus year in our study because 2015 was the latest year for which all the required data was available.

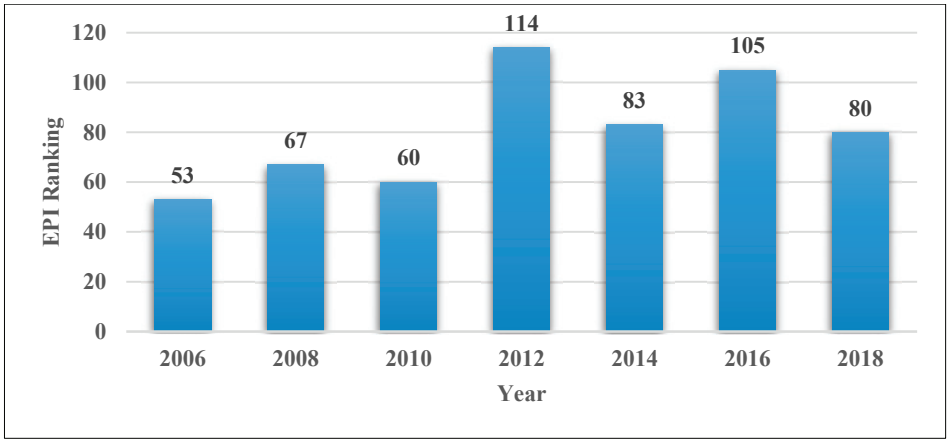
To the best of our knowledge, no studies have tried to rank countries based on the green index by applying TOPSIS, although previous studies have been carried out applying multi-criteria decision-making methods, including TOPSIS, in various aspects related to green economies. Some of the studies are as follows. Gupta et al. (2019) applied multi-criteria decision-making (MCDM) for the evaluation of green supplier selection in the Indian automotive industry. Moghadas et al. (2019) applied the TOPSIS technique, not directly for the green economy, to to rank different districts of urban Tehran in the context of resilience levels. A calculation approach is applied based on a composite index (social, economic, institutional, infrastructural and community capital, and environmental factors of community flood resilience). Barari et al. (2019), using different multi-criteria decision-making models (Decision Making Trial and Evaluation Laboratory (DEMATEL), fuzzy and TOPSIS), evaluated the sustainability indicators of urban transport by the green economy approach in Sari, a city in Iran. A study in Brazil written by Dos Santos et al. (2019) proposed a methodology to evaluate and select the green suppliers with the best environmental performance for the Brazilian furniture industry. For this purpose, they used a hybrid Entropy-TOPSIS-F framework based on the defined criteria. Rashidi & Cullinane (2019) applied fuzzy data envelopment analysis (DEA) and fuzzy TOPSIS to identify the most preferred sustainable supplier. They used a dataset of logistics service providers in Sweden. Azimifard et al. (2018) used the analytical hierarchy process (AHP) to determine the weights of sustainability criteria and then applied TOPSIS to evaluate sustainable suppliers for Iran's steel industry. Rostamzadeh et al. (2015) developed an evaluation model to compute the uncertainty of green supply chain management activities. They used the Vlsekriterijumska Optimizacija I Kompromisno Resenje (VIKOR) method to solve a green multi-criteria decision-making problem. Freeman and Chen (2015) used an AHP-Entropy-TOPSIS framework to focus on the development of a green supplier selection model. They used a Chinese-based electronic machinery manufacturer as their case company. In the following, we will discuss green indices in Section 2 and methodology in Section 3. Results are explained in Section 4 and finally our conclusions and limitations of the study are presented in Section 5.

GREEN INDICES

In the previous sections, we discussed the context of the green economy and its importance. To work on developing green situations in a country, the first step is to find out the ranking of the country based on green economy standards. Then, it would be necessary to determine how green economy indices should be measured. The green economy can be measured in different ways. Here we introduce only two green indices, the Environmental Performance Index (EPI) and Green Index (GI). We are explaining EPI because most of the previous studies about Iran's green economy situation are described by EPI. Then, in Sections 2.2, we shortly explain Green Index.

EPI

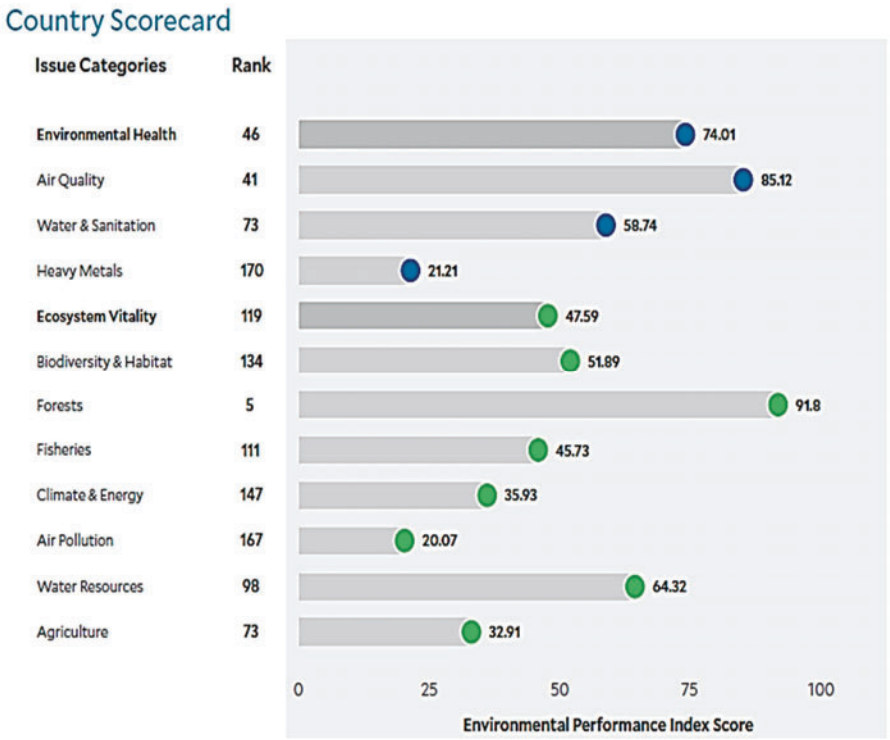
To show Iran's green economy situation, the Environmental Performance Index (EPI) could be a good example. "The 2018 Environmental Performance Index (EPI) ranks 180 countries based on 24 performance indicators across ten issue categories covering environmental health and ecosystem vitality" (Wendling et al. 2018, p.vi). As we discussed in the introduction, the general policies for developing and implementing a green economy in Iran were introduced in late 2015. Iran's EPI ranking (2006-2018) is shown in Figure 1. The higher the EPI ranking, the worse the situation of the country in the green economy. In another word, a lower number indicates a better ranking place. As is shown in Figure 1, the EPI index was very high in 2016, but fortunately, the rank fell from 105 to 80 in two years (2016-2018). It may show that the implementation of this policy had been successful between 2016 and 2018. However, Iran's situation in the green economy is not satisfying in general.



Source: Deputy of production and infrastructure research (2017); Wendling et al. (2018).

Figure 1: EPI ranking for Iran, 2006-2018

To identify in which category Iran needs to work on more, it might be a good idea to look at the issue categories of the EPI Index in 2018, as shown in Figure 2. Based on the ranking in the figure, the five most critical categories are heavy metals, air pollution, climate and energy, biodiversity and habitat, and finally ecosystem vitality.



Source: Country profile Iran (2018). https://epi.yale.edu/sites/default/files/2018-irn.pdf

Figure 2. EPI Index for Iran by issue categories, 2018

Green Index (GI)

Tóthné (2014, p. 62), presents an index which is called the Green Index (GI) to means to "measure, express and at the same time compare the state and progress of countries toward green economy". According to Tóthné (2018), the ability to compare across countries is one important advantage of this index. To calculate the green index for a country, the authors used a group of indices that are introduced in the OECD as green growth indicators (the calculation for the Green Index is given in Section 3.3). They calculated this index for OECD countries and compared the countries with each other. Interestingly, in their research, they found that although OECD countries are on the way to reaching a green economy, they are still quite far from the ideal.

METHODOLOGY

In this study, the green index proposed by Tóthné (2013; 2014), is calculated for Iran and four OECD selected countries: Japan, South Korea, Turkey, and Israel. Then, the TOPSIS technique is applied to find Iran's place among the selected countries. Finally, the results of these two methodologies are compared.

Due to the large number of indices in this study 53 (X) , before the calculation of green growth indicators with the help of the min-max statistics model, all the variables in a category are merged into one variable. For example, variables like production-based CO_2 productivity, production-based CO_2 intensity, and production-based CO_2 emissions are merged into one variable, CO_2 productivity. Before merging the variables, all the variables should be normalized by applying an eigenvector. Then the geometric mean is used to calculate and to merge indicators in a category for one country. After that, both calculation methods (GI and TOPSIS) are applied to rank Iran and OECD selected countries in the green economy.

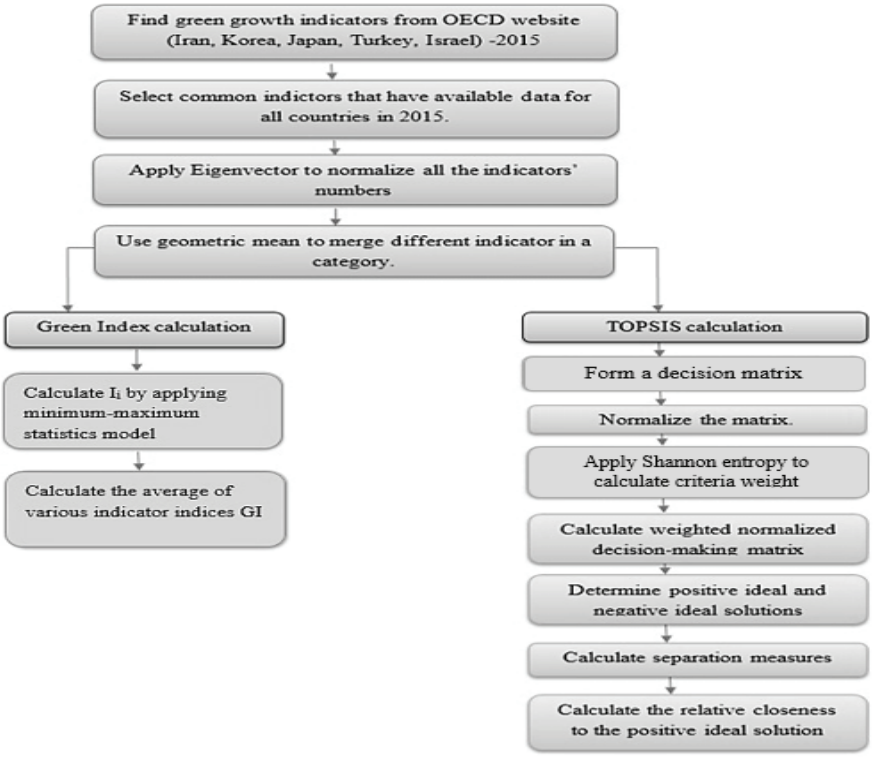


Figure 3. The methodology of calculation of GI in this study

The eigenvector method

To normalize the indicators and reach a unique unit for all indicators, we applied an eigenvector. For example, the unit of production-based CO_2 intensity and energy-related CO_2 per capita is tonnes but the unit of renewable energy supply is percentage (OECD 2015). Saaty's eigenvector method, which is known also as the linear normalization method, is a technique to generate weights and normalization of a vector. The eigenvector gives us the final weights (W_{ij}). The weights are the average of all possible ways to compare the alternatives. The calculation of the eigenvector is shown in Equation (1).

$$W_{ij}=a_{ij}/\sum a_{ij} \qquad i= 1,2,\ldots, m \qquad j=1,2,\ldots, n \tag{1}$$

where a_{ij} represents the numerical value of criterion i for alternative j (Saaty and Vargas 1984).

Geometric mean

The geometric mean is determined as the n^{th} root of the values. The calculation of the geometric mean for a data set like $\{x_1, x_2, \ldots, x_n\}$ is shown in Eq. (2) (Yousefi and Carranza 2015).

$$G_A(x_1, x_2, \ldots, x_n) = \left(\prod_{i=1}^{n} x_i\right)^{1/n} = \sqrt[n]{x_1}.x_2.\ldots.x_n \tag{2}$$

where n is the total number of values.

The geometric mean has been employed in different articles. In the study of Dong et al. (2010), decision-makers applied the weighted geometric mean technique to sum individual judgment matrices. To reach the values in the consensus matrix in the Fuzzy Analytical Hierarchy Process (FAHP) computations procedure Anojkumar et al. (2014) applied the geometric mean. Another study in 2019 stated that the geometric mean is applied to integrate a comparison matrix of criteria for all decision-makers under a fuzzy environment (Gupta et al. 2019). Wu et al. (2010) also applied geometric mean to sum evaluators' values up. In another study, authors utilized geometric average to combine individuals' judgments to reach a group judgment for integrating answers coming from the decision-making group (Liu et al. 2019).

After computing the eigenvector to normalize all indices and applying the geometric mean to merge the indices in each variable category, the green index can be calculated as follows.

Calculation of the green index

To calculate different countries' indicator indices, firstly the OECD green growth indicators should be applied. For this purpose, the "minimum-maximum statistics model" is used (Tóthné 2013; 2014).

$I_i = \quad (X_i - X_{min})/(X_{max} - X_{min})$

where:

I_i : the index of the different indicator (*1–n*);

X_i : the selected indicators;

X_{min}: the minimum value of the selected indicator in the selected countries (in a specified year).

X_{max}: the maximum value of the selected indicator in the selected countries (in a specified year).

Secondly, the average of the different indicator indices should be calculated to gain the Green Index (GI).

$$GI= \sum_{i=1}^{n} I_i /n \tag{3}$$

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) Method

TOPSIS is one of the most commonly used multi-criteria decision-making methods presented by Hwang and Yoon (1981) that use simple logic. This method makes an ideal alternative and an anti-ideal alternative. In this method, based on the lowest interval from the ideal alternative and the most interval from the anti-ideal alternative, all alternatives are ranked. It is a fast and relatively easy method with an organized procedure (Shanian and Savadogo 2006; Irfan and Nilsen 2009; Wang and Chang 2007; Wang and Elhag 2006).

To solve an MCDM problem, some scholars have proposed the TOPSIS. A combination of TOPSIS and AHP logical procedure is proposed by Rao and Davim (2008) for engineering design. Applying TOPSIS is proposed by Ho et al. (2010) to evaluate and select an ideal supplier. To evaluate the performance of groundwater quality, Peiyue et al. (2011) used TOPSIS based on entropy weight. Rouhani et al.

(2012) approached fuzzy TOPSIS to assess the business systems.

There is an important advantage in applying TOPSIS in comparison to the other MCDM methods like AHP. There is no limitation to the number of criteria and alternatives in TOPSIS, while in other techniques like AHP, there is a limitation. Too many criteria and alternatives in other MCDM techniques like AHP make the problem overly complex and sometimes it would be hard to solve such problems.

The reason that we applied TOPSIS in this study is not only the advantage of this method's unlimited number of criteria and alternatives, but the fact that this method has not been applied in prioritizing countries based on their green growth indices.

In our research, the green growth indicators are considered as criteria. Iran and the selected OECD countries are taken into account as alternatives. Therefore, applying TOPSIS as an MCDM technique for ranking countries based on green growth indicators is reasonable.

The TOPSIS technique steps are described below (Ajripour et al., 2019).

1. Convert all criteria into quantitative criteria after making a decision matrix.
2. Normalize the decision matrix and name it N_D.
3. Calculate the weight of all criteria by applying Shannon entropy (W_j).
4. Compute the weighted normalized decision-making matrix (A) by multiplyW_j. N_D.

$$A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix} = W_j . N_D$$

5. Determine A_j^+ and A_j^-

A_j^+= best positive value for each index in matrix A (positive ideal solution)

A_j^- = best negative value for each index in matrix A (negative ideal solution)

In affirmative indicators, the best value is the highest and the worst is the lowest, while in the indicators which are not positive (negative indicators), the best value is the lowest and the worst is the highest.

6. Calculate the distance of a_{ij} from (A_j^+) and (A_j^-):

$$D_i^+ = \sqrt{\sum_{j=1}^{n}(a_{ij} - A_j^+)^2} \quad (4)$$

$i=1,2,\ldots,m$

$$D_i^- = \sqrt{\sum_{j=1}^{n}(a_{ij} - A_j^-)^2} \quad (5)$$

$i=1,2,\ldots,m$

7. Compute the relatively short distance to the affirmative ideal solution.

$$Cl_i^* = D_i^- / (D_i^- + D_i^+) \quad (6)$$

The higher the Cl_i^* value, the higher the rank of alternative.

To find out the rank of the countries by applying the TOPSIS method and based on green growth indices, firstly we have to make the decision matrix (Table 1) based on the data we gathered from OECD green growth indicators. Eight indicators or criteria are considered ($C_1, \ldots, C_8$), to compare five countries ($A_1, \ldots, A_5$). You can see the criteria and alternatives in Table 2. All the data are normalized by applying a geometric mean (N_D). Then the weight of each criterion is computed by employing Shannon entropy (W_j). In the next step, the weight of each criterion should be multiplied by the values in the decision matrix (for example W_1= *0.122* should be multiple to all normalized data in column C_1). Using Equations (4) and (5), the positive ideal and negative ideal solutions will be determined. Finally, applying Equation (6), the countries are ranked based on green growth indicators (Table 3).

Table 1
Decision Matrix

W_j	0.122	0.122	0.122	0.123	0.132	0.133	0.126	0.121
Criteria Type	+	+	+	+	-	+	+	+
	C1	***C2***	***C3***	***C4***	***C5***	***C6***	***C7***	***C8***
A1	0.18	0.15	0.18	0.13	0.28	0.03	0.06	0.15
A2	0.17	0.24	0.13	0.10	0.17	0.04	0.40	0.18
A3	0.21	0.15	0.22	0.15	0.11	0.25	0.21	0.21
A4	0.24	0.20	0.12	0.1	0.00	0.30	0.14	0.16
A5	0.12	0.12	0.10	0.20	0.11	0.08	0.19	0.17
∑aij^2	**0.2**	**0.2**	**0.1**	**0.1**	**0.1**	**0.2**	**0.3**	**0.2**
√	**0.4**	**0.4**	**0.3**	**0.3**	**0.4**	**0.4**	**0.5**	**0.4**

Source: Authors' Calculation

RESULTS

Applying GI, the greenest country among the selected countries is Korea, and the least green country is Israel (*A3 ≻A2 ≻A4 ≻A1 ≻A5*). Iran is ranked in fourth place.

Table 2
Iran and OECD selected countries ranking in terms of GI

Year		2015											
Country		A_1- Iran	A_2-Turkey	A_3- Korea	A_4- Japan	A_5- Israel			A_1- Iran	A_2-Turkey	A_3-Korea	A_4-Japan	A_5-Israel
Variable							Min	Max	li				
Environmental and resource productivity	C_1: CO_2 Productivity	0.18	0.17	0.21	0.24	0.12	0.12	0.24	0.56	0.45	0.78	1.00	0
	C_2: Energy productivity	0.15	0.24	0.15	0.20	0.12	0.12	0.24	0.26	1.00	0.19	0.70	0
Natural asset base	C_3: Freshwater resources	0.18	0.13	0.22	0.12	0.10	0.1	0.22	0.62	0.24	1.00	0.14	0
	C_4: Land resources	0.13	0.10	0.15	0.08	0.20	0.08	0.2	0.46	0.20	0.59	0.00	1
Environmental dimension of quality of life	C_5: Exposure to environmental risks	0.28	0.17	0.11	0.00	0.11	0	0.28	1	0.61	0.40	0.00	0.40
Economic opportunities	C_6: Technology and innovation: Patents	0.03	0.04	0.25	0.30	0.08	0.03	0.3	0	0.06	0.79	1.00	0.18

and policy responses	C_7: Environmental taxes and transfers	0.06	0.40	0.21	0.14	0.19	0.06	0.4	0	1	0.44	0.25	0.40
C_8: Socio-economic context		0.15	0.18	0.21	0.16	0.17	0.15	0.21	0	0.54	1	0.16	0.2
								GI	**0.36**	**0.51**	**0.65**	**0.40**	**0.28**

Source: Authors' Calculation

Considering green growth indicators as criteria and the selected countries as alternatives in the TOPSIS procedure, alternatives are ranked as follows: $A3 \succ A4 \succ A2 \succ A1 \succ A5$. Iran is placed in the fourth place.

Table 3
Iran and OECD selected countries ranking by using the TOPSIS method

	Country	Cl_i^*	Rank
A_1	**Iran**	**0.2897**	4
A_2	**Japan**	**0.2904**	3
A_3	**Korea**	**0.651**	1
A_4	**Turkey**	**0.480**	2
A_5	**Israel**	**0.153**	5

Source: Authors' Calculation

COMPARISON OF TOPSIS AND GI RANKING

Applying the methodology – the green index and TOPSIS methods – Iran and selected OECD countries can be ranked based on green growth indices in 2015. The country ranking based on GI is as follows: Korea ≻ Japan ≻ Turkey ≻ Iran ≻ Israel. The country ranking based on TOPSIS is also Korea ≻ Turkey ≻ Japan ≻ Iran ≻ Israel. Comparing the countries' final ranking based on the two methods, Iran ranked fourth among the five countries. Korea and Israel are in the first and fifth place, respectively. So, South Korea is the greenest country among the five countries. It is shown that both techniques provided almost the same results; the only difference is the rank of Turkey and Japan. It can be concluded that the TOPSIS could be a reliable technique to calculate the ranking of countries based on green growth indices.

Previously, in Section 2.1, we have shown that generally, the rank of Iran in the green economy was not satisfactory. The calculated result of our study also shows Iran does not have a good situation in the green economy, because it is ranked fourth among the five selected countries.

CONCLUSION AND LIMITATION

Talking about the green economy brings a variety of issues to the debate. Governments, especially in third world countries, sometimes are not willing to put so

much effort into this issue; they consider it as an expensive plan. However, the Green Economy is becoming one of the most critical issues in the world, and governments should not avoid the issue. Accordingly, it is vital to measure the place of each country in the green growth economy situation. The green economy can be measured in different ways. In our study, two green indices, EPI and GI, are explained. Based on the latest report of issue categories of the EPI Index, Iran did not have a good situation in the environmental performance index. Also, the green index result represents that Iran needs a great deal of effort to decrease its distance from the greenest countries, like Korea in this study.

There are two main steps in our study, first: the comparison of Iran and selected OECD countries (Turkey, Japan, Korea, and Israel) based on green growth indices in 2015 by using the GI method, and second: applying TOPSIS as a practical method to rank the countries. Calculation procedures in TOPSIS are almost the same as the green index formula. However, there are two considerable differences: (1) in TOPSIS the type (positive or negative) of criteria/indices should be determined, while in the green index all the criteria/indices are considered the same type, and (2) in TOPSIS the weight of each criterion/index is calculated while in the green index the weights of criteria are not considered.

Applying the methodology, countries are ranked based on 53 green growth indices. Results represented that Iran is not sustainable in green growth indices in comparison to Korea, Turkey, and Japan.

The limitation of our research is the lack of data for some indicators which are not recorded on the OECD website in 2015. Also, the data for the years after 2015 was not completely available for the selected countries.

For future studies, we strongly suggest using some other MCDM techniques such as AHP, ELECTRE, and Fuzzy MCDM. Considering all of the green growth indices in MCDM calculation methods may take too much time, so screening some important green growth indices to compare countries' green growth indices would be recommended.

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Is utility a measure of commodity value? On two different approaches to the subjective theory of value

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SUMMARY

This paper reviews two theories of utility. In Jevons' theory, utility denotes an abstract quality of a commodity and value is derived from the knowledge of the utility of a commodity. Menger, however, argued that the concept of value cannot be associated with the fact that things are useful. Goods themselves are worthless unless a human assigns value to them. It is shown that utility as a measure of commodity value is a vague concept.
Keywords: theory of value, marginal revolution, utility, total utility, final degree of utility, human need, economic good, William Stanley Jevons, Carl Menger
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INTRODUCTION

The birth of the subjective theory of value is commonly dated to the 1870s, when Carl Menger, William S. Jevons and Leon Walras (known as the founding trinity of neoclassical economics) almost simultaneously questioned the classical (labour) theory of value and proposed a subjective approach to the issue of value in economics.

Closer analysis of the assumptions underlying the works of Menger, Jevons and Walras reveals fundamental differences in their approaches. Although they all state that value is subjective in nature, each of them defines it in a different way. Jevons introduced to economics the concepts of total utility and final degree of utility. In Menger's work, valuation is a matter of human judgment. The history of economic thought clearly shows that it was the mathematical approach that prevailed. The most popular economic theory today, that of Marshall, is the best evidence of this. As a consequence, the subjective theory of value appears to limit itself to marginal calculation based on the postulate of maximization of utility.

The goal of this article is to re-analyse the implications resulting from the approaches of Jevons and Menger. As we shall see, these two scholars attributed different meanings to the notion of value. They also used a different methodology, which would influence their ultimate conclusions. The promised return to the basic assumptions of Menger's and Jevons' theories is first of all an occasion to verify the meaning and role of the category of utility.

THE NOTION OF UTILITY IN JEVONS' THEORY OF VALUE

The point of departure of Jevons' famous work is the assumption that economics, if it is to be a science at all, must be mathematical science. Economics deals with quantities and as such its laws and relations must be mathematical in nature (Jevons 1931, p. 3). Jevons begins his *Theory of Political Economy* (1871) by redefining the economic system of value, and he does this by introducing mathematical categories into theoretical analysis. The central element of Jevons' theory of value is the notion of utility. How does he explain this term? How is that notion related to Jevons' theoretical system of value?

In Jevons' theory, *utility* denotes the abstract quality whereby an object serves our purposes and becomes entitled to rank as a commodity (Jevons 1931, p. 38). A commodity is defined as any object, substance, action or service which can afford pleasure or ward off pain (Jevons 1931, p. 38). Whatever can produce pleasure or prevent pain may possess utility (Jevons 1931, p. 38)[i]. Elsewhere in Jevons' work one can read that utility is the intensity of effect produced upon the consumer (Jevons 1931, p. 47). Jevons declares that utility must be considered as measured by, or even as

actually identical with, the addition made to a person's happiness (Jevons 1931, p. 45).

In presenting his theory of utility, Jevons discriminates between the total of utility of a commodity and the utility attaching to any particular portion of it. Jevons proves that the very same articles vary in utility according to whether we already possess more or less of the same article (Jevons 1931, p. 44*).* His well-known law of the variation of utility states that the degree of utility varies with the quantity of a commodity, and ultimately decreases as that quantity increases (Jevons 1931, p. 43). The distinct feature of his theory is the application of *utility calculus* to the theory of consumer choice. Pleasure and pain are undoubtedly the ultimate objects of the calculus of economics (Jevons 1931*,* p. 37). Utility as such is a quantity of two dimensions – one consisting in the quantity of the commodity, and the other in the intensity of the effect produced upon the consumer (Jevons 1931, p. 47). He quantifies the degree of utility by the differential coefficient of u as a function of x and states the *principle of the ultimate decrease of the utility of any commodity*. In the case of a good which can be employed for two or more distinct purposes, Jevons argues that the distribution of the good is completed when the increments of utility Δu_1, Δu_2 are equal (Jevons 1931, p. 60). An increment of the commodity would yield exactly as much utility in one use as in another; at the limit we have the equation $du_1/dx = du_2/dy$. This guarantees a distribution of x and y as the distribution offering the individual the greatest advantage.

Jevons generally avoids using the term *value*. He points out that the notion of value has an ambiguous and unscientific character (Jevons 1931, p. 76). It is commonly considered as value in use, or as esteem, i.e. the urgency to desire, or as a ratio of exchange. Jevons himself does not enter into a scientific investigation of the meanings of *value.* Instead he assigns to commonly used value concepts the following categories: to the value in use – total utility, to the value of exchange – an exchange ratio, and to the notion of esteem – a final degree of utility (Jevons 1931, p. 81).

VALUE AS THE RESULTANT OF TRANSFER OF THE IMPORTANCE OF A NEED ONTO THE GOOD

A point of departure of Menger's *Principles of Economics* is the assumption that the goal of economic activities is satisfaction of human needs. The satisfaction of needs is an imperative for each person. His efforts are directed toward complete satisfaction of his needs, or if that is not possible, toward their satisfaction to the highest possible degree. Each person has his individual hierarchy of needs. Menger divides human needs into two classes: those essential for our life and those serving our well-being. The relative significance of each need for human well-being decides its position in the overall hierarchy of needs. Each person satisfies his needs by means of goods. According to Menger, *value* is the importance we assign to a good because we are aware that satisfaction of a need depends on command over the good in question[ii]. The value we attribute to a good derives from the importance of the need it satisfies[iii]. In Menger's system *the value of a good* is the resultant of a *transfer* of the importance of a need onto the good that satisfies that need[iv]. The more important the need appears to be, the more valuable the good is to an individual. Menger noticed that the importance we assign to particular goods depends also on the quantities at human disposal. Humans assign value only to economic goods i.e. rare goods; their loss would result in a need going unsatisfied. Uneconomic goods do not have value to the individual. If goods are in abundance, we do not attribute importance to them; the loss of such goods would not affect (reduce) the degree to which needs are satisfied.

Since needs are satisfied with acts, each successive act of satisfaction of a need, and consequently each successive unit of a good, is less important to the individual. A good's importance decreases as the need is satisfied to a greater and greater extent by that good. A person having at his disposal a certain quantity of a good, and recognizing the significance of the need it satisfies, assigns an appropriate value to the unit of the good that satisfies the least important need.

In other words, an individual who has at this disposal a scarce good that satisfies more than one need makes a choice between needs of higher and lower importance giving priority to the first. As a consequence the value of the good is the value of the unit which satisfies the least important need. Determination of the value always requires an answer to the question of which need would be left unsatisfied if an individual had a smaller quantity of the good than he has today. Each person would give up the need that is the least important to him, i.e. the good that satisfies his least important need.

As we see, Menger departed from the concept of utility as a fundament of value theory. The commodity value is not a property of the good itself; nor does it have anything to do with human preferences and human will. It is a human judgment on the importance of the good for human life and well-being, i.e. for the satisfaction of human needs[v].

On the issue of measuring value

Having introduced the basic assumptions of Jevons' and Menger's theories of values, let us recall their essential characteristics and implications (Table 1).

Jevons referred the economic question of a commodity's value to its utility. Value depends on the utility. The utility is an abstract quality of commodity which serves human purposes. It is, according to Jevons, the intensity of the effect produced upon the consumer (Jevons 1931, p. 47). A similar understanding of utility can found in earlier works, among others those of J.S. Mill (1806–1873), J.B. Say (1767–1832) and E.B. de Condillac (1715– 1780). Mill (1848) argued that utility is an inherent property of a good which serves the satisfaction of human need. In Say's treatise (1814) utility is a quality of a good that makes it desirable for each person. Condillac (1776) demonstrated that value is based on utility, on the need that is satisfied by a commodity or on the benefit (behoof) that a good provides. As we see, Jevons referred to the classical and pre-classical approach to utility. However, it should be noted that Jevons, in introducing the notion of utility as a property of a good, did not provide a scientific analysis of the nature of utility as a category of value. *Value* seems to be identical with the final degree of utility of a commodity. (...) It is measured by the intensity of pleasure or benefit which would be obtained from a new increment of the same commodity (Jevons 1931, p. 80). Jevons did not explain either the genesis or the essence of valuation. In his theory, utility is rooted in a commodity's attribute. As a consequence, Jevons did not succeed in explaining what makes certain goods more useful than others, which factor or process determines the magnitude of the utility and eventually what makes each successive unit of commodity less useful than previous (as required by the law of diminishing marginal utility). This fact has had significant implications for the development of the theory of value in its neoclassical and mathematical versions. In the end, utility as a measure of value has vanished from the theory of economics; or if it formally exists, then only as a vague concept. Pareto introduced the notion of preference, assuming that an individual does not need to determine utility with cardinal numbers – instead he appoints the quantitative set of goods which are to him indifferent.

Menger developed a subjective theory of value without referring to the 'old' notion of utility. In Menger's theory, it is not utility that is the key concept. Goods themselves are worthless unless a human assigns value to them. For Menger, *value* belongs to the category of human judgment. It is a human judgment on the importance of a good for human life and well-being, i.e. for the satisfaction of human need. Each person satisfies his less or more important needs by means of goods. Consequently we assign those goods a certain importance, which can be called a value. The magnitude of the value depends on the relative rank of the need satisfied by the good and on the quantity of the good available to the person. A good's importance decreases as the need is satisfied to a greater and greater extent by that good.

Table 1
Jevons' and Menger's theory of value

	Jevons	**Menger**
origin	commodity	human
category	property/attribute	judgment
notion	total utility final degree of utility	value

Source: prepared by the author.

Menger viewed the theory of economics as a science related to human action which explores relations of cause and effect. Each person seeks to satisfy his needs while having at his disposal a limited quantity of goods. He assigns a certain importance to his needs, and then to the goods which are capable of satisfying those needs. It is assumed that each human being, having his individual (subjective) hierarchy of needs, assigns certain values to goods. The category of value is presented by Menger in terms of cardinal numbers. Cause-effect relations that have roots in human valuation – that is, human judgment on the importance of a good for human well-being – exclude mathematics as a scientific tool. For this reason, we do not find in Menger's economics the concepts of optimization or maximization. Mengerian laws are derived by deductive methods and as such have a qualitative character. As we see, Menger's theory of value is not a non-mathematical version of marginal utility theory. Valuation cannot be the subject of measurement or any attempts at quantification.

Menger departed from the long-held assumption that value is derived from knowledge of the utility/the usefulness of a commodity. He showed that the notion of value cannot be derived

from the principle of utility taken as an inherent property of a good.

Table 2
Economic goods and non-economic goods in Menger's theory of value

	utility	**value**
economic goods	+	+
non-economic goods	+	-

Source: prepared by the author.

Menger used the notion of utility in a narrow, technical meaning, belonging rather to the theory of goods than to the theory of value. A commodity is useful if it satisfies human need. This ability is defined by Menger as utility[vi]. In that sense both economic and non-economic goods are useful (Table 2).

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[i] In further parts of his analysis Jevons argues that the notion of utility is related to human wants (Jevons 1931, p. 39). Utility, though a quality of things, is no inherent quality. It is better described as a circumstance of things arising out of their relation to man's requirements (Jevons 1931, p. 43). However, that line of argument was not further developed by Jevons.

[ii] (...) Es ist somit der Werth die Bedeutung, welche konkrete Güter oder Güterquantitäten für uns dadurch erlangen, dass wer in der Befriedigung unserer Bedürfnisse von der Verfugung über dieselben abhängig zu sein bewusst sind (Menger 2010, p. 78).

[iii] Der Güterwert ist in der Beziehung der Güter zu unseren Bedürfnissen begründet, nicht in den Gütern selbst (Menger 2010, p. 85).

[iv] Die Bedeutung, welche die Güter für uns haben, und welche wir Werth nennen, ist lediglich eine übertragene. Ursprünglich habe nur die Bedürfnisbefriedigungen für uns eine Bedeutung, (...), wir übertragen aber in logischer Konsequent diese Bedeutung auf jene Güter, von deren Verfügung wir in der Befriedigung dieser Bedürfnisse abhängig zu sein uns bewusst sind (Menger 2010, p. 107).

[v] Der Wert ist ein Urteil, welches die wirtschaftenden Menschen über die Bedeutung der in ihrer Verfügung befindlichen Güter für die Aufrechthaltung ihres Lebens und ihrer Wohlfahrt fällen und demnach ausserhalb des Bewusstseins derselben nicht vorhanden (Menger 2010, p. 86).

[vi] Nützlichkeit ist die Tauglichkeit eines Dinges, der Befriedigung menschlicher Bedürfnisse zu dienen (...) (Menger 2010, p. 84).

The waste management sector of Hungary

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SUMMARY

Nowadays, the waste management sector faces a number of challenges. Changes in consumer habits generate huge amounts of industrial and household waste. Today's trends, which involve a higher use of critical raw materials, such as in the manufacture of batteries and solar cells, make it urgent to extract valuable raw materials from waste. The waste sector as a whole, taking into consideration all levels of the waste hierarchy (prevention, reuse, recycling, energy recovery, landfilling), is a significant branch of the national economy, both in terms of employment and income-generating capacity. In addition, the sector can be considered a major intermediary in industrial value chains as it contributes to the generation of secondary raw materials that can be sold to industries and thus help to achieve a circular economy through the collection, treatment and processing of waste.

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INTRODUCTION

Today companies have to face two challenges in enterprise resource management.

On the input side of the value chain, the scarcity of resources and therefore the provision of a sustainable resource supply is an increasing problem. Due to its significant dependence on raw materials, the EU emphasizes the classification of raw materials according to their criticality. The evaluation methodology of 2017 classified raw materials according to their criticality based on two factors, economic significance and supply risk. The EU examined 78 raw materials for criticality in its 2017 study, of which 27 were rated as critical. Based on European Commission 2017a,b,c we compiled a list of raw materials used in the five top value-added manufacturing sectors. According to this, it can be stated that in all sectors the proportion of raw materials considered critical according to the 2017 EU classification is significant. In each of the highest value-added manufacturing sectors the share of critical raw materials in the total variety of raw materials used by the sectors exceeds 50 percent. (The figures for each area of manufacturing are: chemicals and chemical products: 57.%; fabricated metal products: 55.6%; computer, electronic and optical products: 80.0; electrical equipment: 75.0%; machinery and equipment n.e.c.: 46.7%; motor vehicles, trailers and semi-trailers: 55.6%) (based on European Commission 2017a,b,c).

In September 2020, an additional five materials were included in the tested materials, so 30 of the 83 items tested were classified as critical raw materials. The rating of some materials has changed compared to the 2017 rating, and there have been both positive and negative changes (European Commission 2020). Based on the new classification, it is likely that a sectoral analysis today would show similar results to the 2017 data.

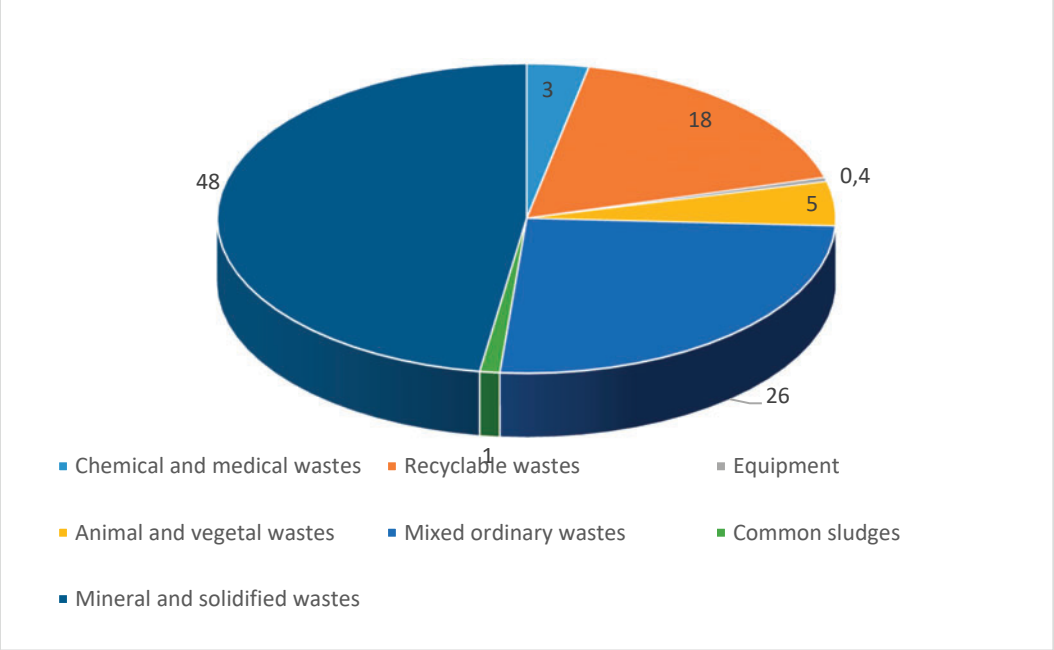
Today's development trends, such as the spread of electric cars and the increasingly ambitious shift

towards renewable energy sources (including solar energy), further enhance this problem while creating other problems due to the waste generated. Batteries and solar cells are increasingly used in the production of high-value, critical raw materials, and their treatment as waste at the end of their life is also a source of significant problems. The construction of appropriate end-of-life management methods and infrastructures can play a key role in reducing this risk, during which valuable raw materials can be recovered from waste (Mathur et al. 2019, 2020). This highlights the key role of the waste sector, which is already facing serious challenges as a result of current production and consumption patterns. The proper management of significant amounts of industrial and household waste and the reduction and avoidance of environmental damage is a serious problem for national economies.

The aim of this article is to describe the current situation of the Hungarian waste management sector with the help of statistical data, analyse the macroeconomic environment of the sector, and draw conclusions about the future of the sector.

THE ROLE OF THE WASTE MANAGEMENT DIVISION IN THE CIRCULAR ECONOMY

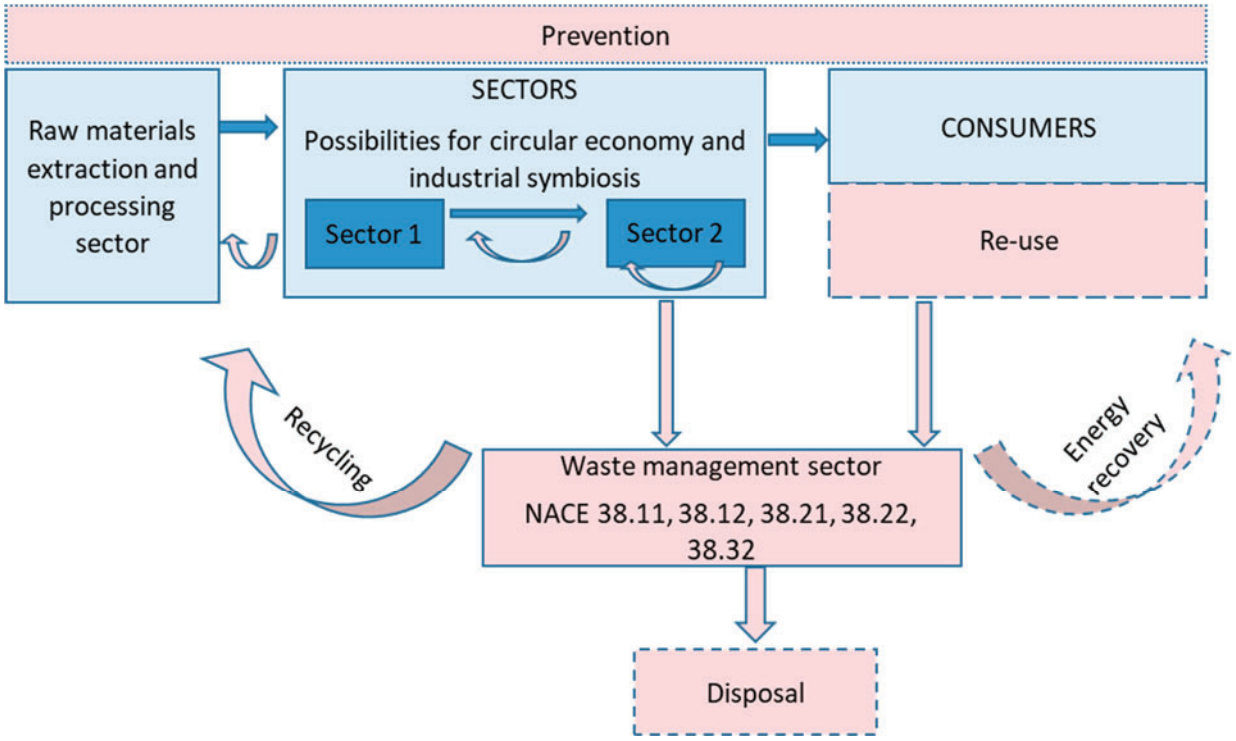
According to Eurostat data, 15,938,077 tonnes of waste were generated in Hungary in 2016 in households and in economic sectors (NACE Rev. 2) together. The distribution of this is shown in Figure 1. It is important to highlight that according to the data, only 18 percent of the generated waste was classified as recyclable waste.



Source: own construction based on Eurostat

Figure 1. Generation of waste by waste category, Hungary, 2016

Figure 2 illustrates the role of the waste management sector, which we consider to be very important for tackling the problems of scarcity of resources and waste management. Our approach is based on the general approach of the industry value chain, where after the raw materials production and raw materials processing sectors, different sectors produce a product for final consumption for final consumers. Some products find a new owner in the form of re-use and eventually end up in the waste sector in the form of waste. The waste management sector is seen as an intermediary that connects waste donors and recipients. It contributes to the production of valuable secondary raw materials through the collection, treatment, disposal, and possible processing of waste. Ultimately, the energy recovery of waste also reduces the amount of materials transported to landfills (Aid et al. 2017; Horváth & Bereczk 2019).



Source: own elaboration

Figure 2: Role of the waste management sector in solutions for sustainable resource management.

The problem of waste management is a burning issue nowadays, and tightening environmental regulations lead to predictions for the growth of the sector while all segments of the waste pyramid offer many opportunities to implement innovative ideas. Based on all of these factors, we consider the waste management division to be a priority area of a solution to the parallel problems of scarcity of raw materials and the high amount of waste generation.

METHODOLOGY OF THE RESEARCH

Information on the waste management sector was compiled based on the data available from the OPTEN database of Hungarian companies. The database contains data on enterprises operating in the sector in December 2019, partly for the closed year 2018 and partly for the period of the last five years (2014–2018). The limitation of the database is that the data for five years are compiled from the data of currently operating enterprises, so they do not include the performance of companies that have been closed down in the meantime. Thus, we draw conclusions for the sector based on the data of companies with five closed years.

The most important characteristics of the domestic waste management sector for Hungary are summarised primarily on the basis of the aggregated data of companies. We examined the business demography characteristics, net sales revenues, employment data, and profitability indicators of the currently operating enterprise in the period 2014–2018.

Beyond the classification according to the main activity, there are typically several areas in the activity of the companies; thus, we examine the five classes of the waste management division together. Division 38: Waste collection, treatment and disposal activities; materials recovery consists of five classes**:** 38.11 Collection of non-hazardous waste, 38.12 Collection of hazardous waste, 38.21 Treatment and disposal of non-hazardous waste, 38.22 Treatment and disposal of hazardous waste and 38.32 Recovery of sorted materials.

THE IMPORTANCE OF THE WASTE MANAGEMENT DIVISION IN THE NATIONAL ECONOMY OF HUNGARY

The waste management division (NACE rev. 2 division 38) belongs to NACE rev. 2 Section E - Water supply; sewerage; waste management and remediation activities. In the publicly available KSH (Central Statistical Office of Hungary) databases we find data only at the level of sections. The most important macroeconomic data on Water supply; sewerage; waste management and remediation

activities in Hungary (2014-2018) is summarised in Table 1.

Table 1
Data on NACE rev. 2 Section E - Water supply; sewerage; waste management and remediation activities in Hungary (2014–2018)

	2014	2015	2016	2017	2018
Gross domestic product (at current price, million HUF)	259 424	277 104	302 060	315 395	312 379
Number of full-time employees (thousand people)	38.7	38.4	41.0	39.9	40.5
Average gross monthly income of full-time employees (HUF)	224 447	230 574	234 037	269 090	300 387
Average net monthly income of full-time employees (HUF)	151 959	154 583	161 091	184 663	204 083
Number of enterprises	1 734	1 689	1 877	1 812	1 717

Source: KSH (Central Statistical Office of Hungary)

Section E accounts for about 0.8% of the total gross value added of the national economy and about 1.5% of the number of employees. The average gross and net monthly incomes of full-time employees are lower than the average monthly earnings in Hungary (by about 8–10%). Of all enterprises, 0.24% operate in this section. The value of gross fixed assets at current prices was HUF 4,795 billion and the value of net fixed assets was HUF 2,886 billion in 2016, which corresponded to about 2% of the total assets of the national economy. However, these data also include data on water supply and wastewater collection and treatment.

In general, the performance and importance of the waste management sector cannot be judged solely on the performance of companies with a given NACE rev 2 code. The performance of the sector is underestimated in official statistics; its real performance can be interpreted along the industry value chain, as many innovations and achievements related to waste management/recycling are reported in the user sectors under other NACE rev. 2 codes.

COMPANIES IN THE INDUSTRY

The companies of the waste management sector and their characteristics were examined on the basis of the OPTEN database.

Table 2
Business demography of Hungarian enterprises operating in the waste management sector

NACE Class	Activity	Number of enterprises 2019	Data available for 2018	Number of companies surviving 5 years	Number of new companies 2014-2019	Closed without a legal successor 2014-2018
38.11	Collection of non-hazardous waste	433	409	356	76	200
38.12	Collection of hazardous waste	43	43	38	4	16
38.21	Treatment and disposal of non-hazardous waste	212	190	138	71	90
38.22	Treatment and disposal of hazardous waste	57	54	46	10	23
38.32	Recovery of sorted materials	311	277	221	95	196
Div. 38	Waste management total	1056	973	799	256	525

Source: own elaboration based on OPTEN database

Table 3
Distribution of companies by size (based on the number of employees) (2018)

NACE class	Enterprises with 0 employees	Share of microenterprises %	Share of small enterprises %	Share of medium-sized enterprises %	Share of large enterprises %
38.11	71	66.3	20.0	12.2	1.5
38.12	8	79.1	18.6	2.3	0.0
38.21	53	76.3	15.3	6.8	1.6
38.22	16	55.6	31.5	13.0	0.0
38.32	82	78.7	16.2	5.1	0.0
Div. 38 total	230	71.7	18.6	8.7	0.9

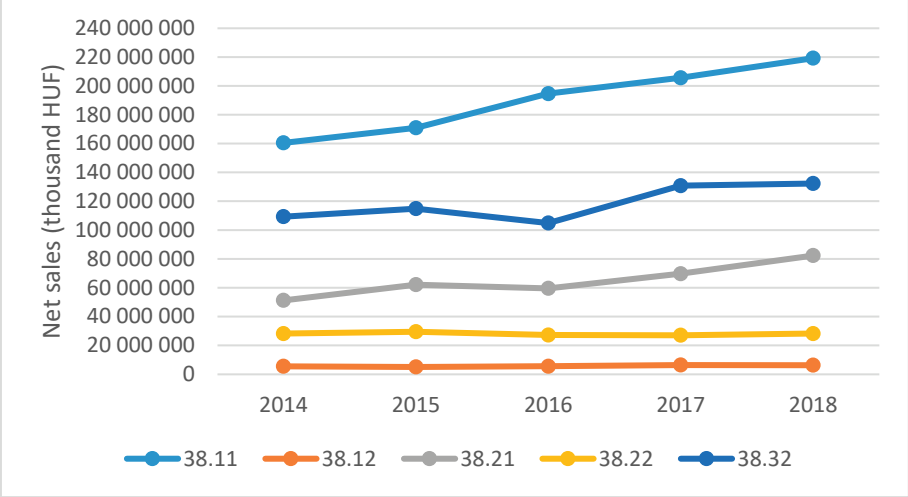
Source: own elaboration based on OPTEN database

In 2019, there were 1,056 companies operating in the examined sector. The dominance of micro-enterprises is typical (72%). The medium company size is mainly found in the field of waste collection and in the treatment and disposal of hazardous waste, which is usually the province of public utility companies and with higher technological demands. There are a total of nine large companies operating in the sector, providing activities related to non-hazardous waste.

In terms of their legal form, out of 973 companies (2018), 855 companies operate as limited liability companies, 61 as limited partnerships, 41 as limited companies, 15 as co-operatives, and 1 company as a general partnership.

The waste management sector employed 20,367 people in 2018, of which the SME sector accounts for 71%. The rate of employees engaged in the collection of non-hazardous waste was 61.5%, 18% were employed in the treatment and disposal of non-hazardous waste and 13.1% in recovery of sorted materials. The collection, treatment and disposal of hazardous waste accounts for 7.4% of employment.

We drew conclusions about the development of the net sales revenue of the sector on the basis of the data of 799 companies with 5 closed business years. The combined net sales revenue of these companies increased by 32% from 2014 to 2018. The largest increases were in the collection, treatment and disposal of non-hazardous waste, but there was also an increase in the recovery of sorted materials. The collection, treatment and disposal of hazardous waste accounts for a smaller share of the sector's net sales revenue, and growth was also the smallest in these areas.



(38.11: 356 enterprises, 38.12: 38 enterprises, 38.21: 138 enterprises, 38.22: 46 enterprises, 38.32: 221 enterprises, total 799 enterprises)

Source: own elaboration based on OPTEN database

Figure 3. The development of the waste management sector's net sales for companies with 5 closed business years, 2014–2018

In the first three years between 2014 and 2018, the profitability indicators for waste collection, treatment and disposal were typically better than those for the recovery of sorted materials, but in the last two years the profitability indicators of the latter sector also increased. In 2018, 64% of companies in the sector were profitable (based on data from 973 companies). The proportion of profitable companies in the field of recovery of sorted materials was lower. Profitability indicators were calculated on the basis of aggregate data from 596 profitable SMEs and the results are shown in Table 4. It can be seen that profitability varies from class to class.

Table 4
Profitability characteristics of the waste management sector of Hungary

NACE class	Rate of profitable enterprises (%, 2018)	Operating profit/total assets (%, 2018)	Operating profit/net sales revenue (%, 2018)
38.11	69	8	7
38.12	81	14	11
38.21	62	12	10
38.22	69	2	13
38.32	54	11	6
Div. 38 total	64	-	-

Source: own calculations based on OPTEN database

Out of the top 50 companies in the waste management sector of Hungary concerning turnover, 24 operate in the collection of non-hazardous waste and 11 in the field of treatment and disposal of non-hazardous waste. This is because most of these companies are public utility companies. Eleven companies operate in recovery of sorted materials among the largest companies. The remaining four companies belong to the treatment and disposal of hazardous waste. Half of the top 12 companies operate in the field of recovery of sorted materials. These companies are: INTER-METAL Recycling Kft., MÜ-GU-Kft., Loacker Hulladékhasznosító Kft., ERECO Zrt., GEOSOL Kft., and Hamburger Recycling Hungary Kft.

PESTEL ANALYSIS OF THE INDUSTRY

The PESTEL analysis concerns six factors: political, economic, social, technological, environmental, and legal. In the following, we examine the selected sector along these lines.

POLITICAL AND LEGAL ENVIRONMENT

The waste sector is subject to strict European Union and domestic regulations. EU regulation is based on three main pillars:

- European Union legislation on waste – Waste Framework Directive 2008/98/EC,
- European Union legislation on waste management operations,
- European Union legislation on specific waste streams.

Waste management issues in the European Union are basically regulated by the European Commission Directive 2008/98/EC. The directive lays down measures to protect the environment and human health. It defines a number of relevant concepts, such as waste, hazardous waste, waste management, recovery, and recycling. Besides it determines the levels of the waste hierarchy, which are:

- prevention;
- preparing for re-use;
- recycling;
- other recovery, e.g. energy recovery;
- disposal.

It also led to tightening of regulations on companies by introducing the “polluter-pays principle” and the “extended producer responsibility”.

The polluter-pays principle has become a guiding principle at both European Union and international level. The point is that "the waste producer and the waste holder should manage the waste in a way that guarantees a high level of protection of the environment and human health" (Directive 2008/98/EC, p. 4). Extended producer responsibility is designed to promote the efficient use of resources in the design and manufacture of products, taking into account the full life cycle of products, including their repair, reuse, disassembly and recycling (Directive 2008/98/EC).

Observing trends in EU legislation, it is clear that the European Union has been introducing continuous tightening since the 2008 Directive (which itself introduced stricter principles). The legislation focuses mainly on reducing industrial emissions and

on hazardous substances used in electrical and electronic equipment and the treatment of waste from such equipment. The most relevant Hungarian regulations are closely related to the EU Directives.[i]

ECONOMIC ENVIRONMENT

For the analysis of the economic environment, we first reviewed research project funds available in the raw materials sector, in particular the waste sector, including Horizon 2020 resources at the European level and the opportunities provided by domestic structural funds and government resources.

The supported H2020 projects were filtered using the keywords "Raw material", "Circular economy" and "SMEs". This yielded a list of 51 projects to be examined. Of these, 11 were coordinated by Hungarian coordinator organizations (UNEXIM, InnoPellet, reNEW (2016), reNEW (2017-2019), OpenHeritage, BrailleJet, START2ACT, CFMEBR, ULTIMATE, ultimate, and OPTOFORCE) while the rest included a Hungarian participant. The project types are: Innovation (IA), Research & Innovation (RIA), Coordination & Support (CSA) and SME. The topics of the supported projects within the raw materials sector is extremely diverse; we did not find a focus area for Hungarian-related projects. Topics include highly automated deep mining, an international training centre for professionals in the raw materials sectors, mapping and developing new co-operation opportunities related to raw materials, an EU databank for secondary raw materials, circular economy, recycling in the textile industry, food waste, agricultural waste, waste heat recovery, industrial symbiosis in the construction value chain, wastewater treatment and sewage treatment. The requested grant in the examined projects ranges from EUR 0 to EUR 1,510,990 euro.

We did not find any indication of a funded Hungarian-related project that specifically supports start-ups, either in the waste management sector or in the circular economy. The reviewed projects can be linked to a total of 29 Hungarian organizations.[ii]

Reviewing the Hungarian funds, we highlighted the projects supported by the operational programmes KEHOP (Environmental and Energy Efficiency Operational Programme) and GINOP (Economic Development and Innovation Operational Programme). We also reviewed EFOP (Human Resources Development Operational Programme) projects, including projects dealing with the raw materials sector, e.g. Project EFOP-3.6.2-16-2017-00010 entitled "Sustainable Raw Materials Management Thematic Network - RING 2017", but these focus primarily on the supply and education of researchers. Within KEHOP the following support schemes deal with the waste management sector:

- KEHOP-3.1.1-17 - Development of municipal waste collection, transport and pre-treatment systems;
- KEHOP-3.1.2-17 - Diversion of biodegradable waste from landfills;
- KEHOP-3.1.3-17 - Attitude formation toward waste prevention
- KEHOP-3.2.1-15 - Development of pre-treatment, recovery and disposal subsystems for municipal waste;
- KEHOP-3.2.2-15 - Systematic development of a network of municipal waste treatment facilities for phased projects.

Evaluating 40 projects, it can be said that these projects primarily serve to support state-owned companies and local governments, while primarily supporting the development of landfills instead of decreasing the quantity of waste or using it as secondary raw materials.

Within the GINOP projects, a number of projects focus on micro, small and medium-sized enterprise development; there is a sub-project related to start-ups (GINOP-2.1.5-15 - Building an innovation ecosystem (startup and spinoff) and supporting young people to become entrepreneurs appears as well (GINOP 5.2.2-14; GINOP 5.2.3.-16; GINOP 5.2.7.- 18). However, they are not sector-specific, so applicants compete strongly with other sectors for resources (https://www.palyazat.gov.hu/).

In addition to EU and national funds, there are a number of other opportunities to be found for start-ups, such as business angels or venture capitalists. However, it can also be said that most of them do not specialise specifically in the raw material sector or, within it, in the activities of the waste management sector, so new companies have to compete with companies in other sectors as well. However, encouraging examples can be found here, e.g. the Bonitas Investment Fund Manager (Bonitas Befektetési Alapkezelő) mentions the sustainable environment as a priority area, to which waste management is also linked (https://bonitasktk.hu/befektetesi-politika/). By the end of 2016, companies in the Water Supply, Sewage and Waste Management sectors had contracted approximately HUF 2.5 billion among the investments of JEREMIE venture capital funds (Equinox Consulting 2016). In the Széchenyi Capital Investment Fund (Széchenyi Tőkebefektetési Alap), we do not find a winning application specifically from the waste management sector, but they support two companies related to wastewater utilisation, which may mean a shift in the circular economy (Biopolus Technológiák Zrt., Cyclator Kft.) (www.szechenyi.szta.hu/befekteteseink/?fwp_page d=2). Hiventures' portfolio includes Plantoon Technologies Ltd, which develops bio-plastic composting technology

(www.hiventures.hu/portfolionk?o=10). Internationally, Chivas Venture (https://www.chivas.com/en-EN/the-venture) is specialised in revitalising the circular economy, supporting a number of start-ups from reducing food waste to recycling used tires.

Low-interest, state-subsidized loan programmes are available for SMEs, e.g. Growth Loan Program Refinancing loans disbursed under the "Hajrá" Programme (Növekedési Hitelprogram Hajrá keretében folyósított refinanszírozási hitelek) or Széchenyi Card Programme. However, the conditions of these are not necessarily suitable for start-up companies. For example, one condition may be at least two closed business years, during which the company cannot be unprofitable.

The preparation of the Hungarian Waste Management Strategy is in progress. The aims are to increase the economic policy role of the sector and to support the achievement of sustainability goals and the transition to a circular economy (A Nemzeti Hulladékgazdálkodási Stratégia kimunkálásához kapcsolódó tanulmányra ad megbízást az ÉMI (2020, April 9). This is also important because shareholders in the waste management sector expect more public support to fully exploit the potential of waste recovery. (Héjja 2020)

SOCIAL ENVIRONMENT

Two levels of the waste management hierarchy, prevention and re-use, are greatly influenced by consumer behaviour in society. The people have a big impact on the production processes, as their consumption habits generate the production processes. If we could achieve significant changes in the demands of the population, it would also change the production processes (the supply side). That is why it is important to give higher priority to the formation of a social opinion on waste, which is still in its infancy in Hungary. Increase in public awareness through awareness-raising programs and initiatives could be the basis for prevention.

Unfortunately, there is still much controversy in this area. For example: a number of good programmes are being launched to change children's attitudes, such as drawing competitions (e.g. "My Environmentally Conscious School" drawing competition, Ministry of Innovation and Technology) and idea competitions ("Be creative from waste!" Ministry of Innovation and Technology; "Become a reuse ambassador", Bay Zoltán Research Institute), while at the same time selective waste collection is not fully established in Hungarian schools. A large number of websites and information materials are being produced to shape public attitudes, while prices of goods do not reflect decision-makers' preferences for waste reduction and do not orient consumers towards more sustainable consumption. Currently a clear, central strategy in the areas of information, awareness-raising and education is lacking.

Reuse, in which case the given product or packaging can be reused for the same purpose as it was originally manufactured for, without any modification, is a good solution to avoid waste. This extends the time of use and saves the product from disposal. A website dealing with possibilities of creation products from waste (http://kornyezetbarat.hulladekboltermek.hu) collects a lot of examples and best practices in connection with reuse opportunities. The examples listed below are summarised based on the collection of the website mentioned above. The most well-known example of this for the Hungarian population was returnable (deposit) glass. Unfortunately, manufacturers today are making their products unique by making the world of glass increasingly diverse, making it impossible to economically recycle and reuse glass. In other areas, however, we are witnessing the emergence of new practices. There are already examples of recycling centres that are becoming more widespread in Western European countries in our region. CERREC (Central Europe Repair & Re-use Centers and Networks) has set up re-use centers on an experimental basis. There are several of these in Hungary, such as the two Attitude Shaping and Reuse Centers in Budapest, the Miskolc Reuse Center and the Kaposvár Reuse Center. The essence of the business model is that the population can place their used, redundant, but still usable objects, tools and equipment for free in the centres, which sell them for a symbolic amount. At present, however, there is no re-use center in Hungary for consumer goods collected during industrial, commercial, service and office disposal, and electronic items cannot be placed in these centres.

Another good example of reuse is the many auction portals and classifieds websites (Vatera, TeszVesz, Jófogás, etc.), which do a lot to extend the life of products by linking the demand and supply side. Also recycling stores (replacement of defective parts, repair shops) are included, including second-hand stores, charity shops and commission stores, and online second-hand stores, of which there are many examples in the country. Finally, we should mention public initiatives, which are typically organised on social media (thematic give-and-take groups on Facebook) or in the form of traditional fairs, such as exchange fairs (books, clothes, antiquities). In the case of these initiatives, quality control and renovation activities are largely lacking; the modern reuse business has not yet developed in Hungary.

TECHNOLOGICAL ENVIRONMENT

An advanced technological environment plays an important role in the development of the sector. The demand for state-of-the-art technologies is emerging

at all levels of the waste pyramid, both within the sector and at the level of related industries.

Stricter environmental standards set increasingly ambitious energy efficiency, emission reduction and waste reduction targets for both products and production methods. Greater use of secondary raw materials in production processes is desirable. The need for processing long-lasting, repairable, modular, low-emission, energy-saving, etc. products is becoming ever more apparent. All this requires continuous technological development from manufacturers.

In the case of recycling the waste (or by-product) is recycled as a secondary raw material for use in the production processes. There is a need for modern technologies on the part of both the sectors that use recycled waste and the waste management sector. Sectors that sell and use secondary raw materials need to recognize the potential of the circular economy and industrial symbiosis. The waste management sector, as a kind of accelerator, is involved in the process of efficient collection, sorting and preparation. Waste collection systems, sorting, cleaning, shredding, and preparation all require different technologies for different wastes. Table 5 collects the quantity and share of recyclable waste categories and also gives possibilities how they can be recycled.

Table 5
The amount of recyclable waste (2016) and its recyclability opportunities in Hungary

Recyclable wastes	**Quantity (tonnes)* 2016**	**Share (%)**	Recyclability opportunities **
Metal wastes, ferrous	1 338 015	47.9	Steel industry, production of steel products
Metal wastes, non-ferrous	125 720	4.5	Metallurgy, manufacture of metal cans
Metal wastes, mixed	23 949	0.9	Metallurgy, manufacture of metal cans
Glass wastes	131 618	4.7	Glass production, glass products, packaging
Paper and cardboard wastes	713 579	25.6	Manufacture of paper and paper products
Rubber wastes	54 113	1.9	Rubber sheets, automotive products, road foundation, energy recovery in a cement plant
Plastic wastes	221 334	7.9	plastic product, packaging, film production, textile production, as fuel in cement industry, thermal power plant
Wood wastes	159 293	5.7	Production of furniture
Textile wastes	23 190	0.8	Textile industry, cloths, carpet
Recyclable wastes total	*2 790 811*	100.0	

Sources: *Eurostat, **Hungarian Waste Management Federation

Energy recovery includes waste incineration and cement plant recovery. Waste incineration as a fuel is mainly found in cement plants to reduce the production costs of cement. Waste incineration in waste incineration plants are used for production of heat and/or electricity. Most incinerators produce combined heat and power (CHP). Central and Eastern European countries lag significantly behind Western Europe in the number of incinerators and in their performance. Modern flue gas purification technologies and processes can ensure that emissions from incinerators are well below the very strict EU limit values. Even so, serious disadvantages of this solution are the air pollution caused by incineration, the loss of secondary raw materials, and other social problems (Bánhidy 2019).

Landfilling is widespread due to its short-term cheapness and simplicity. There are 74 landfills operating in Hungary that meet EU standards. In some cases, landfill gas (biogas) generated in landfills can be used for heat and electricity generation (for example it is used in district heating in Miskolc) (http://kornyezetbarat.hulladekboltermek.hu/hulladek/hulladekhierarchia/).

According to Eurostat data for 2016, in Hungary waste treatment activities occur in the following distribution: disposal - landfill 34.2%, disposal - incineration 0.6%, energy recovery 7.4%, recycling 54.1%, refilling 3.7%.

ENVIRONMENTAL FACTORS

Efficient waste management plays a key role in the fight against climate change and in other issues of environmental protection. Through recycling, waste is converted into secondary raw materials and returned to industrial production, thus the use of primary raw materials is reduced. Due to this process significant reductions can be achieved in energy consumption, CO_2 emissions, air pollution, water pollution, and water consumption compared to the

production from primary raw materials. For the results available in the field of metal recycling see EuRIC Circular Metals Strategy 2021.

CONCLUSIONS

Today's trends and changes in consumer habits pose a major challenge to the waste sector. In this article, by analysing the situation in Hungary, we established the following:

- Statistics show that the waste sector is a very significant sector in terms of turnover and employment data in the Hungarian raw material sector.
- Taking into consideration all levels of the waste hierarchy (prevention, reuse, recycling, energy recovery, landfilling), the performance and importance of the sector is higher than estimations from official statistics, as many innovations and achievements related to waste management/recycling in the user sectors are reported under other NACE codes.
- The role of the waste sector in industrial value chains has been defined as a kind of intermediary, which through the collection, treatment and processing of waste contributes to the generation of secondary raw materials that can be sold to industries and thus help to achieve a circular economy.
- The preparation of the Hungarian Waste Management Strategy is in progress. Its objectives – to increase the role of the sector in economic policy and to support the achievement of sustainability goals and the transition to a circular economy – will further increase the future potential of waste management and this role will appear (and already appears, to some extent) in support systems and in the creation of business opportunities.

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GUESS databases
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OPTEN databases

[i] [i] Hungarian Waste Management Federation, https://www.hosz.org/jogszabalyok
[ii] CORDIS - EU research projects under Horizon 2020 (2014-2020) - https://data.europa.eu/euodp/en/data/dataset/cordisH2020projects - H2020 Projects and H2020 Project Publications tables; Horizon 2020 Environment and resources data hub - https://sc5.easme-web.eu/?mode=7# - filtered to Hungarian data

Usage and Knowledge of Technological Advances in a Multi-Cultural Country: The Level of Digitalisation in the UAE, Dubai

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SUMMARY

The evolution of significant technological discoveries and the appearance of constantly expanding information technology have pushed mankind from the industrial era into the information and digital era. Nowadays, digitalization has become an extensive global phenomenon and the main driving force in this era of mankind. In this research, I would like to investigate and analyse digital knowledge among society. The target for my observation_for which I used a digital survey_is the digitalisation of Dubai: a city with constant economic growth and a steady influx of foreign workers.

Keywords:Digitalization, Digital Knowledge, Dubai
Journal of Economic Literature (JEL) codes: D83; M14; O3
DOI: http://doi.org/10.18096/TMP.2021.02.05

INTRODUCTION

According to Tihinen et al (2016), digitalization has become known as one of the major trends that will change society and business in both the near and long term future. The impact of digitalization is expected to be extensive, and it has been compared to the industrial revolution (Degryse 2016; Tihinen et al. 2016). According to Henriette et al. 2015, digitalization is defined as the ability to turn existing products or services into digital variants, and thus offer advantages over tangible products. Nowadays a digital revolution is taking place in our lives, which is often called the third industrial revolution, the "information age" (Brown and Marsden 2013; Moghaddam 2014). Digitalization refers to the large amounts of data, increasing (algorithm-driven) analytical and processing capabilities, easy access globally, and virtual communication (Bankewitz et al. 2016). Therefore, the growth of digitalization is likely to impact our society, organizations, banking industry, and businesses which could change the organization's strategy and structure. Consequently, organizations and society need to react to these changes to remain sustainable among other competitive. Based on this definition I can say that the era of digitalization changes the way of our working, life, and business. This means changes at several levels, including the following (Parviainen et al. 2017):

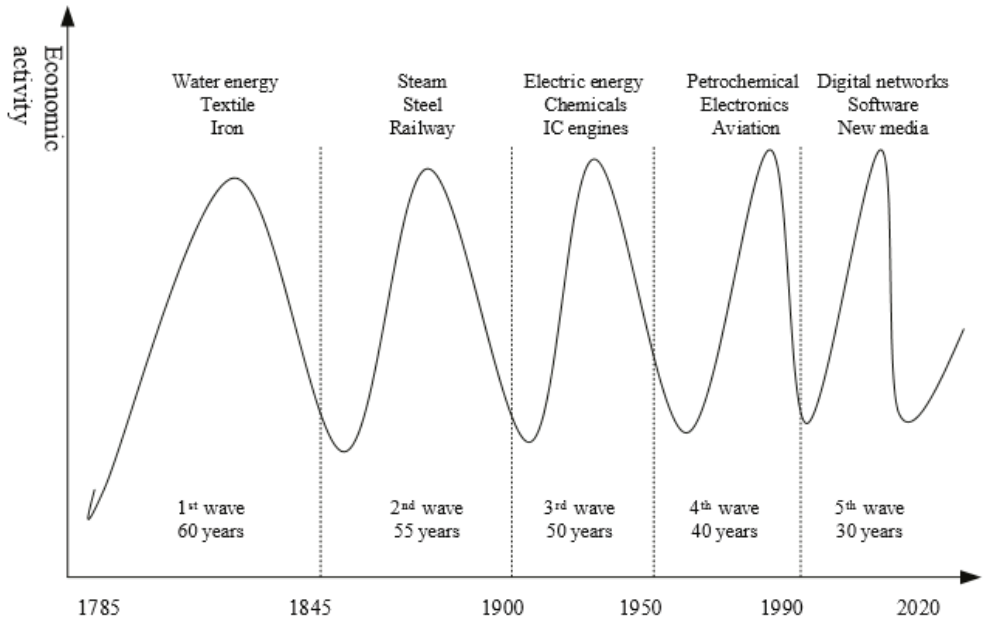
- Process level: Adaptation of new digital tools could decrease our manual steps;
- Organization level: Offering new services could improve and develop the organizational services;
- Business level: Could change the roles and value in ecosystems;
- Society level: develop social structures such as type of work, and decision making.

LITERATURE REVIEW

Today's environment is highly related to technological capabilities and digitalization.

Today's societal characteristics have been highly influenced by the industrial revolutions which occurred during the last three centuries. Revolutions have occurred throughout history when a new technology caused a deep change in economic systems and social structures (Schwab 2016). From the first industrial revolution, which happened in the 1760s, technology has developed and adapted to change from the old ones. The second revolution was in the late 19th and early 20th century, which was a time for developing electricity and starting mass production. According to Jovanović et al. (2018), the 1960s brought computers which shaped the third industrial revolution and this is called the digital revolution. Finally, based on the previous digital revolution, the current, and fourth industrial revolution is happening today, managed by artificial intelligence, machine learning and the Internet of Things (Schwab 2016).

In Figure 1, I would like to present the waves of innovation suggested by Schumpeter. He argued that each wave of innovation does not last equally and that their length is shortened due to the rapid development of new technologies (The Economist 1999; Jakšić et al. 2018a). Currently, we are living in the 5th wave of innovation and digitalization, where digital solutions are becoming the leading impetus of change (Jovanović et al. 2018).



Source: Levi Jakšić et al. (2018)

Figure 1. Schumpeter's long waves of innovation

Digitization in society is transforming the techno-economic environment and socio-institutional operations through digital communications and applications. Unlike other technological innovations, digitization builds on the evolution of network access technologies such as mobile, and fixed broadband networks, or semiconductor technologies such as computers, laptops, and tablets as an electronic application for social networks, and delivery of data. On the other hand, knowledge concerning the usage of this new technology has become a new challenge globally. Thus, organisations, society try to develop and increase their knowledge in the field of technology to survive among their competitors.

According to Rosen (2007), the new generation may be called the "iGeneration", and it is characterized by the "i" which determines the digital technologies such as iPhone and iPad and highly of the individualized activities, what these technologies make it possible for them. Generation "i" says that this generation was born into the world of high technologies, and is characterized by electronic communication for their inquiries in society. Modern digital resources make it possible to meet individual needs very easily (Tomyuk et al. 2020). According to Ustyuzhanin et al. (2018), in the individual's life, digital technologies have already brought numerous advantages such as developing cognitive abilities, and competencies of a contemporary person, which allow a person to integrate and be successful in realizing himself/ herself in conditions of variability and uncertainty. In my opinion, learning and adapting new technologies could carry new opportunities for

developing the individual experience concerning the advantages of digitalization as well.

Digital Knowledge

People are trying to seek information to reduce their uncertainty in the social and work environment (Huber and Daft 1987). For example, members could seek information directly from their colleagues in the organization (Morrison 2002; Palazzolo 2005). On the other hand, many factors are influenced in learning technology and digitalization such as culture, and financial conditions. For instance, Hofstede has already investigated the role of national culture on technology adoption related to uncertainty avoidance. He believed that high uncertainty avoidance cultures have more solutions to the new technology since these solutions are generally more predictable than human solutions. Thus, a high uncertainty avoidance culture is likely to invest more in technology and digitalization (Hofstede 2001). Also, developing knowledge concerning technological devices is defined as a gap between those who have access to digital technologies and those who do not.

Consequently, in my research, I would like to investigate digital knowledge among society in the UAE (Dubai). The UAE has become a modern country with a high level of technology and digitalization which, encourages me to carry out my research there.

UNITED ARAB EMIRATES (DUBAI)

The United Arab Emirates (UAE) is located in the Middle East and it consists of seven parts. It is bordered by Qatar, Saudi Arabia, Oman, and finally with the Persian Gulf on the north. Abu Dhabi is the main capital and Dubai is called the capital of economics in UAE. Dubai has become a metropolitan city with a diversity of cultures. The original language is Arabic, but English is well understood and extensively used for communication between other nationalities. The current population of UAE is 9.89 million, and Dubai, with 3.38 million, has the second-highest population after Abu Dhabi in the United Arab Emirates. The UAE has become a digital country, and its' residents are from different cultures, with origins from Arabia, Persia, Baluchistan, Africa, and the south of Asia such as India, Afghanistan, and Pakistan, according to the Dubai online website (2020) and the UAE Government portal.

METHODOLOGY

In my research, I use both primary and secondary data. Consequently, I chose to use an electronic questionnaire for collecting data, because questionnaires are the best way for finding the assumptions, solutions, and possible answers to the topic of the research. I targeted the community of Dubai because, I was working there, so I used the help of my ex-colleagues to spread the questionnaire, and I shared my questionnaire in several social media platforms which was used by Dubai citizens and residents. Although I aimed for a sample size of 100, 41 people filled the questionnaire. Unfortunately, due to COVID-19, lockdown conditions, and an overall lack of enthusiasm for sharing data of personal preferences, I could not succeed in collecting more data. My questionnaire is divided into three main parts.

1. Demographic Questionnaire;

2. Questionnaire on digital knowledge and demographics in Dubai: It includes 5 categories; Information processing, communication, content creation, safety, and problem-solving;

3. General Questionnaire.

RESULT AND DISCUSSION

In the following analysis, I present and discuss the outcomes of the questionnaire. The opening of the questionnaire was the demographic questions category. Table 1 presents the result.

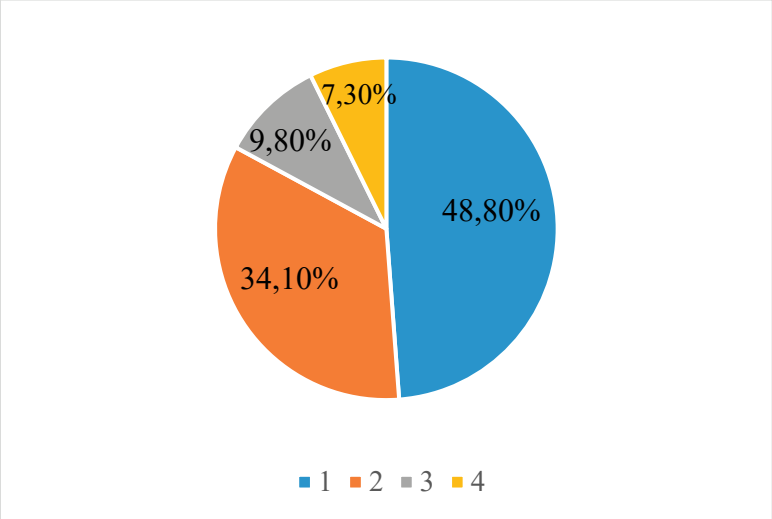
Table 1
Demographical Characteristics of Participants in this Study

		N	N %
Gender	Male	23	56.1
	Female	18	43.9
Age	<=30	11	26.8
	>30	30	73.2
Degree	PhD	1	2.4
	Master	20	48.8
	Bachelor	20	48.8
Marital Status	Married	19	46.3
	Single	17	41.5
	In a long-term relationship	2	4.9
	I prefer not to say	3	7.3

Source: Own Edition

The demographical characteristic's results show that the majority of the participants were male, over the ages of 30, and have a Master's or Bachelor degree gave the most answer.

The second main questionnaire was about digital knowledge and demographics in Dubai, and it includes 5 categories: the first category of the questionnaire (Q1) is "Information Processing". Figure 2 shows the outcome.



In Figure 2, the percentages shows the results to the following answers:

1. I can use different search engines to find information.
2. I can use advanced search strategies to find reliable information on the internet such as using web feeds.
3. I cannot look for information online at all.
4. I cannot look for information online using a search engine.

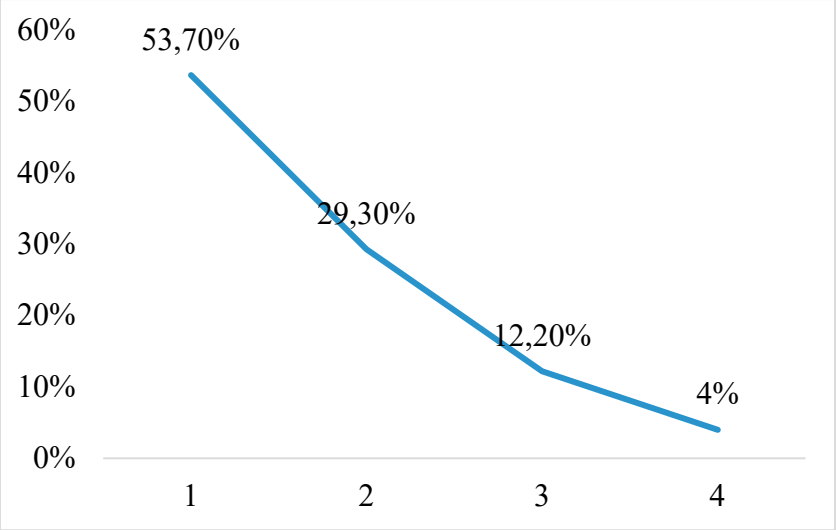
Source: Own edition

Figure 2. Information Processing Category

According to Figure 2, the majority of answerers have the ability to use several search engines or use more sophisticated strategies to search online which shows a very interesting result.

The second question (Q2) was "In terms of information processing category, which one of the following would describe you the best?" The answers show that the majority of the participants (95.1%) know about online information, and more than half of them (58.5%) assess and compare the validity of the information.

The second category is related to communication. Figure 3 shows my response:



1. I actively use a wide range of communication tools (e-mail, chat, etc.).
2. I can use advanced features of several communication tools (e.g. using Skype and sharing files).
3. I can communicate with others using Skype or chat-using basic features (e.g. SMS and voice messaging.
4. I cannot communicate with others using Skype or chat.

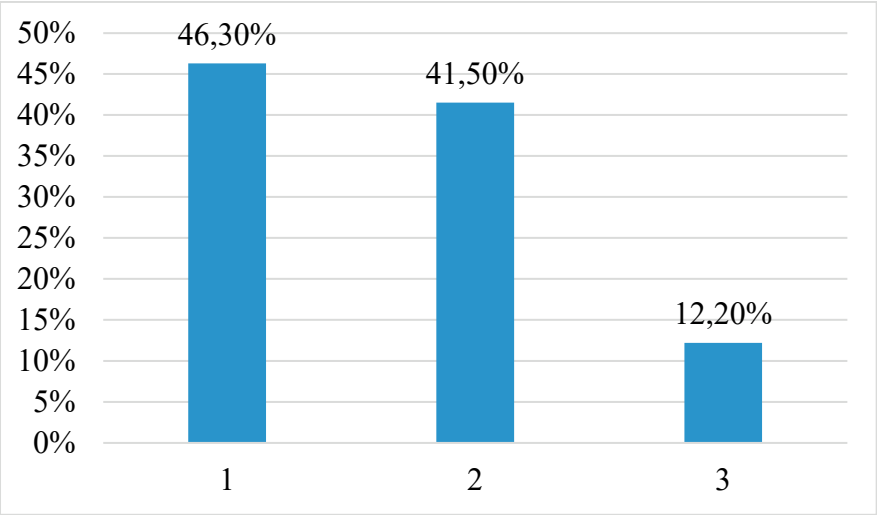
Source: Own edition

Figure 3. Terms of Communication Category

Based on the result, I can say that the vast majority of residents in Dubai know how to use this type of device for their communication.

As for usage of online services (Q4), 85.3% use online services to meet their needs such as digital marketing, Internet banking, and most of the rest know (9.8%) about it, while 4 people did not know about it. I can assume that in Dubai the majority of the people use online services for their inquires both in business and private life.

As for social networking and online collaboration tools (Q5), I obtained the result in Figure 4.



1. I can use advanced features of communication tools (e.g. video conferencing or data sharing)
2. I am aware of social networking sites and online collaboration tools.
3. I pass on or share knowledge with others online (e.g. via social networking tools or in online communities).

Source: Own edition

Figure 4. Social Networking and Online Collaboration Tools

According to Figure 4, I can say that digitalization has become part of everyday life in Dubai. With this, I ended the communication category.

The third category of the questionnaire was about content creation. Table 2, presents the results.

Table 2
Content Creation

Third Category Questions 6	Percentage
I can produce simple digital content (e.g. text, tables, images, audio files) in at least one format using digital tools	56.1%
I can produce complex, digital content in a different format	31.7%
I can produce complex, multimedia content in a different format	9.8%
I cannot produce simple digital content in at least one format using digital tools.	2.4%

Source: Own edition

Based on Table 2, we can say that nearly everybody in the sample knows some level of content production.

Regarding editing and formatting (Q7), one-tenth of the participants (9.8%) cannot carry out basic editing of another's work, 26.8% can do basic editing, 43.9% can do basic formatting and 19.5% can use advanced formatting tools. This shows that participate in the survey know data modification.

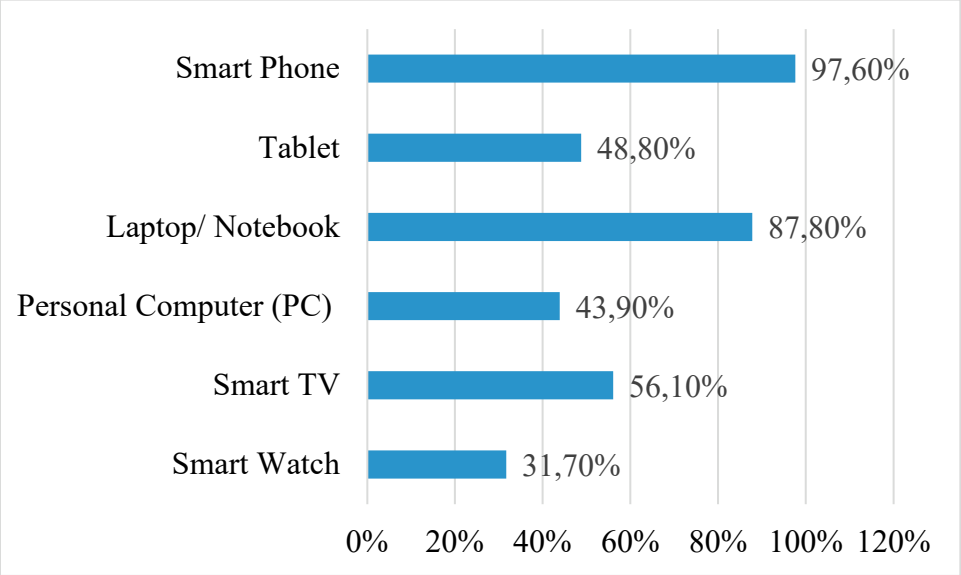
The fourth category is safety. Concerning device security, and online security awareness (Q8). 7.3 % of responses did not know about identity theft, 34.1% knew about the possibility and the basic countermeasures, 48.8% take advanced countermeasures, and 9.8% consciously adapt their security settings to their needs. I can say that the awareness about password and identity theft is very high. The fifth (and last) category was about problem-solving. Table 3 presents my findings.

Table 3
Problem-Solving

Fifth Category, Question 9: *Digital Problem Solving*	**Percentage**
I can find support when a technical problem occurs or when using a new program	53.7%
I can solve most of the more frequent problems that arise when using digital technologies	39%
I cannot solve digital problems at all	Less than 5%
I can solve almost all problems that arise when using digital technology	Less than 3 %
Fifth Category, Question 10: *Application of Problem-Solving*	**Percentage**
I can solve technological problems by exploring the setting and options	46.3%
When confronted with a technological problem, I can use tools I know to solve it.	34.1%
When confronted with a technological problem, I do not know tools I can use to solve it	12.2%
I am aware of new technological development	7.3%

Source: Own edition

As indicated in Table 3, the majority of the participants either can find support or can solve problems themselves. This shows that this sample of Dubai's residents has good skills and knowledge concerning digital problem-solving. Finally, in Figure 5, I would like to present the results regarding the possession of smart devices among society (general questionnaire).



Source: Own edition

Figure 5. Possession of Smart Devices

According to Figure 5, nearly all of the respondents possess a smartphone, most of them owns a laptop or notebook and nearly half of them have a tablet, personal computer and/or Smart TV.

Overall, I can safely assume that majority of the residents that participated in this questionnaire possess the necessary equipment to communicate with an electronic device such as a smartphone or laptop and they know a lot about technological advancements.

DISCUSSION AND CONCLUSION

In the era of digitalization, personal knowledge about digital tools and resources has become so paramount in individuals' success that it warrants further research. This era of digitalization, and Smart technologies have already created a new world full of novel materiality. For instance, it has led to expanding the boundaries and possibilities of human communication. It seems likely that a society that is based on advanced technology can easily accept these challenges and adapt to new conditions.

For instance, as a multicultural society, the United Arab Emirates has a lot to offer for its residents regarding technological advancements: automated traffic systems for public transportation, highly developed digital services for solving their problems such as digital marketing or eCommerce, and efficient laws for controlling the new generation of digital media. Based on the needs of its workforce which comes from multiple nations, the UAE has to be able to provide the necessary tools for communication with their home countries. In my opinion, communication is the key to human society and digitalization has become prevalent in communication as the driving force of globalization. The need for being able to access important data from anywhere is a focus of the early 21st century and every country is competing in the race. To the best of my knowledge, to UAE is one of the leaders in this industrial race. That is why in this paper, I chose Dubai for my research. Also, I cannot deny that Covid-19 has already led people to use more technology than before. Therefore, the environmental condition can also be effective in the usage of technology and digitalization too. Finally, like many studies, my research also faced the limitation of data. For example, I did not explain anything regarding culture. It may be that the type of culture is very influential in learning technology and digitalization. For instance, Hofstede (1997) argued that the use of computer technology could challenge the existential inequality between higher-ups and lower-downs in power distance cultures, particularly when it is being used for communication purposes such as email. Therefore, I recommend future research considering the concept of culture for furture research in this topic.

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Panic Buying in Hungary During Covid-19 Pandemic

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SUMMARY

The study examines buyers' behavior in Hungary during COVID -19 pandemic based on a non-representative online questionnaire that was carried out during the time of lockdown in Hungary in March 2020. We would like to find out whether there was really accumulation of goods, and if so, which product ranges were involved. How did the outbreak of COVID-19 change shopping behavior? In which direction did it move and could retail trade react to the unexpected, rapid challenge of going online? Can the respondents be identified with the traditional buying behaviour pattern and can it be typified with it? In our study we provide an overview of the anomalies detected in the Hungarian "panic buying" concerning shopping frequency, spending and product avoidance. First, we introduce the main behavioral patterns of shoppers during the "panic buying period" in Hungary, then we draft different types of customers. Second, we highlight some statistically significant relations with regional aspects. Here connections are identified between shopping frequency, spending, stock piling and the places of residency of the surveyed people. Third, we categorised customers into five groups with cluster analysis. The main cluster forming differences are the altered sense of well-being and the attitude differences in stock piling.
Keywords: COVID-19, Panic Buying, Hungary, Spatial differences, Customer Behavior
Journal of Economic Literature (JEL) classification: M31
DOI: http://doi.org/10.18096/TMP.2021.02.06

THE AIM AND METHODOLOGY OF RESEARCH

The aim of our research is to investigate the impact of the COVID-19 pandemic on buying behavior, with reference to shopping frequency, spending, accumulation, and shop preference. Our research is based on a data survey in March 2020, when 450 people were involved in online data collection during the lockdown period in Hungary.

We wanted to find answers to the following questions:

- What characterizes panic buying in the first wave of COVID-19?
- How did buyers react to the unexpected, new circumstances, how did their buying behavior change?
- What groups of buyers can be identified and what are the basic features that distinguish them?

For the online questionnaire, we used the Google Forms platform; and we used Microsoft Excel, IBM SPSS 22.0 software for data cleansing and analysis, descriptive statistics, cross-tabulation analysis, and cluster analysis.

CRISIS AND CONSUMPTION

By now, it can be stated that various crises are inherent in market economies. These crises differ significantly in their causes, stakeholders, size, duration, predictability, and so on. (Koos, 2017).

One of the characteristic features of crises is that, due to the combination of many factors, they significantly influence consumers and the development of consumer and shopper behavior. Their various effects on consumption and purchases have been studied in a number of countries and using various approaches during the various crises of recent decades, e.g. Shama (1978), Ang et al. 2000), Alimen & Bayraktaroglu (2011), Alonso et al. (2017). Koos and co-authors modelled the impact of crises on consumption and incorporated it into a unified system (Koos et al. 2017).

Based on their model, the crisis situation we examined (the effect of COVID-19 on purchasing and consumption) can be classified as a natural crisis, containing both unpredictable, tangible and intangible elements, where the whole process of consumption (buying, storing, using the products) was significantly affected by the series of restrictive measures imposed due to COVID-19 and, obviously, by their impact on customer behavior.

As Bourdieu (1984) pointed out, individual responses to individual crises depend on a number of factors: some of these have been found to be the economic situation (Lekakis 2015), the individual's abilities, social network embeddedness (Hall & Lamont 2013), and individual practices of consumers (Smyczek & Glowik 2011; Kaytaz & Gul 2014). For the above reasons, our study aims to show how and to what extent the consumption and shopping patterns of each customer group differed during the early COVID-19 crisis.

THE EFFECT OF COVID-19 ON BUYERS AND SHOPPING

The spread of the COVID-19 pandemic is not only a health challenge in some countries/regions (Kincses & Tóth 2020), but also has a serious social, economic and business impact (Naeem 2021). From among the wide-ranging economic aspects, we will focus on the purchase and consumption aspects. The first panic purchases due to the dynamic spread of COVID-19 have been analyzed from several aspects in the international literature (Tyagi et al. 2020) (Sharma & Sharma 2020) so in our study we will focus on introducing and analyzing Hungarian consumer behaviour and regional aspects of it.

Before presenting the most important results of our empirical research, we provide a synthesis of relevant consumer behavior research that forms the theoretical framework of our topic. Because research on purchasing/consumer behavior is very extensive (Kardes et al. 2011), and there are many social science narratives on the topic (marketing, consumption sociology, and consumption psychology all thematize purchase and consumption as well as buyer and consumer) (Jansson-Boyd, 2010; Wänke, 2009), we will analyze only the effect of COVID-19 on purchases and customer behavior.

In order to do this, firstly, we need to clarify the conceptual differences and connections between purchasing and consumption, and secondly, we outline a system of different factors influencing purchases (Graves 2013; Törőcsik 2018). In this system of factors, we will place the effect of COVID-19, which transformed purchases dramatically in a very short term, as well as the (re)emergence of "panic buying", a phenomenon that has not been experienced in developed countries for decades in this form.

Before we set the place of panic buying in the system of consumer behavior, we have to clarify the differences between shopping and consumption, emphasizing the fact that we examine the effects of COVID-19 in the short term, from the context of shopping and we do not deal with the long-term effect of COVID-19 and how it changes consumption and consumer behavior. As *Table 1* shows, shopping is a prompt, stimulus-based, action-oriented social phenomenon, influenced by current trends; as opposed to consumption, which can be interpreted in a long-term, trend-based time frame, is planned and is based on consumer needs and wants.

Based on the above, we can state that the changes caused by the COVID-19 pandemic in March 2020 mainly affected purchases and their characteristics in the short term, and the analysis of long-term effects will become possible only later – after the pandemic is over. The data of the HCSO (Hungarian Central Statistical Office) indicates that the total retail turnover decreased by 12.3% in Hungary and by 32.7% in Budapest (excluding the rest of Hungary) in March 2020 compared to the same period of the previous year (HCSO, Weekly Monitor, 2021).

Purchasing behavior (similar to consumer behavior) is influenced by several macro-environmental factors (trends, economic, social situation) and individual characteristics (individual nature of decision making factors, lifestyle, etc.), but the conditions of a purchase are the current situation of the buyer (involvement) (Trommsdorff 2002), which are influenced by both the circumstances of the purchase and the situational effects in the store (Törőcsik 2007).

Table 1
Main differences between consumption and shopping

Features	Consumption	Shopping
duration	long	immediate
framework	aptitudes	stimuli, situational effects
	wants	action
starting point	plans	facts
reaction to trends	trends, counter-trends, megatrends	latest trends

Source: Törőcsik 2018

Many of the large number of influencing factors have a continuous or situational effect, while other factors have an occasional or even one-off effect. One-time/short-term/occasional effects include Black Friday-type promotions, holiday opening hours, available inventory (out of stock), product recalls, and more impact on customer behavior. The effect of COVID-19 on purchases falls into this category, i.e., it is a negative, external factor influencing purchases that (hopefully) generated a one-time panic purchase response among the population.

From these examples, we can see that one-off, short-term factors can have positive or negative impacts that affect purchases differently (*Table 2*).

Table 2
The effect of positive and negative one-off factors on purchasing behaviour

	Positive	Negative
Product range	wide, FMCG, durables	mainly FMCG, special items
Place of purchase	mostly the well-known, usual channels	channel preferences change
Shopping period	lengthens	shortens, rationalises
Price effects	stagnating, decreasing prices (promotions)	stagnating or increasing prices
Communication	stimulates purchases	rationalises purchases
Examples	Black Friday, holiday opening hours	product withdrawal, COVID-19 panic buying

Source: own edition

Positive and negative factors differ in many categories. In the first case (positive factors) the product range concerned covers almost all product categories (e.g., Black Friday), while product withdrawals or panic buying are limited to one product or product range (e.g., customers focus primarily on food, detergents and vitamins during panic buying). The place of purchase also appears differently in the two categories. Positive factors (e.g., holiday opening hours) do not change the shop preference, while negative factors (panic buying) can lead to a significant change in shop preference. We will later support this by empirical data.

The purchases themselves take place differently due to the positive and the negative factors. While the positive effects can make shoppers spend longer time in the store, the negative ones can shorten it, some of the buyers also rationalised their purchases during the panic buying period based as the results of our research shows. Prices are also affected differently by positive and negative factors. In the case of Black Friday or holiday promotions, we can experience a decrease in prices, while in the case of panic buying, the typical trend is more increasing (e.g., hand sanitizer, mask prices).

Commercial communication is also different. In the case of positive factors, the goal is to encourage purchases, thereby increasing the volume of sales, while in the case of negative factors (both during product withdrawals and panic buying), the goal of communication is providing information and supporting decision making.

International research indicates that the pandemic may have a long-term effect on shopping behaviour because of technological innovations, altered shopping patterns and changed labour-leisure relations (Sheth 2020). Puttaiah et al. (2020) identified five driving forces in the altered shopping behaviour: Increased digital adoption, Change in mobility patterns, Change in purchasing behaviour, increased awareness of health and changes in interpersonal behavior.

Summarized the above-mentioned factors, we can state that all dimensions of shopping behavior have changed globally from the start of the pandemic. McKinsey & Company reported that even in Japan 30% of customers have tried new shopping behavior, and this ratio is much higher in other countries, e.g. in the USA 73%, in the UK 63% and in India 96% (McKinsey, 2020). Islam et al. (2020) reached similar conclusions in their international comparative research.

Having clarified the theoretical context of the impact of the COVID-19 crisis on purchases, in the following sections we discuss our own research findings.

CHARACTERISTICS OF THE RESEARCH SAMPLE

After the registration of the first case of the COVID-19 pandemic in Hungary on March 4, the Hungarian Government declared a state of emergency on March 11, which marked the entry into force of the special legal order. One of the biggest challenges in the research was how to assess the change in customer behavior during the development of COVID-19 and what impact it would have on the development of the retail model. Given that neither the world nor the Hungarian retail trade has faced a similar phenomenon lately, it has been difficult to predict changes in customer behavior.

The great advantage of online questionnaires in this case is the rapid deployment and availability of a large number of potential respondents, although it does not ensure the representativeness of the sample. (Babbie, 2015; Ghuhari & Grønhaug, 2011). With this in mind, we opted for an online questionnaire. Our empirical research deals with the effects of this first period on retail, the survey was conducted between March 22 and March 29, 2020, the sample size we obtained was N = 450 people. Google Forms was used for the questionnaire, and it was published on a social media platform (Facebook).

In the anonymous questionnaire, we asked about the demographic characteristics and consumption habits of the respondents. Our survey based on simple sampling cannot be considered representative; within the sample there is a predominance of those with higher education, they account for 70.2% of the sample.

The sample provides only limited information on Hungarian citizens with a low level of education, as they were not open to respond, while consumers with a BA/MA degree were happy to respond, so our sample provides insight into changes in the shopping habits of those with a tertiary education (*Table 3*). Within the sample, the proportion of women predominates (76.8%) and the number of residents of Budapest is also significant at about 40.9%. In terms of age structure, the 21-30 age group (28.6%) and 31-40 age group (28%) has almost the same weight within the sample. The proportion of respondents working from home (47.7%) is also significant, suggesting a remarkable change in employment patterns and that the traditional work schedule is changing.

Table 3
Main data of respondents

Variables	Categories	%	Variables	Categories	%
Gender	male	23.2	**Place of residence**	capital	**40.9**
	female	**76.8**		bigger towns (over 40,000 inhabitants)	24.2
Age	under 20 years	0.4		small towns (under 40,000 inhabitants)	14.1
	21-30 years	**28.4**		villages	20.8
	31-40 years	**28.0**	**Work**	works at workplace	19.3
	41-50 years	21.7		works in home office	**47.7**
	51-65 years	14.8		studies from home	7.8
	over 65 years	6.7		works in voluntary quarantine	5.3
Education	primary school	0.2		temporarily does not work	8.3
	vocational training	2.7			
	secondary school	26.9		lost his/her job	2.3
	BSc, BA	**30.2**		retired	0.9
	MSc, MA	**400**		other	8.4

Source: own research

The survey showed that only 19.3% of respondents were working in their actual workplace. This can be considered a large proportion of the respondents, considering that we collected the data in the 2nd and 3rd week of the crisis. The proportion of unemployed and temporarily unemployed people

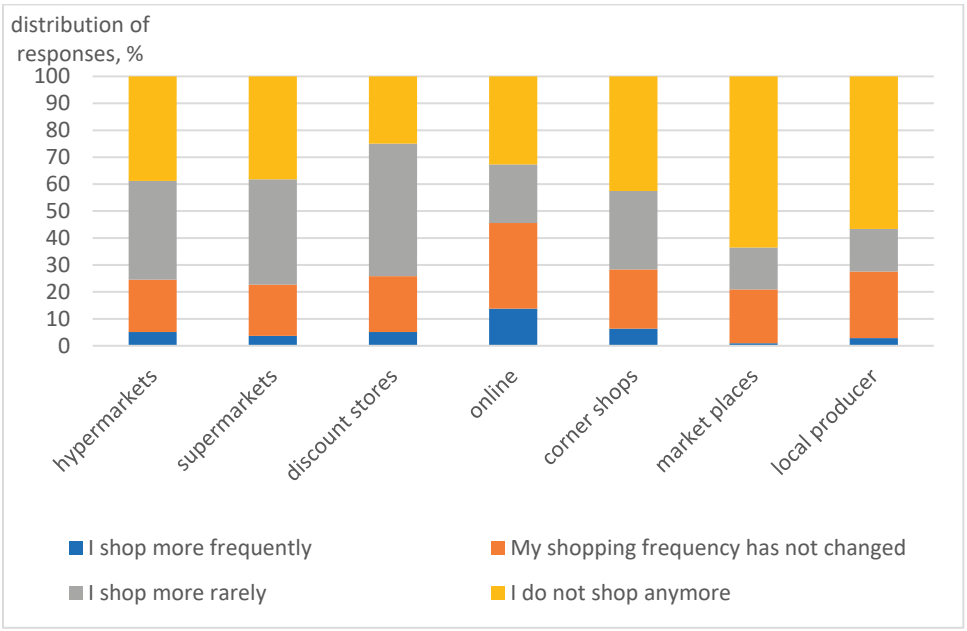
exceeds 10% of the total workforce in both the sample and today (April 2020), which means 376,000 people since the beginning of the COVID-19 pandemic (Lajó, 2020).

CHANGES IN CUSTOMER BEHAVIOR AT THE BEGINNING OF COVID-19

The *Act CII of 2014 on prohibition of work on Sundays in the retail sector* introduced on March 15, 2015 had created unfavorable conditions for the food retail sector before the outbreak of COVID-19 pandemic. The ban was revoked on April 12, 2016. By 2020 the sector had partly recovered. At that time, another blow to the network was the outbreak of the pandemic. We examined this period at the end of March partly in the food retail network in terms of customer habits using the questionnaire. Shoppers were asked where, and how often, they "currently" buy food in each type of store. The answers we received showed a fear of the virus and a panic, as indicated by the fact that shoppers preferred contactless shopping techniques, so that online purchases – among frequent purchases – increased from the previous 6.3% to 13.8% (to compare the before-COVID to the panic buying period, see *Figure 1*).

In the new situation, online shopping was more than double the proportion of hypermarkets and supermarkets in the category of "*frequent shopping*". The biggest losses were those selling in traditional markets and local producers, where the proportion of "frequent buyers" almost completely disappeared and the proportion of "no longer buyers" within the category increased significantly, to 63.5% for markets and to 56.6% for local producers.

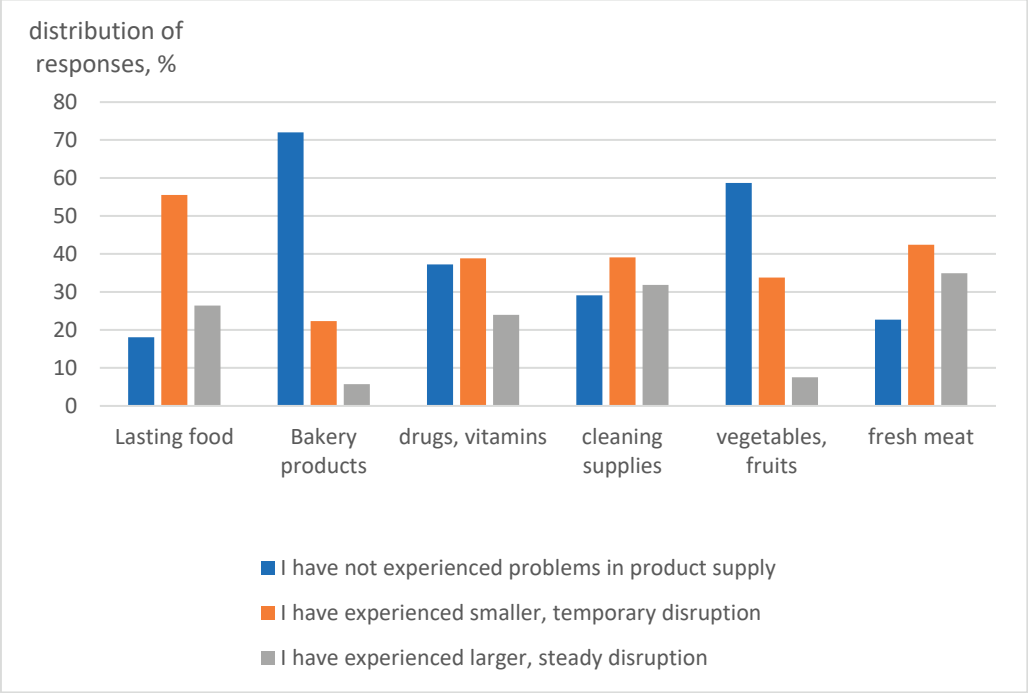
This is partly explained by the fact that face-to-face sales are more prevalent in these forms of sales and that, in the meantime, customers have become more and more conscious of their shopping. The situation of producers was somewhat helped by joining online sales, but there was no guarantee at all that if a farmer traded online, his/her business would be successful. It can also be a "dead end" for the farmer, as the lack of online marketing experience and preparedness makes it extremely risky. We must state that in the case of hypermarkets, supermarkets and discount stores, having a self-service system already in place helped the units to operate more efficiently.



Source: own research

Figure 1. Where and how often respondents bought food after the outbreak of the virus

For some forms of retail, especially for market traders and local producers, the impact of the COVID-19 pandemic on turnover (*Figure 1*) was already noticeable in the short term. This was only compounded by the fact that the pandemic caused a sudden "panic buying", the direct consequence of which was a major supply disruption.

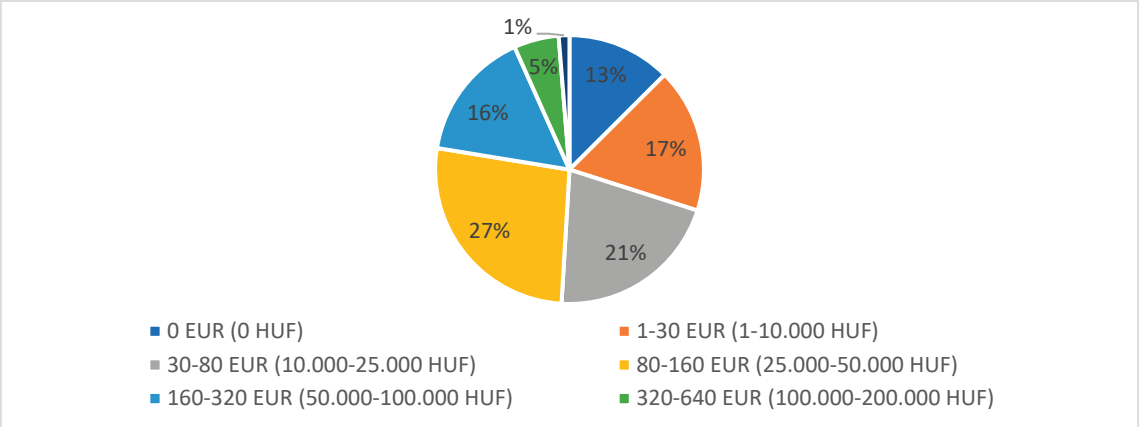


Source: own research

Figure 2. The degree of supply disruption for each product category

Supply disruptions did not occur equally in all product categories of retail (*Figure 2*). Storable foods (sugar, flour, canned food) and fresh meat were the most affected by supply disruptions, as well as cleaning products. This is partly understandable, as customers mostly wanted to ensure their self-supply from this product range. As the frequent use of cleaning products was considered important in the fight against the pandemic, an attempt was made to accumulate significant amounts of this.

In the case of medicines and vitamins, consumers perceived moderate supply problems, though pharmacies adapted flexibly with the help of manufacturers and wholesalers, providing monthly or three-month quantities when dispensing medicines, so interruptions in this area were rare. In the fresh baked goods and cold cuts category, the majority of the respondents barely experienced a major supply disruption due to the relatively stable position of traditional off-line food retail and the rise in online sales. According to a GKI [Economic Research Co.] survey, "between April and June 2020, about HUF 188 billion worth of purchases were made on the domestic on-line market, which is 34% higher than in the same period of 2019, in the DIY (home-garden-DIY) commercial segment[i]". In practice, to able to provide continuous supply has increased the importance of multi-channel sales during the lockdown period.



Source: own research

Figure 3. Amount spent on stockpiling by respondents

Among the respondents, the amount of the additional costs spent on stockpiling depends on both socio-economic and psychological factors: e.g., income situation, level of fear, size and structure of households, etc. Our questionnaire research on the level of expenditures related to "panic shopping"

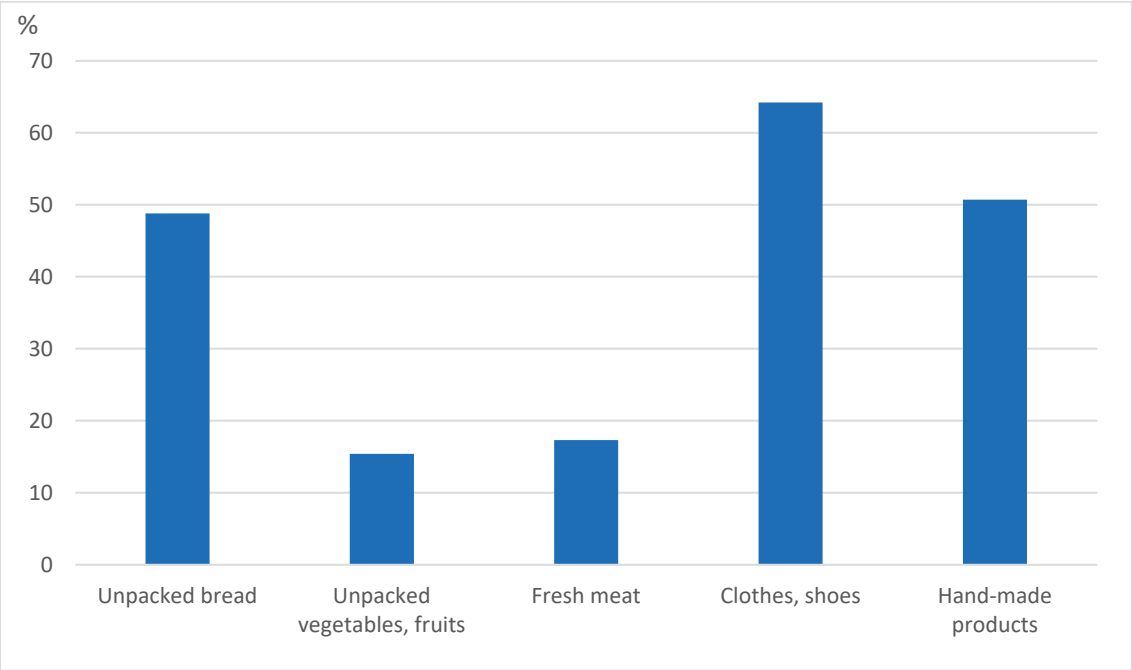
confirmed that the COVID-19 pandemic had a significant impact on the entire Hungarian retail sector. Based on the sample, it can be stated that about 13% of the respondents did not accumulate stocks of goods at all during the critical period. One of the reasons for this may be that this group did not have a significant reserve of food or did not see the need for stockpiling (see later).

The fact that the value of the shopping cart did not even reach 100 EUR in the case of 38% of the respondents indicates that their income is low. Only 22% of the respondents started major stockpiling, this stratum already has a significant financial reserve and was able to prepare for a possible supply disruption. Of course, a further 78% of the respondents also had a significant fear of supply disruptions, but as they were much less well off, they could barely form a reserve, yet they also made purchases to increase their home reserves (*Figure 3*).

During the survey period, the largest proportion of those who formed stockpiles aimed to buy enough food supply for two or three weeks. Longer than a month or even longer reserves are planned only by 19.1% of the respondents. And a small group of respondents (6.8%) barely accumulated anything, they formed only a one- to three-day reserve, and one of the reasons for their low accumulation was their weak purchasing power.

We also asked the respondents what they did not buy during the examined period (*Figure 4*). From the answers it was clear that mainly those products were mentioned which were unpackaged (bread 48.8%, fruits and vegetables 15.4%, fresh meat 17.3% and craft food 50.4%) and products which are dispensable in the short and medium term (clothes and footwear 64.2%).

For companies manufacturing clothing and footwear products, online sales have been a break out point, as overall those who had income and demand during the quarantine period also preferred online sales and seem to prefer to do so in the future instead of buying in traditional stores.



Source: own research

Figure 4. Products not bought in the first period of COVID-19, March 2020

RESULTS OF CROSS-TABULATION ANALYSES

Having presented the descriptive statistics, we wanted to explore the relationship between some grouping criteria and purchasing behavior during COVID-19 pandemic using the method of cross-tabulation analysis. Our aim was to explore possible differences in the relationship between age, place of residence, education variables, and certain characteristics of shopping (location, frequency, amount spent on stockpiling).

During the cross-tabulation analyses, the significance of the relationship between the nominal-ordinal and ordinal-ordinal measurement level variables was tested with a chi-square test, while the direction and strength of the relationship was revealed with the Eta test, and with Kendal's tau-b test.

In the following, we show the cross-tabulations of some variables with significant differences and

the values of the associated test statistics, without claiming completeness. Cross-tabulations where no significant difference was found or where the size of some cell values fell below the critical level (5) were excluded from the analysis.

We first examined the dichotomy of the capital region, because in Hungary, in general, significant differences can be detected in the socio-economic characteristics of the 1.7 million, densely populated capital of Budapest and the less densely populated areas outside the capital with lower urban concentration.

The change in the frequency of purchases by urban areas with large population and rural shoppers during the COVID-19 pandemic (March 2020) shows significant differences in almost all business types: hypermarkets, supermarkets, convenience stores, online shopping, markets and purchases from local producers.

The typical pattern, as shown in *Table 4* for online purchases, is that some shoppers in the capital are more likely than expected to shop online compared to rural shoppers, while the actual (observed) value of absolute non-shoppers in the capital is higher than in the countryside.

This discrepancy may be due to the fact that at the time of the lockdown introduced during COVID-19, the amount of online sales (especially for food) started to expand at such an unprecedented rate that online food retailers could no longer meet orders, and a waiting time of 2-3 weeks was not rare. A lot of people worked from home and tried to do their shopping from home, but since the system could not deliver the orders, they were forced to do their shopping in the traditional way instead of shopping online.

Table 4. Cross-tabulation for capital/countryside and online shopping during COVID-19

			Online shopping during COVID-19 pandemic				Total
			shop more frequently	shopping frequency has not changed	shop less frequently	do not shop at all	
capital/ country-side	capital	Count	27	41	31	62	161
		Expected Count	22.1	51.4	34.9	52.5	161.0
	country-side	Count	32	96	62	78	268
		Expected Count	36.9	85.6	58.1	87.5	268.0
Total		Count	59	137	93	140	429
		Expected Count	59.0	137.0	93.0	140.0	429.0

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.508[a]	3	.037
Likelihood Ratio	8.534	3	.036
Linear-by-Linear Association	.911	1	.340
N of Valid Cases	429		

0 cells (,0%) have expected count less than 5. The minimum expected count is 22.14.
Source: own research

Next, similarly to the method presented in *Table 4*, we tested the relationship between the age of the respondents, their place of residence, the size of their settlement, and purchase patterns typical of different COVID-19 periods (Table 5).

First, we analyzed the relationship between the dichotomous variable of the respondents' place of residence (capital/countryside) and the change in shopping frequencies in hypermarkets, the most popular type of retail outlet in Hungary to date. Based on four attributes – more frequently, shopping frequency has not changed, less frequently and not shopping at all – we identified four groups of buyers. In the questionnaire, we asked about the change in the frequencies of purchases during the COVID-19 compared to the period before COVID-19 for different types of stores, here – due to space constraints – we present only the results for hypermarkets.

The frequency of shopping in hypermarkets clearly shows that the majority of the respondents do their shopping in hypermarkets less often or do not shop there at all (39%) (to avoid large crowds). However, a difference can be identified between the residents of the capital city and rural respondents, as a significant proportion of the residents of the capital (9.3%) even increased their frequency of shopping in hypermarkets, while in the case of rural people this

value was 2.3%. We also identified a considerable (and significant) difference between less frequent shoppers: 33.8% of capital city residents and 38.4% of rural residents did their shopping less frequently compared to the period before COVID-19.

Table 5
Results of cross-tabulation significance tests

Chi-square tests	Capital/countryside * Shopping in hypermarkets during COVID-19			Capital/country-side * Amount spent on stockpiling			Settlement size/ supply disruption for fresh meat products			Respondents by age groups * Amount spent on stockpiling			Respondents by age groups * Further stockpiling from durables during COVID-19		
	Value	df	AsympSig.(2-sided)	Value	df	AsympSig. (2-sided)	Value	df	AsympSig. (2-sided)	Value	df	AsympSig. (2-sided)	Value	df	Asymp Sig.(2-sided)
Pearson Chi-Square	8.508	3	.037	9.079	3	.028	13.478	6	.036	15.365	6	.018	21.335	8	.006
Likelihood Ratio	8.534	3	.036	8.848	3	.031	13.185	6	.040	15.615	6	.016	20.906	8	.007
Linear-by-Linear Association	.911	1	.340	6.425	1	.011	7.476	1	.006	1.466	1	.226	9.802	1	.002
N of Valid Cases	429			448			409			448			440		

Source: own research

Another example of a capital-rural dichotomy is the differences in home stockpiling identified during the COVID-19 period. We examined the difference between the amounts spent by people in the capital and in the countryside on the accumulation of surplus stocks. The amounts spent on stockpiling were organized into four categories: 0 HUF – nothing was spent on stockpiling, 1-25,000 HUF (1-80 EUR) was spent on stockpiling, 25,001-100,000 HUF (80-330 EUR) was spent on stockpiling, and more than 100,000 HUF (over EUR 330) was spent on stockpiling. There is a clearly identifiable difference in the amounts spent on stockpiling in the two regions: those living in the capital spent more on accumulating security stocks than expected, while those living in rural areas spent less. 10.7% of those living in the capital spent more than EUR 330 on it, compared to 4.3% in rural areas. But even in the EUR 80-330 category, there is a similar difference in favor of the capital: 46.4% vs. 40.7%. The proportion of those who did not spend at all on stockpiling is 10.7% in the case of people living in the capital city, while it is 13.6% in the case of the rural population.

The phenomenon may be due to a combination of several factors: higher discretionary incomes in the capital, bigger stocks in the countryside accumulated in the past, and varying degrees of fear of the lockdown and getting infected may all influence these disparities.

Supply disruptions – temporary stock shortages for many product groups (e.g., meat, cold cuts, bakery products, detergents) – were observed during the period of restrictions related to COVID-19 (especially in the first half of the period). According to the place of residence, the respondents were divided into four categories: those living in the capital, large cities, small towns, and villages. Supply disruptions were classified into three groups: no disruptions at all, minor, temporary disruptions, and large, permanent disruptions. In the following only the results in the field of fresh meat are presented.

Shoppers in the capital experienced (perceived) a much stronger and more persistent stock shortage in stores than those living in rural towns and villages: 44.9% of people living in the capital experienced a significant, long lasting supply disruption in the meat product group compared to 29% of people living in big cities, 27.6% of people living in smaller towns, and 31% of the villagers. The reason for this can be traced back to several factors: stockpiling is less characteristic of the metropolitan way of life in the capital today, therefore before/during the COVID-19 stockpiling fever, they had less home reserve stocks than the rural households. Country lifestyle – living in detached houses – provides more opportunities/space for stockpiling, so with larger stockpiles at home and stockpiling under COVID-19 it was easier to "get through" the critical period, so rural people (both in cities and villages) perceived the temporary stock shortage as less significant and less lasting than people in the capital.

In addition to the place of residence, we also explored a link between the age of the respondents and the COVID-19 panic buying. Different age groups (under 30, 30-49, and over 50) responded slightly differently to the challenges posed by COVID-19. Younger people reacted somewhat more extremely to COVID-19 than expected because they either did not spend at all (18.8%) or spent very large amounts (above EUR 320) (7.8%) on stockpiling. These values are 8.2% and 3.1%, respectively, for older customers over the age of 50. Older people (over 50) spent more than expected on buying additional products: 46.4% spent up to EUR 80, while 42.3% spent up to EUR 320) while these values for young people are 40.6% and 32.8%. This

difference is significant. The total amount spent on stockpiling is divided between several product groups. The accumulation time frame of the different product groups is quite different, mainly due to the nature and shelf life of the products. In our research we examined 10 different product groups (storable goods (e.g. flour), bread, dairy products, cold cuts, fresh meat, detergent, mineral water, etc.)

In *Table 6*, we examined the accumulation pattern of items that can be stored for a long time in the age groups already presented above. The results show that different age groups accumulated storable goods to different degrees (these goods – flour, rice, salt, etc. – can be converted into finished meals by further cooking/baking). While young people did not stockpile at a much higher rate than expected (40.6%), or a much smaller proportion of them accumulated storable goods for a long time (longer than a month) (16.4%), the elderly (50+) did not stockpile in a much smaller proportion than expected (22.6%), or they accumulated stock enough for a month or more in a much larger proportion than expected (24.7%) . Overall, therefore, it can be concluded that the nature of stockpiling depends not only on the place of residence but also on age.

In addition to the cross-tabulation analyses presented above, we used the cluster analysis method to analyze customer behavior. Among the clustering methods, two methods were used: Ward Linkage and K-mean methods. First, we explored the number of emerging clusters using a non-hierarchical clustering procedure, and then, using a hierarchical clustering procedure, we sorted the respondents into 5 cluster groups. The results obtained were subjected to a significance test, and the results of the ANOVA F test were continuously examined (Table 6).

During the cluster analysis, we tried to include several variables, and finally identified the variables that proved to be significant in the ANOVA test. Using the results of this, we used a total of 13 variables to develop the set of variables that gave the input variables of the cluster analysis.

Table 6
ANOVA test results

	Cluster		Error		F	Sig.
	Mean Square	df	Mean Square	df		
In your opinion to what extent did your everyday life change in the period of rapid spread of COVID-19 (March 2020)	86.374	4	.753	386	114.682	.000
How much has your well-being changed in the last month?	103.123	4	.968	386	106.540	.000
Changes in shopping conditions	13.958	4	.531	386	26.292	.000
Shopping in hypermarkets during COVID-19	10.359	4	.690	386	15.009	.000
Shopping in markets during COVID-19	5.234	4	.650	386	8.052	.000
Further stockpiling storable goods during COVID-19	174.897	4	.586	386	298.228	.000
Further stockpiling fresh meat during COVID-19	59.855	4	1.134	386	52.793	.000
Changes in the financial situation of the household	2.380	4	.493	386	4.825	.001
Supply problems with cleaning supplies	2.902	4	.580	386	5.001	.001

Source: own research

Table 7 shows the typical values of each variable (final cluster centers) for each cluster. Characteristic differences between the individual clusters were identified in the response to the situation, the change in well-being, as well as the frequency of shopping and the practice of stockpiling.

Table 7
Final cluster centers

Variables	Cluster numbers				
	1	2	3	4	5
yday life change in the period of rapid spread of COVID-19 (March 2020)	5	2	6	4	5
How much has your well-being changed in the last month?	2	2	5	3	5
Changes in shopping conditions	3.8	3.3	4.6	3.8	4.1
Shopping in hypermarkets during COVID-19	3	2	3	3	3
Shopping in markets during COVID-19	4	3	4	3	3
Stockpiling storable goods during COVID-19	1	0	3	3	0
Stockpiling fresh meat during COVID-19	1	0	2	2	1
Changes in the financial situation of the household	3	3	3	3	3
Supply problems with cleaning supplies	2	2	2	2	2
Number of Cases in each Cluster	52	34	116	98	91

Source: own research

Based on the above, the characteristics of customers classified into five different clusters can be described along two main dimensions: first on the basis of their "well-being" and secondly on the basis of their characteristics related to "stockpiling" (*Table 8*).

The first group consists of people feeling "Feeling unwell (in their general attitude), stockpiling in small quantities". They are characterized by fear of the effects of the pandemic and, accordingly, carry out panic buying, only in small quantities.

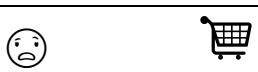
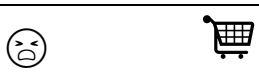
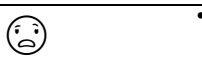
The second group includes those who feel "Slightly unwell, not stockpiling". They have responded the least to the COVID-19 crisis, which is also reflected in their purchases: they do not accumulate, they do not shop more often, that is, they do not "panic".

The third group included people feeling "Very unwell, stockpiling in large quantities". They felt very bad, i.e. did "panic", and their well-being deteriorated significantly, and their purchase expenditure increased in direct proportion with it, i.e. they stockpiled to a greater extent (compared to the other clusters).

The fourth cluster includes customers "Feeling unwell, stockpiling in large quantities". They are the ones who moderately worried about the situation, but stockpiled large amount of extra stock during the first wave (March 2020).

The fifth cluster consists of the group of feeling "Very unwell, stockpiling only in small quantities". These are people who are very worried (similarly to cluster 3) and whose general feelings changed considerably into a negative direction during the panic buying period (this is the difference compared to cluster 1).

Table 8
Clusters and their main characteristics

Cluster no.	Name of cluster	Cluster symbol
1	Feeling unwell, stockpiling in small quantities	
2	Slightly unwell, not stockpiling	
3	Very unwell, stockpiling in large quantities	
4	Feeling unwell, stockpiling in large quantities	
5	Very unwell, stockpiling only in small quantities	

Source: own research

CONCLUSION

The outbreak of the COVID-19 pandemic in Hungary resulted in a similar stockpiling fever as in any other country in the world. The 450 potential consumers we surveyed during the pandemic preferred online shopping to shopping in brick-and-mortar shops. This attitude may remain even in the period after the decrease of the pandemic.

Among the buyers, there was a clear distinction between panic buyers who felt very unwell, who had stockpiled large amounts of food, and a group of buyers who, although feeling unwell, did not accumulate food reserves, probably partly due to financial reasons. During the first month of the pandemic, Hungarian consumers reported that they did not purchase a range of products that were unnecessary for them in the short or even medium term (e.g. clothing, shoes, and handmade products). Product accumulation was more pronounced on the part of the residents in the capital in almost the entire retail segment compared to residents of other areas. Supply disruptions were perceived more by buyers in the capital than by respondents in smaller towns or rural areas.

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