Proceedings of the European Union's Contention in the Reshaping Global Economy

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The conference entitled The European Union's Contention in the Reshaping Global Economy organized by the University of Szeged Faculty of Economics and Business Administration was cancelled due to the COVID pandemic. The registered participants were invited to submit their research papers. This proceedings contains these reviewed papers.

SZEGEDI TUDOMÁNYEGYETEM
GAZDASÁGTUDOMÁNYI KAR

Proceedings of the European Union's Contention in the Reshaping Global Economy

Edited by:
Beáta Udvari

Szeged, 2020

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Faculty of Economics and Business Administration
Doctoral School in Economics, 2020

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ISBN: 978-963-306-772-7
DOI: https://doi.org/10.14232/eucrge.2020.proc

Contents

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Preface

The fifth international PhD workshop at the conference entitled The European Union's Contention in the Reshaping Global Economy was planned in March 2020. Due to the pandemic situation, the organizer Faculty of Economics and Business Administration, University of Szeged had to cancel the conference just one week before the event. Unfortunately, the young researchers could not share their ideas in person, but the organizers decided to invite the registered participants to publish their research papers in the proceedings. This proceedings contains these selected and peer-reviewed papers with authors coming from various doctoral schools and higher education institutions.

This time we invited again papers, addressing a better understanding of the impacts of technological change, industry 4.0, the US-China trade war and changing trade relations on the economy and development inside and outside the EU. The broadly defined subject offered the possibility to the participants to concentrate on the topic, most relevant from the point of view of their theses. This is why the topics and approaches of the volume are rich and varied.

The first chapter of the book include four papers and it deals with business and marketing analyzing online shopping, eating behavior, driverless cars and leadership characteristics. The next chapter analyses financial issues: monetary policy in emerging markets, banking sector in the EU and the impacts of global financial crisis on trade relations in the Visegrad countries. The third part is dedicated to sectoral analyses like productivity differences in the manufacturing sector in Hungary, livestock products and farm-level analysis, innovation performance of Kazakhstan, and the development challenges of small- and medium-sized enterprises in post-socialist countries.

We owe our thanks to the reviewers and to Bettina Ambrus for formatting the document with high precision.

Szeged, 2020

The Editor

Chapter I

Business and marketing

Udvari B. (ed) 2020: Proceedings of the European Union's Contention in the Reshaping Global Economy. University of Szeged, Doctoral School in Economics, Szeged, https://doi.org/10.14232/eucrge.2020.proc.1

Applying MCDM Technique in analyzing the effect of promotion items based on online shopping factors: A case study

Iman Ajripour

Developing technology causes companies in a market to compete with each other in challenging ways. In addition to a holistic marketing concept which focuses on the needs of target markets and delivering superior value, marketing should be adapted with new technology to fulfill consumer needs. Although many strategies have been introduced for marketing, digital marketing or marketing 4.0 is a new generation of marketing that engages with the audience through digital tools. These days, online shopping is only too popular among consumers. Many factors which affect customer decision during online shopping have been explored. In this paper, the effect of promotion items in online shopping will be explained. The main aim of this paper is to apply a multi-criteria decision-making technique in prioritizing eleven promotion items by considering five online customer shopping criteria. The novelty of this paper is to apply PROMETHEE II (Preference Ranking Organization METHod for Enrichment of Evaluations) in analyzing the effect of promotion items based on online shopping criteria. PROMETHEE II completely prioritizes discrete alternatives. A case study is conducted in a home appliance company in Iran.

Keywords: digital marketing, decision making, PROMETHEE, online shopping, promotion

1. Introduction

Due to an increase in customer computer knowledge and access to the internet, the traditional way of purchasing is coming to be replaced with online shopping. It follows that conventional types of advertising and its modes of operation in businesses should be changed. These changes naturally must occur in the digital environment. To succeed in the digital environment, each business should be able to adopt a completely different perspective besides implementing new strategies in digital marketing. Big data, machine learning, live video marketing, and conversation user interface are some of the new digital marketing strategies. These strategies could be applied to different businesses.

As a result of developing digital marketing, an important decision-making process for top managers especially marketing managers in a company is to choose the correct digital marketing strategies to attract, engage, and motivate customers to conduct online shopping. Hence marketing managers, are always seeking to find different ways (promotion items) to motivate and persuade customers to purchase products.

In this paper, I will try to answer the question of what the priority of promotion items is based on online shopping criteria in a home appliance company. To make the main question clear, it can be paraphrased as "ranking different promotion items based on online shopping criteria in a home appliances company".

The literature review, methodology, results, discussion, and conclusion are the next sections, respectively.

2. Literature review

2.1. Digital marketing

Electronic commerce has appeared as a main sector in the international economy. In 1999, U.S. firms sold approximately 109 billion dollars worth of goods over the internet, and by the end of 2000, it reached $251 billion. It is estimated that over 93% of U.S. companies conducted some part of their business trade over the internet in 2002 (Chiu et al. 2004, p. 13). Besides company trades over the internet, customers have trusted the internet to fulfill their daily requirements and even customize their needs with the aid of digital technology. Changing patterns in consumer behavior pose considerable challenges for online service providers. Online retailers should discover the strategies regarding the criteria for further improvements in maintaining consumer trust. They have to gauge consumer expectation (Kumar et al. 2018, p. 675).

2.2. MCDM in digital marketing

Multi-criteria decision making is a discipline which deals with decisions involving the choice of a proper alternative among several potential alternatives based on some common criteria. Multi-Criteria Decision Making (MCDM) methods are divided into two general categories: Multi-Attribute Decision Making (MADM), and Multi-Objective Decision Making (MODM). In Multi-Attribute Decision Making, several alternatives are analyzed and prioritized. The Alternatives will be examined based on the criteria that are identified by decision-makers or researchers. In Multi-Objective Decision Making, several goals are considered for optimization simultaneously. In my research, the problem is to be solved by MADM methods. There are some alternative "promotion items" which will be analyzed and prioritized based on some common criteria. There are different types of MADM methods such as AHP (Analytic Hierarchy Process), ANP (Analytic Network Process), ELECTRE (ELimination Et Choix Traduisant la REalité), TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), and PROMETHEE to solve such a problem. In the following, I will provide a summary of the models.

AHP was developed by Saaty in 1980. This technique is one of the most powerful and flexible methods of MADM. It can be used to solve complex problems. It is called a hierarchical model since its structure is like a tree and hierarchy. The AHP method combines both objective and subjective assessment in an integrated structure based on pairwise comparisons. The hierarchical analytical process emphasizes the importance of decision-makers' intuitive judgments as well as the stability of comparing alternatives in the decision-making process. Decision makers make their judgments based on their knowledge and experience. In AHP, a decision problem is divided into different levels: aim, criteria, sub-criteria and alternatives. Different alternatives are involved in decision making. The alternative must be compared based on the given criteria. It is possible to analyze sensitivity on the criteria and sub-criteria. To summarize, AHP provides a structure of decision-making processes where there are limited numbers of choices, but each has several attributes (Byun 2001, p. 1).

ANP method is one of the MADM methods which is similar to the AHP, but in which the criteria, sub-criteria, or alternatives may have dependency. The AHP method can be considered as a specific form of ANP technique. ANP provides a comprehensive and powerful way for accurate decision-making using decision makers' experimental information or personal judgments. It also provides a structure for organizing different criteria and evaluating the importance and preference of each criterion over alternatives (Saaty 1999).

ELECTRE is another MADM method which is introduced by Roy. Instead of prioritizing alternatives, this method only shows the superiority of an alternative in comparison to other alternatives. In ELECTRE method, Ap→ Aq means decision maker(s) prefer the risk of selecting alternative p to the risk of choosing alternative q. So, in this technique, alternatives should first be compared in pairs. Then, strong and dominant alternatives will be identified. Finally, weak alternatives will be eliminated (Roy 1968, Roy–Bouyssou 1993).

TOPSIS is one of the MADM methods which is based on a clear logic. This technique determines an ideal alternative and an anti-ideal alternative first. Then, it prioritizes alternatives based on the minimum distance from the ideal alternative and the maximum distance from the anti-ideal alternative. The ideal alternative maximizes profitability measures and minimizes cost criteria, while the anti-ideal alternative maximizes the cost criteria and minimizes the profitability measures (Ajripour et al. 2019).

In the next section, the PROMETHEE technique is thoroughly explained. In comparison to the other techniques such as AHP, ANP, TOPSIS, and ELECTRE, this method is too simple. It facilitates matching outputs and assumptions. Moreover, there is no need to change and normalize the decision matrix.

As an MCDM subject, if managers tend to assess and prioritize some strategies in digital marketing, they can apply different decision-making techniques. Recently Singh et al. (2016), Kumar et al. (2018), Lin et al. (2009) have applied different MCDM techniques such as AHP, ANP, TOPSIS, Fuzzy MCDM to solve some complicated decision-making problems in marketing, especially digital marketing. Fuzzy MCDM method was used by Tang et al. (1999) to prioritize electronic marketing strategies. For assessing an e-commerce strategy Chiu et al. (2004) applied fuzzy MCDM and AHP. To evaluate and improve strategies for decreasing the gap in customer satisfaction and aspiration level in e-stores, Chiu et al. (2013) used the combination of DEMATEL-based Analytic Network Process and VIKOR (ViseKriterijumsa Optimizacija I Kompromisno Resenje). Kang and Park (2012) applied TOPSIS, VIKOR, and GRA (Grey Relational Analysis) to analyze customer service satisfaction. Chern and Tzeng (2012) evaluated the problem of business to customer service e-loyalty construct, by using fuzzy ANP.

2.3. PROMETHEE

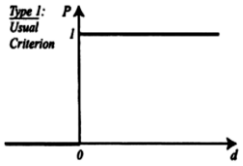
Although many studies have been done to find digital marketing strategies, what is rarely discussed are the strategies (promotion items) which may affect online shopping criteria. Doing a literature review, a considerable amount of literature in digital marketing subjects have applied different MCDM techniques to solve such problems. However, PROMETHEE as a MADM technique has not been employed to find proper strategies in digital marketing. This provides further opportunity for researchers to survey more of this subject.

PROMETHEE is one of the MCDM methods, which was presented by Brans (1982) and developed by Brans and Vincke (1985). It is used for a finite set of alternatives that compare, rank, and select them concerning the commonly conflicting criteria. This method is quite simple and smooth compared to other multi-criteria decision-making methods (Behzadian et al. 2010). Many scholars have applied PROMETHEE methods as practical methods in their researches. For example, Peng and Xiao (2013) selected materials in automotive industrial production. Albadvi et al. (2007) applied PROMETHEE in stock market decisions and Alencar and Almeida (2011) used it for supplier selection. Silva et al. (2015) used PROMETHEE II in organizational management. Social resilience to a disaster was measured by Carone et al. (2018) by Appling PROMETHEE. Antanasijević et al. (2017) have used PROMETHEE to measure the rate of progress in sustainable development. Araz et al. (2007) evaluated the outsourcing of a textile company by linking to PROMETHEE. To increase the efficiency and response time in incident management, Zhao et al. (2013) suggested a modified PROMETHEE II.

Put simply, PROMETHEE is a Non-Compensatory model in MCDM. In Non-Compensatory models, an exchange between criteria is allowed. That is, one criterion's weakness may be offset by another criterion's advantage. The PROMETHEE method simply creates several permutations at the first step, and then calculates the score of each permutation. The higher the score of each permutation, the greater the superiority of the permutation and ranking of the alternatives. The number of permutations in research is always m!, "m" is the number of alternatives. Besides that, PROMETHEE is an outranking method in Multi-criteria analysis. Its main features are simplicity, clearness, and stability. The notion of a generalized criterion is used to construct a valued outranking relation (Brans et al. 1986).

A necessary concept in PROMETHEE is the Preference function (PF). There are six pre-defined functions (Usual, U-shape, Linear, Level, V-shape, Gaussian preference) which are used to implement a pair-wise comparison between all alternatives, and thus calculate the preference degree of one alternative over another for all criteria (Nassereddine et al. 2019). Ishizaka and Nemery (2013) believed PROMETHEE is based on the computation of preference degrees that applies several PFs with pre-defined shapes mapped into a zero-one interval. Different studies have applied different preference functions. For example, to evaluate the public transportation systems in Tehran, Iran, Nassereddine, and Eskandari (2017) applied seven specific PF.

In determining the PROMETHEE II order in current research, the usual (Type I) preference function (1) is applied because decision-makers could not allocate values for the differences between alternatives based on each criterion. Moreover, the selected criteria are qualitative.



$$P(d) = \begin{cases} 0 & d \leq 0 \\ 1 & d > 0 \end{cases} \quad (1)$$

where *d* values are the differences of alternative values for each criterion. (Brans et al. 1986, p. 170)

Because of local market competitiveness, decision-makers in a home appliances company in Iran must find the best ways to attract potential customers besides motivating real customers (customers: those who prefer online shopping). The decision-makers decided to improve the performance of the online sales process.

To improve the performance of the online sales process, marketing managers in the home appliances company tried to find the promotion items which had the most effective impact on customer online shopping criteria. So this paper tries to assess different promotion items based on online shopping criteria by applying "PROMETHEE II" technique.

The suggested technique not only allowed me to cope with the nature of human judgments but also provides a general and rational framework for structuring a decision problem, for recognizing and quantifying its conflicts and synergies, and clusters of actions.

3. Methodology

My research starts with the literature review on digital marketing, and PROMETHEE. After the selection of the decision-makers' team, the evaluation criteria are selected based on the literature review and alternatives are chosen based on the expert's ideas. The data are gathered by distributing a questionnaire (decision matrix) among decision-makers. Then, the geometric mean is applied to obtain a collective decision matrix. After that, the weights of the criteria are determined by Shannon entropy. Finally, PROMTHEE is run to determine the ranks of alternatives by employing the usual preference function.

3.1. Geometric mean

The geometric mean is defined as the n^{th} root of the products of values where n is the count of values. The geometric average, G_A of a data set $\{x_1, x_2, ..., x_n\}$ is given by (2) (Yousefi–Carranza 2015).

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

Geometric mean has been applied in various research like a study entitled "Consensus models for AHP group decision making under row geometric mean prioritization method", in which decision-makers applied the weighted geometric mean technique to aggregate individual judgment matrices to reach a collective judgment matrix (Dong et.al 2010). The geometric mean is also used to obtain the values in consensus matrix in FAHP (Fuzzy Analytical Hierarchy Process) computations process (Anojkumar et al. 2014). In another study in 2019, the geometric mean is applied to integrate a comparison matrix of criteria for all decision-makers under a fuzzy environment (Gupta et.al 2019). In the study of Nassereddine and his colleagues (2019), after the constitution of the decision hierarchy, a pairwise comparison of criteria was performed by the experts. Then, the geometric mean of the values obtained from the evaluations was calculated.

The geometric mean was used in the study of Wu et al. (2010) to sum up the evaluators' values of pairwise comparison in response to the relative importance of market innovation capabilities when compared to human resources assets. The authors in another marketing study utilize geometric mean for combining individuals' judgments to reach group judgment for integrating answers coming from the decision-making group (Liu et al. 2019).

3.2. Shannon entropy

To calculate the weights of criteria in current research, Shannon entropy is applied. Shannon entropy is based on decision-making matrix i.e. if the data in the decision matrix are completely available, the Shannon entropy can be used to calculate the weights of criteria (Momeni 2010). Since all the required data in the decision matrix was available in this study, Shannon is selected to calculate the criteria weights. Shannon entropy is a rather abstract mathematical concept. It is firstly introduced by Shannon in 1948, after which many fields such as engineering, management, etc. widely applied this method. Zeleny (1996) believes Shannon's entropy concept is well suited for measuring the relative contrast intensities of criteria to show the average intrinsic information shifted to the decision-makers.

According to the idea of information entropy, one of the determinants of accuracy and reliability of the decision-making problem is the number or quality of information acquired from a decision-making setting. Entropy is, therefore, a very good method when it is applied to different cases of evaluation in the different decision-making process, and similarly, entropy can also be deployed to measure the quantity of useful information provided by data itself (Wang–Lee 2009, Wu et al. 2011).

The entropy method has been applied in different MCDM studies to compute the relative weights of ranking methods, weights of criteria, and relative weights of performance measures (Barak–Javanmard 2020, Zandieh–Aslani 2019, Çalı–Balaman 2019, Wu et al. 2011).

The steps of calculating criteria weights by entropy measure are as follows (Wang–Lee 2009):

1. The decision matrix must to be normalized for each criterion C_j(j = 1,2,…,n) to obtain the estimated value of each criterion: P_{ij}.

$$p_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \tag{3}$$

2. Calculate the entropy value: e_j.

$$e_j = -k \sum_{j=1}^{n} p_{ij} \ln p_{ij} \tag{4}$$

k is a constant value, $k = (\ln(m))^{-1}$.

3. The degree of divergence d_j of the intrinsic information of each criterion $C_j(j = 1, \dots, n)$ can be computed as d_j.

$$d_j = 1 - e_j \tag{5}$$

The value d_j shows the inherent contrast intensity of C_j. The higher d_j is, the more important the criterion C_j is in the issue.

4. The weights of criteria can be obtained by equation 6.

$$w_j = \frac{d_j}{\sum_{k=1}^{n} d_k} \tag{6}$$

3.3. PROMETHEE method

PROMETHEE can analyze multiple criteria project on an objective mathematical foundation (Chou et al. 2007). This technique has attracted much attention from the side of academics and practitioners (Behzadian et al. 2010). This method is a user-friendly outranking method. Completeness of ranking and high level of flexibility when defining preference/indifference thresholds for criteria are the other advantages of this technique (Ishizaka–Nemery 2011). PROMETHEE considers the deviation between the evaluations of two alternatives on a particular criterion. The relative importance of the criteria and the decision-maker's preference function are the two types of information that are required in the PROMETHEE technique (Nassereddine et al. 2019).

The main steps of the PROMETHEE II method are (Amaral–Costa 2014, Palczewski–Sałabun 2019, Bagherikahvarin–De Smet 2016):

1. Compute the preference function and the difference between the evaluations of two alternatives.
2. Compute marginal preference index considering the criteria weights.

$$\Pi(a,b) = \sum w_j \; F_j \; (a,b) \tag{7}$$

Where, π (a, b) is the marginal preference index ranging from 0 to 1 based on pre-defined preference functions, and W_j is the weight of the j_{th} criterion.

3. Calculate the positive and negative outranking flows.
4. Compute the net outranking flow. The higher the flow, the better the alternatives.

$$\emptyset(a) = \emptyset^{+}(a) - \emptyset^{-}(a) \tag{8}$$

5. Complete the ranking of alternatives based on Ø(i).

The decision-makers (DMs) in a company in Iran decided to analyze the effect of promotion items on online shopping. The company is a home appliances company that produces various home appliances. There are different production lines with different variety of products. The company has been active in the production of four home appliances products (refrigerators, gas cookers, washing machines, and dishwashers) for about 14 years. This company included five departments: planning, sales, marketing, research and development, and finance. The members of the marketing department are responsible for a wide variety of tasks such as maintaining a relationship (correspondence, interviews, face-to-face or telephone calls) with customers, key decision-makers on procurement, financial department, and managers, measuring customer satisfaction, besides identifying opportunities to increase customer satisfaction. Besides that, they identify current customers and classify them with regard to age, sex, income, geographic location, color sensitivity, price, and service.

Based on the literature, consensus decision-making on the criteria is employed among DMs. Five criteria are considered to analyze alternatives (Table 1). The main decision-makers have been working in the company's marketing department for at least 12 years (Table 2).

An interview was done with ten marketing experts to determine alternatives (promotion items). After the interview, eleven promotion items are selected based on expert opinion (Table 3). The interviewees have had 2-year experiences in home appliances marketing.

Then the five main DMs are asked to fill in the decision matrix (see Appendix 1) to evaluate alternatives based on each criterion. The performances of alternatives based on criteria were quantified based on a 9-item scale in which 1 means effective and 9 means "incredibly high effective".

Table 1 Decision-making criteria

Criteria	Description
C_1. Personal Innovativeness on Information Technology (PITT)	This criterion explains consumers who are conscious of personal innovativeness and updating of information technology i.e. experiment with new information technologies, adoption of new technology, try out new information technologies.
C_2. Web quality dimension	This criterion shows the degree of consumer consideration about web quality dimensions provided by the internet malls i.e. web quality, web design, easy navigation, and responsiveness.
C_3. Information and e-service dimension	This criterion determines consumers who are conscious about their privacy, security, sensitivity about price, third party seal, and trustworthiness of online service providers.
C_4. Online reputation	The degree of consumer consideration about good corporate reputation established by the internet malls i.e. centralized reputation, trust value, seller's rating, customer relationship, and social responsibility.
C_5. Incentives and post-purchase service	The degree of consciousness of consumer consideration about motivations and post-purchase services provided by the internet malls i.e. discount coupons, cash-back, free home delivery, cash on delivery, and return policy

Source: Singh et al. (2016)

Table 2 List of decision-makers and their expertise

No.	Designation	Experience	Expertise
1	Digital Marketing Manager	15	Online Reputation, Digital Marketing
2	Washing Machine Marketing Manager	12	Management and Marketing
3	Gas cooker Marketing Manager	13	Management and Marketing
4	Refrigerator Marketing Manager	15	Management and Marketing
5	Dish Washer Marketing Manager	10	Industrial Engineering

Source: own construction

Table 3 Alternatives

Alternatives	Description
A_1. Social advertising	Facebook, Twitter, Instagram, Telegram are excellent platforms for advertising to a switched-on, digital generation.
A_2. Tell the press	New products, should always start with a well-written press release to get the word out to the media.
A_3. Use email	Customers will be interested in seeing the latest products of the company or the latest news on product research and development.
A_4. Create an affiliates scheme	Affiliates are great because they do all the hard marketing for companies for a small amount of commission.
A_5. Referral reward	Satisfied customers will always be happy to recommend the company's brand or products to others, so create referral schemes to reward those who have spread the word about the business.
A_6. Loyalty reward	Firms love customers who come back to them again and again. Promise loyal customers reward repeat purchases with special offers or exclusive discounts.
A7. Use video	Having a video on the company website can increase conversions considerably.
A8. Use images	Customers love visuals while they do online shopping. Using plenty of high-quality images will show off the full potential of the product.
A_9. Create guides	Guides make great resources for customers while carefully directing them toward company products.
A_{10}. Easy sharing	Social shares are important for marketing a product. Companies should make it easy for people to share product information with plenty of handy, instant-share buttons on company product web pages.
A_{11}. Make affordable shipping	Companies should recommend free or cheapest shipping costs for online shopping.

Source: own construction

To combine all the expert comparison matrices and achieve the unit pairwise comparison, the geometric mean is applied. Although arithmetic means can be calculated, the geometric mean is more appropriate because its weights have ratio properties, meaning that ratio comparisons are valid (Aragon et al. 2012, p.8, Dong et al. 2010, Xu 2000). Due to the calculation of the marginal preference index in PROMETHEE II, criteria weights are computed by Shannon entropy (Wang–Lee 2009).

4. Results

The decision matrix of all decision-makers is shown in Table 4–8. Table 9 represents the final decision-making matrix after applying the geometric mean. The matrix of preference indices (average of $P(d)$ preference values for each criterion) is shown in Table 10. The last row (Φ^-) and last column (Φ^+) of the matrix are the sums of columns and sums of rows, respectively. They describe the relative dominance of alternatives. The Φ values of alternatives are the differences of Φ^- and Φ^+ values. The reducing order of Φ values is considered as the order of alternatives. In Table 11 the final orders calculated by PROMETHEE II are summarized. The final order is A8≻A9≻A6≻A1≻A5≻A7≻A2≻A4≻A3≻A10≻A11. Based on the results of final priorities, the three most important promotion items which may influence customers' online shopping would be using images, creating guides, and rewarding loyalty. When a customer tries to do online shopping, the first thing which attracts his/her attention is the picture or the image of a product. The more beautiful a picture of a product with high resolution, the more a customer might be attracted to the product. After checking the image, customers concentrate on the features of the product. Creating guides would provide information regarding the features of a specific product for customers. Giving precise information in the guideline section will help customers to easily choose their desired product. Special offers or exclusive discounts mostly stimulate customers to stay loyal to a special brand. Determining a considerable reward for loyal customers especially in online shopping, motivates customers to constantly purchase the specific brand. For example, reward loyalty in a home-appliances company sometimes motivates customers to purchase not only a required home appliance (like refrigerator) but it also stimulates them to buy unnecessary products (like gas cooker). A customer may not need or use the gas cooker currently but the special offer and discount as a reward of loyalty make him/her purchase the product.

The limitation of my study is the number of experts that determined the alternatives. The chosen alternative might change if more experts were involved in the interview. Also, the results might change if managers' evaluations of alternatives based on the criteria differ in decision matrices.

The calculated criteria weights in Table 9 indicate that the criteria (information and e-service dimension, online reputation, incentives, and post-purchase service, web quality dimension, personal innovativeness on information technology) weights are almost the same while in the literature review the criteria weights are different. It means information and the e-service dimension received the highest weight followed by online reputation, incentives and post-purchase service web quality dimension, and personal innovativeness on information technology (Singh et al. 2016). The main reasons that the criteria weights in my study differ from the literature review are the number of decision-makers and the decision-makers' judgment in pairwise comparisons. So, the weights of criteria might be varied if the number of decision-makers were to increase or decrease. It can affect the final results of ranking alternatives in the MCDM problem.

Table 4 Decision Matrix 1

Criteria / Alternatives	C1	C2	C3	C4	C5
A1	3	3	1	9	5
A2	1	3	3	9	3
A3	1	1	1	3	1
A4	9	9	3	7	7
A5	1	1	1	9	1
A6	1	1	1	9	5
A7	3	9	1	9	1
A8	3	9	1	9	1
A9	3	9	1	9	3
A10	5	9	1	9	3
A11	5	9	1	9	9

Source: own construction

Table 5 Decision Matrix 2

Criteria / Alternatives	C1	C2	C3	C4	C5
A1	5	7	9	3	5
A2	9	1	1	3	1
A3	1	3	3	3	1
A4	5	5	9	7	1
A5	5	3	1	7	5
A6	3	3	1	5	5
A7	3	3	1	7	1
A8	3	3	1	7	1
A9	7	7	1	5	3
A10	7	5	5	5	5
A11	3	3	7	7	9

Source: own construction

Table 6 Decision Matrix 3

Criteria / Alternatives	C1	C2	C3	C4	C5
A1	7	5	5	3	3
A2	5	7	3	3	3
A3	3	1	1	1	3
A4	5	7	3	5	3
A5	7	7	3	3	3
A6	7	7	5	3	3
A7	5	3	1	3	3
A8	7	7	1	3	3
A9	7	7	1	3	3
A10	5	5	3	3	5
A11	3	1	1	1	7

Source: own construction

Table 7 Decision Matrix 4

Criteria / Alternatives	C1	C2	C3	C4	C5
A1	5	6	3	5	5
A2	1	9	1	7	7
A3	1	9	1	9	7
A4	5	1	1	9	9
A5	1	1	1	9	1
A6	1	1	1	9	1
A7	1	9	1	9	1
A8	1	9	1	9	1
A9	1	9	1	9	1
A10	3	9	7	9	3
A11	5	9	1	9	3

Source: own construction

Table 8 Decision Matrix 5

Criteria / Alternatives	C1	C2	C3	C4	C5
A1	7	9	3	9	7
A2	3	3	1	5	7
A3	3	3	3	3	7
A4	5	9	7	7	7
A5	1	9	3	7	7
A6	1	9	3	7	7
A7	3	5	5	5	5
A8	1	9	1	7	7
A9	5	9	3	7	5
A10	7	9	1	9	7
A11	1	5	1	3	7

Source: own construction

Table 9 Final Decision Matrix

W_i	0.2	0.2	0.2	0.2	0.2
Criteria / Alternatives	C1	C2	C3	C4	C5
A1	5	6	3	5	5
A2	3	4	2	5	3
A3	2	2	2	3	3
A4	6	5	4	7	4
A5	2	3	2	7	3
A6	2	3	2	6	3
A7	3	5	1	6	2
A8	2	7	1	7	2
A9	4	8	1	6	3
A10	5	7	3	6	4
A11	3	4	1	4	7

Source: own construction

Table 10 Matrix of preference indices

$\pi(d_i)$	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	Φ^+
A1	–	1	0.8	0.6	0.4	0.2	0	0.8	1	1	0	0.58
A2	0	–	0.8	0.6	0.4	0	0	0	0	1	1	0.42
A3	0	0	–	0.4	0.4	0	0	0	0	0	1	0.24
A4	0.4	0.4	0.6	–	0.2	0.2	0	0	0	0	1	0.40
A5	0.4	0.6	0.6	0.8	–	0.2	0	0	0	1	1	0.52
A6	0.4	1	1	0.8	0.8	–	0.8	0	0	1	1	0.68
A7	0.20	0.6	0.8	0.6	0.4	0.2	–	0	0	1	1	0.48
A8	1	1	1	1	1	1	1	–	1	1	1	1.00
A9	1	1	1	1	0.8	1	0.8	0	–	1	1	0.86
A10	0	0	0	0	0	0	0	0	0	–	1	0.10
A11	0	0	0	0	0	0	0	0	0.00	0	–	0
Φ^-	0.34	0.56	0.66	0.58	0.44	0.28	0.42	0.08	0.20	0.82	0.90	

Source: own construction

Table 11 Alternative ranking

Alternatives	φ_+	φ_-	$\varphi(i)$	**Ranking**
A1	0.58	0.34	0.24	**4**
A2	0.42	0.56	–0.14	**7**
A3	0.24	0.66	–0.42	**9**
A4	0.40	0.58	–0.18	**8**
A5	0.52	0.44	0.08	**5**
A6	0.68	0.28	0.40	**3**
A7	0.48	0.42	0.06	**6**
A8	1.00	0.08	0.92	**1**
A9	0.86	0.20	0.66	**2**
A10	0.10	0.82	–0.72	**10**
A11	0.00	0.90	–0.90	**11**

Source: own construction

5. Conclusion

Recently, digital marketing, which is a new science in marketing theory, has resulted in some businesses earning lots of money. Each company should select proper digital marketing strategies to be a success in the competitive market. Strategies must be selected by top managers according to certain digital marketing factors. There are lots of factors which influence online shoppers' decisions. The present study has tried to prioritize the eleven promotion items based on five online shopping criteria by applying PROMETHEE II. This method is all too simple. It facilitates matching outputs and assumptions. It does not require changing and normalizing the decision matrix. PROMETHEE provides a general and rational framework for structuring a decision problem, recognizing and quantifying its conflicts and synergies, and clusters of actions.

By Applying PROMETHEE II, the most important promotion items which can affect online shopping and motivate the consumer to purchase online goods have been determined. The results, as shown in Table 11, indicate that the three most important promotion items which can influence customers in online shopping would be using images, create guides, and rewarding loyalty. The first important item which can affect customers' online shopping is applying an attractive image. Customers love visuals, especially 3-D moving images, while purchasing online since it helps them to get a feel for a product. Creating a guide not only assists customers in conducting online shopping, but it can also provide information required for using a product. A loyalty reward is a feature for the company to motivate real customers to repeat their shopping.

In summary, this study used PROMETHEE II as a practical MCDM technique that completely prioritizes alternatives based on different criteria. It is recommended that managers in different home appliance companies apply PROMETHEE II to solve certain decision-making problems, specifically in digital marketing.

Besides changing the weights of criteria in the model which may change the alternative ranks, the number of experts and managers with digital marketing experiences was the limitation of this study. The results, therefore, need to be interpreted with caution. However, more research on this topic needs to be undertaken before the association between alternatives and criteria is more clearly understood. Further research should be done to investigate the results when applying different kinds of MCDM techniques.

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Appendix 1: Decision matrix

Effectiveness	Effective	Relatively effective	Too effective	Too much effective	Incredibly high effective	Effective	Relatively effective	Too effective	Too much effective	Incredibly high effective	Effective	Relatively effective	Too effective	Too much effective	Incredibly high effective	Effective	Relatively effective	Too effective	Too much effective	Incredibly high effective	Effective	Relatively effective	Too effective	Too much effective	Incredibly high effective
Scale	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9	1	3	5	7	9
Criteria / Alternatives	Personal Innovativeness					Web quality dimension					Information and e-service dimension					Online reputation					Incentives and post-purchase service				
Embrace social advertising																									
Tell the press																									
Use email marketing																									
Create an affiliates scheme																									
Create an affiliates scheme																									
Referral reward																									
Loyalty reward																									
Use video																									
Create guides																									
Make sharing easy																									
Make affordable shipping a USP																									

Notes: To fill in the questionnaire (decision matrix), decision-makers must use the score in the scale row. For example, if one according to his/her experience finds creating guides is too much effective in online reputation, then he/she will give 7.

Udvari B. (ed) 2020: Proceedings of the European Union's Contention in the Reshaping Global Economy. University of Szeged, Doctoral School in Economics, Szeged, https://doi.org/10.14232/eucrge.2020.proc.2

Measuring eating behaviour: a review of methodologies

Dalma Pető

Obesity has dramatically increased during the last decades and is currently one of the most serious global health problems. The consequences of obesity for physical health are well established. The development of human obesity is attributed to overeating. Studying eating behaviour is an important approach in tackling obesity. Eating behaviours influence energy intake through choices about when and where to eat, and the types and amounts of foods chosen, including decisions about starting and stopping eating. This paper summarizes the measurement tools and methods in analyzing eating behaviour. The aim of this paper was to find the correct questionnaire for future research, which is the Dutch Eating Behaviour Questionnaire in this case.

Keywords: eating behaviour, measuring tools, DEBQ

1. Introduction

The data related to healthcare expenses indicate that households spend increasing amounts of money for that purpose, on medicines, medical appliances, and other goods of medical use in particular (KSH 2017). The factors affecting a person's health can be divided into two groups. The uncontrollable risk factors include innate genetic attributes, characteristics gained over the years, gender, and age. The factor we can control is lifestyle. Health is determined in largest measure by lifestyle (43%), followed by genetic factors (27%), environmental effects (19%) and healthcare (11%) (Varga-Hatos–Karner 2008).

Among lifestyle factors, nutrition is crucial from the perspective of our health. Our eating habits develop as early as our childhood, and they influence our later state of health. Malnutrition may affect our whole life and even shorten it. Therefore, it is important to pay attention to instilling proper eating habits in children from an early age (Huszka–Dernóczy 2015). The current environment is abesogenic, which means food is easily available (larger portions, highly advertised), physical activity has declined, and in interaction with genetic susceptibility, our body is encouraged to positive energy balance and to weight gain (Swinburn et al. 1999, Young–Nestle, 2002).

Malnutrition can be the source of several illnesses, such as cancer or cardiovascular diseases especially if it is accompanied by an unhealthy lifestyle. Children malnourished at an early age will be more susceptible to these illnesses in the longer term. Young people from lower income layers, eating food with low nutrient contents, are particularly prone to this. Parents are forced to put cheap and quickly prepared dishes on the table, which are often high in calories and fat. The spread of nutrient-poor fast foods has contributed to the increasing rate of obesity starting in childhood, and its treatment is a growing challenge all over the world (Khatoon et al. 2017, Vázquez–Torres 2012). Comparing the current data and the data

from two decades ago, it can be seen that the number of obese children has doubled, while the number of obese adolescents has tripled (Vázquez–Torres 2012). The first signs of several chronic diseases (such as cardiovascular diseases, diabetes, and obesity) are already detectable in childhood (Black et al. 2017). In addition, psychological illnesses, such as depression also accompany obesity, which means an even worse quality of life for the individual (Vázquez–Torres 2012).

Based on this, it can be claimed that it is extremely important to deal with nutrition. The purpose of this study is to present the internationally recognized eating behaviour questionnaires on obesity, to learn about their criticisms, and to select the questionnaire that will form the basis for subsequent primary research on self-control and eating behaviour.

2. Eating behaviour

Eating behaviour is considered to be the most important factor regarding the treatment and prevention of obesity and related illnesses (Danielsen et al. 2013). Before examining eating behaviour, it is very important to note that food is not a medication, so it is not suitable for self-medication (Lockwood 2007). Individual foods are not healthy or unhealthy. To achieve their positive or negative effects, we need to consume them regularly. We will not experience an immediate effect, as with medicines. The same is true for obesity. There are no "fattening" or fat-burning foods, weight gain is the result of a very simple formula: if you put more calories into your body than you burn, you will gain weight in the long term (Dovey 2010).

Another misconception is that there are addictive foods. Eating is part of our lives, it is a condition of our survival, so it cannot be addictive, as is the case with air, for example. The addiction to food can be explained by eating disorders, which is a diagnosed disease. Thus, the vast majority of society does not fall into this category (Baicy 2005). However, there are people who, under the influence of emotional stress, consume too much food. Although this is not a disease, it is a normal phenomenon, but it can lead to obesity in the long term, so it must be addressed (Dovey 2010).

Eating behaviours could be divided into three groups. Emotional eating, dietary restraint, and disinhibition. According to the psychosomatic theory, those who eat triggered by emotions (fear, anger, anxiety) do not recognise this stimulus, and therefore they take too many calories in their body. They are emotional eaters (Kaplan–Kaplan 1957). Emotional eaters have an additional component according to food (Dovey 2010). 75% of overweight people are struggling with this problem. Emotional eaters often choose food high in fat and sugar, and therefore tend to be at higher risk of diabetes and heart disease (Frayn–Knäuper 2018). Although eating under the influence of emotions is mainly related to negative emotions, in some cases it is caused by positive emotions (Ganley 1989). Therefore, it is difficult to predict the eating behaviour supposing of emotions by a normal eater. According to Macht (2008) there are five different types of emotional eating. The first and easiest type to define is when emotions cause an individual to change their dietary preference and choose a food richer in energy. In the second case, under the influence of overly intense emotions, the opposite occurs and the individual reduces consumption. The third and

fourth types are related to cognitive eating. Restrained eaters will not be able to follow their own rules under the sway of strong emotions and will consume more. And emotional eaters will eat even more sweet and high-fat foods to control their emotional state.

The theory of restraint is also related to eating behaviour, saying that during diet the individual consciously restrains food consumption to reduce or maintain weight, which leads to metabolic processes slowing down and reducing the feeling of hunger. However, as soon as self-control decreases (for example, as a result of alcohol or negative emotions), cognitive restraint decreases and eating behaviour turns in the opposite direction, leading to excessive food intake. Furthermore, as a result of restrained eating, the individual may lose control over the feeling of hunger and the feeling of satiety, which leads to eating based on emotional or external effects (Herman–Polivy 1975).

Disinhibition, the loss of inhibition indicates an eating behaviour where the individual loses control for some reason, is disturbed by something, so he eats more of that food. One classic example is when we eat a lot more snacks than we really need while watching a movie, and we drink as much as a litre of soft drinks during the movie. This is because the action (in this case, watching the film) distracts us, so we don't realize how much we are eating.

External eating is a specific form of disinhibition. External theory has a similar position, claiming that the external environment determines eating behaviour and the vision and smell of food generate an overly strong reaction in overweight people (Schachter–Rodin 1974). This theory is often linked to obesity (Herman et al. 1980).

3. Measuring eating behaviour

The measurement of dietary behaviour can be carried out by a number of methods. Qualitative research methods have been used in many studies. Among them was focus group interviews (Kubik et al. 2005), in-depth interviews (Krall–Lohse 2009). The problem with these methods and research is that their results cannot be generalized to the entire population. According to Smith (2009), in qualitative research, approach, and hypotheses are based on preliminary assumptions that influence the results. Case studies are also worth mentioning when examining methods of research on food, but this method is used more in medical research, where a group of a small number of individuals is examined. These studies focusing mainly on eating disorders and their therapy (Vansteelandt et al. 2004).

Another method of measuring dietary behaviour is experiments or laboratory tests. Research often requires looking at real dietary patterns, i.e. when and how much they ate (Dovey 2010). However, experience has shown that it is very difficult for those who are surveyed to remember the foods they have consumed in the last 24 hours, and their quantity is even more difficult to guess. They almost always forget about snacks (Hébert et al. 2001; Blake et al. 1989). Two methods are used to eliminate these problems: observing and measuring the dietary diary and the meal. In the former case, the interviewees are meant to describe all the details of the meals. It is not enough to name the food itself, researchers need an accurate description and

quantity. For example, it is not enough to know that the person ate a slice of pizza, but they need to know what topping was on the pizza, even what flour it was made from. The downside of the food diary may be that the filler pays more attention to what he eats, or simply forgets to type something, so that the real picture doesn't emerge from the research (Dovey 2010). Food is observed and measured under laboratory conditions. Here they try to imitate the environment of a real-life situation, and the participants have to choose between dishes. They also monitor the amount of food consumed, weighing before and after a meal, thus calculating the amount consumed. Of course, this method does not guarantee that participants will not be affected by the circumstances (Dovey 2010).

Psychometric (questionnaire-based) measurement methods are most common when examining dietary behaviour (Carnell–Wardle 2007). The best-edited questionnaires also have weaknesses. Although the leading questions are much more effective than simply asking someone if they eat under the influence of emotions, fillers often get tired of asking questions and do not pay enough attention to the quality of the filling (Dovey 2010).

A great number of research questionnaires into eating behaviour and attitudes ha been developed to examine this topic. In the table below (Table 1), we look at the measuring instruments that measure eating behaviour from the body weight management aspect.

For the purposes of this study, food consumption questionnaires are relevant. Pudel and his fellow researchers (1975) created the concept of *latent obesity* and developed a test. We call *latent obese* individuals who have normal body weight, yet they body is biologically programmed to be obese because of their rate of eating. However, they can limit their calorie intake in the long term. They constructed a 40 item questionnaire to measure latent obesity. However, it has limitations both theoretically and practically. Stunkard and Messick (1985) stated that "the concept of restrained eating implies two independently varying dimensions of restraint vs nonrestraint and obesity vs nonobesity; whereas the concept of latent obesity implies either an intermediate range on the obesity–nonobesity dimension or a confounding of the two dimensions. The latent obesity questionnaire thus cannot address the important group of restrained obese. Furthermore, the questionnaire has not been applied beyond the narrow limits of one form of laboratory experiment" (Stunkard–Messick 1985, p. 72).

Table 1 Measuring instruments for weight management

Examined area	***Name***	***Source***
Food consumption	Latent Obesity Questionnaire	Pudel et al. (1975)
	Eating Attitude Test (EAT)	Garner and Garfinkel (1979)
	Restraint Scale, RS	Herman and Polivy (1980)
	Eating Disorder Inventory (EDI)	Garner et al. (1983)
	Dutch Eating Behaviour Questionnaire (DEBQ)	Van Strien et al. (1986)
	Three Factor Eating Questionnaire (TFEQ)	Stunkard and Messick (1985), Karlsson et al. (2000) HRQL Group (2002) Tholin et al. (2005)
	Children's Eating Behaviour Questionnaire (CEBQ)	Carnell and Wardle (2007)
Body Image	Body Attitude Test (BAT)	Probst et al. (2008)
	Fallon and Rozin Test	Stunkard and Messick (1985) Fallon and Rozin (1985)
Physical Activity	Exercise: Stages of Change	Marcus et al. (1992)
	State-Trait Anxiety Inventory; STAI	Spielberger (1970)

Source: Probst et al. (2008), Czeglédi et al. (2010), Czeglédi et al. (2011), Soós (2014)

Garner and Garfinkel's (1979) *Eating Attitude Test* (EAT) is mainly used to study eating disorders. Originally, it had 40 items and measured anorexia on a 6 point Likert scale. EAT has been used in several studies and achieved good psychometric properties of reliability, validity, and sensitivity, but it is useful only in discovering eating disorders in general (Richter et al. 2016).

Herman and Polivy's (1980) *Restraint Scale* uses 10 items to measure how consciously an individual restrains food intake in order to restrain their weight. According to their concept, obese characteristics of people arise from their dieting and not from their obesity. Restraint eating is more common among obese individuals, because they diet often (Hibscher–Herman 1977). Further studies revealed problems with the scale, and it does not predict the obese people's behaviour. Moreover, obese people, whose score was high on the scale did not overeat (Stunkard–Messick 1985).

The Eating Disorder Inventory is a widely used measurement tool for eating disorders like bulimia and anorexia. The test has 64 items on eight subscales (drive for thinness, bulimia, body dissatisfaction, ineffectiveness, perfectionism, interpersonal distrust, interoceptive awareness, and maturity fears) (Garner et al. 1983).

Restraint Scale provided the basis for the *Three Factor Eating Questionnaire* (TFEQ) (Stunkard and Messick 1985) and the *Dutch Eating Behaviour Questionnaire* (DEBQ) (Van Strien et al. 1986). Both analyse three eating behaviours: the TFEQ

distinguishes between uncontrolled eating, cognitive restraint and emotional eating, and the DEBQ differentiates restrained eating, emotional eating and external eating.

The *Three Factor Eating Questionnaire* has two parts, and 51 items in all. The first part has true or false items, for example "*I usually eat too much at social occasions, like parties and picnics".* The second part has a 4-point scale with questions like "*How often are you dieting in a conscious effort to control your weight?"* TFEQ measures uncontrolled eating such as the degree of cognitive control in food intake, cognitive restraint such as the loss of control in food consumption, and emotional eating such as the susceptibility for internal or external hunger signs (Löffler et al. 2015).

The *Dutch Eating Behaviour Questionnaire* examines eating behaviour with the help of three subscales. The *external eating* scale studies the consumption affected by external stimuli related to food regardless of the individual's feeling of hunger. The *restrained eating* scale measures whether the individual restrains food consumption intentionally in order to reduce weight or prevent overweight. The third, *emotional eating* scale analyses the effect of emotions (such as anger, tension, and anxiety) on nutrition (Van Strien et al. 1986).

4. Dutch Eating Behaviour Questionnaire and Three-Factor Eating Questionnaire

Dutch Eating Behaviour Questionnaire and Three-Factor Eating Questionnaire are the most commonly used eating behaviour questionnaires in business studies, because they combine the main scales invented for eating behaviour measurement. They measure almost the same eating behaviour types but with different scales and questions.

Dutch Eating Behaviour Questionnaire (DEBQ) is an internationally well recognised measuring tool for eating behaviour. The questionnaire intended to measure eating behaviour was developed by Van Strien and co. in 1986. The questionnaire originally including 46 items was later reduced to 33 questions, which since then has been validated in many countries (including Brazil, China, Spain and France) (Moreira et al. 2017, Wu et al. 2017, Cebolla et al. 2013, Bailly et al. 2012). Over time, it has been modified, improved and validated several times (Van Strien et al. 1986, Evers et al. 2011, Bailly et al. 2012, Nolan et al. 2010, Schembre et al. 2011, Bozan et al. 2011).

The questionnaire examines eating behaviour with the help of three subscales (Table 2). The *external eating* scale studies the consumption affected by external stimuli related to food regardless of the individual's feeling of hunger. The *restrained eating* scale measures whether the individual restrains food consumption intentionally in order to reduce weight or prevent overweight. The third, *emotional eating* scale analyses the effect of emotions (such as anger, tension and anxiety) on nutrition. These three scales have high internal consistency and factorial validity (Van Strien et al. 1986).

Table 2 The original questions of Dutch Eating Behaviour Questionaire

The original questions	*Scale*
Do you have the desire to eat when you are irritated?	*emotional eating*
If food tastes good to you, do you eat more than usual?	*external eating*
Do you have a desire to eat when you have nothing to do?	*emotional eating*
If you have put on weight, do you eat less than you usually do?	*restrained eating*
Do you have a desire to eat when you are depressed or discouraged?	*emotional eating*
If food smells and looks good, do you eat more than usual?	*external eating*
How often do you refuse food or drink offered because you are concerned about your weight?	*restrained eating*
Do you have a desire to eat when you are feeling lonely?	*emotional eating*
If you see or smell something delicious, do you have a desire to eat it?	*external eating*
Do you have a desire to eat when somebody lets you down?	*emotional eating*
Do you try to eat less at mealtimes than you would like to eat?	*restrained eating*
If you have something delicious to eat, do you eat it straight away?	*external eating*
Do you have a desire to eat when you are cross?	*emotional eating*
Do you watch exactly what you eat?	*restrained eating*
If you walk past the baker do you have the desire to buy something delicious?	*external eating*
Do you have a desire to eat when you are approaching something unpleasant to happen?	*emotional eating*
Do you deliberately eat foods that are slimming?	*restrained eating*
If you see others eating, do you also have the desire to eat?	*external eating*
When you have eaten too much, do you eat less than usual the following days?	*restrained eating*
Do you get the desire to eat when you are anxious, worried or tense?	*emotional eating*
Do you find it hard to resist eating delicious foods?	*external eating*
Do you deliberately eat less in order not to become heavier?	*restrained eating*
Do you have a desire to eat when things are going against you or when things have gone wrong?	*emotional eating*
If you walk past a snack bar or a café, do you have the desire to buy something delicious?	*external eating*
Do you have the desire to eat when you are emotionally upset?	*emotional eating*
How often do you try not to eat between meals because you are watching your weight?	*restrained eating*
Do you eat more than usual, when you see others eating?	*external eating*
Do you have a desire to eat when you are bored or restless?	*emotional eating*
How often in the evening do you try not to eat because you are watching your weight?	*restrained eating*
Do you have a desire to eat when you are frightened?	*emotional eating*
Do you take into account your weight with what you eat?	*restrained eating*
Do you have a desire to eat when you are disappointed?	*emotional eating*
When you are preparing a meal are you inclined to eat something?	*external eating*

Source: Van Strien et al. (1986)

Table 3 Questions of Three-Factor Eating Questionnaire

The question	*Answers*	*Scale*
I deliberately take small helpings as a means of controlling my weight.	definitely true/ mostly true/ mostly false /definitely false	cognitive
I consciously hold back at meals in order not to gain weight.	definitely true/ mostly true/ mostly false /definitely false	cognitive
I do not eat some foods because they make me fat.	definitely true/ mostly true/ mostly false /definitely false	cognitive
How frequently do you avoid `stocking up' on tempting foods?	almost never/ seldom /usually/ almost always	cognitive
How likely are you to consciously eat less than you want?	unlikely /slightly likely/ moderately likely/ very likely	cognitive
On a scale of 1 to 8, where 1 means no restraint in eating (eating whatever you want, whenever you want it) and 8 means total restraint (constantly limiting food intake and never `giving in'), what number would you give yourself?	eat whatever I want, whenever I want it/ constantly limiting food intake, never `giving in'	cognitive
When I smell a sizzling steak or a juicy piece of meat, I find it very difficult to keep from eating, even if I have just finished a meal.	definitely true/ mostly true/ mostly false /definitely false	uncontrolled
Sometimes when I start eating, I just can't seem to stop.	definitely true/ mostly true/ mostly false /definitely false	uncontrolled
Being with someone who is eating often makes me hungry enough to eat also.	definitely true/ mostly true/ mostly false /definitely false	uncontrolled
When I see a real delicacy, I often get so hungry that I have to eat right away.	definitely true/ mostly true/ mostly false /definitely false	uncontrolled
I get so hungry that my stomach often seems like a bottomless pit.	definitely true/ mostly true/ mostly false /definitely false	uncontrolled
I am always hungry so it is hard for me to stop eating before I finish the food on my plate.	definitely true/ mostly true/ mostly false /definitely false	uncontrolled
I am always hungry enough to eat at any time.	definitely true/ mostly true/ mostly false /definitely false	uncontrolled
How often do you feel hungry?	only at mealtimes/ sometimes between meals/ often between meals/ almost always	uncontrolled
Do you go on eating binges though you are not hungry?	never/ rarely/ sometimes/ at least once a week	uncontrolled
When I feel anxious, I find myself eating.	definitely true/ mostly true/ mostly false /definitely false	emotional
When I feel blue, I often overeat.	definitely true/ mostly true/ mostly false /definitely false	emotional
When I feel lonely, I console myself by eating.	definitely true/ mostly true/ mostly false /definitely false	emotional

Source: Karlsson et al. (2000)

The second most popular eating behaviour questionnaire is TFEQ (Three-Factor Eating Questionnaire), developed by Stunkard and Messick (1985). Originally, it consists of two parts and a total of 51 items. Each of the items is measured on a yes-to-no scale. Of the 51 questions, 21 examined cognitive limitations, 16 were for disinhibition, and 14 for predisposition to hunger. There are three categories within the three eating behaviours: low, high, clinical case (Dernóczy-Polyák et al. 2017). The 21-item (TFEQ-R21) most commonly used in current researches (Table 3) was developed by Karlsson et al. (2000) and the 18-item (TFEQ-R18) form by Tholin et al. (2005). The questionnaire examines eating behaviour with the help of three components: restraint eating, disinhibition, and huger. Disinhibition examines eating on the basis of external effect (smells, appearance of food) and eating under the influence of emotions. This scale is most correlated with obesity and high calorie intake (Bryant et al. 2007). In addition to testing the strength of the restraint scale of the DEBQ restraint scale, body image is also considered.

TFEQ and DEBQ are highly similar constructions and used in many international studies. According to Google Scholar DEBQ has 5.530 records, TFEQ has 5.220. But DEBQ provides results that are easier to apply and identify in business science (Dernóczy-Polyák–Keller 2017). However, for our future research about self-control and eating behaviour, DEBQ is more relevant because of the scales, which can be easily paired with self-control measurement.

5. Conclusion

Obesity is associated with increased health care cost, which is why it is important to examine eating behaviour. Obesity is attributed to overeating. Measuring eating behaviour is important to understand obese eating patterns (Van Strien et al. 1986). In the past decades a great number of measurement tools into eating behaviour and attitudes has been developed. In this study we presented the aspects of eating behaviour and introduced the internationally acknowledged measuring methods. The aim of this study was to find the best eating behaviour measurement tool for future research. We found that TFEQ and DEBQ are the most commonly used questionnaires for this topic, but DEBQ is easier to apply and identify in business studies. The main difference between the questionnaires are the measured scales. TFEQ measures disinhibition, but DEBQ only measures one specific form of disinhibition, external eating. For the future research, which examines eating behaviour in the context of self-control, Dutch Eating Behavior Questionnaire is the right choice, because the scales (external eating, restrained eating, and emotional eating) can be drawn parallel with self-control measuring methods.

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Udvari B. (ed) 2020: Proceedings of the European Union's Contention in the Reshaping Global Economy. University of Szeged, Doctoral School in Economics, Szeged, https://doi.org/10.14232/eucrge.2020.proc.3

What drives you to use a driverless car? An investigation of behavioral intention and its influencing factors

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The investigation of driverless car from the economic perspective is one of the most discussed topics nowadays. Although it can be approached from various perspectives there is still a lack of studies focusing on the behavioral intention to use self-driving cars and its influencing factors. Over the last few decades, various psychological models have been developed to investigate the influencing factors of usage of certain technologies, but most of them cannot provide clear answers on consumer attitudes and intentions with regard to autonomous vehicles. Thus, new models have appeared to better describe the psychological factors of this new technological development that will revolutionize the future of mobility.

In our research CTAM (Car Technology Acceptance Model) was used to measure intention to using self-driving cars. In 2019, 314 participants responded to our questionnaire and provided answers to the given questions. We used structural equation modelling to investigate the linkages between the behavioral intention and influencing factors revealed during the literature review. According to the results, the most important influencing factors of intention are attitude, perceived safety and social norms, while anxiety (of using the technology), effort expectancy, performance expectancy, and self-efficacy have not been proven important factors. The model used in our investigation explains behavioral intention to a great extent (63%).

Keywords: self-driving car, consumer behavior, technological acceptance, intention, autonomous vehicles

1. Introduction

There is no doubt that we are facing a revolution in mobility, and the progress of development of autonomous vehicle technologies is faster than we have ever seen. Since the technology is almost on the market, there is a need for theoretical models that can investigate user acceptance of such technologies, and for research that investigate user attitudes towards driverless cars and allows us to understand the influencing factors of this car-related technology.

Davis (1989) developed the Technology Acceptance Model that provided a theoretical basis for almost all models that have been created in recent decades in this research field. This explanatory framework contributed a lot to better understand user opinion on various technologies and to present a wider set of possible associations (Ghazizadek et al. 2012). Nordhoff et al. (2016) suggest that user acceptance greatly depends on multiple psychological, situational, and socio-economic factors that emphasize that user intention and behavior is highly influenced by various factors and circumstances. Thus, there is a need to investigate these trends and their impact on vehicle users, including both passengers and drivers.

This study comprises four main sections. The next two sections demonstrate briefly the literature review focused on driverless cars and the theoretical model applied in our investigation. The third section describes the research method, including the research question, the collection of data and the characteristics of the sample. The fourth section provides a comprehensive overview of the research results, including both descriptive statistics and influencing factors of intention to drive driverless cars, while the fifth section summarizes the results and the consequences of the paper.

2. Literature review

In our study we focus on the driverless car and investigate user acceptance towards this technology with a theoretical model. Thus, we give a short introduction to research that has studied attitudes relating to self-driving cars, and provide a brief overview of theoretical models focusing on technology acceptance.

2.1. Driverless cars

The appearance of driverless cars could revolutionize mobility in many respects. Thus, we wish to highlight some research on this topic. Nielsen and Haustein (2018) investigated the attitudes towards driverless cars in Denmark. Three clusters were identified among the 3,040 respondents in regard as traditional and driverless cars. These clusters are the following:

- sceptics (38%)
- indifferent stressed drivers (37%)
- enthusiasts (25%)

According to the results, the clusters differ by their sociodemographic attributes. While the enthusiasts are mainly young men with a higher educational level who live in cities, the sceptics depend to a large extent on their car, their age is higher than the average in the sample, and they live in smaller towns or/and villages. These results suggest that young men of higher income express greater interest in and openness for driverless cars than the elderly generation in rural areas.

Another research also investigated the attitudes towards driverless cars, but it was conducted internationally. The survey was carried out in 109 countries and 5,000 respondents participated. The research aim was to better understand user acceptance, concerns about, and intention to purchase driverless cars (Kyriakidis et al. 2015). According to the research results, traditional cars with manual transmission provide maximum driving experience for the driver. Furthermore, 22% of the respondents would not be inclined to pay more for a driverless car than for a traditional car, however 5% of the participants would pay more than 30,000$ for a fully automated vehicle. The research also highlighted that the respondents were concerned mostly by software hacking incidents, legal and security problems. The research investigated the impact of age and gender, however the differences were slight and proved not to be significant in the research. However, male respondents did tend to be willing to pay more for driverless cars and were less concerned by driverless cars related fears.

A recurring issue in the area of autonomous vehicle is safety, which can be readily investigated in the case of automobiles and public transport vehicles. Some comprehensive research conducted in France approached this topic with qualitative and quantitative measures focusing on the perceived safety towards traditional public transportation vehicles compared to autonomous vehicles. According to the results, respondents perceive autonomous vehicles as safer in general, however they evaluate safety within the vehicle lower, because they cannot turn to the driver in case of need. Relating to these results, the research highlighted that female respondents would experience safety as being lower than male respondents. The research highlighted that one of the main barriers of introducing self-driving vehicles in public transportation is the low level of perceived safety instead of other factors (Salonen 2018).

2.2. Car Technology Acceptance model

As we reported previously, Technology Acceptance Model (Davis 1989) provided the theoretical framework for investigating user acceptance in the case of various technologies. In recent decades there have been many studies that refined the model and tailored it to different contexts resulting in more developed frameworks.

While Technology Acceptance Model (TAM) was originally developed for investigating the *perceived ease of use* and *perceived usefulness* in the case of personal computers at home and workplaces, TAM2 and TAM3 models were developed for other purposes due to the introduction of various technologies to the consumer market in the 1990s. While TAM2 model focused mainly on *perceived usefulness* and extended the original model with additional factors, like *subjective norms*, *voluntariness*, *image*, *job relevance*, *output quality*, and *result demonstrability* (Venkatesh–Davis 2000), TAM3 investigated *perceived ease of use* and its influencing factors: *computer self-efficacy*, *perceptions of external control*, *computer anxiety*, *computer playfulness*, *perceived enjoyment*, and *objective usability* (Venkatesh–Bala 2008).

As previous user acceptance models investigate user attitudes from various contexts in the case of various technologies in general, there was a need to develop a model with a special focus on driver acceptance towards in-car technologies. As a result, Osswald et al. (2012) provided a framework for investigating car-related technologies that can be applied in our study. It also built on other technology acceptance models, such as Unified Theory of Acceptance and Use of Technology (UTAUT) which emphasize the role of *performance expectancy*, *effort expectancy*, *social influence*, and *facilitating conditions* (Venkatesh et al. 2003).

The Car Technology Acceptance Model consists of 7 factors that can be interpreted in the case of car-related technologies. These factors are the following: *attitude towards the technology*, *perceived safety*, *social influence*, *performance expectancy*, *effort expectancy*, *anxiety*, *self-efficacy*, and *facilitating conditions*. In our study we will use this model and its factors and validated scales to measure potential user opinion relating to driverless cars.

In the next section we will describe the methodology applied in our study.

3. Methodology

In this paper we describe the survey that we carried out in Hungary and its results. The methodology describes the following topics: research question, research method, and the sample. This chapter provides a comprehensive overview of the research and its circumstances.

3.1. Research question

The aim of the research is to investigate the determining factors of intention to use a self-driving car in the future. Although there are various models for investigating behavioral intention, we used a Car Technology Acceptance Model (CTAM) to test various factors in our study. Thus, our research question is: *what factors play the most critical role in the behavioral intention to use a driverless car?* Although driverless cars are not available although similar but less developed technologies are already on the market, we measure the behavioral intention in the context where users cannot experience the technology but can express an opinion about it. This could be a limitation of our study.

We determined 3 hypotheses in order to test our theoretical model. These hypotheses focus on the whole model itself, safety, and anxiety:

H1: The Car Technology Acceptance Model explains to a great extent intention with the factors investigated.

H2: Anxiety plays an important role in intention.

H3: Safety plays an important role in intention.

H1 focus on the model and provides information on the extent to which factors describing the respondents' opinion about driverless cars can be investigated. This is an important hypothesis because it can give a clear answer on whether the model is useful or not. Meanwhile, H2 and H3 provide information about more psychological-related fears towards driverless cars. Anxiety during using the technology and safety are important factors, thus these 3 hypotheses will be tested.

3.2. Research method

In order to answer the research question, we developed a questionnaire based on the literature review. The questionnaire consists of various questions which were partly adopted from previous studies, whilst some of them were developed by ourselves. The next figure demonstrates our model:

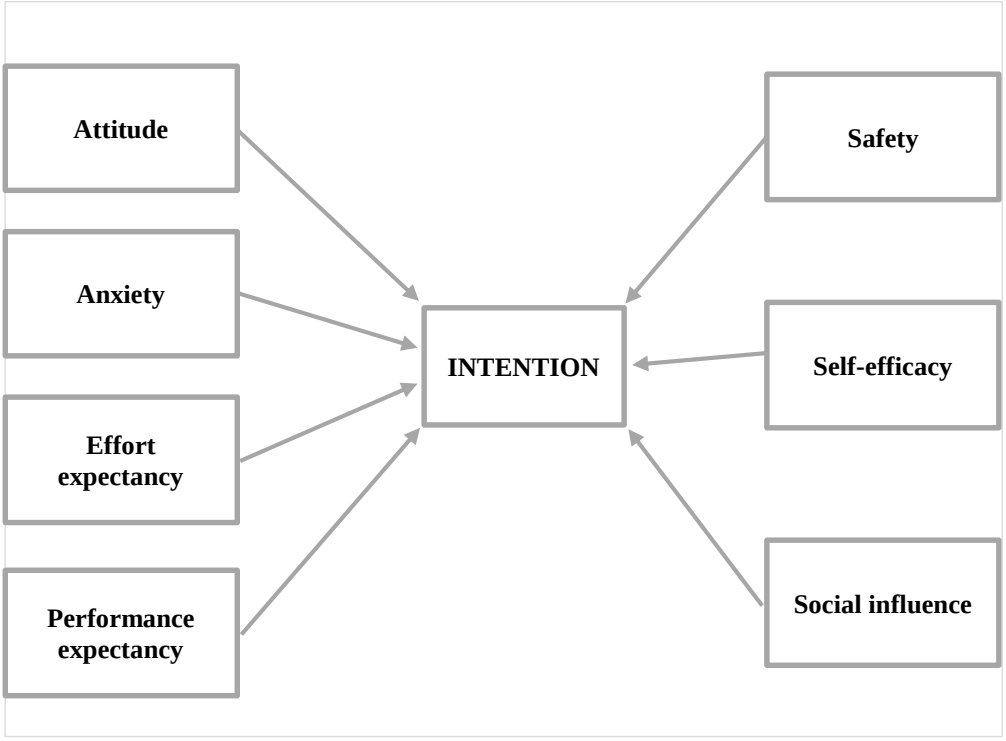
The questionnaire was distributed among students at the faculty of Economics and Business Administration at the University of Szeged and to users of social media channels. In the case of the students, the links of the questionnaire were uploaded to an educational platform on which students have access to teaching materials. Participation in the survey was voluntary and anonymous.

The responses were recorded online and the raw database was exported to Microsoft Excel. The database was cleaned and coded in IBM SPSS Statistics 20 software and was also exported to a .csv format. This database was also processed by SMART PLS 3.0 software to investigate the relationship between different factors.

While IBM SPSS Statistics was used to demonstrate the descriptive statistics of the results, SMART PLS allowed us to gain a better understanding of the influencing factors with partial least squares structural equation modeling (PLS-SEM).

In order to test Car Technology Acceptance Model, structural equation modeling (SEM) was applied, which enabled us to simultaneously investigate the influence of the relevant factors on intention to use driverless cars. Along with the development of more specialized statistical methods, the application of SEM in the field of strategic management has expanded rapidly in recent decades (Shook et al. 2004). SEM represents an extension of general linear modeling (GLM) and allows scholars to investigate latent structures measured by multiple variables. This technique is widely used for testing hypothesized models (Lei–Wu 2007), a term which refers to a variety of statistical models including covariance-based structural equation modeling (CB-SEM) and partial least squares structural equation modeling (PLS-SEM). While the former is the most widely used version of SEM, in many cases scholars are not aware of the disadvantages and application conditions of this technique, such as sample size, equal distribution, etc. In contrast, PLS-SEM is more applicable because it can be used on small samples and uneven distributions of variables as well (Hair et al. 2012).

Figure 1 Our hypothesized model



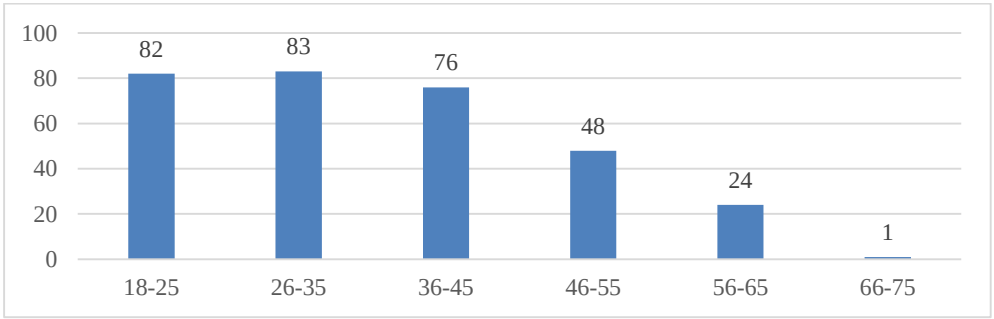
Source: own construction

3.3. The sample

In this section we provide a comprehensive overview of our sample from two perspectives. Firstly, the demographic attributes of the respondents will be demonstrated, secondly, the habits and preferences of the respondents will be described in general in order to better understand participant characteristics.

The promotion of the research at the University and through social media channels resulted in *314 valid responses*. The gender distribution in our sample is quite representative, since 52% male (163) and 48% female (151) respondents participated in our survey. Regarding age, most of the respondents were between 18–45 years.

Figure 2 Age distribution



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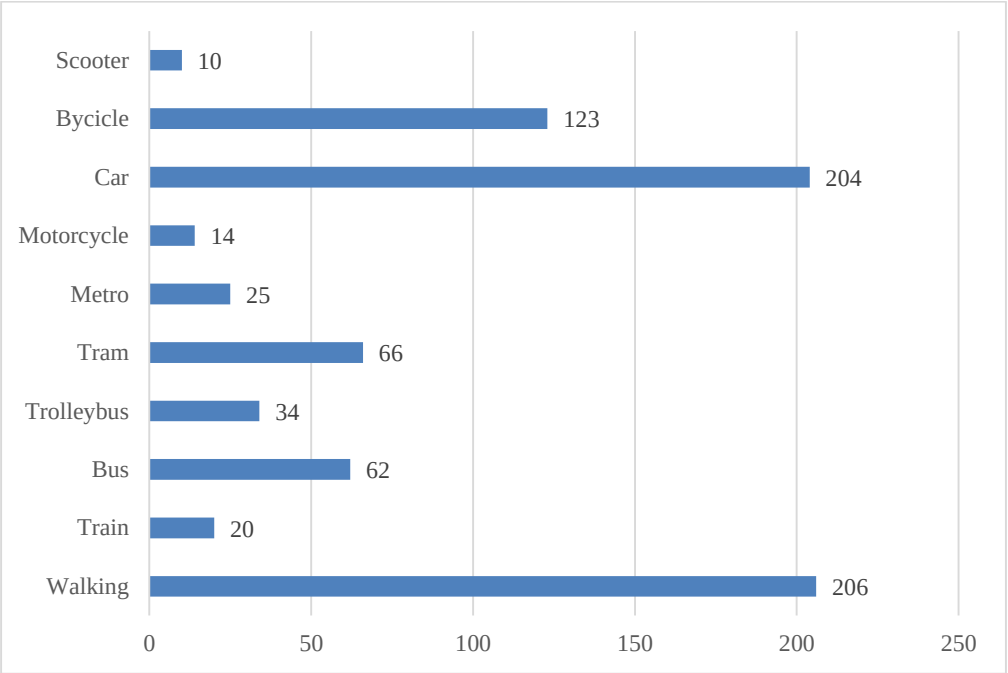
According to the level of education, only 1 respondent finished only primary education, and 89 participants had graduated from high school. The majority of the sample, 224 respondents had graduated from higher education, which is a quite high ratio. Regarding settlement type, 78% of the respondents lived in towns (including county towns as well), while 12% lived in the capital city. The rest, 10% lived in villages or smaller settlements.

84% of the respondents possessed driving license while 16% did not. 20% of the participants had 1–5 years of experience, 11% had 6–10 years of experience, while 46% had more than 10 years of experience in driving. 23% of the sample did not answer this question or do not have driving license.

43% of the participants drove regularly (137), while 27% of them drove weekly. 30% of the respondents drove less often or did not have driving license. 71% of the participants possessed or had access to a car they could use anytime.

We also asked the respondents to indicate which vehicle or services they used regularly (Figure 3).

Figure 3 Regarding mobility preferences



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4. Research results

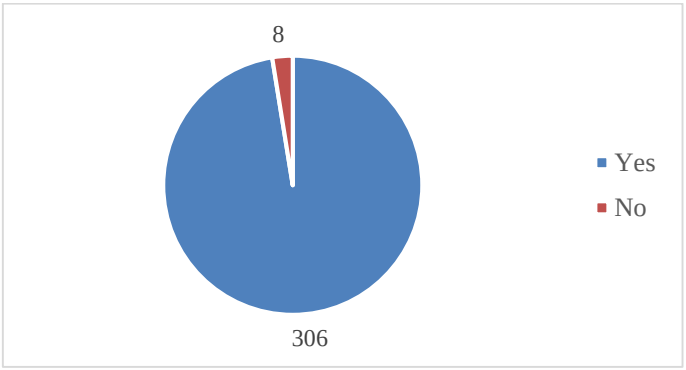
In this section we will provide a comprehensive overview of the research results consisting of the descriptive statistics of related topics and the Car Technology Acceptance model.

4.1. Awareness of driverless cars

This first topic is about the awareness of driverless car, and can be approached from two perspectives. Firstly, how many of the respondents are aware of the driverless cars, secondly, do the respondents gather information relating to driverless cars?

Firstly, respondents had to answer the following question: *„Have you ever heard about driverless car?"* Respondents had two options to answer: „Yes" or „No". 97% of the sample stated that they had already heard about these vehicles. This result contributes to the assumption that driverless cars are already well known in society, however, there is still a small proportion of people who are not aware of them or cannot associate this phrase with this particular vehicle.

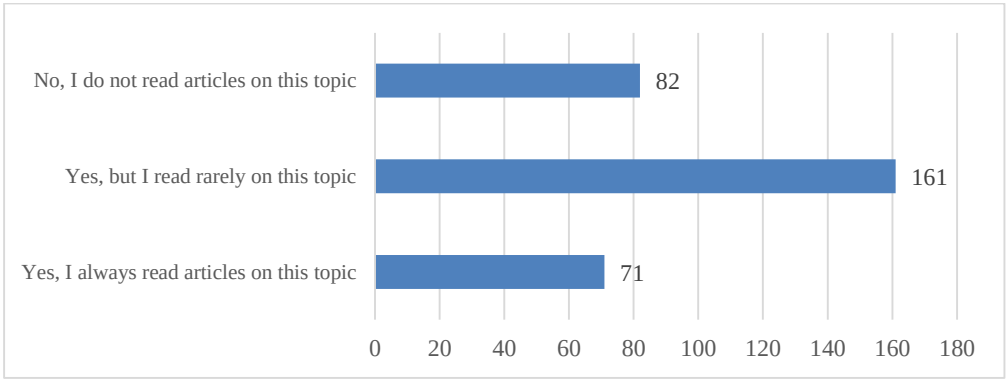
Figure 4 Awareness of driverless car technology



Source: own construction

Although the large majority of respondents are aware of the driverless cars, there is still a question of whether they are actively seeking information about this technology or just passively receiving news relating to this topic? According to the results, around ¼ of the respondents regularly read articles on this topic while ¼ do not read about it at all. About half of the sample read articles about driverless cars but did so only rarely.

Figure 5 Reading articles about driverless cars



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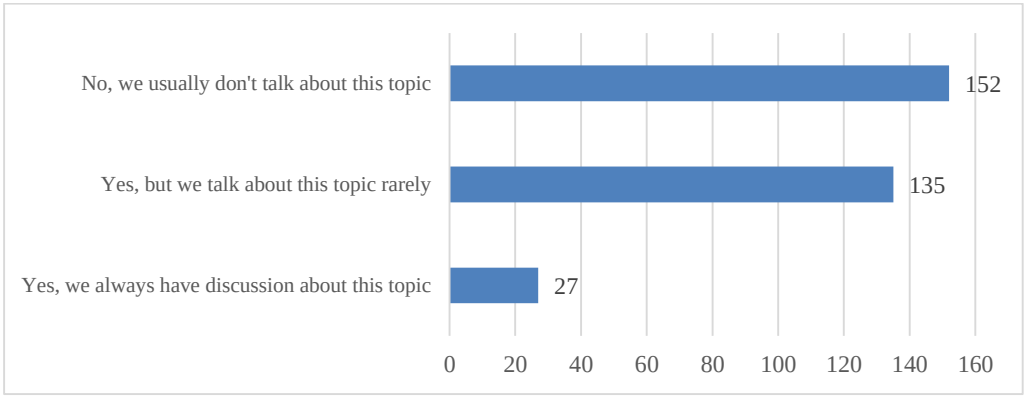
4.2. Social influence

The influence of peers, friends, and family members is a well discussed topic in social behavior. In this sub-section we asked respondents to provide information on whether they have any discussion with others about driverless cars and whether they perceive their social environment as being interested in driverless cars or not.

According to the results, 48% of the respondents do not talk to others about this topic while 43% of the sample does, but they do it rarely and only 9% regularly have discussions on the topic with others.

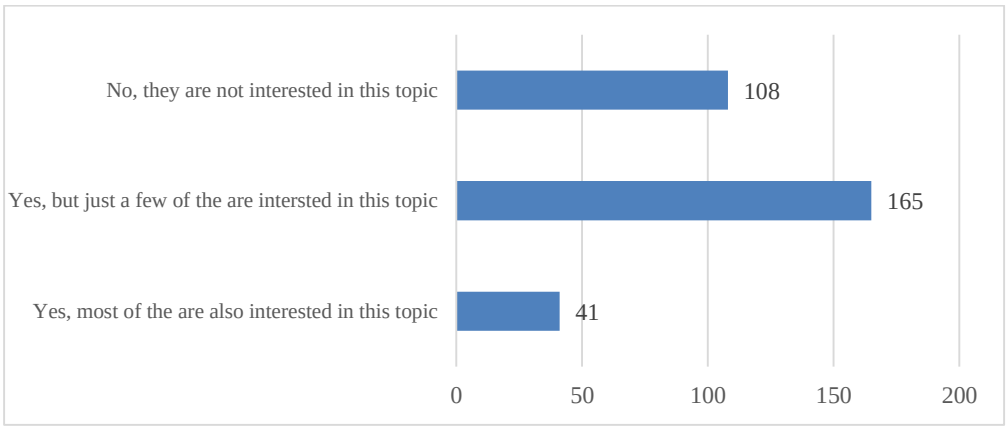
Figure 6 Discussion with others about driverless cars



Source: own construction

Another question investigates the interest of friends and family members towards driverless cars. According to the respondents, 34% do not perceive them as being interested in driverless cars while 53% do, but only in the case of few friends and family members. Only a small proportion, 13%, stated that most of their friends and family members are interested in this topic.

Figure 7 Interest of friends and family members towards driverless cars



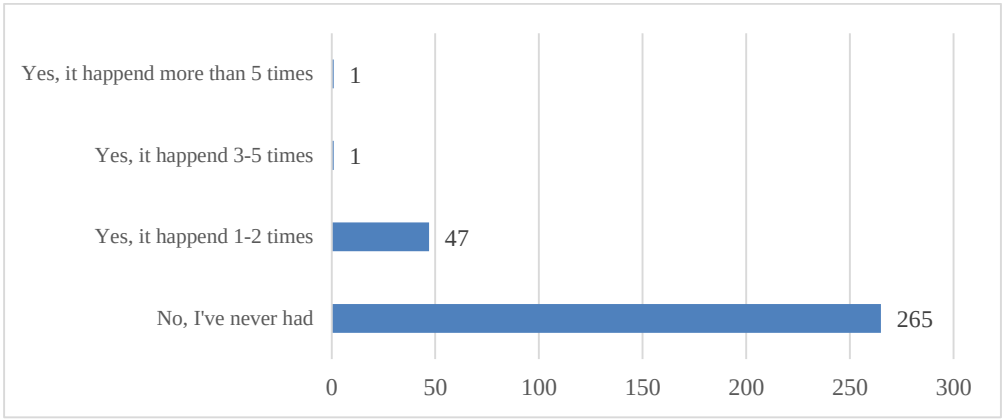
Source: own construction

These results suggest that the driverless car is not a hot topic among the respondents, however a significant number of respondents talk about it rarely and a few of their friends and family members are interested in the topic. But just a small amount of them talk about it regularly and pursue interest towards this technology.

4.3. Safety

Safety is one of the most important aspects in the case of driverless cars because there is a general fear regarding car accidents caused by the technology which will shed a new light on traffic accidents. First of all, we asked the respondents to indicate how many car accidents had happened to them in the last 5 years. According to the responses most of the participants had never had any car accident, but around 15% of them had had 1–2 in the last 5 years.

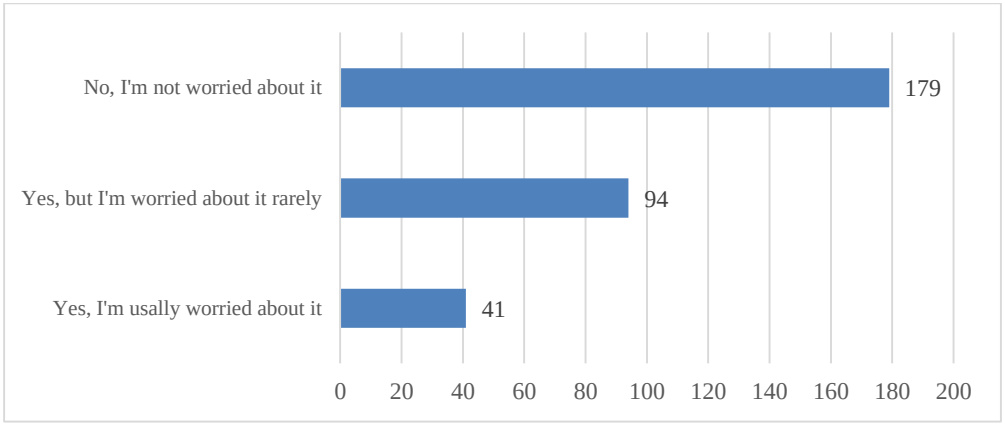
Figure 8 Number of car accidents in the last 5 years



Source: own construction

As we have seen, most of the respondents have not experienced any car accident in recent years. However, asking about their fears, almost half of the participants stated that they worry about car accidents usually or rarely (Figure 9).

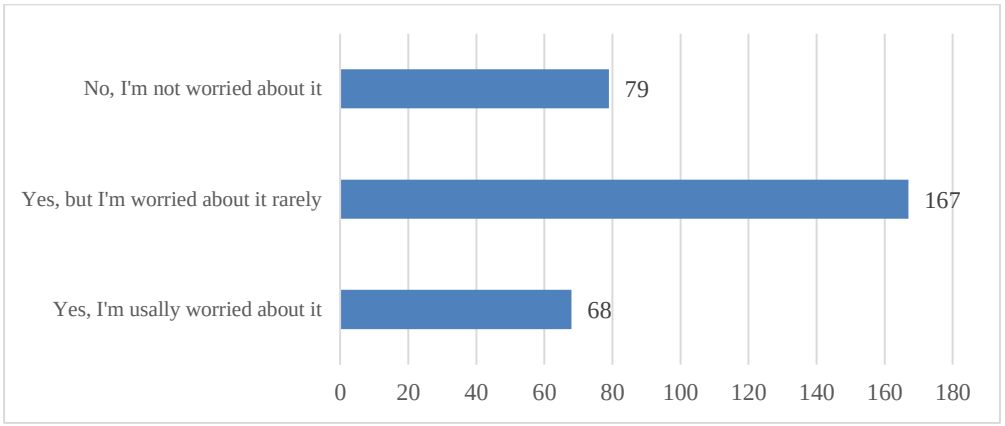
Figure 9 Number of respondents worrying about causing a car accident



Source: own construction

Another important aspect of safety is suffering a car accident caused by others. In the survey we also investigated this question, showing that respondents have greater fear of suffering a car accident caused by others since around 75% of them worry about it usually or rarely (Figure 10).

Figure 10 Number of respondents worrying about suffering a car accident caused by others



Source: own construction

According to the results, car accidents is an important topic even if just a small proportion of respondents have suffered car accident in the last 5 years. Most of the fear of suffering car accidents involves those caused by others rather than causing it themselves.

5.4. Car Technology Acceptance Model

In this subchapter we will investigate the influencing factors of behavioral intention. Intention plays an important role in human behavior since it is usually the trigger factor of actions. In this section we use PLS-SEM to investigate the linkages between the factors and intention. Firstly, we tested the scales used in our survey in order to check the quality criteria. This test was carried out in the case of four quality criteria, namely Cronbach's Alpha, rho_A, Composite Reliability, and Average Variance Extracted (AVE).

According to the results five out 8 factors, meet all quality criteria which are the Effort Expectancy, Intention, Performance expectancy, Perceived Safety, and Social Influence. Self-efficacy (0.699) and Attitude (0.669) does not meet the criteria level of Cronbach's alpha, however Cronbach's alpha in the case of these two factors deviates slightly lower below the quality level. Thus, we accepted these factors for inclusion in our model. However, Anxiety does not meet the criteria of Cronbach's alpha (0.560) and Rho (0.617) which makes the quality in the case of this factor questionable. Since the results do not differ remarkably from the quality level, and there is no strict rule regarding this, we ran the test in the case of all factors.

Table 1 Quality criteria

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Anxiety	0.560	0.617	0.764	0.523
Attitude	0.669	0.820	0.849	0.739
Effort expectancy	0.726	0.726	0.879	0.785
Intention	0.849	0.850	0.930	0.869
Performance expectancy	0.751	0.762	0.889	0.800
Perceived Safety	0.839	0.873	0.892	0.677
Self-efficacy	0.699	0.741	0.867	0.765
Social influence	0.793	0.801	0.878	0.706

Source: own construction

After carrying out the test we can observe that three out of the seven factors were proven to be significant in the case of intention to use driverless car technology (Table 1). According to the results, Anxiety does not show any remarkable relationship with intention, since its influence (β= –0.081; p=0.115) is quite low and represents a negative linkage with intention. This assumes that Anxiety from using this technology does not have any impact on the individual even if it exists. Although university students may fear the usage of the technology, they tend to use it and vice versa.

We can conclude the same in case of Effort expectancy, because there is no significant relationship towards intention (β=0.020; p=0.672). According to this result, we can suppose that those respondents who perceive significant difficulties in using the technology will also tend to use it in the future. The literature review found this factor to be an important barrier which can hinder usage of certain technologies, however – in case of driverless car – respondents show differing opinions towards the technology, thus the role of this perceptional barrier is not clear and does not influence their intention.

Performance expectancy wasn't found to be relevant either. According to the results, its effect is quite low and does not exert any influence on intention (β=0.034; p=0.551). One could assume that those people who do not believe in increased performance by using self-driving cars also tend to use this technology and vice versa, while the opposite is also true among these respondents.

The fourth factor which was not significant either is Self-efficacy. This construct does not exert any influence on intention (β= –0.025; p=0.546) however it is a widely used psychological factor in behavioral studies. In our case respondents with different levels of self-efficacy also tend to use the technology, whilst those respondents who expressed lower level of intention have different levels of self-efficacy.

Table 2 Impact of investigated factors on intention

			Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (|O/STDEV|)	P Values
Anxiety	→	Intention	–0.081	–0.084	0.051	1.578	0.115
Attitude	→	**Intention**	**0.378**	**0.375**	**0.054**	**7.032**	**0.000**
Effort expectancy	→	Intention	0.020	0.018	0.048	0.423	0.672
Performance expectancy	→	Intention	0.034	0.032	0.056	0.596	0.551
Perceived Safety	→	**Intention**	**–0.222**	**–0.224**	**0.057**	**3.859**	**0.000**
Self-efficacy	→	Intention	–0.025	–0.023	0.041	0.603	0.546
Social influence	→	**Intention**	**0.269**	**0.269**	**0.056**	**4.829**	**0.000**

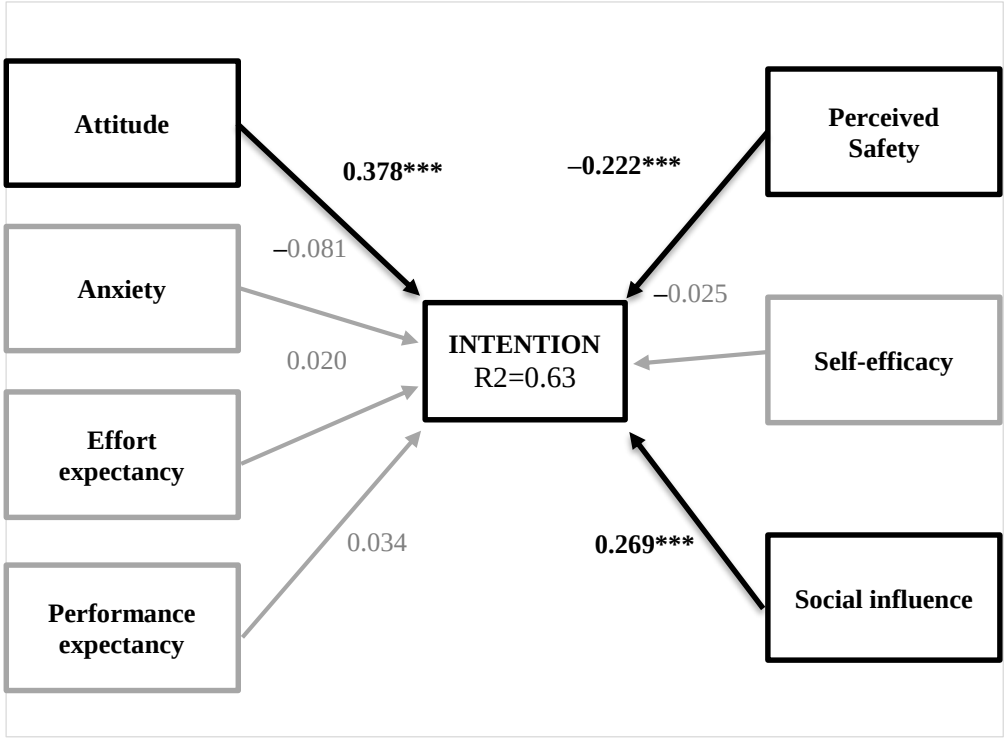
Source: own construction

There are only three factors which were proven significant in our model, and these factors exert strong influence according to the statistical results (see P Values in Table 2). Attitude plays the largest role in the trigger factors, from which it can be assumed that favorable positive Attitude contributes to higher propensity of intention to use the technology. In this case, general opinion regarding technology matters, increasing awareness and creating positive view in the target group, is really important.

Social influence exerts the second highest influence on intention, indicating that the opinion of friends and family members is also important for the individual in this topic. We can assume that if friends and family members express negative opinions relating to the technology, then they do not encourage – or deter – intention to use driverless cars, while those respondents whose friends and family members are supportive, would rather use it in the future.

Perceived Safety has proven the third determining factor in our model which can contribute to intention. These scales were negative scales in our survey thus negative relationship with intention represents that higher perception of danger will lower the propensity of intention and vice versa. If the respondents perceive driverless car as being safe (lower rate on Likert scale) then they will tend to use it in the future. Figure 11 demonstrates the linkages between the factors, Beta coefficients, and the results of the test of significance. This visual representation provides a comprehensive overview of the model with the results.

Figure 11 Impact of investigated factors on intention



Source: own construction

According to the results we can accept H1 and H3, however H2 has been proven as not important in our investigation.

	Hypotheses	Decision
H1	The Car Technology Acceptance Model explains intention to a great extent with the investigated factors.	accepted
H2	Anxiety plays an important role in intention.	rejected
H3	Safety plays an important role in intention.	accepted

6. Conclusion

In this paper we provided a brief overview of driverless car related research in the literature, and demonstrated a framework for scientific investigation. Although in recent decades, various psychological models have been developed for investigating user attitudes and intention to use certain technologies, hopefully these models will be improved in the future for other research purposes and technologies.

We investigated three important topics relating to driverless cars such as awareness, social influence, and safety. In addition, we used Car Technology

Acceptance Model to better understand the impact of the studied factors on user intention to use driverless cars. As the results showed, almost all respondents are familiar with driverless cars and most of them read articles on this topic regularly. Regarding the social influence, driverless cars are not a common topic in conversations with friends and families, however around half of the respondents stated that friends and family members express interest in autonomous cars. Furthermore, respondents have fears of car accidents. The study also investigated the impact of some factors on user intention to drive autonomous vehicles. According to the results, the most important factors are attitude, perceived safety, and social influence. These results suggest that those drivers who will tend to use autonomous vehicle have positive opinions about the technology, perceive the benefits of driverless cars, and receive encouragement from family members and friends to use self-driving cars. Regarding safety, those respondents who do not fear from potential risks of car accidents would engage with the technology. In sum, general opinion, peer influence, and safety play the most important determinants in intention. In order to foster the usage of driverless cars in society, companies should take steps to further improve safety, and communicate this to the target groups.

The respondents represented almost all age groups and the gender distribution was equal, however the distribution of the questionnaire took place mainly on social media channels, which could have had an impact on the results. In order to get more detailed insights into user opinion, further investigations should narrow down the target audience and focus on certain consumer groups who could afford driverless cars. That might lead to other conclusions.

Acknowledgments

The research was supported by the project entitled The aspects of developing a smart, sustainable and inclusive society: social, technological and innovation networks in employment and digital economy with identification number EFOP-3.6.2-16-2017-00007. The project is implemented with the support of the European Union, co-financed by the European Social Fund and the State of Hungary.

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Leadership characteristics that influence corporate efficiency

Annamaria Kazai Ónodi – Rita Répáczki

Economic focus analysis alone cannot answer an organisation's efficiency issues, as the soft attributes associated with management skills and leadership qualities are also important. According to transformational leadership theory (Bass–Avolio 1994, Bass 1990, Judge–Bono 2000, Bass–Bass 2008), there is a transformation between the manager and the subordinate, in which the two parties interact with and affect each other. A joint two-phase study was conducted to investigate the role of management in increasing corporate efficiency. As a first step, financial data of 1752 Hungarian manufacturing firms were analyzed. Companies were grouped according to their TFP (total factor productivity) (Juhász et al. 2020). As a second step, we linked a questionnaire survey to the preliminary TFP categorization. In our questionnaire research, we examined the individual characteristics, qualities, and specialties of leadership practices concerning the economic performance of the organizations. According to our findings, both the individual qualities of the leader and the characteristics of the leadership practice are decisive for the efficiency and results of the organization.

Keywords: leadership, managerial behaviour, TFP, efficiency

1. Introduction

Economic focus analysis alone cannot answer an organization's efficiency issues, as the soft attributes associated with management skills and leadership qualities are also important. According to Syverson (2011), the different productivity of companies can be caused by the different quality of management. Management itself, more specifically its quality, influences profit. Bloom et al. (2010, 2012a, 2012b) conducted an extensive research on 10,000 business organizations in 20 countries, looking, among other things, at the relationship between management and corporate productivity. Based on the performance scoring system for leadership and the performance of companies in the competitive sector, there was a strong correlation between managerial practice scores and work productivity as well as capital efficiency.

Multinational companies adapt their management methods and best practices to their local subsidiaries, which can also be a reason for the productivity differences between domestic and foreign-owned companies. A more developed market and more intense competition force better management practices, but we should not forget that the qualifications of managers also influence the management practices and methods applied.

One study (Czakó et al. 2016) compared 10 case studies of Hungarian-owned companies with high export intensity (Ábel–Czakó 2013) with a quantitative analysis of 4,000 companies (Reszegi–Juhász 2014). The studies confirmed that on the one hand, the background knowledge and experience of the owner or the top manager largely

influence strategy and export performance. On the other hand, encouraging companies to export is not enough by itself. For companies to be competitive or to remain competitive, they need to operate effectively and in addition to generating income and creating value, they need to be able to thrive, innovate, and continually develop.

A joint two-phase study was conducted to investigate the role of management in increasing corporate efficiency. As a first step, the financial data of 1752 Hungarian manufacturing firms were analyzed. Companies were grouped according to their TFP (total factor productivity). (Juhász et al. 2020) This method is based on Reszegi and Juhász's previous researches (Reszegi–Juhász 2014, Juhász–Reszegi, 2017) that presented the multilayer duality characteristic of the Hungarian economy. As a second step, we linked a questionnaire survey to the preliminary TFP categorization. In our questionnaire research, we examined the individual characteristics, qualities and specialties of leadership practices concerning the economic performance of the organizations.

2. Interpretation of leadership effectiveness

There are different definitions for leadership, each of which clarifies one aspect of leadership operation and process. Leadership is defined as the ability to influence the group and direct it towards the intended goals (Judge et al. 2009). Leadership is a structured unit, consisting of the current needs. In leadership, participation is the key and the most important aspect (Bennis 1999). Leadership is said to be a decisive and powerful process in the day-to-day life of an organization, which influences the entire organization through influencing the way of operation, technology, human relationships, and decisions. Leadership is an extremely complex process, as Stogdill (1950) defines: a process in which the leader, influencing the group, ensures the formulation and achievement of goals. According to this interpretation, leadership is such a process in which the leader is able to influence others and make them behave in a specific way. The leadership process typically takes place in a group setting; members of this group are subordinates and followers of the leader; and the leader's goal is to guide the group members towards the goals, whether they are setting goals or achieving them.

There is an interaction between the manager and the subordinates, and leadership can gain space solely through this interaction process. (Burns 1978, Hollander 1992, Jago 1982). One of the interpretations of leadership efficiency says that the key of managerial efficiency is to achieve goals. After the 1980s, this leadership definition was expanded (Pfeffer 1981, Smircich–Morgan 1982, Weick 1995). According to the new point of view, the role of leadership goes beyond reaching goals. Defining organizational reality and goals was said to be the leader's most important task and responsibility. Thereby the leader defines the main direction of the processes, creating order in chaos, setting goals, expectations and frameworks (Grint 2011).

In business life it is particularly difficult to determine what "effective leadership" means. Burns (1978) defines it as a mobilization process that aims to encourage subordinates with different motivations, values, strengths, and weaknesses

to perform. According to Gardner (1995), a leader is one who can influence the behaviour, thinking, and feelings of others through words and personal example. The essence of effective leadership is a balance of performance and satisfaction that creates value for the leader, the organization, and the wider society at the same time. According to the current scientific view, traits do not guarantee managerial effectiveness, yet there is a consensus among different researchers that certain traits can be used to distinguish effective managers from less effective ones (Van Eeden et al. 2008). Ideas about these traits are very diverse. Some see the key to effectiveness in vision-related characteristics (Bennis–Nanus 1985), others trace good performance to emotional factors (George 1995), and many researchers also emphasize the prominent role of interpersonal skills (Balkundi–Kilduff 2005, Hogan–Kaiser 2005).

Trait theory approach (Stogdill 1950, House 1976, House–Jacobsen 2001) strongly emphasizes the importance of leadership qualities and competencies. This approach presumes that the leader's personal qualities are the key of effective leadership. This theoretical framework assigns a prominent role to the leader himself in the leadership process, eliminating other components of leadership (i.e. followers, leadership situation or the leadership process itself) (Kotter 1999, Klein 2002). The main message of the trait theory approach is that it depends on the presence of certain qualities to become an effective leader. According to the concept, these qualities are either innate or not.

However, this approach is worth looking at a little further. Based on the concept of skills theory approach (Katz 1955), leadership competencies can be developed by gaining experience in the leader role. So even if one were not born with the necessary leadership qualities, one can take the chance to acquire them by developing themselves properly. The skill theory approach also considers the leader to be the focus of the leadership process (Northouse 2007), but sees the attributes as variable and upgradeable. If leadership can be learned, more people will have the opportunity to become a leader and even more can become effective leaders.

Although the approach to managerial effectiveness along personality also concluded with a number of valuable research findings, by the early 2000s it became apparent that this approach did not provide an explanation for understanding managerial effectiveness. In addition to managerial characteristics, efficiency is also closely related to the manager-subordinate relationship. This conceptual commitment grounded transactional and transformational leadership theories. These theories were immediately preceded by the results of GLOBE research on leadership, which found that personality traits that characterize a leader act only as mediating variables in leader success and effectiveness (Lord–Emrich 2001). The concepts of transactional and transformational leadership provide a much more realistic theoretical framework for interpreting managerial efficiency. These theories were developed by Burns (1978) and were further developed by Bass (1985). While Burns viewed the two styles as two endpoints of one dimension, Bass declared that transactional and transformational leadership conceptions have already been treated as two separate dimensions, i.e. he believed that a leader could be characterized by both styles to some degree (Judge–Bono 2000).

Leadership process itself ensures the greatest chance of development of a leader. According to transformational leadership theory, the leader and subordinates are in constant relationship with each other, influencing each other. In Burns's concept, transformational leadership is about exploring and harnessing subordinates' motivation to achieve common goals. Thus, in his view, the essence of leadership is not power, but the leadership-subordinate relationship itself (Burns 1978). Burns (1978) distinguishes transformational and transactional leadership. A transactional leader relies on business based on exchanging or dealing with subordinates. (Klein 2002). Depending on the completion of the defined tasks, the transactional leader rewards or punishes. However, the transformational leader already goes beyond this: his goal is to establish a relationship with his subordinates that will increase both the subordinates and the leader's motivation and morale. This type of leader is sensitive to feedback from subordinates and wants to help them make the most of themselves. Such a leader can become much more effective than a leader who cannot go beyond the level of transactional leadership. The transformational leader is able to assess and consider when and where change is needed. This leader constantly develops and adapts himself to meet the changes taking place around him. He is able to activate and mobilize his subordinates for development and needed change (Anderson 1992). This leader is able to think in a system and strive to see things in their own reality. He goes beyond the present status and organizes his own leadership activity in a longer term (Bono–Judge 2004). As its name implies, transformational leadership is a process by which people are constantly transformed. According to Northouse (2007), transformational and transactional leadership are two interrelated concepts, since the concept of transformational leadership encompasses the essence of transactional leadership, somewhat expanding it with modern features of leadership. A transformational leadership style cannot replace the transactional, but can complement it and make it more efficient (Northouse 2007). Transactional leadership style is characterized more by task-oriented behaviour, and transformational leadership style is characterized more by relationship-oriented behaviour (DeRue et al. 2011). Transformational leaders, therefore, act as mediators of social and organizational change over transactional leaders. The theoretical approach that handles the dimensions of transactional and transformational leadership together is commonly referred to as a comprehensive model in the literature (Van Eeden et al. 2008). Transformational leadership is currently the most widely accepted leadership paradigm (Rubin et al. 2005). Research over the past twenty years has most often made leadership effectiveness dependent on transformational leadership style (Judge–Bono 2000), so we can state that this behaviour is considered to be the leadership style best suited to the ongoing market changes of the modern age (Van Eeden et al. 2008).

3. Research method and database

The goal of the research is to test the assumption that different companies' performance is based on different management knowledge, methods, manager characteristics and personal preferences. We aimed to discover the relations among these factors in a joint two-phase study. In the first step, László Reszegi, Péter Juhász

and Miklós Hajdú conducted a comprehensive financial analysis for the period between 2014 and 2017 of Hungarian companies which submit an annual report according to the Hungarian Accounting Standards. The Bisnode company provided a database. The final database contained 5392 companies. (For trends in manufacturing see Juhász–Reszegi 2019 and Juhász 2019.) The second phase of the research focused on the 1725 manufacturing companies involved in the financial analysis. The importance of manufacturing companies is verified by the fact that 55.4% of Hungarian employees and 85.3% of the Hungarian export are related to this sector.

Our research objective is to combine financial performance with soft management factors while maintaining anonymity. Although dealing with this dual goal together was a challenge, forming company groups eventually solved the problem. Reszegi and Juhász (2014) pointed out the double duality of the Hungarian economy. Based on their research it was important to distinguish between foreign and domestic owned companies, exporting and non-exporting companies, and low and high-wage companies, because considering these features revealed significant differences in productivity. Besides these three dimensions, we included TFP (Total Factor Productivity) as the fourth investigative factor in the research. The questionnaire related to this research surveyed the ownership structure and export intensity, therefore, the groups formed were only based on TFP and average wage level. TFP groups were based on cluster analysis and were tested by regression analysis. Juhász et al. (2020) also used the 2016 wage survey data of the Hungarian Central Statistical Office for creating two wage level groups. Manufacturing companies were classified into two groups based on their wage levels and three groups based on TFP, so there were eventually 6 company groups along these two dimensions.

Different codes identified the six groups. A separate questionnaire was constructed for the groups which differed only in one factor that is the corporate group ID code. Using an online questionnaire supported anonymity and facilitated further processing. We examined the characteristics of the company managers, the applied managerial methods and the application of knowledge with the online questionnaire. The study also covered manager motivations, qualities, and preferences. We applied an interdisciplinary approach, combining a financial analysis with information obtained through psychological tools. The questionnaire consisted of 7 question blocks: respondent details, respondent career path, company characteristics, corporate relationships, human resources management, development and decision making.

The online questionnaire was sent to a total of 3970 managers in the manufacturing industry, sorted into six groups. 9.5% of the managers contacted showed initial interest in the questionnaire. 51% of these managers answered all the questions. A total of 197 managerial responses were received. In most companies, only one senior manager completed the questionnaire. Two questionnaires arrived from 13 companies and there were only 3 cases where more than two managers completed the questionnaire. 64.5% of the managers of domestic owned companies responded, while the proportion of responding managers of foreign-owned companies was only 35.5%, which is below the population parameter (49.4%). Based on the number of employees, the majority of respondents (56.8%) belonged to the mid-size category, but small companies (22.4%) and large companies (20.8%) were also

represented in the sample. Slightly more than half (58.9%) of the respondents belonged to the low-wage company category. This is only slightly different from the population parameter (55.6%). 41% of respondents were currently in a managerial position at a high-wage company. More than 67% of the respondents were managers of a company with exports above 25%. 48% of them had an export intensity of 90% or above, so the average export intensity in the sample was 84%. The managers of medium-productivity companies represented the highest proportion (54%) in the survey, this is slightly above the population parameter (46.7%). Managers of companies with low productivity were less likely to respond thus fewer questionnaires (27.4%) arrived from them than expected according to their proportion (44.3%). Although companies with the highest productivity were only represented with 17.8% in our survey, they are still overrepresented in their population (9%). 56% of the respondents are CEOs, managers, 15% are sales managers, 14% are financial managers, 4.6% are production managers, but there are chief accountants, technical directors, quality managers, site managers, office managers and an HR director among the respondents.

In this paper, we focused on explaining the factors behind productivity differences. The starting point of our research was the financial analysis of Juhász et al. 2020. They analyzed the influencing factors of total factor productivity (TFP) with regression analysis. Companies were grouped according to their productivity (TFP). Three clusters have been created. The cluster with the lowest productivity is labelled TFP 1 (TFP value: 10.9). The cluster with the highest productivity is labelled TFP 3 (TFP value: 12.21) and the cluster between these two is TFP 2 (TFP value: 11.42). Significant differences among clusters were verified by correlation and regression analysis. The explanatory power of the regression model (dependent factor: TFP) on the full-sample was 66%. Linked to the Juhász et al. 2020 research we investigated the effect of non-financial factors on productivity. At first, we investigated the individual characteristics of managers (age, gender, educational background, language skills, career path, professional experience). We used an independent samples t-test comparing TFP clusters. Second, factor analysis was used to investigate leadership competence. Finally, we introduced some significant differences among clusters in connection with leadership practices.

4. Results

4.1. Individual characteristics of managers

4.1.1. Age

Several studies address the relationship between top managers' age and corporate performance. (Hambrick and Mason 1984) In our company sample, the average age of the respondents was 50 years. The proportion of corporate executives aged between 41 and 50 was 38%, and it was 28% for managers aged between 51 and 60. An examination of the relationship between the age of the manager and productivity shows that there is an inverse correlation between company productivity and the age

of the manager. (Some other researches have also shown a negative correlation between the age of managers and the profitability of companies. See Belenzon et al. 2019.) The proportion of managers over 61 was the highest (29.6%) in the lowest productivity group (TFP 1), while among the high productivity companies this proportion was only 11.4%. In the case of top managers, the difference was even greater (46% and 18%) (Table 1).

Table 1 Age distribution of managers by corporate productivity (TFP)

	TFP cluster			TFP cluster – only for top managers		
	1	2	3	1	2	3
Age of managers	(n=54)	(n=108)	(n=35)	(n=26)	(n=62)	(n=22)
Between 21–30	0.0%	0.9%	2.9%	0.0%	1.6%	4.5%
Between 31–40	14.8%	14.8%	**20.0%**	7.7%	11.1%	9.1%
Between 41–50	29.6%	41.7%	40.0%	23.1%	34.9%	31.8%
Between 51–60	25.9%	29.6%	25.7%	23.1%	33.3%	36.4%
Over 61	**29.6%**	13.0%	11.4%	**46.2%**	19.0%	18.2%

Source: own constuction

The independent samples t-test did not verify the difference among the TFP groups when the age of the leaders was used as an investigation factor, but in the case of the age group it was confirmed. The correlation analysis also indicated a significant but weak negative relationship. In the lowest productivity cluster, the proportion of the managers who belong to an older generation is significantly higher than in the highest productivity cluster.

4.1.2. Gender

78.7% of the respondents were male and only 22.3% were female. The proportion of female managers in the low TFP group is higher (27.8%) than in the highest TFP group (14.3%). The independent samples t-test also confirmed that the higher the TFP of a company is, the lower the proportion of female executives will be.

4.1.3. Educational background

95% of the respondents had a tertiary level education degree. The proportion of holders of a doctorate / PhD / postgraduate diploma was 6.6% of the total sample. When examining the qualifications of managers by TFP clusters, significant differences can be found. In the highest-productivity company group, the proportion of top managers with university qualifications is over 90%, while in the lowest TFP group this number is only 50%. The independent samples t-test confirmed this difference. There was a 31% correlation between the qualifications of the top managers and TFP. (Table 2)

Table 2 Distribution of manager qualifications by corporate productivity (TFP)

Highest level of qualification	TFP cluster – total company sample			TFP cluster – for top managers only		
	1 (n=54)	2 (n=108)	3 (n=35)	1 (n=26)	2 (n=62)	3 (n=22)
Secondary school diploma	7.4%	3.7%	2.9%	7.7%	3.2%	0.0%
College/bachelor's degree	46.3%	29.0%	25.7%	42.3%	24.2%	9.1%
University/master's degree	42.6%	62.6%	54.3%	42.3%	**66.1%**	**68.2%**
Doctoral degree/PhD/postgraduate degree	3.7%	4.7%	**17.1%**	7.7%	6.5%	**22.7%**

Source: own constuction

4.1.4. Language skills

In the entire company sample, 84% of the respondents were at some level of English and 85% had intermediate-level skills in a certain foreign language. The proportion of managers who do not have any foreign language skills is below 4%, their average age is 55 years. 58% of responding managers had a high level of knowledge (fluent) of at least one language, their average age being 47 years (Table 3).

In a high-productivity group, more than 70% of executives are fluent in at least one language, and there is no top manager who does not have at least a basic knowledge of one language. In the lowest productivity cluster, the proportion of those who have a good command of a foreign language is lower than 50%. However, we cannot claim that the level of the managers' foreign language knowledge directly influences productivity. Further analyses have shown that managers' language proficiency correlates more strongly with the firm's ownership structure than with the firm's productivity. There is a significant correlation between the ownership background and TFP, and between the ownership background and the language proficiency level of the managers. The independent samples t-test verified that the managers at the foreign-owned companies have a higher level of language proficiency than the managers at the domestic-owned firms. Such a clear relationship could not be detected in the different TFP groups.

Table 3 Distribution of managers' language knowledge by corporate productivity (TFP)

	TFP cluster – total company sample			TFP cluster – for top managers only		
	1 (n=54)	2 (n=108)	3 (n=35)	1 (n=26)	2 (n=63)	3 (n=22)
Does not have any language skills	**5.6%**	3.7%	0.0%	**3.8%**	3.2%	0.0%
Has basic knowledge of at least one language	14.8%	11.1%	5.7%	11.5%	11.1%	0.0%
Intermediate or basic knowledge of one or two languages	33.3%	33.3%	22.9%	38.5%	27.0%	27.3%
Advanced knowledge of one or more languages	29.6%	23.1%	42.9%	26.9%	28.6%	45.5%
Advanced knowledge of several languages	16.7%	28.7%	28.6%	19.2%	30.2%	27.3%

Source: own constuction

4.1.5. Career path, professional experience

More than half (57%) of the managers have been working for the same company for more than 10 years. The average length of time spent at their current company in the full sample is 15 years. The longest time was 50 years, where the respondent was 82 years old. The proportion of the managers who joined their current company less than three years ago is below 10%. In the low productivity group (TFP 1), the average time spent at the company was 18 years, while in the highest productivity group (TFP 3) it was 12 years. More than half of the top managers have been at the company for more than 20 years in the TFP 1 group. (Table 4) A negative correlation can be found between the time spent at the company and the productivity of the company. The majority of the executives in each company group has been with the company for more than 10 years. The assumption is that this negative correlation is due to the age of managers. There is a significant (62.6%) correlation between the age of managers and the time spent at the company. Although there is a negative correlation between company productivity and the age of executives (–18.7%) and time spent at the company (–20%), if the partial correlation is considered a control variable, no significant relationship can be detected between the time spent at the company and the productivity.

Table 4 Distribution of time spent by managers at their current company by company productivity (TFP)

	TFP cluster – total company sample			TFP cluster – for top managers only		
	1 (n=54)	2 (n=108)	3 (n=35)	1 (n=26)	2 (n=63)	3 (n=22)
Time spent at the current company: 0–3 years	11.1%	11.1%	2.9%	11.5%	6.3%	4.5%
Time spent at the current company: 3–5 years	9.3%	11.1%	28.6%	0.0%	11.1%	22.7%
Time spent at the current company: 6–10 years	13.0%	21.3%	22.9%	7.7%	19.0%	18.2%
Time spent at the current company: 11–20 years	27.8%	32.4%	28.6%	26.9%	28.6%	31.8%
Time spent at the current company: more than 20 years	38.9%	24.1%	17.1%	**53.8%**	34.9%	22.7%

Source: own constuction

70% of respondents have been in a managerial position for more than 5 years. The proportion of those in managerial positions for 10 years is 45%. (Table 5) In the group with the lowest TFP, more than half of the top managers have been in leadership positions for over 20 years. The proportion is 22.7% in the group of high-productivity companies. The independent samples t-test confirmed the difference. However, it is also true that if we introduce the age of managers as a control variable, there is no significant relationship between productivity and time spent in a managerial position.

Table 5 Distribution of time spent by managers in a managerial position at their current company by company productivity (TFP)

	TFP cluster – total company sample			TFP cluster – for top managers only		
	1 (n=54)	2 (n=108)	3 (n=35)	1 (n=26)	2 (n=63)	3 (n=22)
Less than 3 years	14.8%	13.9%	5.7%	11.5%	11.1%	9.1%
3-5 years	11.1%	14.8%	34.3%	0.0%	12.7%	27.3%
6-10 years	22.2%	27.8%	20.0%	15.4%	23.8%	13.6%
11-20 years	20.4%	27.8%	25.7%	23.1%	27.0%	27.3%
More than 20 years	31.5%	15.7%	14.3%	**50.0%**	25.4%	22.7%

Source: own constuction

Managers have held managerial positions in 2.5 companies on average. 30% of them gained managerial experience only at their current company, 41% at more than two companies. The proportion of managers with managerial experience in more than 5 companies is low at 3.6%. There was no significant difference among the TFP clusters, with the lowest mean (2.39) in the lowest TFP cluster and the highest (2.66) in the middle (TFP 2) cluster (Table 6).

Table 6 Number of companies where the manager has held a managerial position

	TFP cluster – total company sample			TFP cluster – for top managers only		
	1 (n=54)	2 (n=108)	3 (n=35)	1 (n=26)	2 (n=63)	3 (n=22)
1	37.0%	30.6%	17.1%	26.9%	28.6%	9.1%
2	18.5%	27.8%	45.7%	23.1%	22.2%	54.5%
3	22.2%	23.1%	17.1%	23.1%	23.8%	13.6%
4–5	1.9%	4.6%	2.9%	23.1%	17.5%	18.2%
More than 5	1.9%	4.6%	2.9%	3.8%	7.9%	4.5%

Source: own constuction

Given the fact that, for the majority of the companies, whether they are foreign or domestic owned significantly influences the work experience of managers (correlation 68%), it is worth examining this issue separately by ownership structure. Looking at the career paths of the managers at the domestic owned companies, it can be stated that 58% of the managers and 67% of the top managers have gained experience only at domestic-owned companies. Only 30% of managers currently working for domestic-owned companies had their previous job at a foreign-owned company. (Table 7–8) We cannot say that managers who have previously gained work experience with a foreign-owned company would be more successful in managing their company. If we consider the ownership structure as a control variable, we do not find a significant relationship between previous work experience and productivity. 64% of managers currently working for majority-owned foreign firms also had their previous position with a majority-owned foreign company. Neither did we find any significant relationship between corporate productivity and the managers' previous work experience in this group.

Table 7 Distribution of managers in the entire company sample based on previous work experience

	Domestic owned company			Foreign owned company		
	TFP			TFP		
	1 (n=42)	2 (n=70)	3 (n=15)	1 (n=12)	2 (n=38)	3 (n=20)
Has work experience only at domestic owned companies.	**64.3%**	**57.1%**	**46.7%**	0.0%	0.0%	0.0%
Has work experience in a foreign owned company but has not held any managerial position.	14.3%	18.6%	46.7%	0.0%	21.1%	15.0%
Less than 5 years of managerial experience at a foreign-owned company.	9.5%	4.3%	0.0%	8.3%	5.3%	10.0%
5–10 years of top managerial experience in a foreign-owned company.	9.5%	10.0%	0.0%	41.7%	39.5%	15.0%
More than 10 years in a top managerial position in a foreign-owned company.	2.4%	10.0%	6.7%	50.0%	34.2%	60.0%

Source: own constuction

Table 8 Top managers by previous work experience

	Domestic owned company			Foreign owned company		
	TFP			TFP		
	1 (n=20)	2 (n=40)	3 (n=8)	1 (n=6)	2 (n=23)	3 (n=14)
Has work experience only at domestic owned companies.	80.0%	62.5%	62.5%	0.0%	0.0%	0.0%
Has work experience in a foreign owned company but has not held any managerial position.	0.0%	10.0%	25.0%	0.0%	17.4%	7.1%
Less than 5 years of managerial experience at a foreign-owned company.	5.0%	5.0%	0.0%	0.0%	0.0%	7.1%
5–10 years top of managerial experience in a foreign-owned company.	10.0%	10.0%	0.0%	33.3%	34.8%	14.3%
More than 10 years in a top managerial position in a foreign-owned company.	5.0%	12.5%	12.5%	66.7%	47.8%	71.4%

Source: own constuction

4.2. Leadership Competence

4.2.1. Presentation of the Leadership Competence Questionnaire module

In our research we used the Leadership Competence Questionnaire to test the importance of leadership competencies in companies' financial effectiveness. The questionnaire was developed for this research, this was the first time we used it. The development of the items of the questionnaire was based on management models operating with leadership competencies and previous literature results. The Leadership Competence Questionnaire module consisted of 36 items, which we presumably grouped into the following factors: Self-efficacy (7 items), Performance motivation (7 items), Relationship orientation (7 items), Power motivation (7 items), Innovation, Openness (8 items).

4.2.2. Examination of the content structure of the Leadership Competence Questionnaire module by factor analysis

Data were analyzed using SPSS for Windows 26.0. In the first step, exploratory factor analysis was used to process the data obtained during the survey. For exploratory factor analysis, principal component analysis was used by Varimax rotation. Scree-plot test was used to determine the factors (Cattel, 1966). With the help of the Kaiser-Meyer-Olkin (KMO) index, we investigated the suitability of our data for factor analysis. The value of KMO is excellent above 0.9, very good above 0.8, satisfactory above 0.7, and no factor analysis allowed below 0.5 (Ketskeméty et al. 2011, Sajtos–Mitev 2007). The Cronbach-Alpha index was used to examine the internal consistency of the resulting scales, which is acceptable above 0.7, good over 0.8, excellent over 0.9 (Ketskemétyet al. 2011, Schweizer 2011).

Items belonging to the original scales of the original questionnaire were slightly rearranged during the exploratory factor analysis. Based on the answers given by the respondents, not all items that were theoretically scaled remained in their presupposed place. Those items were eventually included in the same groups that were considered to be similar. The main goal of the factor analysis was to see how the items organize themselves.

As the first step of the exploratory factor analysis, we examined how close the variables are to each other, which also shows whether our variables are suitable for conducting factor analysis. The adequacy of the factor analysis is estimated by the Kaiser-Meyer-Olkin (KMO) index, which is 0.853 in our case, and the Bartlett's spherical test, which is significant in $p<0.001$. During the exploratory factor analysis, the items were organized into eight factors, but based on the analysis, five of them proved to be appropriate. As the factors explored beyond these five factors were not appropriate, they were removed. Since we wanted to keep the best items, the factor loading of 0.40 was set as a minimum; and items below were removed. Based on the above factor analysis, items that did not fit were removed from the rest of the analysis, and the remaining items were categorized into five factors.

4.2.3. Reliability analysis of the Leadership Competence Questionnaire module

The five scales were separately tested by reliability analysis: for the first scale Cronbach's Alpha was 0.854; for the second scale Cronbach's Alpha 0.841; Cronbach's Alpha was 0.684 for the third scale, 0.826 for the fourth scale and 0.643 for the fifth scale. Subsequently, by rerunning the factor analysis (KMO=0.857, Bartlett: $p<0.001$), a five-component factor structure was formed, where the explained variance is 57.78%. The first factor is Innovation (Eigenvalue: 9.15; explained variance: 15.36%); the second factor is Power (Eigenvalue: 3.04; explained variance: 12.53% of the total variance); the third factor is Performance (Eigenvalue: 1.97; explained variance: 12.04%); the fourth factor is Problem solving (Eigenvalue: 1.69; explained variance: 9.99%); and the fifth factor is Humaneness (Eigenvalue: 1.49, explained variance: 7.86%). The loading of all retained items for the given factors reached the specified minimum loading of 0.4. After the factor analysis, a new factor reliability test was performed separately for the factors. Cronbach's Alpha values indicate that each scale on the questionnaire reliably measures what we have developed and that the five scales can be considered independent of each other. The Cronbanch's Alpha value indicates a high degree of coherence across all scales. The Cronbach's Alpha value for the complete questionnaire module is 0.899. In the further analysis of the data, the resulting five-component factor structure was considered definitive and this was the basis of the analyses. The scales created and named are shown below.

4.2.4. Presentation of the final version of the Leadership Competence Questionnaire module

Innovation Scale

The Innovation Scale can be interpreted as follows. Those who score high on the scale tend to be open to trying out and applying new opportunities and encouraging their environment to become open to these. These types of individuals are characterized by creativity, the formulation of innovative ideas and the openness to learning and challenges. Situations with change or unknown novelty are inspiring to them. The factor loads of the items included in this scale were between 0.420 and 0.826. (9 items belong to this factor. For example: "I am looking for new possibilities and solutions." "I like to try new things." "I encourage innovation." "I encourage my colleagues to creativity.")

Power Scale

The Power Scale can be interpreted as follows. Those who score high on the scale are characterized by the need to be able to influence situations and strive to be able to do so. They do not like to drift, but rather want to be the makers of situations. They like to win, to convince, to influence and they feel very bad when they cannot. They like situations from which they can come out as winners according to their objective and self-defined subjective aspects. The factor loads of the items in this scale were between 0.530 and 0.840. (7 items belong to this factor. For example: "The greater my influence over the events, the better I feel." "I try to influence the people around me." "I am only calm when things work out according to my plans.")

Performance Scale

The Performance Scale can be interpreted as follows. Those who have high scores on the scale keep meaningful results important. They like to work and always want to be effective and productive. They are willing to do this themselves and expect their environment to do the same. Situations where they can be challenged are inspiring and motivating. They encourage themselves and their environment to win and achieve the best possible performance. Factor loads of the items in this scale range from 0.525 to 0.718. (6 items belong to this factor. For example: "I always achieve my goals." "To achieve my goal, I find the tools even if someone is against me." "I expect productivity and high speed at work.")

Problem Solving Scale

The Problem Solving Scale can be interpreted as follows. Those who score high on the scale are not scared of new or difficult situations but rather find them challenging. They are willing and able to focus on solutions in critical situations, to gather ideas in order to turn the situation into an effective run for a useful output. They can come up with many different solutions and strive to make one of them work. The factor loads of the items included in this scale range from 0.635 to 0.772. (4 items belong to this factor. For example: "I easily get through unexpected situations." "I am a good problem solver." "I always have a suggestion to solve difficult situations.")

Humaneness Scale

The Humaneness Scale can be interpreted as follows. Individuals who deserve high value on this scale are open to people, friendly, and relationship-oriented. They like to talk and they are eager to listen to others. They are interested in problems, thoughts and events in other people's lives. Even when out of work, they are open to connect with their colleagues and others regard them as friendly people. Factor loads of the items in this scale range from 0.527 to 0.740. (4 items belong to this factor. For example: "I often talk to my colleagues about personal things as well." "I am interested in the problems of my subordinates.")

4.2.5. Presentation of TFP clusters along the scales of the Leadership Competence Questionnaire

Differences along the Innovation Factor

Comparing the three TFP clusters along the Innovation scale, we find that there is a significant difference between TFP clusters 1 and 2 ($t = –1.604$; $p<0.05$). This result implies that innovation in TFP cluster 2 is more pronounced than in TFP cluster 1, demonstrating that there is a correlation between innovation and higher economic efficiency. According to our results, organizations with higher efficiency tend to be more willing and open to innovation. Similarly, TFP clusters 2 and 3 were compared along the Innovation scale but no significant difference was found between the two clusters. Comparing TFP clusters 1 and 3, there is also a significant difference along

this factor ($t = –1.058$; $p<0.05$). This result implies that innovation in TFP cluster 3 is more characteristic than in TFP cluster 1, indicating that there is a correlation between greater willingness and openness to innovation with higher efficiency.

Differences along the Power Factor

Comparing the three TFP clusters along the Power scale, we can see that there is a significant difference between TFP clusters 1 and 2 ($t = –0.934$; $p<0.05$). The desire and motivation for power is more characteristic for TFP cluster 2 than for TFP cluster 1. Similarly, we compared TFP clusters 2 and 3 along the Power Scale and found that there is a significant difference between the two groups ($t = –0.522$; $p<0.05$): power is more typical for TFP cluster 3 than for TFP cluster 2. Comparing TFP clusters 1 and 3 with each other, we found that there is a significant difference between these TFP clusters ($t = –1.217$; $p<0.05$). These results indicate that the greater the economic efficiency of an organization, the more the competence of power is typical for the leader. In organizations with greater efficiency, it is more common for a leader to demand the ability to influence situations and to strive to influence processes. These types of leaders prefer to shape the situations rather than adapt. They like to win, to convince, to influence, and they love situations where they feel productive.

Differences along the Performance Factor

We first compared TFP clusters 1 and 2 along the Performance Scale and found significant differences between the two groups ($t = 1.367$; $p<0.05$). Cluster 1 is characterized by the importance of performance, motivation, and effort for good performance. Significant differences were found between TFP cluster 2 and cluster 3 ($t = 0.876$; $p<0.05$), whereas TFP cluster 3 is more motivated by performance. Comparing TFP clusters 1 and 3, we found no significant difference along this scale. From these results, we can conclude that organizations with very low and very high economic efficiency have high motivation for performance and efforts to achieve good performance. For organizations with medium economic efficiency this aspect has been neglected. This is probably due to the fact that low-performing organizations see better performance as the key to efficiency and therefore make efforts. High efficiency groups also consider performance as an important factor in their efforts to achieve good results, which contributes to their efficiency gains; which is why it is important to pay attention to it.

Differences along the Problem Solving Factor

Comparing TFP clusters 1 and 2 along the Problem Solving Scale, we can see that cluster 1 tends to be more problem solving ($t = 1.061$; $p<0.05$), and more active in seeking relevant solutions for problems. Similarly, comparing TFP clusters 2 and 3 with each other, we also found significant differences ($t = –1.760$; $p<0.05$), and we see that cluster 3 is more problem solving than cluster TFP 2. We also compared TFP clusters 1 and 3, where there was not any significant difference, but we found a tendency for TFP cluster 3 to be more problem solving. This result indicates that striving to find solutions to problems and an active willingness to solve problems will most likely lead to a more effective organization.

Differences along the Humaneness Factor

Comparing TFP clusters along the Humaneness Factor, we found significant differences between clusters 1 and 2 ($t = 1.319$; $p<0.05$). Based on this result, we found that the relationship-oriented characteristics of leadership are more typical of cluster 1. Comparison of TFP cluster 2 and cluster 3 also showed differences between the clusters ($t = –2.254$; $p<0.05$) and we found that the humane characteristics of leadership are more typical of cluster 3. Comparing TFP clusters 1 and 3 along this scale, we found that cluster 3 has more humane management characteristics than cluster 1, and the difference is significant ($t = –1.065$; $p<0.05$). The highest value along this managerial competence was found in TFP cluster 3. This is followed by cluster 1, then cluster 2, which suggests that high human competence on behalf of the leader results in a more efficient economic operation at the organizational level. Even in the group with low economic efficiency, there is a relatively high level of human competence of the leader that means a relatively high openness to subordinates. Thus, human competence is most strongly mobilized by organizational results that indicate extreme (low or high) economic efficiency.

The results obtained show that the leader's human competencies correlate with the economic efficiency of the affiliated organization. In general, the characteristics examined are the parameters of leadership efficiency and competencies that provide feedback on the effectiveness of a leader. Based on the results obtained, we can see that along with the majority of important managerial competencies, management groups that operate in economically more efficient organizations show greater value. Our results show that organizations with higher efficiency tend to be more inclined and open to innovation. We have also seen that in more efficient organizations, the leader is more likely to demand the ability to influence situations and to strive to influence the development of processes. We have also seen that high-efficiency groups see performance as an important factor in their efforts to achieve good results, which contributes to their efficiency gains. The willingness to solve problems and active solution seeking will certainly lead to more effective organizational work. Our results also show that high human competence on behalf of the leader leads to more efficient economic operation at the organizational level.

4.3. Leadership practices

Success factors according to managers, HR management, and factors that encourage and promote change were also investigated in the questionnaire survey. Managers were asked to only evaluate the five most important factors on a 10-point Likert-scale. The frequency of factor selection and the value were multiplied and compared to the total value, thus forming an indicator of the relative importance of the given factor. There were significant differences among different TFP clusters. In this paper we only focus on the most important factors.

The less productive companies (TFP 1) considered increasing domestic market share and being a supplier of a multinational company as a success factor in the highest proportion, The most productive companies' (TFP 3) production technology seemed to be better than in the other two clusters, even though

technological investment was the most important success factor in the TFP 1 cluster. Building a motivated, innovative team was more important in the TFP 3 cluster than in the other two clusters (Table 9).

Table 9 Relative importance of success factors over the last three years by company productivity (TFP)
(12 factors were compared, the average rate was 8. 33%)

	TFP 1 (n=54)	TFP 2 (n=108)	TFP 3 (n=35)
We have increased our domestic market share.	**10.4%**	8.9%	7.0%
We are an audited, qualified supplier of a multinational company.	**11.0%**	7.3%	6.4%
We have made significant technological investments affecting at least 5 percent of our production.	**16.9%**	15.7%	14.5%
The technological quality of our production equipment is better than that of our competitors.	5.8%	8.7%	**9.5%**
We have built a motivated, innovative team.	10.3%	13.2%	**15.2%**

Source: own constuction

The majority of managers emphasized the importance of increasing the efficiency of the workforce. Its proportion was the highest in the lowest productivity group (TFP 1). The higher wages and employee training characterized the productive company group more than the other two clusters.

Table 10 Relative importance of characteristics of HR management by company productivity (TFP)
(10 factors were compared, the average rate was 10%)

	TFP 1 (n=54)	TFP 2 (n=108)	TFP 3 (n=35)
We strive to make our company attractive to the labor market by paying wages above the industry average.	5.9%	6.4%	**11.2%**
We continuously develop the skills and abilities of our employees.	9.8%	9.8%	**13.3%**
Our goal is to increase the efficiency of the workforce.	**18.4%**	17.1%	15.0%

Source: own constuction

Considering customer needs during development is decisive in all groups. Responding to consumer needs is not enough to succeed. The most productive companies (TFP 3) relied on employee suggestions more than imitated competitors. Although the proportion of "purchase (license, procedure, product, brand) or cooperation with an external research institute" is one of the lowest encouraging

factors in all clusters, there are significant differences. Purchasing and cooperation characterized the highest productivity group more than the two other groups.

Table 11 Relative importance of factors that encourage and promote change by company productivity (TFP)
(10 factors were compared, the average rate was 10%)

	TFP 1 (n=54)	TFP 2 (n=108)	TFP 3 (n=35)
Customer needs and suggestions	**22.6%**	21.4%	20.6%
Competitor analysis (from flyers, public information, customers, comparative testing).	11.3%	**12.8%**	6.7%
Purchase (license, procedure, product, brand) or cooperation with an external research institute.	0.8%	1.8%	**3.7%**
Internal initiative, based on a proposal from a company employee.	12.3%	14.5%	**16.3%**

Source: own constuction

5. Conclusion

A leader's competencies, attitudes, and behavioural qualities are critical to the economic performance of an organization. Our goal was to test the assumption that different companies' performance is based on different management knowledge, methods, the managers' characteristics, and personal preferences. We conducted a joint two-phase study, linked to Juhász et al. 2020 research. The companies were grouped by their total factor productivity, based on financial analysis. Among the individual characteristics of managers, the educational background proved to be the most influencing factor. Competencies examined are considered to be key factors and show a current state of both managerial and organizational effectiveness. The innate qualities of a leader are decisive for the development of leadership efficiency, but it is a fact that leadership can be learned on the basis of competencies. This means that innate leadership qualities show spontaneous development through situations experienced and hardship endured. Accordingly, leadership is a human characteristic based on life-long development. This spontaneous development can be enhanced and facilitated by the individual through targeted training, either individually or in a group setting, as these external influences, especially in the field of behaviour, can generate changes that gradually make the leader more effective in his or her leadership role. This means that the leader is never "ready". Every new situation, every new problem can be an opportunity and compulsion to reach another level of development if the leader wants to remain effective in his or her leadership role all the time.

Acknowledgements

Project no. NKFIH-869-10/2019 has been implemented with the support provided by the National Research, Development and Innovation Fund of Hungary, financed under the "Tématerületi Kiválósági Program funding scheme."

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Chapter II

Financial issues

Udvari B. (ed) 2020: Proceedings of the European Union's Contention in the Reshaping Global Economy. University of Szeged, Doctoral School in Economics, Szeged, https://doi.org/10.14232/eucrge.2020.proc.5

Measuring monetary policy in emerging economies: the role of monetary condition index

Bui Thanh Trung

Measuring the stance of monetary policy is of importance for the analysis and implementation of monetary policy. The existence of multiple instrument framework as well as the significance of the interest rate and exchange rate channel in emerging economies imply that monetary condition index can play an important role in evaluating whether monetary policy is restrictive or expansive in these economies. In this paper, we use the VAR model to evaluate the role of monetary condition index as an overall measure of monetary policy in emerging economies. The weight of components of monetary condition index is derived from the inflation equation in the VAR estimation. The empirical results suggest that a contraction in monetary policy causes a reduction in inflation. The finding implies that monetary condition index is a useful indicator that can predict the stance of monetary policy and predict the trend of inflation in emerging economies.

Keywords: monetary policy, monetary condition index, inflation targeting, emerging economies

1. Introduction

Effective implementation of monetary policy is necessary to achieve good economic performance. However, to steer the economy effectively, monetary authorities need to have a good assessment of monetary policy stance, which depends to a great extent on the selection of a measure of monetary policy. A good measure of monetary policy is an indicator that can provide numeric information about size and direction of policy actions. In addition to this, measuring monetary policy is the first step in investigating further issues of monetary policy such as reaction function or transmission mechanisms.

Compared to advanced economies where interest rate is the primary operating target (Egan–Leddin 2016), emerging economies have high exposure to international shocks such as sudden increases in oil or commodity prices. The high openness of emerging economies indicates that changes in official interest rate instrument can alter exchange rate, which then influences the relative price of domestic and foreign goods, imports, and finally aggregate demand and inflation. As emerging economies have achieved a higher level of financial development over the last decade, interest rate and exchange rate play a more important role in the conducting of monetary policy. These imply that both interest rate and exchange rate channel are active in emerging economies (Poon 2010). Hence, in emerging economies, a good measure of monetary policy should consider changes in both interest rate and exchange rate.

Monetary condition index (MCI), a weighted average of changes in interest rate and exchange rate relative to a reference period, is a common composite measure of monetary policy, especially in open economies (Goodhart–Hofmann 2001, Osborne-Kinch–Holton 2010). Changes in MCI depict whether monetary policy is in contractionary or expansionary condition (Osborne-Kinch–Holton 2010). The use of MCI is attractive for both foreign and domestic institutions and agents. Since MCI accounts for the two primary transmission channels of monetary policy (Hyder–Khan 2007, Osborne-Kinch–Holton 2010), it provides an important device to analyse and understand the general condition of a small and open economy and policy making (Ericsson et al. 1998, Zulkhibri 2012).

Although the idea of using a composite measure of monetary policy is not new in the literature, there is only a limited number of studies investigating the application of MCI in emerging economies, especially Asian, South American, or African countries. The purpose of this paper is to fill the gap by investigating the role of MCI in measuring monetary policy in emerging economies. In doing so, it contributes to the literature in many aspects. First, it provides empirical estimates of MCI for emerging economies where there are many reforms in monetary policy framework and financial systems. The analysis also provides information about the relative importance of the two channels, interest rate and exchange rate, in emerging economies that follow inflation targeting. Second, it examines the effectiveness of monetary policy in controlling inflation when using MCI as an indicator of monetary policy. Therefore, the study sheds light on the role of MCI in informing the public about monetary condition in emerging economies.

The rest of this paper is as follows. Section 2 presents the existing literature about the construction and basic characteristics of MCI and empirical evidence about the effectiveness of MCI as an indicator of monetary policy. Section 3 discusses methodology and data. Section 4 presents and discusses empirical results. Section 5 concludes the paper.

2. Literature review

2.1. Monetary condition index as a measure of monetary policy

MCI was initially used as an operational target by the Bank of Canada in the late 1980s (Eika et al. 1996, Ericsson et al. 1998, Majid 2012) and then gained more popularity in the 1990s. It is the weighted average of changes in interest rate and exchange rate relative to a reference period. Such a construction implies that MCI captures the movement in the two primary transmission channels to measure the stance of monetary policy (Hyder–Khan 2007). This construction is preferable because both interest rate and exchange rate are two operative transmission channels of monetary policy in a small and open economy (Batini–Turnbull 2002, Qayyum 2002). According to monetary theories, when monetary authorities alter the official interest rate, money market interest rate changes, to in turn affect the behaviour of investment and spending and finally aggregate demand and inflation. However, it should be noted that in emerging economies with flexible exchange rate regime,

changes in the official interest rate also cause changes in the value of domestic currency. The resulting changes in the exchange rate affect the competitiveness of domestic export and import, leading to changes in the price of imported goods and hence aggregate demand and inflation. The transmission from exchange rate to inflation depends on many factors (Hyder–Khan 2007). The presence of the exchange rate channel can magnify or lessen the contractionary stance of changes in the interest rate. In sum, monetary authorities can alter interest rate and exchange rate instruments to stabilize prices in an emerging economy. As a result, observing the two as separate indicators may provide misleading information about expected changes in the stance of monetary policy and the future movement of inflation. To put it differently, a composite measure of monetary policy that captures both channels can give a more accurate representation of monetary policy stance (Batini–Turnbull 2002, Hataiseree 1998, Hyder–Khan 2007).

According to Batini and Turnbull (2002), MCI can be used as an operational target, as an indicator of monetary policy or as a monetary policy rule. Firstly, as an indicator of monetary policy, MCI depicts the movement of both interest rate and exchange rate (Poon 2010) and signals the timing of the expansion and restriction of monetary policy (Şıklar–Doğan 2015). This function is highlighted for many countries such as Nordic countries (Gerlach–Smets 2000), Thailand (Hataiseree 1998), Turkey (Kesriyeli–Kocaker 1999), Croatia (Benazić 2012), Pakistan (Hyder–Khan 2007), Sweden and Norway (Eika et al. 1996, Engelbrecht–Loomes 2002). Secondly, MCI can be used as an operational target. The central bank of Canada and New Zealand utilizes this capacity of the index (Engelbrecht–Loomes 2002, Ericsson et al. 1998) because they believe that exchange rate can affect inflation through its impact on import prices (Gerlach–Smets 2000). In this case, the central bank can use monetary policy tools to move the MCI to the desired level (Osborne-Kinch–Holton 2010). With this function, the desired MCI should be consistent with the objective of monetary policy such as price stability (Osborne-Kinch–Holton 2010, Qayyum 2002). Finally, MCI can be used as a monetary policy rule. This requires the rearrangement of the interest rate to construct the parallel between the interest rate and exchange rate (Batini–Turnbull 2002). The idea is supported by Us (2004) in the case of Turkey.

However, the use of MCI as an operational target can cause difficulties for the practical implementation of monetary policy (Eika et al. 1996, Engelbrecht–Loomes 2002). Firstly, many difficulties emerge because interest rate is a monetary policy tool whereas exchange rate is a macroeconomic outcome (Osborne-Kinch–Holton 2010). Such a conflict may cause confusion when monitoring or adjusting the movement of MCI. Secondly, MCI may provide ambiguous communication with the financial market when there is a negative relationship between interest rate and exchange rate (Engelbrecht–Loomes 2002). If the depreciation of the exchange rate causes inflation whereas interest rate cuts reduce inflation, it is difficult to interpret the effect of monetary policy changes on the economy and inflation. The transparency issue forced the Reserve Bank of New Zealand to replace MCI by an official cash rate in March 1999. Thirdly, changing MCI requires an understanding of drivers underlying changes in the exchange rate (Engelbrecht–Loomes 2002, Ericsson et al. 1998, Gerlach–Smets 2000). If the exchange rate is affected by changes in supply and

demand, it is optimal to adjust the target of MCI. On the other hand, if exchange rate is affected by other shocks, it is optimal to maintain the current MCI and adjust the interest rate. Caution when using MCI as an operating target is intensified when the terms of trade has substantial effects on exchange rate movement (Gerlach–Smets 2000).

Since using MCI as an operational target causes difficulties for the implementation of monetary policy, using MCI as an indicator of monetary policy is gaining more attention (Hyder–Khan 2007, Osborne-Kinch–Holton 2010). It should be noted that with this function, MCI can provide more information about the current status of monetary policy stance. In this case, monetary authorities do not need to change their tools to return MCI to its desired path.

It should also be noted that short-term interest rate is a good measure of monetary policy when monetary policy effectively operates through the interest rate channel. Since the effectiveness of the interest rate channel depends on the existence of a well-functioned financial market, the role of interest rate as an indicator is crucial for advanced economies. For emerging economies, financial systems are still underdeveloped even though there have been substantial improvements and liberalization in financial systems over the last few decades. Therefore, the interest rate channel remains weak in emerging economies. Furthermore, compared to advanced economies, the exchange rate channel plays a more important role in emerging economies. The importance of the exchange rate is conditional on the high degree of openness in the emerging economy. Moreover, foreign exchange intervention can be a policy option when capital flows are volatile (Goyal 2016). According to Osborne-Kinch and Holton (2010), MCI rather than interest rate is a better indicator of monetary policy when the exchange rate plays an important role in the transmission mechanism.

Another reason supporting the indicator function of MCI is that monetary authorities in emerging economies use multiple instruments to influence the movement of output or prices. It is common for monetary authorities to change many instruments at the same time or at two very close points of time. Changes in interest rates may provide little information about changes in monetary policy (Egan–Leddin 2016, He–Pauwels 2008, Ma 2014). Consequently, observing changes in only interest rate can provide misleading interpretation about the intention of monetary policy. On the other hand, MCI can provide more information about changes in monetary policy. According to Egan and Leddin (2016), MCI can be considered as an accurate representation of various monetary policy instruments.

2.2. Empirical studies on the use of MCI

The literature examining the construction of MCI is extensive for advanced economies. Freedman (1994), Freedman (1995), Peeters (1999), and Ericsson et al. (1998) are seminal papers that provide excellent explanations of the calculation of monetary condition index. Gerlach–Smets (2000) argue that the construction of MCI requires little weight on the exchange rate, which is associated with its effect on aggregate demand. Osborne-Kinch and Holton (2010) examine the role of MCI for the Euro zone, the UK, and the US from 1999 to 2009, and find that the index can be

used as a timely indicator of monetary policy stance. However, they note that the index copes with the uncertainty caused by its estimation and interpretation. Similarly, Batini and Turnbull (2002) survey the case of UK from 1984 to 1999 and conclude that MCI can be used as an indicator of monetary policy.

However, the literature for small and open economies is rather limited. Furthermore, the literature for emerging economies mainly focus on the construction of the MCI and a few studies investigate the role of MCI in fulfilling the ultimate objective of monetary policy. Qayyum (2002) take into account the openness of emerging economies when constructing the MCI for Pakistan. The author defines MCI by summarizing the deviation of two quantitative variables, the interest rate and the exchange rate, from the base period. The author determines the weight of the two MCI components by their relative importance in the inflation equation. Therefore, the construction of the MCI involves the estimation of a system of a Philipps curve and a reaction function. Hyder and Khan (2007) use Johansen cointegration method to determine weights of components in MCI for Pakistan over the period March 1991 to April 2006. They use both price and output equation to calculate the weights of interest rate and exchange rate and find that the importance of the exchange rate is model-dependent. While the interest rate has a greater effect on prices, the exchange rate has a greater effect on output. However, their findings show that two MCIs calculated from the two equations show a strong co-movement. Moreover, deviations between MCI and interest rate show a reduction after September 2001. With respect to the usefulness of MCI in the implementation of monetary policy, MCI can be considered as an important indicator of monetary policy and can be used alongside other indicators. Hyder and Khan (2007) do not support the use of MCI as an operational target.

Benazić (2012) combines effects of both interest rate and exchange rate to determine MCI for Croatia. The author constructs the index by using the Engle–Granger co-integration method since variables of interest are cointegrated, meaning that they are stationary at first difference and their linear combination is stationary. The weight derived from the price equation suggests that the exchange rate is more important than the interest rate. The finding suggests that the feasible function of MCI is as an indicator of monetary policy. One factor that constrains the use of the index as a monetary policy instrument is the liberalization of international financial flows and the widespread use of the euro in Croatia.

Berument (2007) argues that monetary authorities in a small and open economy such as Turkey cope with the problem of currency substitution and the fear of floating, and that monetary authorities can use both interest rate and exchange rate to fulfil the objective of price stability. Therefore, monetary policy should be measured by an index that captures changes in both instruments. Berument (2007) introduces a new measure which is the differential between the interbank interest rate and the depreciation rate. This implies that the exchange rate and interest rate have equal weights in the construction of MCI. If the spread is positive, monetary policy is restrictive; otherwise, it is expansive. Using this measure, Berument (2007) finds that the response of output, prices, and exchange rates to restrictive monetary policy is consistent with the theory. Other studies construct the traditional MCI for Turkey, but

the relative importance of exchange rate and interest rate is different depending on the methodology of weight calculation and research period. Kesriyeli and Kocaker (1999) derive the weight of MCI components from the price equation and conclude that the exchange rate is the principal source of price fluctuation in Turkey over the period 1987–1999. They urge caution in using MCI in the analysis and implementation of monetary policy. Nevertheless, Şıklar and Doğan (2015) emphasize the time-varying characteristic of the MCI weights over the period 1992–2012 and conclude that the interest rate is more important than the exchange rate. The reduction in the importance of the exchange rate may stem from development in the financial system in Turkey, which has strengthened the effectiveness of interest rate policy.

Memon–Jabeen (2018) use the Principal Component Analysis to compute the weight and the MCI and use a vector autoregression (VAR) model to investigate the effect of MCI in Gulf countries – Bahrain, Iraq, Kuwait, Oman, Qatar, the Kingdom of Saudi Arabia (KSA), and the United Arab Emirates (UAE). They find that MCI rather than interest rate or exchange rate is a good device to predict prices and economic growth in the long run. Moreover, monetary authorities can use MCI to access the expansionary and contractionary condition for Gulf countries. Kannan et al. (2007) add credit growth to the construction of MCI for India. They note that interest rate is more powerful than exchange rate in affecting economic activity and inflation. Furthermore, MCI is better than any single component in representing the stance of monetary policy in India.

Hataiseree (1998) constructs MCI with weights derived from inflation model and emphasizes the advantage of MCI as an indicator of monetary policy in the short run in Thailand. The author uses autoregressive distributed lagged model to estimate the inflation equation. The finding emphasizes the significance of MCI relative to either exchange rate and interest rate. The study also finds that the correlation between MCI and inflation is high. Therefore, MCI plays an important role in the conducting of monetary policy.

Poon (2014) augments the traditional MCI with financial variables such as changes in credit, share prices, and long-run interest rate. The author uses the ARDL bound test to prove the existence of the long-run relationship between GDP and its determinants which include components of MCI. The finding shows that exchange rate plays a very important role because the ratio of exchange rate over interest rate is 11.89. However, the high ratio indicates that monetary authorities in Philippines may put a great emphasis on exchange rate rather than the objective of price stability.

3. Methodology and data

3.1. Measuring MCI

Selecting an appropriate measure is of great importance in evaluating the stance of monetary policy. As an indicator of monetary policy, MCI indicates whether monetary policy is contractionary and expansionary. Following previous studies (Batini–Turnbull 2002, Benazić 2012, Ericsson et al. 1998, Freedman 1994, 1995, Peeters 1999), we determine MCI using the following equation:

$$MCI_t = \beta^{INT}(INT_t - INT^b) + \beta^{EX}(DLNEX_t - DLNEX^b) \quad , \quad \beta^{INT} + \beta^{EX} = 1 \qquad (1)$$

where $DLEX_t$ is the first difference of the logarithm of the nominal effective exchange rate. An increase in EX_t reflects the appreciation of the domestic currency. INT_t is the short-term interest rate. It is a proxy for policy rate because it is closely linked and quickly responds to the central bank policy rate (Osborne-Kinch–Holton 2010). According to Equation 1, an increase in interest rate or an appreciation of exchange rate indicates a higher value of MCI, which suggests the restrictiveness of monetary policy.

As shown in Equation (1), the estimate of weights of MCI components is important in calculating MCI. Since MCI weights reflect the relative importance of the exchange rate and interest rate channel in the transmission mechanism of monetary policy and in influencing the objective of output or inflation (Hyder–Khan 2007, Şıklar–Doğan 2015), their estimates require modelling the objective of monetary policy (Qayyum 2002). This implies that the weight of the two MCI components can be derived from their relative impact on aggregate demand (Egan–Leddin 2016, Ericsson et al. 1998, Gerlach–Smets 2000, Knedlik 2006, Majid 2012, Poon 2010) or prices (Hataiseree 1998, Kesriyeli–Kocaker 1999, Qayyum 2002) or both (Hyder–Khan 2007). Generally, the exchange rate weight derived from the price equation is greater than the weight derived from aggregate demand equation because the calculation combines the direct effect of the exchange rate on import price and the indirect effect of the exchange rate on aggregate demand (Kesriyeli–Kocaker 1999). In addition, the weights can also be the coefficient of variance (Egan–Leddin 2016). According to Peeters (1999), the ratio β^{INT}/β^{EX} depends on the degree of the openness of the economy under investigation. For small and open economies, the weight on exchange rate may be larger than the weight on interest rate, which opposes large and closed economies where the weight on the exchange rate is negligible (Knedlik 2006). Because price stability is the objective of monetary policy in emerging economies investigated in this paper, we measure the weight of MCI components by the price elasticity to interest rate and exchange rate. Following previous studies (Hataiseree 1998, Kesriyeli–Kocaker 1999, Qayyum 2002), we measure MCI weights as follows:

$$p = \alpha + \alpha^{INT} INT_t + \alpha^{EX} DLEX_t + \alpha^{y} Y_t \qquad (2)$$

where p_t is price. Y_t is output, which is a control variable.

The weight of interest rate (β^{INT}) and exchange rate (β^{EX}) are calculated as follows:

$$\beta^{INT} = \frac{\alpha^{INT}}{\alpha^{INT} + \alpha^{EX}} \tag{3}$$

$$\beta^{EX} = \frac{\alpha^{EX}}{\alpha^{INT} + \alpha^{EX}} \tag{4}$$

The existing literature (Batini–Turnbull 2002, Şıklar–Doğan 2015) suggests three basic methods to estimate the MCI weights: single equation, trade elasticities equation, and the system of equation such as cointegration and VAR. The first method estimates the MCI weights by coefficients from either price or output equation. The second method estimates the elasticity of trade share (export expressed as the percentage of GDP) to exchange rate and interest rate. The final method extracts coefficients of exchange rate and interest rate in the corresponding equation, either output or prices, in the system.

The paper uses the VAR model to estimate the elasticity of inflation to interest rate and exchange rate. The choice of VAR is of importance to take into account certain issues that emerge in the estimation of the MCI weights: the endogenous relationship between regressors, the problem of simultaneity biasedness, and the lagged effect of exchange rate and interest rate on inflation. In particular, we sum all coefficients that are statistically significant.

3.2. Measuring the effect of monetary policy

To examine whether MCI is an appropriate indicator of monetary policy, we focus on the significance of the inflation response to MCI shocks and the absence of price puzzle in their impulse response. For this purpose, we use a VAR model of five variables as follows:

$$Y_t = [DLCOM, MCI, DLNEX, DLCPI, DLY]' \tag{5}$$

Where MCI is the monetary conditions index determined by weighted average of changes in exchange rate and interest rate from the value of previous year. The weights are derived from their estimated coefficients in the inflation equation.

It should be noted that the VAR model is recursive with the ordering specified in Equation (). The ordering indicates that MCI has a contemporaneous effect on inflation and other economic variables. On the other hand, inflation, output, and exchange rates have an effect on monetary policy with lags.

3.3. Data

We focus on ten emerging economies: Brazil, Colombia, Mexico, Hungary, Poland, Romania, Turkey, Korea, Philippines, and South Africa. These countries adopted the inflation targeting framework after the 1990s. The sample contains monthly data from January 2000 to June 2018. IMF and national central banks are the primary sources of the data.

Table 1 presents basic statistics, mean and standard deviation, of inflation, output growth, exchange rate growth, and interest rate in emerging economies under investigation. As observed, inflation fluctuated in the range from 2% to 5% in most emerging economies. In Turkey, the inflation rate reached a double digit high of 12.56%. On the other hand, Brazil and Romania experienced moderate inflation at 6.29% and 7.43% respectively. Output growth was quite similar between emerging economies. Compared to other countries, output growth was relatively low at about 1% in Brazil and South Africa. Furthermore, exchange rates growth was negative in most countries with the exception of Poland, suggesting the depreciation of the domestic currency over the research horizon.

Table 1 Mean and standard deviation of selected variables

	Inflation	**Output growth**	**Exchange rate growth**	**Interest rate**
Brazil	6.29	0.81	–2.09	13.70
	(2.56)	(6.41)	(15.91)	(4.44)
Colombia	4.77	2.19	–0.61	6.43
	(1.81)	(5.48)	(10.75)	(2.52)
Mexico	4.26	0.78	–4.06	6.95
	(1.07)	(3.77)	(8.4)	(3.57)
Hungary	3.96	2.41	–0.49	5.88
	(2.61)	(8.47)	(5.7)	(3.25)
Poland	2.14	4.95	0.28	7.12
	(1.81)	(5.88)	(8.51)	(5.27)
Romania	7.43	4.10	–4.02	7.60
	(7.75)	(6.52)	(9.02)	(5.54)
Turkey	12.56	5.59	–11.25	20.54
	(10.96)	(8.96)	(17.87)	(33.02)
Korea	2.53	4.23	–0.23	3.18
	(1.19)	(6.98)	(9.63)	(1.24)
Philippines	3.76	2.31	–1.36	5.25
	(1.94)	(10.33)	(6.22)	(1.73)
South Africa	5.21	0.90	–3.97	8.07
	(2.72)	(5.5)	(14.2)	(2.55)

Source: Author's estimation
Notes: Standard deviation is in the parentheses; otherwise, it is mean.

Table 2 presents the ADF test for stationarity of the logarithm of commodity price index, industrial production index, consumer price index, nominal effective exchange rate, and money market rate. The superscript (a) indicates the stationarity

test at level; otherwise, the test is for first difference. Accordingly, the results indicate that interest rate is likely to be stationary at level in Colombia and South Africa. In other countries, interest rate is stationary at first difference. For other variables, it is stationary at first difference for most cases and just achieve stationarity at level in a few cases, superscript (a). In a nutshell, variables enter the VAR model in its first difference. However, in line with previous studies, interest rate enters the regression model in its level form.

Table 2 ADF test for the stationarity of variables

	LCOM	LY	LCPI	LNEX	INT
Brazil	–7.32*	–7.65*	–6.39*	–9.37*	–5.02*
Colombia		–12.23*	–7.60*	–9.64*	–3.08**(a)
Mexico		–10.49*	–8.51*	–9.58*	–9.64*
Poland		–10.54*	–3.16**(a)	–9.67*	–11.1*
Czech Republic		–14.07*	–8.76*	–3.48*(a)	–5.26*
Turkey		–11.11*	–5.86*(a)	–4.58*(a)	–6.91*
Korea		–11.62*	–4.05*(a)	–7.82*	–5.59*
Philippines		–13.13*	–3.62*(a)	–7.96*	–6.21*
Thailand		–8.64*	–6.36*	–3.12**(a)	–8.37*
South Africa		–8.25*	–7.40*	–9.91*	–2.58***(a)

Source: Author's calculation

Notes: The table describes stationarity tests at first differences. (a) indicates variables are stationary at level. The optimal lag is selected by AIC criterion. *, **, *** indicates the significance at 1%, 5%, and 10% respectively.

4. Empirical results

The paper estimates the relative importance of exchange rate and interest rate in MCI by the VAR model. Since the two variables have a delayed effect on the present value of inflation, it is important to evaluate the size and significance of estimated parameters in the price equation at different lag orders. Table 3 summarizes all the statistically significant coefficients of the two channels and the corresponding lag specified in the parentheses. As observed, exchange rate and interest rate have a statistically significant effect on inflation at different time. For instance, in Brazil, the exchange rate effect on inflation is significant at first, second, fourth, fifth, and seventh lag, whereas the effect of interest rate on inflation is statistically significant at first and second lag. On the whole, interest rate affects inflation with shorter lag than exchange rate. For most of the cases, the elasticity of inflation to changes in exchange rate and interest rate has the expected sign and is consistent with most theoretical models. The results indicate that exchange rate and interest rate parameters are economically meaningful.

Table 3 Coefficients on interest rates and exchange rates

	Variable	Estimated parameters
Brazil	EX	(1)–0.01*, (2)–0.01**; (4) –0.01**; (5)–0.01**; (7)–0.01***
	INT	(1)0.16*; (2)–0.22***
Colombia	EX	(1)–0.02**; (5)–0.02*; (7)–0.01***
	INT	(2)0.18***
Mexico	EX	(3)0.02***; (12)–0.02**; (13)0.02**
	INT	(12)0.13**
Hungary	EX	(5)–0.04**
	INT	(6)0.14**; (8)–0.09**
Poland	EX	(1)–0.03*; (5)–0.02**
	INT	(1)–0.08***; (2)0.12**; (8)–0.07**
Romania	EX	(1)–0.06**
	INT	(1)0.07**; (6)0.06**
Turkey	EX	(1)–0.05*; (3)–0.03***; (4)–0.04*; (7)–0.03**
	INT	(1)0.12*; (2)–0.13*; (3)0.08**; (7)–0.06***
Korea	EX	(2)–0.03**; (5)–0.02***
	INT	(1)0.41***
Philippines	EX	(1)–0.03***; (2)0.03***
	INT	(1)0.21**; (6)0.27***
South Africa	EX	(1)–0.02**; (4)–0.02*; (7)–0.02**
	INT	(1)0.4**; (2)–0.44***; (6)–0.48***; (7)0.56**

Source: Author's estimation. Notes: significant lag order is in the parentheses. ***, **, * denote significance at 10%, 5%, and 1%, respectively.

Table 4 shows the weight of interest rate and exchange rate in MCI by summing the absolute value of the statistically significant coefficients of the two in the inflation equation, which is estimated by using the VAR model. Such a calculation accounts for the fact that exchange rate and interest rate have an effect on inflation at different times. As observed, exchange rate plays a less important role than interest rate in determining the fluctuation of inflation in emerging economies. While the exchange rate plays a trivial role in Brazil, Korea, Philippines, and especially in South Africa, the role of exchange rate is more pronounced in Eastern European countries such as Hungary, Poland, and Romania. The significant role of the exchange rate suggests that disregarding it would lead to a volatile monetary condition (Knedlik 2006).

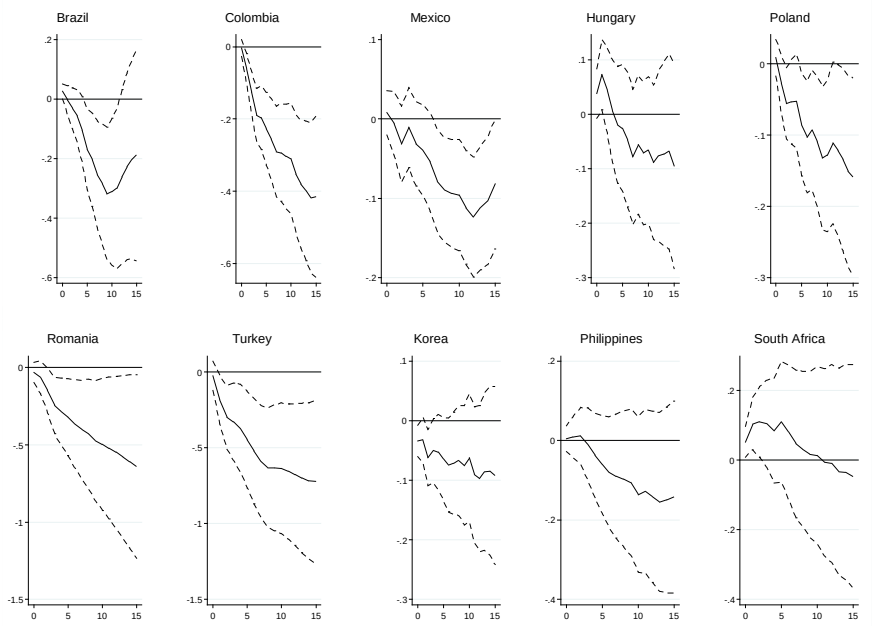
Table 4 Weights on exchange rate and interest rate in MCI

	Lag	β^{EX}	β^{INT}
Brazil	8	0.12	0.88
Colombia	8	0.22	0.78
Mexico	13	0.29	0.71
Hungary	8	0.14	0.86
Poland	8	0.15	0.85
Romania	6	0.32	0.68
Turkey	8	0.29	0.71
Korea	8	0.13	0.87
Philippines	14	0.11	0.89
South Africa	8	0.03	0.97

Source: Author's estimation

Figure 1 shows the response of inflation to surprise changes in MCI, which is determined by the VAR model. The results show that MCI has a strong correlation with inflation in emerging economies. In particular, MCI has a negative, statistically significant, and expected-signed effect on inflation in Hungary, Colombia, Mexico, Poland, Romania, Turkey, and Romania. The inflation response is negative but not statistically significant in other countries. South Africa is the exception, whereby inflation shows a positive response to MCI shocks. These findings suggests that a higher level of MCI causes a fall in inflation and vice versa. The finding also implies that MCI is a useful indicator of monetary policy in most emerging economies. However, its naïve application is not recommended in the implementation of monetary policy.

Figure 1 Response of inflation to changes in MCI



Source: Author's construction

5. Conclusion

Measuring monetary policy is an important step in the analysis of monetary policy. Since monetary policy in emerging economies affects inflation through two principal channels, interest rate and exchange rate, indicators of monetary policy should capture information from both channels. MCI, which is a weighted average of interest rate and exchange rate, is recommended. This paper investigates the role of MCI in ten emerging economies that follow inflation targeting.

The paper shows that MCI can capture the effect of monetary policy on inflation. In particular, the inflation response is negative as expected, implying that a monetary policy contraction causes a reduction in inflation. Therefore, MCI can be used to evaluate the stance of monetary policy and predict the inflation trend. However, it should be noted that MCI should not be used as an operating target.

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EU competitiveness in a changing world economy – and the banking sector

Katalin Botos

The region as a whole is lagging behind the recovery of others in the world. The future shows a shift in global economic power, away from the established advanced economies, especially from those in Europe, towards emerging ones in Asia and elsewhere. Compared to earlier years, risks related to euro area economic conditions have increased. This influences the function and effectiveness of the banking sector as well. The global outlook has deteriorated. The top three prominent risks expected to affect the euro area banking system over the next years are: (1) economic, political, and debt sustainability challenges in the euro area, (2) business model sustainability, and (3) cybercrime and IT deficiencies. The study discusses these factors with special emphasis on banking supervision. It analyses EU bank regulation after the financial crisis and its prospects.

Keywords: economic and demographic outlook, monetary integration, banking union, banking supervision

1. Introduction

We see rapid changes in technology and big uncertainties in global trade and finance (Gál 2015). It has been said many times: "Europe is at a crossroads". But, maybe, "this time really is different..." There are new challenges before Europe both in environmental policies, digitalization, and defence. Finance plays a role in these changes.

A detailed analysis shows that the world economy really has arrived in a fully new era. We live in the age of digitalization, robotics, big data, and artificial intelligence. Since 2008 nothing is like it was before. The financial system had to change, too. The globalization of the former decades when world exports were growing quicker than world GDP, has ended. In theory, GDP grows alongside the credit/asset (financial deepening) – but asset backing cannot be higher than 100%. How then to give impetus to growth by financial deepening? Some economists think that we should not force growth, but rather stop it. If growth after all that arises, it will happen by robots. That means, we should tax the owners of robots and owners of data, and transfer it as basic income to those persons who fall out of the world of work… New ideas, new institutional solutions.

As the global economy evolves, how can Europe best position itself?

Christine Lagarde, the former IMF head, subsequently became the President of the ECB. She has a world-wide overview of global competitivness and of the factors influencing growth. Her field is monetary policy and banking system stability. There are intensive efforts in the EU to complete the banking union and to build a

capital markets union. Will it be enough? Surely, competitiveness doesn't depend only in financial backing. But it is important, we may be convinced.

In some of her speeches, Lagarde tried to position the EU on a world scale. We do the same in the following.

2. Economic prospects

In the last decade, we can see a realignment of the world economic centres. It is to be found in the shift in global economic power away from established advanced economies, especially those in Europe, towards emerging economies in Asia and elsewhere. According to PwC analysis (PwC 2017), by 2050, six of the seven largest economies (in PPP terms) in the world could come from today's emerging economies (E7).

The E7 countries could comprise almost 50% of world GDP by 2050, while the G7's share declines to only just over 20%. Well, absolute figures of GDP depend on the population of the country, and the emerging market economies include the world's most populous countries. They clearly show the realignment, partly due to their large and growing populations, partly because of their high rate of per capita GDP-growth.

In 2018, China already overtook the US and is to become the world's larges economy (in terms of purchasing power parity –PPP). India currently stands in third place. But, in the projections, India is set to overtake the US in PPP by 2040. By 2050, France will no longer be among the world's ten largest economies on this basis. The UK will be on 10th place, while Indonesia could rise to 4th place by 2050.

Growth will be in the world economy driven largely by emerging markets and developing countries. The E7 economies, Brazil, China, India, Indonesia, Mexico, Russia, and Turkey will be growing at an annual average rate of almost 3.5% over the next 34 years. The advanced G7 nations of Canada, France, Germany, Italy, Japan, the UK, and the US will have a growth rate of only 1.6%. (PwC 2017)

Naturally, it doesn't mean that G7 countries will change places with these champion nations concerning GDP per capita. What is important for the citizens of countries, is really the per capita GDP. But even then, we may not say that absolute terms are irrelevant. Sooner or later, the E7 will influence the growth possibilities of the more advanced nations and indirectly, the working places and the living standard there.

Nowadays, the small oil-rich countries are on top of the list in high GDP/capita. The USA is ranked only at 11–12. (We looked at different data collections: IMF, WB, CIA.) Among the top contenders are Luxembourg and Switzerland. In the first 10, are the Norwegians. Surprisingly the Irish are 5–7th. Germany's ranking is only 17–19, Japan's: 25–28. Hungary is: 45–46th.

2.1. World trade and the EU

The division of labour usually results in higher GDP. Therefore the trade activity of the different nations (regions) is very important.

In the early 1980s, Europe's share in world trade was overwhelming. By 2019 it had been shrinking significantly. But even today, it has a leading role.

The EU-28's share of world trade in 2018 in goods was the largest in terms of exports. China had almost exactly the same share (16.2 %). The EU was the second-largest in terms of imports, behind the United States (18.3 %). The United States had the third-largest share of world exports of goods and China the third-largest share of imports, with Japan recording the fourth largest shares for both exports and imports. Canada and South Korea had the fifth and sixth largest shares of exports and import of goods, with Canada having more imports and South Korea more exports, while Mexico had the seventh largest share.

Turning to services, regardless of whether analyzing exports or imports, the United States had the second-largest share of the world's trade in services, followed by China and Japan. South Korea, Canada, and India had the next largest shares of imports, whereas India had a higher share of exports than South Korea or Canada. The EU-28's contribution to world trade was even greater, totaling 24.7 % of exports and 21.1 % of imports. In the field of services, the EU is a net exporter. The EU-28's extra-EU trade in services was clearly larger than any of the other G20 members, both in terms of exports and imports (EC 2018).

2.2. Trends in demography

The populations of 55 countries or areas are projected to decrease by one percent or more between 2019 and 2050 because of sustained low levels of fertility, and, in some places, high rates of emigration.

More than half of the projected increase in the global population up to 2050 will be concentrated in just nine countries: the Democratic Republic of the Congo, Egypt, Ethiopia, India, Nigeria, Pakistan, the United Republic of Tanzania, Indonesia, and as one exception, in a developed country: the United States of America. Disparate population growth rates among the world's largest countries will re-order their ranking by size: for example, India is projected to surpass China as the world's most populous country by around 2027.

A total of 21 countries are projected to experience a population decrease of between 10 and 20 percent between 2019 and 2050, many of which are located in Eastern Europe (and the Caribbean). The largest relative reductions in population size over that period, with losses of around 20 percent or more, are expected in Bulgaria, Latvia, Lithuania, Ukraine, (and the Wallis and Futuna Islands). The number of deaths has been exceeding the number of births in: Belarus, Estonia, Germany, Hungary, Italy, Japan, the Russian Federation, Serbia, and the Ukraine. In some of those countries, immigration compensated for the diminishing number of births, namely in Germany, Italy, and Russia.

With regard to emigration: net inflow in 14 countries exceeded 1 million people over the past decade. All 14 were among the high-income or upper-middle-income countries.

Ten countries experienced a net outflow of more than 1 million migrants between 2010 and 2020. For many of these, losses of population due to migration mainly involve temporary labour movements. Some of them – from Syria, Venezuela – were real refugees. (According to the international institution's definition). However, migrants coming from Africa, (who can be seen in Serbia, nowadays, and partly in Turkey) do not look like refugees, rather temporary work-seekers or, (as some information in the northern countries would have it) in most cases: social support seekers…

The clear tendency is that populations will be diminishing in the European region. The American population will not be reducing in the coming period. But in Europe, the eastern part of the continent will see the greatest losses compared with other parts of the world. Interestingly, the international organizations do not deal with the question, *why.* A few years ago the World Bank published a study with the title: "From red to gray". Now, 30 years after the political changes, nobody is interested in *that* legacy of the socialist times… It cannot be incidental coincidence, that *most of the countries with the greatest population losses are former CMEA members*… Nobody is analysing the impact of socialist dictatorship on the East European countries. This dictatorship has left its mark not only in the deficit of capital in these countries, but also in the low number of babies born. Lost hope in the future results in low fertility ratios. And it is reflected in emigration, too… The political changes came so quickly, that the transition time was not long enough to recover the skills of the people which would have been necessary for free-market - type entrepreneurship. And the lack of capital, which was the legacy of socialist planning, forced the transfer of national wealth in those countries into foreign hands. All this resulted in a hopeless future, instability, weak local cooperation of the countries' youth. The low living standard in these countries and the better wages in the West drained a lot of people from these countries.

Aging is another characteristic phenomenon in the developed world, especially in Europe (in China, too, where the one-child program from Deng Xiaoping will bring about a radical shrinking of the population and a growing proportion of elderly people). In 2018, for the first time in history, persons aged 65 years and over outnumbered children under age five worldwide. Projections indicate that by 2050 there will be more than twice as many people over 65 compared to children under five. By 2050, the number of people aged 65 years or over globally will also surpass the number of adolescents and youth aged 15 to 24 years. It will have its impact on the state-household financial equilibrium of the countries involved. Pension financing will be more difficult, the labour force diminishing, payed pension contributions and taxes less, volumes of allowances more; demand on health services will also increase…

There are projections in the EU for the coming 50 years. The old-age dependency ratio (people aged 65 and above relative to those aged 15 to 64) is projected to increase by 21.6 percentage points, from 29.6% in 2016 to 51.2% in 2070.

This implies that the EU would go from having 3.3 working-age people for every person aged over 65 years to only two working-age persons (EC, 2018).

2.3. Consequences of aging

The European Commission summarizes the economic consequences for Europe as follows:

"The evolution of aging-related costs, however, will vary widely among Member States, with costs falling in eight Member States (Greece, Croatia, France, Latvia, Estonia, Italy, Lithuania and Spain); increasing by up to 3 percentage points of GDP in ten Member States (Portugal, Denmark, Cyprus, Poland, Sweden, Romania, Bulgaria, Finland, Hungary and Slovakia); and rising by more than 3 percentage points in the remaining ten Member States (Netherlands, Austria, Ireland, Germany, United Kingdom, Belgium, CzechRepublic, Slovakia, Malta and Luxembourg).

Long-term care and healthcare costs are expected to contribute the most to the rise in age-related spending, increasing by 2.1 percentage points. Public spending on pensions is expected to rise until 2040, before returning close to current levels by 2070. Education expenditure is projected to remain unchanged by 2070. Unemployment benefit expenditure is projected to decline by 0.2 percentage points.

Pension reforms have made it possible to stabilize public pension spending as a share of GDP over the long term, through by increases in the retirement age and changes to the parameters of pension systems, including pension indexation. As a result, the public pension benefit ratio, which describes the average public pension in relation to the average wage, is projected to fall by 10.6 percentage points on average in the EU. In Member States with supplementary private pension schemes, the total value of pensions relative to average wages is projected to be 10.5 percentage points higher than in Member States without. Moreover, retirement ages will be higher in the future in general." (Aging Report 2018)

All these estimations take for granted the trends in fertility. They do not see any factors which could change the trends in society. The only possibility they see is to adjust to the trends: simply raising expenditures for health purposes, raising retirement ages, and other parametric changes in pension systems. We hardly see active arrangements which would try to change the trends. As if everything were fated for mankind, as if we were not human beings of intelligence and free will… As if there were only private interests, and no public good… However, economic policy could be active in influencing social trends. The diminishing of the population is slower in countries boasting active pro-family social support. Unfortunately, even that is not enough to change the main tendencies.

Why are demographic changes relevant to the competitiveness of the region? Because it is a growing burden on the financing of the ever-increasing share of the elderly in the region compared to the active population. Those parts of the world, where the demographic structure of society is more balanced between the younger and the elder groups, the burden of the pension systems is not such a big challenge for both employees and employers. That is, *the region is more competitive*.

Let us summarize the situation: The main factor in the former growth of Europe was the very intensive participation in the world trade. The EU is now

shrinking in the world economy because other countries are growing quicker, both in terms of GDP and trade. They are able to do so because their internal market is enlarging thanks to the growing population and the massive capital inflow, which is making use of the qualified and relatively cheap labour there. For the EU, an aging societiy means a burden. In that sense, some emerging markets are more competitive than the EU.

3. Banking union

We may say that the shrinking share of the EU in world trade is in a certain sense, a sign of diminishing competitiveness of the region compared with other parts of the world economy. We have seen that the competitiveness of the region is dependent on aging, too. But many experts say that a more integrated financial system in the USA contributes to the better functioning of American economy, and this is the direction where the EU must seek to raise the competitiveness of the economy of integration. We may say, that the ideology in the EU leading organisations has *turned back to the concept of deepening cooperation*. (Not only *enlarging* integration by the admission of the Eastern countries in the European Union.) The EU realized, that it is not enough to raise the competitiveness of the core countries by adding more countries to the Union. It must, in a certain sense deepen the integration mechanism, too. The financial system, the euro, and the banking system must be an effective support of more robust growth in the region.

But the financial crisis not only caused a drop in GDP-growth but it threatened the collapse of the whole banking system. It demonstrated how problems can spread throughout the financial system and how they directly affect people's lives. The slow recovery in the EU since then has been indicating, that there are great and deep problems in the European economies. It is necessary to stimulate a more liberal allocation of capital, which must be guaranteed by the free flow of capital.

The European Banking Federation's Board called on governments in Europe to recognize the key economic role of banks in funding growth and supporting prosperity:

"Looking ahead to the upcoming policy cycle in the European Union, the Board reaffirmed the European banking sector's constructive commitment to sustainably and responsibly financing businesses and households. Specifically, banks recognize their role in society when it comes to developing sustainable finance and supporting the energy transition together with other industries in order to meet international climate change objectives… Banks are fully committed to supporting further European integration, specifically in the EU financial services markets through the completion of the Banking Union and the creation of an effective Capital Markets Union (CMU). This is particularly important at a time of increasing political and regulatory global fragmentation, in order to ensure that sufficient financing will remain available for the European economy" (EFB 2019).

Ineffective and excessively burdensome regulations clearly have a negative impact on the European economy.

If the capital market and banking is fragmented in the EU, it surely will continue to lag behind the US, the latter having a more integrated banking market as a result of liberalization in recent decades. With regard to banking, following

the establishment of the Single Market in 1993 in the EU, banking became increasingly cross-border in nature. But this was not accompanied by the development of a regulatory framework at the supranational level. This became obvious during the crisis.

"The segmentation of banking markets within the euro area is one of the more concerning legacies of the financial crisis. Banks were bailed out by national governments, under a loose coordination framework defined by the Council, and with lighter scrutiny exercised under the State aid framework. Integrated cross-border groups were broken down along national lines to allow national tools to be deployed to manage crises; and the often difficult negotiations to bring about these results dented the trust between Member States" (Enria 2020).

The national states played the role of crisis managers, and oriented the banks towards the internal economy. As a result, a *sharp decline* happened in cross-border banking, even within the euro area.

Let me quote a longer text from an ECB analysis: "The EU's banking sector is not only the largest in the world, but also accounts for the bulk of the 'financial de-globalisation' observed in cross-border banking since the global financial crisis. In this paper we provide an anatomy of the great cross-border banking retrenchment in the EU and investigate a wide range of possible drivers of this phenomenon, including indicators of banking sector performance and stability, prudential policies and bank levies. Using a granular breakdown of cross-border bank lending by instrument and counterparty sector, we are able to identify the most affected components of cross-border lending and shed light on the underlying causes. Banks located in the euro area and in the rest of the *EU reduced their cross-border bank claims by around 25% since the global financial crisis*, driven by a sharp and sustained reduction in intra-EU claims, which make up 60% of total EU cross-border claims. Within the EU, banks have cut their cross-border loans by around 40%, which particularly affected cross-border interbank lending. Our empirical analysis shows a significant link between deteriorating asset quality and the great retrenchment in cross-border banking, highlighting the spillovers from national banking sector conditions across the EU. We also find evidence that prudential policies can entail spillovers via cross-border banking in the EU, albeit with heterogeneity across instruments in terms of direction, magnitude and significance. In particular, our results suggest that regulatory arbitrage might be possible via the use of foreign branches, while stricter policies at home may preclude banks from direct lending activities abroad, even though this does not apply within the euro area. For newly introduced bank levies, we do not find a discernible link to the great retrenchment, but they may have affected the composition of cross-border banking by incentivising lending to the non-bank sector. Our analysis suggests that tackling the persistent asset quality problems in the EU is pivotal in order to reap the potential benefits of cross-border banking which relate for instance to risk diversification and risk-sharing. Hence, the findings of this paper make a case for completing the banking union. For instance, the rulebook for financial actors in the EU needs to be amended by adding a chapter on a harmonised approach to the resolution of non-performing loans (NPLs), complemented by countryspecific elements in each high-NPL constituency…" (Emter–Schmitz-Tirpák 2018; italics mine)

So, the banking groups lack a Europe-wide identity: they are broken into parts along national borders. It is really difficult to envisage the centralized management of capital and liquidity at the parent level, when there is no clear understanding of how to deploy capital and liquidity support to subsidiaries within the banking union, in the event of shocks in some countries. The branching structure is still not really being used more widely (at least within European banking supervision). The production of a single passport of the sort already planned many decades ago in the late 1980s, is still not a reality.

"European corporate and consumer protection laws and our insolvency and tax regimes have formed more of a patchwork of legal, regulatory and supervisory approaches, with national practices overlapping in some aspects and colliding in others. In many areas this still holds true today" – cites Andrea Enria, Chair of the Supervisory Board of the ECB (Enria, A. ECB 2020)

In recent years EU leaders have often spoken about how to "complete the banking union." But, it raises the question of what criteria should be used to assess the banking union's "*completeness"*?

Can the playing field for European enterprises be equal, when governments are too strongly connected with their county's banking institutions? When the banks are stimulated even by taking risks to support some "important" national enterprises, in the hope, that the government will not let them fail? And, when in exchange, they support the goverment in financing the deficit stemming from irresponsible expenditure motivated by politics?

It is clear: the *stronger members of the EU did not* – and still do not – *want to bail out governments which are in trouble.* Even not by bailing out the banks. They think the government forced them – or they were anyhow ready – to buy the governments' bonds, that is, monetize the government deficit.

When will we be able to say that there is completeness in the banking union? "A narrow interpretation, based on euro area leaders' past commitments, equates that with breaking the bank-sovereign vicious circle; a more ambitious long-term vision for complete banking union implies the removal of all cross-border distortions within the euro area banking market. Even the minimalist version, however, entails more reforms than those publicly under current consideration" (Schnabel and Véron, 2018).

Sovereign risks and bank risks are highly correlated. Irresponsible management in big banks may lead to sovereign crises and badly managed state budgets can result in bankrupt governments… It may cause a vicious circle, a "doomloop". (In economics, a doomloop is a negative spiral that can result when banks hold sovereign bonds and governments bail out banks.)

The indebtedness of the Greek government was not just a question of the link between domestic banks and government. Buying sovereign bonds was a bonanza for other buyers as well, not only domestic banks, because the bonds were offering high-interest rates. Banks in the euro-zone have willingly bought them... Nevertheless, one has to question, why did they not think the fact over a bit, as in how could the interest-rates for those bonds be so much higher, compared, for instance, to the German state bonds? Did they not think, that it indicates greater risks? We may assume that investors thought that EU would in no way let governments go bankrupt in the euro-zone.

The banking sector in the EU must answer the big challenges of our times. The responsibility of the sector for the world-wide crisis is unquestionable. In the EU even the greatest achievement of the European integration process, the creation of the euro, could be in danger. Even more: the EU itself may fall into pieces.

4. Changes in regulation

As a reaction to the financial crisis, the EU has planned a lot of changes in the financial sector regulation. As a first reaction, it established the European System of Financial Supervision (ESFS) in 2010. This was a new supervisory architecture at the European level, consisting of three European Supervisory Authorities on the field of capital market, banking and insurance, (ESAs: ESMA, EBA, EIOPA), and a board to monitor systemic risks – the European Systemic Risk Board (ESRB). The ESAs and the ESRB started their operations in January 2011.

EBA, the European Banking Authority, had started to harmonize banking regulation EU-wide. It published over 250 guidelines, regulatory standards, and implemented technical standards. So, since then the *single rulebook* has become a reality. These rules are designed to prevent bank crises from happening in the first place, for example by increasing the amount of capital that banks are required to have (Capital Requirements Directive/Regulation). It is not just a matter of the amount of capital held by the banks. It also is a question of capital quality. That, too, has improved dramatically as a result of regulatory reforms in 2010. Euro area banks focus now on Common Equity Tier 1 (or CET1), the highest quality of capital (EU, 2016). In terms of capital ratios as a measure of the resilience of banks, in 2016 it was a couple of percentage points away – since 2008, banks in the euro area have increased their Tier 1 capital ratios from 8.4% to 13.7%.

If banks should get in trouble, there is a common framework to manage the process of winding the banks down. (Directiveon Bank Recovery and Resolution). The rules would also help protect consumers if banks should get into difficulty. For instance, deposits of up to € 100,000 are guaranteed throughout the EU, which should help prevent panic withdrawals if a bank is threatened. But, the Deposit Guarantee Schemes (DGS) remained national in nature (until 2020). The Commission had reviewed the functioning of the DGS Directive by 2019 and was looking for a single, pan-European DGS in the context of the banking union.

Let us start at the beginning. The years after 2010 were burdened with weighty discussions of the Greek case. The recent financial crisis demonstrated how contagious problems in the financial sector of one country can be, especially in a monetary union, and how these problems can directly affect citizens across the euro area. It was urgent to go ahead with the deepening of financial-monetary integration…

The establishment of the Single Supervisory Mechanism (SSM) in 2013 was a great step forward. (With the creation of the SSM, changes were made to the European banking authority's (EBA) voting arrangements to ensure countries participating in the SSM would not unduly dominate the EBA's board of supervisors, because some countries are not members of the eurozone).

SSM has been created to oversee banks in the euro area and other participating European Union (EU) countries. The SSM is the first pillar of Europe's banking union. The second is the Single Resolution Mechanism, which aims to deal quickly and efficiently with failing banks. The Single Resolution Board and the Single Resolution Fund have been created as an important element of the infrastructure. (The safety net is not yet fully established at the European level. As long as deposit insurance remains national, Member States will have an incentive to ring-fence their banking sectors. This is why there is a need to finalize the banking union by establishing a European deposit insurance scheme.)

The aim, anyhow, was to put in place the banking union. To help lay the groundwork for the SSM, an Asset Quality Review was carried out, involving an in-depth expert examination of some € 3.7 trillion of euro area banks' assets. A series of stress tests were also carried out. The aim of the exercises, which were concluded in October 2014, was to assess the resilience of EU banks in the face of adverse economic developments, in order to understand remaining vulnerabilities and give the ECB a clearer idea of the banks' financial health. The stress tests and the comprehensive assessment together helped to dispel doubts and restore confidence in EU banks.

There is no official or legal definition of what the banking union should be. The most common definition is that it means shifting banking-sector policy instruments from the national to the European level. The creation of a truly European supervision mechanism weakens the link between banks and sovereign nations. This indirectly helps to rebuild trust in Europe's banking sector.

To strengthen oversight of the banking system, the SSM is a new system to supervise banks in the euro area (and other participating EU countries.) The ECB as a monetary authority was first of all responsible for money creation, the value of the euro, and the monetary policy of the euro-zone. Its tasks are now enlarged. In cooperation with the national supervisors, it is responsible for the functioning of the SSM. Its Board also includes national supervisory authorities as members. So, the legal standing of the Board is unique: different from other EU institutions, though member-state institutions are represented in it. According to Annunziata Filippo: „it provides a peculiar model of centralization and cooperation amidst European and national institutions in the field of banking supervision within the Euro area. Since its birth, the SSM has received wide attention from scholars and practitioners, raising an overriding amount of discussions and debates. As much as the SSM becomes mature, the underlying legal structure becomes clearer, and recent jurisprudence shows that it may well be referred to as a highly experimental field of EU Legislation. Indeed, also considering traditional topics such as the allocation of powers between Member States and EU institutions, or the relationship between EU law and national one, the SSM is providing new insights, that might also provide for fruitful developments at a broader level of EU Law" (Annunziata 2019).

The Supervisory Board is part of the ECB, an autonomous entity. At the same time, its functions (fulfilling the supervisory tasks), are strictly separated from the monetary policy of the ECB. To avoid any conflict of interest between the two, restrictions enforce the division; for example, by allowing for the exchange of sensitive information only when certain safeguards are observed. (Or so the regulations say…)

As a guard of financial stability, ECB by SSM has the role of mitigating the prospect of disruptions in the financial intermediation process, to avoid severe impact on real economic activity. Financial stability can be defined as a condition in which the financial system – which comprises financial intermediaries, markets and market infrastructures – is capable of withstanding shocks and unraveling financial imbalances.

The role of banking supervision on ECB level doesn't mean only micro-prudential supervision of the influential big banking institutions, but fulfilling macroprudential policies. This activity has different dimensions. Macroprudential policies – according to ECB publications - aim to:

– prevent the excessive build-up of risk, resulting from external factors and market failures, to smoothen the financial cycle (time dimension)
– make the financial sector more resilient and limit contagion effects (cross-section dimension)
– encourage a system-wide perspective of financial regulation to create the right set of incentives for market participants (structural dimension) (EU regulation – ECB 2013)

The ECB directly supervises significant banks. A bank may be qualified as significant depending on its size, its importance to the domestic banking sector or whether it has been recapitalized by public funds. The ECB has the authority to do the following: (I quote the relevant regulations, EU2013):

"–conduct supervisory reviews, on-site inspections and investigations;
– grant or withdraw banking licenses;
– assess a bank's acquisition and disposal of qualifying holdings;
– set higher capital requirements ('buffers') to countercurrent or future financial crises;
– impose sanctions for any breach of EU law on credit institutions, financial holding companies and mixed financial holding companies.
– Indirectly supervise banks that are considered to be less significant and are directly supervised by their national supervisory authorities."

National supervisors remain responsible for issues such as consumer protection, money laundering, payment services, and the supervision of branches of banks in EU countries that are not part of the SSM.

Peterson Institute, the independent foreign relations research center also studied the EU competitiveness issue. Experts from the Institute summarized their views immediately after the start (2013) of the SSM's aim, the banking union, as follows:

"Beyond centralizing supervision, the plan as envisioned by euro area leaders has three pillars:

(1) minimizing the near-term need for taxpayer contributions to rescue troubled banks;
(2) preventing moral hazard at the euro area country level by minimizing the euro area backstop for troubled banks; and
(3) preventing moral hazard at the financial institution level by designing rules to force shareholders, creditors, and depositors to share in the cost of a future rescue" (Ubide 2013).

Together these proposals amount to a policy of "national bail-ins" (as most investors in the banks are locals) to avoid "euro area bailouts."

Some experts found it troublesome that the interest rates are different for the periphery than the central economies of the EU because such rates reflect higher perceived risk for banks and borrowers. "As long as private lending rates in each country are allowed to reflect the location, rather than the ECB's policy stance, monetary policy in euro area countries with troubled banking systems will remain too tight, discouraging demand and keeping banks' balance sheets fragile" - wrote one of the the Petersen Institute's (PIIE) experts (Ubide 2013).

5. New challenges

Finance is likely to undergo intensive change over the coming decade for other reasons as well. One of the newest challenges for the EU – for the banks and banking supervision – is the appearance of innovative technology in all fields of the economy. Dealing with banking regulation we must take into consideration that competitive banking must be at the same time secure.

The attitude of bank clients has changed worldwide. Across Europe, 59% of internet users now do their banking online, and this number is on the rise. Interesting, that for instance in some aspects Sub-Saharan countries are much further ahead in use (by adults) of electronic money, than Europe (Relevant data: 25% to 10%). In Europe, there is a developed banking infrastructure. It does, as one would put, lower the progress in some fields... But European banks have also begun to implement a range of innovative technologies. Prime examples are artificial intelligence, or AI, for analyzing big data, mobile wallets, and cloud computing. AI and big data help banks overcome information asymmetries efficiently: the new tools help banks assess credit scores for clients with a limited credit history, at low costs. Without these new tools, it would be very difficult to analyze huge amounts of unstructured data.

This is an opportunity for banking supervisors as well. Enlargement of the tasks of the EU- level regulation needs more concentration on the information technology. It is more and more important in the banking business, and so for the supervisors. Automated reporting, for instance, could ease the burden on banks, and allow the authorities to collect data more efficiently. At the same time, machine learning could help them to validate – and even analyze – the data.

A new phenomenon is the appearance of the *new fintech institutions*. How to evaluate all this from the point of view of stability in the banking sector? Fintechs step in some of the banks' playing fields, and are competitors for them. They compete with banks in parts of the value chain. They are no banks, but it is important to closely follow their activity, when they do step in the field of banks, and engage in core banking business. Then they must be treated as banks. As fintech banks might come under the scope of banking supervision, it is needed to tackle the relevant risks. There are general discussions with the national authorities and the European Banking Authority on how to supervise fintech banking. This joint approach is crucial. Some countries, like Germany, have already carried into effect a licensing practice concerning fintechs. Fintech is a new phenomenon. For this reason the ECB has to

have the chance to take a common European stance, right from the start. In April 2020 the ECB will have a workshop on the topic of fintech supervision.

6. Conclusion

We have collected some forecasts on the future role of the European integration in the world economy. To preserve the competitiveness of the region- even if its share in world GDP and trade will sink in the coming decades-, with special importance on the evolution of the banking sector. So we have surveyed the changes in the banking regulations over the last quarter of the century, how it helped banking to be more effective in the region. The review paid special attention to the period after the worldwide financial crisis. Partly, because the crisis had a negative legacy on the integration process of the sector, partly, because fully new phenomena have been observed in technology in recent years.

Everything is changing very quickly, so the stability of the banking system is a vital question. The study could only be a snapshot of the current situation of the banking system and its supervision in Europe. But for countries in the Eastern part of the continent, it is worth thinking about the overall European attitude. The free movement of labour has been a reality since 2007. Now banking integration is for the greater free movement of credit and capital across borders, (though, in a more controlled, supervised way). Were it is not necessary to evaluate, what does it mean, for all the longed after freedoms in the EU- for instance, the free movement of labour –, regarding the East European countries?

Will the banking union and the free capital movement *really serve the interests of the whole population* of the EU? Or, is it not necessary to put into operation certain smoothing mechanisms - more, than what still exists - in different aspects of the economy, within the integration? The attenuate results of the banking union over the last decade, certainly do not provide strong incentive to join the euro for those countries who are still outside the zone.

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Effects of the Global Financial Crisis on the V4 – Western Europe trade relations

Peter Artur Nagy

The aim of the research is to explore the development of trade relations between the Visegrád countries and their major Western European partners since accession to the European Union. The topic is currently an important one, as the Visegrád region is highly dependent on Western European countries, especially in the area of foreign trade. The research analyzed how the 2008-2009 global economic crisis and the subsequent sovereign debt crisis in Europe affected these trade relationships, i.e. did it cause significant changes in levels of relationship and/or trends. To answer this question, this paper used a time-series analysis method called Interrupted Time Series Analysis. As a result, statistically significant changes in the level and trend of foreign trade relations between the Visegrád countries and their Western European partners were detected. Finally, a more detailed breakdown of product groups also revealed which product groups are most responsible for slowing down the growth of trade relations.

Keywords: Visegrád, trade, export, crisis

1. Introduction

One of the most-cited facts of international economics is that international trade grew much faster than global GDP in the last few decades, until the global financial crisis in 2008–2009. Since then, the growth rate of international trade cannot exceed the growth rate of the global production. This paper aims to analyze the foreign trade relations of the Visegrád countries in the context of "trade slowdown". The subject of this paper is the international trade of the Visegrád region with the EU-15, the so-called old member states. The reason for this is the fact that the vast majority of exports and imports of the Visegrád countries head to and come from this region, even though the role of Asian countries – especially China – is becoming more and more important. In the first part of the paper, I collect the most relevant literature and its findings in this topic. In the second part of the paper, I present the methodology and its results in connection with the slowdown of trade growth between the Visegrád countries and the EU-15 region. After this, I present the trade profiles of the Visegrád countries and identify the main product groups that are responsible for the sluggish trade growth of the region. In the last section, I present my conclusion with respect to the literature and the empirical findings, as well as the limitations of the study.

2. Background

Global trade growth has slowed significantly since the global financial crisis. During the crisis there was a sharp collapse, and shortly after it recovered to its pre-crisis level, but since then the yearly average growth of trade has not been able to reach pre-crisis figures. Between 1985 and 2007, global trade grew twice as fast as global output, but after the crisis the growth of global trade has not been able to exceed the growth of global output (IMF 2017). There is still no consensus in the literature about the factors and especially their weights underlying this sluggish trade growth. It is quite clear however, that both cyclical (short term) and structural (long term) factors have contributed to the phenomenon.

2.1. Cyclical factors

The first and foremost cyclical factor that the literature identifies is the weak demand in advanced economies after the crisis period (Constantinescu et al. 2015, Ollivaud and Schwellnus 2015). For example, in the US and the Eurozone, GDP levels are respectively 8% and 13% lower than would be suggested by historical average growth rates, which causes a 20% deviation from the trend in import volumes in both areas (Constantinescu et al. 2015). In addition to weak demand, private investment has been subdued in advanced and emerging economies since the global financial crisis and the European debt crisis (IMF 2015). Another short-term factor is uncertainty, as emphasized by Taglioni and Zavacka (2013). They employ a VAR model to estimate the effects of uncertainty. Their findings show that the negative effect of uncertainty on trade is higher for trade relationships more focused on durable goods. Conversely, countries specialized in non-durable and investment goods are not affected by uncertainty. A recent study of the European Central Bank claims that financial frictions may also play an important role in the trade slowdown after the global financial crisis. It states that the finance-trade nexus may involve both cyclical and structural effects. The cyclical component involves variations in financing conditions and the availability of trade finance. The study concludes that tighter financial conditions do indeed have a restrictive effect on international trade, especially in the most credit-dependent sectors. However, there is hardly any evidence of long term – structural – effects (ECB 2016).

2.2. Structural factors

An important factor is the changes in the pace of income convergence across countries. In particular the faster income convergence after 2000 may explain the rapid expansion of world trade, and the slowdown of the convergence after the global financial crisis may eliminate this driver (Constantinescu et al. 2015). Another important factor is the changes in the composition of world income, such as the relative importance of investment and consumption. Constantinescu et al. (2015), Boz et al. (2014), Bank of Japan (2016) argues that the decline in investment – which is the most trade-intensive component of GDP – may be one possible explanation for lower trade growth after the GFC.

In addition, changes in the composition of world trade can also explain some of the sluggish trade growth in the recent years. Constantinescu et al. (2015) emphasizes that the relative changes between durable and non-durable goods may have also contributed to the slowdown of world trade. Another main cause of the slower trade growth is the slower pace of expansion of global value chains. Like Constantinescu et al. (2015), Bank of Japan (2016) states, as production fragmented internationally in the 1990s, there was a rapid surge of trade in parts and components, but this has decelerated in the 2000s. Crozet et al. (2015) employs gravity modeling to analyze the effect of global value chains on recent trade slowdown, and their estimation results suggest that while global value chains used to boost trade growth significantly before the crisis, this effect vanished after 2008.

A recent study of the European Central Bank finds that, for example, major car manufacturers have reduced their domestic production and shifted production towards export markets, which again dampens international trade growth (ECB 2016). Last but not least, the changes in international trade regime, namely the renaissance of protectionism, is another significant part of the slow trade growth. According to the European Central Bank, trade growth in the 1990s and 2000s was boosted by widespread trade liberalization policies and tariff reductions. Average tariff rates decreased by three-quarters to less than 10 percent among emerging economies and halved to below 2.5 percent among advanced economies. The study also mentions that in the future there will be less room to boost trade growth by these measures. The study also emphasizes that non-tariff measures are on the rise. These non-tariff measures such as export subsidies, domestic clauses in public procurement and restrictions on licensing, technology transfer, and FDI restrict or distort trade flows, however, their effect is often hard to quantify precisely (ECB 2016). Constatinescu et al. (2019) measures the effect of the trade war between the USA and China. The study shows that the so called "tit-for-tat" tariffs between the world biggest economies alone accounted for about 2 percent of world merchandise trade. They also point out that increasing tariffs between the USA and China not only reduces trade but is also diverting it (mirroring trade creation versus trade diversion in the case of reducing tariffs).

3. Impact of the 2008–2009 global economic crisis on the European Union and the Visegrád region

The size of the decline in world trade for 2009 has been widely estimated by various international organizations (WTO – 9%, World Bank – 9.7%, OECD – 16.5%, 32% in the first quarter of 2009). However, there is no argument in the literature that European Union trade was hit particularly hard by the global financial crisis. Furthermore, this effect was different in magnitude among the member states. The biggest drop in trade volume was in the "new member states", i.e. Central and Eastern European countries (in which we there was a 30-40 percent decline). This is due to the fact that during the years preceding the crisis, these countries were highly integrated into the value chains of the European Union, significantly increasing intra-industry trade in semi-finished products. As a result, the Central and Eastern European countries were highly dependent on the performance of the EU-15, in

particular Germany (Curran et al. 2009). In addition, the global automotive sector in the last quarter of 2008 and the first quarter of 2009 suffered the largest decline of all industries (–14% in Q4 2008 and –49% in Q1 2009) (Escaith 2009). Trade between the Visegrád countries and the EU-15 increased dynamically between 2001 and 2018. However, the period October 2008-December 2012 was characterized by turbulence, which was clearly a sign of the global financial crisis that started in the United States and resulted in the subsequent European debt crisis. It is thus clear that after the initial shock, the impact of the crisis on intra-regional trade was prolonged in the European Union. In addition, it is almost impossible to isolate the effects of the crisis and the existing literature usually does not undertake it.

4. Methodology

The research methodology is based on the Interrupted Time Series Analysis (ITSA) method. In ITSA, the dependent variable is observed several times before and after a certain event/intervention. Prior to the analysis, the event/intervention is expected to interrupt the level (i.e., time series mean) and/or trend (slope of the time series fitted to the time series) of the dependent variable, thereby causing a structural break (Linden 2016). One of the main assumptions for most statistical models is that the observations are independent and uncorrelated (see the Gauss-Markov theorem for OLS). However, this assumption is almost always violated in the vast majority of time series. The closer the observations are to each other in time, the more likely they are not independent of each other i.e. they are autocorrelated (Wooldridge 2013). The most commonly used method for filtering out the effect of autocorrelation is to incorporate its effect into the model. By doing this we can estimate the effect of the examined intervention (the effect of GFC on trade) by controlling the effect of autocorrelation. Thus an Autoregressive Moving Average (ARMA) model will be employed in this paper which was developed by Box and Jenkins (White 1985, Velicer and Fava 2003).

Instead of OLS, the models will be estimated with generalized least squares (GLS). I use the UN COMTRADE and Trademap.org databases for the analysis. The time series range from January 2004 to November 2018 on a monthly basis. The crisis period is defined – in accordance with the main literature on the topic – from October 2008 to December 2012. By removing the crisis period from the time series, the models still have 116 observations each.

The employed model in general form is the following:

$$x_t = \alpha_0 + \beta_1 time_t + \beta_2 level + \beta_3 trend_t + \sum_{i=1}^{p} \alpha_i x_{t-i} + u_t + \sum_{i=1}^{q} \phi_i u_{t-i} \quad (1)$$

x_t: dependent variable
β_0: intercept
β_1: the slope before the crisis
β_2: dummy variable, which is 0 before the crisis and 1 after the crisis; post crisis difference in level
β_3: post crisis slope

α, ϕ: coefficients of delayed variables and residual terms
p, q: values of delays (based on the ACF and PACF correlograms)
u_t: residual.
Altogether eight parallel cases will be investigated, specifically: exports and imports of Hungary; exports and imports of Slovakia; exports and imports of the Czech Republic; exports and imports of Poland.

5. Hypotheses

In line with the methodology, the hypotheses to be tested is as follows:

H1. The global economic crisis has caused a significant change in the level of trade of all Visegrád countries with the EU-15.

H2. The global economic crisis has caused a significant change in trends in trade relations between the Visegrád countries and the EU-15, both statistically and economically.

6. Results

6.1. Hungary: Export

According to the model, in the case of Hungarian exports all variables are highly significant. The Level variable shows the percentage point decrease in trade after the crisis as a result of the GFC, assuming that without the crisis event, international trade would have grown at the same pace as in the pre-crisis period. As can be seen, the estimated percentage change is quite high for the Level variable. As Wooldridge suggests, at this magnitude the $\%\Delta y \approx 100\Delta\log(y)$ approximation is inaccurate. To fix this issue we need a correction which is the following: $\%\hat{\Delta}y = 100[e^{\hat{\beta}_2} - 1]$. This correction will be also necessary in the following subsections. Accordingly, in January 2013 the total value of exports to the EU-15 was 39.329 percentage points lower than would have been possible without the crisis event. The Time variable shows an average increase of 0.8443 percentage points in total exports to the EU-15 from one month to another before the crisis. The Trend variable is intended to represent the difference between the pre-crisis and the post-crisis trend. This means that the post-crisis trend is 0.3094 percentage points lower than before the crisis. The total value of exports to the EU-15 increased by 0.5349 percentage points. The vertical dashed line (at October 2008) marks the beginning of the crisis, while the gray area represents the whole crisis period until January 2013. The red dashed line is the so-called counterfactual, which illustrates how the value of exports would have developed without the crisis event. From Appendix: Figure A-3 to A-10 it is shown, how the level of export and import values and the trend of export and import value growth have decreased as a result of the crisis event.

Table 1

AIC	**-456.6377**
BIC	**-409.8267**
Observations	**116**

Source: own consturction

Table 2

HU_exp_TRADE	Value	Std. Error	p-value
Intercept	14.779788	0.008562353	0
Time	0.008443	0.000335554	0
Level	–0.499706	0.025509907	0
Trend	–0.003094	0.000370079	0

Source: own consturction

6.2. Hungary: Import

The imports of Hungary from the EU-15 show a similar picture. The output of the model shows that in January 2013 the total value of imports were 41.8 percentage points lower than would be assumed without the crisis event. Before the crisis, the total value of imports increased by a monthly average of 0.8108 percentage points while after the crisis it decreased by 0.2570 to 0.5538 percentage points.

Table 3

AIC	**–450.4257**
BIC	**–428.397**
Observations	**116**

Source: own consturction

Table 4

HU_imp_TRADE	Value	Std. Error	p-value
Intercept	14.721849	0.01318058	0
Time	0.008108	0.00049181	0
Level	–0.541324	0.03806909	0
Trend	–0.002570	0.00055441	0

Source: own consturction

6.3. Slovakia: Export

In the case of Slovakia, the total value of exports in January 2013 was 59.9267 percentage points lower than would be assumed without the crisis. The total value of exports increased by a monthly average of 1.8362 percentage points. This fell to 0.5291 percentage points after the crisis.

Table 5

AIC	**–315,2538**
BIC	**–301,4859**
Observations	**116**

Source: own consturction

Table 6

SK_exp_TRADE	Value	Std. Error	p-value
Intercept	13.912452	0.01837486	0
Time	0.018362	0.00069566	0
Level	–0.914460	0.05359075	0
Trend	–0.013071	0.00077918	0

Source: own consturction

6.4. Slovakia: Import

The imports of Slovakia after the crisis were 50.2896 percentage points lower than the assumed time series without the crisis. The average monthly increase during the pre-crisis period was 1.4341 percentage points, which fell to 0.6721 percentage points after the crisis.

Table 7

AIC	**–347.851**
BIC	**–334.083**
Observations	**116**

Source: own consturction

Table 8

SK_imp_TRADE	Value	Std. Error	p-value
Intercept	13.826834	0.01596627	0
Time	0.014341	0.00060448	0
Level	–0.698958	0.04656604	0
Trend	–0.007620	0.00067705	0

Source: own consturction

6.5. Czech Republic: Export

Czech exports to the EU-15 were 47.00 percentage points lower in January 2013 than they would have been without the crisis. The monthly increase in the total value of exports was 1.2970 percentage points on average before the crisis and 0.655 percentage points on average after the crisis.

Table 9

AIC	**–442.7692**
BIC	**–420.7405**
Observations	**116**

Source: own consturction

Table 10

CZ_exp_TRADE	Value	Std. Error	p-value
Intercept	14.978221	0.01276760	0
Time	0.012970	0.00047857	0
Level	–0.635022	0.03698864	0
Trend	–0.006420	0.00053843	0

Source: own consturction

6.6. Czech Republic: Import

Total imports of the Czech Republic from the EU-15 were 44.2475 percentage points lower in January 2013 than would have been assumed without the crisis. The average monthly growth rate before the crisis was 1.0288 percentage points, which fell to 0.5988 percentage points after the crisis.

Table 11

AIC	**–500.4292**
BIC	**–478.4005**
Observations	**116**

Source: own consturction

Table 11

CZ_imp_TRADE	Value	Std. Error	p-value
Intercept	14.979866	0.02092231	0
Time	0.010288	0.00073924	0
Level	–0.584249	0.05823508	0
Trend	–0.004300	0.00085053	0

Source: own consturction

6.7. Poland: Export

Polish total exports of goods to the EU-15 were 44.475 percentage points lower after the crisis period than the counterfactual. Before the crisis, exports of goods increased by a monthly average of 1.3341 percentage points. After the crisis, this fell to a monthly average of 0.7174 percentage points.

Table 12

AIC	**–376.1413**
BIC	**–345.8518**
Observations	**116**

Source: own consturction

Table 13

PL_exp_TRADE	Value	Std. Error	p-value
Intercept	15.090480	0.01491915	0
Time	0.013341	0.00055353	0
Level	–0.588337	0.04292549	0
Trend	–0.006167	0.00062542	0

Source: own consturction

6.8. Poland: Import

Total imports of goods of Poland were 57.556 percentage points lower in January 2013 than the estimated value of the assumed crisis-free time series. The average growth rate of total pre-crisis imports was 1.488 percentage points per month. After the crisis, this fell to a monthly average of 0.6376 percentage points.

Table 14

AIC	**–446.6457**
BIC	**–410.849**
Observations	**116**

Source: own consturction

Table 15

PL_imp_TRADE	Value	Std. Error	p-value
Intercept	15.211827	0.01521324	0
Time	0.014880	0.00052361	0
Level	–0.856983	0.04151546	0
Trend	–0.008504	0.00060791	0

Source: own consturction

7. Summarized results

According to the results, Hungary's trade in goods was the least affected by the 2008–2009 global financial crisis and the European sovereign debt crisis, both on the export and import side. However in Hungary, the pre-crisis average monthly growth rate was also the lowest among the Visegrád countries. Exports and imports of goods of Slovakia, the Czech Republic, and Poland increased at a higher average rate and thus the crisis also caused a greater change in levels and trends, assuming that the pre-crisis growth rate would have been the same had the crisis not occurred.

Slovakia had the highest monthly average export growth rate in the Visegrád region before the crises. However, the crisis hit the level and growth rate of exports of goods of Slovakia the most. Thus Slovakia ranked from first to last in terms of the average monthly growth rate of exports of goods to the EU-15 among the Visegrád countries. From January 2013 Poland had the highest average monthly growth rate of exports of goods to the EU-15.

Commodity trade in the Czech Republic was also significantly reduced by the crisis on both the export and the import side, yet it is characterized by an average decline compared to other countries in the Visegrád region.

In terms of the region's imports of goods, Poland recorded the highest monthly average growth rate in the pre-crisis period. Nevertheless, the crisis caused the highest decline in the case of Poland in terms of level and trend change. Still, Poland's post-crisis growth rate of imports of goods is the second highest in the Visegrád region, topped only by Slovakia. The summarized results are shown on the following table:

8. Main partners and trade composition of the Visegrád countries

The Visegrád countries are highly open regarding their export/ GDP ratio. Based on the databases of Eurostat and UN COMTRADE, the export/GDP ratios of the Visegrád countries are shown on Appendix: Figure A-1. The export share in GDP of Hungary, Slovakia, and the Czech Republic rose similarly from 56.5%, 59%, and 50% in 2001 to 78.5%, 89%, and 82.5% in 2018, respectively. The export/GDP ratio of Poland also rose significantly from 18.5% to 44.5% during this period. It is important to emphasize that Poland is an exceptional case in the Visegrád region both in terms of land area and population and thus in most economic indicators. For example, its nominal GDP is higher than that of the other three Visegrád countries combined. Thus, although Poland has a lower share of total exports and imports relative to GDP, it is nominally the largest exporter and importer of the region. Germany is by far the biggest trade partner of the Visegrád countries accounting for about 22–32 percent of total exports and 20-26 percent of total imports in all cases. In fact the value of trade between Germany and the Visegrád region exceeded the value of trade between Germany and France by about 71.4 percent in 2018. As a result, the economic performance of the region is highly dependent on the performance of the German economy. In the past 10 years, the V4 economies have benefited greatly from the prosperity of the German economy. Through manufacturing and the automobile industry, the expansion of German multinational

companies has led to a major development in the Visegrád region. However, as the researchers of the Hungarian Institute of Foreign Affairs and Trade claim, the real question in the future will be the extent to which the Visegrád countries can surpass their current „assembly plant" role, relying on their own development, R&D capacity, and education systems (Tulok et al. 2018).

According to the data of the International Trade Centre (Appendix: Table A-1) for the year 2018, it is quite clear that the EU-15 represents more than 50% (in the case of the Czech Republic it is even about 60%) of the total trade (exports and imports combined) of the Visegrád countries. In the case of Slovakia, the second biggest trading partner is the Czech Republic which is not a surprise considering the common history of the two countries. However, for the Czech Republic although Slovakia is the third biggest trading partner, it is not as significant as the other way around. Another interesting fact is that in the case of the Czech Republic and Poland, China appears to be among the top five trading partners, but it is mainly because of its strong position on the imports side. In the following section I will focus on the trade relations of the Visegrád countries with the EU-15 since as it was proved, it represents more than half of all trade in value. According to the database of the International Trade Centre, the Visegrád countries have a very similar pattern of foreign trade (Appendix: Table A-2). The three biggest commodity categories, namely *Electrical machinery and equipment and parts thereof, sound recorders and reproducers, television **...;** machinery, mechanical appliances, nuclear reactors, boilers, parts thereof; and vehicles other than railway or tramway rolling stock, and parts and accessories thereof* are identical. In the case of Hungary and Slovakia these three commodity groups accounted for more than 30% of total exports and more than 25% of total imports. In the case of the Czech Republic they accounted for more than 35% of total exports and about 20% of total imports. As for Poland, these ratios are a bit smaller, 24 percent and 18 percent respectively. Considering the trade relations of these countries only with the EU-15, it can be stated that exports and imports are even more concentrated around these commodity groups. A more detailed breakdown of product groups reveals that Hungary exports to the EU-15 mainly spark-ignition reciprocating or rotary internal combustion piston engine, and vehicles with spark-ignition internal combustion reciprocating piston engine of a cylinder capacity more than 1,500 cm^3 but not more than 2,500 cm^3. Furthermore, automatic data-processing machines and units thereof; magnetic or optical readers, machines for transcribing data onto data media in coded form, and machines for processing such data represents a significant role among export products. The most imported products include parts of internal combustion piston engines and parts of passenger cars with the above mentioned parameters and electronic integrated circuits and parts thereof.

Slovakia mainly exports television projections and passenger cars with a cylinder capacity of more than 1,000 cm^3 but not more than 1,500 cm^3 and of 1,500 cm^3 but not more than 2,500 cm^3. Its largest import products are the parts and gearboxes needed for the industrial assembly of the aforementioned vehicles and their accessories and telephone sets, incl. telephones for cellular networks or for other wireless networks; other apparatus for the transmission or reception of voice, images

or other data, incl. apparatus for communication in a wired or wireless network [such as a local or wide area network]; and parts thereof.

The most exported products of the Czech Republic - similarly to Slovakia - are passenger cars with a cylinder capacity of more than 1,000 cm^3 but not more than 1,500 cm^3, and passenger cars with a cylinder capacity of more than1,500 cm^3 but not more than 2,500 cm^3, and parts and accessories of these products. In addition, vehicles with a cylinder capacity of up to 1,000 cm^3, which is the power category most typical of motorcycles, can be found among the most exported products. The largest import products are electronic integrated circuits, components for the industrial assembly of the aforementioned power vehicles and automatic data-processing machines and units thereof, magnetic or optical readers, machines for transcribing data onto data media in coded form, and machines for processing such data.

As for Poland, the largest export products are vehicles with a cylinder capacity of more than 1,000 cm^3, but not more than 1,500 cm^3, as well as television projectors and automatic data processing machines (e.g. laptops, notebooks) weighing less than 10 kg. The largest import products are passenger cars with a cylinder capacity of more than 1,500 cm^3 but less than 2,500 cm^3 and with a cylinder capacity of more than 1,000 cm^3 but not more than 1,500 cm^3. Furthermore, parts of internal combustion piston engines and parts of passenger cars with the above mentioned parameters represent a significant part of the imports.

9. How did trade relations alter as a result of the crises?

The Bank of Japan (Nakajima et al. 2016), created a comprehensive study of the effects of the global financial crisis on world trade. One part of the study deals with the sectoral pattern of the trade slowdown across countries. As for geographical areas, they analyzed China, Japan, ASEAN, the US, the UK, Latin America, the Euro zone, and the G7. According to their study, there was a significant slowdown in every product category they analyzed. The study compared the pre-crisis growth trends to the post-crisis growth trends and the conclusion was that capital goods (except transport equipment), intermediate goods, and consumer goods (durable) exhibited the largest slowdowns.

Following up on this study I have created an analysis of the Visegrád countries' trade relations with the EU-15 (from Appendix: Figure A-11 to A-18). The greater the downward deviation from the 45-degree line revealed by a goods category, the more it contributes to the slowdown of trade after the crisis (2013–2018), compared with the pre-crisis period (2002–2007). The size of the dots represents the percentage share of the given commodity group in the total trade. Although the study of the Bank of Japan created their own product categories, in this study I used the Harmonized Commodity Description and Coding System (HS), which is used by the International Trade Centre from which the database was downloaded. I analyzed the ten most exported and imported commodity groups (2-digit classification) in the case of each Visegrád country.

In the case of the exports of Hungary the biggest decrease was exhibited by the *pharmaceutical products* group and the *optical, photographic, cinematographic,*

*measuring, checking, precision, medical or surgical…*commodity groups. The other product groups showed a moderate slowdown and the *vehicles other than railway or tramway rolling stock, and parts and accessories thereof* category even showed an acceleration after the crisis. On the import side there was no acceleration in the case of any commodity group in the top ten. The biggest deceleration was in the *aluminium and articles thereof* and the *mineral fuels, mineral oils and products of their distillation; bituminous substances* product categories.

The case of Slovakia is an interesting one. On the export side all of the top ten product groups showed a slowdown. Especially the *electrical machinery and equipment and parts thereof; sound recorders and reproducers, television…*product group revealed a deceleration, as the second most exported product category of Slovakia. But also the most exported product group e.g. *vehicles other than railway or tramway rolling stock, and parts and accessories thereof* category showed a significant slowdown. However, on the import side, the situation is rather mixed. The most imported product group e.g. *electrical machinery and equipment and parts thereof; sound recorders and reproducers, television…*product group growth rate showed a significant acceleration as well as the *furniture; bedding; mattresses, mattress supports, cushions and similar stuffed furnishings* product group. The *machinery, mechanical appliances, nuclear reactors, boilers; parts thereof* commodity group growth rate also seemed to accelerate after the crises. Nevertheless the other product groups' growth rate decreased significantly, especially the *iron and steel* and *optical, photographic, cinematographic, measuring, checking, precision, medical or surgical…* commodity groups.

In the case of exports of the Czech Republic to the EU-15, the only commodity group that showed an accelerated growth rate after the crisis was the *furniture; bedding; mattresses, mattress supports, cushions and similar stuffed furnishings* product group. All the other commodity groups including the three major ones decelerated significantly. On the import side, the second most imported commodity group e.g. *electrical machinery and equipment and parts thereof; sound recorders and reproducers, television…*product group growth rate accelerated slightly. Huge deceleration was revealed by *the mineral fuels, mineral oils and products of their distillation; bituminous substances*, and the *iron and steel* product categories.

In the case of Polish exports, the only product group that accelerated after the crises was the *wood and articles of wood; wood charcoal* group. A huge decrease was shown by the *meat and edible meat offal* commodity group. On the import side, the *electrical machinery and equipment and parts thereof; sound recorders and reproducers, television…* product group revealed acceleration and also the *pharmaceutical products* group accelerated slightly. The greatest decrease was showed by the *mineral fuels, mineral oils and products of their distillation; bituminous substances* and *iron and steel* product categories.

10. Conclusion

This paper examined the trade relations of the Visegrád countries with the EU-15 and the impact of the 2008–2009 global financial crisis and the subsequent European sovereign debt crisis on these relations. Two closely related research questions have been formulated in this context. The first one is whether the crises have caused a significant change in the level and trend of trade relations of the examined regions. The other is which product groups are the most responsible for the slowdown.
The paper synthesized the existing literature and contributed to it by approaching the problem with a relatively unusual methodology. In addition to this, the geographical area analyzed is also rarely examined in the broader literature.

In the paper it was shown that the global financial crisis caused a significant (both statistically and economically) level and trend decrease in the trade relations of the Visegrád region with the EU-15. In terms of commodity exports Slovakia revealed the most serious negative effects. In the case of imports of goods, Poland had the highest level and trend decline. In the region, Hungary had the least negative effects, and the Czech Republic revealed average deceleration of trade growth. Thus, both hypotheses were justified.

A more detailed breakdown of product groups has been also analyzed in order to show how the top ten most traded commodity groups contributed to the slowdown of trade. It has been revealed that apart from one or two exceptions, all the commodity groups show a deceleration in growth rate as a result of the crises. The only exception in this question was the case of the imports of Slovakia, where in addition to significant decelerations there were also significant accelerations. This finding confirms the first part of the paper, where my model showed that the growth rate of imports of Slovakia decreased the least among the Visegrád countries.

11. Limitations of the study

The most striking limitation of the research is the assumption that without the crises, foreign trade would have grown at the pre-crisis growth rate. This assumption is due to the nature of the methodology, but there is no econometric model that does not make any preliminary assumptions. However, this assumption only threatens the validity of the "level" difference, it has nothing to do with the „trend" change.

Another limitation is that I did not control for price effects when I analyzed the specific commodity groups' contribution to the total trade slowdown in the second part of this paper. This is due to the fact that there is no such data I could have used for that correction. In most studies inflation or some kind of price indices are used, but in my opinion these methods do not solve the problem either.

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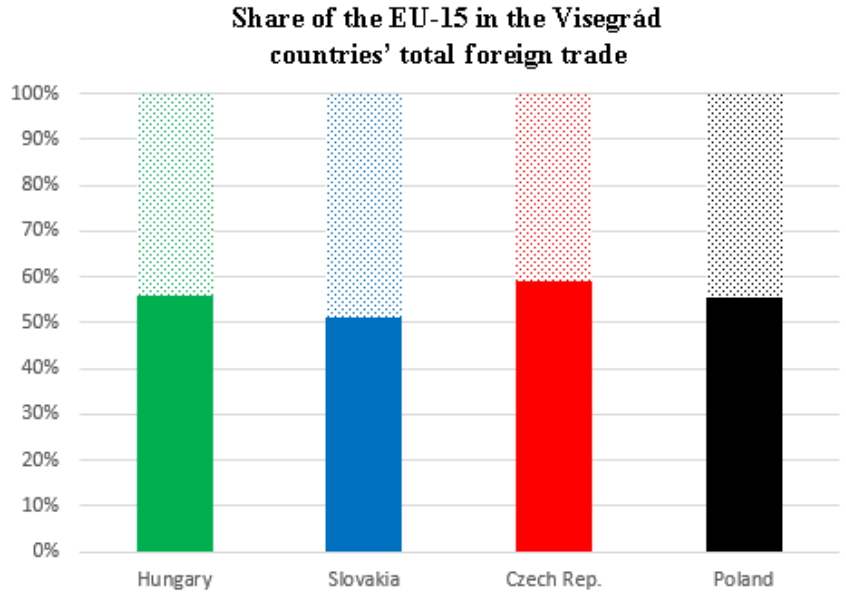
Appendix

Figure A-1 Exports of goods as % of GDP in the case of the Visegrád countries

Source: www.trademap.org

Figure A-2 Share of the EU-15 in the Visegrád countries' total foreign trade in 2018



Source: www.trademap.org

Table A-1 Main trade partners and their shares in total trade of the Visegrád countries, based on 2018 data

Hungary		
No.	**Partner country**	**% in total**
1.	Germany	26.63%
2.	Austria	5.40%
3.	Slovakia	5.08%
4.	Poland	4.97%
5.	Italy	4.94%
Slovakia		
No.	**Partner country**	**% in total**
1.	Germany	21,06%
2.	Czech Republic	13,83%
3.	Poland	7,24%
4.	France	5,15%
5.	Italy	4,60%
Czech Republic		
No.	**Partner country**	**% in total**
1.	Germany	30.25%
2.	Poland	7.44%
3.	Slovakia	6.60%
4.	China	5.06%
5.	Netherlands	4.76%
Poland		
No.	**Partner country**	**% in total**
1.	Germany	25.24%
2.	China	6.32%
3.	Russia	5.22%
4.	Czech Republic	4.87%
5.	Italy	4.82%

Source: www.trademap.org

Table A-2 Most exported and imported commodities of the Visegrád countries by HS 2-digits categories, based on 2018 data

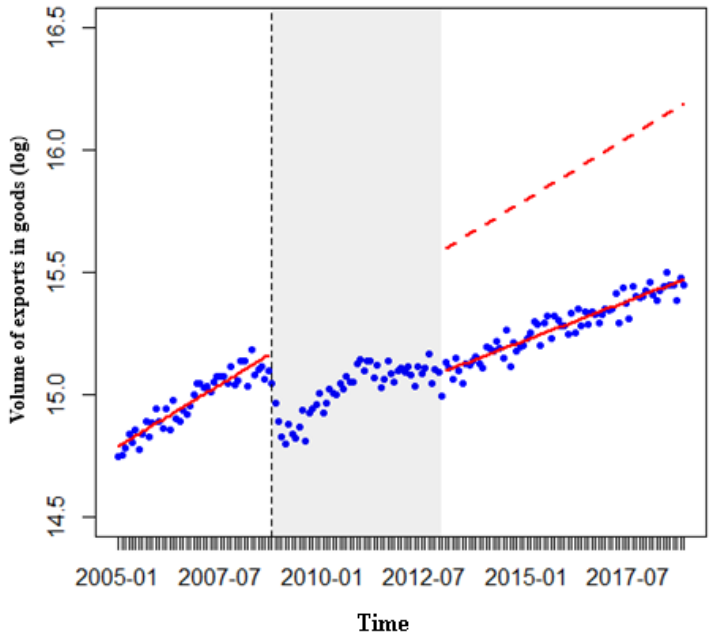
Hungary					
Export			**Import**		
Product label	**Value**	**%of total**	**Product label**	**Value**	**%of total**
Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television **...**	13,410,580	12.78	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television **...**	10,421,463	10.48
Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	11,994,334	11.43	Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	9,235,574	9.29
Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	10,850,653	10.34	Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	6,654,162	6.69
Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical **...**	2,514,396	2.39	Plastics and articles thereof	3,132,661	3.15
Pharmaceutical products	2,099,144	1.99	Pharmaceutical products	3,089,302	3.11
Slovakia					
Export			**Import**		
Product label	**Value**	**%of total**	**Product label**	**Value**	**%of total**
Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	15,648,922	19.59	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television **...**	8,226,547	10.32
Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television **...**	8,479,628	10.62	Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	7,023,045	8.81
Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	5,666,476	7.09	Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	4,936,311	6.19
Rubber and articles thereof	1,339,195	1.68	Plastics and articles thereof	1,783,714	2.24
Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral **...**	1,304,360	1.63	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral **...**	1,721,031	2.16

Czech Republic					
Export			**Import**		
Product label	**Value**	**%of total**	**Product label**	**Value**	**%of total**
Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	23,504,980	13.71	Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	12,079,726	7.71
Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	23,076,358	13.46	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television **...**	10,323,094	6.59
Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television **...**	20,929,018	12.20	Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	9,522,399	6.08
Articles of iron or steel	4,076,397	2.38	Plastics and articles thereof	5,570,768	3.56
Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; **...**	3,634,739	2.12	Iron and steel	2,949,659	1.88

Poland					
Export			**Import**		
Product label	**Value**	**%of total**	**Product label**	**Value**	**%of total**
Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	17,777,565	8.02	Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	15,770,839	6.96
Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	17,715,486	7.99	Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	14,703,195	6.49
Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television **...**	15,944,714	7.19	Plastics and articles thereof	9,336,171	4.12
Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; **...**	8,633,668	3.89	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television **...**	9,226,613	4.07
Plastics and articles thereof	7,103,881	3.20	Iron and steel	4,809,560	2.12

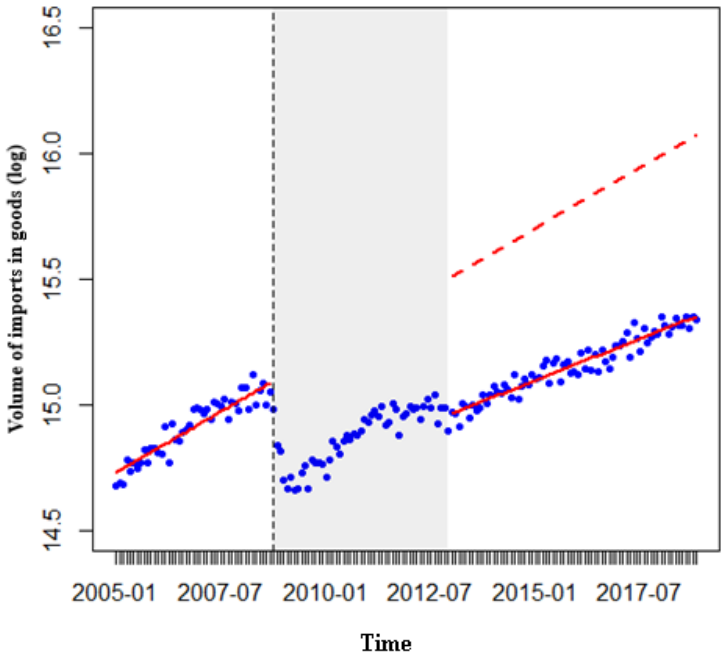
Source: www.trademap.org

Figure A-3 Exports of Hungary and the applied Interrupted Time Series Model



Source: own consturction

Figure A-4 Imports of Hungary and the applied Interrupted Time Series Model (R plot)



Source: own consturction

Figure A-5 Exports of Slovakia and the applied Interrupted Time Series Model (R plot)

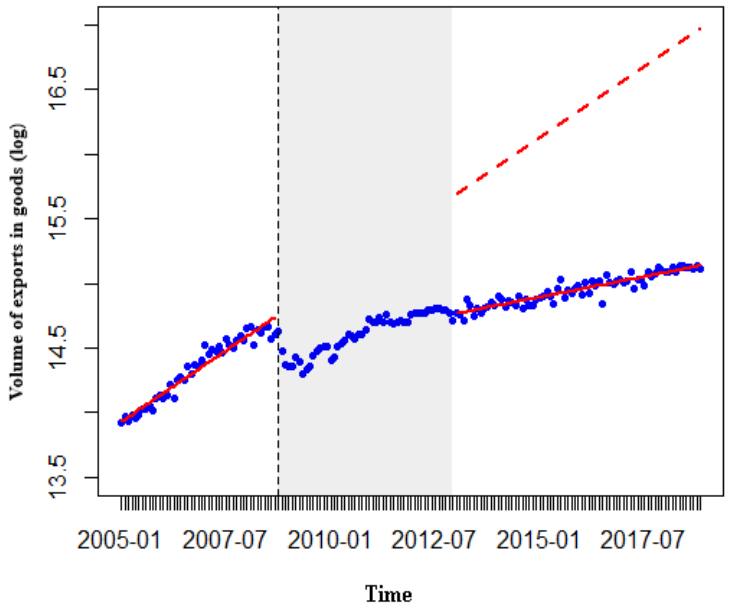


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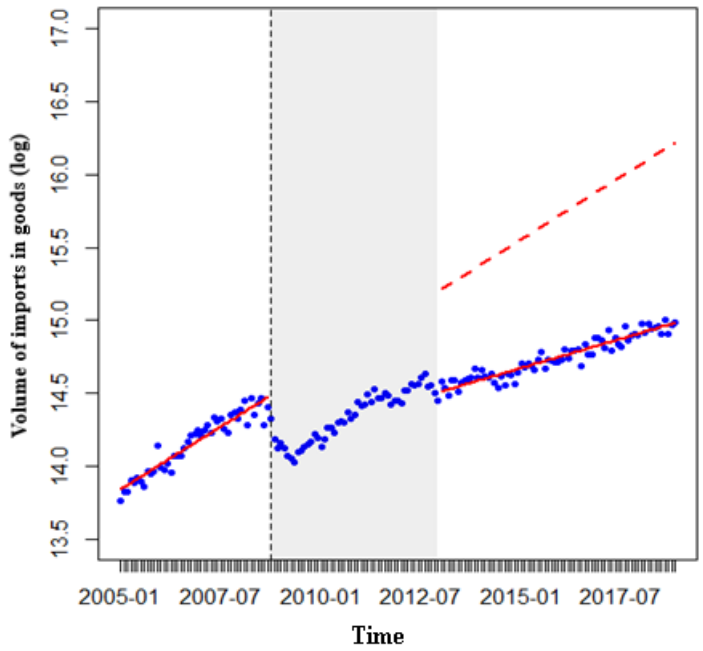
Figure A-6 Imports of Slovakia and the applied Interrupted Time Series Model (R plot)



Source: own consturction

Figure A-7 Exports of the Czech Republic and the applied Interrupted Time Series Model (R plot)

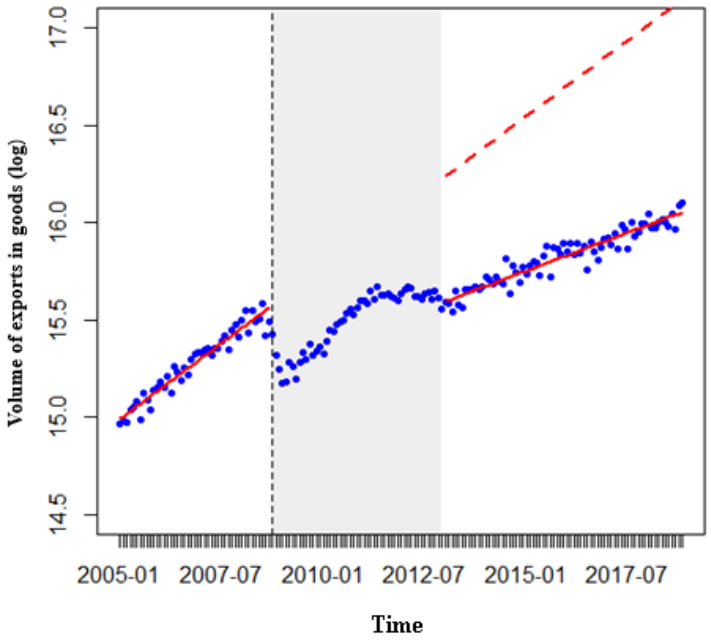


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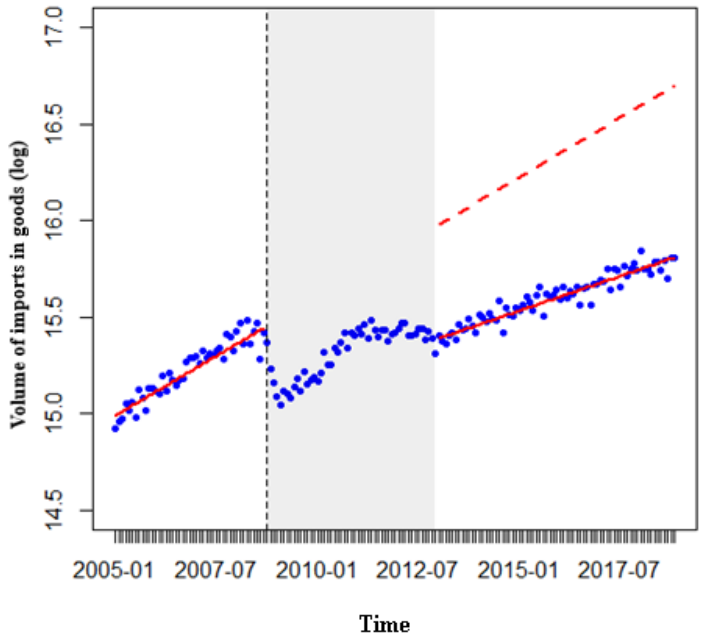
Figure A-8 Imports of the Czech Republic and the applied Interrupted Time Series Model (R plot)



Source: own consturction

Figure A-9 Exports of Poland and the applied Interrupted Time Series Model (R plot)

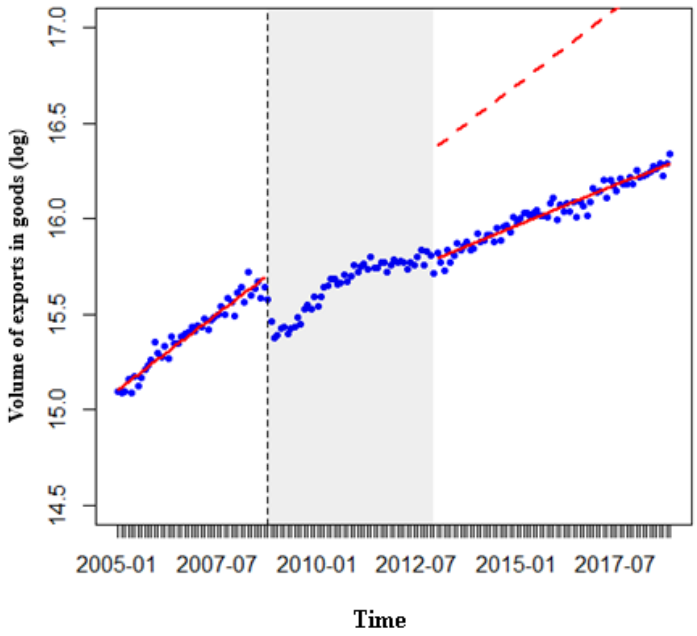


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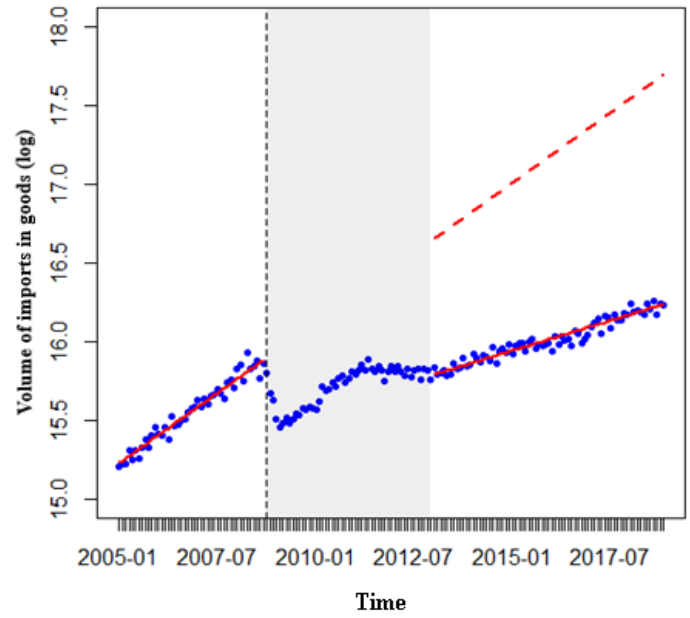
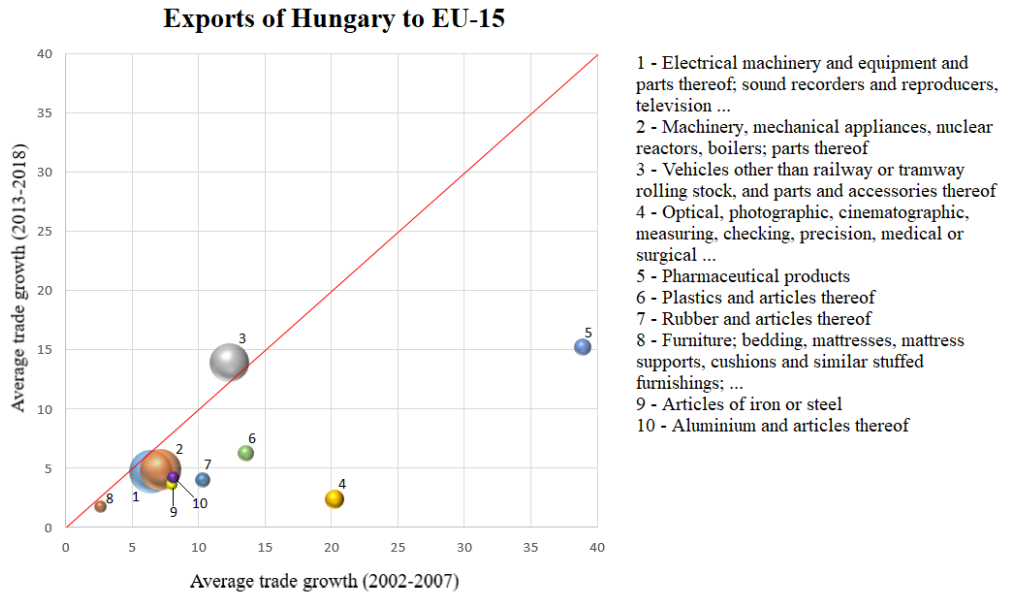
Figure A-10 Imports of Poland and the applied Interrupted Time Series Model (R plot)



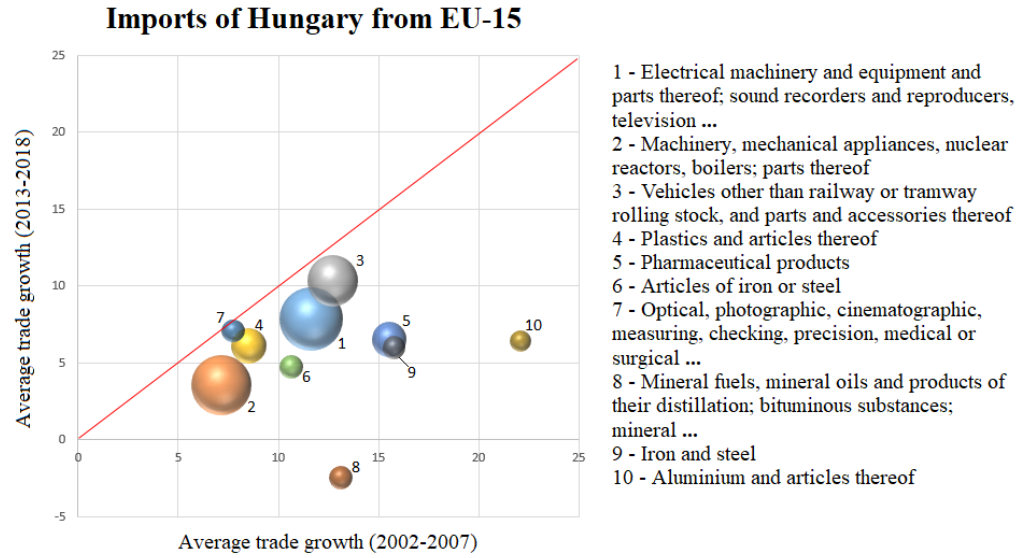
Source: own consturction

Figure A-11 Contribution of the 10 most exported commodity groups at HS 2 digits level to the trade slowdown of Hungary



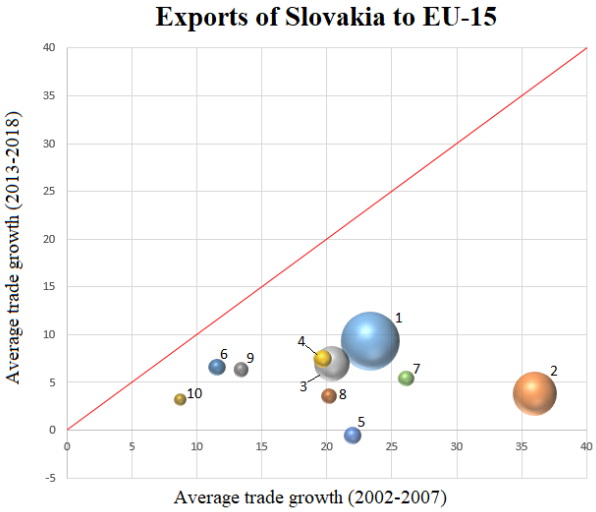
Source: www.trademap.org

Figure A-12 Contribution of the 10 most imported commodity groups at HS 2 digits level to the trade slowdown of Hungary



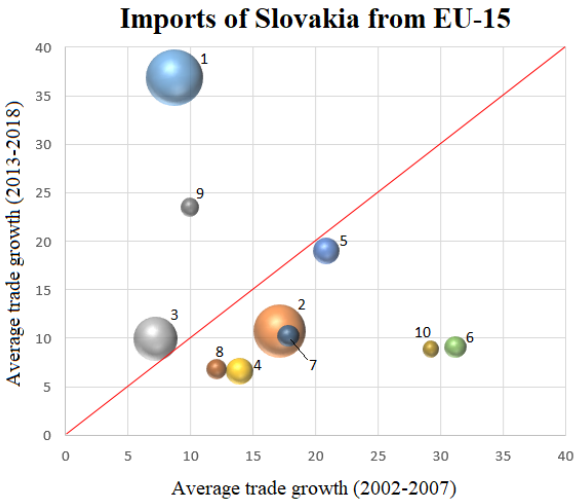
Source: www.trademap.org

Figure A-13 Contribution of the 10 most exported commodity groups at HS 2 digits level to the trade slowdown of Slovakia



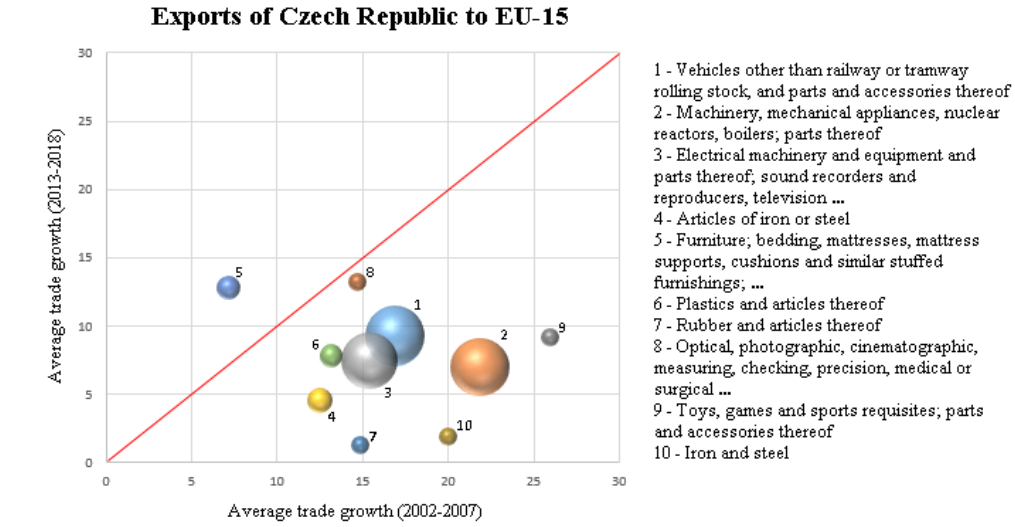
Source: www.trademap.org

Figure A-14 Contribution of the 10 most imports commodity groups at HS 2 digits level to the trade slowdown of Slovakia



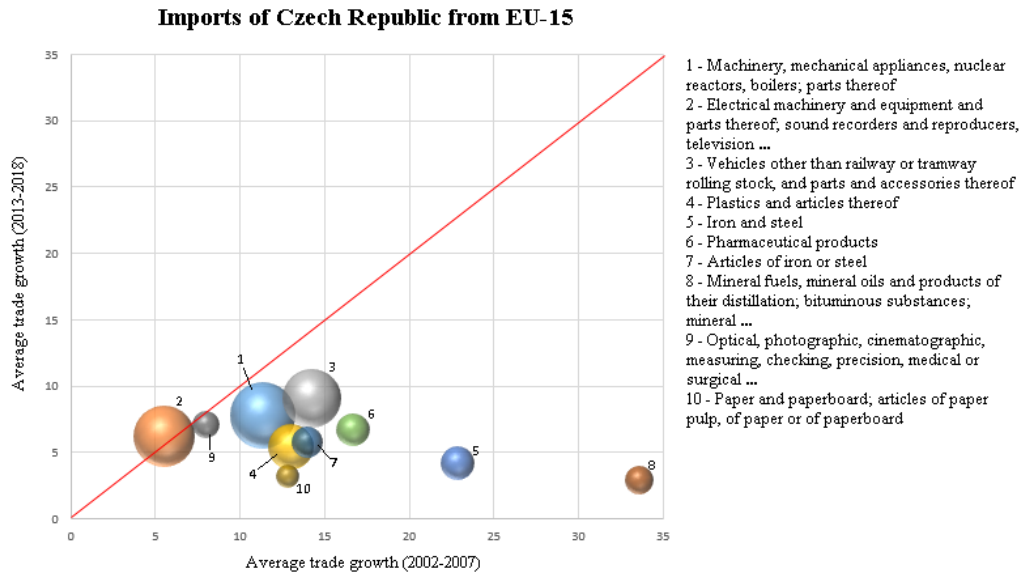
Source: www.trademap.org

Figure A-15 Contribution of the 10 most exported commodity groups at HS 2 digits level to the trade slowdown of the Czech Republic



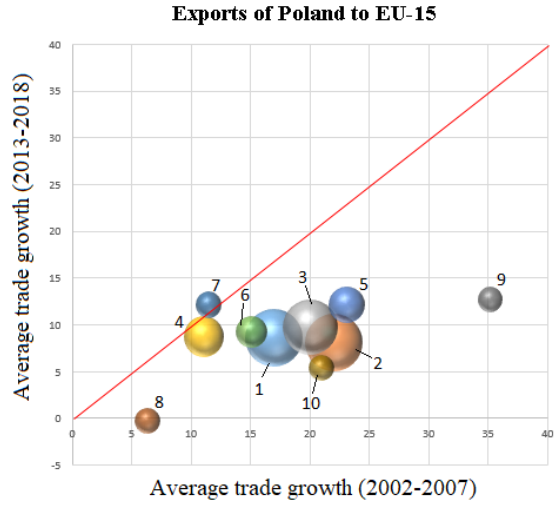
Source: www.trademap.org

Figure A-16 Contribution of the 10 most imported commodity groups at HS 2 digits level to the trade slowdown of the Czech Republic



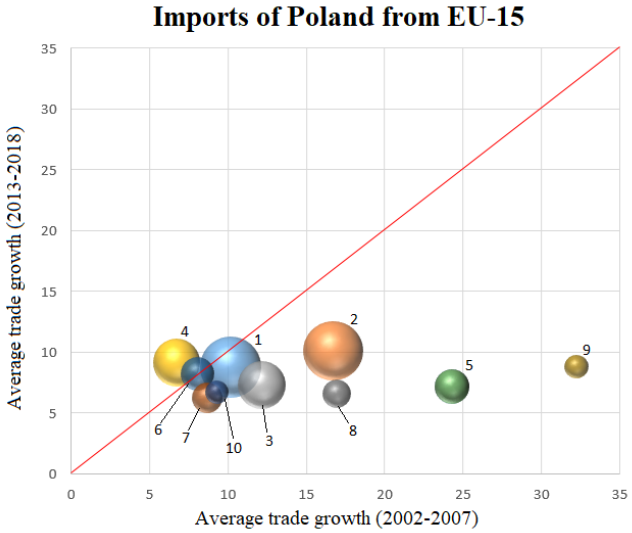
Source: www.trademap.org

Figure A-17 Contribution of the 10 most exported commodity groups at HS 2 digits level to the trade slowdown of Poland



Source: www.trademap.org

Figure A-18 Contribution of the 10 most imports commodity groups at HS 2 digits level to the trade slowdown of Poland



Source: www.trademap.org

Chapter III
Sectoral analysis

Udvari B. (ed) 2020: Proceedings of the European Union's Contention in the Reshaping Global Economy. University of Szeged, Doctoral School in Economics, Szeged, https://doi.org/10.14232/eucrge.2020.proc.8

Drivers of productivity differences in the Hungarian manufacturing sector 2014–2017

Péter Juhász – Lászó Reszegi – Miklós Hajdu

Earlier research proved the existence of multilayer dualities within the Hungarian Economy. Based on these findings, this paper examines the driving forces of productivity differences comparing two groups in Hungarian manufacturing sector: locally owned and foreign-owned companies. The cluster analysis and the panel regression based on financial data of 1725 firms for the period 2014 to 2017 revealed that, while crucial driving forces may match, their direction and importance differ considerably. While foreign companies have an apparent advantage in productivity, their increase in export ratio correlates with lower efficiency; in contrast, export intensity boosts the efficiency of the locally owned companies. While the proportion of highly trained workforce correlates with productivity, this effect appears to be weaker in foreign-owned companies, which signals inefficient use of intellectual resources. These results raise questions regarding the efficacy of the current Hungarian economic policy of promoting foreign investments (FDIs).

Keywords: competitiveness, TFP, ownership, export, wage level

1. Introduction

International statistics show a considerable difference among the productivity levels of different countries, and within countries across industries, company size, and ownership types. Usually, locally owned entities are less productive than foreign-owned ones, particularly in emerging countries. Such productivity lag hampers inter-firm cooperation and the convergence of countries – a fundamental goal of the European Union.

Understanding the drivers of productivity differences may help to find appropriate economic development policy measures, increasing the efficiency of firms, and boosting GDP growth. After a short literature review, this paper focuses on comparing differences in drivers of productivity across various groups of Hungarian manufacturing firms for the years 2014–2017.

2. Literature review

There is an extensive and diverse literature concerning the differences in business productivity. Results underscore that productivity disparities across countries are mostly due to inequalities in access to resources like technology and human knowledge. Besides that, different levels of managerial skills also have a considerable role in both inter- and intranational productivity differences (Bloom et al. 2010, 2012a, 2012b). Within countries or industries, these differences also depend on the

level of development of the economy. Syverson (2010) states that in China and India, the most productive ten percent of the business sector may perform four or five times better than the rest of the economy. In comparison, in the USA, there is only a ninety percent difference between these two groups

Duality is not a new problem, as it is inherent in foreign direct investments (FDIs). It inevitably occurs when investments from more developed countries take place in less developed regions (McMillan–Rodrik 2011). Halpern et al. (2015) highlight that during or after the transitions in the Central and Eastern European (CEE) countries, productivity growth stemmed from the expansion of the private economy, the increased investment activity of foreigners, the breakdown of trade barriers, and thereby boosted exports and imports.

Expanding FDI has deepened duality in CEE. Subsidiaries of foreign companies adapted their structures developed elsewhere within a short period; that is, as Dyker (2004) emphasises, the workforce had the capacity for internalisation in terms of education, social, and ethical standards. In addition to utilising existing capabilities, capital, investments into technology and equipment was also needed, but systems, including management techniques, had to be adapted too to realise productivity benefits. However, this process caused an increase in duality rather than any convergence.

The lack or the limitations of convergence appeared on several fronts. For example, foreign-owned firms created significant exports and intensive imports. Nevertheless, their impact on productivity and growth remained localised; it manifested only within the group of privatised firms or greenfield investments. However, based on Majcen et al. (2009) and Vukšić (2016), they had little or no impact or spillover effects on locally owned firms, or sometimes they even had apparent negative consequences.

Researchers could not identify any convergence on productivity between locally and foreign-owned firms in ten CEE countries over the period between 1995 and 2014, either at country level or the level of most industries. (Table 1) Although the productivity gap has somewhat narrowed, this was mainly due to significant productivity increases in some countries, especially the Baltic States, while Bulgaria lagged behind during this period. Niţoia and Pocheab (2016) underline that meanwhile, significant divergences have emerged across sectors.

Table 1 GDP per capita in purchasing power parity (EU 27 (without UK) average=100)

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Bulgaria	44	46	47	46	47	48	49	50	51	53
Czechia	84	84	83	85	87	88	88	90	91	92
Estonia	66	72	75	77	79	77	77	79	82	84
Latvia	53	58	61	63	64	65	65	67	69	69
Lithuania	61	66	71	74	76	75	76	79	81	82
Hungary	66	67	66	68	69	70	68	69	71	73
Poland	63	66	68	68	68	69	69	70	71	73
Slovakia	76	76	77	78	78	78	73	72	73	74

Source: Eurostat-FATS (2020b)

Foreign companies bring benefits to the host countries; however, their presence in the region is mostly due to the lower wage level. Trends in employment in developed European countries between 1993 and 2010 showed that employment increases in host countries occurred in outsourceable activities with medium wage demand, such as machine operators and assembly activities. Cost advantage was the primary driving force behind this restructuring, and these trends led to a stiffening of the division of manufacturing activities across countries. This phenomenon is reflected in longer-term variations in economic development (GDP), wage differentials, and lack of convergence. In the dual-economy structure, insufficient convergence may also originate from foreign subsidiaries exercising full process control in their business model.

Based on Goos et al. (2014), within the locally owned companies, more complex reasons restrict cooperation with foreigners and the ability to catch-up by themselves. Primary factors include the available amount of capital, business size, and the quality of the management.

The lack of convergence is apparent beyond the field of corporate productivity, according to Hungarian researchers, like Kotosz and Lengyel (2018). The V4 countries (Slovakia, Czech Republic, Poland, and Hungary) did not show convergence in GDP per capita between 2000 and 2014. However, some post-crisis convergence appeared due to the slowdown in the developed regions. The causal relationship between FDI and economic development could not be confirmed for the V4 countries. Instead, the squeeze-out effect of multinational companies on the domestic market is likely to gain importance.

While FDI does not lead to a higher level of development in V4 countries, the relative level of development affects their ability to attract capital. The economic model based on FDI was distorted, and the policy of supporting foreigners was not coupled with the strengthening of domestic companies. Gál and Juhász (2016) underline that this phenomenon was particularly real in Hungary, and least valid in Poland, where the internationalisation of Polish companies was an explicit economic policy objective.

In the division of production activities within the European Union, the weight of manufacturing in the ten post-socialist countries almost doubled after 2000, rising from 5.5% to 10.6% by 2016 (Nagy et al. 2019). This growth is a consequence of the intensive FDI and indicates the main direction of the division of activities within the EU. Regional FDI activity mainly covers low value-added, labour-intensive activities based on the cheap workforce. This group of countries emerged into assembling locations, while higher value-added activities tend still to concentrate on more developed countries. This division reproduces a centre-periphery relationship. Obviously, beyond the natural interests of countries, there may be fundamental reasons for this, which are rooted in the low productivity, weak innovation, reduced knowledge level, and poor management skills in these peripheral countries. Late arrivals would find it difficult to obtain positions even if they had no fundamental disadvantages.

Koppány (2017) highlights that foreign investments in Hungary are mainly export-oriented, using imported materials for creating an export. The growth effect derives mostly from the increase in volume, as the value-adding of exports is mostly low. Companies of the automotive industry are at the forefront of the group of firms following this scheme.

In the manufacturing sector dominated by foreign companies (manufacturing of vehicles, computers and optical products), the value-added content is the lowest among all sectors, according to the input-output tables. Besides these sectors, very few rely on domestic suppliers, while electronics is ranked first based on import activity, and automotive industry achieves the third or fourth position. During recent years, the positive effect of economic growth has been accompanied by an increase in risk in the economic structure. Duality was maintained and strengthened. The domestic corporate sector did not strengthen, and the "sectoral portfolio" of the manufacturing industry did not improve. Economic stability requires diversification, competing domestic and foreign companies, and a risk-reducing sectoral structure.

Research shows that multilayer duality characterises the Hungarian economy (Reszegi–Juhász 2014, Juhász–Reszegi, 2017). A sample of more than 4000 non-financial private firms showed that neither the foreign-owned nor locally owned firms form homogeneous groups themselves. To separate firms using different kinds of technology, we created groups based on whether the given firm paid an average wage higher than what its sub-industry did. For instance, low-wage foreign companies performing usually simple, low-added value tasks had low productivity and performed no better in efficiency than locally-owned counterparts. In contrast, locally owned firms with significant export sales (at least 25 percent of the total sales) showed significantly higher efficiency than the other part of the sub-sample. Foreign firms with high technical equipment level (PP&E/capita) and a high wage (paying over 70–80 percent above the average) could be statistically linked to extraordinary productivity.

Financial statement data do not explain the vast differences within other groups of firms; factors like management skills or innovation level seem to play a role – this requires further research. Ten case studies by Ábel and Czakó (eds. 2013) on export intensive Hungarian companies supported this idea. It became clear that the knowledge and experience of the owners and the top management have a strong influence on the export orientation and the strategy of these firms. These suggest that, in order to be competitive, a company has to be efficient, profitable, and able to learn market and technology; thus, a simple governmental export incentive will not be enough for substantial uplift.

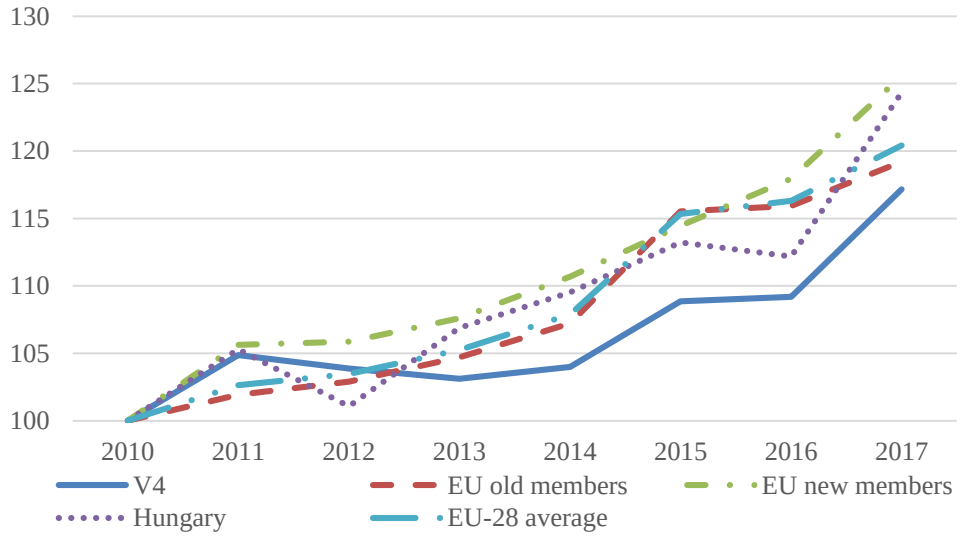
Due to the different dualities existing in parallel with each other, the competitiveness of firms cannot be enhanced by a general, uniform economic policy. (Chikán et al. 2018) To uncover the main drivers behind the differences and identify possible roads leading to convergence, a more complex multidimensional approach is required.

3. Productivity differences across the EU

During recent years, the productivity of V4 country firms has grown in par with their counterparts in the EU (Figure 1). This trend practically implies a lack of convergence, as closing the gap would require a considerably faster development of V4 than the average of old EU members.

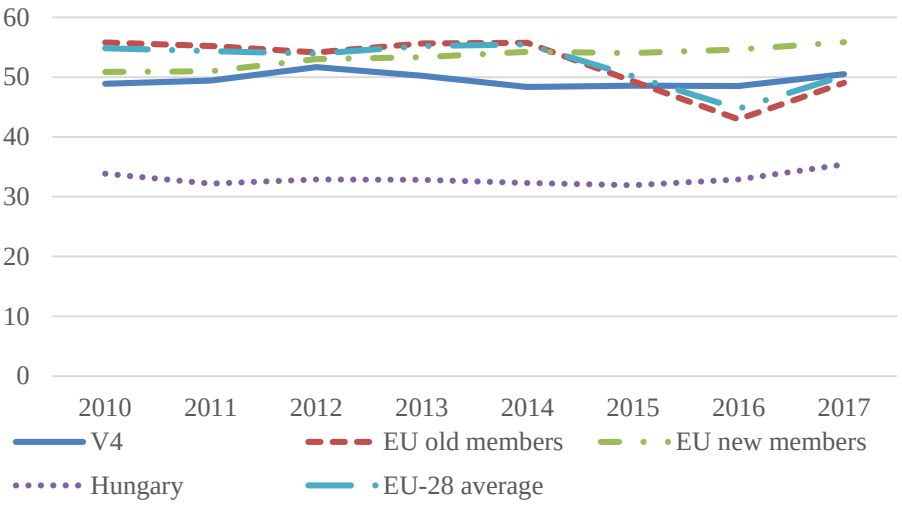
Can we expect the investment of foreign firms to help this process? Seemingly, yes, as based on the data from Eurostat-FATS, foreign firms achieve a higher added value per employee level in any EU member country (Figure 2). Though when considering the historical development path, the hope fades. In 2017, the performance fallback of the locally owned companies in old member states was higher than in 2010 by almost 7 percentage points. While the same lag in the new member states decreased by 5 percentage points, the local firms still did not reach 56 percent of the foreign-owned performance. So, a considerable convergence is nowhere to see. On top of that, Hungary produced a far more unfavourable ratio of 35 percent, and the value even decreased by 1.5 percentage points over the years considered.

Figure 1 Productivity* of firms by regions (2010=100)



*Gross value added per person employed, thousand euro
Source: Eurostat-FATS (2020a)

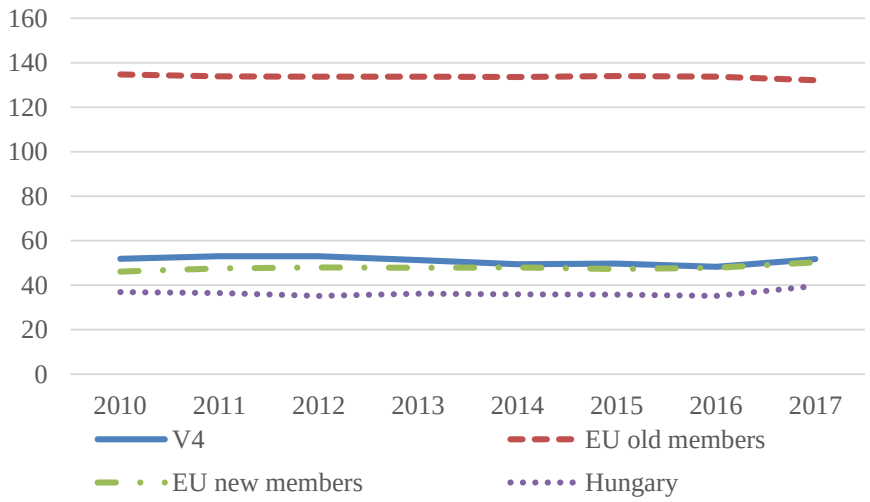
Figure 2 Productivity of locally owned firms as a percentage of that of foreign-owned companies in the same country (%)



Source: Eurostat-FATS (2020a)

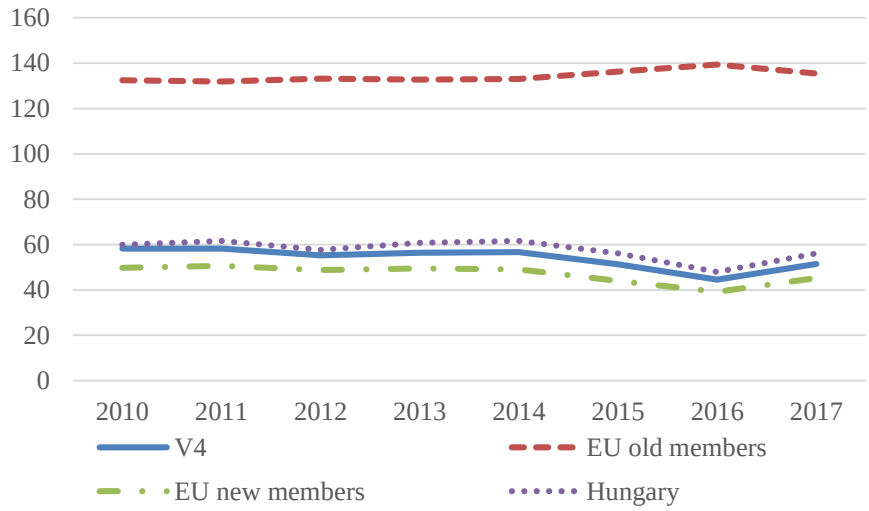
There could be many causes explaining the higher performance of the foreign-owned firms. International business activity usually favours bigger size and higher efficiency, while the average locally owned firms are in a far smaller size range.

Figure 3 Productivity of the locally owned firms as a percentage of that of the locally owned companies in the EU (%)



Source: Eurostat-FATS (2020a)

Figure 4 Productivity of the foreign-owned firms as a percentage of that of the foreign-owned companies in the EU (%)



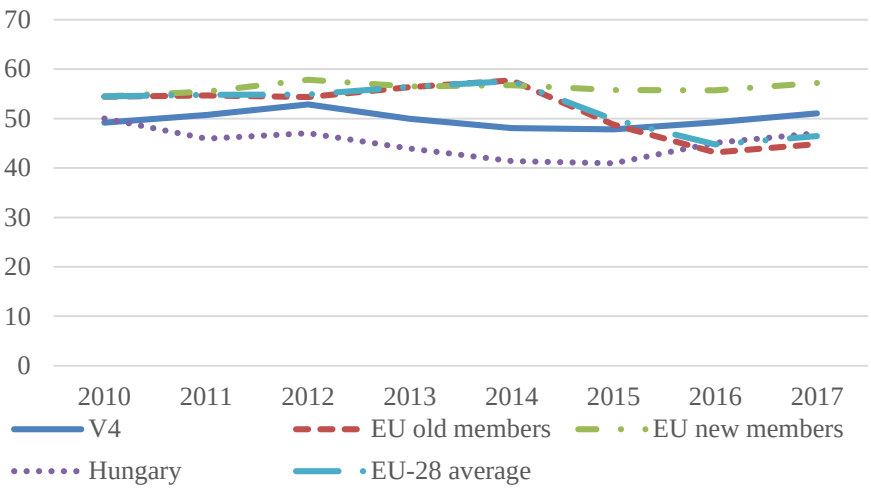
Source: Eurostat-FATS (2020a)

Due to this difference, when contrasting the efficiency rates to the EU average, we should separate the companies on ownership to avoid distortions caused by the complex structuring of the countries (Figures 3 and 4). As for the locally owned firms, new EU members have shown some closing-up to the old members' level. Statistics on foreign-owned companies show a similar picture but with a small deterioration. It is only the average of the new members that got closer to the average of the old ones, but there was no considerable closing-up, neither for locally nor for foreign-owned companies.

When we only focus on the manufacturing industry, the specific research area of this paper, the trends are no different. (Figure 5) During the period 2010 to 2017, locally owned companies experienced a worsening position, typically, compared to foreign-owned companies. Those were only the average of the V4 and the new members that have shown some improvement, while Hungarian firms have a slightly more significant lag. Once again, generally, we see no trace of measurable convergence in any of the groups.

Without any doubt, the growing number of foreign companies and their increasing role in employment has boosted the average productivity of the receiving countries. At the same time, the productivity of foreign companies lags behind the EU average most likely due to the role foreign companies play in the international supply chains. The low added value content of their production may explain why they show little or no positive effect in host countries during the period 2010–2017. The productivity of foreign firms in CEE countries (EU new members) has grown to a lesser extent than their locally owned counterparts and their Western-European counterparts. The gap between a locally owned firm in new and old Member States has slightly narrowed while that between the foreign-owned firms in those two regions instead extended. (See Figures 3 and 4)

Figure 5 Productivity of locally owned firms as a percentage of that of foreign-owned companies in the same country in the manufacturing industry (%)



Source: Eurostat-FATS (2020a)

Thus, the inelasticity of the role these foreign-owned firms play in the global division of labour hampers any closing-up of the host countries. For instance, even if the economy of a less developed country consisted of such foreign-owned firms entirely, the national average productivity would appear to be only 50–60 percent of the developed countries.

Locally owned companies do not show a secure sign of considerable improvement potential either. Their productivity lag is so massive that it makes the opportunities offered by the export markets and the cooperation opportunities with multinationals nearly unreachable.

The presence of the foreign companies is not disadvantageous, of course, but the convergence also calls for successful locally owned entities. However, the question remains: what do locally owned firms that promote catching-up look like.

4. The performance of the Hungarian manufacturing industry

Dramatic differences appear in the workforce efficiency across firms in Hungary (just like in other CEE countries). Our research aims at identifying the key factors that influence the level of added value and those that could support convergence to the Western countries.

4.1. Dataset and methodology

Our database covers the financial statements of privately held Hungarian manufacturing companies with at least ten employees and continuous operation from 2014 to 2017 that published non-simplified financial reports and reported positive equity in each of the years. Companies that went through restructuring, liquidation, or mergers were excluded.

We winsorised the raw data by replacing outliers with the 2nd and 98th percentile, respectively. The Bisnode company provided a dataset extended with details on employment. We also clarified the ownership background of each entity to categorise them as locally or foreign-owned considering their majority shareholder.

With the kind allowance of the Ministry of the National Economy, we were also able to use details for the 2016 wage survey of the Hungarian Central Statistical Office. This survey covered 50 percent of our sample and allowed for estimating the educational breakdown of the employees for the firms in the database. To do so, we created 40 subsamples based on added value/employee, return on investment, and total factor productivity and used the average percentage of employees with higher education for those subgroups from the survey for all companies in our sample belonging to that subgroup.

Based on the data form the financial statements we performed a cluster analysis on return on investment (EBITDA/Invested capital=ROIC), labour productivity (added value/employee), and total factor productivity (TFP). Each of the firms was also categorised on the average wage paid compared to that of the average in their sub-industry. This information allowed us to separate companies with more advanced technology calling for a more trained workforce that usually implies a salary payment higher than sub-industry average. The data collected was organised into a panel.

Table 2 The economic importance of the sample
(Total sample/Total of the Manufacturing industry in Hungary)

Year	N	Sales	Export	Added value	Employment
2014	1725	76.66%	74.78%	67.40%	41.60%
2015	1725	78.13%	75.99%	66.97%	43.39%
2016	1725	80.13%	78.92%	70.73%	43.62%
2017	1725	79.53%	79.02%	74.26%	42.94%

Source: based on KSH (2019a, 2019b)

Table 3 The structure of the sample

	N	Proportion
Foreign-owned (F)	853	49.45%
Locally owned (L)	872	50.55%
Low wage (L)	959	55.59%
High wage (H)	766	44.41%
F low wage (FL)	350	20.29%
F high wage (FH)	503	29.16%
L low wage (LL)	609	35.30%
L high wage (LH)	263	15.25%
Sample total	**1725**	**100.00%**

Source: own construction

We performed all analyses on four data subsets. We created separate groups for locally owned low-wage (LL), high wage (LH), and foreign-owned low wage (FL), and high wage (FH) entities.

We have also sent out questionnaires to top managers of the manufacturing companies to gain a picture on management attitudes and methods applied. The 197 replies collected helped us to describe further each sub-category of wages, ownership, and performance.

Our sample includes a considerably important set of firms in the Hungarian economy (Table 2). As we have seen from the data of FATS (Eurostat-FATS 2020) and an earlier paper on the Hungarian manufacturing industry (Juhász and Reszegi, 2017) two of the main drivers of the inter-firm differences are the ownership and the relative wage level compared to the sub-industry average. Table 3 presents the breakdown of the sample in these dimensions.

4.2. Most important results

To get a deep understanding of the productivity differences across Hungarian manufacturing firm, we performed a two-step analysis. First, we used panel regressions on the financial statement of the firms to see how specific factors influence total factor productivity (TFP). Next, we used management questionnaires to investigate how top performers differ in management aims and style from laggards. This way, we could identify differences even in factors not included in the classic accounting statements.

When we examined the differences in TFP across the wage-ownership groups defined, it became clear that the ownership background alone explains the productivity differences only partly. Foreign companies have a nearly 30 percent advantage over their locally-owned counterparts, though this gap showed a modest decrease over time. We may see an even more differentiated picture if also considering the relative wage level (Table 4).

Table 4 Differences in TFP across wage and ownership groups*

	2014	**2015**	**2016**	**2017**	**Change in TFP (%)**	**N**
Foreign-owned (F)	11.52	11.54	11.55	11.56	4.5	853
Locally-owned (L)	11.22	11.26	11.27	11.29	6.8	872
LL	11.10	11.14	11.16	11.19	8.5	609
LH	11.51	11.53	11.54	11.54	2.7	263
FL	11.27	11.27	11.27	11.31	4.2	350
FH	11.69	11.74	11.75	11.74	4.8	503
Total	11.37	11.40	11.41	11.43	5.7	1725

*Paired group differences are significant at 1 percent in each year.
Source: own construction

Lower than average productivity goes hand-in-hand with low wage level (LL, FL). While still being better, foreign companies lost some of their advantages as the gap between the two groups decreased from 17 to 12 percent thanks to the improvement of the local firms. This increase could be partly the result of the pressure coming from the increasing wage level in the economy, calling for efficiency improvement.

It is important to note that local high wage companies perform much better than the foreign low-wage FL group, so it is not generally true that foreign companies are more efficient than locally owned ones. This misconception comes from the overwhelming advantage of the FH cluster that performs as much as 20 percent above the LH companies. Sadly, the local high wage firms have achieved the lowest improvement over time.

To understand what factors drive the differences in TFPs, we built panel regressions including fundamental ratios, spatial data, and information on sub-industries. As productivity is often linked to the level of the quality of the workforce, education information was added. Given that the percentage of employees with secondary education was very similar across groups, the rate of the employees with higher-level education grew against primary education only. Due to this strong connection, we could only use one of these ratios in our panel regression. Thus, we included the deviation of the company group rate for higher education employees from the industry average.

Table 5 shows the results of our initial linear panel regressions. As a point of reference for the dummy variables, we used the 2014 performance of firms with less than 50 employees and without any export that are headquartered in the capital (Budapest) and were active in one of the thirteen sub-industries without dummies.

Our base model controls for the environmental effects at a relatively low corrected R squared. Based on the panel of 1725 firms, export intensity and TFP are positively interrelated. It seems that the level of technical equipment (PP&E and Intangibles per employee) plays little role in efficiency contradictory to popular belief. Still, investment intensity was significant, either because more efficient firms spent more on new equipment as they can afford it, or as more up-to-date equipment supports efficiency.

It is important to note that the significant effect of sub-industries disappeared once the level of education was added while explanatory power of the model was boosted. We found a robust connection between the level of education of the human resource and the efficiency of the company. This link might be explained by the type of tasks the firm performed, the intensity of innovation and the level of technology used at the given companies.

Table 5 Results of the panel regressions

Dependent variable: TFP	Base run	Education added	Locally owned	Foreign-owned
Corrected R squared	**0.09**	**0.49**	**0.49**	**0.47**
Constant	11.181	11.408	11.393	11.638
Export below 25% of Sales	0.188	0.083*	x	x
Export 25-50%	0.196	0.120	0.071*	x
Export 50-75%	0.227	0.118	x	–0.098*
Export 75-100%	0.225	0.128	0.139	–0.153
Number of employees 50-249	x	X	0.049*	x
Number of employees above 250	x	X	x	x
Vehicles	x	X	x	x
Metalwork	x	X	x	x
Machinery	x	X	x	x
Rubber	–0.080*	X	x	x
Computers	x	X	x	x
Electric equipment	x	X	x	x
Food	–0.090	X	–0.050*	x
Central Hungary	–0.098*	X	x	x
Northern Hungary	–0.278	–0.097	x	–0.100*
Northern Great Plain	–0.219	–0.107	x	x
Southern Great Plain	–0.186	–0.077	x	x
Central Transdanubia	x	X	x	x
Western Transdanubia	–0.143	–0.052*	x	x
Southern Transdanubia	–0.330	–0.172	–0.162	–0.119
Year 2015	0.044	0.036	0.043	0.028*
Year 2016	0.053	0.050	0.060	0.040
Year 2017	0.069	0.070	0.087	0.055
(PP&E+Intangibles)/employee (M HUF)	0.003	–0.006	–0.007	–0.006
Investments/Invested assets_	0.524	0.258	0.259	0.261
Rate of employees with higher education		0.054	0.060	0.047

Unmarked variables are significant at 1 percent. X marks tested variables that proved not to be significant. * Significant at 5 percent.
Source: own construction

When assessing locally and foreign-owned entities separately (Table 5, last two columns), the models showed some surprising results while the explanatory power did not fall. These results are the following.

(1) Export intensity goes hand-in-hand with efficiency only in the case of the locally owned firms. The productivity of the local firms increased together with their export intensity.

(2) Higher export intensity for the foreign-owned companies was linked to lower efficiency. This decrease could not be due to a weaker level of management. Instead, it relates to the type of activity (most likely mass production for the supply chain of the parent company) leads to lower profitability.

(3) The TFP growth of the foreign-owned firms was less than that of the locally owned counterparts in each of the surveyed years. The increasing local wage level put the locally owned firms under severe efficiency pressure. At the same time, the future of foreign companies depends on the performance of the whole supply chain and not solely on the performance of the Hungarian branch. This result also supports

the idea that just because of the presence of foreign-owned firms, we should not expect the dynamisation of the economy. That change will only happen if foreign-owned companies switch to products with higher added value.

Table 6 Results of the panel regressions for ownership and wage level groups

Dependent variable: TFP	**Locally-owned Low wage**	**Foreign-owned Low wage**	**Locally-owned High wage**	**Foreign-owned High wage**
Corrected R squared	**0.44**	**0.40**	**0.49**	**0.45**
Constant	11.348	11.587	11.670	11.838
Export below 25% of Sales	0.087*	x	–0.094*	x
Export 25-50%	0.130	x	x	x
Export 50-75%	0.143	x	–0.089*	–0.142
Export 75-100%	0.222	–0.101*	x	–0.149
Number of employees 50-249	x	x	x	–0.138
Number of employees above 250	x	x	x	–0.160
Vehicles	x	x	–0.126*	–0.123*
Metalworks	x	x	x	–0.070*
Machinery	x	x	x	x
Rubber	x	x	x	x
Computers	x	x	x	x
Electric equipment	x	x	0.197*	x
Food	x	x	x	x
Central Hungary	x	x	x	x
Northern Hungary	x	x	–0.168*	x
Northern Great Plain	x	x	–0.099*	x
Southern Great Plain	x	x	–0.099*	x
Central Transdanubia	x	x	x	x
Western Transdanubia	x	x	–0.097*	x
Southern Transdanubia	–0.137	x	–0.209	–0.145
Year 2015	0.046	x	x	0.055
Year 2016	0.062	x	x	0.070
Year 2017	0.102	0.056	x	0.059
(PP&E+Intangibles)/employee (M HUF)	–0.008	–0.012	–0.007	–0.005
Investments/Invested assets_	0.203	0.196*	0.291	0.305
Rate of employees with higher education	0.067	0.056	0.045	0.039

Unmarked variables are significant at 1 percent. X marks tested variables that proved not to be significant. * Significant at 5 percent.
Source: own construction

(4) It is shocking to see the vast difference in the coefficient of the level of education. While the efficiency of the foreign-owned firms is undoubtedly higher, it is hard to interpret that a higher ratio of well-educated employees couples with lower productivity improvement. Why do foreign-owned firms not use well-trained workforce as efficiently as locally owned companies?

As a next step, we estimated the regressions for each of the four ownership-wage groups separately (Table 6). Based on the result, we may add some additional essential findings.

(5) Higher export is coupled with higher TFP level only in the locally-owned low wage firm group. For the foreign-owned low wage and the locally owned high

wage groups, export is negatively correlated with TFP. However, what is most surprising is that in the most efficient foreign high wage entities, high export intensity is coupled with a TFP fallback that is even bigger in extent than that for the foreign low wage firms. This disrupting effect could be a sign of the inferior position of these firms in the global supply chains.

(6) While the vehicle manufacturing industry is usually considered to raise the general efficiency level in emerging countries, our results show that in Hungary, this industry actually underperforms the other manufacturing sectors in TFP among companies with higher wage or higher technology level.

(7) The coefficients suggest that the efficiency of the locally owned high wage firms only stagnated during the four years analysed. In other words, the best local firms that are meant to contribute heavily to closing the efficiency gap failed to improve. The only group that shows significant efficiency improvement is the locally owned low wage firms – this can be attributed to increasing pressure due to the general wage level increase they experienced during the surveyed years.

(8) An increase in the ratio of employees with higher education contributes most to higher efficiency in the locally owned low wage LL group, where the higher education rate is the lowest. The education effect is diminishing across the groups when the TFP level is increasing. This incident could be an outcome that the more efficient companies hire too many high-educated employees or use them in positions that do not require that high level of education. Our data show that the FH group employs 71.9 percent of labour with secondary education in positions that do not require any particular pre-knowledge. This bias occurs (45.6 percent) even within the LH group.

While most of the factors that are generally considered as influencers of productivity ended up without any significance in several cases, equations could only explain less than half of the variance in TFP. So, it became clear that we would have to look for additional information sources to get a better explanation. As a first step, we run a k-means clustering process to find three groups of firms of similar size (Table 7).

Table 7 Total factor productivity (TFP) cluster centres

	2014	**2015**	**2016**	**2017**	**Change in TFP (%)**	**N**
TFP1	10.80	10.82	10.86	10.90	10.0	518
TFP2	11.39	11.41	11.41	11.42	3.0	848
TFP3	12.14	12.21	12.21	12.21	7.0	359

Source: own construction

The centres of TFP clusters (Table 7) show vast differences among firms. The productivity of the third cluster is almost 130 percent higher than that of the first one and also exceeds that of the second cluster by 80 percent. (Due to the equation, estimated percentage differences are equal to absolute differences in TFP.)

During the four years examined, there were no major changes in these. Nominal efficiency improvements amounted to 3 to 10 percent while inflation and exchange rate effects are of similar size. (Consumer prices climbed by 2.76 percent,

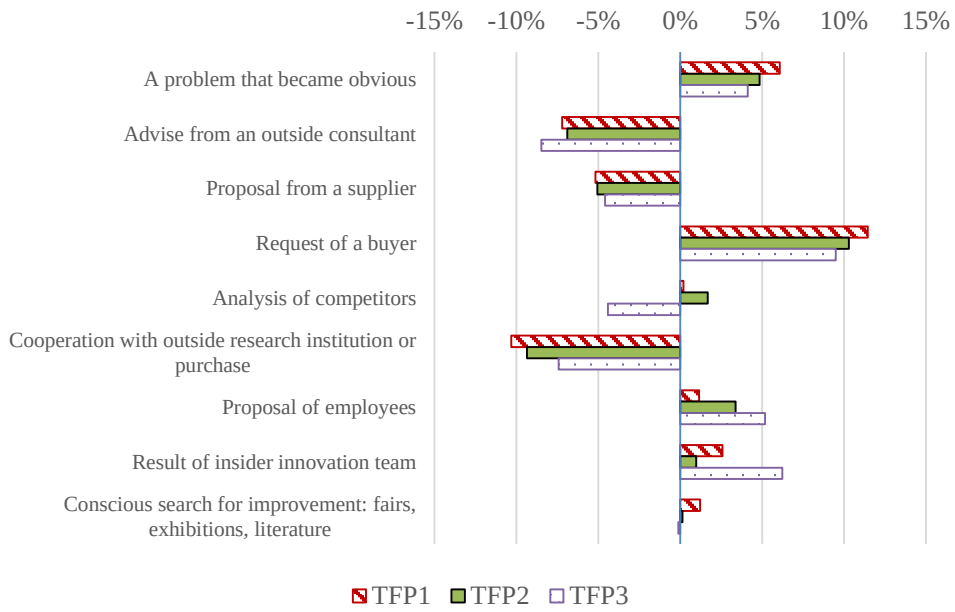
industrial prices rose by 0.63, manufacturing prices grew by 1.13 percent. Export prices went up by 0.18 percent, while import prices fell by 1.74 percent. The euro-HUF exchange rate showed a 1.5 percent fall; KSH, 2020a, 2020b)

As a next step, we asked top managers of firms belonging into one of these TFP clusters about their management style, toolset, and goals to see how TFP3 (top-performer) cluster is different from the other two. (Figure 6) Respondents from the most efficient firm cluster signalled a more than average importance to the initiatives of a development team within the firm and proposals from colleagues when it came to innovations.

Manages stated that buyer request was the most dominant source of innovation. The cooperation with outside research institutions played the least important role. It is interesting to note that the most efficient group (TFP3) paid the least attention to competitors as these companies might be already the best in their sector.

When asked to highlight the most critical success event of the company, top managers mostly voted for introducing a product that subsequently made up more than five percent of sales. (Figure 7) It was only in the group TFP3 that creating an innovative team played a particular role. The group with the lowest productivity gave particular weight to improvements in efficiency, turning into a supplier of a multinational company, and increasing their share in the domestic market.

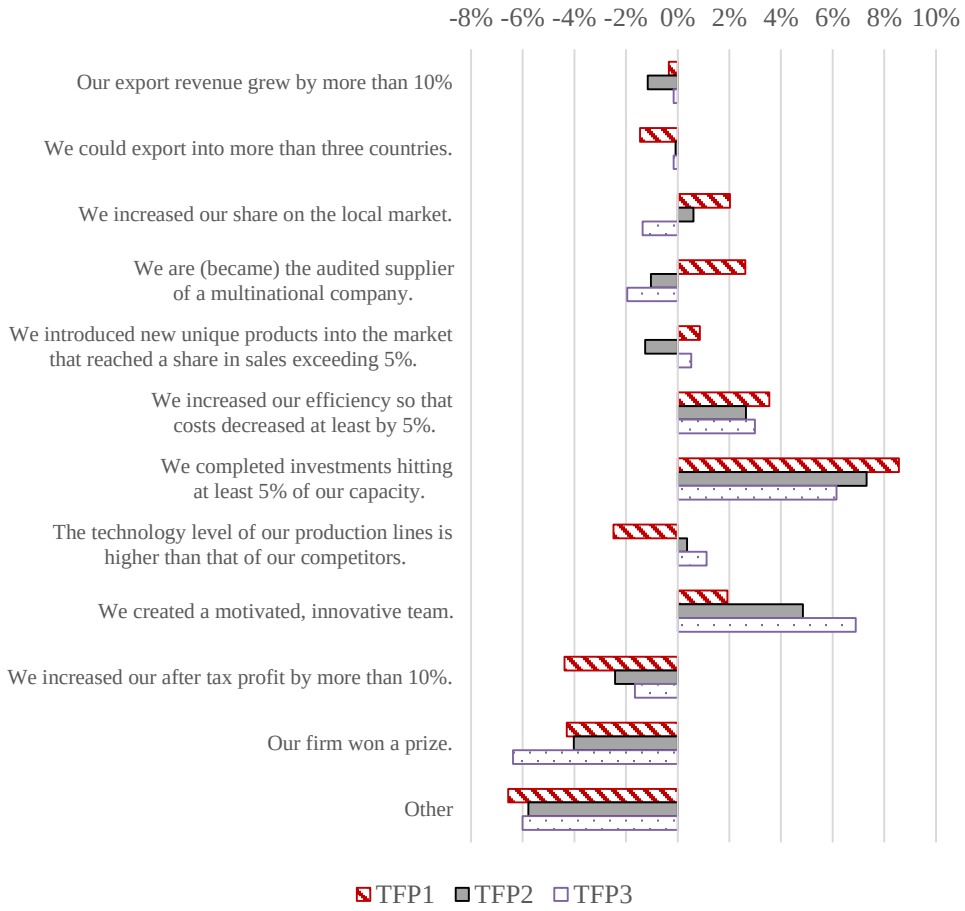
Figure 6 Factors promoting change and innovation during the last three years (questionnaire responses)*



*Altogether there were ten options offered of which a maximum of five should have been chosen. For those selected items, the importance was measured on a 1 to 10 Likert scale. The figure shows the deviation from the average for the importance weighted frequency of each answer.
Source: own construction

The growing shortage of labour boosted the importance of human resource. When asked on HR policy (Figure 8), top managers gave a high weight to statements like "We aim at improving labour efficiency", "Skills and abilities of our employees contribute seriously to competitiveness", and "Keeping our professionals is a critical issue in what corporate culture plays an important role". The most efficient TFP3 group put a more prominent weight than the other two groups on continuously developing the skills of their colleagues, and providing training to achieve that. While training sessions were organised at 61.3 percent of the firms in TFP3, this rate was only 43.0 percent in TFP2 and just 18.5 in TFP1. This extreme difference could be the result of not only managers not considering development essential but also of employees at firms performing such simple tasks that education had little chance to pay off.

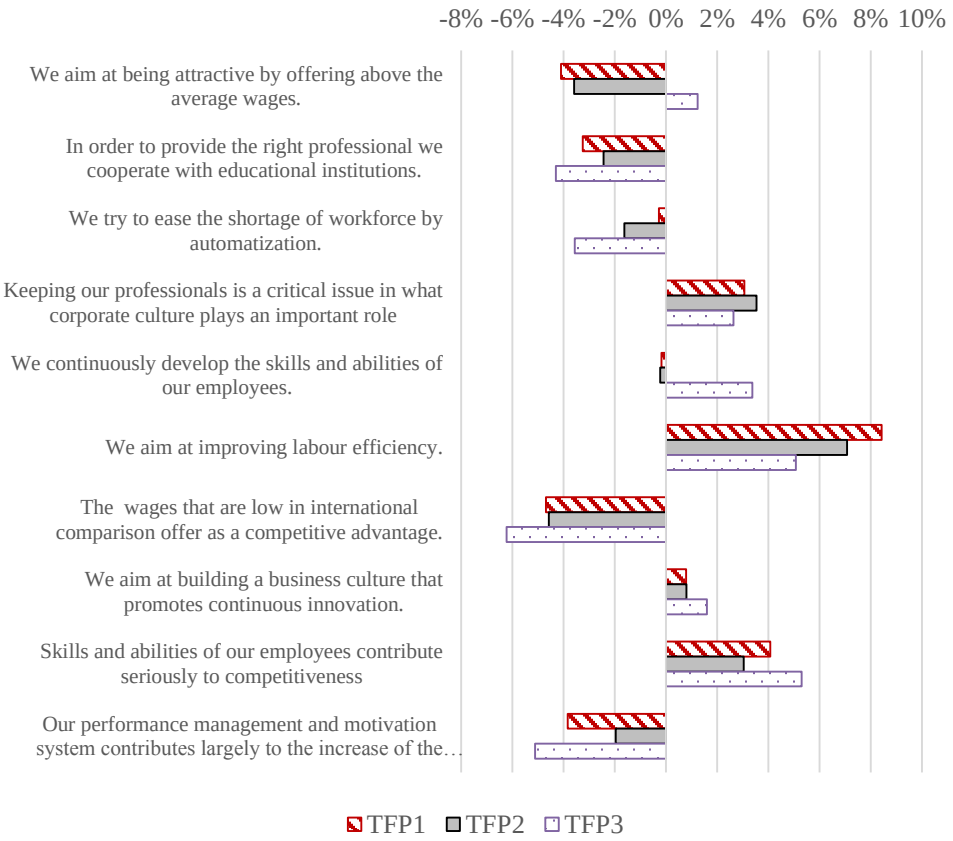
Figure 7 The most critical success events the last three years*



*Altogether there were twelve options offered of which a maximum of five should have been chosen. For those selected items, the importance was measured on a 1 to 10 Likert scale. The figure shows the deviation from the average for the importance weighted frequency of each answer.
Source: own construction

It is also in group TFP3 that the importance of getting human resource by higher than industry average wages is above the average. The other two groups had this with a lower than average importance only that may also be the result of the fact that with lower productivity, it is tough to cover the dynamically increasing wages.

Figure 8 The essential traits of human resource management*



*Altogether there were ten options offered of which a maximum of five should have been chosen. For those selected items, the importance was measured on a 1 to 10 Likert scale. The figure shows the deviation from the average for the importance weighted frequency of each answer.
Source: own construction

The most efficient TFP3 group overweighed answers linked to skills and abilities and excellent and innovative teams. Other clusters instead focus on requests from the buyers, the demand of the local (national) market, and issues that come to light by themselves. When we checked for the employment structure, we found a more significant rate of employees with higher education and a lower rate for those with primary education in the TFP groups with higher efficiency (Table 8).

Table 8 The educational structure of employees across TFP clusters (%)

Level of Education	TFP1	TFP2	TFP3	Average of the Manufacturing Industry
Primary	21.4	17.5	11.9	17.6
Secondary	68.0	67.3	64.5	67.0
Higher	10.6	15.2	23.6	15.4

Source: own construction

More trained human resource has a higher chance to be innovative, more capable of learning and of performing high added value tasks. So, these results show again that the educational structure could have an effect on efficiency. These differences also appear in the wage level. In 2017, an average employee earned 680 euro per month in TFP1 cluster, 942 in the TFP2 cluster and 1,329 in the most efficient TFP3 cluster (1 euro equalled 310 HUF that time).

5. Summary and policy recommendations

Our paper investigated productivity differences across Hungarian manufacturing firms. Based on a sample of 1725 firms, we showed that productivity differences spring out of a wide range of different factors. Still, these effects are different in size and direction for various subsets of firms surveyed, which confirms the earlier identified existence of multilayer duality in the Hungarian economy. Our analysis focused on relative wage level and ownership background of firms with full accounting report published, continuous operation, and positive equity during the period 2014–2017, and identified numerous unique connections.

For the locally owned firms with lower than subindustry average wage (LL), low productivity appears to be linked to a low employee educational level and weak strategic position, in other words, to their disadvantaged role in the supply chain. As for the foreign-owned low wage (FL) companies, those seemed to focus on profit-seeking as the main driving force for their operation seemed to be the low local wage level. The tasks the Hungarian branches performed did not require a high level of training, and thus, no matter what quality the management was, it was not possible to reach a high level of added value.

Theoretically, the locally owned high wage (LH) firms could be the main drivers for the convergence of the national economy to the EU. However, these firms stagnated and showed a weakening position compared to the other three groups in the surveyed period. The foreign-owned high wage firms (FH) had a positive impact on national income. However, their future profitability and growth depend on the supply chain they belong to rather than the progress of the local economy. FH firms showed a slow improvement in efficiency during the surveyed years that might be the result of structural changes or the increase of the share of low added value tasks in their operation while maintaining a higher than average wage level. This latter explanation is supported by the fact that lower TFP accompanied higher export intensity in the FH group.

To sum up, the period 2014–2017 was far from being a success for economic convergence to Western countries. The foreign-owned firms in Hungary had a far lower average efficiency than in old EU member states. On top of that, foreign-owned firms paying a lower than sub-industry average wage were even worse in TFP than their high wage-paying locally owned counterparts. This lag is why policymakers should put more emphasises on carefully selecting what kind of FDI should receive state subsidies. It seems that promoting the growth best performing locally owned firms could have a more prominent boosting effect on the Hungarian economy.

Our panel regressions could not confirm that, as widely believed, the growing export intensity coupled with increasing efficiency in the Hungarian manufacturing industry in surveyed years. It was only valid in case of the low-wage paying locally owned firms. This phenomenon calls for a more careful review of the transfer pricing techniques of the foreign-owned firms, as it is hard to believe that the local market offers higher profitability than export.

Also, we could not find evidence that the vehicle manufacturing firms were more efficient than other sub-industries, that is another widely-quoted misbelief. That is why there is limited justification in offering particular governmental support for developing this sector, particularly if that leads to an overdependence of the local economy on car production as experienced during the period examined.

Further, results do not confirm that the level of technical equipment (PP&E/employee) would correlate with higher efficiency. This result may question the justification of the state subsidies provided during the years of analysis for companies to invest in machinery used in production.

The paper exemplifies that various groups of firms exist that use different business models and thus have heterogeneous drivers of efficiency. This divergence calls for a differentiated economic policy that targets various groups with tailor-made programs to enhance the performance of the firms.

Based on management questionnaires, we concluded that the firms with high TFP built on competitive and profitable products using innovation and motivated, well-trained staff. Hence, the policymakers may want to consider offering subsidies towards innovation, improvement of management techniques, and employing a highly trained workforce.

The need for such programs is highlighted by the fact that during the years analysed, it was particularly the locally-owned firms with more advanced technology and higher wage level that faced difficulties when improving performance.

Besides the coronavirus crisis, the main challenge the Hungarian economic policy faces in 2020 is how to support companies to get out of the trap of performing low added value tasks at low wage level, and renew themselves to cope with the intense wage pressure. Policymakers should focus on motivating the foreign-owned low wage firms to increase their added value while offering a boost to the locally owned high wage firms to develop further. These steps require an increasing amount of well-trained workforce.

At the same time, it is time to realise that the traditional general support of foreign direct investment in Hungary will not promote convergence, and recent political steps that lowered the number of students in higher education further

undermine the convergency process. We also see the government welcoming an increasing number of poorly trained employees from Eastern countries meant to replace well-trained Hungarian professionals who have left to work in Western countries to earn better wages. These tendencies in the labour market give little hope for closing the development gap in the foreseeable future, and call for immediate action from the side of the government.

Acknowledgements

Project no. NKFIH-869-10/2019 has been implemented with the support provided from the National Research, Development and Innovation Fund of Hungary, financed under the Tématerületi Kiválósági Program funding scheme."

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Livestock product supply and factor demand responsiveness: A farm-level analysis in the Southern Rangelands of Kenya

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Despite there being incredible challenges in enhancing livestock development in Kenya, this article isolates product supply and factors input demand responsiveness as the main constraints facing the smallholder. A flexible-Translog profit function permits the application of dual theory in the analysis of livestock product supply and factor demand responsiveness using farm-level household data. The results indicate that own-price elasticities were elastic for cattle, while goat and sheep were inelastic. Cross-price and scale elasticities were found to be within inelastic range in all cases, with the goat being a preferred substitute for cattle. All factor inputs demand elasticities were inelastic with the exception of elastic cattle output prices and labour cost. Thus, the recommended policy option would be supportive pro-pastoral price policies, enhanced investment in pastureland improvement and an increasing wage rate, since these assume key significance in improving the livestock production/marketing.

Keywords: duality, own-price elasticity, cross-price elasticity, livestock, Kenya.

1. Introduction

In the ongoing debate over implicit taxation through changes in macroeconomic policies and movement quarantines in the Kenyan livestock trade (Ronge et al. 2005), economic analysis of potential output, price, and trade responses have played an essential role in the negotiation process. The markets in which livestock compete are increasingly influenced by intense livestock inflow from neighbouring countries of up to 25% (Behnke–Muthami 2011), rapid technological change (Thornton 2010, Collier–Dercon 2014), shorter product production life-cycles, and customers increasingly unwilling to settle for sometimes mass-livestock produced items of limited value. The "new breed of customer" (Robinson–Pozzi 2011), who demands greater responsiveness (Kariuki et al. 2013), and a new competitive environment (Yego–Siahi, 2018), which exposes local livestock farmers to competition, forms a new scenario that needs to be addressed. In this new scenario, responsiveness may be one of the essential options required for farmers to achieve competitive advantage. A critical element in this analysis is knowledge of the responsiveness of Kenyan livestock output to the own- and cross-price elasticities of supply, and input factor demand (FD).

While the available studies have given some insight into output-price responsiveness (e.g., Nyariki 2009, Manyeki et al. 2016, Mathini et al. 2017), they have not fully extended our understanding of factor substitution/complementarity in the livestock sector. One of the shortcomings inherent in their approach as cited by Debertin (2012) was that input demand and output supply (OS) are parts of a

comprehensive system, hence estimating the latter alone may provide inefficient results for the underlying supply relationship. Therefore, it is desirable to determine the interlinked livestock OS and factor input demand equations simultaneously. The utility of these few studies directly addressing livestock production and marketing behaviour is limited because, in most cases, they restrict themselves to only a few livestock products, targeting specific small regions, most employ estimation samples that are small, and some fail to meet behavioural (curvature) conditions necessary for the approaches used, partially because they aggregate many agricultural variables that have been criticised for obscuring the behaviour of individual input variables (Nyariki 2009, Olwande et al. 2009, Zhou–Staatz 2016, Manyeki et al. 2016, Tothmihaly 2018). This study was designed to fill a portion of this information gap, and a profit function analysis based on duality theory was the procedure employed to simultaneously derive these systems of OS and FD equations, and use it on extensive household-farm level data collected in the entire difficult terrain of the southern rangelands of Kenya.

Such robust estimation of farmer responsiveness was deemed to be important in informing the policy-setting process because it focuses on many decisions facing farmers, such as what portion of resources to devote to livestock production (land, capital, labour both family and hired) and policy incentives to stimulate livestock product market participation. The discussion proceeds in the next sections with a theoretical framework that set the empirical model used in analyses. The data and estimation procedure are then presented, followed by the analysis and discussion of results.

2. Theoretical framework

This paper applies duality theory (Shepard 1954) and uses it to analyse livestock product supply and input responses sequentially. The concept behind dual method (Shepard 1954, Debertin 2012) implies that the shape of the total variable cost function is closely linked to the shape of the production function that underlies it. If input prices are constant, all the information about the shape of the variable cost function is contained in the equation for the underlying production function. Therefore, in the dual theoretical framework, two short-run versions of duality can be generated; if it is assumed that either output level or input levels are known and constant. In the former case (i.e. constant output), objective function simplifies to the minimisation of cost subject to the requirement of generating the given output level. In the latter case of known and fixed input levels, the objective function simplifies to maximisation of revenue subject to the use of the given input levels. In either case, corresponding marginality conditions may be derived for these short-run variants of the profit maximisation or cost minimisation problem.

While the goal of the study is to use dual approach to obtain a system of OS and FD equations, the possible estimation problems are associated with production function (Chambers 1988, Sadoulet and de Janvry 1995). The reason for adopting a profit maximisation approach (maximum profit attainable given the inputs, outputs, and prices of the inputs) over the cost minimisation approach, is that the latter assumes that output levels are not affected by factor price changes and, thus, the indirect effect of factor price changes (via output levels) on FDs are ignored (e.g., Olwande et al.

2009, Debertin 2012). Indeed, the inclusion of output levels as explanatory variables in cost minimisation function may lead to simultaneous equation biases if output levels are not indeed exogenous. The profit function approach overcomes most of these problems, although it requires a stronger behavioural assumption. The FDs estimated using a profit function framework allow one to measure input substitution and output scale effects of factor price changes. Additionally, one can measure the cross effects of output price changes on FDs, and vice versa, as well as OS responses and their cross-price effects. Finally, the profit function framework allows the estimation of multi-output technologies in a much simpler way than a cost function or a transformation function.

The econometric application of the variable profit/cost function represents a significant step forward towards generating an appropriate system of agricultural OS and input demand functions which are crucial for the application of economic theory to farm development policy (Lau–Yotopoulos 1972, Yotopoulos et al. 1976, Sidhu–Baanante 1981). To examine the behavioural decisions of smallholder pastoral livestock producers on output and input use, specifically on their responsiveness, farmers were assumed to maximise restricted profit conditional on a convex production possibility set or technology T expressed by

$$\pi(P, W; Z) = \underset{Q,X}{Max}\{pQ - wX | F(Q, X; Z) \in T\} \quad (1)$$

Subject to the constraint that $\pi = R - C \geq \pi^*$

Where, $R = pQ$ is the gross receipts, and $C = w(.)$ is the cost functional structure. Q and X are vectors of quantities of outputs, and variable inputs, and P and W are the corresponding vectors of output and input prices respectively; Z denotes the amount of fixed factors inputs(e.g., land, capital). The profit function, $\pi(.)$, is assumed to be non-decreasing in *p*, non-increasing in *w*, linear homogeneous and convex in *p* and *w*. The function $\pi = R - C \geq \pi^*$ shows the farmer specific minimum acceptable profit level, π^*, referred to as lower bound, and capture satisfictory behaviour due to information asymmetry in the market.

In this profit function, the major impediments are the variable inputs cost structure, $w(.)$ given the independence of the production possibility sets and, therefore, the concept of normalised restricted profit function was adopted. Normalisation has the purpose of removing any money illusion (in other words, producers respond to relative price changes) and also reduces the demand on degrees of freedom, by effectively reducing the number of equations and parameters to estimate. In the case of a single output, a normalised restricted profit function (defined as the ratio of the restricted profit function to the price of the output), $\boldsymbol{\pi}^*$, can be specified. In the case of multi-output normalised profit function, the numéraire is the output price of the nth commodity and, following Färe and Primont (1995), the restricted profit function was specified as:

$$\pi_i^* = \pi_i^*(P^*, W^*; Z) \quad (2)$$

Where normalised profit, output prices and input prices are defined by $\pi_i^* = {}^{\pi}/_{p}$, $P_i^* = {}^{P_i}/_{P}$ and $W_i^* = {}^{W_i}/_{P}$ respectively. Here, P is the minimum acceptable price for cattle and sheep and goat outputs (shoat hereafter) satisfactory to a smallholder household i – referred to as farm gate price. Differentiating the normalised profit function with respect to prices of outputs and inputs respectively would yield the supply function of output and demand functions for input.

3. The empirical model

To implement this process empirically, it is necessary first to specify a profit function form. In the literature, the use of several flexible, functional forms to give a second-order Taylor approximation to an arbitrary (true) functional form such as Translog by Christensen et al. (1973), generalised Leontief by Diewert (1973), generalised symmetric McFadden by Diewert and Wales (1987), and normalised quadratic by Lau (1976) permits the application of the duality theory for a more disaggregated analysis such as livestock sector of Kenya. To formulate an effective livestock production and marketing policies, one needs reliable empirical knowledge about the degree of responsiveness of demand and supply for factors and products, to relative prices and technological changes. The normalised Translog version of the profit function was considered to be one of the general functions for the approximation of production function and simultaneously for estimation of OS and FD responsiveness since they are closely interlinked to each other. The logarithmic Taylor series expansion of normalised profit function (equation 2) can be written as:

$$Ln\pi_i^*\left(P_i^*, W_j^*; Z_k\right) = \alpha_0 + \sum_{i=1}^{N}\beta_i LnP_i^* + \sum_{j=1}^{M}\gamma_j LnW_j^* + \sum_{k=1}^{K}\delta_k LnZ_k + \sum_{i=1}^{N}\sum_{j=1}^{M}\vartheta_{ij} LnP_i^*\, LnW_j^* + \sum_{i=1}^{N}\sum_{k=1}^{K}\theta_{ik} LnP_i^*\, LnZ_k + \sum_{j=1}^{M}\sum_{k=1}^{K}\xi_{jk} LnW_j^*\, LnZ_k + \frac{1}{2}\left(\sum_{i=1}^{N}\sum_{h=1}^{N}\tau_{ih} LnP_i^*\, LnP_h^* + \sum_{j=1}^{M}\sum_{l=1}^{M}\phi_{il} LnW_j^*\, LnW_l^* + \sum_{k=1}^{K}\sum_{u=1}^{K}\psi_{iu} LnZ_k\, LnZ_u\right) \quad (3)$$

Where, subscripts i, stand for output and run from 1 to N; [1], subscripts j and l stand for variable inputs (prices) and run from 1 to M; [2], subscripts k and u stand for fixed inputs and run from 1 to K;[3], P_i and W_j are output and input prizes respectively; Z_k denotes the quantity of factor k that are assumed to be fixed in the short term (e.g., area of pasture land, the value of capital assets = household income).The term, π_i^*, is the restricted profit of ith product normalised by the average product price P_i; P_j^* is the normalised price of multi-output technologies, normalised by the output price P_i, that is, $P_j^* = P_j/P_i$ where i, j= cattle price, sheep, and goat price; $\boldsymbol{P}^*; \boldsymbol{W}^*; \boldsymbol{Z}$ are

[1] In our case $N = 3$, because we have three outputs: cattle, goat, and sheep.
[2] In our case $M = 1$, because we have only one variable input: Labour.
[3] In our case $K = 2$, because we have two fixed inputs: Pasture land area and Household income.

vectors of these variables; Coefficients α_{i0} , β_{ij} , γ_{ik} , δ_{ih}, ϑ_{ijk} , θ_{ijh}, ξ_{ikh} , τ_{ijl}, ϕ_{ikm}, and ψ_{ihn} are the parameters to be estimated and *Ln* = natural logarithm.

Using Hotelling's Lemma, the first-order derivatives of equation (3) with respect to normalised prices of variable outputs *i* yield a system the OS *(Y)* equations:

$$Y\left(P_i^*, W_j^*; Z_k\right) = \frac{\partial Ln\pi_i^*\left(P_i^*, W_j^*; Z_k\right)}{\partial LnP_i^*} = \beta_i + \sum_{j=1}^{M} \vartheta_{ij} LnW_j^* + \sum_{k=1}^{K} \theta_{ik} LnZ_k + \sum_{h=1}^{N} LnP_h^* + \varepsilon \quad (4)$$

Further, a system of inverse input demand equations that represent technological change is obtained by differentiating equation 3 with respect to normalised variable input prices W_i^* and fixed factor Z_k, yielding a system of inverse variable inputs equations X and shadow-value equations, Q expressed as:

$$X\left(P_i^*, W_j^*; Z_k\right) = -\frac{\partial Ln\pi_i^*\left(P_i^*, W_j^*; Z_k\right)}{\partial LnW_i^*} = \gamma_j + \sum_{i=1}^{N} \vartheta_{ij} LnP_i^* + \sum_{k=1}^{K} \xi_{jk} LnZ_k + \sum_{l=1}^{M} \phi_{il} LnW_l^* + e \quad (5)$$

$$Q\left(P_i^*, W_j^*; Z_k\right) = -\frac{\partial Ln\pi_i^*\left(P_i^*, W_j^*; Z_k\right)}{\partial LnZ_k} = \delta_k + \sum_{i=1}^{N} \theta_{ik} LnP_i^* + \sum_{j=1}^{M} \xi_{jk} LnW_j^* + \sum_{u=1}^{K} \psi_{iu} LnZ_u + \eta \quad (6)$$

These systems of supply and demand response equations (4–6) show the relation between OS and input demand to the output prices, input prices and the quantities of fixed factors respectively. To exhibit the properties of a well-behaved profit function, equation 3 must be non-decreasing in output price ($\beta_i \geq 0$, for *i*=cattle, sheep, and goat outputs), non-increasing in input prices ($\delta_k \leq 0$, for *k*=pasture land, capital, and labour, and $\gamma_j \leq 0$ for labour price) and symmetry constraints are imposed by ensuring equality of cross derivative (e.g., $\vartheta_{ij} = \vartheta_{ji}$ $\vartheta_{ij}$for all *i, j*; $i \neq j$, $\theta_{ik} = \theta_{ki}$ for all *i, k*; $i \neq k$ and $\xi_{jk} = \xi_{kj}$ for all *j, k*; $j \neq k$). This implies that all own price responsiveness (elasticities) are expected to be positive for OS and negative for input variable costs, and less than unity. However, the cross-price elasticities are expected to be indeterministic such that a negative sign implies a degree of substitutability with a positive sign indicate a degree of complementarity. The homogeneity and algebra are automatically maintained by constructing a normalised Translog profit function. Similarly, the OS functions (4) and inputs demand functions (5–6) exhibit theoretical restrictions reflecting the properties of the profit functions.

The empirical model consists of equations 4–6 with symmetry imposed and truncated normal distribution (with mean μ and standard deviation σ appended *iid* error terms $\{\varepsilon, e, \eta\}$). In total, a system of nine equations was derived from the normalised profit function, and the variables were converted to logs before subjected to analysis. The nine equations considered included three OS (each for cattle, sheep, and goat) and six FD – two for each livestock product. Variable inputs include labour

(a composite of family and hired labour) and two fixed inputs presented by a total area under pasture measured in hectares and farm capital asset expressed in monetary value. With regards to fixed input demand response, size of improved pastures land demand equation was regarded as important in production decisions, improvement is an extra production cost in the short-run, but in the long-run, help reduces production cost and increases profit, and thus stimulates higher supply. The size and quality of pastureland form an extra cost to livestock production in the short run. Therefore, a negative effect is expected, but in the long-run, help reduces production cost and increases profit, thus stimulating higher supply. When it comes to variable input demand equation, we only included labour since data on other variables such as costs of livestock supplies (e.g. drugs, vaccines) and veterinary services/consultancies was not available as farmers in the study areas don't keep records and estimating the same for the last year proved very difficult. Labour variable was captured in man-days and included both hired, and family labour, and the prevailing government wage rates were used to estimate the cost of labour. As such, the more the man-days holding the marginal product of labour constant, the more the production costs and, therefore, the less the expected profit and vice versa.

4. Data and estimation procedure

The dataset used was the Kenyan Household Survey which was a nation-wide survey of rural households that was conducted during September and October 2013. The survey was undertaken in the 47 counties across the country, of which 12,651 agricultural households were randomly selected from a total of 6,324,819 (GoK 2010) by applying a systematic *Probability Proportional to Size* sampling technique and considering the prominent production systems (agro-ecological zones) found in Kenya. The sampling frame comprises 1512 households interviewed in Garissa, Kajiado, Kilifi, Kitui, Kwale, Lamu, Makueni, Narok, Taita-Taveta, and Tana-River counties. These counties were deemed representative of many livestock production zones in Kenya. Outputs and inputs variable data were extrapolated based on the prevailing market values as of 2013.

To estimate the OS and FD functions, a maximum likelihood estimation (MLE) technique that involved a two-stage approach was used. In the first step, it was necessary to assume a stochastic structure and, thus any deviations of the observed profit, OS and FD from their profit-maximising levels were due to random errors in optimisation and that the disturbances were additive and followed a multivariate normal distribution with a zero mean (μ), and a constant contemporaneous covariance matrix (Σ) expressed in shorthand notation as $X \sim N(\mu, \Sigma)$. Then, by taking the first-order derivative using Hotelling's Lemma, we derived a system of five equations from the normalised profit function.

The second phase of analysis involved the estimation of derived systems of OS and FD equations, and a truncated regression analysis was adopted. An MLE technique was involved assuming truncated (at zero) normal distribution, which is the probability distribution of a normally distributed random variable with mean μ and

standard deviation σ (Wooldridge 2010). To simplify the mathematical expression of the functional form both output and variable input quantities are included in the vector y_i. Thus, y_i is a 'netput' vector where positive values are outputs, and negative values are variable inputs. In addition, both output and input prices and both fixed inputs are included in the vector x_i. For this study, to avoid bias in the estimation, sample selection was determined solely by the value of x variable, and the density of the truncated normal distribution of the i-th observation was expressed by

$$L_i = \frac{\frac{1}{\sigma}\phi\left(\frac{y_i - x_i'\beta}{\sigma}\right)}{\Phi\left(\frac{x_i'\beta}{\sigma}\right)} \tag{7}$$

Where ϕ and Φ are the density and distribution functions of the standard normal distribution. The log-likelihood function is given by

$$LogL(\beta,\sigma) = \sum_{i=1}^{N} LogL_i = -\frac{N}{2}[Log(2\pi)] + Log(\sigma^2) - \frac{1}{2\sigma^2}\sum_{i=1}^{N}\varepsilon_i^2 - \sum_{i=1}^{N} Log\left[\Phi\left(\frac{x_i'\beta}{\sigma}\right)\right], \tag{8}$$

Where the values of (β,σ) that maximise LogL are the maximum likelihood estimators of the truncated regression. Using the parameter estimates, and assuming output prices and input prices are defined by $\bar{x}_j = {}^{P_i}/_{P}$ and $\bar{x}_j = {}^{W_i}/_{P}$ respectively, the own-price responsiveness was calculated at the population means using:

$$e_{ij} = \beta_{ij} * \frac{\bar{x}_j}{\bar{y}_i} \text{ for } i = j,\ j = \text{cattle, sheep, goat, labour, and land,} \tag{9a}$$

And the cross-price responsiveness:

(9b)

$$e_{ij} = \beta_{ij} * \frac{\bar{x}_j}{\bar{y}_i} \text{ for } i \neq j,\ j = \text{cattle, sheep, goat, labour, and land,} \tag{9b}$$

For own price response, e_{ij} represent the per cent change in quantity demand (supplied) of input (output) of type i in response to a 1% change in the prices of input (output) of type i. Likewise, for the cross-price response, e_{ij} represent the per cent change in quantity demand (supplied) of input (output) of type i in response to a 1% change in prices of input (output) type j, holding all prices of other than of the j-th input (output) constant. Positive (negative) value of ***cross-price elasticities*** indicated that i and j were substitutes (complements). Additionally, following Färe et al. (1986), we estimated responsiveness of scale via the output-oriented measure of scale elasticity.

5. Empirical results

Parameter estimates from the derived system of OS and input demand are given in Tables 1 to 4. With three outputs and two inputs in the model, only 6 and 5 parameters respectively are freely estimated. Tables 2 and 4 give the elasticity computed (with their corresponding standard error) of the three outputs supply and three input demand equations for the farm-household data. In all cases, the output and inputs prices were normalised and directly included in the equations. In Table 1, the results of the coefficient estimate for OS and labour demand are found to be robust in all cases. The signs of the own-price coefficient estimate for livestock supply are all theoretically consistent and significant at 1% and 5% level (Table 1), with a positive supply elasticity (Table 2). The result indicates that own-prices are inelastic for goat and sheep. The most inelastic being sheep followed by the goat. Own-price elasticity is relatively elastic for cattle.

Cross-price elasticities were found to be in the inelastic range in all cases which indicate that a price change will result in a relatively small uptick in supply of livestock products. The cross-price elasticities indicate that cattle can be a substitute for sheep and goat, and sheep and goat a complement for cattle. Moreover, cattle output is less price responsive to goat and sheep prices than goat, and sheep output is to cattle prices. The only cross-price elasticity that was significant was between cattle and goat prices and sheep and goat prices. The cross-price elasticities for sheep and goat are similar (as they are both negatives), while those between cattle and goat and cattle and sheep output are indeterministic.

Outputs response to variable input was measured by the cost of labour normalised by output price of type *i*, the individual household income and the size of improved pastureland in hectares. Labour price portrayed a cross-relation to herd size and the greater the labour costs, *ceteris paribus*, the larger the herd size, and this would translate to more livestock available for marketing. The livestock supply equations had unexpected negative elasticity with respect to the household income. In contrast, the most essential fixed input in terms of livestock output response was the size of improved pasture land. Pastureland was specified as the total hectares of (natural or enhanced) land pasture and in this case, captured technological change that is regarded as valuable in production decisions.

The elements in the row labelled 'scale elasticities' in Table 2 reflects the OS response to a change in all exogenous variables combined. Generally, the scale elasticities for the three livestock products were less than one (though not less than zero, giving the possibility of free disposal), which indicates decreasing returns to scale. However, goat output seems to be more responsive to factor inputs than cattle and sheep output are. The possible explanation to this finding is, in pastoralist areas, where frequent droughts and diseases are experienced, goats are becoming attractive since they are hardier, can easily be de-stocked during drought and re-stocked afterwards, hence reducing the losses due to starvation (Degen 2007). The estimates of sigma square (σ^2) are significantly different from zero at 1% level of significance, implying a good fit and correctness of the specified distribution assumptions of the composite error term. The Wald Chi-square value (Wald chi2(6)) showed that statistical tests are highly significant ($P < 0.000$), suggesting that the model had strong explanatory power.

Table 1 Parameter estimates of OS equations for the southern rangeland of Kenya

Parameter	Cattle	Goat	Sheep
_cons	–2.6762	–3.4803**	–1.2101
	(2.3173)	(1.6920)	(1.5326)
Cattle prices	0.4916**	0.2407	0.2318
	(0.2389)	(0.2212)	(0.2672)
Goat prices	–0.2841*	0.6341***	–0.7178***
	(0.1766)	(0.1975)	(0.2152)
Sheep prices	–0.1500	–0.1082	0.4003**
	(0.1488)	(0.1428)	(0.1606)
Labour cost	0.2987***	0.3628***	0.3397***
	(0.0802)	(0.0801)	(0.0897)
Household income	–0.1427***	–0.0949***	–0.1053***
	(0.0311)	(0.0302)	(0.0342)
Pastureland area	0.1337***	0.1966***	0.1634***
	(0.0471)	(0.0426)	(0.0509)
Sigma	0.8214***	0.7809***	0.8683***
	(0.0489)	(0.0463)	(0.0539)
Wald chi2(6)	65.41***	73.63***	54.98***
Log likelihood	–176.041	–167.439	–168.420

Note: * p <0.10, ** p <0.05, *** p <0.001; Parentheses is the standard deviation.
Source: Author's construction.

Table 2 Livestock products OS elasticity

With respect to:	Cattle	Goat	Sheep
Cattle Price	0.689	0.077	0.108
	(0.911)	(0.299)	(0.443)
Goat Price	–0.0052	0.565	–0.081
	(0.023)	(0.780)	(0.435)
Sheep Price	–0.0015	–0.006	0.221
	(0.010)	(0.089)	(0.276)
Labour Cost	0.120	0.375	0.440
	(0.454)	(1.366)	(1.394)
Household Income	–0.156	–0.058	–0.042
	(0.197)	(0.092)	(0.064)
Pastureland	0.040	0.028	0.027
	(0.040)	(0.053)	(0.041)
Scale elasticities	0.686	0.981	0.673
	(0.273)	(0.447)	(0.442)

Note: Parentheses is the standard deviation.
Source: Author's construction.

Tables 3 and 4 contain the parameter estimates and price elasticities for the FD system, respectively. All factor input demand elasticities were found to be in the inelastic range with the exception of cattle output prices and labour cost, which was elastic for land demand in cattle and goat production enterprises respectively. Estimates for labour input demand equations were robust, though less precise in many cases than that of pastureland counterpart. With regards to output prices, all production enterprise showed an elastic response of pastureland demand to cattle output price. However, labour demand was reasonably responsive to cattle output prices in the cattle production enterprise. The situation with regards to goat and sheep output prices on FDs is opposite except for labour and land demand response to goat and sheep output prices respectively, which is relatively inelastic. The pastureland response in the goat and sheep production enterprise are similar and relatively elastic, an increase in sheep and cattle output prices puts substantial positive pressure on land demand, and indeed, this can explain the great effect shown on sheep and cattle supply. Increases in goat output price would encourage the expansion in demand for labour under goat production enterprise, while it would result in a reduction in pastureland demand in all cases.

When it comes to the effect of labour costs on labour demand responsiveness, it should be pointed out that demand for labour was very significant and influenced much more by a change in labour prices than by a change in livestock output prices. The situation is the opposite with a relatively elastic response of pastureland demand on labour costs in the goat production enterprise, but an inelastic response to cattle and sheep production enterprises. This strong elasticity of labour costs on pastureland demand equation for goat production possibly may be associated to the fact that goats are browsers, unlike cattle and sheep, which are heavy grazers. The results have important implications for agricultural research and development policies for developing countries such as Kenya. The availability of labour is a more serious constraint owing to its relatively low elasticities but very significant across all livestock type.

Finally, household income portrayed a positive effect in factor input demand elasticities in all cases with a relatively low negative impact on labour demand recorded in the cattle production enterprise. The income effect can be observed under two scenarios: if a household aggregate level of income increases or if the relative cost of expanding pastureland or wage for labour decreases. Both situations increase the amount of discretionary income available, so does the quantity of pasture and labour. FD in sheep production enterprise was relatively more responsive to changes in household income. The estimates of sigma square (σ^2) are significantly different from zero at 1% level of significance, implying a good fit of the specified distribution assumptions of the composite error term, and the Wald chi2(5) showed that statistical tests are significant, suggesting that the model had strong explanatory power.

Table 3 Parameter estimates of input demand equations for the livestock production

	Cattle		Goat		Sheep	
Variables	**Land**	**Labour**	**Land**	**Labour**	**Land**	**Labour**
_cons	–11.549***	–0.568	3.283	0.936**	–0.552	1.945
	(4.042)	(0.620)	(3.265)	(0.417)	(2.684)	(0.406)
Cattle prices	1.484***	0.391***	1.119**	–0.341***	1.347***	–0.444***
	(0.412)	(0.064)	(0.446)	(0.055)	(0.457)	(0.069)
Goat prices	–0.380	–0.465***	–0.156	0.292***	–1.266***	–0.380
	(0.315)	(0.051)	(0.382)	(0.049)	(0.361)	(0.055)
Sheep prices	0.230	–0.177***	–0.256	–0.168***	0.222	0.178***
	(0.267)	(0.044)	(0.302)	(0.035)	(0.280)	(0.043)
Labour cost	–0.086	0.939***	–0.269*	0.979***	–0.108	1.029***
	(0.144)	(0.023)	(0.159)	(0.020)	(0.156)	(0.024)
Household	0.013	–0.003	0.043	0.020***	0.048	0.030***
income	(0.056)	(0.009)	(0.060)	(0.008)	(0.060)	(0.009)
Sigma	1.455***	0.243***	1.506***	0.196***	1.490***	0.231***
	(0.093)	(0.014)	(0.098)	(0.012)	(0.100)	(0.014)
Wald chi2(5)	18.73***	2030.10***	9.84*	2991.53***	16.53***	1925.97***
Log likelihood	–254.143	–0.4728	–253.841	30.086	–234.621	5.8765

Note: * p <0.10, ** p <0.05, *** p <0.001; Parentheses is the standard deviation.
Source: Author's construction.

Table 4 Factor input demand elasticity for livestock production

With respect	**Cattle**		**Goat**		**Sheep**	
to:	**Land**	**Labour**	**Land**	**Labour**	**Land**	**Labour**
Cattle Price	2.322	0.059	0.882	–0.021	0.833	–0.018
	(3.436)	(0.096)	(3.959)	(0.108)	(2.126)	(0.034)
Goat Price	–0.006	–0.001	–0.594	0.085	–0.255	–0.006
	(0.017)	(0.006)	(0.618)	(0.142)	(0.565)	(0.017)
Sheep Price	0.002	–0.0002	–0.189	–0.002	0.401	0.029
	(0.008)	(0.0005)	(0.467)	(0.028)	(0.685)	(0.071)
Labour Cost	–0.047	0.016	–1.185	0.088	–0.322	0.086
	(0.114)	(0.017)	(2.371)	(0.048)	(0.970)	(0.079)
Household	0.011	–0.0003	0.008	0.004	0.047	0.003
Income	(0.017)	(0.0005)	(0.013)	(0.006)	(0.081)	(0.007)

Note: Parentheses is the standard deviation.
Source: Author's construction.

6. Discussion and conclusion

Despite the importance of understanding producer response to price and non-price incentives, few studies have examined the own-price elasticities of Kenya livestock product supply over the past two decades. To formulate an effective price and food security policy, one needs reliable empirical knowledge about the degree of livestock product supply responsiveness, and factor demand to relative prices and technological changes. The results of the study show that all own-price elasticities of OS for the three livestock product had the correct, positive signs. The own-price elasticity was elastic for cattle while for goat and sheep supply were inelastic, with the most inelastic being sheep followed by the goat. The relatively elastic own-price elasticity cattle product concurred with the finding of Nyariki (2009) and Manyeki et al. (2016). The only explanation for this finding is that producers respond to an increase in prices accompanied by diverting resources into increasing cattle herds in anticipation for a better price in future. Sheep and goat are less responsive to own-prices elasticity than cattle, which can be associated with longer production cycle in cattle that tends to make producers more responsive to changes in cattle prices.

Cross-price elasticities were found to be inelastic in all cases which indicate that a price change will result in a relatively small uptick in supply of livestock products. The cross-price elasticities result also shows that cattle can be a substitute for sheep and goat while there are some complement possibilities between sheep and goat for cattle. This coincides with Farmer and Mbwika (2016) that goat meat prices at the consumption level are high, and a slight increase in the price of goat prices would reduce the demand compressing the producer prices, and this would result in reduction in the supply. The high price would make the consumer shift to cattle meat, thereby increasing the demand for the cattle meat. Subsequently, the prices of cattle meat will increase, and that would increase the supply. Sheep quantity is more than thirteen times as sensitive to the goat output prices than goat quantity is to sheep output prices. This finding, therefore, suggests that, in order to understand economic substitutability (or complementability) and the potential economic impacts of introducing livestock type-specific programs policy, it is informative to understand the relationships among the existing livestock product types.

Outputs supply responsiveness was further measured to variable input such as cost of labour, the individual household income, and the size of improved pastureland in hectares. A slight change in labour price would have a more significant effect on output level than pastureland improvement price in all the livestock types. The unexpected negative elasticity with respect to household income can be associated with data type, which was from survey sources and, thus, only the short-run response was able to be captured. However, in long-run, a sign switch is expected. The policy incentive that would increase capital investment to the bottom of the income pyramid, such as the poor farmers who, in the absence of formal insurance markets, tend to diversify including keeping livestock to achieve a balance between potential returns and the risks associated with climatic variability and market and institutional imperfections would improve livestock off-take. As observed by Bebe et al. (2003), enhancement of capital resources level through either injecting capital resources into

the livestock industry or provision of affordable microloans in remote rural areas would provide households with an incentive to invest in livestock, because of the wide spectrum of benefits these provide, such as cash income, food, manure, draft power and hauling services, savings and insurance, and social status and social capital.

With regards to the livestock supply response to the fixed inputs, size of pastureland was found to be the most significant and positive as expected, which is consistent with theory (Freebairn 1973, Malecky 1975). In relative terms for the three type of enterprises, cattle OS is almost twice as sensitive to the size of the improved pastureland. The large magnitude on the pastureland variable for cattle OS may possibly be associated to the fact that cattle being the primary beef producer in Kenya are pasture-based and hence dependent on land availability (Kahi et al. 2006). Based on the pastureland elasticities, red meat would expand by about 2–4% if the land area under livestock production were to increase by 100%. This, however, need not imply support for a general policy of increasing the size of holdings so that more land can be allocated to livestock production. It may be that following the recent trend of land subdivision experienced in the rangelands of Kenya, there are many small-holding farms, which would strangle the carrying capacity of pastures, leading to uneconomical production systems. Land policies that prevent undesirable land fragmentation and protect holders of large tracts of land should be encouraged. Other factor inputs such as labour cost and household income were significant but had an unexpected sign. This is because a change in the cost of labour and household income appears to influence livestock supply in the opposite direction.

Concerning FD responsiveness, all variable considered were found to be in the inelastic range with the exception of cattle output prices and labour cost, which was elastic for land demand in cattle and goat production enterprises respectively. Of importance was labour cost, its effect on labour demand being inelastic, having a positive own-price elasticity estimate that is not consistent with economic theory. This scenario is possible because despite livestock farming being one of the leading sources of employment, and young people often being said to prefer employment in non-farm sectors, perhaps low returns and lack of prestige associated with agriculture compared to white-collar jobs (Afande et al. 2015) are responsible. If this is a general phenomenon in all livestock production areas, then 'surplus' labour available in the agricultural areas of Kenya will only be attracted to livestock production, if it is, by and large, accompanied by an increase in wage rates. The household income in both demand equations was positive in all cases with a relatively low negative effect on labour demand recorded in the cattle production enterprise. The household income effect can be observed under two scenarios: if a household aggregate level of income increases, or if the relative cost of expanding pastureland or wage for labour decreases. Both situations increase the amount of discretionary income available, as does the quantity of pastureland and labour. FDs in sheep production enterprise was relatively more responsive to changes in household income.

The policy option on increasing livestock production and hence off-take in the country should, therefore, be geared towards improving the institutional and environmental conditions that support livestock output prices and input marketing, with an emphasis on specific livestock species. Priority areas of action in order to

reduce the constraints in livestock production and incomes among smallholders without damage to the rangeland would include strengthening the capacity of investment among the livestock farmers by improving their capital base; and accelerated livestock productivity through intentional pasture improvement to increase the land carrying capacity. Finally, the empirical results are based on a restricted profit function, that included few independents variables, partly because of data limitation, and a promising suggestion for future research would be to use an integrative differential model that includes risk aversion of livestock producers, since livestock producers' attitudes toward risk would affect the selection of livestock for sale. Even with such limitations, the results of this study are an essential step in providing insight into the economic responsiveness of the livestock industry in Kenya.

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Comparative analysis of the innovation system of Kazakhstan: Applying the European Innovation Scoreboard

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In the modern world, economic growth is closely linked to the development of innovation. Today, to become an economically developed country, it is necessary to invest in innovation and improve factors that have a direct impact on innovation activity. However, the significant problem in innovation is the gap among the industrialized countries, countries with economies in transition, and developing countries. This study focuses on a country with a transition economy – Kazakhstan, and its ability to make an innovation breakthrough. In search of the indicators influencing innovation activity in Kazakhstan, we drew on the methodology of the European Innovation Scoreboard. Through data harmonization, we found Kazakh indicators and compared them with European indicators. This empirical result allows us to draw conclusions on the importance of human resources in science, and of fast-growing enterprises with innovation activity. The growth in R&D expenditure also positively affected Kazakh innovation in line with world practice. In this way, the quality improvement of some key factors is positively affecting the growth of many innovative indicators in Kazakhstan. The contribution of this empirical result allowed us to compare Kazakhstan with European Union countries through the European system of innovation estimation.

Keywords: Innovation gap, Kazakhstan, European Innovation Scoreboard, comparable analysis

1. Introduction

Technological progress and movement forward have always been a natural development in society. The blossoming of inventive evolution encouraged technological growth during the Enlightenment (Hesse 2002). In the eighteenth century, Adam Smith wrote in his work about the division of labor and the widening of the market as the main factors in encouraging technological innovation (Landes 2015). Since the time of Schumpeterian theory about innovation, the world has started building capacity in the field of technology and gained vast productivity.

At the present time, Industrial countries invest in innovation and reduce technological catch-up between upper-tier countries. While developing countries seek to catch up in the innovativeness of mid-tier countries, and start with technologies necessary for local society. The technological competition has reached fever pitch for some countries. Gradually the gap between countries began to widen by dividing the world according to economic and innovation development. Despite this gap, some EU countries have reached significant results in innovation and technology development for decades: Slovenia (Bučar 2005, Koschatzky et al. 2011, Markič et al. 2011, Likar et al. 2014) Estonia (Linnas 2008, Nauwelaers et al. 2013, Karo–Looga 2016), Czech Republic (Uzagalieva et al. 2012, Krasniqi–Kutllovci 2008), Hungary (Havas 2002, Varga 2006, Lengyel–Leydesdorff 2011, Lukovics et al. 2017), and others. Evaluating the level of innovativeness of EU countries is possible thanks to the Global Innovation

Index (GII), the European Innovation Scoreboard (EIS), and so on. World results in innovation are published at the GII for approximately 130 countries. Global Innovation Index includes near 80 indicators with various parameters. In this paper, we chose EIS as the basis of our calculations. The EIS has a huge impact on the practitioners and theoretical specialists of EU countries by forming innovation indicators in Europe. However, the main benefit of EIS is a focus on EU countries and their indicators in innovation. The EIS measures average performance in 27 indicators in 10 innovation dimensions for EU countries. In the interest of spreading the effectiveness of indicators and their comparable strength in the Eurasian continent, the developers of EIS included several non-European countries in the list. Certainly, every country has its own approach in the calculation of innovation performance, including Kazakhstan. In this paper, we take EIS as the basis of our calculations. This article is an attempt at a comparative analysis of Kazakhstan data with EU indicators on the basis of EIS. This article helps to understand the strength and weaknesses of innovation indicators in Kazakhstan. Whereas the development and promotion of innovation is rather a fresh and current topic in Kazakhstan, we used the data of one decade to identify any progress in the indicators.

The main purpose of this research is the harmonization of Kazakhstan data with the EIS. We intend to determine if Kazakhstan data can be comparable with the EIS indicators. The indicators for calculating innovation in some countries is a long process started from gathering data and continue with data processing. To ensure that indicators can effectively interconnect with data from other countries, a close examination of what indicators do is very much needed (Iizuka–Hollanders 2020). This stage involved several steps before we reached results. The research question for this paper hence was how to harmonize Kazakh data with the EIS? This step required an explicit understanding of methodological stages and an explanation of indicators. The second part of the article includes the results and discussion in which we explained the state of innovation in 2008 and 2018.

This paper is organized as follows: section 1 describes differences in structuring innovation between developed and developing countries. The main focus of the literature review was on innovation in developing countries; section 2 introduces the origins of the data, the explanation of indicators and methodology in detail; section 3 then combines the results of the calculation to determine if the calculation of Kazakh data was in fact harmonized with EIS; section 4 describes the discussion of harmonized data; and finally, section 5 presents our conclusions.

2. Literature review

There is a variety of opinions about the division of countries into certain categories in the fields of economics and innovation. We have chosen the EU concept that is close to our study and subdivide countries into 4 groups: Innovation Leaders, Strong Innovators, Moderate Innovators, and Modest Innovators. The possibility of transition from one group to another was smoothly carried out over decades. During the chosen decade a significant number of countries reduced the gap from one stage to another in the EIS from 2008 to 2018.

The transition to a new innovative stage takes on average about 10 years according to our observation. Hungary, Lithuania, Latvia, Malta, Poland, Slovakia, and Turkey have been promoted from Modest to Moderate innovative countries since 2008. By 2018, Slovenia and Norway had reached a new stage as Strong Innovators and Netherlands – Innovation Leaders.

However, most of these countries are countries with transition economies. What happens with developing countries? How should they bring down expanding lag?

The measurement and understanding of innovation has been essentially constrained by the lack of comparable and reliable data in developing countries outside of the EU (Rahayu–Day 2015, Cirera–Muzi 2020).

Moreover, the problem of bridging the rupture between the Third and the Industrialized countries has always been regarded by scientists. Paulo Antônio Zawislak with Luciana Manhães Marins (2007) proposed a new idea at the microeconomic level for innovation – a total innovation management system for firms through the structuring of innovation management activity in the reality of developing countries' firms. The scientists used traditional indicators: investment, intellectual property, and non-conventional indicators such as cadence and project mix. Thus, they showed the importance of supporting SMEs in innovative activity for countries with a low level of innovation.

Years later, the topic of entrepreneurship in innovation was also raised by researchers Adam Szirmai, Wim Naudé, and Micheline Goedhuys (2011). They considered that the policy and institutional environment is an important determinant of innovative behaviour in developing countries. However, they highlighted that the extent of entrepreneur innovativeness depends on the characteristics of the entrepreneur and the sector in which the firm is active (Szirmai et al. 2011).

Nowadays, the quantity of sources with regard to the firm-level in developing countries is widening. It includes not only the impact of firms on economic development in the country but also examines firm characteristics, its economic performance, business strategies, and opportunity for innovativeness (Goedhuys et al. 2008, Goedhuys–Sleuwaegen 2010).

Furthermore, Bronwyn Hall, Francesca Lotti, and Jacques Mairesse (2013) and Michael Polder, George van Leeuwen, Pierre Mohnen, Wladimir Raymond (2009) researched the impact on R&D and ICT investment on innovation and productivity. The main findings showed that the basic role for innovation is assumed by R&D investment, while for productivity – ICT investment. Thus, the impact of R&D on innovation is significant.

More recently, a group of scientists analyzed the effect of competition on technological innovation in developing countries through the Boone index. Their findings reveal a negative and robust impact of competition on innovation (Alvarez et al. 2015). Later, Roberto Alvarez (2016) found that for the service industry it works vice versa, R&D impact not being as significant as ICT investment.

Vijay Govindarajan with Chris Trimble (2012) put forward five gaps between developing and developed economies: performance gap; infrastructure gap; sustainability gap; regulatory gap; preferences gap. However, in 2017 the concept of inclusive innovation was discussed, and providing a framework of four key

dimensions (people, activities, outcomes, and governance) to consider in its implementation (Schillo–Robinson 2017).

Despite an increasing number of scientific papers about developing countries in innovation, there is not enough empirical evidence about Kazakhstan and the Central Asian region. Most articles discuss developing countries in the EU and Latin America. During the collection of Kazakh data, we noticed a relatively small number of Kazakh scientific articles with empirical results. Over two decades, the evolution of indicators impacting on innovation in Central Asia had increased modestly, but did not provide sufficient innovation growth in comparison with Europe (Table 1).

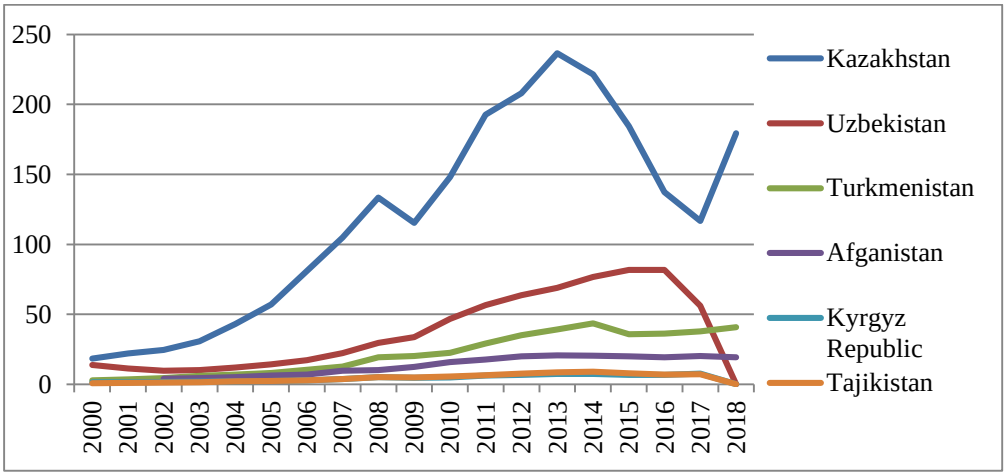
Table 1 Selected Sustainable Development Goals (SDG) Indicators in Central Asia and Europe, averages, 2000–2016

SDG Indicator	**Central Asia**				**Europe**			
	2000	**2005**	**2010**	**2016**	**2000**	**2005**	**2010**	**2016**
Adjusted net enrolment rate (%)	…	68.4	73.0	78.5	92.0	90.8	93.9	94.6
R&D expenditure as a proportion of GDP (%)	0.18	0.25	0.16	0.18	1.62	1.60	1.75	1.83
Researchers (in full-time equivalent) per million inhabitants	337.4	363.2	391.2	500.0	2458.0	2730.3	2985.7	3181.1
Proportion of the population covered by at least a 2G mobile network (%)	30.0	60.2	86.7	97.5	94.3	98.5	98.3	97.2

Source: Global and regional data for Sustainable Development Goal Indicators, 2017 session, 28 July 2016–27 July 2017, Agenda items 5, 6 and 18 (a) (UN document E/2017/66)

We concentrated on the articles concerned with the Kazakh innovation system for two decades. Kazakhstan's economy has shown remarkable growth over the decades in Central Asia. The significant increase in GDP from USD 18.292 billion (2000) to USD 179.34 billion (2018) stands comparison to other Central Asian countries. From 2000 until 2018, the GDP indicators of the Kyrgyz Republic and Tajikistan had approximately similar values, near USD 8.093 billion and USD 7.523 billion in 2018. The GDP growth of Uzbekistan showed a significant increase, and reached near USD 50.5 billion in 2018. The GDP indicator of Afghanistan and Turkmenistan reflected similar development until 2005. At the end of 2018, Turkmenistan's GDP demonstrated a noticeable rise and achieved the result approximating the GDP of Uzbekistan. In 2018 Afghanistan also showed GDP growth, approaching USD 19.4 billion (Figure 1).

Figure 1 GDP of Central Asian countries from 2000 to 2018 (USD, billion)



Source: own construction based on World Bank data (2000–2018)

Innovation problems in Kazakhstan and related topics have often been discussed by Kazakh researchers over the last two decades. Some Kazakh researchers have worked towards a descriptive basis for national innovation policy and strategy. Certainly, most of these works are unconvincing due to the limited number of scientists in this area. The main discussions have been about how to modernize economics through innovation, and how to include enterprises and society in this process (Nurlanova 1998, Doskaliyeva–Orynbassarova 2016). The main body of descriptive articles studied technology and innovation through branding and methods of investment appraisal taking into account both commercial and tax requirements (Nurlanova 1998, Tulegenova 2007); investment regulation mechanism with development of venture capital (Doskaliyeva–Orynbassarova 2016); the importance of ICT development for realization innovation projects (Utepbergenov et al. 2018), and so on.

In the study of Kazakh scientific articles, a number of articles are devoted to the development, the interaction, and impact of R&D on innovation, science, and intellectual property rights in Kazakhstan. The general topics are connected with the scientific sphere where the main issues are investment in R&D (Kurmanov et al. 2016, Ziyadin et al. 2018, Shaikin–Estes 2018), quality of scientific articles (Adambekov et al. 2014), the quantity of the researchers, and interaction of science with business through intellectual property (Radosevic–Myrzakhmet 2006, Abazov and Salimov 2016). Certainly, most of these scientists noted the importance of R&D in the innovation process. In comparison with the EU countries, the amount of R&D expenditure in Kazakhstan was low over the last decade. For instance, the average amount of R&D expenditure in Europe was near 1.75 in 2010, whereas in Central Asia it was 0.16. In Kazakhstan, specifically, this indicator equalled 0.153 in 2010.

Table 2 R&D indicators in Kazakhstan (2010–2018)

Indicators	2010	2012	2014	2016	2018
GDP (billion USD)	148.047	207.999	221.416	137.278	179.34
Research and development expenditure (% of GDP)	0.153	0.165	0.167	0.142	0.123
Scientific and technical journal articles	323.91	445.67	934.97	1601.18	2367.46
Researchers in R&D (per million people)	370.533	612.183	798.665	693.683	666.935
High-technology exports (billion USD)	1.813	3.571	3.396	2.077	1.784

Source: own construction based on World Bank Data, 2010–2018

The development of innovation activity must also include the enhancement potentiality of regions (Cooke–Morgan 1999, Nauwelaers et al. 2013). In particular, the most high-potential regions for innovation in Kazakhstan were East Kazakhstan, Aktobe, Zhambyl, South Kazakhstan, and Mangistau regions (Mukhtarova–Myltykbayeva 2015). However, according to the data of the Statistics committee in Kazakhstan, the GDP for the last 8 years had increased from USD BLN 148.047 (2010) to USD BLN 179.34 (2018). Despite this, high-technology exports remained at the same level between 2010 and 2018 (Table 2).

In practice, Kazakh scientists often refer to the world rankings occupied by Kazakhstan. When accounting for innovative activity in Kazakhstan, for example, they refer to the Global Innovation Index (Stavbunik–Pělucha 2019, Mukhammedov et al. 2019). The studies also provided comparisons between countries for certain parameters that affect innovation in general (Brunet 2012, Suyunov et al. 2018).

Typically, every country has its own calculation of innovation activity. It is impossible to say that one method can be applied to all countries. The key differences lie in each country having different innovative strategies, according to its individual ideas, resources, and possibilities. In any case, the initial data is different, the strategy is different, and the method of calculation is also different. In this study, we tried to bring Kazakhstan innovation data closer to that of European countries. The assumption of this study is that we test the possibility of transferring Kazakhstan data and overlaying it onto the EIS for 2008 and 2018 by normalization of data.

3. Data and methodology

The data for this empirical analysis comes from 2008 and 2018 following EIS and identifying the main variables and objects for analysis. The researched period shows how innovation developed in different countries during the decade between 2008 and 2018. The individual variables are presented for developed and developing countries in the European Union and Central Asia. Namely, we observe about 30 countries, divided into 4 groups: Innovation Leaders, Strong Innovators, Moderate Innovators, and Modest Innovators (Annex A, Table 1). This study reflects the innovation activity

of 29 European and Central Asia countries: Austria (1), Belgium (2), Bulgaria (3), Cyprus (4), Czech Republic (5), Germany (6), Denmark (7), Estonia (8), Spain (9), Finland (10), France (11), Croatia (12), Hungary (13), Ireland (14), Italy (15), Lithuania (16), Latvia (17), Malta (18), Netherlands (19), Norway (20), Poland (21), Portugal (22), Romania (23), Sweden (24), Slovenia (25), Slovakia (26), the United Kingdom (27), Turkey (28), and Kazakhstan (29).

For determining the development of innovation activity at the European level, an aggregate indicator of innovation based on 19 indicators was used. These 19 indicators were present and defined in the EIS, except for Kazakhstan, and include: 1) New doctorate graduates per 1000 population aged 25–34 (Q1); 2) Percentage population aged 30–34 having completed tertiary education (Q2); 3) Lifelong learning of population aged from 25–64 (Q3); 4) R&D expenditure in the public sector (% of GDP) (Q4); 5) R&D expenditure in the business sector (% of GDP) (Q5); 6) Non-R&D innovation expenditure (% of turnover) (Q6); 7) SMEs innovating in-house (% of SMEs) (Q7); 8) Innovative SMEs collaborating with others (% of SMEs) (Q8); 9) Public-private co-publications per million of population (Q9); 10) PCT patent applications per billion GDP (Q10); 11) Trademarks applications per billion GDP (Q11); 12) Designs applications per billion GDP (Q12); 13) SMEs introducing product or process innovations (% of SMEs) (Q13); 14) SMEs introducing marketing or organizational innovations (% of SMEs) (Q14); 15) Employment in fast-growing enterprises in innovative sectors (% of total employment) (Q15); 16) Employment in knowledge-intensive activities (% of total employment) (Q16); 17) Exports of medium and high-technology products as a share of total product export (Q17); 18) Knowledge-intensive services exports as % of total services exports (Q18); 19) Sales of new-to-market and new-to-firm innovations as % of turnover (Q19).

These 19 indicators were divided into four main groups for a clear understanding of the roles of components in the analysis: human capital with indicators Q1, Q2, Q3; investment – Q4, Q5, Q6; innovation activity including Q7 to Q14; and innovation effect - Q15, Q16, Q17, Q18, Q19. Finally, we had 29 countries and 19 indicators. The data sources are from the EIS 2008 and 2018, World Bank, Eurostat and national statistical centers.

The methodology of transforming Kazakh statistical data for comparable analysis started with studying the differences in the statistical data. Central Asia is still in the process of development, and comparative economic research is commensurately rare (Peck 2004, Brück 2014). However, we posed ourselves this brainteaser and accounted for Kazakhstan`s data according to the EIS. Every indicator had its own capacity (load), proved by the EIS for nearly 2 decades from 2001 to recent years. We also looked at the Global Innovation Index and found the evidence basis for our research. In addition, past scientific studies give direction in choosing indicators (Hollanders–van Cruysen 2008, Schibany–Streicher 2008). During normalization, we changed the definition from "SMEs" to "enterprises" in our calculation. The next step was to find indicators for Kazakh data according to the EIS in 2008 and 2018. The main indicator components in calculating are numerator and denominator (Table 3).

Table 3 Indicator components

Indicator	Numerator	Denominator	Data source
Q1	Number of doctorate graduates	Population between and including 25 and 34 years	World Bank data and Committee on Statistics of the Republic of Kazakhstan
Q2	Number of persons in age group with some form of post-secondary education	Population between and including 25 and 34 years	World Bank data and Committee on Statistics of the Republic of Kazakhstan
Q3	Population of lifelong learning statistics refers to all persons in private households aged between 25 and 64 years	Total population of the same age group	Analytical report on the implementation of the principles of the Bologna process in the Republic of Kazakhstan (2018) and webpage: theglobaleconomy.com
Q4	All R&D expenditure in the government sector	Gross Domestic Product	Committee on Statistics of the Republic of Kazakhstan
Q5	All R&D expenditure in the business sector	Gross Domestic Product	Committee on Statistics of the Republic of Kazakhstan
Q6	Sum of total innovation expenditure for enterprises, excluding intramural and extramural R&D expenditures	Total turnover for all enterprises	Committee on Statistics of the Republic of Kazakhstan
Q7	Number of Small and medium-sized enterprises (SMEs) with in-house innovation activities	Total number of Small and medium-sized enterprises (SMEs)	Committee on Statistics of the Republic of Kazakhstan
Q8	Number of Small and medium-sized enterprises (SMEs) with innovation co-operation activities	Total number of Small and medium-sized enterprises (SMEs)	Committee on Statistics of the Republic of Kazakhstan
Q9	Number of public-private co-authored research publications	Total population	Committee on Statistics of the Republic of Kazakhstan
Q10	Number of patent applications	Gross Domestic Product in Purchasing Power Standard	National Patent Office in Kazakhstan and Committee on Statistics of the Republic of Kazakhstan
Q11	Number of trademark applications applied	Gross Domestic Product in Purchasing Power Standard	National Patent Office in Kazakhstan and Committee on Statistics of the Republic of Kazakhstan
Q12	Number of individual designs applied	Gross Domestic Product in Purchasing Power Standard	National Patent Office in Kazakhstan and Committee on Statistics of the Republic of Kazakhstan
Q13	Number of Small and medium-sized enterprises (SMEs) who introduced at least one product innovation or process innovation either new to the enterprise or new to their market	Total number of Small and medium-sized enterprises (SMEs)	Committee on Statistics of the Republic of Kazakhstan
Q14	Number of Small and medium-sized enterprises (SMEs) who introduced at least one new organizational innovation or marketing innovation	Total number of Small and medium-sized enterprises (SMEs)	Committee on Statistics of the Republic of Kazakhstan
Q15	Number of employees in high-growth enterprises in 50% 'most innovative' industries	Total employment for enterprises with 10 or more employees	Committee on Statistics of the Republic of Kazakhstan
Q16	Number of employed persons in knowledge-intensive activities in business industries	Total employment	Committee on Statistics of the Republic of Kazakhstan
Q17	Value of medium and high tech exports	Value of total product exports	Committee on Statistics of the Republic of Kazakhstan
Q18	Exports of knowledge-intensive services	Total value of services exports	Committee on Statistics of the Republic of Kazakhstan
Q19	Sum of total turnover of new or significantly improved products, either new-to-the-firm or new-to-the-market, for all enterprises	Total turnover for all enterprises	Committee on Statistics of the Republic of Kazakhstan

Source: own construction

During the normalization of data, we chose eight years: 2001–2009 and 2010–2018. We replaced close to 20% of absent data with previous or subsequent years. The main idea of the EIS lay based on normalization data among comparable countries. However, before reaching the normalization of Kazakh data, indicators and denominators need to be calculated. The next steps in harmonizing data, according to the EIS are a) identifying and replacing outliers, setting reference years, b) importing for missing values, c) determining Maximum and Minimum scores, d) transforming data that have highly skewed distributions across countries, e) calculating re-scaled scores, f) calculating composite innovation indexes, g) calculating relative-to-EU performance scores.

The first sub-step for calculating Kazakhstan indicators was identifying positive and negative outliers. The positive/negative outliers were identified as the country scores which were higher/lower than the mean across all countries plus/minus twice the standard deviation. The replacement of outliers was carried out by maximum and minimum values over all the years studied. The next sub-step included the second and third sub-steps together. The setting of reference years was conducted on the basis of data availability for Kazakhstan, specifically, where it was at least 75% complete. In practice, the reference year is one or two years behind the year in which the performance of a score is measured. The data of reference years replaces the value for the previous year. The replacement of missing data in the time series is carried out using the next available year according to the EIS. The Maximum/Minimum scores was determined as the highest score and, similarly, the lowest score for the last eight years in Kazakhstan, excluding positive/negative outliers. In the middle of the normalization process, the data required transformation. The data, which was skewed for eight years, was transformed using a square root transformation. This sub-step meant using the square root of the indicator value instead of the original value. In doing so, we decreased volatile and skewed data distributions.

A possible transformation of the data leads to rescaled scores by subtracting the Minimum score and then dividing by the difference between the Maximum and Minimum score. The maximum rescaled score is thus equal to 1, and the minimum rescaled score is equal to 0. For positive and negative outliers, the rescaled score is equal to 1 or 0, respectively, according to the EIS 2018.

The calculation of a Summary Innovation Index is the unweighted average of the rescaled scores for all indicators where all indicators receive the same weight. The final step in the normalization of data comes to calculating relative-to-EU performance scores. This score calculates as the SII of the respective country divided by the SII of the EU multiplied by 100.

The detailed explanation of these steps are to be found in the Report of the EIS 2008 and 2018.

4. Results and discussion

The main result that we achieved through research proved our hypothesis on the possibility of the normalization of Kazakh data according to the EIS (Table 4). The findings refer only to Kazakh data because the data of other European countries were normalized and reported in the EIS 2008 and 2018.

Table 4 Normalization of Kazakhstan data according to EUIS 2008, 2018

Indicator	2008	2018	Indicator	2008	2018
Q1	0.07	0.3	Q11	22.6	29.2
Q2	22.7	53.98	Q12	1.1	1.1
Q3	1	1.1	Q13	2.4	6.6
Q4	0.22	0.25	Q14	0.8	10.5
Q5	0.23	0.1	Q15	0.2	2.3
Q6	0.002	0.37	Q16	8.7	10.3
Q7	3.1	36.6	Q17	20.2	17.3
Q8	3.3	36.8	Q18	5.94	3.5
Q9	1.6	5.9	Q19	17	32.7
Q10	11.3	7.1			

Source: own construction

The first group of indicators showed low values after the normalization of Kazakh data, except the indicator Q2. This indicator was at a fairly high level in comparison with other European countries. The indicators of the second group illustrated sustainable R&D expenditures only in the public sector whereas the other two improved their rates but not significantly. The most substantial and important group of indicators showed the activity in innovation through intellectual property and companies involved in the process. The results of the involvement of Kazakh companies in innovative production indicated poor underlying progress. Besides that, the evaluation of the level of intellectual property was found in the different significance of figures in 2 comparable years. The result considered in the context of each year individually revealed the growth of intellectual property in Kazakhstan in 2018. At the end of 2018, the last group of indicators also demonstrated growth in comparison with the previous decade (Annex C, Tables 1 and 2).

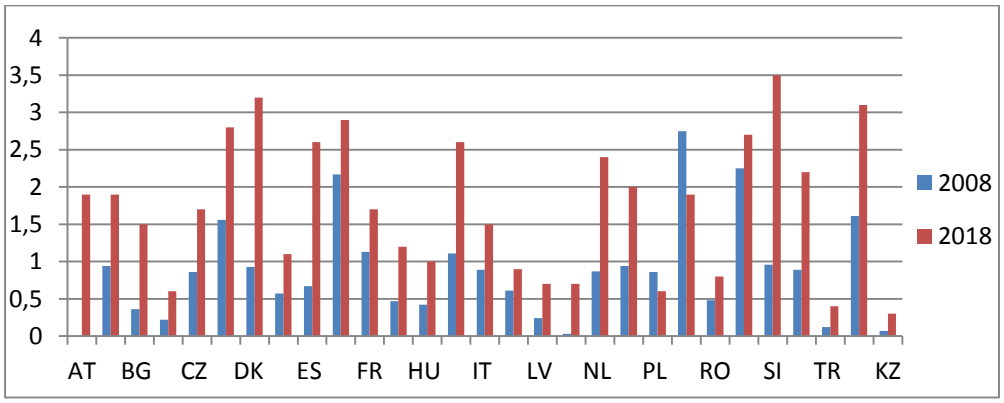
The group of first three indicators connected closely with human resources (Q1, Q2, Q3). The importance of human resources in economics (Agiomirgianakis et al. 2002, Dakhli–Clercq 2004, Kato et al. 2015, Bohdan 2019, McDonald 2019) and innovation (Gupta 1993, Sternberg–Lubart 1999, Acs 2005, Blaga–Jozsef 2014, McKeown 2019) cannot be underestimated. Despite rapidly increasing robotization and automatization, human capital plays a major role and remains a driving force of economic growth (Iosif 2014, Grodzicki 2018, Faggian et al. 2019). The micro-level of the economics shows the dependence of firm performance and ability for innovative activity on human resources through empirical results: in the USA (Coleman 2007, Marvel–Lumpkin 2007, Sullivan–Marvel 2011, Tang–Murphy 2012), in Italy (Colombo–Grilli 2005), in Belgium (De Winne–Sels 2010), in the UK (Ganotakis 2012), in Israel (Gimmon–Levie 2010), in China (Huang et al. 2012), in Germany (Rauch–Rijsdijk 2013), and in Japan (Kato et al. 2015).

The level of tertiary education in the country also plays a major role in shaping economic activity, the development of society, and SMEs. It is a start for continuing to the next phase of full-education, and is given by our first indicator (the number of

doctorates). Indeed, the population of people with tertiary diploma forms the middle and higher classes in the country (Easterly 1999). Tertiary education has a more positive impact than secondary education (Agiomirgianakis et al. 2002). At the same time, we didn`t find a significant impact of tertiary education on innovation (Annex B, Figure 1). We surmise that the growth of population with completed tertiary education aged 30-34 impacts more on internal processes without direct proximity to innovation. Specifically, no dependence of the influences of tertiary education growth on the country's transition from one stage of innovation development to stronger countries was observed.

The level of highly-educated people in a country imposes conditions of growth in science and technology in the long-run (Grodzicki 2000, Duru-Bellat–Gajdos 2012, Bogoviz 2019). Thus, the result of the first indicator illustrated progressive growth during the decade for most countries studied. Only one country saw this indicator decreasing slightly from 0.86 to 0.6 at the end of 2018 - in Poland. In the comparison between 2008 and 2018, the first indicator (Q1) grew significantly from 0.07 to 0.3 in Kazakhstan (Table 4). We found that the higher the number of doctoral graduates indicator, the higher the innovation activity in the country (Figure 2). Thus, we would like to note that the number of doctorates has to be increased by attracting young people to science, by paying competitive salaries, improving laboratories and conditions for research, and raising the prestige of scientists, etc.

Figure 2 Indicator Q1 – New doctoral graduates per 1,000 population aged 25–34



Source: own construction

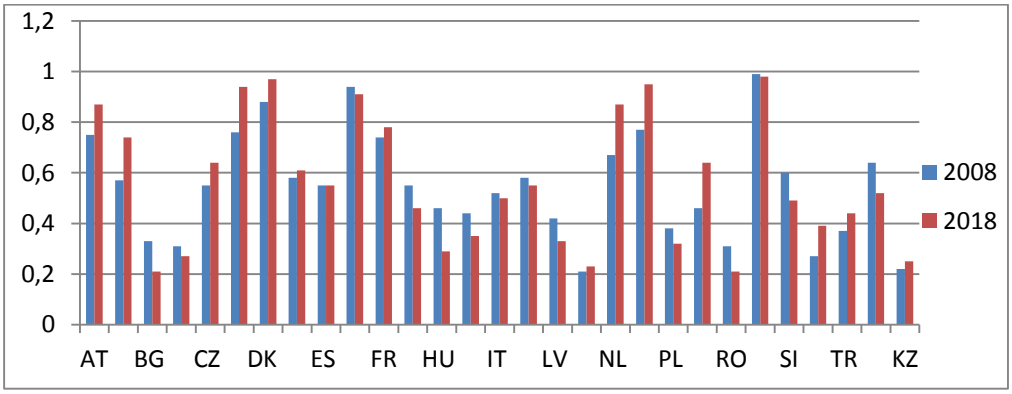
Education and skill improvement became a continuing process in the Digital Age (Fischer 2000, Fischer–Konomi 2007, Sahlberg 2009). Indicator Q3 illustrated lifelong learning in European countries, and in Kazakhstan that calculated as all persons in private households aged between 25 and 64 years, according to EIS 2018. The multifaceted approach to lifelong learning statistics in different countries showed some ambiguity for this indicator in Kazakhstan. However, we found some statistics pertaining to lifelong learning. Thus, in the process of normalizing Kazakh data, we arrived at the result of 1.0 for 2008 and of 1.1 for 2018 (Annex B, Figure 2). Moreover, it was the lower mark among European Union countries for lifelong learning. However, the approaches in collecting data were different – in European countries, it

was by questionnaire, while Kazakh data was collected through the report. We are convinced there is a higher degree of lifelong learning in the population of Kazakhstan through practical experience.

The second group of indicators highlight investment (Q4, Q5, and Q6). Finance is an important part of the commercialization process (Nickell–Nicolitsas 1997). Through research, we found that investment has a positive impact on innovation (Popov–Roosenboom 2009). Further, the integration between innovation and R&D showed a positive relationship in empirical results (Pegkas et al. 2019).

In Kazakhstan, R&D expenditure in the public sector (% of GDP) (Q4) in 2008 was 22.2 and grew slightly in 2018 – 22.5 (Figure 3). The indicator Q5 reflected business expenditure in R&D. R&D expenditure in the private sector was 0.3 in 2008 and tripled in 2018 – 0.10 (Annex B, Figure 3). The last indicator in this group was the indicator of non-R&D innovation expenditure excluding intramural and extramural R&D expenditure. This indicator measures non-R&D innovation expenditure as a percentage of total turnover (Report of EUIS 2018). The rate was 0.002 (2008) and 0.37 (2018) in Kazakhstan (Annex B, Figure 4). Ostensibly, this indicator showed significant growth in 2018 compared with 2008. Measured in the national currency, these 3 indicators always grew. In fact, growth was poor due to the difference in the exchange rate of foreign currencies to the national currency (KZT). Namely, from 2008 to 2018, the foreign rate to tenge (KZT) doubled and lead to significant fluctuation in the national currency and declining values in the case of some q-indicators dependent on foreign currency in 2018. Countries with high involvement in innovation have an indicator of R&D expenditures upwards of 0.6, according to the EIS. While countries with transition economies show performance from 0.5 to 0.2. indicator value of less than 0.2 is characteristic of the modest group of innovators (Figure 3). Thus, the improvement of R&D expenditure indicators will have produce significant growth in Kazakh innovation.

Figure 3 Indicator Q4 – R&D expenditure in the public sector (% of GDP)



Source: own construction

Unfortunately, due to the limited data about venture capital, we excluded the calculation of this indicator. Moreover, according to the Law in Kazakhstan, the understanding of venture capital is blurred and such capital is usually provided by the

government. Certainly, private venture capital also exists in the Kazakhstan innovation market but as a low proportion. The development of R&D by strong financial support and the availability of venture capital at the stage of a start-up is recommended for progress in innovation. The potential for innovative activity of the enterprise is sown through resources such as human capital, intellectual property, investment, and state support of innovative projects, and depends on many other factors. Importantly, the companies have to be interested in the invention and production of new products needed by society in the present time. In the innovation activity part of the analysis, we included indicators of innovation enterprises, intellectual property, and other assets. In general, we were able to point to positive results in 2018 in comparison with a decade ago.

In the table of the EIS, the indicators reflected an underestimated average value in comparison with highly developed innovative countries. However, at the level of the countries with a transition economy, Kazakh indicators showed a stable rise in the potential development of innovative activity in the country.

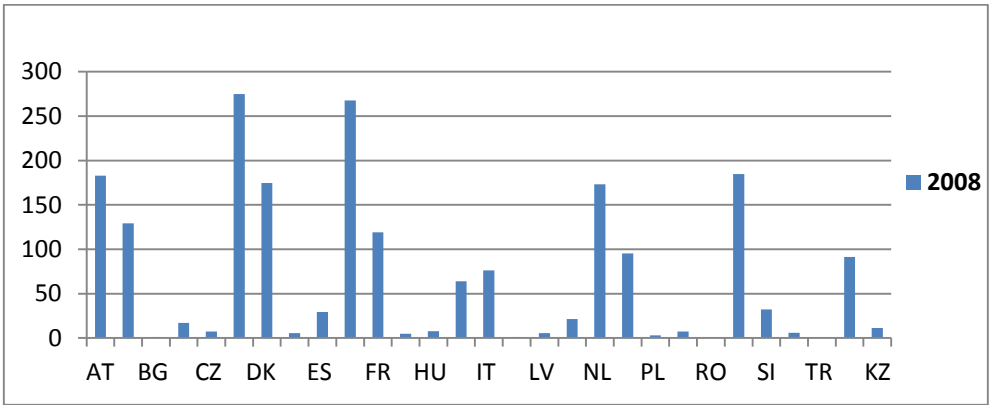
The world crisis of 2008 produced the collapse of the financial sphere and led to difficulties in innovation too. Kazakhstan's economy also suffered during the crisis. At that time, the economy was in a precarious position, which probably contributed to the revision of innovation strategy in Kazakhstan.

The level of development of companies that have introduced any new or significantly improved products or production processes after 2008 improved to 36.6 in 2018 (Annex B, Figure 5). The indicator of co-operation Kazakh enterprises grew significantly from 3.3 to 36.8 in 2018 (Annex B, Figure 6). This indicator illustrated the enormous dependence of Kazakh enterprises on external interconnections. Thus, output demonstrated that Kazakh companies need to build the strong potential of human resources and equipment. There also remain strategically important challenges for the innovative development of Kazakhstan in the future. Naturally, enterprises have to support contacts and co-operate with other firms during the innovation process, but this indicator should be at the average or less level than in 2018.

The position of Kazakhstan in terms of the number of public-private co-authored research publications (Q9) has borne out the problems discussed in this article. Low results for the indicator (less than 6) are shown by several countries: Bulgaria, Lithuania, Latvia, Malta, Poland, Romania, Turkey, and Kazakhstan (Annex B, Figure 7). The indicator Q9 correlated significantly with indicator Q1 – number of doctorate graduates (Figure 2).

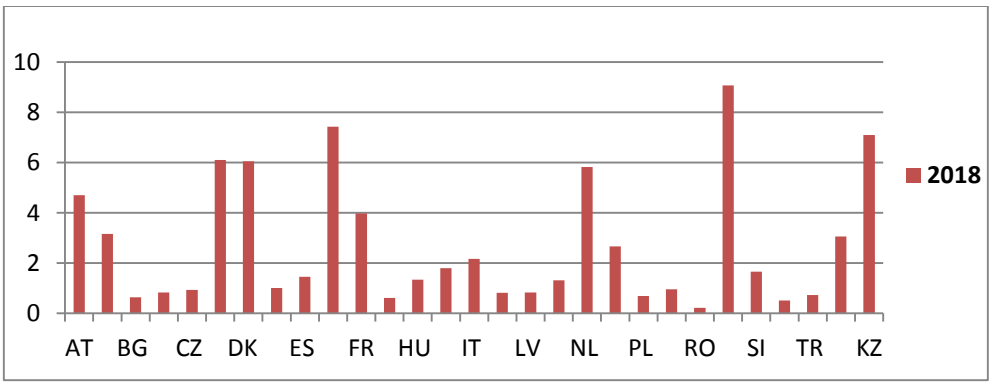
The indicators Q10 (Figure 4, 5), Q11, Q12 (Annex B, Figure 8, 9) indicate the development of the intellectual property in Kazakhstan. During 27 years of independence, Kazakhstan continues improving its intellectual property system from year to year. The significant growth of patent and trademark applications has led to increased interest from business and government. Public awareness of intellectual property protection remains at a low level, but the number of applicants is increasing every year, indicating that the dissemination of information about the need for registration the future intellectual capital (Figure 4, 5) has been effective.

Figure 4 Indicator Q10 – PCT patent applications per billion GDP in 2008



Source: own construction

Figure 5 Indicator Q10 – PCT patent applications per billion GDP in 2018



Source: own construction

In 2018 SMEs introducing product or process innovations and SMEs introducing marketing or organizational innovations grew significantly in comparison with 2008. However, in comparison with EU countries, Kazakhstan reached the level of a few moderate innovator countries in 2018 (Annex B, Figure 10, 11).

The indicators of employment in fast-growing enterprises in Kazakhstan matched those of strong innovator countries: Austria, Finland, and Belgium with similar growth in 2018 (Annex B, Figure 12, 13). However, with the same level of employment in fast-growing enterprises in Austria, Finland, Belgium, and Kazakhstan, the difference in the indicator of exports of medium and high-tech products in Kazakhstan was less than twofold (Annex B, Figure 14).

Due to the limited scope of this article, we would like to identify future directions for exploring the impact of the employment rate in fast-growing companies on the exports of medium and high-tech products in Europe and Central Asia. For future practical contributions, it would also be necessary to clarify exactly what factors influence indicators Q15 and Q17, and also the impact and interaction of Q18 and Q19 (Annex B, Figure 15, 16). Perhaps this will lead to subsequent in-depth discoveries in the management of innovative processes in enterprises.

5. Conclusion

The ability of a country to innovate helps it stay competitive on the global market. Innovation policy defines the weaknesses and strengths of a country in innovation. Innovation strategy determines the direction in innovation, mitigates weaknesses, supports technology breakthroughs, and so on. Most developed countries are able to identify their innovation strengths, which allow them to move forward at a faster pace. For instance, the strengths of Germany in innovation are high-tech density and patent activity; for Singapore – tertiary efficiency; for Sweden – R&D intensity; for Finland – productivity and researcher concentration. For the mitigation of weaknesses and reinforcement of strengths in innovation, developing countries need to know in detail the comparative level of their innovativeness. In this article, we normalized and calculated Kazakh data by 19 indicators according to the methodology of EIS. Thus, we answered the main question of this research. During our calculations, we found the weak spots in innovation in Kazakhstan. We surmise that the slow development of innovation depends on the lack of investment in R&D. Moreover, we consider the impact of human resources on innovation through low values in the indicators of published articles and new doctorates to be significant. The harmonization of data allowed us to see the dependence between employment rate in fast-growing companies and the export of medium and high-tech products to Europe and Central Asia (Annex C, Table 1, 2).

In the end, we have an idea of the innovative potential Kazakhstan has on a global scale after normalizing Kazakh data. It is difficult to deny that the need for catching up in most of the indicators, which is interconnected for many of the indicators presented, will lead to a shift in the positive direction. This study showed the improvement of Kazakh indicators from Modest Innovator to Moderate Innovators country between 2008 and 2018.

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Annex A

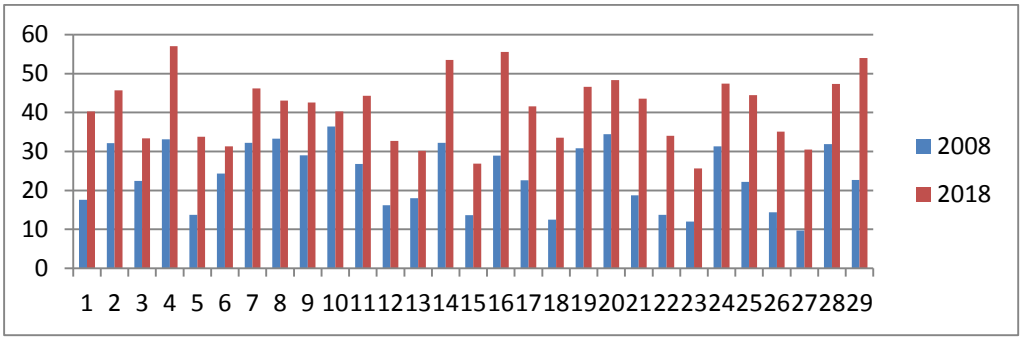
Table 1 Countries rate in European Scoreboard (2008; 2018)

Individuals	In table	European Scoreboard 2008	European Scoreboard 2018
Austria	1	Strong Innovators	Strong Innovators
Belgium	2	Strong Innovators	Strong Innovators
Bulgaria	3	Modest Innovators	Modest Innovators
Cyprus	4	Moderate Innovators	Moderate Innovators
Czech Republic	5	Moderate Innovators	Moderate Innovators
Germany	6	Innovation Leaders	Strong Innovators
Denmark	7	Innovation Leaders	Innovation Leaders
Estonia	8	Moderate Innovators	Moderate Innovators
Spain	9	Moderate Innovators	Moderate Innovators
Finland	10	Innovation Leaders	Innovation Leaders
France	11	Strong Innovators	Strong Innovators
Croatia	12	Just moved	Moderate Innovators
Hungary	13	Modest Innovators	Moderate Innovators
Ireland	14	Strong Innovators	Strong Innovators
Italy	15	Moderate Innovators	Moderate Innovators
Lithuania	16	Modest Innovators	Moderate Innovators
Latvia	17	Modest Innovators	Moderate Innovators
Malta	18	Modest Innovators	Moderate Innovators
Netherlands	19	Strong Innovators	Innovation Leaders
Norway	20	Just moved	Strong Innovators
Poland	21	Modest Innovators	Moderate Innovators
Portugal	22	Moderate Innovators	Moderate Innovators
Romania	23	Modest Innovators	Modest Innovators
Sweden	24	Innovation Leaders	Innovation Leaders
Slovenia	25	Moderate Innovators	Strong Innovators
Slovakia	26	Modest Innovators	Moderate Innovators
Turkey	27	Just moved	Moderate Innovators
United Kingdom	28	Innovation Leaders	Innovation Leaders
Kazakhstan	29	Unknown	Unknown

Source: own construction based on the European Innovation Scoreboards 2008, 2018

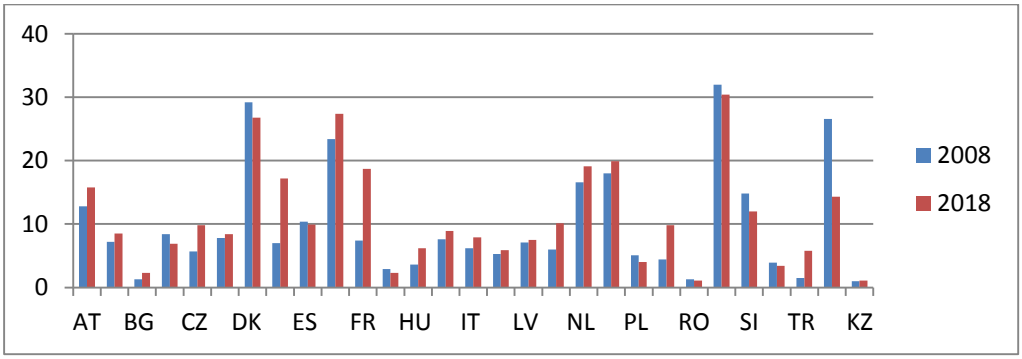
Annex B

Figure 1 Indicator Q2 – Percentage population aged 25–34 having completed tertiary education



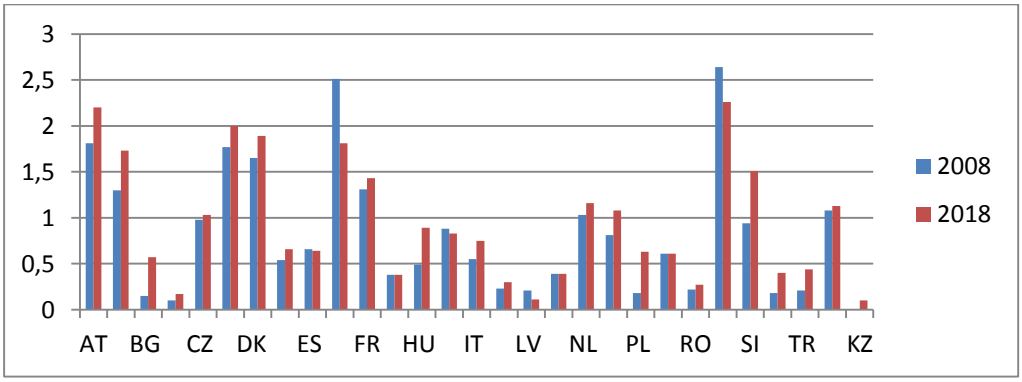
Source: own construction

Figure 2 Indicator Q3 – Lifelong learning of population from 25–64 aged



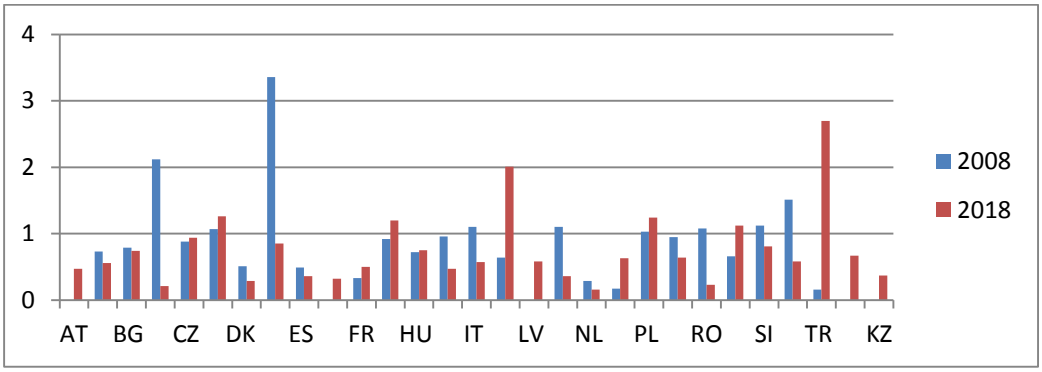
Source: own construction

Figure 3 Indicator Q5 – R&D expenditure in the business sector (% of GDP)



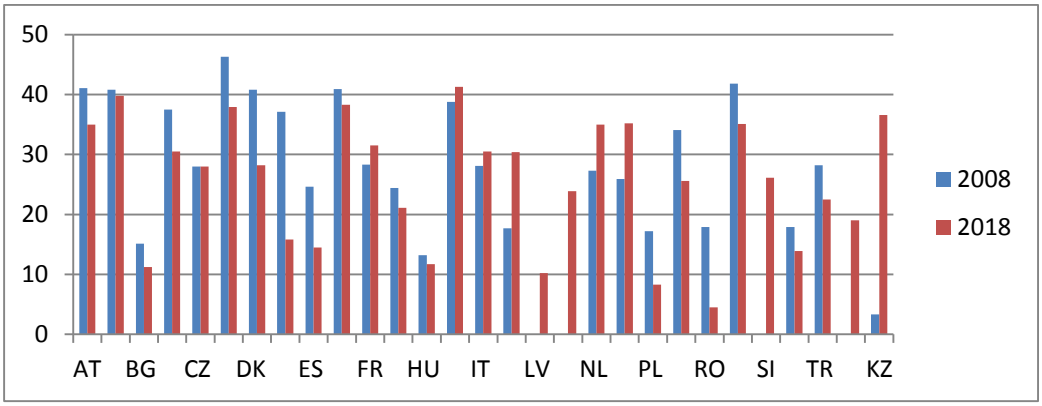
Source: own construction

Figure 4 Indicator Q6 – Non-R&D innovation expenditure (% of turnover)



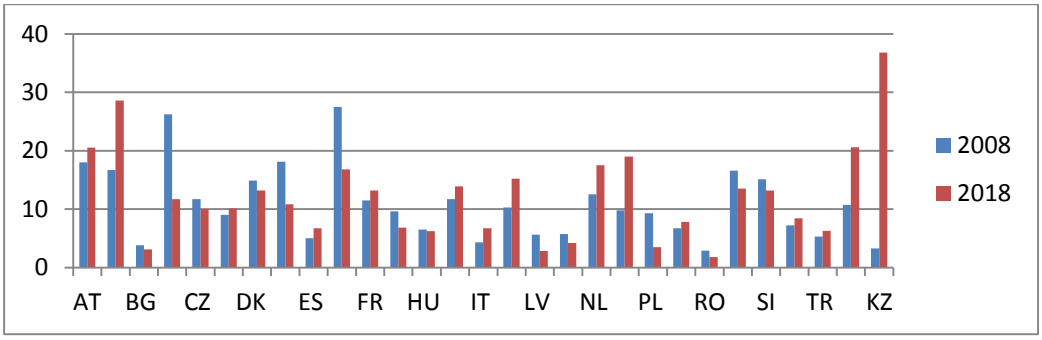
Source: own construction

Figure 5 Indicator Q7 – SMEs innovating in-house (% of SMEs)



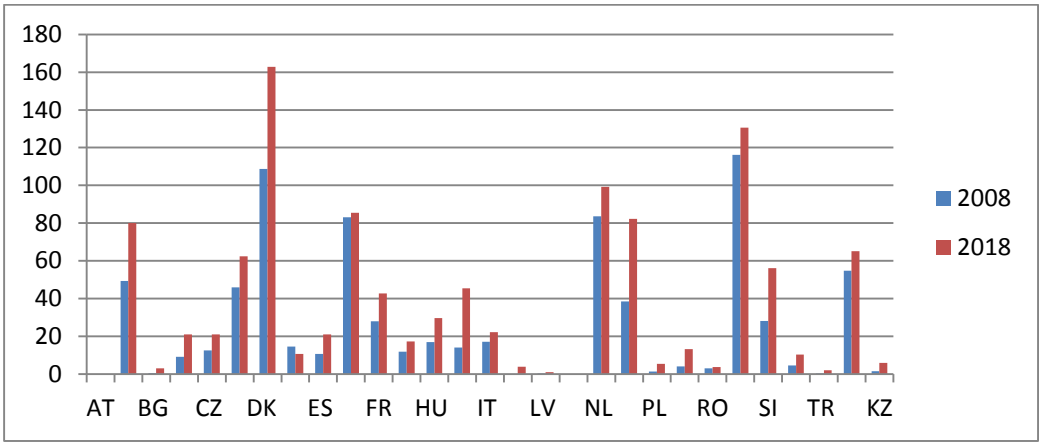
Source: own construction

Figure 6 Indicator Q8 – Innovative SMEs collaborating with others (% of SMEs)



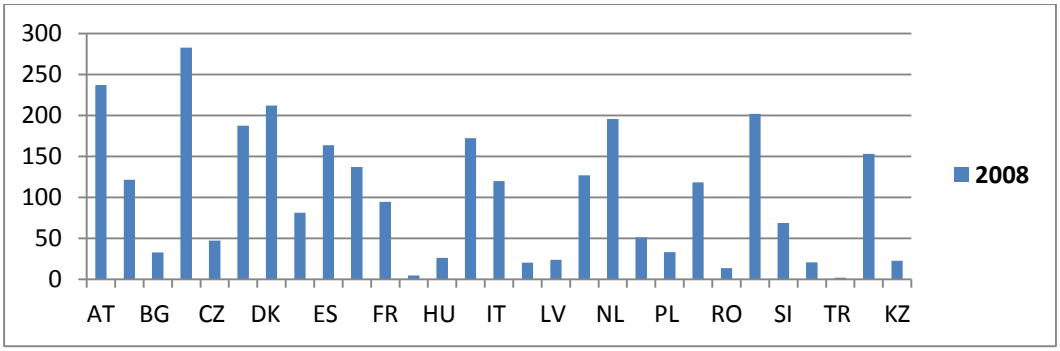
Source: own construction

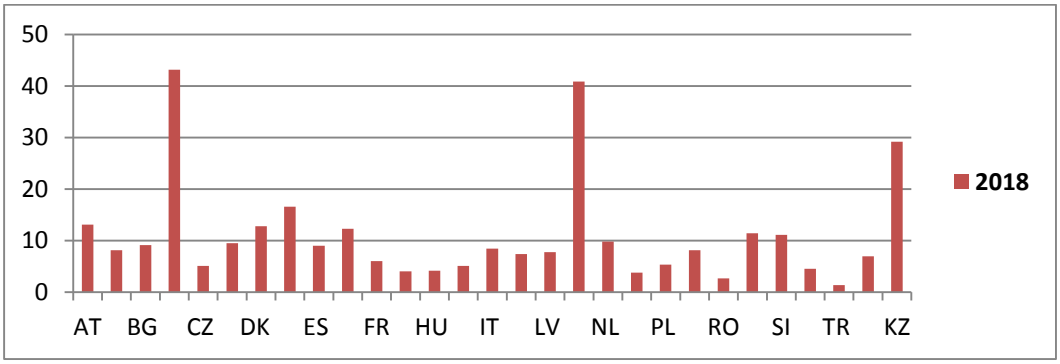
Figure 7 Indicator Q9 – Public-private co-publications per million population



Source: own construction

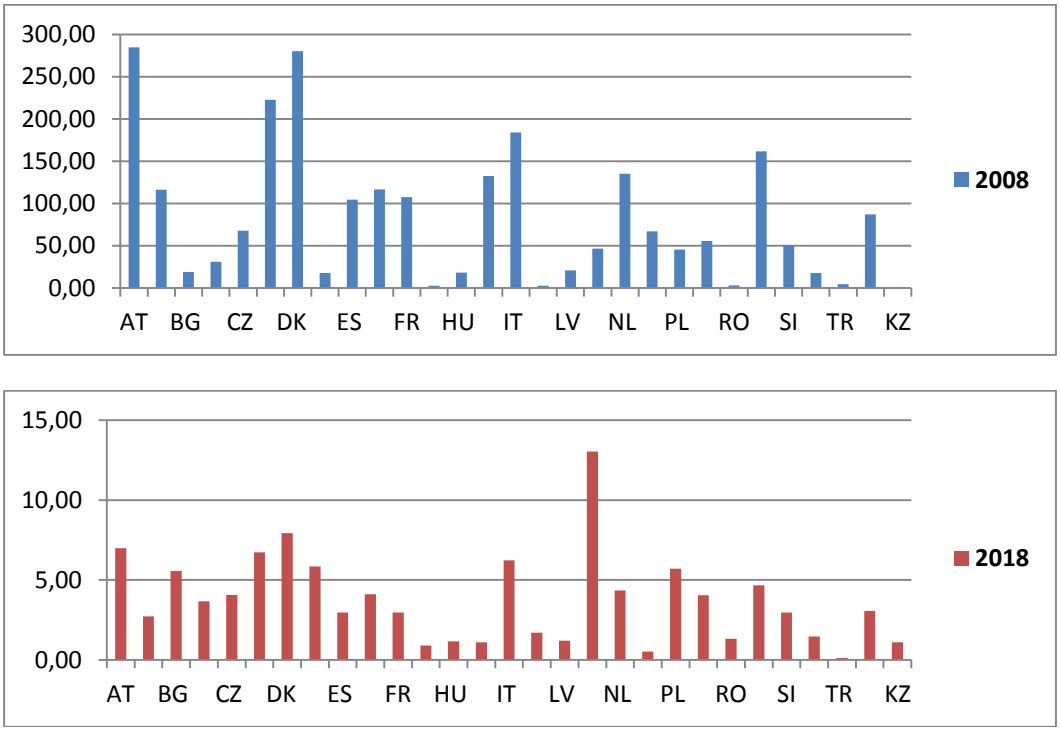
Figure 8 Indicator Q11 – Trademarks applications per billion GDP in 2008 and in 2018





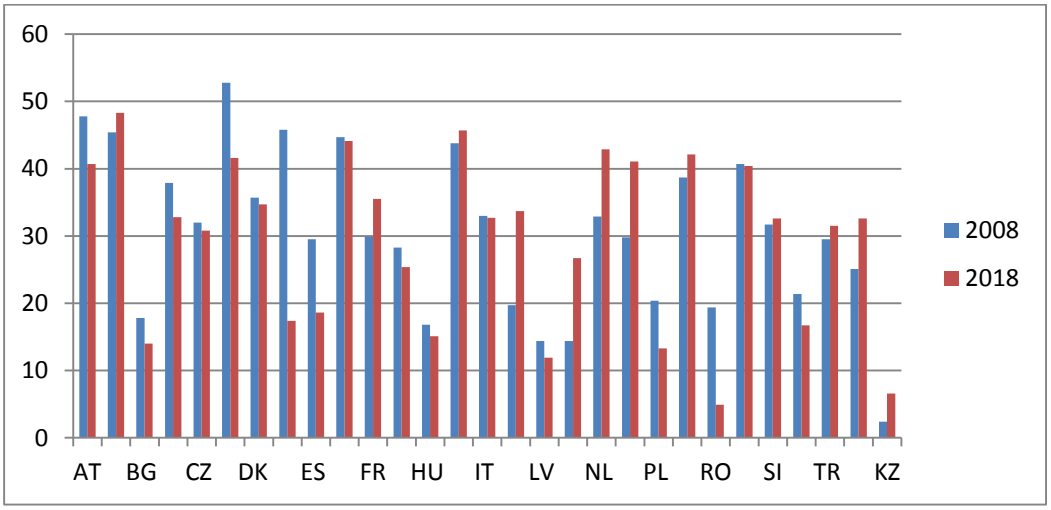
Source: own construction

Figure 9 Indicator Q12 – Designs applications per billion GDP in 2008 and in 2018



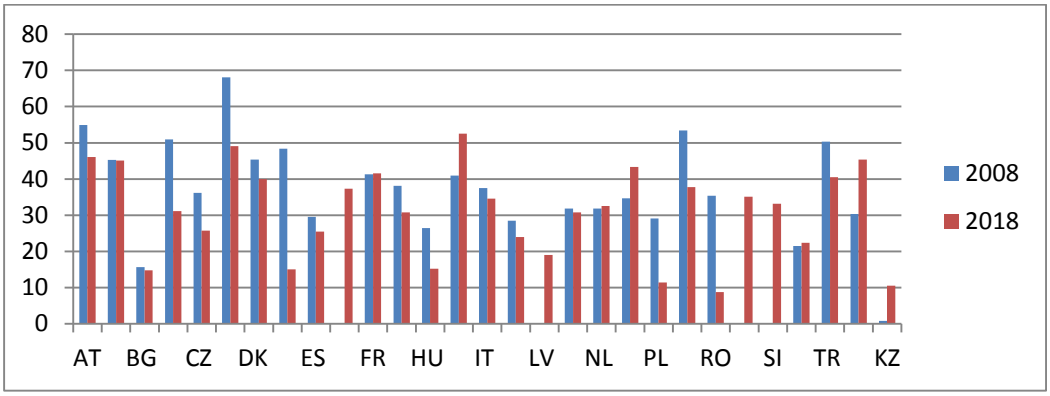
Source: own construction

Figure 10 Indicator Q13 – SMEs introducing product or process innovations (% of SMEs)



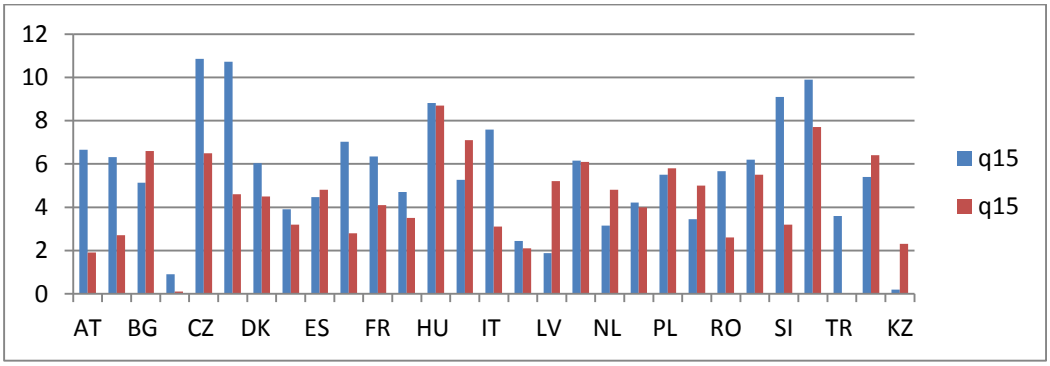
Source: own construction

Figure 11 Indicator Q14 – SMEs introducing marketing or organizational innovations (% of SMEs)



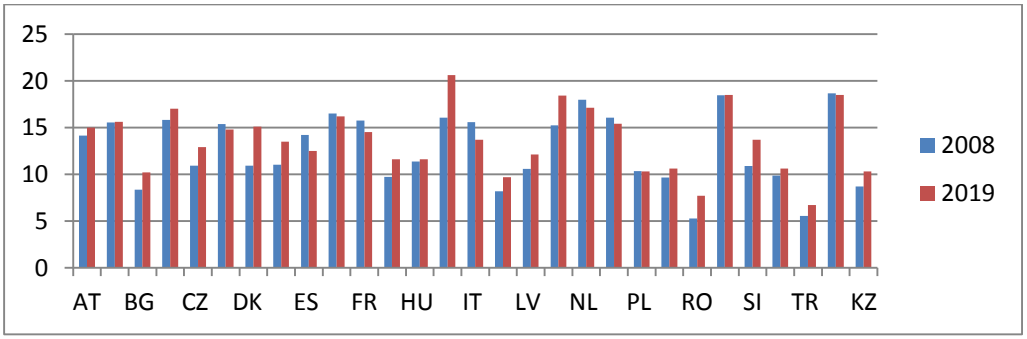
Source: own construction

Figure 12 Indicator Q15 – Employment in fast-growing enterprises in innovative sectors (% of total employment)



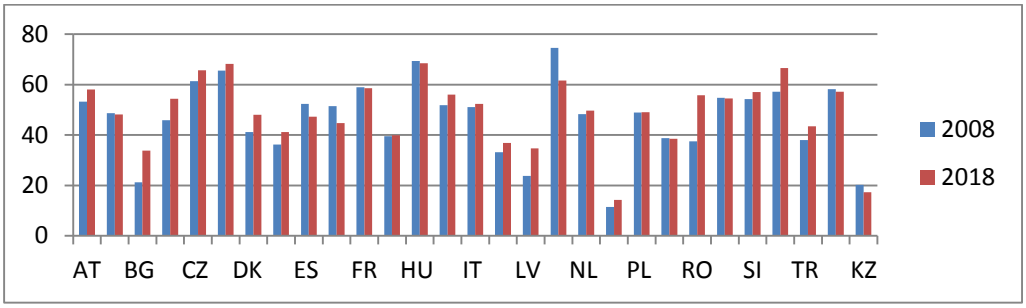
Source: own construction

Figure 13 Indicator Q16 – Employment in knowledge-intensive activities (% of total employment)



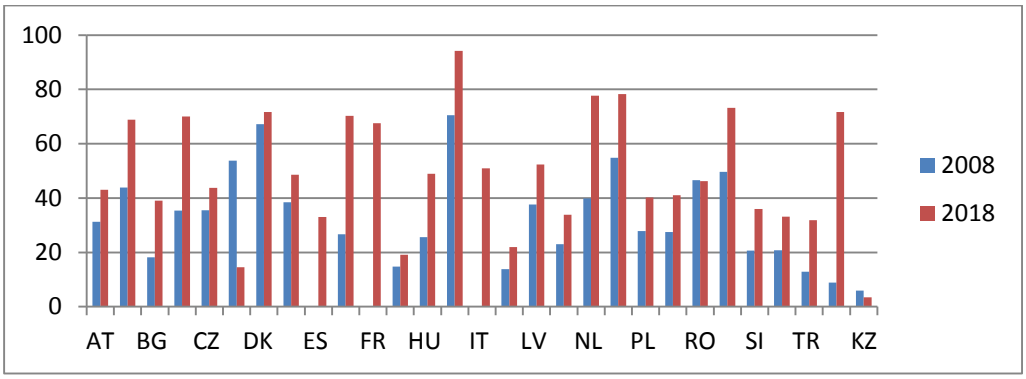
Source: own construction

Figure 14 Indicator Q17 – Exports of medium and high-technology products as a share of total product export



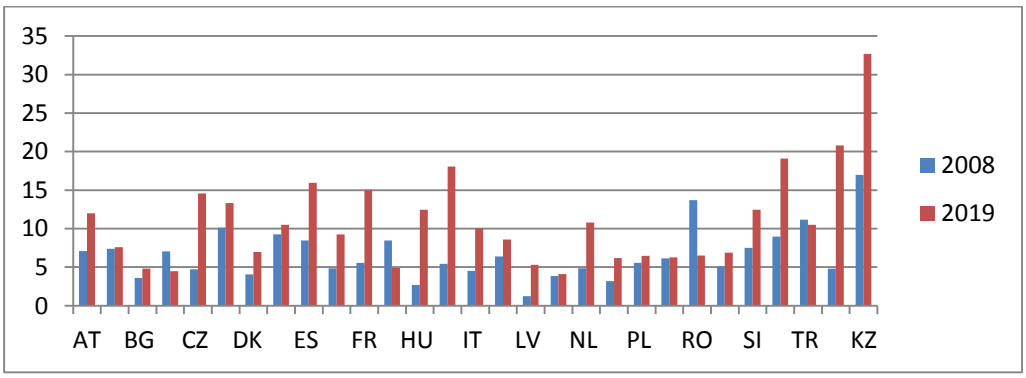
Source: own construction

Figure 15 Indicator Q18 – Knowledge-intensive services exports as % of total services exports



Source: own construction

Figure 16 Indicator Q19 – Sales of new-to-market and new-to-firm innovations as % of turnover



Source: own construction

Annex C

Table 1 Harmonized Kazakh data according to the EIS in 2008

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q14	q15	q16	q17	q18	q19
AT	1.72	17.6	12.8	0.75	1.81	n/a	41.1	18	58	183.1	237.1	284.6	47.8	54.9	6.66	14.15	53.2	31.3	7.08
BE	0.94	32.1	7.2	0.57	1.3	0.73	40.8	16.7	49.4	129.1	121.4	116.2	45.4	45.3	6.31	15.54	48.7	43.9	7.39
BG	0.36	22.4	1.3	0.33	0.15	0.79	15.1	3.8	0.5	1.4	32.8	19.2	17.8	15.7	5.13	8.35	21.2	18.2	3.59
CY	0.22	33.1	8.4	0.31	0.1	2.12	37.5	26.2	9.1	17	282.8	31.2	37.9	50.9	0.9	15.8	45.9	35.4	7.04
CZ	0.86	13.7	5.7	0.55	0.98	0.88	28	11.7	12.6	7.3	47.1	67.7	32	36.2	10.85	10.92	61.3	35.5	4.72
DE	1.56	24.3	7.8	0.76	1.77	1.07	46.3	9	45.9	275	187.7	222.6	52.8	68.1	10.72	15.37	65.5	53.8	10.11
DK	0.93	32.2	29.2	0.88	1.65	0.51	40.8	14.9	108.7	174.6	212.1	280.4	35.7	45.4	6.03	10.92	41.2	67.2	4.05
EE	0.57	33.3	7	0.58	0.54	3.36	37.1	18.1	14.5	5.6	81.4	17.9	45.8	48.4	3.9	11.01	36.2	38.5	9.27
ES	0.67	29	10.4	0.55	0.66	0.49	24.6	5	10.6	29.3	163.8	104.5	29.5	29.5	4.47	14.22	52.3	n/a	8.48
FI	2.17	36.4	23.4	0.94	2.51	n/a	40.9	27.5	83.1	267.6	137.3	116.8	44.7	n/a	7.03	16.49	51.5	26.7	4.83
FR	1.13	26.8	7.4	0.74	1.31	0.33	28.3	11.5	27.9	119.2	94.4	107.5	29.9	41.3	6.35	15.76	58.9	n/a	5.56
HR	0.47	16.2	2.9	0.55	0.38	0.92	24.4	9.6	11.9	5	4.5	2.9	28.3	38.1	4.7	9.71	39.5	14.8	8.45
HU	0.42	18	3.6	0.46	0.49	0.72	13.2	6.5	16.9	7.8	26	18.3	16.8	26.4	8.82	11.35	69.3	25.6	2.7
IE	1.11	32.2	7.6	0.44	0.88	0.96	38.8	11.7	14	64.1	172.5	132.7	43.8	40.9	5.26	16.05	51.8	70.5	5.43
IT	0.89	13.6	6.2	0.52	0.55	1.1	28.1	4.3	17.2	76.1	120	184.2	33	37.5	7.59	15.57	51.1	n/a	4.52
LT	0.61	28.9	5.3	0.58	0.23	0.64	17.7	10.3	0	1.3	20.4	2.6	19.7	28.5	2.44	8.19	33.1	13.8	6.39
LV	0.24	22.6	7.1	0.42	0.21	n/a	n/a	5.6	0.4	5.7	23.7	21	14.4	n/a	1.88	10.57	23.8	37.6	1.25
MT	0.03	12.5	6	0.21	0.39	1.1	n/a	5.7	0	21.6	127.1	46.7	14.4	31.8	6.16	15.22	74.5	23	3.85
NL	0.87	30.8	16.6	0.67	1.03	0.29	27.3	12.5	83.7	173.3	195.8	135.3	32.9	31.8	3.15	17.97	48.3	39.9	4.87
NO	0.94	34.4	18	0.77	0.81	0.17	25.9	9.8	38.5	95.5	51.2	67.1	29.8	34.7	4.21	16.05	11.4	54.8	3.17
PL	0.86	18.7	5.1	0.38	0.18	1.03	17.2	9.3	1.3	3	33.2	45.5	20.4	29.1	5.5	10.33	48.9	27.9	5.55
PT	2.75	13.7	4.4	0.46	0.61	0.95	34.1	6.7	4	7.4	118.5	55.8	38.7	53.4	3.45	9.65	38.7	27.5	6.12
RO	0.48	12	1.3	0.31	0.22	1.08	17.9	2.9	3.1	0.7	13.5	3	19.4	35.4	5.66	5.26	37.5	46.6	13.69
SE	2.25	31.3	32	0.99	2.64	0.66	41.8	16.6	116.1	184.8	201.9	161.9	40.7	n/a	6.2	18.45	54.8	49.7	5.1
SI	0.96	22.2	14.8	0.6	0.94	1.12	n/a	15.1	28.2	32.2	68.7	50.5	31.7	n/a	9.09	10.89	54.2	20.7	7.5
SK	0.89	14.4	3.9	0.27	0.18	1.51	17.9	7.2	4.5	5.8	20.6	18	21.4	21.5	9.89	9.86	57.2	20.8	8.95
TR	0.12	9.7	1.5	0.37	0.21	0.16	28.2	5.3	0.3	1	1.9	4.5	29.5	50.3	3.6	5.53	38	12.9	11.17
UK	1.61	31.9	26.6	0.64	1.08	n/a	n/a	10.7	54.7	91.4	153.1	87.1	25.1	30.3	5.4	18.64	58.2	8.9	4.81
KZ	0.07	22.7	1	0.22	0.23	0.002	3.1	3.3	1.6	11.3	22.6	1.1	2.4	0.8	0.19	8.7	20.2	5.94	17

Source: own construction based on the EIS 2008

Table 2 Harmonized Kazakh data according to the EIS in 2018

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12	q13	q14	q15	q16	q17	q18	q19
AT	1.9	40.3	15.8	0.87	2.2	0.47	35	20.5	82.3	4.7	13.0	6.98	40.7	46.1	1.9	15	58	43.1	11.9
BE	1.9	45.7	8.5	0.74	1.73	0.56	39.8	28.6	80	3.16	8.11	2.72	48.3	45.1	2.7	15.6	48.2	68.9	7.6
BG	1.5	33.4	2.3	0.21	0.57	0.74	11.2	3.1	3	0.64	9.1	5.56	14	14.8	6.6	10.2	33.8	39	4.8
CY	0.6	57	6.9	0.27	0.17	0.21	30.5	11.7	21.1	0.82	43.1	3.67	32.8	31.1	0.1	17	54.4	70	4.49
CZ	1.7	33.8	9.8	0.64	1.03	0.94	28	10	21	0.93	5.09	4.07	30.8	25.7	6.5	12.9	65.7	43.8	14.5
DE	2.8	31.3	8.4	0.94	2	1.26	37.9	10.1	62.4	6.11	9.51	6.72	41.6	49.1	4.6	14.8	68.2	14.6	13.3
DK	3.2	46.2	26.8	0.97	1.89	0.29	28.2	13.2	162.	6.05	12.7	7.94	34.7	40	4.5	15.1	48	71.7	6.96
EE	1.1	43.1	17.2	0.61	0.66	0.85	15.8	10.8	10.6	1.01	16.5	5.84	17.4	15	3.2	13.5	41.2	48.6	10.4
ES	2.6	42.6	9.9	0.55	0.64	0.36	14.5	6.7	21.1	1.45	8.99	2.97	18.6	25.5	4.8	12.5	47.2	33.1	15.9
FI	2.9	40.3	27.4	0.91	1.81	0.32	38.3	16.8	85.4	7.43	12.3	4.11	44.1	37.3	2.8	16.2	44.7	70.3	9.27
FR	1.7	44.3	18.7	0.78	1.43	0.5	31.5	13.2	42.8	3.98	6.04	2.96	35.5	41.6	4.1	14.5	58.5	67.6	15.0
HR	1.2	32.7	2.3	0.46	0.38	1.2	21.1	6.8	17.3	0.61	4	0.9	25.4	30.8	3.5	11.6	39.9	19.1	4.91
HU	1	30.2	6.2	0.29	0.89	0.75	11.7	6.2	29.6	1.34	4.15	1.15	15.1	15.2	8.7	11.6	68.5	49	12.4
IE	2.6	53.5	8.9	0.35	0.83	0.47	41.3	13.9	45.4	1.8	5.08	1.09	45.7	52.5	7.1	20.6	56	94.2	18.0
IT	1.5	26.9	7.9	0.5	0.75	0.57	30.5	6.7	22.2	2.16	8.46	6.23	32.7	34.6	3.1	13.7	52.4	50.9	10.0
LT	0.9	55.6	5.9	0.55	0.3	2.01	30.4	15.2	3.9	0.81	7.39	1.71	33.7	24	2.1	9.7	36.9	22	8.57
LV	0.7	41.6	7.5	0.33	0.11	0.58	10.2	2.8	1	0.82	7.77	1.2	11.9	19	5.2	12.1	34.7	52.4	5.31
MT	0.7	33.5	10.1	0.23	0.39	0.36	23.9	4.2	0	1.31	40.8	13.0	26.7	30.8	6.1	18.4	61.6	33.9	4.12
NL	2.4	46.6	19.1	0.87	1.16	0.16	35	17.5	99.3	5.82	9.78	4.34	42.9	32.5	4.8	17.1	49.7	77.7	10.8
NO	2	48.3	19.9	0.95	1.08	0.63	35.2	19	82.2	2.66	3.79	0.52	41.1	43.3	4	15.4	14.3	78.3	6.16
PL	0.6	43.6	4	0.32	0.63	1.24	8.3	3.5	5.4	0.69	5.33	5.71	13.3	11.4	5.8	10.3	49	40.2	6.45
PT	1.9	34	9.8	0.64	0.61	0.64	25.6	7.8	13.2	0.95	8.1	4.04	42.1	37.8	5	10.6	38.5	41.1	6.27
RO	0.8	25.6	1.1	0.21	0.27	0.23	4.5	1.8	3.7	0.22	2.64	1.31	4.9	8.8	2.6	7.7	55.8	46.2	6.51
SE	2.7	47.4	30.4	0.98	2.26	1.12	35.1	13.5	130.	9.08	11.4	4.67	40.4	35.1	5.5	18.5	54.5	73.2	6.89
SI	3.5	44.5	12	0.49	1.51	0.81	26.1	13.2	56.1	1.65	11.0	2.97	32.6	33.2	3.2	13.7	57	36	12.4
SK	2.2	35.1	3.4	0.39	0.4	0.58	13.9	8.4	10.3	0.51	4.49	1.46	16.7	22.4	7.7	10.6	66.5	33.2	19.1
TR	0.4	30.5	5.8	0.44	0.44	2.7	22.5	6.3	2	0.73	1.34	0.11	31.5	40.5	n/a	6.7	43.4	31.9	10.5
UK	3.1	47.3	14.3	0.52	1.13	0.67	19	20.6	65.1	3.06	6.95	3.07	32.6	45.4	6.4	18.5	57.1	71.7	20.8
KZ	0.3	53.9	1.1	0.25	0.1	0.37	36.6	36.8	5.9	7.1	29.2	1.1	6.6	10.5	2.3	10.3	17.3	3.5	32.7

Source: own construction based on the EIS 2018

Udvari B. (ed) 2020: Proceedings of the European Union's Contention in the Reshaping Global Economy. University of Szeged, Doctoral School in Economics, Szeged, https://doi.org/10.14232/eucrge.2020.proc.11

The development of innovative SMEs in post-socialist countries

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The Small and Medium-Sized Enterprises (SMEs) are a necessary element of the social and economic development of the national economy from the perspective of their significant contribution to employment, innovative capacity, and flexibility. Innovative SMEs are necessary building block in the restructuring of transition economies. The successful reformers of the Central and Eastern Europe countries can promote policies conducive to the development of innovative SMEs, and consequently benefit from the economic advantages of SMEs. However, the majority of the Commonwealth of Independent States (CIS) countries are lagging behind significantly.

This paper gives the analytical description of the development of SMEs in post-socialist countries during the transition process within the framework of the market reforms. The main barriers to growth of SMEs with innovation capacity are the institutional environment, and the inadequate attitude of the government towards small companies. The countries which integrated to European Union been able to overcome these barriers considerably, while the CIS countries do not have a record of significant achievement in this area.

1. Introduction

Until the 1970s, the scientists did not pay enough attention to role of Small-Medium Enterprises (SMEs) in economic development. Economists investigated the development of the national economy against the background of the large companies. It was taken for granted that only gigantic companies were capable conducting Research and Development (R&D), introducing innovations, and improving efficiency (Klapper et al. 2006). "Since the early 70s, the main larger manufacturing companies began to lose competitiveness and the studies on the role of the SME in economic progress came to scene" (Klapper et al. 2006, p. 5). The measurement of innovative activity changed from R&D performance to the introduction of the new products and production process (Acs and Audretch 1988). The smaller companies outperformed the larger ones in the introduction of new products and production process, and turned into the providers of intermediate goods and services to larger companies (ibid). Another objective reason for scientists` reluctance to conduct research on the SMEs is the absence of consistent and reliable data sources to depict their business activity (Iwasaki 2012).

The transition to market economy in the Post-Socialist (PS) countries puts the importance of the development of SMEs on the agenda. Since the development of SMEs is the triggering force for successful transformation as well as its indicator. Particularly, SMEs are the driving force for building the innovative environment in PS transition countries. The gigantic companies, which were established during communism in PS countries, do not have sufficient innovation capacity due to lack of capital in the realm of the market economy. In such an environment, SMEs can

maneuver to adjust to requirements of the consumers by doing necessary innovating thanks to their flexibility and capacity for quickly responding to changeable market conditions. My conceptual framework is the measurement of the level of patents by SMEs in the background of a comparison with developed economies. I deploy this concept in evaluating the role of SMEs in economic restructuring and gaining national competitiveness in PS countries.

The distinctive features of the SME define its importance in economic and social progress. The average share of the SME in GDP is 50 percent across countries (World Bank 2017). It stands for 90 percent of the number of businesses and half of all employment globally (ibid). One of the distinguishing features of SMEs is their propensity to utilize labor intensive technologies and absorb the labor force**.** By opening up employment opportunity for society, SMEs are conducive to alleviating the poverty problem. It has special importance for PS countries because the period after the demise of communism was accompanied by intolerable levels of unemployment and poverty in those countries. Nevertheless, some of these countries have not yet achieved favorable levels of employment and affluence since the early years of the transition. I will touch on the main reason – incompleteness of market reforms in the abovementioned countries in more detail in the paper.

Another important feature of SMEs is their flexibility. Piore and Sabel (1984) claim that SMEs are more efficient than larger firms because they are more flexible. This relative flexibility allows SMEs to adapt to market and real condition by introducing new products and production process. The lower adaptation cost of the SME contributes to its flexibility (Sak–Taymaz 2004). It is important to pay attention to the terms of flexibility and lower adaptation cost in order to understand the role of SMEs in the transition of PS countries to functioning market economy. The flexibility is a necessary feature to restructure the national economy of the transition countries to a more efficient level. But this structural change incurs a cost, and PS economies are not capable of covering the cost of restructuring due to immature financial markets and weak states. Thus, the lower adaptation costs of SMEs allow taking initial necessary steps to contribute to the restructuring of the economy. In contrast, the larger companies lag behind in restructuring due to the huge cost of restructuring.

Apart from the above mentioned features, a significant proportion of SMEs is specialized in producing intermediate goods and services for larger companies. This capability facilitates the integration of the domestic economy to Global Value Chains (GVCs). Being the supplier for larger companies opens up the opportunity for advancing the economies of PS countries. So, there is great opportunity in attracting the export oriented FDI into PS countries, and the transition economies of Central and Eastern Europe (CEE) have not missed this opportunity. As the suppliers of the export oriented FDIs, the SME can achieve technological and organizational innovation and upgrade the national economy. The manufacturing companies Czech Republic, Hungary, Poland and Slovakia succeeded in benefitting from the positive spillover from FDIs (Ivanyi and Vigyari 2012). At the same time, they can integrate their national economies into GVCs.

In this paper, I will give an analytical description of the development of SMEs in PS countries of Central-Eastern, South-Eastern Europe, Baltic States. and

Commonwealth of Independent States during the transition process within the framework of the reforms. I will analyze the previous works on SME development in those countries, and investigate the prospects of innovative SMEs and their contribution to growing national competitiveness. The following section briefly touches on the differences in the development of the SME between developed and developing countries. After that, I will describe the emergence of the SMEs from scratch and the development of the innovative in PS countries. Later, I will specify the barriers for the development of the SMEs with innovation capacity in PS countries. The last section provides a conclusion.

2. SMEs in developing countries

As in other features of the economy and society, there are also considerable differences in the state of SMEs between developed and developing countries. As belonging to the category of developing economy, up to significant extent, the PS countries have similar differences with developed societies. Therefore, general understanding of the state of SMEs in developing countries will be a guide for an initial understanding the situation of SMEs in PS economies. The specificity of SMEs in PS countries will be analyzed in the forthcoming sections in detail. The SMEs of developing countries are at a disadvantaged position in terms of access to inputs, financial resources, human capital, and policy assistance in comparison with developed countries.

One of the most important distinctions is in access to capital. The traditional theories of capital structure explain the financing decisions of companies in advanced countries and are not quite powerful enough to explain the same decisions in developing countries, because their assumptions do not hold in developing countries. The institutional environment in developing countries impedes the emergence of developed financial markets. Absence of the full-fledged capital markets leads to widening of the asymmetric information between borrowers and companies. Under the condition of a high level of information asymmetry, SMEs have difficulty accessing formal sources of financial resources (Borgia–Newman 2012).

The neoliberal policies suggested in the 1970s and 80s for economic development in Latin American countries damaged the SMEs in those countries. SMEs are inherently disadvantaged in access to inputs, technology, financial resources, human capital, and policy support in comparison with larger corporations. As a part of globalization, trade and market liberalization placed SMEs in an even more disadvantaged situation. In contrast, the larger corporations could access the necessary resources to be competitive. As a result, a deep gap and dualism emerged between a small number of advanced foreign and larger national companies and smaller, outdated domestic firms (Parrilli 2007). The number of SMEs in Chile decreased from 60,000 to 40,000 between 1996–2000, and their sales dropped from USD 8 billion to USD 5.5 billion in the same period. Their market share was squeezed by imports as a result of liberalization of foreign trade. In this case, government intervention to coordinate the activity of SMEs is necessary in order to keep them competitive and alive. The government policy to assist the development of SMEs from

1960 to 1990s in central and northern Italy significantly contributed to the economic development of Italy (ibid). A small number of researchers claim that the Italian approach could be applied in other developing countries (Schmitz 1989).

Regarding the state of SMEs, the main differences between developed and developing countries are higher levels of uncertainty and the absence of adequate government assistance to SMEs in developing countries. Weaker state apparatus and property rights cause SMEs have considerable difficulty in accessing necessary capital and input in the background of immature financial markets. On the other hand, the governments of developing countries do not have the competency and sufficient resources to institute assistance programs to SMEs.

3. Emergence of SMEs in PS countries

In this section, I analyze the emergence of SMEs in PS countries literally from scratch after the collapse of the omnipotent state owned economy. I touch on the necessity of the rise of entrepreneurship due to the arrival of market ideology as well as loss of stable jobs as a result of the closing of the state companies. I evaluate the contribution of the different kinds of SMEs to market building and economic development in PS countries especially with regard to their innovative capacity.

The share of GDP attributable to SMEs is not homogeneous across PS countries. It varies from 8 percent in Belarus, 22.9 percent in Russia, 47 percent in Ukraine and 64 in Hungary (Figure 1). In general, this indicator averages from 23 percent in the CIS to 41 percent in CEE countries (Anders 2012). The number of SMEs per 1000 people varies across countries. Romania performs worst with 29, whereas Hungary and Latvia share the same place at 70, while Poland lies behind them at 55. Slovakia and Czech Republic, however, are the best performers, at 103 and 115, respectively. There is non-linear correlation between this indicator and GPD per capita.

In communist ideology, private property was forbidden and not respected during the socialist period in PS countries. Nevertheless, private, self-employed, and small entrepreneurs existed within the socialist system. In most countries, their activity was illegal but tolerated, while in couple of countries like Hungary and Poland, a limited level of small business activity was legally permitted. Nevertheless, it is literally possible to say that all PS countries began to build up their SMEs from scratch. Smallbone and Welter (2001) emphasize that in order to transform into functioning market economies, the PS countries have to promote privatization, market liberalization, and market reforms. The rise of SMEs is part of the privatization process, and it can be in the form of new enterprises or privatization of state-owned enterprises. SMEs can be both a consequence and the driving force of the marketization process. The initial necessary market environment promotes the flourishing of SMEs. At the same time, the rise of SMEs can create the power to affect government as well as society to create and to shift to a market economy.

Figure 1 Contribution of SME to GDP in PS countries

Country	SME Contribution to GDP (percent)
Hungary	64 [1998]
Lithuania	55 [1998]
Poland	54 [1998]
Czech Republic	53 [1998]
Latvia	50 [1998]
Tajikistan	43 [2006]
Azerbaijan	41 [2003]
Bulgaria	39 [2005]
Georgia	39 [1998]
Uzbekistan	38 [2006]
Slovak Republic	37 [2005]
Armenia	35 [2003]
Ukraine	30 [1998]
Russian Federation	23 [1998]
Kazakhstan	22 [1998]
Belarus	8 [2006]

Source: Anders (2012)

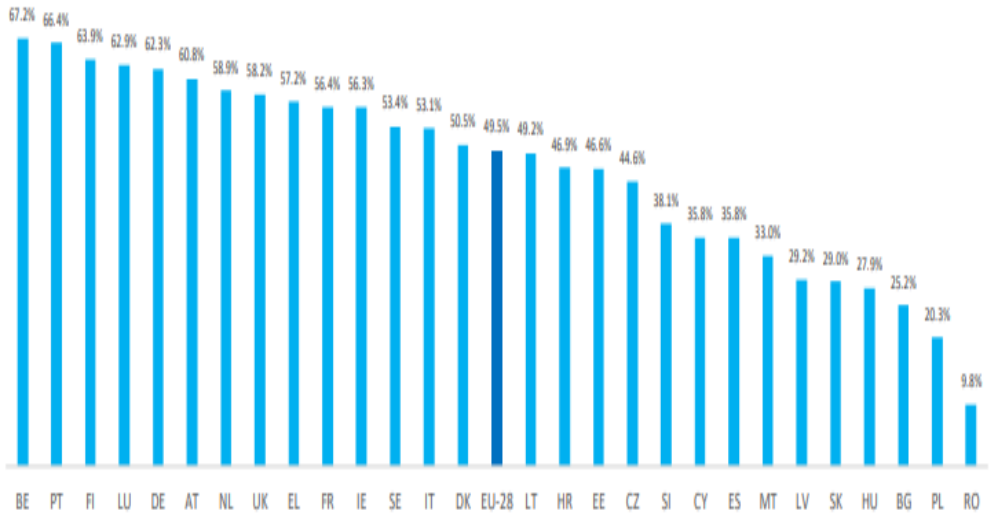
Given the reality of the literal non-existence of private enterprises during socialism, analyzing the source of emerging SMEs is helpful to understand the state of SMEs in PS countries in the early transition period. The understanding of the initial emergence of SMEs is helpful in defining the quality of these small businesses in the early stages of transition in these countries. On the basis of this understanding, it would appropriate to determine the needs of the SMEs and prepare SME development policies.

One of the most important reasons for starting business in the transition period was related to job losses and insufficient income from employment. As a result of the collapse of the relations of production and trade among socialist countries developed during socialism, privatization as well as the incapability of state companies to compete in new market environments, these countries faced significant levels of unemployment in the new social-economic system, conditions not experienced during socialism. So, people who found themselves unemployed and earning insufficient income from what jobs they had, began to do trade and service business in order to survive. Literally, all such self-employed and small business activity was outside of the official registration (Malle 1996). The approach of the Birmingham (UK) model is partially applicable for explaining the emergence of SMEs in the PS transition economies (Smallbone–Welter 2001). This model claims that the rise of self-employment and small business activities was a result of the collapse of the industrial sector, consequently diminishing of job opportunity (Storey–Johnson 1987). However, in Hungary, the number of self-employed people fell from 567,100 to 486,300 from 2000 to 2007 (Hungarian National Statistics). As mentioned above, the majority of the self-employed entrepreneurs were fired workers. As the economy recovered, they went back to their professions.

In order to evaluate the contribution of the SMEs to economic transformation in general and to economic development in particular, it is purposeful to study them in categories related to their growth potential. In general, various approaches to the definition of the enterprise can be employed to test the specific features of the emerging SMEs in PS countries. "Kirzner (1973) regarded an entrepreneur as a person who can spot an information asymmetry and take advantages of it, an arbitrager" (Hashi–Krasniki 2010, p2). In its original context, Kirzner suggested this definition of an entrepreneur to compare the capitalist and socialist system, rather than to classify entrepreneurs in a capitalist environment. However, there is always imperfect knowledge of an economy regardless of in a capitalist or socialist system, and entrepreneurship is the most efficient way to minimize this asymmetry. However, Hashi and Krasniki (2010) misunderstand Kirzner`s entrepreneur as a short-sighted trader. Despite, this misunderstanding they can correctly depict the growth capacity of entrepreneurs in PS countries. In the initial stage of transformation, the existent shortage opened the room trade style business activity. Since, the availability of produce was the top priority rather than its quality. The contribution of this type of entrepreneurship to economic development is limited, since it can avoid shortage and alleviate unemployment, but is not able to carry out structural change.

Another distinctive approach to defining the entrepreneur is the Schumpeterian type approach. According to Schumpeterian approach, the entrepreneur is an innovator who introduces a new product, new production process, and new organizational structure, as well as identifying new markets (ibid). Estrin et al. (2006) classify entrepreneurship as necessity-driven and opportunity-driven. A considerable share of necessity driven entrepreneurship is observable in the successful reformers of the CEE after the first phase of transition. In the initial stage of transition, the majority of small businesses mushroomed in the trade and low value service sectors rather than in manufacturing industry. After the ebbing of the turmoil of falling production, surging unemployment, and high levels of inflation, these countries managed to promote innovative entrepreneurship (Smallbone–Welter 2001). Due to the incompleteness of market reforms, the majority of the SMEs sector of the former Soviet states consisted of low value business (ibid). The effect of the surrounding environment is important for the emergence of the Schumpeterian innovative entrepreneur, and I will touch on it in the next section in more detail. Figure 2 shows the innovation capacity of the PS countries which joined the European Union in comparison with other EU member countries. However, the innovation capacity of the aforementioned PS countries is below than EU average, while the successful CEE and Baltic countries such as Latvia, Estonia, Czech Republic, and Slovenia passed this stage with aplomb, and accumulated a significant share of innovative SMEs.

Figure 2 Share of small and medium-sized EU-28 SMEs which reported having undertaken some innovation activity over the period 2014–2016.



Source: European Commission (2019)

Scase (1997) introduces the relationship between the informal economy and innovation capacity of SMEs. He contrasts the "entrepreneurs" phenomena with the "proprietors" one. The entrepreneur is inclined to capital accumulation and enlargement of business, while the proprietor is the asset and property owner, consumes the surplus from business, and hardly contributes to capital accumulation. Scase claims that the proprietorship type of small business prevailed in the SMEs of PS countries in the early transition period (Scase 1997). At the same time, the level of informal economy contributes to which type of small business prevail. As the informal economy is bigger, then the small entrepreneurs will not have stimuli to invest in long-term capital accumulation. Because, there is always greater uncertainty in informal economy. The share of the informal economy in Hungary was at 34% of GDP in 1990 and levelled off at 10–17% in the 2000s (OECD 2017).

4. Impediments to the development of SMEs in PS countries

There are significant obstacles to the development of the SMEs in PS countries, due to the special historical circumstances of the emergence of private property. Modern capitalist private property literally never arose in the FSU countries until the demise of socialism, and it was stopped by forced socialism in CEE countries. Therefore, these countries did not have the experience of private property, and the legal and social environment and the production factor were not designed for the functioning of private property. As a result of these factors, the economies of the PS countries were not ready to form a favorable environment for the development of SMEs.

In the transition process, innovative SMEs are important for economic restructuring. Therefore, the level of the SME-led innovation and the environment conducive to such innovation will now be analyzed. For the sake of easier understanding, I employ the Bartlett and Bukvic's approach. They categorize the factors which impede the growth of SMEs under five categories; institutional, internal to firm, external, financial, and social barriers (Bartlett–Bukvic 2001). These categories cover all decisive factors which can affect the development of SMEs. I will use this categorization as an analytical framework. I show that some countries perform better than others on these factors. At the same time, there are improvements in these factors in the same country within the transition period. Subsequently, I will analyze the role of SME-led innovation in economic restructuring and economic development for EU member PS countries.

Institutional barriers: Bartlett and Bukvic define the institutional environment as an interaction sphere of firms with government and their consumers, and they pay attention to effects of interaction with government on firm growth. They analyze the effect of this interaction in the duality of official and non-official institutions (Bartlett–Bukvic 2001). As official institutions, they propose the effects of taxation and the legal framework for the regulation of business activity on SME growth. According to them, an inappropriate tax system and complicated regulations wastes the already insufficient resources of small growing companies. İn the early years of the transition, the PS countries did not have the legal framework for taxation or the regulation of business activity. Thus, the majority of these countries just copied the respective legislation of the developed social market economies of continental Europe without considering the needs of their newly emerging businesses. The corporate tax rate in Poland was 40 percent in 1990 but was reduced to 19 percent in 2004 (Rae 2015). The same tendency can be observed in Bulgaria. The corporate tax rate was 40 percent at its peak in 1997 and today is 10 percent (Trading Economics). Such a high tax rate was smothering small nascent business entities, especially those self-employed businesses. To some extent, all PS countries began from such a high level of income tax rate excepting some countries like Kazakhstan and Kyrgyzstan (Anders 2007).

In addition to the high level of income tax rate, the over-complicated business regulations are stifling for small companies. The small entrepreneurs, especially those sole-trader and classic partnerships, are not capable of complying with complex regulation. Bartlett and Bukvic state that such an unfriendly government attitude to business opens the door to the informal economy. Many entrepreneurs are willing to pay bribes to avoid the headache of compliance with such a heavy regulation (Bartlett–Bukvic 2001). The successful reformers of CEE countries passed this stage and managed to create business-friendly conditions for SMEs. Meanwhile, the majority of the FSU countries are partially still trapped in this stage. Smallbone and Welter (2007) write that in their slow reforms the government sets taxation and business regulation to squeeze tax revenue rather than promote the building of market institutions. The majority of CIS countries lack the capable government to pursue economic policy conducive to development of SMEs. Anders proposes that the bureaucratic apparatus of the weak PS states complicate the tax and legal system

intentionally in order to grasp bribes from micro-enterprises (Anders 2012). He suggests that firstly, the legal procedure for SMEs should be simple. Thus, there would be minimum opportunity for incumbents to exploit SMEs. Secondly, the conventional wisdom of treating all enterprises equally does not prove a reality in PS countries, since taxation and regulation involves economies of scale. The larger companies have separate divisions to handle legislation and taxation, so it gives them more opportunity to minimize tax costs in comparison with SMEs. Therefore, simplified taxation and regulation is a recommended option for transition economies in providing favourable initial conditions for emerging SMEs (Hellman et al. 2000 Anders 2012). However, since 2011, there has been consistent improvement in the ease of doing business index for Russia, Ukraine, Azerbaijan, and Armenia (The World Bank).

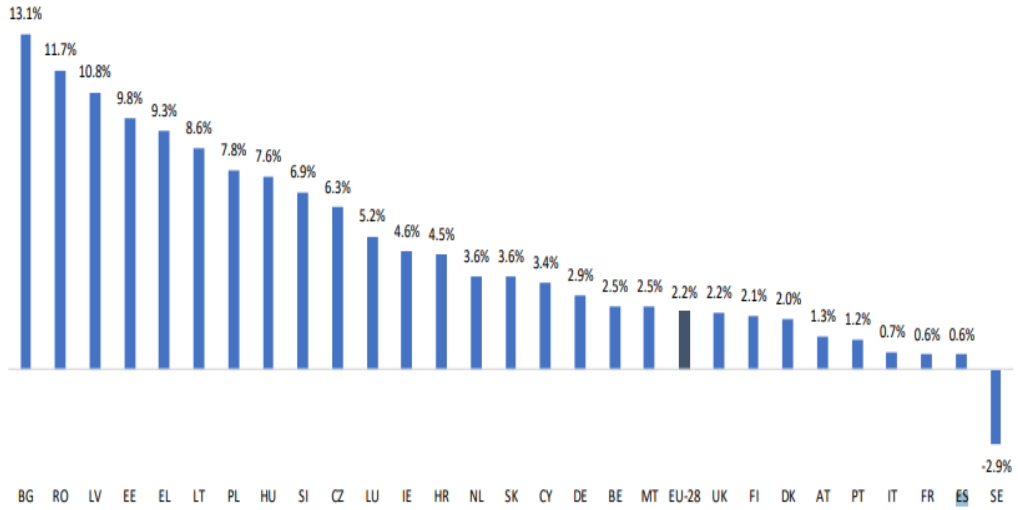
An unwelcoming government attitude towards small business opens the possibility for the rise of the informal economy. "Frequent changes in the tax system, combined with a prohibitive tax level and an unpredictable behavior of state officials, encourage entrepreneurs to shift some or all their activities to the informal economy, or in some cases abroad" (Smallbone–Welter 2001, 11). Cumulatively, USD 750 billion capital has left Russia due to capital flight since 1994 (Bloomberg). In the early stage of the transition in Poland, Romania, and Slovakia, the small businesses hide their actual revenue due to high levels of corruption (Johnson et al. 2000). A. Anders points to weak state apparatus as a reason for the prevalence of bureaucratic corruption and unregistered business activity (Anders 2012).

Barriers internal to firm: These barriers entail the obstacles to exploit the potential of the firm due to human resource and organizational management problems. One side of the problem is connected with labor legislation and other side quality of labor and managerial skills. One of the features distinguishing small companies from larger ones is their ability to adjust their production to market demand via firing and hiring labor (Sak–Taymaz 2004). In the early period of the transition, the governments of most of the PS countries did not take this reality into consideration, and labor legislation was not flexible either as it put a high rate of social contribution costs for workers on employers. in effect, small entrepreneurs are unwilling to expand their business by employing more permanent workers (Bartlett–Bukvic 2001). Such a burden on small entrepreneurs led to rampant non-registration of labor in the weak states of PS countries. Integration into European Union and competition among PS countries to attract foreign capital resulted in flexibilization of labor legislation and the labor market, especially in PS countries. Since 2004, the great majority of the employees in Poland work on non-fixed labor contracts (Rae 2015).

The second impediment on the growth of SMEs in PS countries is the quality of labor and managerial skills. Due to the coordination of all human capital to the configuration of the centrally-planned economy, in the early stage of transition, it would be hard to find capable employees to work in the reality of the market economy (Bartlett–Bukvic 2001). As well as managers for small companies, the market and business lacked development skills (ibid). Even though the majority of small entrepreneurs were university graduates, they lacked those managerial skills necessary in the market economy (Smallbone and Welter 2001). The uncertain

environment and macroeconomic instability of the early transition period put more demands on the managerial skills of SMEs (Aidis 2005). Another problem with managerial competency is the unwillingness of the owners to delegate the managing to professional managers when the company has reached this point and it is necessary for the growth of the company (Bartlett and Bukvic 2001). Figure 3 depicts labor productivity growth in EU member PS countries being significantly higher than for developed members of the Union. It can be explained by growth opportunity of those countries and the growth conducive policies of respective states.

Figure 3 Annual SME apparent labor productivity growth (in %) in EU-28 Member States 2018



Source: European Commission (2019)

External barriers: Bartlett and Bukvic define external barriers as the impediments on the growth of the company which result from the market environment companies are in (Bartlett–Bukvic 2001). The low level of demand for product due to low purchasing power of the consumers is one factor that impedes company in enlarging production (Bartlett–Bukvic 2001, Aidis 2005). The entrepreneurs lack incentive to conduct quality improvement of the product since the consumers are not able to pay the higher price for quality, and price is the main determinant. As a result of the considerable growth in GDP and labor income, the successful CEE countries managed this problem up to manageable level. But in the majority of the FSU and Southeastern European countries, the insufficiency of demand impedes the growth of small businesses.

Access to inputs and technological opportunities is another decisive factor. From another perspective, due to the small amount of purchasing of inputs by small business, and as also to pressure from larger companies to expel small companies from the market, suppliers would sell inputs at higher than market price to SMEs and be

reluctant to share technological advancement with small companies. In such a case, government regulation is necessary. The late payment of bills by customers is another reason which disturbs the continuity of business activity at small firms (Bartlett–Bukvic 2001). The main reasons for late payment are the low purchasing power of end consumers and the ineffectiveness of the compelling authorities to enforce payment of the bill in time. The Polish government enacted the regulatory act on late payments on commercial transaction. According to this legislation, the creditor has the right to implement a penalty after 60 days of delayed payments (Korolko 2013)

Financial barriers: Insufficient capital is the decisive impediment on the development of small business. Capital is important in the setting up and expansion stage of SMEs. Due to lack of access to capital in these necessary phases, a significant share of small companies never emerge, and existing SMEs stay small in the majority of PS countries (Oakey 2007). The main reasons for the reluctance of lenders to supply SMEs with capital are their size and risk due to asymmetric information. With regard to size, it costs more to check the prospects of one business entity for a small loan by an SME compared to a huge amount of borrowing by larger corporations. Secondly, poor accounting management in SMEs could be considered the main factor for the emergence of asymmetric information between lender and company. That is the financial intermediates do not have proper record of the business activity to evaluate the prospects of the applicants (Bartlett–Bukvic 2001). As a result of these factors, the cost of capital is significantly higher for small companies.

Bank loans are the main source of external capital for SMEs in PS countries. The commercial banks prefer to lend to companies with fixed assets. They are not able to evaluate the prospects of SMEs in the modern sectors like internet-related, new technologies, and biotechnologies. Since in these sectors, companies have insufficient amounts of fixed assets, it is hard to define market and market demand. As a result, such progressive sectors lack the necessary amount of capital (Klonowski 2012).

Social barriers: In order to understand the social barriers on the development of SMEs in PS countries, Bartlett and Bukvic (2001) introduce the "social capital" phenomena in business environment. They define social capital in business as the trust and network between entrepreneurs. A weakness of trust among business partners initiates opportunistic behavior, and this results in the higher cost of transaction and preempt of transaction. The main reason for the emergence of such a social barrier is state apparatus too weak to enforce the property rights and the existence of a larg informal economy. Until recently, the "rackets" in Russia and similar illegal powers in some other PS countries were the judges of business due to inability of the states to function. Thus, the PS countries which integrated into the European Union succeeded in incorporating the government assistance to SMEs mechanism as a tool of overcoming the social barriers on SMEs. Despite, in the early years of transition, mistrust among business partners being higher, upon integrating into the EU, it weakened as a hampering factor. According to the latest survey, 6.5 percent of the respondents indicate the lack of collaboration as a hampering factor in their innovative activity (EC 2019)

As mentioned above, a significant share of SMEs emerged as a survival strategy of fired workers and lacked entrepreneurship quality. The SMEs which can

contribute to the upgrading the efficiency of production technology are important in this study. I refer to the concept of the innovation led by SMEs in order to evaluate the contribution of SMEs to restructuring transition economies. I employ the findings of the EC Report on the contribution of SMEs in patenting, and interpret them according the aim of this paper (EC 2014). The report covers the EU-27 countries including PS member states. The first finding shows that SMEs in the post-socialist EU member countries have more participation in patent applications than old members (Figure 1). It confirms that the role of the SME is significant in restructuring the transition economies via innovations.

Figure 4 Patent applications by EU members

Country	Large	Unknown — non-matched	Unknown — matched	SME
EU-27	78.9	2.3	1.2	17.6
BE	79.2	0.0	2.6	18.2
BG	36.8	9.5	0.0	53.8
CZ	60.1	2.8	0.0	37.1
DK	67.2	3.7	1.5	27.6
DE	84.9	2.8	2.0	10.3
EE	19.9	0.0	2.3	77.8
IE	50.4	2.6	2.8	44.1
EL	46.1	14.4	0.0	39.6
ES	61.3	3.8	0.0	34.8
FR	83.4	2.4	0.1	14.1
IT	60.8	2.0	0.2	37.1
CY	28.3	9.0	0.0	62.7
LV	33.7	9.5	0.0	56.8
LT	50.5	0.0	0.0	49.5
LU	49.4	11.5	0.0	39.1
HU	59.3	3.8	0.0	37.0
MT	23.4	2.3	0.0	74.3
NL	83.8	0.9	0.7	14.6
AT	77.2	1.9	0.0	20.9
PL	62.0	0.0	4.0	34.0
PT	42.7	6.0	2.8	48.5
RO	46.9	0.0	5.6	47.5
SI	62.8	3.0	0.0	34.2
SK	43.7	5.3	0.0	51.0
FI	83.6	2.2	0.9	13.2
SE	78.8	2.2	0.2	18.9
UK	62.1	1.4	1.2	35.3

Source: European Commission (2014)

Another finding indicates the innovation intensity of SMEs across various technology sectors (Figure 2). The indication ratio is between –1 and 1. As the ratio is close to 1, it means SME innovation is strong in this sector. There is a rough positive relationship between degree of SME intensity and the national specialization. Therefore, it can be surmised that SME-led innovations have the positive effect of heightening national competitiveness. Due to lack of reliable data, the paper limits itself to CEE countries in concluding on the role of SME-led innovation on economic restructuring.

There are a couple of factors that can contribute to the flourishing of SME-led innovation. By referring to Bartlett and Bukvic's approach, it can be said that those group of PS countries succeeded in surpassing the barriers on the development of SMEs. In order to be accepted as a member of the EU, these countries have had to adjust their legislation to EU standards. Such institutional harmonization has created a favorable business environment for enterpreneurship to thrive. As a result, institutional barriers have been alleviated. The transition period was accompanied by a considerable rise in the wages of skilled labor (Kezdi 2002). This incentive led to a rise in human capital accumulation. So the internal to firm barriers such as lack of skilled labor force have been overcome. The existence of the large EU market allowed the bypassing of external barriers related to market and input suppplies, incentivizing entrepreneurship activity on the SME level. At the same time, the existence of foreign competition via the single market forces SMEs to innovate. Free movement of capital via foreign owned banks finances innovation by SMEs and lessens the effects of financial barriers. The institutional harmonization and strengthening of the legislative and enforcement capacity of states further weakened social barriers among business units.

Figure 5 Sectoral distribution of patents accross EU member countries

Fh036	Field of technology	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	IT	CY	LV	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK
1	Electrical machinery, apparatus, energy	-0.09	-1.00	-0.32	-0.28	-0.20	0.07	0.68	0.42	-0.04	-0.24	-0.11	-1.00	-1.00	-0.31	0.29	0.09	0.00	-0.22	-0.23	0.07	-1.00	0.24	0.22	-0.05	-0.02	0.10
2	Audio-visual technology	0.07	0.15	0.38	-0.31	-0.01	0.07	-0.61	-1.00	-0.28	-0.12	0.05	0.06	-1.00	0.37	-1.00	-1.00	-0.76	-0.01	-1.00	0.27	-1.00	-1.00	0.22	-0.22	-0.23	-0.02
3	Telecommunications	0.62	0.15	0.38	-0.04	-0.23	0.07	0.09	0.42	-0.22	-0.57	-0.41	-0.09	-1.00	-0.01	-1.00	0.14	-0.62	-0.10	0.42	-0.03	0.32	0.84	0.22	-0.77	-0.77	-0.11
4	Digital communication	0.76	0.15	-0.06	0.07	-0.24	0.07	0.07	-1.00	0.03	-0.48	-0.63	-1.00	-1.00	-1.00	0.76	0.14	-0.72	0.10	-1.00	0.35	0.32	-1.00	0.22	-0.77	-0.85	-0.20
5	Basic communication processes	0.72	-1.00	-1.00	-0.64	-0.27	-1.00	0.33	-1.00	0.46	-0.21	-0.21	-1.00	-1.00	-1.00	-1.00	-1.00	-0.88	-1.00	-1.00	-1.00	-1.00	0.84	-1.00	-0.84	-0.19	-0.14
6	Computer technology	0.26	0.15	-0.39	0.14	-0.15	0.07	-0.60	0.42	-0.08	0.05	-0.16	-0.49	-1.00	-0.06	-1.00	0.08	-0.63	0.17	0.22	0.07	-1.00	0.86	0.22	-0.24	0.03	-0.12
7	IT methods for management	0.72	-1.00	0.52	0.28	0.01	0.07	-0.54	0.42	0.39	-0.19	0.22	-1.00	-1.00	-0.18	-1.00	0.14	0.25	-0.27	-1.00	-0.19	0.32	0.88	0.22	0.12	-0.16	0.24
8	Semiconductors	-0.17	-1.00	-1.00	0.16	-0.01	-1.00	-1.00	0.42	-0.43	0.27	-0.02	0.09	-1.00	-0.68	-1.00	-1.00	-0.37	-0.30	0.42	0.35	-1.00	0.88	-1.00	0.52	0.05	0.28
9	Optics	-0.52	0.15	0.38	0.07	-0.05	0.07	-0.02	-1.00	-1.00	0.26	-0.29	0.23	-1.00	0.44	-1.00	0.14	-0.42	0.01	-0.34	0.35	-1.00	0.63	-1.00	0.40	0.37	0.02
10	Measurement	0.36	-1.00	0.09	0.21	0.00	-0.07	0.15	-1.00	0.03	0.01	0.00	0.03	-1.00	-0.86	-1.00	-0.81	-0.47	0.05	-0.13	0.01	-1.00	0.41	-0.12	0.17	0.18	-0.08
11	Analysis of biological materials	0.53	-1.00	-1.00	0.31	0.56	0.07	-0.11	0.42	0.35	0.52	0.31	0.23	-1.00	0.22	0.76	0.14	0.51	0.60	-1.00	0.35	-1.00	-1.00	-1.00	0.69	0.72	0.26
12	Control	0.14	0.15	0.03	0.13	-0.30	0.07	-0.09	0.42	0.08	-0.23	0.08	-1.00	-1.00	-1.00	0.76	-1.00	0.07	-0.52	-0.09	-0.03	-1.00	-1.00	0.22	0.28	-0.17	0.05
13	Medical technology	0.66	-0.38	0.13	-0.39	0.36	-0.04	0.10	-1.00	0.24	0.65	0.18	0.03	-1.00	0.47	0.71	0.02	-0.05	0.33	0.10	0.35	0.32	-1.00	0.22	0.55	0.19	0.17
14	Organic fine chemistry	-0.50	0.15	-0.18	-0.01	-0.22	-0.02	-0.10	-0.16	-0.26	-0.33	-0.39	0.01	-1.00	0.43	-0.47	-0.27	-0.37	-0.14	-1.00	-0.40	-1.00	-1.00	-1.00	0.23	0.23	-0.39
15	Biotechnology	0.27	0.15	-0.23	-0.16	0.57	-0.15	-1.00	0.42	0.48	0.73	0.20	0.23	-1.00	0.17	0.38	0.14	0.62	0.49	0.49	0.13	-1.00	0.28	-1.00	0.69	0.62	0.29
16	Pharmaceuticals	0.01	-1.00	0.36	0.31	0.41	-0.04	-0.08	-1.00	-0.22	0.57	-0.20	0.08	-1.00	0.46	-0.73	-0.58	0.50	0.31	-0.27	-0.05	-0.01	-1.00	-0.63	0.78	0.43	0.11
17	Macromolecular chemistry, polymers	-0.61	-1.00	0.51	-0.50	-0.27	0.07	-0.85	0.42	-0.08	-0.59	-0.68	0.23	-1.00	0.25	0.76	0.14	-0.28	-0.14	-1.00	-0.10	-1.00	-1.00	-1.00	-0.68	0.45	-0.07
18	Food chemistry	0.27	-1.00	0.63	-0.25	0.56	-0.13	0.31	-1.00	0.47	0.55	0.16	-1.00	-1.00	-1.00	0.42	-1.00	0.31	-0.16	-0.01	0.35	-1.00	-1.00	0.22	0.33	0.78	-0.26
19	Basic materials chemistry	-0.37	-1.00	0.48	-0.22	-0.15	-0.10	-0.28	0.42	0.21	-0.16	-0.32	0.15	-1.00	-0.05	0.10	0.14	-0.36	-0.14	-0.06	-0.26	-1.00	-1.00	-1.00	-0.28	0.52	-0.24
20	Materials, metallurgy	-0.12	0.15	0.28	0.09	-0.08	-1.00	-0.66	-1.00	0.01	-0.04	-0.18	-1.00	-1.00	-0.81	0.57	0.14	-0.63	-0.44	0.13	-0.59	0.32	-1.00	-0.31	0.55	0.00	-0.21
21	Surface technology, coating	-0.42	-1.00	0.48	-0.08	-0.03	0.07	-1.00	0.11	0.00	0.01	-0.02	0.08	-1.00	-0.05	-1.00	0.13	0.12	-0.18	0.37	-0.10	-0.12	-1.00	-1.00	0.67	-0.03	-0.04
22	Micro-structure and nano-technology	0.58	-1.00	-1.00	0.13	-0.43	-1.00	-1.00	-1.00	0.70	0.08	-0.27	-1.00	-1.00	0.17	-1.00	-1.00	0.11	-1.00	-1.00	-1.00	-1.00	-1.00	-1.00	0.62	0.82	0.22
23	Chemical engineering	0.00	-1.00	0.42	0.11	0.10	-0.02	0.26	0.28	0.06	-0.12	0.18	0.23	-1.00	-0.08	0.61	-0.27	0.18	0.31	0.26	-0.25	-0.21	-1.00	-1.00	0.35	0.43	-0.08
24	Environmental technology	-0.04	-1.00	0.15	0.19	-0.01	-1.00	0.67	0.42	-0.15	-0.20	0.15	-1.00	-1.00	-0.86	0.76	0.14	0.12	0.07	0.45	0.24	0.32	-1.00	0.22	0.52	0.26	-0.10
25	Handling	-0.04	-1.00	0.22	0.08	0.11	-0.27	-0.66	0.42	0.06	0.03	0.09	0.09	-1.00	-0.03	0.76	-0.06	0.50	0.01	0.22	0.26	0.32	0.85	-1.00	-0.19	0.12	0.02
26	Machine tools	0.13	-1.00	-0.06	0.27	0.11	-1.00	-0.49	-0.77	-0.17	0.07	0.19	-0.06	-1.00	-0.62	-1.00	0.12	0.64	-0.38	-0.34	-0.04	-1.00	-1.00	-0.31	0.55	0.12	-0.09
27	Engines, pumps, turbines	-0.11	-1.00	-1.00	-0.77	-0.56	-1.00	0.74	0.11	-0.48	-0.75	-0.22	-1.00	-1.00	-0.67	-1.00	-1.00	0.51	-0.22	-1.00	0.01	-1.00	0.68	-1.00	0.28	-0.13	-0.19
28	Textile and paper machines	-0.67	-1.00	-0.83	0.32	0.25	0.07	-0.59	-1.00	0.53	-0.26	0.09	0.16	-1.00	-0.40	-1.00	0.08	0.10	-0.10	-1.00	-0.19	-1.00	-1.00	-1.00	-0.18	0.22	0.06
29	Other special machines	-0.28	-1.00	0.09	0.04	0.08	0.07	0.09	0.23	-0.12	0.20	0.03	0.23	-1.00	-0.31	-1.00	-0.02	0.49	0.08	0.19	0.06	-1.00	0.77	0.22	0.40	-0.08	0.09
30	Thermal processes and apparatus	-0.59	-1.00	0.19	-0.24	0.06	0.07	0.71	-1.00	-0.06	0.02	0.00	-0.11	-1.00	-0.58	0.76	0.14	0.53	0.15	-0.33	-0.26	-1.00	0.17	0.22	0.32	-0.27	0.17
31	Mechanical elements	0.00	0.15	0.08	-0.17	-0.32	-1.00	0.02	-1.00	0.03	-0.53	0.06	-1.00	-1.00	-0.90	-1.00	0.09	0.60	-0.23	0.23	-0.36	-1.00	0.65	0.19	0.03	-0.32	-0.07
32	Transport	-0.30	-1.00	-0.85	0.19	-0.51	0.07	0.35	0.42	-0.34	-0.69	-0.04	-0.06	-1.00	-0.91	-1.00	-1.00	0.45	0.13	0.35	0.19	0.32	0.51	-0.73	0.50	-0.52	-0.06
33	Furniture, games	-0.15	0.15	-0.01	0.31	0.10	0.07	-0.34	-1.00	0.33	0.16	0.11	-1.00	-1.00	-1.00	-1.00	0.14	0.48	-0.44	-0.41	0.26	-1.00	0.34	-1.00	0.52	0.38	0.17
34	Other consumer goods	-0.72	-1.00	0.12	-0.05	-0.02	-1.00	0.47	0.42	0.18	0.02	0.06	-0.41	-1.00	-0.80	-1.00	0.14	0.07	-0.42	-0.69	0.26	0.32	-1.00	0.22	0.43	0.41	0.01
35	Civil engineering	0.11	0.15	-0.03	-0.20	0.32	0.07	-0.53	0.42	0.23	0.08	0.20	0.05	-1.00	-0.72	-1.00	0.14	0.24	-0.17	-0.62	-0.51	0.32	-1.00	-1.00	0.48	-0.17	0.11

Source: European Commission (2014)

5. Conclusion

SMEs have special importance for PS countries due to their innovative and labor absorptive capacity. Hence, transition economies need their innovation for shifting to efficient form of production and to alleviate unemployment problems. One distinctive fact about the small entrepreneurs in PS countries was that they were not innovative enough in the early phase of transition. The majority of the small entrepreneurs were in the trade and service sectors in the form of sole-traders and partnerships. Thus, the growth and innovative potential of these SMEs were limited in the early stage of the transition. However, some of the PS countries were successful in passing through this stage and promoting innovation-driven SMEs

After the legalization of private business in PS countries, SMEs mushroomed. However, there have been couple of factors which have limited the growth and development of SMEs. The attitude of the government in the form of legal environment and control was not suitable for the needs of small business in the initial period of the transition. There is dual tendency among PS countries regarding the development of the SME-led innovation. Some of the PS countries, especially those integrated into European Union were able to build an initial business-friendly environment and provide government assistance to SMEs in the next period of reforms. While these PS countries has been able to provide SMEs access to finance through government assistance, others have not. The SMEs in EU member PS countries are capable of innovating and have significantly contributed to strengthening the international competitiveness of their economies.

Considering the reasons for much the better performance of SMEs in CEE countries, the modification of tax legislation, business regulation and labor legislation conducive to growth of SMEs, as well as building a bureaucracy immune to bribes could be a first step to promoting small companies with growth potential in worse performing regions. Provision of government assistance to tackle the problem of access to finance and inputs and technologies would be another cornerstone in the promoting of a business-friendly environment for SMEs. Last but not least, the strengthening the enforcement of contract law could avoid uncertainty in the business community.

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