The Challenges of Analyzing Social and Economic Processes in the 21ˢᵗ Century

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The Challenges of Analyzing Social and Economic Processes in the 21st Century conference is organized by the University of Szeged Faculty of Economics and Business Administration to commemorate the 20th anniversary of the Faculty's founding. The conference is co-organized by the Szeged Regional Committee of the Hungarian Academy of Sciences and its Economic Committee.

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The Challenges of Analyzing Social and Economic Processes in the 21st Century

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Preface

In honour of the 20th anniversary of the founding of the Faculty, between 7 and 9 November 2019 an international scientific conference, entitled "The Challenges of Analyzing Social and Economic Processes in the 21st Century" was organized by the Faculty of Economics and Business Administration of the University of Szeged, in connection with the Science Week series of events. The co-organizer of the conference was the Szeged Regional Committee of the Hungarian Academy of Sciences and as a result of their collaboration, three academic scientific committees also held external meetings under the auspices of the conference. We compiled this volume from the English-language lectures given at the conference, which were revised by the authors on the basis of the opinions expressed during the discussion at the conference and the remarks of the peer-reviews of the reviewers.

Based on the section schedule of the conference, the volume presents a series of thematically extremely diverse studies organized into four major topics, all of which are examining very actual issues and challenges. The first chapter deals with digital and technology-related issues, in the topics of *Industry 4.0, digital economy, digitalization, artificial intelligence and economics*, while the articles examining the issues related to *regional and local economic development* are included in the second chapter of the volume. Papers are examining r*elations between social economic and demographic processes in the present* in the third chapter. Last, but certainly not least, the fourth chapter of the volume reviews the *trends and latest challenges of marketing and management*.

During the editing of this volume, we aimed to give young researchers, in addition to well-known and recognized experts in the field, the opportunity to publish their papers. We hope that the volume commemorates the twenty-year anniversary of the Faculty of Economics and Business Administration of the University of Szeged and provides the readers a great insight to how diverse economics really are. We would like to give a special thanks to every author, reviewer and colleagues who contributed to organizing the conference and editing this conference proceedings book.

Szeged, December 2020
the Editors

Chapter I

Industry 4.0, Digital Economy, digitalization. Artificial intelligence and Economics

Digitalization in the food industry – opportunities and impedimental factors

Judit Nagy – Zsófia Jámbor – Anna Freund

The study examines the appearance of Industry 4.0 and digitalization in the food industry that is not typically considered high-tech. Our aim was to point out that Industry 4.0 is also present in the food industry and offers many opportunities in two areas that are a particular focus of this industry: increasing traceability and food safety. During the research, we asked seven companies about their digital development and Industry 4.0 experience. We have explored the factors that drive companies to adopt digital solutions and the technologies that have been applied. Our results show that companies, not consciously moving towards Industry 4.0 but taking advantage of the opportunities offered by digitalization, are making improvements, often with a lack of workforce, eager to reach higher efficiency and thus competitiveness, as well as to serve the company's growth strategy.

Keywords: Industry 4.0, digitalization, food industry, technology

1. Introduction

The world population has tripled since the 1950s, and by July 2019, the Earth's population had already exceeded 7.7 billion. This number, although is slowing, continues to grow and is estimated to exceed 9 billion people worldwide by 2050 (KSH 2018). For this reason, the food supply issue is a constant challenge all over the world, and is one of the central topics of discussion at the 2018 World Forum in Davos. World Economic Forum has taken a global initiative to address the nearly 70% increase in food demand (World Economic Forum 2018). As countries develop and the standard of living increases, the range of foods people consume changes significantly, the energy requirements of the population are much higher, and animal protein intake is increasing (Horn 2013). According to the list of Food Engineering published in 2017, Nestlé (1), Pepsi Co. (2) and AB Inbev (3) are among the world's largest food companies based on sales revenue.

The study examines the appearance of Industry 4.0 and digitalization in a sector that is not typically considered high-tech, the food industry. Although automation has been present in many sub-sectors of the food industry for decades, the achievements of the Fourth Industrial Revolution are being explored mostly by researchers and professionals in the automotive and electronics industries. The study points out that Industry 4.0 is also present in the food industry and offers many opportunities in two areas that are particularly focused in this sector: traceability and food safety. During the research, we interviewed seven companies belonging to the three most important subsectors of the food industry – meat, dairy and pasta industry – about their digital development and their Industry 4.0 experience.

After reviewing the state of the food industry, the study briefly outlines potential industry 4.0 solutions and then deals with the research methodology and process. The results section describes the solutions experienced by each company and concludes with conclusions on the direction and features of the developments.

2. The importance of the food industry

The Hungarian food industry contributed 1.9% of GDP. The gross value added of the sector represented approximately 2.2% of the total national economy (KSH 2017). Generally speaking, the major international successes of the Hungarian food industry in the past have moderated over the past 20–25 years, as their share of world food production has halved (Kapronczai 2016).

Following our accession to the European Union (2004), the results of the food industry in Hungary and abroad showed a different direction. Food exports increased both in volume and due to the weakening HUF exchange rate, thus doubling export sales within the sector (Kürthy–Radóczné 2016a). Domestic sales, on the other hand, declined significantly, and domestic food consumption declined due to low domestic solvency. This kind of success on foreign markets is not so clear given that high value-added products are still not successful abroad.

Regarding foreign trade, food products have grown significantly on both the export and import side, with a total of HUF 900 billion surplus (KSH 2017). This resulted in an almost double-digit increase on the export side compared to previous years. Hungary mainly exports and imports food products to and from certain member states of the European Union, and its main trading partner is Germany in both directions. In addition to the clearly increased foreign trade turnover, Hungary's foreign trade can be described with the same, almost unchanged product structure, both in terms of imports and exports (KSH 2017).

According to Kürthy et al. (2016a), the efficiency of the domestic food industry labour force lags behind that of the EU, which can be explained by the relatively low domestic labour costs, which reduces the incentive for enterprises to move towards technological development due to their extremely high price level.

According to the data of the Central Statistical Office (2017), food industry investments amounted to HUF 198 billion, which meant a 1.6% decrease in the share of the industry in the total national economy. Interestingly, however, the structure of food industry investments has changed, with machinery investment at over 7%, while building investment has declined. Thus, the investment in machinery concerns the 2/3 of the total investment in the food industry.

The most important sub-sectors of the food industry are meat, fruit and vegetable processing, dairy processing, bakery and pasta. In a study by Kürthy et al. (2016b), various efficiency and financial indicators for Hungary and a few other EU Member States were examined for each food sub-sector. The results confirmed that in all sub-sector comparisons Hungary is generally characterized by very low net sales, low labour productivity and value added. It is also clear from the domestic companies that the higher export activity significantly improved the profitability and efficiency indicators of the companies.

Overall, the domestic food industry is still lagging far behind the EU member states at the sector level, apart from some unique success stories.

3. Interpretation of Industry 4.0

Industry 4.0 is based on small data production, storage, and transmission devices that observe a product or a production process (sensors) in some way (Lee et al. 2014). This data is transferred to the cloud via an internal or Internet-based network to be analyzed by various software, either automatically or through human work (Rüssmann et al. 2016). Analyzed data is rendered in a user-friendly manner, available to different levels of enterprise decision-makers, complexity and access rights, or to the consumer using the product. The transmission of information is the basis of any decision, approval or intervention, whether automated, on automated production lines or by robots. The most important product and source of Industry 4.0 is data (big data), which is analyzed (big data analytics) and can be used in real time (Wang et al. 2016).

Figure 1 Context of Industry 4.0 technologies analysed in the study
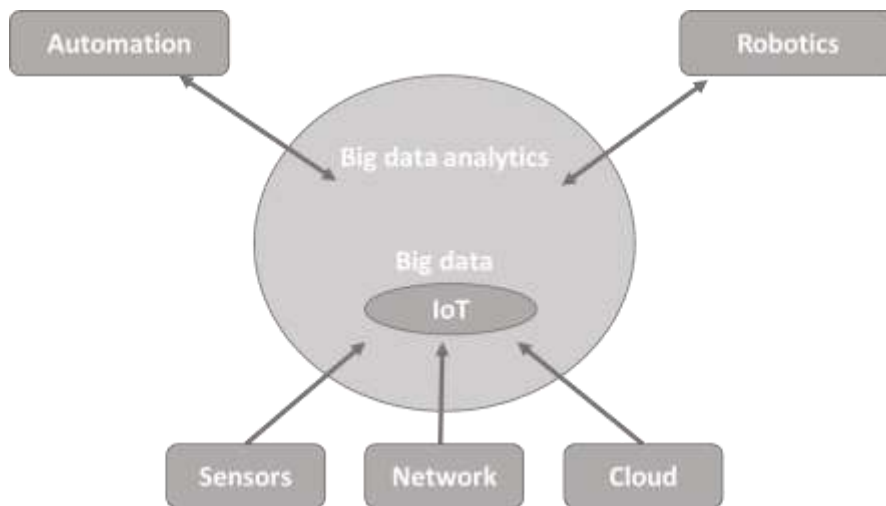
Source: own construction

Industry 4.0 permeates the entire enterprise value chain. However, its scope may extend beyond the boundaries of the company, covering the supply chain or, more broadly, the supply network. It builds on new types of networked technology devices (eg sensors, RFID) and requires new processes (eg data analysis software, cloud, programming) that require new capabilities from the company and may even require the development of new business models. "Industry 4.0 is, therefore, a phenomenon that, by involving new technologies, leveraging the full potential of digitalization, elevates process transparency, integrates value chains and supply chains, and takes customer value creation to the next level" (Nagy 2019, p. 15).

3.1. Industry 4.0 in the food industry

One of the industries most exposed to the variability of consumer demand is the food industry. In addition to consumer trends (healthy lifestyle, aging society, obesity), the food economy also has to cope with pressure from retailers, which means lower prices, higher quality, a constantly renewed range of products and, of course, unquestionable food security. In order to address these challenges from both sides, Industry 4.0 tools can provide many solutions.

While automation and robotization have long been present in many sectors of the food industry (pasta, dairy), others are only partially applicable, and the share of human labour in production is high due to poorly standardized processes (meat industry, bakery products). According to Simutech (2016), machine shutdowns in food processing can cost up to $ 30,000 per hour, so the use of sensors in predictive maintenance to prevent machine shutdowns due to failure can quickly pay off. Processes made transparent with sensors and tracking can help increase energy efficiency, reduce waste and reduce waste. Agility, rapid machine changeover, and the ability to produce smaller series are important considerations when selecting a technology (Carpenter–Wyman 2017).

According to experts (Bibi et al. 2017, Carpenter–Wyman 2017, Bottani–Rizzi 2008), food safety and traceability are clearly areas where Industry 4.0 can greatly support the food industry. Different identification systems can make it possible to trace raw materials incorporated into food from the point of origin to the point of use (Bibi et al. 2017, Carpenter–Wyman 2017).

Researchers see blockchain technology as a tool for food monitoring (Tian 2017, Tse 2017). RFID, barcode, and wireless sensors are well-suited to the food supply chain for transparency and traceability, especially for data collection and transmission. However, you need a medium that makes this information visible. Blockchain raises the level of trust by making the flow of data, goods or money transparent and traceable. The system may be excellent for e.g. the investigation of the cooling chain (Tian 2017). The food industry can therefore take advantage of Industry 4.0 in many ways, thanks to digitalisation. However, some technologies are either expensive, immature, or have little practical experience, so there is no benchmark for learning.

4. Research methodology

We conducted an exploratory study for two reasons. On the one hand, there is little to read about the industry 4.0 experience in the food industry in the academic literature; We reached seven companies from the Hungarian food industry, where we conducted interviews at top management level (managing director, factory director) and carried out on-site monitoring in five cases. The interviewees did not allow us to use the companies' names during the study for confidential reasons. The interviewees were selected in two ways. First of all, we targeted the three largest sectors of the Hungarian food industry: meat processing, dairy industry, pasta production. We were looking for the biggest players in the given sub-sector, and asked for an interview with other

players by snowball method. As a result, we managed to reach three dairy farmers, two dairy processors, a meat processor and a pasta factory.

Interviews were usually 90 minutes long each, followed in most cases by a further 60 minutes of site visit and further information.

4.1. Interview data

The following table provides basic information about the interviews that have been conducted.

Table 1 Interview data

Company Data	„A"	„B"	„C"	„D"	„E"	„F"	„G"
Sub-sector	pasta prod.	dairy prod.	dairy prod.	dairy prod	dairy process.	dairy process.	meat process.
Location	West Hungary	West Hungary	West Hungary	West Hungary	West Hungary	West Hungary	East Hungary
Inter-viewee	plant manager	site manager	site manager	site manager	plant manager	plant manager	CEO
Date	23.08. 2018	21.02. 2019.	21.01. 2019.	07.02. 2019.	19.09. 2018.	04.04. 2019.	21.08. 2018.

Source: own edition

In 1.5-hour long structured interview with company executives, we talked about the company's Industry 4.0 approach, the digitalisation solutions used, the projects and the directions for development. As all interviewees are top managers of a given company, they are aware of both production and strategic issues and were considered relevant sources of information. The reliability of our research is enhanced by the fact that, although the number of interviews is low, they were conducted with the three largest subsectors of the Hungarian food industry, the bakery and pasta industry, the dairy industry and the meat industry.

5. Interview experiences

In presenting the interview experiences, we will discuss the technologies shown in Figure 1. There are many other technologies that can be linked to Industry 4.0, but these have been found to be dominant in the companies and their application shows correlation.

Sensors

The pasta company (A) tests the weight, moisture content and humidity of the raw material entering the automatic production line with integrated sensors. The consistency of the dough is also controlled and then the temperature of the dryer. The finished dough passes through several checkpoints before and after packing, where any piece of metal found in the production process is screened with a metal detector

and the weight and bar code of the packet are also checked. The machines are equipped with preventive maintenance sensors (counting operating hours), any deviation from the norm can be detected immediately and the necessary intervention can be made. In dairy farms, sensors are most important in identifying and tracking animals. Each cattle is provided with RFID transponders, which record all the events of the animal throughout its life, such as birth, ancestors, lactation phase, nutrient mix, treatments, vaccinations (B, C, D companies). Milking equipment also provides data on milking conditions: individual milk yield, milk quality. Companies B and C also use sensors to monitor cattle housing conditions, and ventilators and water chillers are turned on automatically to prevent heat stress, and canopies to protect animals in case of wind. Company D uses an activity monitor to monitor the animals' moving intensity. Company E does not use any sensors. Company F monitors production processes with milk processing sensors to ensure high quality and food safety. At the meat company (G), the purpose of sensory data collection during the construction of the new production line was to monitor the processing process and thereby increase process efficiency.

Network and cloud

Some level of networking can be observed at each of the companies examined. The pasta producer uses its own corporate cloud and load it with data from machines and other systems. At dairy farms, this is mainly limited to identifying and tracking the cattle and recording the related transactions, and to the milking machines transmitting the milking data to the data center. There is no integrated network in dairy B, but monitoring is completed by nutrient planning and monitoring data of the cattle-pen. Data is moving to corporate data warehouses, not yet implemented in the cloud. The Dairy E's network covers the collection of traditional company data, stock management, production planning, financial data, but in the absence of sensors, there is no Industry 4.0-like data collection. Dairy processor F performs extensive data collection, and its machinery equipment is all connected to the corporate cloud. Company G collects data on its meat processing machines, equipment and processes to enhance process efficiency and serve controlling functions.

In our approach, the Internet of Things is based on the three technologies discussed above: sensors that capture product, process and equipment data, connected to the network, and the enterprise data center, whose latest technology solution is the cloud. Not only does the cloud allow to store large amounts of data, but it makes them also accessible to the authorized users. In this sense, IoT exists at the dough maker and dairy processor F, but the germs are also present at dairy B.

Big data and Big data analytics

The problem of large volumes of data was encountered by all the companies investigated. As discussed earlier, not only storage is a major challenge, but also data processing and integration into enterprise information systems. Data can be of real benefit if it is analyzed within a short period of time and can be used in real-time decision-making processes. The pasta company has the highest level of integration

and data collection among the respondents, and their challenge is to process the data appropriately. Significant resources are devoted to the development and purchase of data processing software that can be connected to the ERP system. Dairy company B is also making improvements to utilize the resulting data as much as possible to improve animal welfare, optimize production and improve feed efficiency. At companies C, D and E, data processing is low. Company F has an international background, and the parent company expects extensive data collection and analysis, which means that developments in this area are significant and best practices are shared at group level. The meat company is also analyzing the data collected to increase efficiency and increase transparency in the processes.

Automation

In many cases, automation was the basis of production technology in the companies examined, and it was well before the phenomena of Industry 4.0. The pasta producer had already used full automation when investing before 2010, but in many respects, it did outperform it with its 2018 development. Much higher energy efficiency prevails, and sensors have made it possible to achieve even higher levels of optimization, predictive maintenance and transparency. Similarly, automation in milk production and processing is significant in the dairy companies, and the sensitive nature of the product requires closed-loop treatment. This is the case for all three production plants in milking technology and processing. Dairy processor E manufactures hand-made products, where automation is only possible for the minority of the products and significantly raises the quantity produced. According to processor F, automation is the key to high product quality. The meat processor was also able to perform only partial automation, because of the many labor-intensive operations in production.

Robotics

Advanced Industrial Robotics is a branch of robot development that can perform intelligent tasks with sensors and dynamic programming that require more flexibility and precision than traditional robot tasks. Examples of these can already be found in the companies under investigation, but also in cases where, although they have been tried, the nature of the product does not allow it.

The pasta manufacturer uses robots for packaging and serving warehouse processes, which allows handling of manufactured products that would not be possible with human labor. In milk production, a robot is employed in the support process, and in company B, a feed sweeping robot is used. Its task is to dredge the animal's feed at regular intervals, by which the animals reach the food. The dairy processor F employs cooperative robots (cobot) to facilitate manual elements of the production process and robots to perform packaging tasks. In addition to automation, processor E gave up robotization, as it would have had a negative impact on the consistency of its main product. Meat processing robotization efforts could not be realized in the processing process either, because a sophisticated series of human movements would have to be mechanized that could not be realized at a realistic cost.

6. Conclusions

According to Kürthy et al. (2016b), the Hungarian food industry is lagging behind its Western competitors in terms of efficiency and technology, although export activity can significantly boost business revenues. This is also evident in the case of company A, which has reached its capacity limit and is clearly committed to a growth strategy that it plans to build on exports when setting up the new plant. In order to achieve higher efficiency, companies can buy advanced technology and analyse the data it produces to further optimize processes and increase their competitiveness. Our results correspond with Simutech (2016) survey, as interviewees reported serious investments where the focus was not on the cost of technology but on its knowledge, one of the most important of which is predictive maintenance, and they are still working on further exploiting opportunities.

Although corporate interviews report many technological advances only a few of them form systematically structured system (A, partly B, and F). Although these are very large-scale investments, many developments have benefited from national or EU funding, which, according to many interviewees, is a good incentive for digital development (A, B, C, E, G). Another motivating force for development is the shortage of labour in many sectors. In some companies, the intention of automation and robotization was to eliminate the operational risk of losing workforce, or to replace missing workers (partly A, F, G).

However, the food industry companies have a strong interest in Industry 4.0, it is important to mention that there are several factors hindering the development and the investments. Based on the opinions of the interviewees, they feel that the long payback time of the projects, the lacking knowledge and skills of existing workforce to develop, maintain and operate the new technologies and the high labour cost of hiring such employees, as well as the limited tender resources and supporting economic environment are the main reasons behind the postponement of the investements.

In conclusion, we have experienced that there are developments in the food industry that are taking advantage of Industry 4.0 and digitization has begun in many places.

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Autonomous cars and responsible innovation

Miklós Lukovics – Bence Zuti – Erik Fisher – Béla Kézy

Digitalization, a dominant megatrend in today's global world, offers numerous intriguing technological possibilities. Out of these novelties, self-driving cars have rapidly come to be a primary focus; the literature categorizes them as a radical innovation due to the possibility that the mass adoption of self-driving cars would not only radically change everyday life for members of industrialized societies, but calls into question the infrastructural, legal, and social ordering of towns and numerous aspects of transportation in the societies that adopt them. Meanwhile, the results of several international surveys with large samples show that public opinion of self-driving cars is ambivalent, indicating parallel signals of enthusiasm and concern. The aim of this paper is to develop key components of a general strategy for addressing the societal challenges associated with self-driving cars as identified in international surveys and relevant literature and using the framework of responsible innovation.

Keywords: fourth industrial revolution, autonomous car, responsible innovation

1. Introduction

Recently, commentators have heralded what is being termed "the fourth industrial revolution," which is defined as a process that emphasizes the role of systems and networks based on information and communications technology (Kovács 2017a), and which they anticipate to reshape the global division of labor (Lengyel et al. 2016). Widespread and accessible internet, artificial intelligence and machine learning, and also green energy make up the foundation of the corresponding industry 4.0. Its key elements may in turn include physical (autonomous motorcars, 3D printing, advanced robots), digital ("The Internet of Things") and biological (gene technology) factors (Kuruczleki et al. 2016, Prisecaru 2016). As with similar revolutions heralded in the recent past (e.g., nanotechnology; cf. Kennedy 2008), the fourth industrial revolution promises considerable opportunities aided by radical innovations and global, fast-paced change that affects most aspects of everyday life.

A definition of breakthrough technologies has been created by OECD (2015, p. 3): "The definition of breakthrough technologies adopted is rather wide and include new, fast-growing, radical technologies that either introduce new product or process with very high market potential, or that make existing established technologies rapidly obsolete".

The autonomous vehicle is one example of the radical innovations or breakthrough technologies of the fourth industrial revolution. Such vehicles would be completely automated and maintain control under all circumstances; i.e. they would be able to operate without human intervention. In contrast to automated metro operation that is increasingly visible on roadways today, autonomous cars are not

track-based; and since the final objective is complete autonomy, artificial intelligence is expected to play a considerably more significant role in these vehicles. There are two aspects associated with this innovation worth noting: i) according to the visions and forecasts, this innovation has the capacity to fundamentally shape the future of humanity; and ii) it is in a far more advanced stage than many in the public may think, as final-phase tests are currently under way on the public roads of 73 cities.

At the same time, this radical innovation significantly divides the opinions of global society. For instance, the widespread adoption of autonomous vehicles will bring about changes in the value chain of the automotive industry and related sectors, in the ways people relate to transport vehicles, and also in everyday transport. Thus, beyond the issue of the reliability of autonomous vehicles, such broader aspects raise a host of social, ethical, environmental and economic risks, which are as of yet unaddressed by their promoters and designers.

Such broader societal issues are closely related to the area of responsible research and innovation, which aims to minimize the unintended effects of research, development and innovation processes in early stages. Accordingly, the objective of this research is to explore the most debated societal risks of the autonomous vehicle as an example of radical innovation, and to offer solutions utilizing the framework of responsible innovation.

In the first part of the paper, we shall address digitalization, one of the key capabilities of the fourth industrial revolution. We shall continue by defining non-track-based autonomous vehicles, describing their social reception, and outlining the positive vision for the future as well as the possible risks related to these vehicles. In the second part of the paper, we shall offer possible solutions for addressing the likely risks associated with non-track-based autonomous vehicles using the framework and concepts of responsible innovation.

2. The Fourth Industrial Revolution: The Growing Use of Digitalization

Industry 4.0 is projected to have considerable influence not only over production processes in certain industry sectors, but also over the lives of individuals (Schmidt et al. 2015). Given the sweeping nature of its visions, it is not surprising that the definitions of Industry 4.0 show considerable diversity (see Davies 2015, Kovács 2017a, Nagy 2017, Pfolh et al. 2015, Schuh et al. 2017, Schmidt et al. 2015, or Smit et al. 2016). In an effort to be comprehensive, this study will adopt the definition by Pfolh et al. (2015, p. 37), according to which "*Industry 4.0 is the sum of all disruptive innovations derived and implemented in a value chain to address the trends of digitalization, autonomization, transparency, mobility, modularization, network-collaboration and socializing of products and processes.*"

Recent technological innovations are closely linked to digitalization. Digitalization is a self-catalyzing process that assigns a virtual projection to all aspects of life. From an economic perspective, it provides process and organization development opportunities to stakeholders; and from a social aspect, it enables continuous exchange of data between individuals and devices supported by info-communication infrastructure and the internet (Capgemini 2011, Krishna 2017, OW

2014). At present, we see the emergence of a socio-economic environment in which smart devices constantly communicate with each other and customers interacting with the material and the virtual realms in a parallel fashion (Hwang 2016, Kagermann et al. 2013, Pfolh et al. 2015). A large part of people's lives is present in the digital space whose online presence and connectedness with smart devices has dramatically grown over the past decade (OW 2014).

Considering contemporary advances in research related to Artificial Intelligence is inevitable when it comes to the discussion about autonomous vehicles. With the use of AI, autonomous vehicles will be able to interpret metrics related to their surroundings, understand traffic and environmental conditions. Eventually, this mass of information acts as an input to the driving-related decision making of autonomous cars, hence aiming to replicate or even exceed the precision of human driver actions. One of the ultimate goals is to significantly reduce car accidents in traffic, however there are concerns regarding the ethical aspects (e. g. the Trolley Problem) and the trustworthiness of AI systems (Cunneen et al. 2019, Nascimento et al. 2019, OECD 2019). AI is currently in an infant state, providing researchers and experts with a multitude of questions and challenges to consider (OECD 2019). However, the expectation is that AI will ultimately add significant value to society and economy and offer a great potential, hence the research and deep level understanding of AI bears great significance (Cunneen et al. 2019).

In short, the autonomous vehicle exemplifies digitalization, the relevance of AI and is categorized by the literature as a radical innovation, which refers to the idea that the mass adoption of such cars would radically alter everyday life, the structure of urban environments, and numerous aspects of transportation, insurance, labor, and regulation – among other things.

3. Autonomous Vehicles: Emergence, Public Opinion and Risks

As a result of several decades of research and development (R&D), conventional cars previously entirely under human control are thought to be approaching full autonomy and can be regarded as self-driving (Giffi et al. 2017, Yeomans 2014). Digitalization allows recent cars to be equipped with an array of different sensors that are meant to make driving, transportation and other vehicle-related industrial activities safer and more technologically advanced (SMMT 2017a, SMMT 2017b, Yeomans 2014). The terms "self-driving," "autonomous" and "driverless" are not only applied to cars, but also to drones, trains, buses, spacecraft and other freight vehicles (Yeomans 2014).

In this study, we focus on autonomous vehicles (defined in Chapter 3.1) as examples of radical innovation that could affect large populations throughout the industrialized world; importantly, radical innovation is characterized by immense uncertainty, complexity, and moral and sociological ambivalence (Goorden et al. 2008).

3.1. Autonomous Vehicles

The definition of autonomous vehicles (including non-track-based autonomous buses and lorries) is based on the meaning of the term "autonomous", which is better understood with further insight into the levels of automation. Definition of these levels may vary with each authority; the three leading categorization systems for levels of automation are those of the NHTSA (National Highway Traffic Safety Administration), the SAE (Society of Automotive Engineers), in the United States, and the German BASt (Bundesanstalt für Straßenwesen). In this paper, we shall review the system of the SAE, as this is the most detailed in defining the levels of automation. SAE defines the following levels of automation (Glancy 2016, ITF 2015):

- Level 0: No automation. The vehicle is entirely in the hands of the human driver who exercises full control.
- Level 1: Driver assistance. Driver assistance systems are able to provide specific information for the driver and are also able to take over tasks related to either acceleration/deceleration or steering, but not both. The vehicle remains under human control.
- Level 2: Partial automation. Driver assistance systems are able to take over tasks related to both acceleration/deceleration and steering, even simultaneously. Still, the vehicle remains under human control.
- Level 3: Conditional automation. The vehicle's automated driving system is able to take control of dynamic driving tasks (lateral and longitudinal control), yet the system assumes that the human driver is capable of responding and regaining control.
- Level 4: High automation. As with the previous level, the vehicle's automated driving system is able to take over and maintain control of dynamic driving tasks (there is lateral and longitudinal control), even when the human driver is unable to regain control.
- Level 5: Full automation. The vehicle's automated driving system is able to maintain control under all conditions, i.e. the system is able to drive without any human intervention.

Throughout the study we shall define autonomous vehicles as fully automated vehicles that fall into the category of Level 5.

3.2. Autonomous Vehicles: Broad Societal Implications

The widespread adoption of autonomous vehicles could bring about the largest, fastest and the most profound changes in the history of mobility.

A number of predictions place the worldwide adoption of autonomous vehicles early on or at the end of the current decade (Wadud et al. 2016), or in the first half of the next one; Arbib and Seba (2017) calculate that by 2030, 95% of passenger miles in the United States will be served by autonomous vehicles run by fleet operators. If made possible by regulations, people – instead of using their own cars and especially in urban traffic – may use transportation as a service , which would be

cheaper than maintaining a car – without considerable compromises regarding convenience (Keeney 2017, Litman 2017); but it may even complement railway transportation as a viable alternative for short trips between railway stations and final destinations (Yap et al. 2016). If such a regime is adopted, some of the considerable changes in daily life would likely include the following (Arbib–Seba 2017, Fagnant–Kockelman 2015, Hohenberger et al. 2016, Keeney 2017, Litman 2017):

- Implications for local economies. Less expensive transportation results in greater household savings that may partly be channeled to local businesses as extra spending. Although municipal revenues (parking fees, vehicle tax) may decline, this will probably be counterbalanced by a reduction in the maintenance and development costs of the road infrastructure and parking system, which will be used by fewer cars. Time spent in autonomous vehicles can also be put to other uses – even work (Yap et al. 2016). In addition, autonomous vehicles may appear in the production sector (fork-lift trucks, lorries), which may reduce turn times, and also downtime during long distance trips with the disappearance of mandatory resting periods (Fagnant–Kockelman 2015).

- Use of space, urban environment. With the proliferation of autonomous vehicles, transportation is predicted to become a service in everyday life, thus liberating significant amounts of valuable city space. While nowadays an average car spends 96% of its lifetime parking, this time is expected to drop to below 50% for autonomous cars run by fleet operators. New community spaces, parks may be established, but former parking spaces may also be used to ease the pressing housing shortage. In summary, cities would become less crowded, and also more walkable, safer and livable.

- Environmental and health implications. Carsharing based on electric autonomous vehicles would reduce traffic-related air emissions to a fraction of its current rate, which, in turn, would improve air quality – as well as the quality of life – in cities. Wadud et al. (2016), however, note that the emergence of electric vehicles may also result in a reduced demand for conventional vehicles, changed transportation habits (e.g. carsharing), thus a smaller number of cars on the roads, which would again lead to reduced emissions and falling fuel demand. Eliminating human reaction time as a limiting factor would speed up motorway traffic, which, in turn, would also reduce fuel consumption as well as the burden on the environment. Autonomous cars are supposedly safer than human-driven cars, and a considerable drop in the number of car accidents would be expected.

- Access. Universal access to mobility is a key function of transportation systems. Built on autonomous vehicles, door-to-door services may grant mobility to even those who cannot afford to maintain a car, or those who cannot drive (the elderly or handicapped people), and also to those for whom public transportation cannot offer a solution due to the location of their residence.

Despite the considerable advantages currently predicted by its promoters, public opinion is not similarly unanimous. In the past few years, a large number of large-scale studies have been published that suggest reliable trends in public opinion of autonomous vehicles. Most of these studies were conducted in the United States, but many also include international surveys. We present the findings of these studies in the next section.

3.3. Autonomous Vehicles: Public Opinion Surveys

Schoettle and Sivak (2014) conducted a survey involving a total of 1533 people in three countries pioneering in autonomous vehicle technology: The United States, the United Kingdom and Australia. These surveys yielded mixed results: most respondents had a positive opinion of autonomous vehicle technology. Almost 60% of respondents had a very positive or positive general opinion on autonomous cars; 30% had a neutral opinion, and only slightly over 10% voiced a negative opinion. The respondents expressed bold expectations regarding the benefits of autonomous cars: these include fewer accidents and reduced severity of accidents; less traffic congestion, shorter travel times, a reduced environmental burden and lower insurance rates. However, the majority of respondents also expressed serious concern: the option "I am very concerned" was marked by 46.8% for problems resulting from system failures, 34.7% for uncertainty regarding legal liability, 35.2% for hacker attacks, 30.2% for data privacy (location and destination tracking), 33.5% for interacting with non-autonomous vehicles, 37% for interacting with pedestrians and bicyclists; and they were also concerned about system performance in poor weather (28%) and about the system getting confused by unexpected situations (32.4%).

A survey by Kyriakidis et al. (2015) is based on the largest sample surveyed so far on the topic of autonomous cars. Involving 5,000 people from 109 countries, their survey revealed that the majority of respondents were concerned about software hacking and misuse, and also about legal issues and safety. In addition, the positive attitude of respondents was related to the tasks they could engage in when travelling in an autonomous vehicle: checking emails, making phone calls, watching movies, reading, resting, or observing the scenery.

The survey conducted by the AAA (2017) is especially important for our study, as it was conducted in a time when one could actually meet autonomous vehicles in the streets due to the advanced stages of testing. In this study, 1012 people were involved from the United States, a country in which pedestrians may have already seen autonomous vehicles on the streets. In light of this fact it is remarkable that among the respondents who think that the introduction of autonomous vehicles is imminent, 66% would be afraid to ride in an autonomous vehicle, 19% would trust the vehicle and 4% are unsure. In addition, 54% would still feel less safe sharing the road with autonomous vehicles while driving a regular car. 34% feel it makes no difference, 10% would feel safer sharing the road with autonomous vehicles and 2% are unsure. It is interesting that 59% want autonomous technology in their next car.

In summary, research findings clearly indicate that there is a positive anticipation towards the emergence of autonomous vehicles in society, which is also

surrounded by a shroud of concern, unease and uncertainty. It is also a clear trend that these concerns are linked exclusively to fully autonomous vehicles (Level 5, as discussed in Chapter 3.1), yet respondents seem to accept high levels of automation (Level 4) without concern, as long as they have control over the driving process. Most studies also show that there is limited amount of information available on fully autonomous vehicles, and also that respondents find this technology immature and feel the need for additional testing.

3.4. Autonomous Vehicles: Identified Risks

With the introduction of autonomous vehicles – as with any new technology – one may identify a wide range of risks, some of which are directly derived from the concerns revealed by studies on the public opinion on autonomous vehicles. These risks can be classified into five larger categories: technological, environmental, sectorial, ethical and governance risks.

Ethical risks are some of the most strongly emphasized groups of the risks identified, since the most emphasized question is how the autonomous vehicle system reacts to a suspected accident situation (Blyth et al. 2015, Bonnefon et al. 2016). It is important to realize that it is not the autonomous vehicle engine and mechanics that provide a solution for these dangerous situations, but the algorithms that operate the vehicle, algorithms written by people (Bonnefon et al. 2016, Lin 2016, Yeomans 2014). The scenarios we need to examine already raise bafflingly complex issues and the individual elements that make up these scenarios offer almost infinite opportunities to discuss moral dilemmas, which touch upon areas of engineering, law, economics, philosophy and information technology. Adding to the importance of this issue is the fact that it is impossible to arrive at an all-embracing societal consensus on what is considered the favorable outcome of any given (dangerous) traffic situation (Holstein 2017).

Responsible innovation provides analytical and procedural principles that can be leveraged to generate solutions to begin addressing this immense challenge.

4. Responsible Innovation: Addressing the Challenges

Despite the promises and optimism surrounding autonomous vehicles, they raise a number of challenging issues and questions, and most respondents to public opinion surveys voice skepticism and concerns about these cars, pointing to potential problems with the widespread introduction, adoption, and use of the technology. way to achieve that is if developers move forward using tools and concepts associated with responsible research and innovation (RRI).

4.1. Responsible Research and Innovation

The concept of responsibility is not new in the process of research and innovation (Genus–Stirling 2018, Stilgoe et al. 2013); however, effective means of integrating responsibility in to all stages of R&D and of achieving synergy between top-down mandatory and bottom-up voluntary efforts have been inadequate, as controversies

around nuclear power and genetically modified agriculture have shown. Responsible research and innovation in today's sense appeared in the United States at the beginning of the 21st century and was adopted by the European Union a few years later (Fisher–Rip 2013). Since the roots of RRI are found in management, technology assessment, science and technology studies, and other areas (Inzelt–Csonka 2014, Owen et al. 2012), the concept has several definitions suggestive of its multidisciplinary origin (Buzás–Lukovics 2015, Chorus et al. 2012, Owen et al. 2012, Fisher–Rip 2013, Sutcliffe 2013, Tihon–Ingham 2011). A common feature found in all definitions is social responsibility, but each definition emphasizes environmental, ethical and political responsibility differently, and only a few definitions address the importance of open, transparent and accountable research and innovation (Buzás–Lukovics 2015, de Campos et al. 2017).

Despite this diversity, the definition of von Schomberg (2011, p. 60) appears to be the most widely accepted, thus we shall also use this definition in our study. According to this definition, RRI "is a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)." Thus, RRI delegates an important role to cooperation between the actors of innovation. In responsible innovation it is not enough to provide solutions concerning the product itself; it is also important to consider the research process and issues affected by the goals (Stilgoe et al. 2013).

To examine whether a certain research and development or innovation project (including its processes) accords with the principles of responsible innovation or not, the following four dimensions of responsible innovation offer a clear starting point (Buzás–Lukovics 2015, Carbajo–Cabeza 2018, Owen et al. 2012, Stilgoe et al. 2013):

1. Anticipation refers to the need for researchers and developers to constantly think about both known and yet unknown, but potential adverse effects, with questions like "What if?" in mind. Taking uncertainty, complexity and contingency in mind significantly increases our ability to identify and mitigate potential societal risks and harms.

2. Reflexivity examines the assumptions that limit technical experts' ability to identify and anticipate possible repercussions of their decisions, objectives, and motivations. In essence, it provides a mirror for the research process.

3. Inclusion refers to genuinely listening not only to the opinion of direct stakeholders, but to that of diverse and wider publics – whether through large or local public forums and discussions.

4. Responsiveness is closely related to the previous three items but has to do with taking actions that take into account during R&D&I processes the values, concerns and opinions of diverse stakeholders regarding hazards and risks by adjusting the course of research, development and commercialization accordingly.

In addition to these procedural principles that can help both scientific and industrial actors identify and integrate stakeholder values into their technical processes, the European Commission has also listed six key elements of responsible innovation (RRI keys) (EC 2014), which overlap to some extent with the aforementioned dimensions and can also help guide the process toward the practical implementation of RRI:

1. Public engagement in innovation ensures wider acceptance of outputs and more effective ways to tackle the urgent societal challenges. This practically refers to the dimension of inclusion.

2. Gender equality aims to improve the opportunities of women and the under-representation of women researchers, which is closely related to the dimensions of reflexivity and responsiveness.

3. Scientific education aims to broaden the knowledge of future researchers and other societal actors, so that they are able to participate more fully and actively in the innovation processes (including participating in public engagement). This key also stresses the importance of nurture creativity in children at the lowest possible age and to awaken and maintain their curiosity towards natural sciences in order to promote innovation in society.

4. Ethics: respect and adherence to shared values of the European Union (basic human rights and ethical standards) are key aspects for European understandings of responsible innovation, which influence how the dimensions of anticipation and responsiveness are applied.

5. Open access seeks to ensure the availability of research results to everyone. This key seeks to catalyze innovation but also to prepare a variety of stakeholders, experts and societal actors for informed participation in the innovation processes.

6. Governance: both the formal regulatory environment and the informal interactions among innovation actors greatly influences the outcomes of innovation processes and therefore can make the final difference in terms of whether these outcomes harmonize with the RRI dimensions of responsiveness and reflexivity.

These six key elements have shifted the emphasis towards the practical implementation of RRI, and the EU is also committed to integrate RRI into the daily activity of research institutes (Arnaldi et al. 2015, Forsberg et al. 2015). During our research we have found no analysis regarding the possibilities of integrating the concept of responsible innovation into a concrete example of (radical) innovation that is already under testing. Therefore, the autonomous vehicle as an example of radical innovation is an exceptional example and therefore, in the following section, we shall study how it can become an example of responsible innovation.

4.2. Tailoring Responsible Innovation to Address the Challenges of Autonomous Cars

Based on the above, fully autonomous vehicles (on Level 5 automation) are currently defined as innovation outputs that are highly significant for humankind according to predictions and may also bring about considerable change.

We construct a framework for addressing the specific challenges facing autonomous vehicles described in Chapter 3 based on the RRI keys and dimensions (see Table 1). It is clear that tackling each challenge requires multiple keys and dimensions. For instance, the challenge of societal division towards autonomous cars can be addressed by the inclusion of society and providing information in a transparent manner to members of the public, scientific education and open access to research results. Anticipation, inclusion and reflexivity are key dimensions for this challenge. This approach also indicates that undertaking an R&D project or innovation in a responsible manner requires a complex attitude and a complex set of tools with an important role of the interdisciplinary approach mentioned above.

Table 1 Managing the challenges of autonomous cars using RRI keys and dimensions

Challenges of Self-Driving Cars	RRI Key	Dimension	Recommended Action
- Societal division - Lack of information and trust in Level 5 automation - Fear of immature technology and influence by extreme weather - Uncertainty of medium and long-term impacts on society	1. Public engagement 2. Gender equality 3. Scientific education 5. Open access	1. Anticipation 2. Inclusion 3. Reflexivity 4. Responsiveness	Consideration of societal aspects in daily decisions by R&D&I innovators High levels of transparency and providing information
- Uncertainty of medium and long-term impacts on the environment	1. Public engagement 4. Ethics		Consideration of environmental aspects in daily decisions by R&D&I Innovators and in supply chains
- Problems caused by system failures - Hacker attack, data privacy	1. Public engagement 2. Gender equality 4. Ethics 5. Open access 6. Governance		High levels of transparency and providing information Engagement of stakeholders
- The effect of interaction with other traffic partners - The "decisions" of cars in emergency situations - Uncertainty of medium and long-term ethical impacts	4. Ethics		Consideration of ethical aspects in daily decisions by R&D&I innovators
- Immaturity of the regulatory environment - Uncertainty regarding legal liability	6. Governance	1. Anticipation 2. Inclusion 3. Reflexivity 4. Responsiveness	Governance, control

Source: own construction

Once the key elements and dimensions in Table 1 are identified, we can recommend concrete measures to tackle most of the challenges related to the introduction of autonomous vehicles with the help of responsible innovation criteria. These recommendations are as follows:

1. We must regard R&D&I decisions of researchers and innovators as key factors in the practical implementation of responsible innovation. It is important to note that this does not only apply to key strategic decisions, but also to all small and seemingly insignificant decisions made during everyday R&D&I tasks. The challenge in the factor of decisions lies in the fact that during R&D&I processes related to autonomous vehicles it is usually people with a technical and scientific mindset who make technical-scientific decisions, with unusually far-reaching impacts that – based on the above – point well beyond the realms of engineering and natural sciences. Therefore, there is a need for the integration of social sciences into decision-making, which may be achieved by many methods including widely accepted methods such as Socio-Technical Integration Research (STIR).

2. Given that the matter of concern is a radical innovation with the potential to influence wide segments of the populations of industrialized societies, particular attention must be focused on transparency, and continuous and accurate public information. Since the public to be informed is extremely heterogeneous, their media consumption also ranges across a wide variety of channels. This must be kept in mind when planning a communication strategy, considering that those supportive of and skeptical of autonomous vehicles are not simple binary and opposing groups but can comprise the same social groups.

3. Early understanding and integration of the needs and values of all stakeholders is also paramount and provides the basis for an optimal balance of key values (e.g. sustainability, safety, ethics, transparency) in the stages of planning. Since concern is a natural, inherent factor present in the tough questions raised in relation to radical innovations, addressing these concerns responsibly is indispensable.

4. The three steps described above reflect a bottom-up approach; however, in our view, a top-down approach is also important: to create a regulatory environment that provides for the integration of the elements of responsible innovation (e.g. societal, ethical and environmental impacts) and also creates the opportunity (provides for) multiple feed-back, to ensure that research and development processes and innovation truly result in socially important outputs.

Based on the above, two important aspects must be considered for responsible innovation to succeed, which, at the same time, also provide the basis for intervention:

- An interdisciplinary approach, which promotes collaboration among engineers, social scientists, policymakers and public stakeholders to shape future directions for technological development.

- Anticipatory analysis at an early stage of technical planning when a wider range of opportunities for planning are still available, thus technical development can easily be modified.

We must emphasize that the application of the framework of responsible innovation is not a panacea; no single framework will be able to tackle all challenges automatically. It will, however, be able to handle a significant proportion of challenges effectively (Figure 1), if the implementation of the recommended steps is based on an interdisciplinary approach and the necessary but not sufficient conditions of a proactive mindset; and if all stakeholders actively participate in the process – rather than passively following it.

Figure 1 The logical framework of autonomous cars and responsible innovation
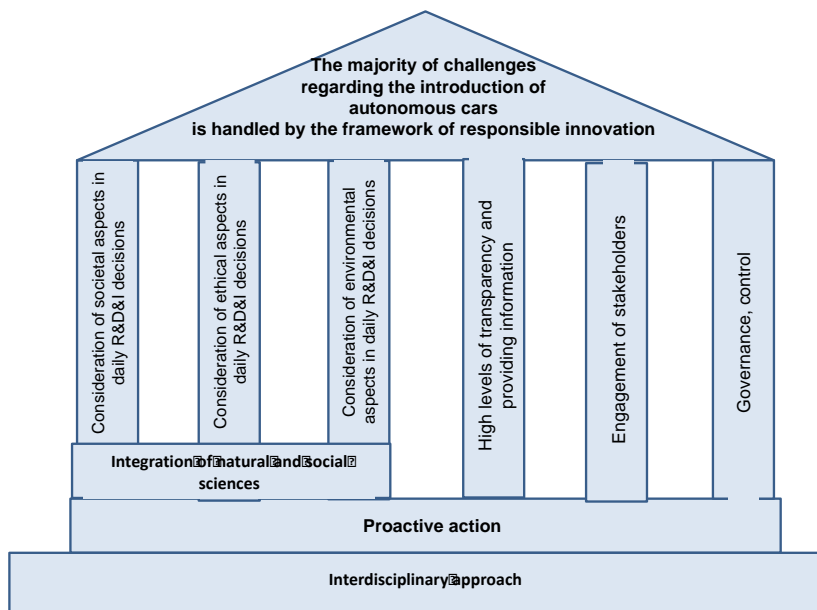
Source: own construction

5. Summary

The development of autonomous vehicles is in a far more advanced stage than many in the general public may think citizens in 73 cities may already encounter autonomous vehicles regularly in traffic in their cities; moreover, they may even use these vehicles as participants in final-phase tests. According to predictions, autonomous vehicles may, in many cases, bring about radical changes in the lives of everyday people.

However, a host of questions still lack satisfactory answers, and there are numerous risks that are recognized by public opinion on autonomous vehicles. In theory, such concerns may be successfully managed if the development of autonomous vehicles moves forward with the framework of responsible innovation, thereby reducing the probability of potential unintended future adverse effects.

The dimensions and keys of responsible innovation suggest a framework in which the concrete activities that may help reduce risks and find satisfying solutions to questions still open can be provided. We must take R&D&I decisions of researchers and innovators into consideration as key factors in the practical implementation of responsible innovation, with particular regard to the societal, ethical and environmental aspects of those decisions. This effort is efficiently enhanced by the integration of natural and social sciences. Special attention must also be focused on transparency, and continuous and accurate publicly available information; on the early understanding and integration of the needs and values of all stakeholders; and on the creation of a flexible and supportive regulatory environment. An interdisciplinary approach and proactivity are necessary but not sufficient conditions for all these.

We must note that the application of the framework of responsible innovation will not be able to tackle all challenges automatically. However, this framework may prove able to handle a significant proportion of challenges effectively and efficiently, if the recommended steps are implemented with the active participation of all stakeholders in the process.

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Investments in an intelligent and digital future –

The case of an ICT company

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Over the past few years, there has been an avalanche of new digital technologies in the business services sector, many of which proved to be disruptive. Business service centres (BSCs) even in innovative industries like information and communication technology (ICT) find it highly challenging to accommodate these changes. New technological solutions transform consumer needs, shape organizational processes, and alter the way employees cooperate in a computerized environment. These changes make it inevitable for companies to adjust their business models. In this paper, we present a case study of IT Services Hungary Ltd., a Hungarian based BSC in the ICT industry. We carried out semi-structured interviews with the CEO and four senior technology experts of the company to analyse digital transformation plans they initiated. We investigated and now reveal three projects through which they implemented cognitive automation, cloud computing, and advanced cybersecurity technologies. We also describe the general organizational, financial, employment, and motivational background of these projects at IT Services Hungary Ltd. With this paper, we aim to present transferable best practices and appealing management efforts to invest in an intelligent and digital future.

Keywords: service sector, business service centre, digital transformation, cognitive automation, cloud computing:

1. Introduction

The business service market based on the shared services and outsourcing model has undoubtedly been one of the fastest-growing economic sectors in Hungary in the last one and a half decades (Marciniak 2015). Today, approximately 150, mostly multinational companies are headquartered in the capital, employing approximately 67,000 people.

While in the 1990s, the number of companies focusing on outsourcing increased, in the past one and a half decades the shared service model has become more prevalent due to the region's favourable characteristics (multilingualism, stable economic, legal and financial regulatory environment, relative geographical proximity to Western Europe). Shared Service Centres have now expanded their operations focus to become a multi-functional, multi-model organizational solution with strategic importance (Drótos et al. 2018).

Although the primary goal of the shared service model remained to increase cost-efficiency until today, it has become increasingly important to create new, innovative business value for the customer and to foster effectiveness. The digital transformation of service centres' internal and external customers is increasingly impacting and significantly driving the integration of technological advances into

service delivery models. Today, technological innovation has become the primary driver of change in service centres (Chandok et al. 2016). However, it is a question of how these technologies are implemented and impacted in the practice of service centres in Hungary.

2. Theoretical framework

The shared service model, including outsourcing, is a relatively old concept, at least 40 years old. According to some authors (Ferreira 2016), it has been in existence for over 60 years but has gained real popularity over the last two decades. Today, it is widely adopted by multinationals, and about 90% of Fortune 500 companies have at least one Shared Service Centre (SSC). (Röder et al. 2013) However, in the early 1990s, in addition to the private sector, the public sector also discovered the benefits of the shared service model and in many countries (United States of America, United Kingdom, Australia, the Netherlands, etc.) shared services became part of government strategy as a widely proven solution (Schulman et al. 1999).

The concept of the shared service model can be properly grasped by several definitions:

- According to Ulrich (1995) it is an organizational model that combines certain corporate support functions into a separate organizational unit to provide them as a service to the rest of the company.
- According to Quinn et al. (2000) the idea is that shared service centres are created to provide a single service from there rather than being replicated across multiple parts of the organization.
- According to Schultz and Brenner (2010) it is an organizational concept that reduces redundancies, reduces operating costs, follows best practices, focuses on internal customers, and operates on a business basis by consolidating enterprise processes.

The most typical service features organized in a shared service model are customer service, finance, accounting, human resources, IT, sales, facility management, and general administration. According to Vollmer and Rasper (2013), SSCs in the financial accounting sector are leaders with 56%, followed by IT (19%) and HR (18%). Half of the SSCs worldwide (51%) are based in Europe. (Vollmer–Rasper 2013)

There are several benefits to consolidating certain enterprise areas and centralizing them into one SSC (Constantine 2018, Bergeron 2002, Röder et al. 2013, Marciniak 2015):

- It improves process standardization and efficiency: because standard processes simplify the design and upgrade of process control environments and produce consistent input and output reports. Revisions can be simplified and the number of iterations reduced.

- It improves service quality: improves the internal customer focus and applies best practices.
- It reduces operating costs: consolidation, automation, and other process improvement solutions can significantly reduce costs.
- It provides a deeper business insight: without it is slower and more difficult to gather decision-making information form fragmented functional areas in a company, and often by the time this information becomes outdated.
- It improves process transparency: clearer operation of standard processes, cost structure, and responsibilities.
- It increases the focus of the company's core activities: unlocking business units allows you to focus on higher value-creating activities.

The primary goal of the shared service model is to reduce enterprise operating costs, i.e. efficiency gains, which have been continuously promoted by various technological innovations. However, in recent times, the shared service model has been used extensively and nowadays, besides pure cost efficiency, innovative value creation and effectiveness have become one of the main goals (Durou et al. 2019). As technology solutions have become the focus of business renewal over the past few years, there has been an increasing focus on technology incentives within shared service centres.

According to the research of McKinsey (2017) organizations typically use five key capabilities or approaches to improve their operations (Bollard et al. 2017):

- Digitalisation: able to renew the traditional process by incorporating digital tools and technologies, transforming customer relationships and often creating self-service systems.
- Advanced analysis: automated processing of data using cutting-edge technologies to uncover relationships and make well-supported suggestions.
- Intelligent process automation (IPA): operating new technologies capable of combining traditional process redesign, robotic process automation (RPA) and machine learning.
- Business process outsourcing: the use of external resources to perform certain functions or activities for cost efficiency.
- Lean process redesign: streamline processes, reduce wastage and promote a culture of continuous improvement.

According to Röder et al. (2013), new digital technologies (such as mobile devices, cloud computing, social media or big data) mean significant contributions to enabling SSCs to simultaneously achieving effectiveness and increasing their efficiency. This could lead to digital or intelligent shared service centres. It represents a new maturity stage of service centre where holistic services and supply chain focus ensure strategic importance, and where highly automated end-to-end processes are operated locally and globally in a global process control model. (Röder et al. 2013)

Business service centres are organizations that organize themselves on a process basis and typically provide services to other departments within the parent

company or to other external clients. As a result, digitalization and automation potential are extremely high at service centres, as they provide a large number of, often repetitive, standardized processes, typically with IT support (Darino et al. 2016).

The three most significant technologies driving shared service centres today are the expansion of cloud services, the robotic process automation that automates routine, repetitive, well-structured processes, and artificial intelligence (AI) enhancements that can automate tasks that require human intelligence. (Durou et al. 2019)

Utilizing the benefits of automation for business providers can be the result of a reactive and proactive approach:

- Reactive: Business Service Centres (BSCs) are suppliers to their (mostly internal) customers, so they must follow the needs of their environment. If digital channels are used with customers, then service providers must also follow this.

- Proactive: Business Service Centres are in constant competition, even with internal service centres (captive centres) that only provide services to their parent company. Transformations in service aim to improve service levels and to reduce costs. This is vital for survival. It creates a continuous transformation pressure on the operation of the centres, which can be reduced by technological innovation.

The rise of automation and digitalisation in service centres contributes to the digital transformation of the entire sector, which in various senses (number of employees, service and pricing models, geographical location of service centres, etc.) may even be disruptive for the whole sector in the future (Edlich et al. 2017). The essence of digital transformation is to integrate digital technologies across all areas of the business in a way that fundamentally changes how the business operates and creates value. Thus, the goal is to create new value and to reap the benefits that these technologies bring to organizations, but not to use technology anyway (Eden et al. 2019) (Westerman et al. 2014).

Thus, the use of new digital technologies from the digital transformation process serves primarily digital optimization by improving quality, process flow, and work flexibility. At the same time, the impact of successful transformation projects can be twice as effective as efficiency (Edlich et al. 2017). However, as new technologies are being adopted, service centres may significantly transform in many of their features:

- Process automation primarily focuses on low value-added activities. Automation provides an opportunity for the workforce to do higher value-added work, and to position the portfolio of service centres and the entire sector up in the value chain (Marciniak–Berend 2017, Willcocks–Lacity 2016, Chandok et al. 2016);

- Although software robots replace the human workforce in certain activities and it is not labour arbitrage that determines deployment and service migration decisions for new service centres, but a rather low-cost server operation and the presence of automation professionals. This shifts the focus

of the enterprise HR from lower-skilled to highly-skilled to talented (Sowinski 2016, Chandok et al. 2016);

- New technologies such as smart chatbots or virtual assistants make some front-office activities robotic (Bornet 2017);

- Technologies like voice recognition, face recognition, and other cognitive technologies accelerate customer service and omnichannel solutions become widespread;

- Higher value-added jobs require a more specialized workforce, as opposed to previous practice, where many foreign-language graduates have been trained in many cases;

- Digitalisation allows for better customization of services, which increases customer satisfaction.

3. Methods

3.1. Research methods

This case study focuses on ITSH SSC practice. At the beginning of the research, general information about the company, public data, news, and press releases were processed using secondary sources. This was followed by interviews. Four interviews with five interviewees were conducted, including the managing director of the ITSH SSC and some leaders in several areas of digital technology. Prior to the interview, a methodological guide was prepared for broader research and a question list that was adapted to service centres. This guide provided the framework, the lead topics and main questions for the semi-structured interviews. The interview also included a short questionnaire about the adopted technologies. The subject area of the interviewees is summarized in the table below.

Table 1 Details of interviews

No.	Name	Affiliation	Date
1.	Bálint Zsíros	Head of Business Unit	11:00 AM, 13rd of December 2018
2.	Richárd Réfi	Product Owner and Head of Team of Managed Services and Connectivity/Network	14:00 AM, 14th of December 2018
3.	Erik Slooten	Managing Director	10:00 AM, 19th of December 2018
4.	László Kónya	Vice President Growth Portfolio	10:00 AM, 19th of December 2018
5.	Árpád Jorzsits	Head of Public Cloud and IoT Hungary	13:00 AM, 19th of December 2018

Source: own edited

Although the company operates service centres in four locations in Hungary and not all of the interviewees worked in the capital, but the interviews were always recorded at the company's headquarters in Budapest. In the interviews, two researchers of research teams participated, one researcher recorded the interview in writing while the leading researcher asked questions. Interviews were written on a computer and recorded with a smartphone. University students were also involved in the interview processing.

3.2. Company introduction

As a Hungarian subsidiary of T-Systems International, IT Services Hungary (ITSH) is a significant element of T-Systems' international supply-chain. Its main activities are system integration and IT outsourcing, but they also offer SAP system services for all widely used software and hardware platforms, remote and local server operation, and network management.

In 2019, they have 12 units in their service portfolio. Some of them (such as public cloud, IoT) are growing strongly, while others (such as x86-based virtualization) are already shrinking. ITSH primarily provides services internally to T-Systems International or other subsidiaries of Deutsche Telekom (DT) but they have their international clients (e.g. BMW, Daimler, etc.) as well. Usually, they do not have clients from the Hungarian market. Although ITSH operates in cost centre responsibility status, it is represented in the international top management bodies as well. As a global service centre, the company serves clients with languages in English, German, Dutch and Hungarian. About 40% of its services, provided on a continuous basis every day of the week, are still transactional. 40% of employees are women at the level of employees and management as well, which may be due to the general under-representation of women in the IT field.

From six offices, which are equipped with state-of-the-art infrastructure, the ITSH now serves its typically European customers with 4,765 employees. It is currently the largest business service centre in Hungary. The average age of employees at the company is 34, with 70% having a university degree. In 2018, the company generated sales of HUF 60 billion. Founded in 2006 in Budapest, the company continues to operate offices in Debrecen, Pécs, and Szeged.

4. Results

The relation of the corporate strategy to the Business Services 4.0

According to the company's management, the past of ITSH was based on cost efficiency, but its future lies in innovation. The challenge is to be able to apply technologies as soon as possible. "Do it today and become excellent in it tomorrow: this can be our key competence" – says the company's management. To this end, the company is no longer just looking for new projects from its parent company but wants to do "tech projects" for itself.

Available financial resources for the purposes of the Business Services 4.0

According to the company's executives, they don't spend money on technology simply because it is fashionable or affordable, but only if there is added value in its use. They look at the level of benefit each technology brings and in what areas. In their view, innovation is increasingly a matter of mindset and not a matter of return. It is a huge challenge to transform Germany's and Europe's leading ICT companies into a culturally innovative organization.

The company operates an innovation fund to support useful internal ideas. Even smaller ideas with low resource requirements are supported in this initiative. Otherwise, more robust ideas that may result in new products are preferred by this fund. Beyond cost savings, new products can also generate additional revenues.

In case of efficiency improvements (e.g. Robotic Process Automation – RPA), as ITSH operates as a cost centre, the savings contribute to the central overhead costs. However, it another existing model when the site management decides on the use of the savings generated. Although the company can reinvest some of the savings from the projects, it is far from sufficient for major innovations.

External Relations and Business Services 4.0

The company provides its services primarily to external customers of the parent company. For this reason, managing its inter-organisational relations and its role in the supply chain is particularly important at ITSH. The main focus is on the external clients, the end-users. Therefore, technology development initiatives are also primarily driven by how they can generate value for customers. The downside to this is, as our interviewees denoted, that internal efficiency improvements have lower priority.

ITSH is basically a system integrator company. For this reason, before deciding whether to buy or develop, they typically look for the most suitable open-source components which they can easily work with and build on. Of course, wherever possible, they favour the internally available solutions. Regarding the externally developed components, the company has strategic suppliers for certain products. When choosing strategic suppliers, they always decide on the best solution after a thorough market analysis.

Employee participation in the Business Services 4.0 projects

Each department is responsible for its ongoing developments. There is a dedicated process development team that supports, designs, and develops. But, ultimately, this team strives to keep an innovative approach in the minds of all employees.

All employees are encouraged to participate in innovation projects, and later the project initiators have the chance to lead the implementation of the projects. Interviewees said that there are many ideas generated at the company, so the challenge is not to encourage the colleagues to come up with ideas, but to persuade them to develop those into something feasible. This is not funded by the company. People have to devote their free time to the elaboration of the idea. At the same time, this is supported by a facilitator workshop based on a design thinking methodology – but the host of the idea must commit to this in addition to the 40-hour workweeks.

Employment structure, trends

The management of the company expects the current automation trends to continue and intensify. The need for manual, repetitive work will surely decrease, but in the future, there will be automated and non-automated workflows as well, which means that human labour cannot be replaced everywhere. The management must already think about how employment and wages are going to change. They think there is a need for a completely different system to pay-per-hour billing, which means a complete change of philosophy.

Although ITSH technology does not endanger workplaces, the management is aware of the resistance at all organizational levels when it comes to automation and robotisation issues. This, however, is not considered a problem, as the ethical, legal, or cultural aspects of many issues are still unclear on the subject, but it still should be treated with caution.

In addition to stimulating an innovation climate and bringing new ideas to the market, they also operate formalized support structures, such as centres of excellence, in service areas that are important to the company. The employees can contact these departments in order to implement a process improvement project.

Governance of innovation processes at the company

The management believes that the large organisational size comes with some bureaucratic constraints on the one hand, but with opportunities to do development projects internally on the other. They also see the advantage of being very close to the parent company, this way they quickly learn about new internal innovations. Deutsche Telekom has an innovation department with a relatively large annual R&D budget. ITSH employees can also submit proposals to this department. Some of these proposals were successful in the past. The parent company also operates an innovation fund, which finances five to six employees for up to a year. On average, two out of ten projects, depending on their results, and move on to the next stage of the funding. After this stage, a committee from the innovation fund analyses the potential of the project and decide whether to proceed or terminate. Proceeding means that the development project has to evolve into a product, an application or a service that has a market value.

Innovation is an important and recurring issue for a system integrator company like ITSH. Such a company has to maintain its distinctive character in order to prevent being perceived as a "LEGO-building" company. The distinctive character is maintained by the additional developments that ITSH typically adds to the services it sells.

Development projects can be initiated in all directions. From the top, from the management of the company, or even from the customers. To support this, the company organises workshops using design thinking methodology, university collaborations or internal innovation and process development. The latter is assisted by an internal process development team that focuses on internal processes. They have a list of processes that have already been automated and have a service tracking system, although in connection with that there is resistance from the employees.

ITSH actively encourages all employees to come up with new ideas. The implementation of these ideas is fully democratic, the initiators can even get the role of a project leader. The management rewards innovative employees with a number of awards, including the "Best Employee" and "Best Idea" corporate awards. They also organize annual hackathons and innovation quest events in which they evaluate results from the aspects of value creation and efficiency.

Selected projects

Project 1: Cognitive automation project

Motivation, planning

ITSH is a very large organisation that has been expanding over the past 12 years and is expected to continue to do so in the future. Like in other organisations, the fluctuation is present. As a result of these two facts, the company has to hire hundreds of people each year. Therefore, it is a challenge for the HR organisation to manage the recruitment volume, especially as the labour market competition for talented people increases. The time spent on finding and selecting candidates has to be reduced. In parallel, the HR organisation is expected to hire talents who will become good-performer in her jobs.

The company was looking for a solution to this problem. They decided to focus on curriculum vitae processing. Checking, sorting and ranking of the CVs is probably the most repetitive and low-value activity, yet inevitable, in the hiring process. A bottom-up initiative emerged; the proposal was developed by the HR team leader. The idea was to use artificial intelligence for robotising this task. Assuming that 80 percent of the incoming CVs can be processed without human intervention, significant cost savings could be achieved.

The final idea was developed through several stages. At the first stage, all ITSH developers ever involved in any artificial intelligence projects were involved. Several rounds of meetings were deployed in order to develop ideas regarding the simplification of the recruitment process. As a result of the workshops, the development of the CV processing software robot has started.

Implementation

The idea was discussed with the stakeholders of the recruitment process. Data security issues were also addressed at the beginning of the project. Then, a small development team has started to develop a prototype and tested it. The results of these were constantly consulted with the HR field. After several iterations, a final version of the software robot was completed.

Several issues have arisen during the implementation. At one point in the project, for example, the software had to be rewritten in order to make it capable to work on a larger scale as well. Maintaining anonymity was another issue to be addressed. The solution for this was the introduction of a pseudo-anonymity approach.

Responsibilities

It was the branch leader who decided to partly use the branch profit for dedicating budget for the preparation of a project plan. One reason for this was that the German parent company, heavily involved in artificial intelligence research, asked the Hungarian subsidiary to also present new ideas in the field of AI. In case of a convincing business case, an approval decision may fund 5 to 30 FTE workforce.

The project manager devoted 20 percent of his working time to the project. Junior Python developers worked on coding. The HR staff was involved in the project part-time, in the field of the software features. The project was supported by design thinking facilitators. Minor prototypes were constantly created as new people entered the project organization. Finally, the project became so popular that even those who had not been involved in AI development earlier had applied. Even external AI experts had to be involved to assure the successful completion of the project.

Results, impacts, experiences

The project has produced several results. The main result is the software robot that performs the selection of the CVs. Its most important feature is its machine learning ability. Based on new development ideas, the project manager plans to incorporate heuristics in the future.

The project is still going on, but apparently, it hasn't grown as much as it was expected at the beginning. The robot is still in the form of a prototype. ITSH started to use it internally, however, not on a large scale yet. Therefore, this solution is not yet ready to be introduced as a product to the market.

Another benefit of the project is that ITSH gained direct experiences in artificial intelligence technologies. Managers of the company denoted that the team that experimented with AI may evolve into a larger department or even a new product line. This is the reason why management supports progressive experiments. However, this requires critical mass. Three to four additional staff can fit into a cost centre, but a separate department is needed for a larger team like 8 to 16 people.

As another result of the project, ITSH started building a portfolio of AI solutions. The portfolio helps to identify what type of AI solution is suitable for what type of problem. When an AI-related client need arises in the future, the experts working on the previous projects can be mobilized.

There are plans to continue the project. A proposal for using the blockchain technology in smart contracts was submitted to the parent company's innovation fund. Future steps depend on the decision of the innovation fund, that is, the availability of the financial resources.

Project 2: Data Science Workstation Project

Motives and planning

ITSH works on various technology solutions and development areas within publicly available cloud services. In particular, they sought to make it easier for data scientists to use their working platform on their own notebooks. It was an upscaling service identified by a pre-sales colleague. First, they wrote a one-page description of the capabilities this solution should possess.

Based on this one-pager plan, a call for tenders was also created so that the company can benefit from state innovation support. The application was written here according to very strict criteria and the waterfall planning logic. A six- to eight-person project was scheduled for a two-year term. The project was planned for half a year and, after submitted, had eventually won support from the government. However, they did not take this funding, as in the meantime, they realized that open source products had evolved, and they could develop the solution with fewer people at a lower cost.

Implementation

Compared to the funding application, a smaller project was implemented. Colleagues in the field who supported client operations were involved in working on the development through this time.

Responsibilities

ITSH manages a couple of expert teams who operate on sub-platforms and provide developers with this capability. This capacity was dedicated to the development project together with a professional project manager.

Results, effects, and lessons learned

It was not a classic cloud-based solution; however, it was primarily built on it. The novelty of the project was the creation of a cloud-based database that had not been previously used in this field. The result was particularly innovative in two areas: on the one hand, in the integrity of the constituents, and on the other, in data mining.
It is used in the Cassandra database, developed in a pilot big data project to capture the world-renowned game Sea Hero Quest by a start-up company they have acquired. Millions of users played this globally, and many petabytes of data were collected in just a few days. This data were all stored in the Cassandra database, which was not easy to manage, but also tested the scalability of the platform. Finally, they needed external developers to extract the information stored in the database.

Project 3: Cyber Threat Intelligence Project

Motives and planning

One of their customers requested to be notified of expected cybersecurity threats as a form of clandestine activity. The customer requested an information monitoring service that would send a weekly report of potential risks that could be shared within the company.

Implementation

Internal resources were collected for development. Several service levels have been defined. On the first level, they observe the world, see what is going on, what is in the news, what useful information emerges. It is challenging to determine where to look for information. For instance, hackers frequently announce planned attacks on social media to gain a reputation. Organizing and visualizing social media pages, forums, and other platforms proved to be a complicated task to solve. On the second level,

they analyze content that is relevant to the company in this flow of data and information; and filter out what may be relevant for them concerning their vulnerabilities. This also depends on the customers, the assets, the sector and other factors. The second level is, therefore, a service tailor-made for the customer company. On the third level, they identify potential attackers and prepare for the attacks. Being a company, not an authority, the variety of usable tools is limited due to their lack of privileges.

Responsibilities

The development did not require the involvement of an external supplier, and the company was able to implement it entirely on its own. No additional staff was recruited for this project. As cyber threat monitoring is a new area, it is easy to find interested people to participate in the project. It was a challenging, yet essential task to balance the rate of day-to-day work and project tasks for internal employees

Results, effects, and lessons learned

The project has been running for one and a half years but has not yet been completed. Developments are ongoing and the potential customer base is also growing.

They have developed a unique cybersecurity monitoring activity into a stand-alone service that sends daily reports to the clientele on relevant security topics (e.g., security news, attacks on the IT systems they use). For the time being, this information is sent to the customer via email rather than through a dashboard interface. The future goal of the project is to eventually create a complete dashboard through which potential plans on attacks can be narrowed and tracked. This is important because by knowing the country from which the attack may come from is "easier to filter out potential attackers from network noise."

As a result of the service, it is possible to monitor groups of hackers (for example, on the dark web), and to infiltrate their ranks. They can set up a trap ("a honey pot") to learn from controlled attack situations.

The development did not cause high costs. Although the buyer paid for the deliverables of the project, the most significant benefit was that it improved the quality of their other services and improved their goodwill.

5. Conclusions

ITSH ensured an exciting case study to get a deeper insight into the real issues at a market-leader technology company. The analysed 4.0 projects revealed that not only knowledge and skill are necessary for successful implementations but favouring innovative environment, human resource and financial resources dedicated by top management, etc.

The company runs in the ITC market, so the utilization and application of various new digital technologies are constantly in focus. In many areas, the company develops its state-of-art solutions for external customers. Most internal efficiency improving developments turn into external products as well if successful.

The management of the company is aware of and preparing for the disruptive impact of 4.0 technology. Since ITSH is Hungary's largest business service centre, they have excellent capabilities in a wide range of areas. They rely not only on internal resources but also on leveraging the company's supply chain position and developing knowledge and technology in the broader network of T-Systems and Deutsche Telekom.

The company is proud of its innovative and agile organizational culture and approach that creates a vital basis for developments. They successfully operate an internal innovation fund to discover, realize and market new ideas. Employees are also rewarded with prizes and rewards for new improvements. At the beginning of a project, the employees need to realize an idea with extra work, but if the idea became successful and got support, the company will already ensure dedicated resources. In the case of technology development, they are always working to create a product with the highest added value, either entirely by their development or by combining with open source products. The company allocates the workforce to the developments, either from the start of the development or from the approval of the internal support system.

ITSH uses an open-innovative approach. Initiatives usually come from a variety of directions: clients, university partners, and in-house staff. Many times, they improve their internal processes to reach operational excellence but usually do not stop here. The ultimate goal is always to create a higher value-added product or service through development that could sell for external clients as well. They successfully operate not only research and development but also the innovation phase.

Acknowledgments

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The possibilities of electric vehicles nowadays

Áron Drabancz

Global warming is one of the biggest problems in the world: international organizations, states, companies and individuals must respond to the challenges that arise. This fact has led to significant changes in the automotive industry, which can revolutionize the way the industry operates in the future. The aim of my study is to examine how the strengthening of sustainability aspects influenced the transformation of the automotive industry, with special regard to the spread of electric cars. I also examined how markets responded to technological change, thus the announcements that help drive the spread of electric cars have had a positive impact on the value of companies in recent years. With the help of event analysis, I have shown that equities had systematically outperformed after innovative announcements, but the effect was not always significant.

Keywords: electric vehicle, event analysis, innovation

> *„Failure is only the opportunity more intelligently to begin again."*
> *Henry Ford*

1. Introduction

The development of the automotive industry began during the Second Industrial Revolution (1871–1914). The appearance of the engine and the mechanical improvements made it possible to replace the horse-drawn vehicles. In the early stages of the automotive industry, electric cars were dominant compared to steam and gasoline cars, as they started faster and were easier to handle (Bobák 2013). This is well illustrated by the fact that electric vehicles accounted for 38% of traffic in the United States at the end of the 19th century. However, at the beginning of the 20th century there were significant changes in the production of gasoline vehicles: In 1912, Charles Kettering invented the electric starter motor, which made it easier to start gasoline vehicles, and then the Henry Ford's conveyor belt made the production of gasoline cars considerably cheaper and faster. As a result of technological advancements, Ford Model T has become the most popular car brand. Electric cars have been pushed out of the car market due to their high cost and short range, and for almost 100 years, cars powered by internal combustion engines have only been truly competitive in the market. By the end of the 20th century, however, the issue of global climate change was becoming more prominent, calling into question the continued legitimacy of petrol vehicles. There is a growing social demand for more environmentally friendly car production: hybrid, electric or hydrogen powered vehicles have been appearing on the market. In many countries, environmental movements have been organized to bring about radical changes in reducing car emissions. As a result, developed countries have begun to reduce environmental

damage by facilitating the proliferation of electric cars through incentives (e.g. tax burden relief, bus lane use) and legislation (e.g. mandatory reduction of average CO2 emissions from car fleets).

According to Bullard (2019), the initiatives have largely been successful, as by 2022 the price of electric cars may be below the cost of petrol or diesel powered vehicles. The pace of technological change is shown by the variable estimation of crossover point – when electric vehicles become cheaper than their combustion-engine equivalents – which was 2026 in 2017 and 2024 in 2018. Thus, a new "renaissance" of electric cars may begin in the near future.

In my paper, I will use the event analysis methodology to examine how the market has judged electromobility and how it has rewarded innovative announcements by individual firms. In my hypothesis, companies that have been more intensively involved in the development of cars with renewable energy sources have outperformed the market. In other words, investors in the automotive industry have supported companies that have been at the forefront of developing electric motor vehicles.

In the next chapter of my paper, I present the most important alternative propulsion technologies and the current major limitations of electric motoring. Then, in Chapter 3, I will conduct an event analysis among the largest automotive companies and show that the companies that laid the foundation for the new industry structure performed better or worse than the market. In the final section of the paper, I deal with the evaluation of the results and describe the most important conclusions.

2. Green mobility

In addition to improving the efficiency of conventional engines, automotive manufacturers are basically developing either electric or hydrogen powered cars. The hybrid vehicles are also important, which have both conventional and electric motors, and significant market shares. This technical solution combines the benefits of petrol and electric cars.

A *hybrid car* that can be powered by both electric power and an internal combustion engine is considered to be a mixture of an electric car and a gasoline powered vehicle. The electric motor is really efficient at low speeds, the internal combustion engine at higher speeds. Thus, in slow city traffic or traffic jams, the lower-powered electric drive is used, while on the highway the internal combustion engine runs. In some hybrid cars, the electric motor provides only the extra power needed for acceleration, and the car cannot be driven by a pure electric motor. The hybrid car thus combines the benefits of electric and gasoline drive. This may be the reason for its relatively high penetration: since 2007, 2% of cars sold in the United States have been linked to hybrid technology (Voelcker 2017). However, in most of the cars sold, the electric motor only serves as an auxiliary function to the internal combustion engine, hybrids with more powerful electric motors (*plug-in hybrids*) accounting for only 0.42% of US car sales (own calculation based on IEA (2017) data). Hybrid cars could become very popular in the future if the electric car catches up with competitiveness but does not outperform conventional cars. Thus, the synergy resulting from the combination of two different technologies could make the hybrid car the most widespread vehicle.

The *hydrogen car* is the least common of the "green" cars. This is due to the immaturity of the technology and the high cost of production. The operation of the hydrogen car is based on the reversing of electrolysis: in the fuel cell, hydrogen combines with oxygen and generated electricity drives the car. One of the challenges facing hydrogen cars is that explosions are serious problem, as fuel cells have to deal with one of the most dangerous, most flammable materials, hydrogen. Nowadays, it is still very expensive for car manufacturers to ensure that hydrogen in fuel cells does not explode under any circumstances. That's why this technology first appeared on buses, since the cost and consumption of the bus can give a relatively fast return on the investment. Hydrogen propulsion is therefore particularly effective for large vehicles that need to travel long distances every day (CAFCP 2012).

The technology has continued to evolve in recent years, with only 0.5kW of energy being released per cubic decimeter in 1999, compared with 2.5kW in 2012. In addition, the latest fuel cells can operate in colder environments. Previously they were not safe below 0°C and today they are even operating at –30°C (Greene 2013, p. 6–7). However, many companies believe that the technology is unlikely to be competitive by 2025, and significant cost reductions are unlikely until then (Greene 2013, p. 17, HydrogenEurope 2018, p. 40). The immature nature of the technology is well illustrated by the fact that there were only 376 hydrogen refuelling stations in the world in 2018, compared to more than 500,000 electric charging stations, of which more than 140,000 were fast chargers (IEA 2019a, IEA 2019b). However, in the long run, hydrogen cars can become a viable alternative. The main reason is that their charging time is short, only 5 minutes. On the other hand, with a quick charger, it takes at least 25–45 minutes to charge an electric car. As a result, 78% of senior executives in the automotive industry believe that hydrogen cars can be a real alternative to petrol and diesel powered vehicles (KPMG 2017, p. 14).

Battery-powered *electric cars* are well-known to consumers, especially through Tesla's activities. These vehicles are particularly popular in Norway, thanks to particular generous discounts: in 2017, 39% of cars sold were pure electric (Knudsen–Doyle 2018). Such cars have a relatively high worldwide penetration rate, in 2016, 0.68% of car sales were attributable to electric cars (own calculation based on IEA 2017 data). In 2010 it was only around 0.01%, but between 2010 and 2016, electric car sales increased by an average of 104% per year. If the trend continues, assuming a 5% annual increase in car sales, electric cars could become the market leader within 10 to 15 years. However, the widespread adoption of new technology today is set back by three factors (PwC 2014, p. 14):

1. Relatively low number of charging stations and length of charging time.
2. Short range of cars (150–200 km).
3. The high price of cars.

In the following chapters, I will explain in detail the factors influencing the radical diffusion of new technology, and examine how car manufacturers have helped break down barriers and contributed to the transformation of the automotive industry.

2.1. Charging stations

Increasing the number of charging stations is a key factor in increasing the penetration of electric cars (IEA 2019b). The vast majority of motorists are only willing to replace their internal combustion car if their mobility is not reduced when using an electric car. In recent years, fast and slow charging network coverage has increased tremendously (*Table 1*), exceeding the growth rate of electric car sales (IEA 2019b, p. 218).

Slow chargers can charge a significant amount of discharged batteries in about 8–10 hours, while for fast chargers it is 25 to 45 minutes. Slow chargers are therefore most often used in the car owner's home. The owner puts his own slow charger on his car every night so he can start working the next day with fully charged batteries.

Table 1 The number of publicly accessible slow and fast chargers in the United States and World

	World		United States of America	
	Fast chargers	Slow chargers	Fast chargers	Slow chargers
2009	47	373	47	373
2010	372	3 682	60	482
2011	1 356	11 311	489	3 903
2012	3 332	29 620	1 464	11 695
2013	5 044	43 932	1 877	14 990
2014	16 762	90 859	2 518	20 115
2015	26 784	156 072	3 524	28 150
2016	73 851	257 518	3 079	35 089
2017	107 650	325 598	3 436	39 601
2018	143 502	395 107	4 242	50 258

Source: own construction based on IEA (2019b) data

The fast charging network has been set up that the car owner can reach more distant destinations, so its coverage can be a decisive factor for electric cars. If the coverage of the fast charging network in the United States were even, these chargers would be approximately 48 kilometers apart today (own calculation based on IEA 2019b). However, fast chargers of the automakers are not always compatible, so presumably the country coverage is still incomplete. However, given the population density and distribution of the federal states, it can be stated that in major cities and on the motorways connecting larger cities, the charging network is now close to dense not to cause inconvenience to consumers. Tesla's Supercharger network have well built in the United States, Western Europe, Eastern China and Japan. The filling network makes it possible to reach any of the major cities in Western Europe today, so you can easily go from Narvik to Calabria or Lisbon to Budapest by Tesla car (Supercharge.info 2020). The expansion of the charging network in the future will make it possible to reach smaller towns and then rural settlements safely. The main obstacle to the spread of electric cars lies in the slow charge time. Unlike petrol and diesel vehicles few minutes of charging time, it takes at least half an hour to charge electric vehicles on the high-speed network. However, the new ultra-fast chargers could charge car batteries in 15 minutes (REW 2019). With this development, one of the biggest obstacles to the proliferation of electric cars would be overcome.

2.2. Range

The shorter range of electric cars is still a deterrent for consumers. Industry analysts say there is a *„range anxiety"* phenomenon, which puts a strong constraint on consumers purchasing a vehicle if they think that the range of the vehicle is not sufficient for daily use. According to international experts, the minimum distance that can be covered by pure electric vehicles is at least 200–300 kilometers in order to grow the electric market substantially (PwC 2014, p. 15). A study by Figenbaum–Kolbenstvedt (2016) confirms this, because 40% of Norwegian electric car owners saying that cars need a range of at least 200 kilometers to get more people interested in electric motoring. However, only more than 20% of traditional car owners believe that such a range is sufficient. At over 300 kilometers, there is a majority in both groups who believe electric cars would be competitive for society. At a distance of 500 kilometers, the ratio was close to 100% for electric car users and almost 90% for traditional car owners (Figenbaum–Kolbenstvedt 2016, p. 77).

Predictions indicate that a 300 km range will be available in most models in the near future. A good example of the increase in range is the Nissan Leaf: the model launched in 2011 and later it was upgraded and the range of the 2016 Nissan Leaf was nearly 50% bigger than the original version (Figenbaum–Kolbenstvedt 2016, p. 62). Norwegian electric car users estimate that today's models can travel up to 100–150 kilometers on a single charge. The owners of the Tesla Model S have stated that their car has already crossed this psychological limit and is able to cover at least 300 kilometers on a single charge (Figenbaum–Kolbenstvedt 2016, p. 61).

However, practical examples show that the range of 200-300 kilometers is just a psychological limit, and in most cases consumers do not take advantage of their car. The Norwegian survey looked at the car usage patterns of owners of electric cars and conventional cars. They found that conventional car users drove an average day of 50 kilometers and electric car users drove an average day of 66 kilometers, so average distance did not reduce by the use of an electric car. These values are well below the 200 kilometers, with less than 5% of car owners using their car for distances greater than 200 kilometers (Figenbaum–Kolbenstvedt 2016, p. 44). Although the rarer longer roads are still clearly a problem for electric car owners, the range of today's models in urban transport is satisfactory. The range of future models, together with the development of the fast charging network, can help to bridge the mobility gap between conventional and electric cars.

2.3. Pricing

The last barrier to the proliferation of electric cars is that they are still relatively expensive for middle class. New technology products are usually available at relatively high prices and low added value at the start of their life cycle. Some customers choose a new product based on their individual, specific preferences, which is too expensive and low value for the rational consumer:

1. high price – low value
2. medium price – average value
3. low price – high value

The electric car has been in the 1. segment for a long time because of the high price of the product, coupled with the lack of charging stations and short range, which has limited customer mobility compared to users of conventional cars. However, environmentally conscious buyers and state tax breaks have helped to develop technology, which has lowered prices and led to new customers. As a result of increasing economies of scale and technological advances, the price of batteries, the main cost factor for electric cars, has declined significantly in recent years. Cost reductions have surpassed industry expectations: Analysis expected lithium-ion batteries would cost $200 per kilowatt-hour by 2020 and $160 per kilowatt-hour by 2025 (McKinsey 2012). However, the average price of lithium-ion batteries in 2017 has barely exceeded $200 per kilowatt hour, and, in 2019, it was under $160 per kilowatt hour (Figure 1, Holland 2019). As a result of the cost reductions, medium-sized electric cars have also appeared, which can further expand the number of consumers. In America, in 2015, the average selling price of new cars was $34,500 with tax breaks, however, you can buy nearly a dozen electric cars at this price nowadays. The GM Bolt or Tesla Model 3 electric car, is already approaching the "people's car" category in the United States, starting at less than $30,000, with a range of almost 400 kilometers on a single charge (Szandányi 2016, Portfolio 2017). Thus, the higher price associated with electric cars will gradually disappear, and in the future electric cars may become real competitors of conventional cars.

Figure 1 The price of lithium-ion batteries in kilowatt hour from 2010 to 2019
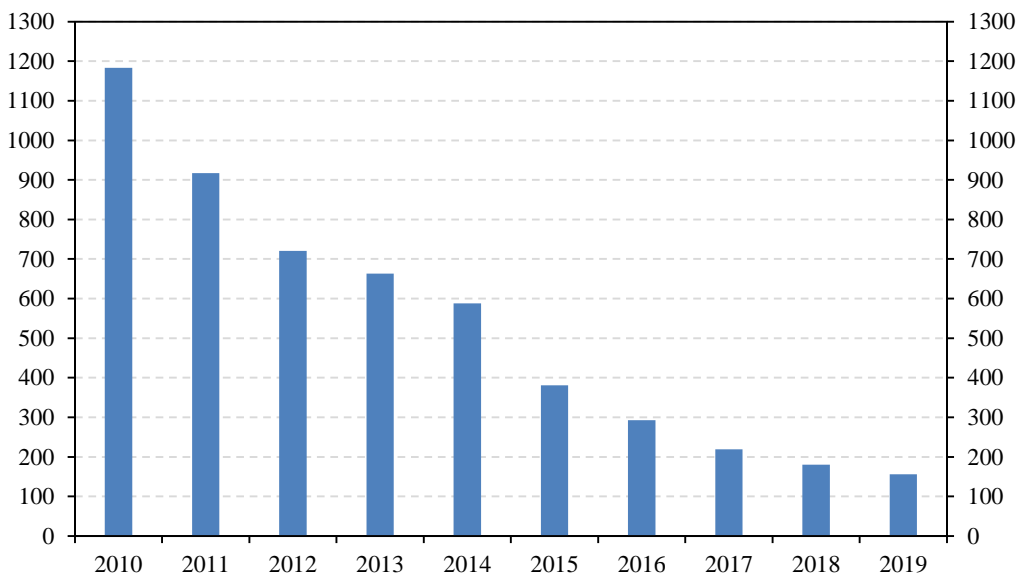
Source: Holland (2019) based on Bloomberg NEF data

3. Event analysis

In this section, I examine the impact of announcements on electric cars on the stock market. I analyze the performance of Toyota, General Motors, Ford and Tesla between November 19, 2011 and January 31, 2018.[1] My aim is to demonstrate through the event analysis methodology that innovative initiatives have been market-favored, resulting in positive abnormal returns on the shares of reporting companies.

I chose General Motors, Ford and Toyota because they are significant players, their share of production is 25.8% (own calculation based on OICA 2016). Toyota produced the most cars in 2016, GM the fourth and Ford the fifth (OICA 2016). Tesla's market share is so far negligible, but it has a unique ability and reputation for innovation in the electric motor industry, and its market capitalization is significant. Furthermore, shares of all four automakers are traded on NASDAQ or the New York Stock Exchange, which have the same trading hours.[2] As a result, the price data of the four companies is consistent over time, and external news is always integrated into the price of their shares at the same time. This allows us to measure unique effects with the help of event analysis. In this section, I examine the innovative, electric car related announcements of the four automotive manufacturers. The exception is the announcement of the Volkswagen scandal, which is not closely related to any company, but has had a significant impact on the industry.

The essence of event analysis is that asset prices contain all public information, so new relevant news must have an immediate price effect (Campbell et al. 1997). The model states that the return of a share is based on the market return (Fama et al. 1969):

$$R_{i,t}^* = \alpha_i + \beta_i R_{m,t} \qquad\qquad 3.1.$$

where α_i and β_i are estimated parameters from the regression, $R_{m,t}$ is the market return, $R_{i,t}^*$ is the estimated return on the share. The difference between the estimated return of a share ($R_{i,t}^*$) and the actual realized return ($R_{i,t}$) is called an abnormal return:

$$\varepsilon_{i,t} = R_{i,t} - R_{i,t}^* \qquad\qquad 3.2.$$

In most cases, the value of abnormal returns is not zero, as there are many factors that influence the share price. The significance of these can be examined in the framework of the APT model, characteristic factors could be (Ross 1976):

1. *Industry effects*: state regulation; changes in consumer preferences; appearance of new competitors, etc.
2. *Company Announcements:* change in profitability; change of strategic direction; acquisitions, etc.
3. *Trading processes:* buying or selling shares of large investors; closing positions; market microstructure, etc.

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[1] As of November 19, 2011, share prices for all four car manufacturers are available. Download date: 02.02.2018.
[2] The second (Volkswagen) and third (Hyundai) most car makers company did not have data on US trading values at Yahoo Finance (2018), so I could not include them in my analysis.

Estimating the market and share price characteristics from past data and incorporating it into the model's analytical framework (see model in detail in *Appendix*) determines whether the event had a significant effect on the share price, significant abnormal returns were appeared or not.[3] Therefore, the presence of a significant abnormal return indicates that the value of the company was significantly affected by the event. According to my hypothesis, in the case of a positive announcement concerning electric cars, I expect a positive abnormal return.

During the analysis, I used the S&P500 index, which consists of the largest companies on the NASDAQ and the New York Stock Exchange, so it provide a good overview of market trends. I always calibrated the parameters of the model based on the daily return data of one year (252 trading day) preceding the event (Yahoo Finance 2018). The length of the event window is always 6 days, so I compared the estimated returns of nearly a week after the event with the actual realized returns. I accumulated the abnormal yields for each day and examined whether the abnormal yields were significantly different from zero.

3.1. Volkswagen scandal

In this section, I examine the impact of the Volkswagen scandal that erupted in the morning of September 18, 2015 on Tesla's and on the other three car makers' share prices. I wonder if the news resulted in a significant abnormal return.

Manufacturer of petrol and diesel powered vehicles have been hit hardest by the news, since the scandal has put the automotive companies' emissions reduction requirements on target. Then, numerous investigations were launched to assess whether other car manufacturers had manipulated their consumption data. As a result of the scandal, consumer demand for alternative fuel cars has increased. So, according to my hypothesis, Tesla had a positive abnormal return while the other three car makers had a negative abnormal return.

Calculation results for the scandal are shown in *Table 2*. Results are not significant at either 1% or 5%, although it can be stated that after the outbreak of the scandal, Tesla reached positive cumulative abnormal returns at each time point, while the other three car makers showed negative cumulative abnormal returns, so after the scandal, Tesla outperformed its competitors.

The lack of significance may be due to the longer-lasting nature of the Volkswagen scandal. When the case came out, on September 18, 2015, it was only known that Volkswagen had cheated in measuring car emissions, so it had to withdraw 482,000 cars from its customers. It was later discovered that up to 11 million cars could be affected, most of which had to be recalled later. Furthermore, it was only at the end of the autumn when emissions investigations for the entire automotive industry began (Kollewe 2015).

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[3] An abnormal return with a p-value of less than 1% is considered significant.

Table 2 Cumulative Abnormal Returns (CARs) for Tesla and the three major automakers, and the associated p-values during the Volkswagen scandal

	Tesla		Toyota		Ford		GM	
	CAR	p–érték	CAR	p–érték	CAR	p–érték	CAR	p–érték
09.18.2015	1,58%	23,01%	–0,57%	31,99%	–0,53%	31,95%	–0,86%	24,83%
09.21.2015	2,31%	22,15%	–0,64%	35,55%	–0,69%	33,31%	–0,97%	29,26%
09.22.2015	2,70%	23,36%	–1,63%	22,10%	–2,21%	13,00%	–1,60%	23,21%
09.23.2015	2,99%	24,30%	–1,86%	22,41%	–3,70%	5,15%	–2,41%	17,00%
09.24.2015	4,20%	19,13%	–1,53%	28,87%	–3,55%	8,09%	–3,00%	14,50%
09.25.2015	1,87%	36,12%	–0,03%	49,62%	–4,36%	5,89%	–3,04%	16,35%

Source: own calculations based on Yahoo Finance (2018)

3.2. Company announcements

The three major automobile manufacturers and Tesla with numerous announcements have reinforced the notion that a radical change in the automotive industry could take place in the near future. After the Volkswagen scandal, this commitment was further strengthened. GM and Ford announced on October 2, 2017 that they will launch about 20 new electric vehicles by 2023 (Walz 2017). Toyota announced on December 18, 2017 that it will launch 10 hybrid cars in the early 2020s and intend to produce electric or hybrid vehicles throughout the supply chain by 2025. Its target is to sell 5.5 million electric vehicles in 2030, which 53.4% of its current production (own calculation based on OICA 2016, Lambert 2017).

Table 3 Cumulative Abnormal Returns (CAR) for Tesla and Toyota, Ford, and GM, and related p-values after demonstrating Ford and GM's electrical strategy

	Tesla		Toyota		Ford		GM	
	CAR	p–érték	CAR	p–érték	CAR	p–érték	CAR	p–érték
10.02.2017	–0,53%	40,19%	–0,58%	22,91%	0,56%	30,18%	3,86%	0,19%
10.03.2017	0,97%	37,36%	–0,07%	47,46%	2,40%	5,81%	6,63%	0,02%
10.04.2017	2,63%	23,88%	0,98%	23,65%	1,97%	14,63%	7,19%	0,10%
10.05.2017	1,84%	33,44%	0,71%	32,67%	0,90%	33,98%	6,60%	0,68%
10.06.2017	2,26%	31,90%	1,47%	20,31%	1,58%	25,82%	9,15%	0,11%
10.09.2017	–1,56%	38,34%	1,70%	19,14%	2,10%	21,50%	10,22%	0,10%

Source: own calculations based on Yahoo Finance (2018)

Table 4 Cumulative Abnormal Returns (CARs) for Tesla and Toyota, Ford and GM, and related p-values after demonstrating Toyota's electrical strategy

	Tesla		Toyota		Ford		GM	
	CAR	p–érték	CAR	p–érték	CAR	p–érték	CAR	p–érték
12.18.2017	−2,20%	15,55%	1,93%	0,30%	0,03%	48,81%	2,27%	3,14%
12.19.2017	−4,22%	8,48%	2,58%	0,48%	0,72%	30,79%	3,49%	2,13%
12.20.2017	−4,90%	9,66%	3,01%	0,68%	1,11%	26,36%	3,68%	4,07%
12.21.2017	−4,51%	15,05%	3,14%	1,30%	0,22%	45,76%	2,59%	14,37%
12.22.2017	−6,55%	9,00%	3,08%	2,55%	−0,07%	48,83%	2,33%	19,65%
12.26.2017	−9,00%	4,69%	3,04%	3,93%	0,28%	45,59%	1,59%	25,71%

Source: own calculations based on Yahoo Finance (2018)

As a result of the "green" announcements, there is a positive abnormal return on car manufacturers' returns (*Table 3* and *Table 4*). In the case of GM, the cumulative abnormal returns reported from October 2 till the end of the event window were also significant in every day. However, the results cannot be clearly interpreted, as GM also outlined the advanced development of self-driving vehicles, which may have had an impact on asset prices (Walz 2017). In the case of Ford, the plans outlined seemed more conservative – they did not increase the funding for developing electric cars, no information was provided on the planned number of electric cars - which may explain the company's lack of significant abnormal returns. As a result of Toyota's announcement, the company achieved positive abnormal returns throughout the next six days, which proved to be significant in the first three days.

Examining corporate announcements, it is not clear that electric and alternative propulsion developments have a positive impact on share prices. Although the above examples showed positive abnormal returns, in most cases, they were not significant. Then, I examined the significance of the estimated abnormal yield for each trading day. In connection with this, it can be basically stated that the clear presence of significant abnormal returns is mostly related to traditional announcements (e.g. change in profitability, change in dividend policy).

Thus, my hypothesis could not be proved. The direction of the abnormal yield associated with innovative announcements is the same as I have assumed, but it is usually not significant. This may indicate that the market rewards initiatives to transform the automotive industry, however, the speed of the transformation of the automotive industry and its precise picture are not yet clear to investors.

4. Conclusion

In this study, I examined the transformation of the automotive industry, with special regard to the potential of electric driving. In Chapter 2 of the study, I showed the new technologies and analyzed in detail the main limitations associated with electric motoring. In Chapter 3, I investigated the Volkswagen scandal and innovative electric car announcements on the stock market with the help of event analysis methodology.

The hypothesis of my research could not be clearly proved. However, the analysis showed that at the event of Volkswagen scandal and other innovative announcements, the manufacturers which committed themselves developing alternative technologies outperforming the market. Although, in most cases, the cumulative abnormal returns were not significant, and recent years' significant abnormal returns were mainly attributable to traditional reporting. Overall, it is not clear that the market already favors companies actively developing this technology. In addition, one of the limitations of the research is that the electromobility are a quick changing emerging technology, so since the analysis of the 2018 stock market data, market events have been able to shape market conditions even further. Due to the complex transformation of the automotive industry, the future role of electric cars may not be fully defined today, but technology is likely to play an increasingly important role in our everyday lives.

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Appendix

Calculation of abnormal return

The structure of the model is based on the study of Campbell–Lo–Mackinlay (1997).

Let R_t be the $(N * 1)$ vector, which contains the returns of assets for t period. Suppose that returns are independent distributions of normal probability variables with μ mean and Ω covariance matrix for each t!

If the event was reported after the close of trading on the stock exchange:

- Let $\tau^*=T_1$ be the time when the time occured, $\tau_1=T_1+1$ and $\tau_2=T_2$ the event window, and $\tau_3=T_0+1$ and $\tau_4=T_1$ the length of the estimation window.

On the other hand, if the event was reported during stock exchange trading:

- Let $\tau^*=0$ be the time when the time occured, $\tau_1=T_1$ and $\tau_2=T_2-1$ the event window, and $\tau_3=T_0$ and $\tau_4=T_1-1$ the length of the estimation window.

Figure 2 Schedule of the model when the event was reported after the close of trading on the stock exchange
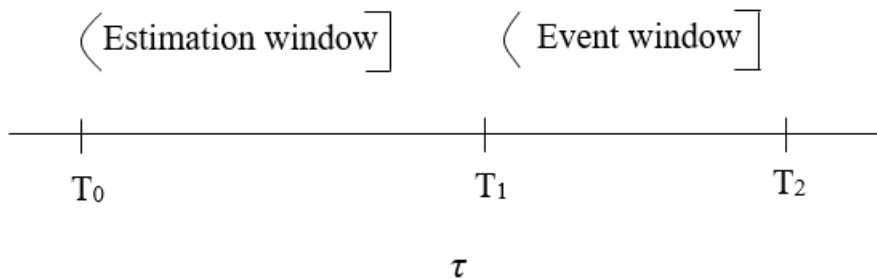
Source: own construction bases on Campbell et al. (1997)

Let there be a linear relationship between market and equity return:

$$R_{i,t}^* = \alpha_i + \beta_i R_{m,t} \qquad 3.1.$$

where $R_{m,t}$ is the market return, $R_{i,t}^*$ is the vector containing the estimated returns on share, while α_i and β_i are estimated from OLS regression based on the datas of the estimation window. The difference between the estimated return of a share

$(R_{i,t}^*)$ and the actual realized return $(R_{i,t})$ is the abnormal return, which is normally distributed:

$$\varepsilon_{i,t} = R_{i,t} - R_{i,t}^* \qquad\qquad 3.2.$$

$$E[\varepsilon_{i,t}] = 0 \qquad Var[\varepsilon_{i,t}] = \sigma_{\varepsilon_i}^2 \qquad\qquad 3.3.$$

where $\sigma_{\varepsilon_i}^2$ is the estimated parameter of the model based on the datas of estimation window (lásd: Campbell et al. 1997, p. 158). Based on the estimated regression parameters (α_i, β_i), and the realized ex-ante market return, the abnormal yield can be calculated from Equation 3.2.. Based on the estimation period, the expected value of the abnormal return (μ=0) and the conditional variance matrix (V_i) can be calculated (Campbell et al. 1997, p. 159). The one-day abnormal return thus has the distribution $\varepsilon_{i,t} \sim N(0, V_i)$ and the cumulative abnormal return follows the following distribution:

$$\widehat{CAR}_i(\tau_1, \tau_2) \sim N(0, \sigma_i^2(\tau_1, \tau_2)) \qquad\qquad 3.4.$$

To standardize the cumulative abnormal return:

$$\widehat{SCAR}_i(\tau_1, \tau_2) \sim \frac{\widehat{CAR}_i(\tau_1,\tau_2)}{\sigma_i^2(\tau_1,\tau_2)} \qquad\qquad 3.5.$$

The result obtained follows Student's t-distribution with degree of freedom τ_4-τ_3-1 (Campbell et al. 1997, p. 161). The model assumes that a new event does not affect the share prices during the event window, so events are not clustered.

Facing urban challenges – Tungsram smart city action plan

Mihály Lados – Ferenc Pongrácz

Closed to three-quarters of Europeans live in cities today, and by the growth of the population worldwide, this ratio is ever increasing. The accelerated speed of urbanization poses unprecedented challenges on people, cities, and the environment. Sustainability became a key global objective since Rio via Tokyo until Paris Agreement. The United Nations prepared an agenda for a better and more sustainable future for all. The 17 Goals are related to global challenges such as climate change, poverty, and the effects of urbanization. Over the last decade, various Smart City approaches have emerged among the government, non-profit sectors, and industries to use Information and Communication Technology as a tool to manage these challenges and to improve the quality of life for their citizens. At the same time, Industry 4.0, the digitalization of industries, has diffused across the world, setting the scene for a new stage of innovation yet keeping the competitiveness of business players.

Tungsram, a multinational corporation headquartered in Hungary, has refocused its mission and stood up to expand its product portfolio by including Smart City solutions. Tungsram Edge focuses on three major Smart City offerings: indoor farming, efficient buildings, and Smart Solutions. Indoor farming (AgriTech), a science-based approach to agriculture, uses the latest research to establish precision indoor farming facilities. Efficient buildings (PropTech) has come to life to support the universal goal of reducing cities' ecological footprint. Each smart solution has a direct or indirect effect on several objectives of the Sustainable Development Goals of the United Nations.

The first part of the paper identifies the key contemporary challenges of cities and industries and the evolution and links of Smart City and Industry 4.0 approaches. The second part of the paper is a case study of a multinational company headquartered in Hungary entering into these processes by building a Smart City Action Plan and by developing key smart products (Smart City portfolio) to react to and to provide solutions for urban challenges.

Keywords: Sustainability, Smart City, Industry 4.0, Tungsram

1. Introduction

By the latest estimation of the *United Nations* (UN) the world population reaches 10 billion until 2100 (UN 2019b). Distribution of population by continents has changed over time. In the forthcoming decades 80% of the future global population growth is expected in Africa (Figure 1). While the continent has approximately 1.3 billion inhabitants today, this number is expected to grow to 4.3 Billion by the end of the century. According to the forecast of the UN meanwhile the 750 million population of Europe in 2020 will decline by 100 million by 2100. The relative weight of our continent in this respect is seriously declining: While in 1950 22% and in 2020 closed to 10% (CSO 2020) of the population of the Earth lived in Europe, this proportion will below 6% in 80 years from now (UN 2019c).

Figure 1 Global population by continents, 1950–2100
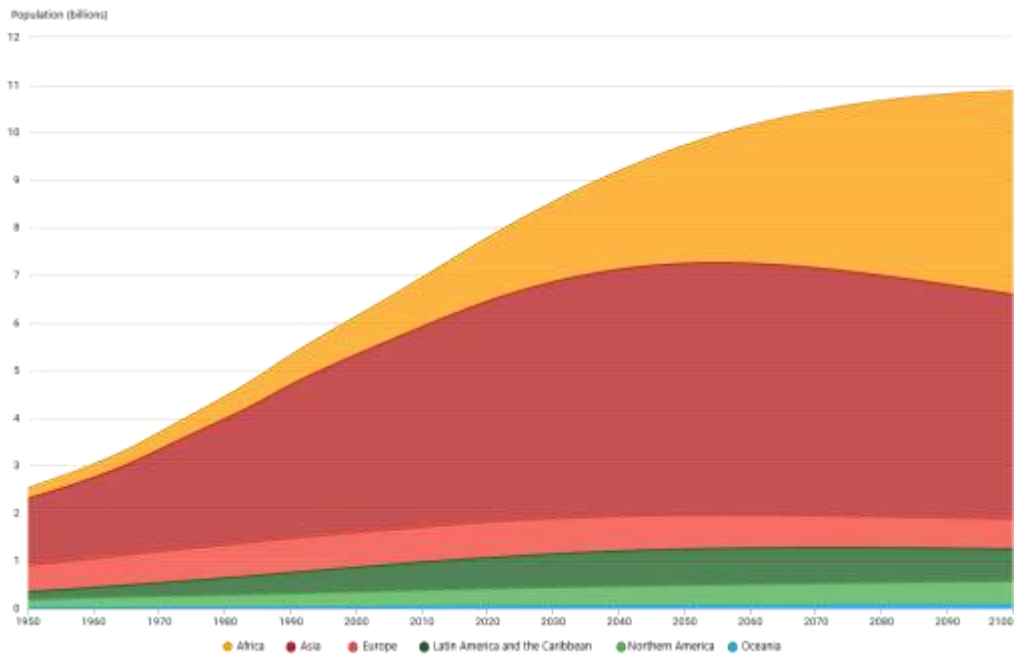
Source: based on CSO (2020)

In 2010, the first time in history, there were more people living in cities than in rural areas (UN 2014). About half of all city dwellers live in cities with a population of less than 500,000 inhabitants, while every 8th person lives in one of the 33 megacities that have a population of over 10 million inhabitants (UN 2019a). This trend keeps continuing: less and less people choose to live in rural areas and the growth of the planet's population is increasing the inhabitants of the existing cities and megacities.

This accelerated increase poses unprecedented challenges we are all facing in the world, but it particularly affects cities, where all the environmental, societal, and economic challenges are being concentrated. These challenges can no longer be tackled with traditional methods that once used to offer one-size-fit-all solutions: we need to pull in the new *Information and Communication Technologies* (ICTs) and all the innovative management methodologies in order to keep up, and not only to keep up, but to proactively anticipate the future challenges and solve them before they present themselves. *One of the fast growing approach to handle these challenges is Smart City concept in all over the world.*

In our paper, we investigate what aspects of the global challenges a Hungarian multinational company, Tungsram has determined to tackle, that has transformed itself from a traditional lighting manufacturer into an innovative and smart company by establishing a remarkable smart city product portfolio; and how they address the UN's Sustainable Development Goals (SDGs) that are an integral part of the everyday operations of the corporation.

In the first part of our study, we are going to review the contemporary challenges that cities and industries are facing. In the second part we are going to address why Smart City concept is a relevant approach facing contemporary global challenges. Finally, we are going to present Tungsram's Smart City model at its current stage, which aims to tackle some of the most critical challenges that cities are facing.

2. Contemporary Challenges of Cities and Industries

"As the world continues to urbanize, sustainable development challenges will be increasingly concentrated in cities, particularly in the lower-middle-income countries where the pace of urbanization is fastest" (UN 2015a, p. xxi.). Sustainable development challenges primarily drill down to *environmental issues*, which must be addressed in order to be able to slow down, and perhaps, *reverse climate change*. ICTs, while they help economies to grow and cities to prosper, create more challenges just by solving the previous ones: more efficient and livable cities attract more people, which in turn create even more environmental, social, and economic issues to solve; and once solved they – again – become attractive and prompt for another growth curve. (Figure 2) In this chapter, we are going to examine the circularly evolving challenges that drive the need for cities to be smarter.

Figure 2 Relationship between technology development, demographic shifts and sustainability issues
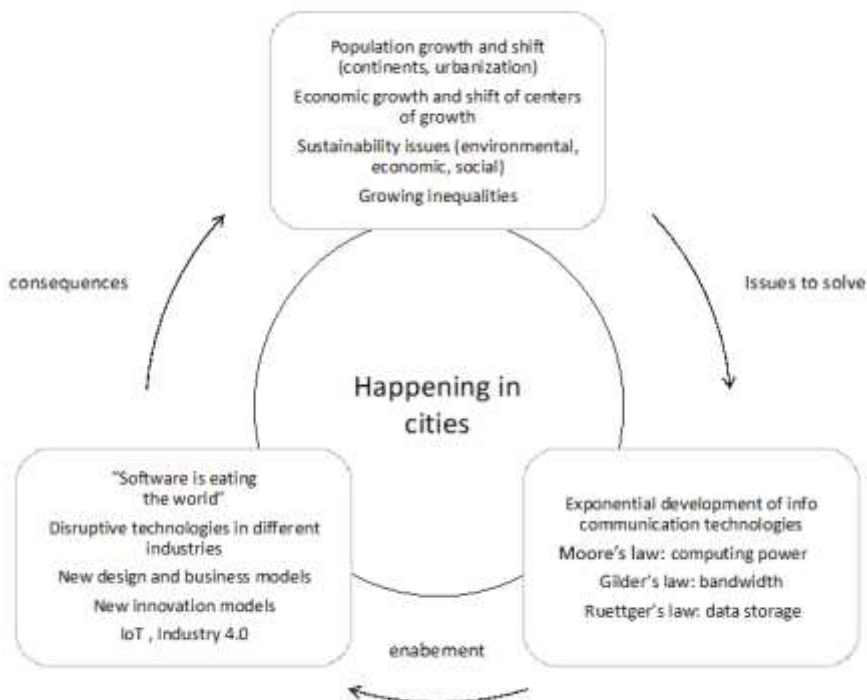
Source: Nick et al. (2018. p. 66)

2.1. Issues to Solve

"People, and thus populations, are at the centre of sustainable development" (UN 2019b, p. iiii) start the authors of the 26th edition of the United Nations *World Population Prospects*. The latest release confirms that the world's population continues to grow, and while it signals a slower growth rate than previously projected, it is still going to increase from the 2019 population of 7.7 billion to 8.5 billion in 2030 and to 9.7 billion in 2050. While in 1950, only 30% of all people lived in cities, today, it is 55%, and by 2050, it is projected to reach 68% (UN 2019a). The relative volume of the urban population varies in all continents; however, the growth is concentrated in cities everywhere in the world.

"As the world continues to urbanize, sustainable development depends increasingly on the successful management of urban growth, especially in low income and lower-middle-income countries where the most rapid urbanization is expected between now and 2050." (UN 2019a, p. xix) Since economic growth is also shifting from urban areas to cities, we need to increasingly focus on managing cities smarter and more efficiently.

The previous 8 Millennium Development Goals (UN 2015b) the UN had set in 2000 more than doubled: for 2030, they addressed 17 sustainable development goals (SDG17) worldwide in 2015 to face global challenges (Figure 3).

Figure 3 Sustainable Development Goals of the United Nations

Source: United Nations (2019, p. 36)

Some of the objectives are relevant in urban environments. Objective 11, *Sustainable Cities and Communities* is specifically linked to cities. The *UN's Economic Commission for Europe* (UNECE) has also published a guide to action plans for cities to become smart and sustainable[1]. This guide derives the goals to be set specifically from the UN's 17 sustainability goals. The 8th goal *Decent Work and Economic Growth*, the 9th goal *Industry, Innovation and Infrastructure*, and the 12th goal *Responsible Consumption and Production* provide guidance directly to the stakeholders of economic actors.

In the empirical part of our paper, we will see *how Tungsram*, despite being a comparatively small company on worldwide scale, *is able to address over half of these sustainable development goals, directly or indirectly*.

2.2. Enablement

The change in demographics and its concentration to cities pose a new level of challenge to the municipalities, governments, and states. Since there has been an exponential development in ICTs, a reasonable amount of these challenges had proven to be improved: public safety and security, traffic congestions, or energy consumption optimization, just to name a few.

Moore's Law (Moore 1965), which states that computer processing power doubles every two years, *Gilder's Law* (Nick et al. 2018), which declares that bandwidth grows at least three times faster than computing power, and *Ruettger's Law* (Tassebehji 2003), which highlights that companies double their storage needs every 12 months, in other words, the info communication infrastructure that they describe makes it possible that growing cities can tap into the technology they need to keep up with the population growth. And while ICTs are all enablers of growth, they lead to the consequences described in the next chapter.

2.3. Consequences

The exponential growth of ICTs leads to *disruptive technologies* in different industries. *Amazon*, *Uber*, or *Airbnb* are all based on new business models and use *Open Innovation 2.0* (Curley 2016) As ICTs are being integrated into the environmental, economic, and social ecosystem of the cities, they solve some of the challenges.

These concepts, as well as the *innovation management approaches and methodologies*[2], such as *disruptive innovation* (Christensen et al. 2015)*, design thinking* (Brown 2008, IDEO 2020, Schoonmaker 2014)*, lean startup* (Liker 2004, Ries 2011, Blank 2013)*, agile project management methodologies* (Morris 1997, Rico 2019, Davies 2018)*, and exponential organizations* (Malone et al. 2014) will play an important role in the case studies described in the empirical section on the Tungsram Smart City Action Plan.

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[1]

https://www.unece.org/fileadmin/DAM/hlm/documents/Publications/Guidelines_for_SSC_City_Action_Plan.pdf

[2] In detail see Pongrácz (2019).

3. Why the Smart City concept?

The megatrends, namely the conflicts of urbanization and environmental sustainability on the one hand, and the exponential advancement of ICTs on the other, led to the development of the Smart City concept. In the introductory chapter, we have outlined why these changes require cities to innovate continuously. *The main drivers of the changes are the expansion of population, the influx of people into cities* (Enyedi 2012), *the growing challenges of environmental sustainability, social inequalities, and the exponential development of ICTs*, which, in some views, provide an opportunity to address these challenges.

3.1. Approaching Smart City

There is a vast number of definitions of smart cities that have been published (Giffinger et al. 2007, Palmisano 2008, Batty 2012, Cavada et al. 2014, Höjer – Wangel 2014, Manville et al. 2014) and analysed (ITU-T 2014, Albino et al. 2015)- They all highlight some of the key aspects of the big picture of the Smart City concept. Such aspects include the use of ICTs, innovation, sustainability, inclusion of community, efficiency, and, for example, transparency. According to the group of researchers led by Giffinger et al. (2007) „*Smart city generally refers to the search and identification of intelligent solutions which allow modern cities to enhance the quality of the services provided to citizens.*" (Albino et al. 2015, p. 6).

Based on the analyses of 116 definitions set by academics, government agencies, corporates, and non-profit organizations, the International Telecommunication Union's Telecommunication Standardization Sector (ITU-T) created the following comprehensive definition: „*A smart sustainable city is an innovative city that uses ... ICTs and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social and environmental aspects.*" (ITU-T 2014, p. 13).

Definition created by corporations like IBM, CISCO, Siemens are focusing on the ICT aspects of Smart City. IBM's Smart City approach is not only to engage in the digital transformation of a city's existing systems, but to create a "Smarter City" by comprehensively transforming its "system of systems" (Dirks–Keeling 2009). In the view of IBM based on ICTs, cities may build an *instrumented*, *interconnected* and *intelligent* system. Instrumentation or digitization means that everything is measurable by IT tools such as sensors and hence cities' systems become data points. Interconnection means that the data collected can "talk to each other", so it makes plain data turning into information. Intelligence means the ability to analyze the information thus created and to make strategic decisions.

This approach is very close to that of Tungsram's, as it is represented in its Smart City Action Plan. However, *we developed our own definition* which is more aligned with suppliers of smart city solutions. The Smart City definition *we use for the Tungsram case study* combines the following items:
1. High quality public services, living and working conditions for citizens and businesses;

2. Involving as many citizens in the decision-making as possible;
3. A conscious effort to use scientific and technological tools;
4. Emphasis on the use of info-communication as a key tool;
5. Conscious consideration of environmental, social and economic sustainability, and minimizing vulnerability as a prime constraint.

3.2. Relation of Smart City concept and parallel models

Over the last three decades, several similar concepts have emerged among researchers, government agencies and professionals, i.e. a livable city, a green city, a sustainable city, an eco-city, a resilient city, a digital city, an intelligent city, and many more related nomenclatures. The concept of a smart city can also be seen as an umbrella that conjoins a number of related concepts under it. In some cases, these can be interpreted as a sub-area of the overall smart city concept, in other cases they are more or less a synonym for it. In the following sections, we describe four concepts that we consider relevant to our work.[3]

Green City

On the one hand, a green city literally means a city with a large and high-quality community green space, but on the other hand, its meaning extends to a city having a high priority for environmental sustainability, thus providing healthy living conditions.

When talking about an approach based on environmental sustainability, the term *green* is being interpreted in many different ways various authors (Brilhante et al. 2018). For example, the European Bank for Reconstruction and Development (EBRD) study "Green City Program Methodology" defines a green city as a city that achieves significant results compared to others based on specific performance indicators in the following ways:

− Preserves and improves the condition of available natural resources (air, water, soil, biodiversity) and utilizes them in a sustainable way
− Manages climate change risks and adapts to climate change
− Ensures that legislation relating to environmental sustainability contributes to the social and economic well-being of the population

Creative City

A creative city is a city where creativity is considered a key factor in sustainable urban development. The concept of a creative city has been interpreted in many ways by many scholars. It could be about emphasizing the importance of creativity as a value, but it can also be interpreted as a city where the economic impact of the creative industry is higher than average.

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[3] Pongrácz (2020) analyzed 10 parallel concepts in his dissertation. From this list, we selected only four, frequently used synonyms related to Smart City.

An example to the first approach is the idea of "The Creative City" by Australian businessman David Yencken, published in 1988, which triggered a global movement. Yencken explains that while cities need to operate efficiently and fairly, they must, at the same time, encourage the creativity of their residents and provide an emotionally comfortable environment (Yencken 1988).

If we wish to assess the impact of creative industries in a city, then first, we shall define what we call creative industries. The concept of the *creative industry* is not being used consistently in the literature. The picture is further being blurred by the use of the term *cultural industry* with a content very similar to that of the *creative industry* (Keresnyei 2015). But we must note that the cultural industry is a subset of the creative industry characterized by the promotion of cultural values (e.g. cultural tourism, museums, libraries).

Digital City

The digital city is a city that prioritizes the use modern ICTs (IoT, AI, Cloud, Big Data, etc.). The term digital city can also be used as a synonym for the technological approach of a smart city (Tregua et al. 2014). Another interpretation of the term digital city is that it is not necessarily the city itself that employs digital technologies, but it creates an atmosphere that encourages innovation in digital technologies. The *European Digital Cities ranking index* (EDCI 2016) uses this approach and classifies cities specifically from the perspective of the friendliness of the environment offered to startups and scale-up companies that are engaged in digital innovation.

Intelligent City

The term *intelligent city is often used as a synonym for a smart city*, while others mean a dynamic digital urban environment that can adapt to users and the environment, going beyond static buildings and urban infrastructure.

In fact, the term smart city has started to become "occupied" in the world of science and governance since the mid-1990s. In June 1994, the so-called *Bangemann Report* "*Europe and the Global Information Society – Recommendation to the European Council*" was released. The key message of the report is that the appearance of the information society is inevitable, which would lead to another industrial revolution. The latter can be matched with the onset of Industry 4.0 but appeared almost a decade and a half after the Bangemann Report.

The report identified 10 main areas for improvement, including the establishment of a *trans-European public administration network* and an *urban information superhighway* (Lados 2015). The message had an almost immediate effect, the development of *intelligent city, region and country strategies* commenced across Europe in the second half of the 1990s. Intelligent city strategies across Europe have started focusing mainly on laying *the foundations for e-government*, enabling back-and-forth communication with citizens through ICT tools, and expanding online public administration services (e-government).

In our view, *the smart city concept is a collective notion that combines various approaches*. Using the smart city criteria, we analyzed the relationship between the smart city concept and some other relevant concepts discussed above (Table 1).

Table 1 Relation of Smart City and paralel concepts

Relevant concept	Short definition	1. High quality public services, living and working conditions for citizens and businesses	2. Involving as many citizens in the decision-making as possible	3. A conscious effort to use scientific and technological tools	4. Emphasis on the use of ICT as a key tool	5. Conscious consideration of environmental, social and economic sustainability, and minimizing vulnerability as a prime constraint
		Smart City Criteria				
Green city	1. A city with many high-quality community green spaces 2. A city that prioritizes environmental sustainability and provides healthy living conditions	▓				▓
Creative city	A city where creativity is viewed as a key element of sustainable urban development	▓	▓			▓
Digital city	A city that uses modern ICTs (IoT, AI, Cloud, Big Data, etc.)	▓		▓	▓	
Intelligent city	It is often used as a synonym for smart city, while others mean a dynamic digital urban environment that can adapt to users and the environment beyond static buildings and urban infrastructure	▓	▓	▓	▓	▓

Source: edited by the authors based on Pongrácz (2020)

The intelligent city, most often used as a synonymous term, relies heavily on the use of ICTs. By using two-way communication, they also have the opportunity to involve their local community in urban decision-making processes, which became even stronger in the *e-democracy* approach later. The intelligent city aims to develop an efficient ICT-based system. However, *it does not directly address the issue of environmental sustainability.*

The other, frequently used synonym is *green city*. This approach focuses on creating a sustainable and livable environment. Its key focus areas are the provision of green spaces and a system of green areas in cities, and the use of renewable energies as much as possible in order to meet the city's energy needs. However, *the green city approach does not directly rely on ICT.*

We can conclude that, comparing the individual approaches with the definition of a Smart City we presented in this study, the notion of *the Smart City is*

the most general and integrative term and concept among the aforementioned urban visions. Based on our definition above, *this approach is the one that is suitable to offer solutions to the Smart City challenges addressed within SDG17*. An example to this approach is the Tungsram Smart City Action Plan.

3.3. Evolution of Smart City concept

Cohen distinguishes 3 generations of smart city process from the perspective of whether only large company recommendations are taken into account in the design phase, or whether there is a wide range of stakeholders involved when defining the goals or implementing the projects. These stages are the following (Cohen 2015):

- − *Smart City 1.0 – Technology driven:* IT companies develop and offer smart solutions.
- − *Smart City 2.0 – City driven:* Technology enablers utilized to improve of quality of life. Cities prepare Smart City strategies and action plans. Development decisions of smart solutions are based on these strategies.
- − *Smart City 3.0 – Community driven:* Citizen co-creation of the concept. Citizens are not only beneficiaries of smart solutions but they are involved in the preparation process of strategy, and also offer smart solutions and locally used applications.

Nowadays a mixture of Smart City generations exists among cities in the world. For example, Sondgo and Masdar City belong to Smart City 1.0, Barcelona and Rio de Janeiro are rather under Smart City 2.0, Amsterdam and Vienna represent Smart City 3.0 (Gere–Czirják 2016). The Smart City Vision and Action Plan of Tungsram demonstrates the technology-driven stage of a Smart City.

4. Tungsram's Smart City Vision and Action Plan[4]

Tungsram has a history of over 120 years. *Founded in 1896*, it was the first internationally recognized Hungarian brand (Figure 4). It has always aspired – and succeeded – to stay ahead of the curve: the company owned the first research lab in Europe in 1921, founded by the CEO *Lipót Aschner* at the time. Ten years later, in 1931, world-class researcher *Imre Bródy* invented, and received a patent for the krypton light bulb; and in 1946 *Zoltán Bay* laid the foundation of radar astronomy. *"Innovation is our heritage"* stands in the slogan of the company.[5] Tungsram has always had a *strong vision to foster leading technological inventions*. Today, Tungsram employs over 4000 people and has a presence in over 100+ countries.
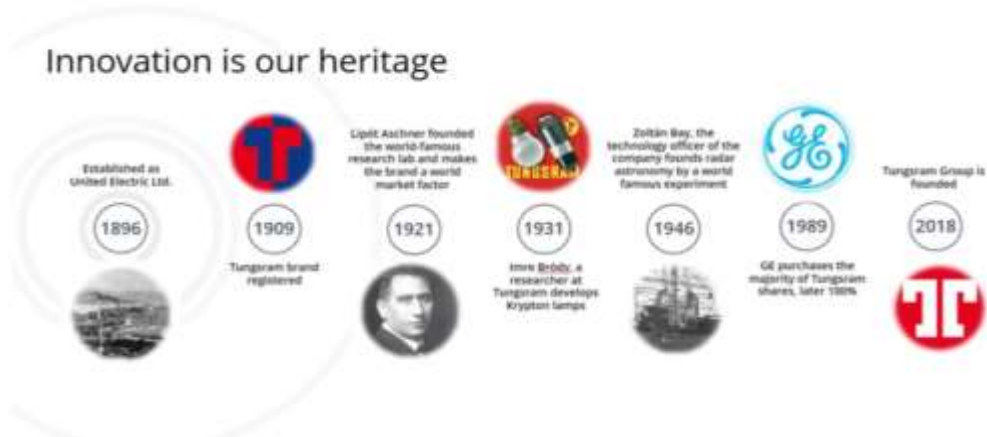
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[4] The inception and implementation of these elements of innovation are presented from a corporate point of view, based on the personal experience of one of the authors Ferenc Pongrácz, who is the General Manager of Innovation at Tungsram Group.
[5] https://tungsram.com/en/news/tungsram-innovation-is-our-heritage

Figure 4 A brief history of Tungsram

Source: Tungsram (Introductory presentation)

Tungsram's vision continues its rich heritage. In 2018, it established a separate Business Unit called *Tungsram Edge*, which has been made responsible for seeking out the most promising opportunities for innovation. Tungsram Edge's vision is, in line with many of the UN's SDGs, to provide smart and innovative physical and digital solutions for inhabitants of a city and for enterprises within or on the outskirts of a city to strengthen their environmental, social, and economic sustainability. While Tungsram itself does not own all the products and services, yet its major competitive advantage is that it acts as a technology integrator. Tungsram Edge, at the same time, operates on a *new business model*: it *matches demand with supply* as it aims to bring together all those startups and SMEs who have smart and innovative products *and has created a platform for cities and companies* who wish to take advantage of the synergies that an integrator – such as Tungsram – has to offer. The extensive use of ICTs, disruptive technologies, non-traditional business models, and the use of open innovation are all present in its mode of operation, as we have seen outlined in Figure 2.

4.1. Tungsram's Smart City Model

The key concept in Tugnsram's Smart City model is its human-centric design. As we have also quoted earlier from the UN's 2019 study, "populations are at the centre of sustainable development". Hence Tungsram's most important strategic imperative is to always keep *the people* in focus.

Tungsram highlights *three groups of stakeholders*: inhabitants, enterprises, and city management (Figure 5). In the definition of the stakeholders, we can discover the application and adaptation of the Triple Helix model of universities, industry, and government cooperation. While Tungsram does not name universities explicitly, the company has multiple agreements of cooperation with top Hungarian and international universities. Furthermore, Tungsram does not only limit the ground for innovation to universities, albeit they play a very significant role in the process, but it extends its reach to all "inhabitants", which is in line with the Open Innovation model.

Figure 5 Tungsram Smart City Model

Tungsram has identified *ten focus areas* through which it aims *to contribute to the SDGs* through helping build and manage smart cities. While some were initially part of the company's core competencies, others are new in the portfolio and currently being developed. As an Action Plan, the company formed *Tungsram's Smart City portfolio*, and highlighted three distinct areas: *AgriTech*, *PropTech*, and *Smart Solutions* that are coming from Open Innovation based collaboration with 3rd parties.

4.2. Tungsram AgriTech

Tungsram brought into existence its AgriTech division in 2018. AgriTech targets the indoor farming or vertical farming needs that keep increasing along with the growing population worldwide that is concentrated in cities. The increasing scarcity of natural resources also contribute to the growth: 80% of arable land is already in use; 70% of all fresh water is used for food production while 65% of the water used is lost due to evaporation and runoff. At the same time, about 30% of fossil fuels are being consumed by food production.

On average, food often travels 2500 km or more to get from field to fork, while 50% of the crops that were planted are not harvested. Overall, about 14% of food is contaminated with pesticides while 0.1% of all pesticides used would actually reach the target.

Consumers become more and more aware of the health and environmental issues that food production is causing, and there is a change in demand around food production. People demand *shorter field to fork cycles to reduce CO2 emission*, and with a closer production facility, the *food will stay fresher and cheaper*, due to the *decrease*

of the transportation and refrigeration costs. While in 2011, around 1/3 of all food was lost or wasted every year, in 2019, the *UN's Food and Agriculture Organization* (FAO) estimates about 14% waste from harvest to retail. Despite a significant improvement since 2011, there is still a long way to go, especially that the target within the UN's SDGs is to half the per capita global food waste by 2030 (FAO 2019).

The increasing customer demand around organic products and the year-round availability of seasonal fruits and vegetables are also driving the need for more indoor farms, while exotic products for the medical and cosmetic industry are also increasingly sought after.

During the short time period since 2018 Tungsram become an internationally recognised premium quality producer of lighting products for indoor farms and developed its state-of-the-art vertical farming product portfolio.

Among Tungsram's most notable results, there are top international universities and research organizations that use its indoor farming lighting technologies for research and production, while Tungsram has also started its own vertical farm, and by now, even the UN's FAO recognizes it as a company "*responding creatively to crises with non-traditional farming*".

Research partnership with the University of Reading

The University of Reading, which is one of the most notable universities in the field of horticulture in *the United Kingdom*, has chosen *Tungsram's indoor farming lighting technologies to research strawberry production*. Their aim was to investigate growth, yield, and quality of strawberries lit by LED lights and compare them to the performance of plants under high pressure sodium lamps and unlit controls. The research toplights produced by Tungsram have been set to four different spectral distributions to investigate the results of different spectral compositions.

The results of the research, carried out August 2019, have shown that all four LED-lit compartments provided higher than average berry weights and a more compact fruit texture. In Class 1 of the experiment, the plants also produced a significantly higher yield. "In addition to better yield and higher crop quality, the most immediate benefit of using LED is to reduce the amount of power that is being used for plant cultivation. *The results of the experiment showed that energy consumption dropped by 40-50% in some cases*." explained Keith Thomas Tungsram AgriTech UK commercial leader (Thomas 2020).

Vertical farm developed in-house

Tungsram started its first hydroponic vertical farm in-house in 2020. A large factory building previously used to assemble lighting products has been turned into a world-class vertical farm home to various microgreens, such radish, garden cress, dill, lettuce, and other significant research plants such as chamomile, chilli, strawberry, and pak choy.

The shelves, divided into three levels, are being lit by 4-channel and 6-channel lightbars and can be controlled remotely. The light spectrums and their intensities can either be pre-programmed or changed real-time, just as researchers see a need to adjust

the spectral composition to best suit the plants' needs. There are various sensors monitoring the environment and sending data about the pH, the temperature, and the electrical conductivity of the hydroponic solution, as well as about the room temperature, the CO_2 level, and the relative humidity. All lights, other hardware components just like the software itself, has been developed and manufactured by Tungsram.

The first results have shown an overall significant success. For certain plants, such as chili, Tungsram is still waiting for the laboratory results on capsaicin level, and chamomile is currently being evaluated for oil content. There are also some lessons the company learned about their integrated pest control strategies and will revisit those in the next coming trials.

In the next coming months, this in-house vertical farm will host, for the first time, a high wired plant nursery including tomatoes, peppers, and cucumbers.

Tungsram's strategy is to become an advocate and continue supporting indoor farming as a safe and sustainable food production methodology that saves energy, water, and pesticides providing various health benefits and being able to commercialize it as a "*plant as a service*" with well-established crop production strategies and consulting services to indoor farmers.

Food and Agricultural Organization recognizing Tungsram

Large urban operations, such as vertical farms are a great way to complement the urban food supply chain. *Precision indoor farming*, however, aims at serving a niche market, such as high-end restaurants or hotels. These closet-sized hydroponic cabinets create, establish, and maintain an ideal cultivating environment for select microgreens and offer an alternative smaller businesses or specialty kitchens.

In a recent article about *"Responding creatively to crises with non-traditional farming"* FAO recognized Tungsram as a notable company being able to respond well to the COVID-19 pandemic by quickly compacting its know-how about large vertical farm operations into a smaller-scale indoor farm that is more affordable for smaller businesses and individuals.

4.3. Tungsram PropTech

PropTech, or property technologies are the newest addition to Tungsram's business. *The reduction of property maintenance and utility consumption* tends to appear already in most municipality's strategic documents in Hungary and are the heart of sustainable development and smart cities. While the AgriTech division was primarily built on the core competence of lighting manufacturing, PropTech evolved from the need to make the buildings more efficient not only in the area of lighting, but in the *overall area of facility management*: smart buildings make up smart cities.

The lifecycle of a building consists of the design phase, the construction phase, and the operation and maintenance phase. While the design phase is only 1% of the overall costs, construction is about 9%, and the remaining 90% is spent during the operation and maintenance phase. There is an increasing need to use *computer aided facility management* (CAFM) systems in the operation and maintenance phase.

In the summer of 2019, Tungsram has acquired an IT company and it now owns a property and facility management and maintenance software called *ArchiFM*. With ArchiFM, facility managers can better automate asset, area, and tenant management, optimize maintenance and workflow management, and thus reduce the overall costs of a building's operation. The solution improves Energy efficiency and helps to reduce CO2 emission.

Puskás Arena

One of our most recent and most notable references in the field of efficient building management is Hungary's largest public building, the *Puskás Arena*. The 67,000-seat stadium's senior management carefully examined the possibilities and decided to entrust ArchiFM to integrate and manage their *Building Information Modeling* (BIM) models and their related systems. "Among our most important selection criteria when trying to find a service provider were that they have to be able to offer services locally while seamlessly adjusting to our facility management needs, that they have relevant references, and be experienced and dedicated to manage the BIM model of the largest public building in Hungary," explained Puskás Aréna manager Barnabás Mesics in Tungsram's reference video.

When setting up the system, ArchiFM thoroughly merged and consolidated all heating, ventilation, air conditioning, electricity, IT, and safety-related information and mapped all parameters from various sources that were used during the design of the building. It resulted in over 10GB of structured data that we imported into ArchiFM. After creating a comprehensive asset inventory, we implemented our facility management best practices to be able to optimize their workflow management.

After the implementation, we have been able to achieve success in

- Environmental efficiency, by being able to digitally control heating, ventilation, and air conditioning that matches occupancy and thus by reducing CO2 emissions

- Cost reduction, by using less electricity and a more efficient workflow management process

- Service quality improvement, by having a cleaner, safer, and more proactive environment for workers, athletes, and visitors

4.4. Open innovation Partnerships – Smart Solutions

Tungsram has been continuously collaborating with innovative Hungarian and international Small and Medium Businesses and Start-ups in order to create a comprehensive Smart City product portfolio that includes solutions provided by multiple players but can be seamlessly integrated and supported by an internationally recognised player. Smart Solutions product portfolio currently includes solutions for *indoor and outdoor positioning, smart parking, building automation, people counting cameras, ambient sensor network, workspace management*, and various *audiovisual solutions*. Tungsram has established, and keeps building, a remarkable partner ecosystem and constantly maintains and manages its product portfolio.

As one of our first achievements is a demo environment at the Budapest Headquarter placing ambient sensors in meeting rooms that are able to track data about the physical environment, such as room temperature, CO_2, humidity. People counting sensors are able to monitor occupancy, which can be used to scale back heating / air conditioning or provide information about meeting room usage and frequency.

Outside, in the parking lot, sensors are installed complemented by a navigation system available through an app to guide one to the closest available parking spot.

By these actions, three objectives are achieved:

- Environmental efficiency, by reducing CO_2 emissions through less energy (electricity of fuel) consumption
- Cost reduction, by also using less energy
- Service quality improvement, by having a pleasant meeting room to enter, or by not having to waste time trying to find a free parking spot when in rush to make it on time for a meeting

Each actions of Tungsram's Smart City porfolio may directly or indirectly contribute to the UN SDGs. Table 2 presents *indicative measures of the effects* of Tungsram's Smart City portfolio. The establishment of the AgriTech division within Tungsram directly addresses the following UN sustainable development goals: 2, 6, 7 and 12, and it indirectly contributes to 3, 8, 9, 11, 13 and 17. Indoor and vertical farming extend the capacity of food production in different climate conditions, use water and energy efficiently, reduce food losses along production and supply chain. It is also a manifestation of a human-centric design that addresses people's needs and demands in a sustainable and yet profitable manner.

Table 2 Relation of Tungsram's Smart City Portfolio to SDGs

Sustainable Development Goals	Tungsram's Smart City portfolio		
	AgriTech	PropTech	Smart solutions
SDG1: No Poverty		Indirect	
SDG2: Zero Hunger	Direct		
SDG3: Good Health and Well-Being	Indirect	Indirect	
SDG4: Quality Education			
SDG5: Gender Equality			
SDG6: Clean Water and Sanitation	Direct		
SDG7: Affordable and Clean Energy	Direct		Indirect
SDG8: Decent Work and Economic Growth	Indirect		Indirect
SDG9: Industry, Innovation and Infrastructure		Direct	Indirect
SDG10: Reduced Inequalities			
SDG11: Sustainable Cities and Communities	Indirect	Direct	Indirect
SDG12: Responsible Consumption and Production	Direct	Indirect	
SDG13: Climate Action	Indirect	Direct	Indirect
SDG14: Life Below Water			
SDG15: Life on Land			
SDG16: Peace, Justice and Strong Institutions			
SDG17: Partnership for the Goals	Indirect	Indirect	Indirect

Direct contribution
Indirect contribution

Source: edited by the authors

With the establishment of the PropTech division, Tungsram directly addresses the following UN sustainable development goals: 7, 9, 11 and 13, and it indirectly contributes to 1, 3, 12 and 17. Efficient buildings increase the efficient resource use and have greater adoption of clean and environmentally sound technologies including renewable energies and focusing on improvement of energy efficiency. Additionally, proper facility management ensures safe, and affordable housing and basic services.

Tungsram Smart Solutions directly addresses the following UN sustainable development goals: 7 and 9; and it indirectly contributes to 8, 11, 13 and 17. The different smaller and larger scale solutions contribute to IT-based, adequate, safe, and efficient public and private basic services.

Some of the direct effects were quantified in the presented case studies (research partnership with University of Reading, vertical in-house farming, Puskás Aréna, ambient sensor network). Most projects of the Action Plan are under design or at the starting phase. That is why some other measures represent a subjective evaluation of the authors. Based on feasibility studies and/or monitoring of implemented projects, future studies may establish a methodology to elaborate exact quantification of the effects on SDGs by Tungsram's Smart City actions.

5. Conclusion

The accelerating speed of urbanization create sustainability challenges in all cities. The complexity and the severity of these challenges varies geographically. We have examined the circular driving forces that are happening in cities today and reviewed the UN's SDGs.

Nowadays, theSmart City concept is an integrative and a general future city vision. Smart City is featured by efficient use of ICTs, involvement of community, and environmental, social and economic sustainability. These characteristics ensure that a well thought through Smart City approach is indeed able to provide solutions to manage challenges described in the UN's SDG17.

In the empirical part of the paper, we have investigated the Smart City action plan of a Hungarian multinational company Tungsram and demonstrated how the business units that aim to make cities smarter evolved. Tungsram's strategy to promote a human-centric design helped create a healthy partner ecosystem, and it is a driving force to attract those businesses and business models that believe in the same concept. We have also seen that the product portfolios of the three divisions under Tungsram Edge are capable of significantly contributing to the UN's sustainability goals.

With the shift in demographics and the increasing need to act prevent climate change, we believe that any city and any company at their own capacity should use ICTs, innovation, and smart solutions of any kind to contribute to the SDGs of the United Nations.

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Chapter II
Regional and local economic development

The economy of Bulgarian Districts and its effect on environmental performance

Lyubomira Dimitrova

The aim of this study is to examine on the relationship between economic growth and environmental performance in the 28 Bulgarian districts for the period between 2010 and 2016. The results show that when in the cases where CO2 emissions are medium, the relationship with the economic growth is very weak. However, for those districts with higher CO2 emissions per capita there is a significant relation with the economic variables. This would mean that economic growth would have a strong effect on the air quality only after certain amount of CO2 emissions.

Keywords: environment, local economy, CO2 emissions, economic growth

1. Introduction

The relationship between economic growth and environmental conditions has been widely discussed in academic literature. Despite the common agreement that economic growth has an impact on the environment, there is still room for improvement in terms of finding the exact direction of the relationship and the main features that define it. So far, researchers have focused on the correlation between the two variables (Panayotou 2016, Suri–Chapman 1998), but the information on the exact relationship between the economy and the environment is scarce. The aim of this paper is to define those aspects of the local economy that have the strongest effect on the environmental performance using data for the 28 districts in Bulgaria between 2006 and 2017.

The paper begins with an overview of the literature, focusing on the economic growth in terms of its relations with the environmental quality and the way the relationship is described. The next step is to present the rationale behind the case selection, followed with a presentation of the dataset, containing all economic factors that may influence the environmental quality. Three regression models are build based on the CO2 emissions in the Bulgarian districts – the first uses districts with low CO2 emissions per capita, the second – with medium CO2 emissions and the third – with high CO2 emissions. Using stepwise regression I have selected only those economic variables that have the strongest effect on the environmental factors. The results show that there is a significant relationship between the CO2 emissions and the economic growth only in those cases where the emissions are the highest.

2. Economic growth and the environment

When it comes to the effect of the economic performance on the environment, there are two competing schools of thought. The roots of this debate can be traced as back as the 19th century when the boundaries, defining economic growth are set. As Romer (1994) suggests, the idea is that the economic growth describes a situation in which the economic input (resources plus labor) is always lower than the economic output. Since by definition resources are scarce, it seems likely that increases in economic input will lead to the exhaustion of all recourses. The negative externalities every human activity has on the environment also need to be taken into account (Stieglitz 1974).

The first side of the argument states that human action harms the environment, firstly due to the exploitation of natural resources, and secondly due to pollution that influences the climate (Beckerman 1992). The second one argues that the economic growth will have negative impact on the environment only until a certain point. After that, it will have a positive effect on the environment (Grossman–Krueger 1991). This relationship is known as the Environmental Kuznets Curve (EKC). Furthermore, as Julian Simon (1986) suggests, the price of all natural resources in the past decades shows no signs of their scarcity. And, as so far no know nonrenewable resource has disappeared completely, there is no reason to believe that human action could lead to such impact on the environment.

The claim of the first group of researchers is based on the understanding that the global economy and the goods produced are growing exponentially and that their relationship with environmental quality is strong, therefore at a certain point economic progress will lead to an environmental disaster. Meadows et al. (1972) predict that within six thousand years the economic and demographic development of the planet will reach their capacity, which will have fatal consequences. They point to the growing population, food production, consumption and use of inexhaustible resources as a potential cause. Accordingly, their solution is immediate intervention and policies that need to be implemented at the government level. Repeating their research in 1992, they came to the same conclusions, shortening the "disaster period" by a thousand years. Ehrlich and Holdren (1971) go even further, stating that each individual has a negative impact on the environment because of its own needs. The only way to protect the environment is to control the population and reduce technological progress. In his book "The stationary-state economy", Daly (1971) also argues that exploiting the planet's resources through overproduction and consumption will lead to a decline in wealth, despite rising incomes. The logical approach of the population in this context is to oppose any kind of economic activity, since any negative external impact will endanger their well-being.

The idea is that every human activity generates negative externalities for the environment, leading to its exhaustion. Stieglitz (1974) proposes a model of optimal consumption that will guarantee sustainable economic growth while protecting the environment from the depletion of natural resources. Others, such as Mishan and Mishan (1967), take an even more radical stance, challenging the need for economic growth. According to them, there is no link between personal well-being and rising consumption.

Following this paradigm it is often assumed that investment in economic activities will also lead to negative consequences for the environment. Researchers such as Dasgupta and Heal (1979) propose investment control as a mechanism that would limit economic growth to "acceptable limits". Boons et al. (2009) add to this concept, focusing on direct private investment in developing countries. According to them, in the desire of their governments to attract the maximum amount of foreign capital, they neglect the possible negative impact on the environment. This, in turn, increases moral hazard, attracting companies that generally would not seek to maintain a clean nature.

In recent years, the focus of the discussion has shifted from limiting the human population and its access to commodities to finding alternative means of production. Sehrawat et al. (2015) claim the energy consumption and growth of household income as the main reasons behind the environmental degradation in India. In this case they operationalized the state of the environment solely through the CO_2 emissions. Ladha et al. (2009) focus on the agricultural sector, arguing that conservation agriculture (farming system that promotes minimum soil disturbance) is the key factor for promoting limitation of the environmental footprint in South Asia.

The opposite position suggests that the relationship between environmental quality and economic growth is not exponential. Even though the two are related, the economic growth has a negative impact on the environmental quality only in the early stages of its development. Then after a certain point good economic performance actually leads to the improvement of the environment. This relationship is known in the literature as the Environmental Kuznets Curve (EKC) and was proposed for the first time by Grossman and Krueger in 1991, examining the effects NAFTA has on the environment in Mexico. Their results suggest that the trade relations between the USA and Mexico lead to a reduction of the pollution levels in Mexico City. The authors extend their study and in 1994 suggest that economic growth starts leading to less pollution around an income of 8000 USD per capita. Acaravci and Akalin (2015) came to a similar conclusion, claiming that the EKC can be observed only among developed countries opposed to developing ones.

Another argument in favor of the positive effect economic growth has on the environment is that wealthier societies are more likely to care more about problems such as biodiversity and pollution. Authors such as Beckerman (1992) argue that as personal income grows, so does the awareness regarding environmental conditions. Furthermore, access to clean water and sewerage systems should be considered more important than the discussion on limited natural resources. The change in the economic structure as the wealth increases is another factor, expected to have a positive effect on the environment (Jänicke–Binder–Mönch, 1997). On the other hand, the transition from agricultural to industrial economy is expecting to have more hazardous environmental effects (Van Alstine–Neumayer 2010). This shift in the attitudes towards environmental protection can therefore be seen as a positive externality of economic development.

The EKC has been an object of dispute ever since its introduction. By focusing on the relationship between economic growth and sulfur emissions, Perman and Stern (2003) show that when analyzing the long-term relationship between the

two variables (for a period of 34 years) and using the appropriate statistical adjustments, the relationship described by the EKC is missing. Dasgupta et al. (2002) argue that the reason behind the environmental improvement following economic growth is not due to the relationship between the two variables, but rather the governance intervention and the promotion of more rigorous environmental regulations.

In the majority of cases comparison has been made either between large populations of different countries (Perman–Stern 2003, Arouri et al. 2012) or by observing a long period of time in the same country (Zhang–Cheng 2004, Stern 1993). However, Franzen, and Meyer (2009) have suggested that when studying the relationship between economic performance and environmental conditions it is better to use regional level data, as it is more precise and the comparison is more accurate. This could be difficult to implement, as the majority of environmental performance indicators are calculated on national level.

Following the discussion in the literature regarding the relationship between economic growth and environmental quality the following hypothesis is going to be tested:

H1: *As economic growth increases the air quality will decrease.*

The hypothesis is built on the assumption of EKC and the work of scientists such as Beckerman (1992) and Alstine and Neumayer (2012). If the EKC holds this would mean that there is an optimal level of CO_2 emissions and after it is reached the economic growth will improve the environmental quality.

The next sections of this paper are dedicated to the rationale behind the case selection, the operationalization of the variables, the scientific methods that are going to be used, data description, results and conclusions.

3. Case selection

In order to test the hypotheses of this research I will be using panel data from the 28 Bulgarian districts for the period 2010–2016. As Franzen and Meyer (2009) have suggested, when studying the relationship between economic performance and environment it is better to use regional level data, as it is more precise and the comparison is more accurate. The second reason is the economic diversity and inequality of Bulgarian districts. According to Ivanov (2018) the gap between the districts in terms of competitiveness has been increasing in recent years. Thus the dataset contains cases with both high and low levels of economic development. Third, the districts share the same regulatory framework thus omitting the effect different policy approaches can have on the economic-environment relations.

4. Operationalization

The next step for hypothesis testing is to determine the indicators that are going to be used for the dependent and the independent variables of the models. As it was previously stated, usually when it comes to the operationalization of the environment, indicators such as CO_2 emissions are used in the majority of cases. Unfortunately when the analysis is to be made on local level there is lack of indicators with which environmental quality could be measured. That is why CO_2 emissions are going to represent the air quality of this study as well. However, as the variable is heteroscedastic the districts are going to be regrouped based on their CO_2 emissions into three groups.

The level of economic growth has also been operationalized in various ways. In order to assure comprehensiveness I have included all the relevant economic indicators available in order to deduce them only to those that have the strongest impact on the economy or can explain to personal economic situation of the population. The initial number of independent economic variables are eleven: household access to the internet (percentage), number of enterprises (per 1000 inhabitants), tangible fixed assets investment (BGN per capita), foreign direct investment (FDI) (stock in BGN per capita), gross domestic product (GDP) (BGN per capita), mean wages (in BGN), average household income (in BGN), the share of the population living in material deprivation, the share of the population with tertiary education, unemployment rate and the share of people living below the poverty line. The data has been collected from the Bulgarian National Statistical Institute.

These indicators can be grouped in three categories based on their purpose. The first category is macroeconomic conditions (number of enterprises, tangible fixed assets investment, FDI, GDP and production value added). They have been used in the past to study the effect on the environment by scholars such as Low (2016), Asghari (2013) and Zhengge (2008). The second category is related to the economic situation on a household level (wages, income, access to the internet, material deprivation, unemployment and poverty rate). Such an approach has been used in the past in the empirical work of Fleury-Bahi et al. (2017), Gyourko et al. (1999) and Lipfert (2004). The last category contains those variables that are related to the education of the population (percentage of the population with higher education diploma). The relation between this indicator and the environmental quality has been studies by Sacks et al. (2010) and Farzin et al. (2006).

5. Methods used

The method that is going to be used is linear regression analysis. As there are three dependent variables describing the environmental performance, three regression models are going to be built.

As the initial number of independent variables is fourteen, the first thing to do is to find a way to reduce the dimensionality. To do so I will use a stepwise regression model for determination of the most significant variables in terms of their effect on the environment. The next step is using a simple OLS model following the formula:

$$y_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots \beta_n x_n + \varepsilon$$

Where y_i is the environmental variable and x_n is the corresponding economic variable plus error.

The next step is to standardize both the dependent and independent variables in order to perform the stepwise regression which will select only the most relevant economic indicators. This is done through calculation of the standardized regression coefficients for each variable.

$$b_{j\,std} = b_j \left(\frac{s_{xj}}{s_y} \right)$$

Where s_y and s_{xj} are the standard deviations for the environmental factors and the corresponding j is the corresponding economic indicators. This standardization enables the comparison between the independent variables. Then the next step is to begin the model adding an additional variable every time until it reaches the point where any additional variable will not lead to an improvement of the model.

6. Data description

As it was previously stated the indicators used to represent the environmental quality in the Bulgarian districts are the emissions of CO2 per capita and Table 1 gives information on the variable's distribution.

Table 1 Characteristics of the environmental indicator

	CO2 emissions per capita
Mean	5.7
Med.	1.2
Min	0.1
Max	75.8
St. Dev.	12.9

Source: Regional profiles dataset, IME

The data in Table 1 illustrates the inequality between the Bulgarian districts in terms of environmental performance. As can be seen the CO2 emissions per capita may vary from 0.1 tons per capita (Sofia region 2010) to 75.8 tons per capita (Stara Zagora 2011). This goes to show that the distribution in this case is not normal. Following the assumptions following the EKC the cases are going to be divided into three groups by their CO2 emissions. To handle the not normal distribution, the variable is going to be log transformed.

Table 2 Characteristics of the three groups of districts, based on their CO2 emissions

	CO2 emissions per capita < 1 tones	CO2 emissions per capita > 1 and <9 tones	CO2 emissions per capita > 9 tones
Mean	0.4	3.0	31.9
Med.	0.3	2.8	31.4
Min	0.1	1.0	10.4
Max	1.0	8.9	75.8
St. Dev.	0.3		20.2
N cases	88	84	24

Source: Regional profiles dataset, IME

The independent variables are presented in three groups, and Table 3 summarizes the data on the macroeconomic indicators.

Table 3 Macroeconomic indicators

	GDP per capita	FDI per capita	Tangible fixes assets invested per capita	Number of enterprises per 1000 inhabitants
Mean	8501	1684.4	1789.7	43.96
Med.	7464	1046.4	1505.0	40.61
Min	4785	64.5	457.9	29.00
Max	28465	9936.7	7160.4	88.20

Source: National Statistical Institute

The data again show large differences between the cases. The difference between the highest (Sofia capital 2016) and the lowest (Silistra 2010) GDP per capita is nearly 500%. When it comes to the FDI the distribution across districts is even more visible, as this difference reaches 15305%. The situation with the investment in tangible assets is similar, as in the case of Kardzhali in 2010 (457.9 BGN) they are 1463 % less than in Sofia region in 2016 (2768 BGN). Based on this extreme values the distribution of enterprises between the districts is more homogeneous.

The state of inequality between districts becomes even more evident from the household data. Both income and wages vary significantly across cases, as the latter jumps from 5422 BGN minimum mean wage in Vidin in 2010 to 15658 BGN in Sofia (capital) in 2016. The lowest income for the period has been registered in Targovishte in 2010 (2354 BGN) and the highest – in Sofia (capital) in 2015 (7441 BGN).

Table 4 Household economic characteristics

	Income	Wages	People living with material deprivation (%)	People living below the poverty line (%)	Access to internet (%)	Unemploy ment (%)
Mean	4091	7720	41.69	25.62	46.98	12.41
Med.	4008	7420	40.95	24.26	47.95	12.00
Min	2354	5422	11.30	5.70	11.50	1.70
Max	7441	15658	76.30	60.13	75.30	28.80

Source: National Statistical Institute

The variance in the share of the population living in material deprivation is quite similar as their share is only 11.30% in Yambol in 2015 and 76.3% in Veliko Tarnovo in 2011. The lowest share of people living below the poverty line is registered in Sofia (capital) in 2013 (5.7%) and the highest – in Kardzhali in 2014 (60.13). Kardzhali is also the region with the lowest unemployment rate (in 2016) with 1.7% and the region with the smallest percent of the population having access to the internet in 2010 – 11.5%.

Table 5 Education variable

	Higher education
Mean	20.74
Med.	19.30
Min	8.90
Max	51.40

Source: National Statistical Institute

The education characteristics of the Bulgarian districts follows similar pattern – Kardzhali is the region with the lowest share of people with tertiary education in 2011.

7. Results

In order to test the relationship between environmental quality and the economy, three models are built, based on the CO_2 emissions per capita of the districts. To do so I first build linear regression models containing all the variables and then select the most significant ones through stepwise regression. In order to ensure the validity of the results I check the initial diagnostics of the models. First, I use a Variance inflation factor test to check for multicollinearity (if the variable has a score higher than 5, than it has a strong effect on the collinearity of the regression model). (Breaux et al. 2019).

As two of the independent variables had higher score than 5 (mean wages and GDP per capita), they were excluded from the models. The linearity, homoscedasticity and normality tests were made via the residual plot, the scale-location plot and the QQ plot. Due to the not normal distribution of the dependent variable, it is going to be log transformed.

Table 6 gives an overall information on the full model using cases with lower CO_2 emissions generated as the dependent variable and the results from the optimal model selected with the "regsubsets" package in RStudio.

Table 6 Results from the regression analysis of the "Low" CO_2 emissions per capita group

	Model 1	**Model 2**
Access to internet	0.00 (0.00)	
Number of enterprises	0.00 (0.00)	
Tangible fixes assets investment	0.00 (0.00)	
Foreign Direct Investment	−1.0 (0.01)***	0.0 (0.00)**
Income	0.00 (0.00)	0.0 (0.0)
Share of the population living in material deprivation	2.0 (0.00) **	2.0(0.0)***
Higher education	12.00 (0.3)***	12.0 (0.3)***
Unemployment	0.00 (0.00)	
Share of the population living below the poverty line	0.00 (0.00)	
R2	0.44	0.43
Number of cases	88	196

Entries are regression coefficients with standard errors in parentheses. The dependent variable is the logarithm of the CO_2 emissions per square kilometer. The coefficients have been multiplied by 100 in order to interpret them as percentages. Pr(>|z|) *** < 0.01 ** < 0.05 * < 0.1

Source: Author's calculation

What can be seen from the results of the first two models is that when it comes to districts with low CO_2 emissions, the most significant economic variables are the share of population living in material deprivation (where one percent increase leads to an increase of CO_2 emissions of 2.0% per capita) and the share of people with tertiary education (where one percent increase leads to an increase of CO_2 emissions of 2.0% per capita). Even though the relationship with FDI is significant, its effect is negligible.

Table 7 Results from the regression analysis of the "Medium" CO_2 emissions per capita group

	Model 3	Model 4
Access to internet	0.00 (0.00)	
Number of enterprises	1.0(0.01)	
Tangible fixes assets investment	0.00 (0.00)	
Foreign Direct Investment	0.00(0.00)	0.00(0.00)*
Income	0.00(0.00)***	0.00(0.00)**
Share of the population living in material deprivation	0.00(0.00)	1.0 (0.05)***
Higher education	1.0 (0.02)	
Unemployment	0.00 (0.02)	
Share of the population living below the poverty line	2.0 (0.00)**	1.0 (0.06)***
R2	0.27	0.23
Number of cases	84	84

Entries are regression coefficients with standard errors in parentheses. The dependent variable is the logarithm of the CO_2 emissions per square kilometer. The coefficients have been multiplied by 100 in order to interpret them as percentages. $Pr(>|z|)$ *** < 0.01 ** < 0.05 * < 0.1

Source: Author's calculation

What can be seen in Table 7 is that when districts with medium CO_2 emissions per capita are used as cases, there are other independent variables with significant effect on them. In this case one percent increase in the population living in material deprivation leads to 1% increase in the CO_2 emissions per capita. The same is valid for the share of people living below the poverty line.

Table 8 Results from the regression analysis with CO2 emissions as dependent variable

	Model 5	**Model 6**
Access to internet	0.00(0.01)	
Number of enterprises	−5.0 (0.01)	−5.0(0.01)***
Tangible fixes assets investment	0.00 (0.00)	
Foreign Direct Investment	0.00(0.00)*	
Income	0.00(0.00)	
Share of the population living in material deprivation	0.00(0.0)	
Higher education	−3.0(0.02)	−3.0(0.02)
Unemployment	−6.0(0.2)***	−6.0(0.2)***
Share of the population living below the poverty line	0.02(0.01)	
R2	0.9	0.9
Number of cases	24	24

Entries are regression coefficients with standard errors in parentheses. The dependent variable is the logarithm of the CO2 emissions per square kilometer. The coefficients have been multiplied by 100 in order to interpret them as percentages. $Pr(>|z|)$ *** < 0.01 ** < 0.05 * < 0.1

Source: Author's calculation

The models using the cases with the highest CO2 emissions per capita show the most significant results with R2 of 0.9. The three variables that have the strongest effect on the dependent variable in that case are the number of enterprises, the share of people with tertiary education and the unemployment. Surprisingly enough, the results suggest that as the number of enterprises per capita increase by 1 this would lead to a decrease of the CO2 emissions per capita with 5.0%. The reason for this results is that the most polluted Bulgarian district – Stara Zagora cannot be characterized with a wide number of enterprises. The other districts which are included in this category – Sofia (capital) and Varna have much more enterprises operating in their territory but the CO2 emissions are lower than in Stara Zagora.

Following the same logic, there is negative relationship between unemployment and CO_2 emissions – with one percent increase in the former the latter is expected to decrease by 6%. This also follows to show that as the economic situation improves the CO_2 emissions tend to decrease but only for those cases where the values are already high.

The results from the regression analysis suggest that the relationship between the economy and the environment is the most significant for those cases where the CO_2 emissions are the highest. Following the conclusions from the last two models it is possible to conclude that as the economy grows the CO_2 emissions will decrease only in those cases, where the emissions are already high. Following the R^2 coefficients, it can be seen that the correlation between the variables is the strongest within districts with very low and very high CO_2 emissions. In districts with low CO_2 emissions, the share of people living in material deprivation and the share of people with tertiary education are the variables that have the strongest effect on the dependent variable.

8. Conclusions and final remarks

The aim of this study was to find those economic factors that have the strongest impact on the environment. The results from the regression analysis suggest that variables such as the share of the population with access to internet, the investment in tangible fixes assets and the household income do not have effect on the CO_2 emissions despite the set of cases selected.

Despite the common assumption that economic activity has a negative influence on the environment, the results cannot support this claim for neither the districts grouped by CO_2 emissions. Thus the hypothesis of this study cannot be supported for the low, medium and high CO_2 emissions groups. On the other hand what can be seen is that the environment-economy relation does depend on the levels of air pollution – the economic conditions have positive effect on the environment for those cases where the CO_2 emissions per capita is already high.

As it was mentioned earlier, the environmental – economic relation can be best observed on local level (Franzen–Meyer 2009). However, information on this level is extremely scarce, as usually composed indicators such as the Environmental Performance Index, developed by the Yale University are made only on country level and this is also the case for other environmental variables such as water and air quality plus deforestation. This raises the question about the necessity for the development of such indices on local level that could provide better measurement and thus would help us to present a better picture on the environmental-economic dynamics. Having said that, the data availability is a serious limitation for such researches. Additional information on the PM10 particles in the air, the biodiversity and pollution from other particles can give more comprehensive picture. Extending the time series that were included can also give further inside on the relation between economic and environmental performance.

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Global competitiveness divide and the middle-income-trap: an empirical analysis

Timothy Yaw Acheampong

In recent times, the middle-income trap (MIT) has become a pertinent issue as economists, researchers and development practitioners continue seek answers to why the majority of middle-income countries find it difficult to advance to high-income status. There is still no consensus in literature as to the exact cause(s) and the solution to the MIT. The World Economic Forum posits that, the score of countries on the Global Competitive Index (GCI) 4.0 accounts for over 80% of the variation in income levels of countries. This suggests that the extent of global competitiveness of countries could potentially help them to escape the MIT. However, some competitiveness literature have identified an apparent competitiveness divide among countries. This paper therefore seeks to answer the following questions: how does middle-income countries differ from the high-income countries in terms of global competitiveness. The study utilises an independent samples t-test and effect size measures to examine the GCI 4.0 scores of 140 countries. The study finds a very large and significant competitiveness divide between the high and middle-income countries ($\eta^2 = 0.54$).

Keywords: Global Competitiveness Index 4.0; Middle-Income-Trap; Economic Growth; Competitiveness Divide

1. Introduction

For a little over a decade now, the concept of middle-income trap (MIT) has received enormous, attention from economists, development practitioners and international development organizations, such as the United Nations, World Bank, and the IMF. Estimates from the World Bank indicate that out of 101 middle-income countries in 1960, only 13 were able to become high-income by the year 2008 (World Bank 2012). Thus, the countries that were unable to advance to high income status are considered to be stuck in the MIT (Glawe–Wagner 2016, 2018). The MIT is a global development concern due the negative welfare consequences such as higher rates of poverty and inequality in the affected countries. Meanwhile, addressing issues of world poverty and equality continues to be a global priority as captured in the Sustainable Development Goals (UN 2015, 2017).

Although different definitions have be proposed in literature, the concept of MIT is generally accepted to describe the phenomena whereby countries that enter the middle-income bracket are unable to advance to high-income status as a result of stagnations in economic growth (Gill–Kharas 2015, Eichengreen et al. 2013, Glawe–Wagner 2016). Currently the MIT literature is still inconclusive on the specific causes of the MIT and how countries can avoid and escape the trap. Several factors including technological development, international trade, strong institutions, and human capital have been proposed as solutions to overcoming the MIT in view of their respective

roles in promoting economic growth (Glawe–Wagner 2016). In recent times, some literature have suggested that the competitiveness of countries is a strong determinant of their economic growth. For instance, the World Economic Forum's Global Competitiveness Index (GCI) Report 2018 posits that the performance of countries on the GCI explains over 80% of the variation in income levels and 70% of the variation in long-term growth across countries and economies (Schwab 2018, WEF 2018). According to the Report, economies that underperform in competitiveness given their current income level may have difficulty sustaining that level without improving their competitiveness.

Although the GCI Report suggests that there is a strong positive relationship between the competitiveness and income level of countries, empirical studies are yet to investigate the veracity of this hypothesis within the context of the MIT. Furthermore, whiles competitiveness has been identified as an important factor for promoting economic growth, some literature have found the existence of a competitiveness divide among countries particularly in Europe (Pelle–Végh 2014; Annoni et al. 2017). However, the magnitude of this divide is yet to be quantified. This paper therefore seeks to investigate the magnitude of the difference between the recent GCI 4.0 scores of high-income and middle-income countries by answering the question: how does middle-income countries differ from the high-income countries in terms of their global competitiveness? Since this can give an indication of the potential role of competitiveness in escaping the MIT.

The subsequent sections of this paper provide a brief overview about the concept of the MIT and competitiveness and their nexus. This is followed by a detailed methodology on how the study investigated the magnitude of the difference between the competitiveness of the middle-income and high-income countries. The findings are then presented and discussed before the paper concludes with recommendations for policy and areas for further research.

2. Theoretical and Conceptual issues

2.1. The concept of middle-income trap

The concept of the 'middle-income trap' (MIT) is relatively new in economics and development discourse (Glawe–Wagner 2016). According to Gill and Kharas who introduce the term MIT) in a 2007 World Bank Report, the MIT concept emerged due to the inability of the existing economic growth theories – endogenous growth theories and the Solow growth model – to inform development policy satisfactorily in middle income countries (Gill–Kharas 2015). They argued that although the endogenous growth theories and the Solow growth model were successful in addressing growth problems in high income and low-income countries respectively, neither of those two frameworks were satisfactory in understanding and addressing the nature of economic growth challenges in middle-income countries (Gill–Kharas 2015).

Different definitions of the MIT have been proposed since the emergence of the concept; however, the term is generally used to describe countries that experienced rapid growth and reach middle-income status but are not been able to catch up to the

developed countries and achieve high-income status; but rather, they get stuckt in the middle-income range – the so-called MIT (Gill–Kharas 2015, Glawe–Wagner 2016, Li–Wang 2018, Wang et al. 2018, Zhou et al. 2018). Currently the most widely used definition of middle-income, is derived from the World Bank's classification of countries. The World Bank uses the gross national income (GNI) – formerly GNP per capita) to classify countries into four different income groups – high-income, upper-middle-income, lower-middle-income, and low-income (World Bank 2018). Countries are considered to be stuck in the MIT if they remain in the middle-income group for a long period of time (Glawe–Wagner 2016). For instance, some authors consider a country as being stuck in the MIT if they remain in the middle-income range for over 40 years (Felipe et. al. 2012, Glawe–Wagner 2016); however, other authors differ on the duration.

Authors such as Aiyar, et al. (2013) and Eichengreen et al. (2013) also describe the MIT as economic slowdowns or declines in growth rate of GDP per capita. According to these authors a country is in the MIT if they experience an average GDP growth of at least 3.5% for several years, and then stepped down by at least 2% between successive seven-year periods. The growth slowdowns they argue are always total factor productivity slowdowns (Eichengreen et al. 2013, Glawe–Wagner 2016). Based on the different perspective on the MIT, it can be concluded that the MIT is associated with low productivity and slow economic growth that prevent countries in the middle-income group from advancing to high-income.

Meanwhile, the World Economic Forum and authors such as Sala-i-Martin 2010, Sala-i-Martin et al. 2011, Schwab 2018 have argued that improvements in competitiveness within countries can enhance productivity and increase incomes. Based on this premise, it is reasonable to assume that, if the MIT is associated with low productivity, and competitiveness can increase productivity, then theoretically competitiveness can help countries to overcome the MIT. This provides the basis for investigating the role of competitiveness in overcoming the MIT. Agénor et al. have touched on the importance of competitiveness in avoiding the MIT by noting that "productivity growth from sectoral reallocation and technology catch-up are eventually exhausted, international competitiveness is eroded, output and growth slow, and economies become trapped, unable to transcend to high-income status" (2012, p. 3). Thus, Schwab (2018) points out that, competitiveness factors matter for all countries, regardless of their stage of development, and any pillar can be considered a potential priority.

2.2. Concept and measurement of competitiveness

Ketels (2016) points out that, the debate over the concept of competitiveness which emerged in the 1980s and 1990s through the works of authors such as Michael Porter and Paul Krugman is yet to be reconciled in literature. For instance, Krugman (1994) in his article *'Competitiveness: A Dangerous Obsession'* argued that competitiveness is a meaningless word when applied to national economies. However, Porter (2004) notes that competitiveness is not a zero sum game in which one country gains at the expense of the other but rather it is a concept which encompasses both the static and

dynamic factors of productivity within every country that determine the sustainable current and medium term prosperity (Sala-i-Martin 2010, Sala-i-Martin et al. 2011, Schwab 2018).

The World Economic Forum (WEF) defines competitiveness as the set of institutions, policies and factors that determine a country's level of productivity which in turn sets the level of prosperity that every economy can achieve – a definition that is also shared by authors such as Sala-i-Martin (2010), Sala-i-Martin et al. (2011), and Schwab (2012, 2018). Since the introduction of the first GCI Report in 1979 by the WEF, the GCI has been the most comprehensive index for comparing competitiveness of nations (Cetindamar–Kilitcioglu 2013). The GCI evaluates the factors that collectively determine the level of a country's productivity and is updated periodically. The most recent GCI 4.0 framework is organized into 12 main drivers of productivity, or 'pillars' (See Figure 1). The Pillar and GCI scores are expressed on a 0 to100 scale. The overall GCI score is the simple average of the 12 pillars that make up the index (Schwab 2018, WEF 2018). The World Economic Forum also groups the 12 pillars under 4 thematic areas: Enabling Environment, Human Capital, Markets, and Innovation Ecosystem (See Figure 1).

Figure 1 The Global Competitiveness Index 4.0 thematic areas and pillars

Source: World Economic Forum (2018, p. 2)

2.3. Previous studies on competitiveness

Some authors have sought examine the relationship between competitiveness and various aspects of economic development. For instance, Pelle and Végh (2014, 2015), Farkas (2016) and Annoni et al. (2017) among others have particularly focused on the nexus between competitiveness and various aspects of economic development within the European Union. These authors have found the existence of a competitiveness

divide between the core and periphery countries of the EU (Pelle–Végh 2014, Annoni et al. 2017). For instance, Pelle and Végh (2014) investigated the relations between the common R&D&I policy and the competitiveness divide in the European Union and concluded that, there is a competitiveness gap within the EU. Furthermore, the authors observed that, there appears to be both an East-West and a North-South divide within the EU. Similarly, Annoni et al. (2017) analysed the competitiveness divide of EU countries focusing on the capital regions and other regions with metropolitan areas and found the capital regions to be stronger in terms of competitiveness.

Figure 2 The Global Competitiveness Index and national income
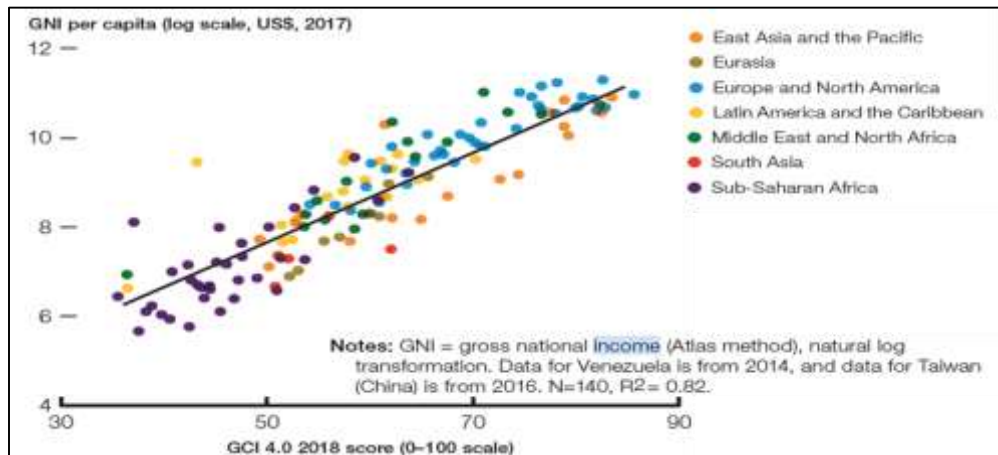
Source: Global Innovation Index Report (2018, p. 7)

The nexus between the competitiveness and income levels has also been previously analysed in the GCI reports (See Schwab 2012, 2017, 2018). For instance, the GCI Report 2018 found a strong correlation between the competitiveness and income levels of countries (See Figure 2); noting that out of 140 countries analysed high-income economies make up the entire top 20 and only three non-high-income economies namely Malaysia (25th), China (28th), and Thailand (38th) feature in the top 40 of the GCI 4.0 rankings. Although the GCI Report 2018 finds a strong positive relationship between income and competitiveness, coupled with the literature that also indicates there is a competitiveness divide among countries, existing studies are yet to investigate the significance and magnitude of this divide particularly between the middle-income and high-income countries. Furthermore, it is still not clear which of the 12 pillars of the GCI 4.0 has the greatest impact on the income levels of countries. Answering these questions could lead to a breakthrough in finding the solution to MIT that has so far alluded economists, researchers, and development practitioners. This paper therefore seeks to fill this empirical gap and policy gap. The next section discusses the methodology used to address this gap.

3. Methodology

3.1. Research design, population, sample, data sources

This paper uses a cross-sectional research design to empirically investigate the magnitude of the competitiveness divide between countries of different income groups. In this study, scores on the GCI 4.0 constitute the dependent variable whereas the income group of countries is the independent variable. The study utilises the most recent GCI 4.0 data drawn from the World Economic Forum database (WEF 2018). The income group classifications are based on World Bank (2018) and the GNI per capita (Atlas Method) data are drawn from the World Development Indicators World Bank (2019). A total of 140 countries were analysed based on availability of GCI 4.0 data (See Appendix 1).

Table 1 Distribution of countries studied by income groups

Group of Countries	Frequency	Total Countries Studied (%)
High-income	52	37.14
Upper-middle-income	34	24.29
Lower-middle-income	32	22.86
Low-income	22	15.71

Source: Author's Construct based on World Bank classifications

Out of the 140 countries with GCI 4.0 data available, most of the countries were classified as middle-income (66 representing 47.14%) followed by the high-income countries 52 representing 37.14%, and low-income countries respectively (See Table 1). Out of the 66 middle-income countries, 34 countries were in the upper-middle-income group whereas 32 were in the lower-middle-income group. As indicated earlier, the countries were selected based on the availability of GCI and GNI per capita (Atlas Method) data. One of the fundamental assumptions that justifies studies on the MIT is that every country aspires to achieve high income status; therefore, studies on the MIT requires comparisons of different income groups (Glawe–Wagner 2016). Since the analysis of the MIT requires the comparison of middle-income against high-income countries, the sample size of each group was inspected to ensure that were above 30 to satisfy the requirements for making statistical comparisons using t-tests.

3.2. Data analysis tools and procedure

The study sough to answer the question of whether there is significant statistical difference between the GCI 4.0 scores of the middle-income and high-income countries. Descriptive statistics and t-test were the main analytical tools used to answer the research questions. Based on the existing literature the following two hypothesis were examined:

H_0: $GCI_{Income\ group\ A} = GCI_{Income\ group\ B}$ with the assumption there is no significant difference in the mean GCI scores of different income groups (i.e. middle-income and high-income countries).

H_1: $GCI_{Income\ group\ A} \neq GCI_{Income\ group\ B}$ with the assumption here is a significant difference in the mean GCI scores of different income groups (i.e. middle-income and high-income countries)

To answer these hypotheses, the study utilises an independent samples t-test. In addition to establishing whether a significant statistical difference exist between the GCI scores of the different countries, another objective was to quantify the magnitude of the expected competitiveness divide between the various income groups. In this regard, an effect size statistic for the independent samples t-test was computed using the following formula:

$$Eta\ Squared\ (\eta^2) = \frac{t^2}{t^2 + (N_1 + N_2 - 2)} \tag{1}$$

Where the 't' represents the t-statistic obtained from the t-test and N_1 and N_2 represents the sample sizes of the two income groups being compared.

3.3. Interpretation of effect size statistics

Pallant (2011) notes that in order "to interpret the strength of the different effect size statistics, the following guidelines were proposed by Cohen (1988, p. 22) when assessing research involving the comparison of different groups" (p. 210):

Table 2 Cohen's criteria for interpreting effect size for independent samples t-test

Magnitude	Eta squared (η^2)	Cohen's *d*
Small effect	0.01 or 1%	0.2
Moderate effect	0.06 or 6%	0.5
Large effect	0.14 or 14%	0.8

Source: Author's construct based Pallant 2011

4. Findings and Discussions

4.1. Competitiveness divide among countries by income groups

Since literature suggests that competitiveness is a good determinant of income levels (Schwab 2018, WEF 2018), the study sough to investigate whether there is a significant difference in GCI scores of the high and middle-income countries in order to be able to make an inference as to whether competitiveness can help countries to overcome the MIT. Based on descriptive statistics, the study finds that on average, the high-income countries (72.18) had the highest GCI scores followed by the middle-income countries (55.88) with the low-income countries (43.20) having the lowest GCI scores (See Figure 3). An independent samples t-test was conducted to investigate the statistical significance of this competitiveness divide among countries in different income brackets.

Figure 3 Trend of Global Competitiveness Index scores and GNI per capita by income groups

Averages	High-Income	Upper-middle income	Lower-middle income	Low income
GCI	72.18	59.63	52.12	43.2
GNI/capita	34,005.88	6,809.71	2,335.31	684.09
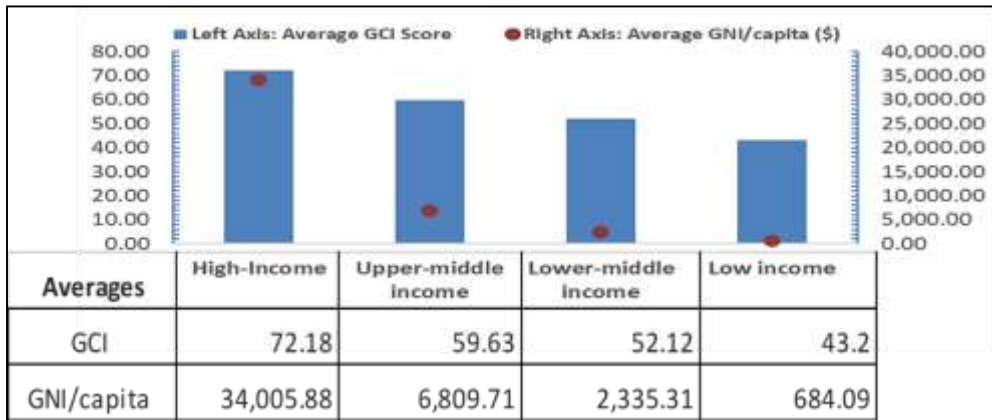
Source: Author's calculations based on GCI 4.0 data; World Bank (2018, 2019)

Note: These calculations are based on 139 countries since the GNI per capita (Atlas Method) for the current year was unavailable for Taiwan.

The independent samples t-test revealed a significant gap between the average GCI scores of the high and middle-income countries. The results are as follows: the high-income countries (M = 71.70, SD = 8.64) were found to have a higher average GCI score than the middle-income countries (M = 55.99, SD = 7.11); t 98) = 10.59, p = 0.00, two-tailed). The mean difference was 15.71 (95% CI: 12.77 to 18.66). The magnitude of the difference in mean scores was investigate using the eta square formula for independent samples t-tests (Equation 1). The computed η^2 was 0.54. Using the guidelines for interpreting this value as outlined in Table 2, the study finds a very large competitiveness gap between the high and middle-income countries. The implication of this finding is that, over 50 per cent of the variance in GCI scores can be explained by the income status of the countries.

Table 3 Magnitude of competitiveness divide between lower- and upper-middle countries

Income Groups	t	Sig	η^2	Magnitude
Middle vs High	11.735	0.00*	0.54	Large effect
Upper-middle vs Lower-middle	5.025	0.00*	0.28	Large effect
Upper-middle vs High	8.496	0.00*	0.46	Large effect
Lower-middle vs High	12.875	0.00*	0.67	Large effect
*Significant level at 1% and 5%				

Source: Author's calculations

Further independent samples t-test of the GCI 4.0 scores of the different country groups revealed that there is also a significantly large competitiveness divide even among the middle-income countries. However, an inspection of the computed eta squares shows that the competitiveness divide is largest between the lower-middle income countries and high-income countries on one hand and closer between the upper-middle income countries and lower-middle income countries on the other hand (See Table 3).

5. Conclusions and recommendations

The study was able to establish a very strong positive relationship between the GCI 4.0 and the GNI per capita of countries confirming earlier position of the World Economic Forum. There was a significant difference between the GCI 4.0 scores of all the countries analysed. In all instances, the higher income groups had higher GCI scores. Therefore, the study rejects the null hypothesis that there is no significant difference in the mean GCI scores of different income groups. The study also finds a very large competitiveness divide between the various income groups analysed. In the case of the high-income and middle-income countries, the computed η^2 was 0.54. Even among the middle-income countries, the study finds a significant large competitiveness divide between the upper-middle income and lower-middle-income countries. However, the largest competitiveness divide is between the lower middle-income countries and the high-income countries. Since, the study has confirmed that higher income groups tend to have higher GCI scores, it can be concluded that improving the overall level of global competitiveness of middle-income countries has the potential to help them to escape the MIT. It could also be the case that the low level of competitiveness in these countries can also account for countries being stuck in the MIT since the level of competitiveness depends on factors such as strong institutions, quality human capital, and technological advancement which have already been identified in existing literature as being among some of the most important determinants of the MIT. The limitation of cross-sectional studies of this nature, is that, they do not allow for explanations and understanding of causal processes that occur over time; however, the findings still show that that the GCI 4.0 is highly correlated with income levels of countries. Although, the GCI is a good predictor of income levels, it is also very important to know the unique contributions of each of the 12 pillars and even the components of each of the pillars. It is therefore recommended that future studies should investigate how these aspects of the GCI impact the income levels of countries. The implications of this study are that, policy makers would have to identify factors within their countries that either inhibits or promotes competitiveness and productive in order to ensure sustainable economic growth.

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Appendices

Appendix 1: List of countries studied by income groups

High-income					
1	Argentina	20	Iceland	39	Saudi Arabia
2	Australia	21	Ireland	40	Seychelles
3	Austria	22	Israel	41	Singapore
4	Bahrain	23	Italy	42	Slovakia
5	Belgium	24	Japan	43	Slovenia
6	Brunei	25	South Korea	44	Spain
7	Canada	26	Kuwait	45	Sweden
8	Chile	27	Latvia	46	Switzerland
9	Croatia	28	Lithuania	47	Taiwan
10	Cyprus	29	Luxembourg	48	Trinidad and Tobago
11	Czech Republic	30	Malta	49	UAE
12	Denmark	31	Netherlands	50	UK
13	Estonia	32	New Zealand	51	USA
14	Finland	33	Norway	52	Uruguay
15	France	34	Oman		
16	Germany	35	Panama		
17	Greece	36	Poland		
18	Hong Kong	37	Portugal		
19	Hungary	38	Qatar		
Upper-middle income					
1	Albania	13	Ecuador	25	Namibia
2	Algeria	14	Guatemala	26	Paraguay
3	Armenia	15	Iran	27	Peru
4	Azerbaijan	16	Jamaica	28	Romania
5	Bosnia	17	Jordan	29	Russian
6	Botswana	18	Kazakhstan	30	Serbia
7	Brazil	19	Lebanon	31	South Africa
8	Bulgaria	20	Macedonia	32	Thailand
9	China	21	Malaysia	33	Turkey
10	Colombia	22	Mauritius	34	Venezuela
11	Costa Rica	23	Mexico		
12	Dominican Republic	24	Montenegro		

Lower-middle income					
1	Angola	12	Ghana	23	Morocco
2	Bangladesh	13	Honduras	24	Nicarag
3	Bolivia	14	India	25	Nigeria
4	Cambodi	15	Indonesia	26	Pakistan
5	Cameroo	16	Kenya	27	Philippines
6	Cape Verde	17	Kyrgyzstan	28	Sri Lanka
7	Côte d'Ivoire	18	Lao PDR	29	Tunisia
8	Egypt	19	Lesotho	30	Ukraine
9	El Salvador	20	Mauritania	31	Viet Nam
10	Eswatin	21	Moldova	32	Zambia
11	Georgia	22	Mongolia		
Low-income					
1	Benin	9	Haiti	17	Sierra Leone
2	Burkina	10	Liberia	18	Tajikistan
3	Burundi	11	Malawi	19	Tanzania
4	Chad	12	Mali	20	Uganda
5	Congo,	13	Mozambique	21	Yemen
6	Ethiopia	14	Nepal	22	Zimbabwe
7	Gambia	15	Rwanda		
8	Guinea	16	Senegal		

Note: The list includes all the 140 countries captured in the GCI 4.0 Report 2018

Impact of working capital management on the profitability of smes through cash operation cycles in Kumasi

Genesis Gyasi Sah

A business ought to be able to breed an adequate amount of cash and cash equivalent to meet its short-term liabilities if it is to carry on and develop in business. For that reason, working capital management which helps an entity to, efficiently and effectively manage current assets and liabilities is a key factor in the company's long-term success; without working capital, the non- current assets will not function. The better the degree to which current assets exceed current liability, the more solvent or liquid a company is likely to be.

This paper observes the relationship between working capital management practices of small and medium enterprises (SMEs) and the performance and profitability of these businesses in the Kumasi Metropolis distinctively Asafo, to evaluate key ratios of industries of such working capital management policies in ensuring that current assets meets current liabilities, to assess the degree to which management of SMEs are dedicated to the effective and efficient management of working capital. The implication of the findings is that the government of Ghana should pursue policies aimed at encouraging training and improving the managerial skills of SME owner/managers as well as creating the enabling environment for the development of improved modern technologies to transform the business processes of these vital industries.

Keywords: small medium enterprises, working capital, profitability Ghana

1. Background of the study

An organization`s financial performance has usually been measured with its ability to gain surplus revenue over expenditure or profit for the period. In most performance standards, a successful organization is usually deemed as the one with the higher profit (or profit on capital employed ratio).

Simply generating profit cannot be the only motive for engaging in business activities as profit in itself does not guarantee the availability of liquid resources to finance further business operations. Considering that revenue and profits can be recognized as earned when cash has not yet been received, companies may record high profits and still have to contend with liquidity problems in the form of inability to provide cash and cash equivalents to finance operating activities. This has created the awareness of the need for organizations to adopt policies and programmed toward the management of their working capital since the organizations" success of both long and short term decisions depend on it.

Long-term investment and financing decisions give rise to future cash flow which, when discounted by an appropriate cost of capital, determine the market value of a company. However, such long-term decisions will only result in the expected benefits for a company if attention is also paid to short-term decisions regarding current

assets and liabilities. Current assets and liabilities, that is, assets and liabilities with maturities of less than one year, need to be carefully managed (Watson–Head 2016).

Several indicators have shown that working capital management plays a pivotal role in keeping the wheels of a business enterprise running (Kishore 2008). By definition, working capital management refers to all management decisions and actions that influence the size and effectiveness of the working capital. It is that portion of a firm`s capital invested in short term or current assets to carry on its day to day operations smoothly (Kishore 2008). It emphasizes the management of currents assets, current liability and the relationships that exist between them. In other words, working capital management may be defined as the management of firm`s liquid assets that is cash, account receivable, market securities and inventories and its current liabilities such as accounts payable, outstanding expenses, short term borrowings among others (Chowdhury–Amin 2007). The requirement of working capital varies from firm to firm depending upon the nature of business, production policy, market conditions, seasonality of operations, conditions of supply etc. (Kishore 2008).

Working capital which considers the ability of an organization to meet its current liabilities (trade creditors, short term loan, expenses owing) with its current assets(cash, bank, debtors and stock) by measuring its liquidity in the form of current and acid test ratios will need to be managed for the success of the company.

To prevent liquidation or bankruptcy, most companies have taken various policies like just-in-time stock policies, investing surplus cash, credit control system, factoring, buffer stock and lead time policies, credit analysis system, invoice discounting, debtor collection system and others. Many of the recent cases of Small and Medium Scale Enterprises collapse might have been avoided if owners/managers had been in a position to interpret the early signs of collapse. Existing financial models provide some indication of how to avoid failure, but these need to be supplemented by a holistic, strategic management approach (Buttery–Shadur 1991).

The working capital cycle of a business can either gobble up more than its fair share of cash or it can be managed as an efficient cash flow system. If managed, it can become one of the company's most significant competitive advantages (Kaufman 2009).

This study therefore seeks to assess the impact of working capital on the profitability of Small and Medium Scale Enterprises within the Kumasi Metropolises by using Cash Operation Cycle. Working Capital Management is therefore necessary for the success of any organization and must not be underestimated in meeting long-term corporate goals.

2. Literature Review

This chapter discusses and reviews existing literature on the subject matter from a general perspective. A lot of studies have been conducted on the subject of working capital management and small and medium sized enterprises (SMEs) on the international as well as national levels but not necessary in the study area. Hence, the review of this subject is based on literature by both foreign researchers and local ones.

There are a lot of factors that are considered in relation to working capital management; Definition, Management of Inventories, Management of Debtors,

Management of Cash, Management of Trade Payables, Objectives of Working Capital Management, Level of Working Capital, Short-term Finance, Financing Working Capital, Cash Operating Cycle and Overtrading.

But this paper seems to focus on the use of Cash Operation Cycle. The chapter also looked at Definition, Role and Impact, and Challenges of SMEs as well as SMEs and Working Capital Management.

3. Working Capital Management

Working Capital Management is the functional area of finance that covers all the current accounts of the firm. It is concerned with the adequacy of current assets as well as the level of risk posed by current liabilities. It is a discipline that seeks proper policies for managing current assets and liabilities and practical techniques for maximizing the benefit from managing working capital (Hampton 2007).

Further, Working capital management is our ability to effectively and efficiently control current assets and current liabilities in a manner that will provide a firm with maximum return on its assets and will minimize payment for its liabilities (Adelman–Marks 2007).

According to Baghiyan (2013), "proper selection and management of working capital management policies can create competitive advantage" and brings about improved management of companies. However, these ratios have to be constantly reevaluated for each industry and situation given uncertainties in the business environment caused by political instability, weakening law and order, wars, technological developments, monetary shortage, food and energy crises and high business operational costs (Baghiyan 2013, Satish 2014). Furthermore, Satish (2014) noted the lack of current theories, models, and survey based studies in the area of WCM.

Working capital management is the administration of the firm`s current assets namely; cash and marketable securities, receivables, and inventory and the financing (especially current liabilities) needed to support these current assets (Horne–Wachowicz 2008). Again, it refers to all management decisions and actions that influence the size and effectiveness of the working capital.

Watson and Head 2007 identified that the level of current assets is a key factor in a company‟s liquidity position. A company must have or be able to generate enough cash to meet its short- term needs if it is to continue in business. Therefore, working capital management is a key factor in the company‟s long-term success: without the „oil‟ of working capital, the „engine‟ of fixed assets will not function. The greater the extent to which current assets exceed current liabilities, the more solvent or liquid a company is likely to be, depending on the nature of its current assets.

Management of associated cash inflows and outflows is the basic aim of managing each of the components. Selected solutions must result in acceptable cash flows, and also produce a return in excess of costs (Thachappilly 2009).

The major elements of current assets are: Stocks, Trade Debtors and Cash (in hand and at bank) whereas the major elements of current liabilities are Trade creditors and Bank overdraft (Atrill 2000)

According to Vishnani and Shah (2007), a company`s inventory management policy, debtors" management policy and creditors" management policy play an important role in its profitability performance. Managers should give due attention towards policy formulation in this regard as well as implementation of such working capital policies. From their findings, they advised managers to see for themselves the practices followed by their peers in the area of working capital management. Corporate value is enhanced when return on capital employed (ROCE), a function of working capital management, exceeds cost of capital, a function of capital investment decisions.

4. Management of Inventories

Firms can produce or purchase raw materials, they can also produce to meet order or produce in block. The costs of holding inventories must be set against its benefits. Money tied up in inventories does not earn interest; storage and insurance must be paid for; and there a risk of spillage or obsolescence. Therefore, production managers need to strike a sensible balance between the benefits of holding inventories and the costs (Brealey et al. 2006).

Given the large variety of products that are manufactured and marketed, and hundreds of different raw materials used by a company, accurate forecasting of inventory is very important for effective working capital management. A wrong forecast can lead to piles of inventory, thus blocking unnecessary investment and increasing storage cost as well as the risk of damage associated with perishable items (Ahuja–Sweta 2007).

According to Watson and Head, 2016, the benefits of holding stock must be weighed against any costs incurred. They identified the costs which may be incurred for holding stock as holding costs, replacement costs, the cost of the stock itself and the opportunity cost of cash tied up in stock. The economic order quantity, buffer stocks and lead times or a just-in-time policy must be adopted for effective and efficient management of stock.

5. Management of Cash

Cash management, which is part of the wider task of treasury management, is considered with optimizing the amount of cash available, maximizing the interest earned by spare funds not required immediately and reducing losses caused by delays in the transmission of funds. Companies need to hold cash for transactions motive, precautionary motive and speculative motive.

Although cash can be held for each of the reasons identified, it may not always be necessary to hold cash for these purposes. The decision as to how much a particular business should hold is influenced by the nature of the business, the opportunity cost of holding cash, the level of inflation, the availability of near- liquid assets, the availability of borrowing, the cost of borrowing, the economic conditions and the relationship with suppliers. According to Watson and Head (2016) and Atrill (2000)

companies need to determine the optimum cash levels, solve cash flow problems, prepare cash budgets and manage cash flows by the use of cash flow forecast.

A cash flow forecast is a detailed forecast of cash inflows and outflows incorporating both revenue and capital items. A cash flow forecast is thus a statement in which estimated future cash receipts and payments are tabulated in such a way as to show the forecast cash balance of a business at defined intervals. A cash flow forecast shows the cash effect of all plans made within the flow of forecastary processes and also gives management an indication of potential problems that could arise and allows them the opportunity to take action to avoid such problems. A cash flow forecast can show four positions: short-term surplus, short-term deficits, long-term surplus and long-term deficits. The optimal cash holding levels can be calculated from formal models, such as the Baumol model and the Miller- Orr model (ACCA 2009).

6. Objectives of Working Capital Management

Working capital management is highly important in firms as it is used to generate further returns for the stakeholders. When working capital is managed improperly, allocating more than enough of it will render management non-efficient and reduce the benefits of short term investments. On the other hand, if working capital is too low, the company may miss a lot of profitable investment opportunities or suffer short term liquidity crisis, leading to degradation of company credit, as it cannot respond effectively to temporary capital requirements (Afza–Nazir 2008).

According to Gitman (2009) the objective of Working Capital Management (WCM) is to minimise the Cash Conversion Cycle (CCC) the amount of capital tied up in the firm's current assets. It focuses on controlling account receivables and their collection process, and managing the investment in inventory. Working capital management is vital for all business survival, sustainability and its direct impact on performance.

The two main objectives of working capital are to increase the profitability of a company and to ensure that it has sufficient liquidity to meet short term obligations as they fall due and so continue in business (Pass–Pike 1984).

Maintaining adequate working capital is not just important in the short term but adequate liquidity is needed to ensure the survival of the business in the long term. An excessively conservative approach to working capital management resulting in high level of cash holding will harm profit because the opportunity to make a return on the assets tied up as cash will have been missed. The two main objectives will often conflict as liquid assets give the lowest returns (ACCA 2009).

Profitability is related to the goal of shareholder wealth maximization, so investments in current assets should be made only if an acceptable return is obtained while liquidity is needed for a company to continue in business, a company may choose to hold more cash than is needed for operational or transaction needs, for example for precautionary and speculative reasons (Watson–Head 2007).

7. Level of Working Capital

There are three levels of working capital management; aggressive, conservative and moderate policy. A company''s working capital policy can be characterized as aggressive, moderate or conservative only by comparing them with the working capital policies of similar companies.

An aggressive policy is where a company chooses to operate with lower levels of stock, debtors and cash as well as delaying payment to suppliers for a given level of activity or sales. This policy increases profitability since less cash will be tied up in current assets but will also increase risks since the possibility of cash shortages or stock outs is increased. A conservative policy is associated with maintaining a larger cash balance, offering more generous credit terms to customers and holding higher levels of stock. Suppliers are paid promptly to ensure their goodwill. Such a policy lowers risk of financial or stock problems but at the expense of reducing profitability. A moderate policy will tread a middle path between the aggressive and conservative approaches (ACCA 2009, Watson–Head 2007)

8. Cash Operating Cycle

The cash operating cycle is the period of time which elapses between the point at which cash begins to be expended on the production of a product and the collection of cash from a purchaser (ACCA 2009).

Figure 1 The Firm's Operating Cycle and Its Impact on the Firm's Balance Sheet

Source: http://www.drawpack.com

When managing cash it is important to be aware of the operating cash cycle of the business. The payment for goods acquired on credit occurs sometime after the goods have been purchased and, therefore, no immediate cash outflow arises from the purchase. Similarly, cash receipts from debtors will occur sometime after the sale is made and so there will be no immediate cash inflow as a result of the sale. The operating cash cycle is important because it has a significant influence on the financing requirements of the business. The longer the cash cycles the greater the financing requirements of the business and the greater the financial risks. For this reason, a business is likely to want to reduce the operating cash cycle to a minimum (Atrill 2000).

9. Overtrading

Overtrading (also called undercapitalization) occurs if a company is trying to support too large a volume a trade from too small a working capital base. Overtrading can arise in the early years of a new business if it starts off with insufficient capital (Watson–Head 2007). Overtrading happens when a business tries to do too much too quickly with too little long-term capital, so that it is trying to support too large a volume of trade with the capital resources at its disposal. Even if an overtrading business operates at a profit, it could easily run into serious trouble because it is short of money. Symptoms of overtrading are rapid increase in turnover, rapid increase in volume of current assets, small increase in proprietors" capital and some debt ratios and liquidity ratios alter dramatically (ACCA 2009).

According to Atrill (2000), overtrading usually reflects a poor level of financial control over the business. It results in liquidity problems such as exceeding borrowing limits, slow repayment of lenders and creditors, and so on. It can also result in suppliers withholding supplies, thereby making it difficult to meet customer needs. A business may collapse because it cannot meet its maturing obligations.

10. The Concept of Small and Medium Scale Enterprises (SMEs) Introduced

The term SME covers a assorted group of businesses in a developing economy, ranging from a single artisan working in a small shop making handicrafts for a village market to sophisticated engineering firms selling in overseas markets (Reuber–Fischer 2003).

There are various criteria to distinguish an SME from a large firm. According to (Wignaraja 2003) three possible criteria are: the number of employees, the value of sales and the value of production equipment. Each of these can be useful depending on the purpose at hand. Although the definition varies between developing countries, SMEs are commonly defined by employment because it is readily available. Setting a cut-off point between an SME and a large firm is difficult and can vary depending on the level of development, the structure of an economy, sectoral characteristics and the nature of given production technologies. Ultimately, it becomes a matter of judgment as to what is appropriate to the specific context.

According to Hussain (2000) SMEs have been defined according to size, turnover, activity, ownership and legal status. There is, however, an emerging consensus that size (i.e., number of employees) may be the most appropriate defining characteristic, given the heterogeneity of enterprises operating in this sector. SMEs may, therefore, be defined as firms employing less than 100 employees while entities with less than ten employees are categorized as micro-enterprises (MEs).

Although this sector has not been largely enumerated, available estimates suggest that SMEs account for roughly 60 percent of the workforce and 25 percent of industrial output in value terms in Africa. Wynarczyk et al (1993) identified the other characteristics of the small firm than size. They argued that there are three ways of differentiating between small and large firms. The small firm has to deal with:

(a) Uncertainty associated with being a price taker;
(b) Limited customer and product base;
(c) Uncertainty associated with greater diversity of objectives as compared with large firms.

11. SMEs Internationally Defined

UNIDO (1983) considers the number of employees as the sole yardstick for determining an SME. According to their definition for developing countries, medium firms are firms with an employee size between the range of 20 and 99. Small firms, on the other hand, covers firms with employee size of between 5 and 19 while micro firms employ less than 5 workers (Elaian 1996).

The USAID, on the other hand, did not consider fixed assets in their definition. In the 1990s, they described Small and Medium Scale Enterprises as firms with less than 50 employees and at least half the output sold (Kayanula–Quartey 2000).

The European Commission in 2005 in their definition qualifies enterprises as micro, small and medium-sized enterprises (SMEs) if they fulfill the criteria laid in Table 1. In addition to the staff headcount ceiling, an enterprise qualifis as an SME if it meets either the turnover ceiling or the balance sheet ceiling, but not necessarily both.

Table 1 European Commission's definition of SMEs

Enterprise category	Headcount	Turnover	Balance sheet total
medium-sized	< 250	≤ € 50 million	≤ € 43 million
Small	< 50	≤ € 10 million	≤ € 10 million
Micro	< 10	≤ € 2 million	≤ € 2 million

Source: European Commission (2005)

The Bolton Committee in 1971 employed different definitions of the small firm to different sectors as given in Table

Table 2 Bolton Committee's definition of SMEs

Sector	Definitions
Manufacturing	200 employees or less
Construction	25 employees or less
Mining & Quarrying	25 employees or less
Retailing	Turnover of 50,000 pounds or less
Miscellaneous	Turnover of 50,000 pounds or less
Services	Turnover of 50,000 pounds or less
Motor Trades	Turnover of 100,000 pounds or less
Wholesale Trades	Turnover of 200,000 pounds or less
Road Transport	Five Vehicles or less
Catering	All excluding multiples and Brewery- managed houses

Source: The Bolton Committee (1971)

The best description of the key characteristics of a small firm remains that used by the Bolton Committee in its 1971 Report on Small Firms in the table above. This stated that a small firm is an independent business, managed by its owner or part-owners and having a small market share.

The Bolton Report also adopted a number of different statistical definitions. It recognised that size is relevant to sector - i.e. a firm of a given size could be small in relation to one sector where the market is large and there are many competitors; whereas a firm of similar proportions could be considered large in another sector with fewer players and/or generally smaller firms within it.

Similarly, it recognized that it may be more appropriate to define size by the number of employees in some sectors but more appropriate to use turnover in others. Across government, it is most usual to measure size according to numbers of full-time employees or their equivalent.

Table 3 Other SME Definitions Used by Multilateral Institutions

Institution	Maximum number of Employees	Maximum Revenue or Turnover ($)	Maximum Assets ($)
World Bank	300	15,000,000	15,000,000
MIF-IADB	100	3000,000	None
African Development Bank	50	None	None
Asian Development Bank	No official definition. Uses only definitions of individual national governments		
UNDP	200	None	None

Source: Gibson, T. – van der Vaart, H. J. (2008) Definitions by other multilateral organizations are given in Table 3.

12. Ghanaian Definitions of SMEs

In Ghana, SMEs have been defined by various institutions.
The National Board for Small Scale Industries (NBSSI) classifies SMEs into:

- Micro Enterprises; Enterprises employing up to 5 employees with fixed assets not exceeding $10,000
- Small Enterprises; Employing between 6 and 29 employees with fixed assets of up to $100,000
- Medium Enterprises; Employing between 30 and 99 employees with fixed assets of up to $1,000,000.

The Ghana Statistical Service (GSS) considers firms with less than 10 employees as Small Scale Enterprises and their counterparts with more than 10 employees as Medium and Large-Sized Enterprises. Ironically, The GSS in its national accounts considered companies with up to 9 employees as Small and Medium Enterprises. The Ghana Enterprise Development Commission (GEDC) on the other hand uses a 10 million Cedis upper limit definition for plant and machinery (Kayanula–Quartey 2000).

Steel and Webster (1990) and Osei et al. (1993) in defining Small Scale Enterprises in Ghana used an employment cut off point of 30 employees to indicate Small Scale Enterprises. The latter however dis-aggregated small scale enterprises into three categories:

- Micro -employing less than 6 people;
- Very small, those employing 6–9 people;
- Small -between 10 and 29 employees

Financial accounting and control systems are very important for small businesses, especially at the start-up and development stages when SMEs" needs for investment and working capital are greatest. However, these are also the times when institutional credit is comparatively much more difficult to obtain by them.

13. Challenges Faced by SMEs

The success or failure of new business is often dependent on overcoming a series of potential barriers, such as securing financial backing, adequate and appropriate guidance and training (Fielden et al. 2000). UNCTAD (2001) recognized that many financial institutions in developed and developing countries find it difficult to serve small and medium-sized enterprises (SMEs) because of high perceived risk and high transaction costs and lack of experienced personnel and appropriate corporate structures, which bias them against SMEs.

Bharadwaj (2009) identified three main challenges that need to be addressed by SMEs: penetrate the market, access finance, skilled power and infrastructure and lastly influence the external environment and check unfair trade practices and illegal dealings. Despite the important role of SMEs in the economy, their growth is often constrained by the lack of capital, among other impediments such as regulatory red tape. Their small size, lack of credit ratings and the generally underdeveloped capital markets in the region deny SMEs access to bond and equity financing. Banks are also reluctant to lend to SMEs or charge them a high interest rate, since SMEs usually do not have strong credit history and cannot provide substantial collateral (Pang 2008).

In Ghana, the challenges of SMEs have been identified as input constraints, inadequate finance, limited skilled labour, poor equipment and technology, poor market for produce and legal constraints (Kayanula–Quartey 2000).

I also see the current major challenge to the SME`s as lack of quality working capital management because the past and present governments have implemented various policies to revamp the private sector with special attention to SME` seen as the drivers of economic growth and poverty reduction. The National Board for Small Scale Industries (NBSSI), the Business Advisory Center and the Ministry of Trade and Industry Private Sector development and the Presidential Special initiatives were consequently established to provide special advice and support to SMEs to enable them identify the growth opportunities available to them and measures they can take to expand their business. But the problem for most is their ability to manage the working capital very well because most of the owners finds it difficult to employ a qualify accountant to help them making financial decisions such cash operation circle, inventory management, debtors management etc.

14. SMEs and Working Capital Management

Adequate working capital and working capital management are critical in the survival and success of Small and Medium-Sized Enterprises (SMEs). Most owners/ managers have experienced at some point in the life of their enterprises the impact of lost sales and business opportunities due to the inability to purchase stock; or having to juggle payments between supplies or long delays in collecting receivables and finding the right balance between sales and credit to customers (CBSL 2007).

Managers of SMEs can create value by reducing their inventories and the number of days for which their accounts are outstanding. Moreover, shortening the cash conversion cycle also improves the firm's profitability (Garcia-Teruel–Martinez-Solano 2007).

According to Uyar (2009), there is a significant negative correlation between the Cash Conversion Cycle (CCC) and the firm size in terms of both net sales and total assets. This means the larger the firm size, the shorter the CCC or the smaller the firm size, the longer the CCC. This finding indicates that the smaller firms should look for ways to shorten their CCC by shortening inventory period and accounts receivable period, lengthening accounts payable period.

As pointed out by most authors, the general characteristics of SMEs make it difficult for them to employ the required skilled personnel needed for the effective and efficient management of working capital. In addition to this, most SMEs have no working capital policies and therefore usually go out of business due to lack of funds to run the day-to-day activities of the business.

As pointed out by Parker et al, 1995 Access to finance remained a dominant constraint to small scale enterprises in Ghana. In their survey, credit constraints pertaining to working capital and raw materials were cited by respondents (small business owners). Owners of failed businesses often point to shortages of working capital as the prime cause of business failure (Brough 1970, Hall–Young 1991, Hall 1992).

This failure can be attributed to the fact that most businesses fail to efficiently implement good working capital policies. This is evident in the research conducted by Prasad 2001 on the working capital management in paper industry. His sample consisted of 21 paper mills from large, medium and small scale for a period of 10 years. He reported that the chief executives properly recognised the role of efficient use of working capital in liquidity and profitability, but in practice they could not achieve it. The study also revealed that fifty percent of the executives followed budgetary method in planning working capital and working capital management was inefficient due to sub-optimum utilisation of working capital.

According to UNCTAD (2001) SMEs in India receive assistance from The Small Industries Development Bank of India (SIDBI) through direct financing which includes loans to finance their working capital. Venture Capital is another important source of Finance for SMEs. Most entrepreneurs (SMEs in Ghana) see the establishment of the venture capital industry as the solution to their financial difficulties; however they would want the venture capital firms to relax their criteria and conditions a little bit so that more of the SMEs can benefit from this source of finance. It also came up that, venture capital accounts for only a small part of SME financing (fewer than 2%) concentrated in certain industries (Poku–Frimpong 2009).

In Ghana, projects currently on-going for the MSME sector include the Financial Sector Improvement Project, Financial Sector Strategic Plan (FINSSP), the Rural Financial Services Project (RFSP), the United Nations Development Programme (UNDP) Microfinance Project, the Social Investment Fund (SIF), the Community Based Rural Development Programme (CBRDP), Rural Enterprise Project (REP), and Agricultural Services Investment Project (ASSIP). A recent impact assessment of MSME financing programs that have been implemented across the country suggests that significant challenges remain in ensuring the effectiveness of MSME programs.

The study found that access to finance and low cash flow was a significant problem for MSMEs (Asiama–Osei 2007).

15. Small Medium Enterprise Profitability

Profitability is the primary goal of all business ventures, without profitability the business will not survive in the long run. Profitability is measured with an income statement (or profit and loss statement). This is essentially a listing of income and expenses during a period of time (usually a year) for the entire business. Profitability can be interpreted as a ratio, which expresses the rate of the profit amount benchmarked against some point of reference in percent. As decision tools profitability ratios can be used to assess the financial health of a business. Profitability can be defined as either accounting profit or economic profit.

Accounting profit (or net income) is the difference between the revenues and expenses of a company in a given period presented by the income statement. Accounting profit can give a view of the viability of the business. Although one year of losses may not permanently harm the business, consecutive years of losses (or net income insufficient to cover living expenditures) may jeopardize the viability of business.

The concept of Economic profit based on the following logical consequences: in addition to deducting business expenses, opportunity costs are also deducted when computing economic profit. Profitability is one of the most important objectives of financial management because one goal of financial management is to maximize the owner`s wealth (McMahon 1995). Growth, profitability, cash flow for short-term are important for the survival of enterprises, while all these may at times be critical performance goals for organizations, the drive for profitability may be most important in smaller owner-operated firms.

Three important ratios of profitability are return on sales (ROS), return on assets (ROA) and return on equity (ROE). Return on sales: is computed by dividing profits by total operating revenue. Return on assets: is the ratio of income to average total assets. Return on equity: is defined as net income divided by average stockholders‟ equity.

16. Impact of Working capital management on Profitability

First, it considers the most recent pool of literature related to WCM. Second, unlike Singh and Kumar (2014), this study does not aim to analyze only the existing literature on certain themes such as impact of WC on profitability of the firms. Rather, its purpose is to take a complete stock of literature, classify them on different themes, and then identify some future scopes of research

Until recently, the main advances in financial research in business were in the fields of long-term investment and financial decision-making. Short-term financing received less attention, probably because of its small impact on organization (Singh–Kumar 2014). Things seem to have changed significantly, however, since the drop in corporate performance during the financial crisis starting in 2007. Whereas in the earlier research on WC focused on analyzing how it was managed in different types of company and environment (Belt–Smith 1991, Kim et al. 1992), today, the

emphasis is on how WCM can issue capital for more deliberate objectives, reduce financial costs and improve profitability

According to the definition of Weston and Brigham (2005), "Working Capital refers to a firm`s investment in short-term assets, cash, short-term securities, accounts receivables and inventories". Working capital management is important because of its effects on the firm`s profitability and risk, and consequently its value (Smith 1980). On the one hand, maintaining high inventory levels reduces the cost of possible interruptions in the production process or of loss of business due to the scarcity of products, reduces supply costs, and protects against price fluctuations, among other advantages.

Decisions about how much to invest in the customer and inventory accounts, and how much credit to accept from suppliers, are reflected in the firm`s cash conversion cycle, which represents the average number of days between the date when the firm must start paying its suppliers and the date when it begins to collect payments from its customers. Some previous studies have used this measure to analyze whether shortening the cash conversion cycle has positive or negative effects on the firm"s profitability. Specifically, Shin and Soenen (1998) analyze the relation between the cash conversion cycle and profitability for a sample of firms listed on the US stock exchange during the period 1974–1994. Their results show that reducing the cash conversion cycle to a reasonable extent increases firms" profitability.

Deloof (2003) analyzes a sample of large Belgian firms during the period 1992–1996. His results confirm that Belgian firms can improve their profitability by reducing the number of day accounts receivable are outstanding and reducing inventories. Moreover, he finds that less profitable firms wait longer to pay their bills. Most of these companies" assets are in the form of current assets. Also, current liabilities are one of their main sources of external finance in view of their difficulties in obtaining funding in the long-term capital markets (Rajan–Petersen 1997) and the financing constraints that they face (Fazzari–Petersen 1993).

It was found out that small and medium-sized US firms use vendor financing when they have run out of debt. Thus, efficient working capital management is particularly important for smaller companies (Peel–Wilson 1996). A part from that, Teruel and Solano (2007), also find a significant negative relation between an SME"s profitability and the number of days accounts receivable and days of inventory. We cannot, however, confirm that the number of accounts payable affects an SME"s return on assets, as this relation loses significance when we control for possible problems.

Finally, SMEs have to be concerned with quality working capital management because they can also create value by reducing their cash conversion cycle to a minimum, as far as that is reasonable.

17. Conclusion

Businesses do not survive just because they make profits but also their ability to remain solvent plays a vital role in their sustainability. In other words, a business might report high accounting profits but face liquidity problems. Quality working

capital management that considers how an entity ensures that enough cash and cash equivalents are available to meet short term debts needs not be overemphasized in achieving organizational success. Most business failures have been as a result of poor working capital management.

It is no doubt that effective working capital management is essential to the success of every business. It plays an important role in maximizing shareholder wealth and increasing return from investments. SMEs can as a means of effectively managing working capital adopt tighter credit control, better methods of inventory management such as EOQ and also negotiate for better creditor days. Government agencies and bodies such as NBSSI could further enhance this course by devoting much attention to education and training on working capital management.

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The problem of economic growth in Sub-Saharan Africa – The case of Ghana, Republic of Congo, Kenya and Lesotho

Senanu Kwasi Klutse

A wide range of policy-related variables have a persistent influence on economic growth. This has consistently maintained the interest of economists on the determinants of economic growth over the years. There is consensus however that for countries to grow sustainably, a lot of stall must be placed on higher savings rate as this makes it easy for such countries to grow faster because they endogenously allocate more resources to inventive activities. Due to data difficulties in Sub-Saharan Africa (SSA) it is nearly impossible for one to consider important variables such as accumulation of knowledge and human capital when analysing growth sustainability.

Studying four lower middle-income countries in SSA – Ghana, Republic of Congo, Kenya and Lesotho – this study tests the hypothesis of sustainable growth by using a Dynamic Ordinary Least Square (DOLS) model to examine the relationship between savings, investment, budget deficit and the growth variable. The results showed that savings had a significant but negative relationship with the GDP per capita (PPP). A Granger Causality test conducted showed that savings does not granger cause GDP per capita (PPP), the HDI index, deficit and investment. This leads to the conclusion that growth in these countries are not sustainable. The study recommends that policy makers focus on the savings variable if these countries will want to achieve sustainable growth.

Keywords: Savings, Investment, GDP per Capita

1. Introduction

Aggregate economic performance in Sub-Saharan Africa (SSA) during the past decade have been robust. In most of these countries, high economic growth has translated into improved standard of living translating into poverty reduction and improved social indicators. In some of these countries (SSA) progress in these areas has fallen short of expectations. Despite this SSA is seen as the engine of World growth in the foreseeable future. A glance at various economic indicators will show that current growth in SSA is not leading to the desired improvements in the standard of living of its populace (see Figure 1).

Both domestic and external factors have contributed to this disproportionate overall performance. The external environment, characterized by sharp declines in world commodity prices and substantial losses in the terms of trade, has been generally unfavourable. Most countries in the SSA region have been confronted with deep-rooted developmental constraints including low human capital development and inadequate infrastructure which have constituted major impediments to private sector development and the supply response of economies in general (Ghura–Hadjimichael 1996).

Figure 1 Performance of SSA countries (selected indicators)
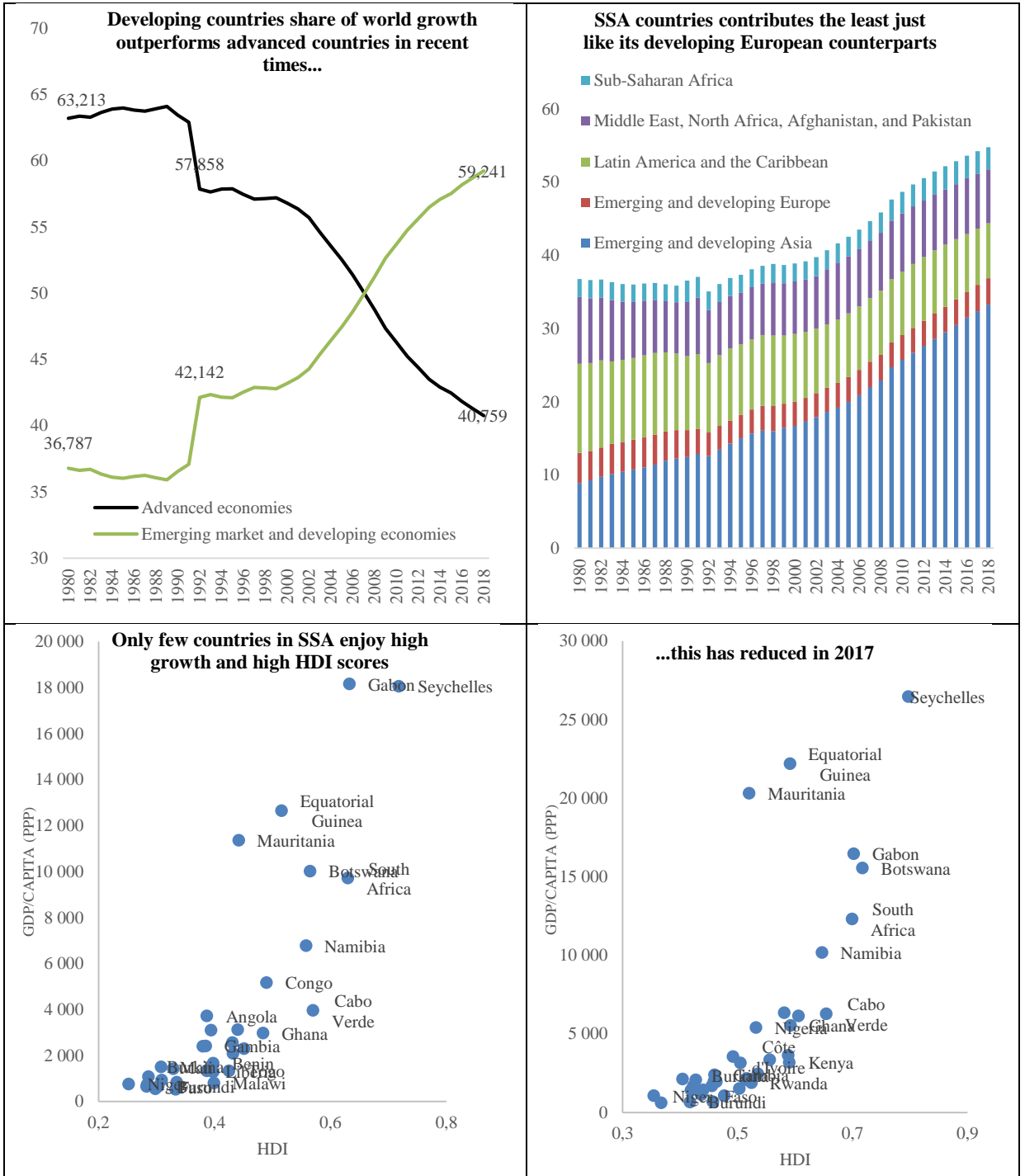
Though literature has been debating factors that are likely to keep developments of countries sustainable over long periods of time, there appear to be a consensus that economies with higher savings rate grow faster because they allocate (endogenously) more resources to inventive activities (Helpman 2004). The view that investment drives savings cannot also be ignored in this regard. These studies have however failed to link their findings to the issue of growth sustainability.

By using Ghana, Republic of Congo, Kenya and Lesotho as case studies this paper tested the hypothesis that the deficit, savings and investment have a significant effect on per capita GDP growth adjusted for by the purchasing power parity. The analysis showed that savings does not granger cause economic growth, the deficit and investment. The DOLS model estimated showed significant but negative relationship between the GDP per capita and all variables considered. The HDI on the other hand produced mixed results. These results point to the issue of sustainable growth which is expected to be driven by savings which is also the main catalyst for investment and growth. The Harrod –Domar growth model was thus not confirmed in this study.

The rest of this paper discusses various literature on the subject, the type of data and methodology employed, discussion of results and conclusion.

2. Theoretical Background and Literature Review

Growth has important implications for the welfare of individuals. In fact, aggregate growth is probably the single most important factor affecting individual levels of income. Data will suggest that the average person on the planet has been getting richer over time. A careful look at the data will reveal that inequality has increased along with economic growth (Barro et al. 2003). The emphasis over the years have been on the accumulation of physical (stock of machines, equipment and structures) and human (stock of education and training embodied in the labour force) capital as major forces behind income growth (Helpman 2004). This was an attempt to try and investigate why some countries are better off than others – a phenomenon Helpman (2004), refers to as the "two polarized clubs". This early attempt assumed technological change to be outside the influence of economic incentives (exogenous process). It focused more on the accumulation of physical and human capital.

Economists of the late 1950s led by Solow (1956, 1957), came out with the idea that growth of output can be decomposed into components that can be attributed to the growth of inputs and a residual growth rate that is not attributed to the growth on inputs (neoclassical growth model). The growth of output exceeds the contribution of inputs. The difference between the two is the rate of growth of total factor productivity. Like the early models of growth, the early proponents of the neoclassical growth models did not premise their arguments on technological change.

The neoclassical models without technological change predicts that the economy will converge to a steady state with zero per capita growth – the diminishing returns to capital problem. One way out of the problem was to broaden the concept of capital notably to include human components and then assume that the diminishing returns did not apply to this broader class of capital – the non-rival nature of technology problem (Barro et al. 2003).

Romer (1986) and Lucas (1988) discovered that the model proposed by Solow (1956, 1957) predicts declining growths which contradicts the real-world situation were growth rates has accelerated overtime. They proposed models that emphasizes externalities in the accumulation of knowledge and human capital respectively (Helpman 2004). The idea here is that the stock of knowledge rises over time as firms invest in knowledge accumulation. Therefore, each firm has an incentive to invest in private knowledge. However, this investment contributes to the aggregate public stock of knowledge hence the externality. For externalities in human capital Lucas's (1988) model, viewed human capital as a measure of skills that can expand without bound. Under these circumstances human capital accumulation can serve as a source of permanent long-run growth. This according to him was a better measurement compared to empirical researchers use measures of human capital that are based on years of schooling. In this event, human capital per person cannot grow without bound, because individual lifetimes are finite. As a result, the growth of human capital cannot be a source of permanent economic expansion.

The clear distinction between the growth theory of the 1960s and that of the 1990s is that recent research pays close attention to empirical implications and to the relationship between theory and data. However, it still requires empirical hypothesis from the older theory, notably the neoclassical growth model's prediction of conditional convergence (Barro et al. 2003). Developed economies have the capabilities to measure these indicators – human capital as a measure of skills and knowledge. For instance, in attempt to measure knowledge, it is assumed the Research and Development (R&D) creates new knowledge. As a result, if knowledge externalities do exist, they should show up in R&D activities. Here the private return of R&D depends on institutional features such as the length of patent protection. The stock of knowledge available to innovators is a function of past R&D efforts making it cheaper to do R&D today. R&D is effectively captured in the fiscal statements of most developed and advanced countries. The same cannot be said for most developing countries.

Romer (1990), identified technological features that lead to the balancing of these forces so that the incentive to innovate remains constant over time and as a result the resources deployed to R&D activities remain constant as well. An economy that follows this type of trajectory experiences a constant rate of productivity growth. Arguably, economies with higher savings rate grow faster because they allocate (endogenously) more resources to inventive activities – R&D (Helpman 2004). Helpman (2004), showed that productivity is even more important than these factors in explaining income differences and growth rate differences across countries. Thus, to understand the sources of economic growth, one must understand what causes productivity – the size of the coefficient that converts natural units of the inputs such as hours of labour or acres of land, into effective units of the inputs – growth.

Fujita (2016), Tang and Tan (2017), Agrawal (2001), Mohan (2006) and Saltz (1999) have all conducted studies to investigate the linkages between savings and economic growth in developed and developing economies. The causal relationship between savings and economic growth has also been studied in Sub-Saharan Africa (SSA). Odhiambo (2008, 2009) tested this relationship in Kenya and South Africa.

He used causality and co-integration test to analyse the relationship between the variables. The results showed a positive relationship between savings and economic growth in both countries.

In analysing this relationship in Sub-Saharan Africa (Kenya, Zimbabwe and Botswana), Elbadawi and Mwega (2000) showed that savings granger causes the increase in investment in these countries. They found at the time that Botswana was a country with lower private saving rate. Anoruo and Ahmad (2001) on the other hand investigated the relationship between savings and economic growth in Congo, Cote Ivoire, Ghana, Kenya, Nigeria, South Africa and Zambia using a vector error correction model. The result indicated that there is a long run relationship between economic growth and saving. Jagadeesh (2015) in his study of the relationship between savings and economic growth in Botswana found that there is significant relationship between Savings and Economic growth and the study supported Harrod Domar growth Model.

These studies notwithstanding, the causal relationship between savings and economic growth remains mixed. Just as corporations tend to fund themselves first by drawing upon internal funds, households and to some extent governments are expected to address funding problems by first relying on their savings (Setterfield–Kim 2016). The view that investment drives savings cannot also be ignored. This view is a Kalecki-Keynes theory which is different from the orthodox theory which states that savings rather drives investment. Atkinson and Hamilton (2003), explains the link between savings and natural resources by postulating that the measurement of sustainability is the finding of a negative and significant relationship between natural resource abundance and economic growth – which he terms the resource curse hypothesis. They conclude that countries that had lagged in terms of growth are those where among others have a low rate of genuine saving – net saving adjusted for resource depletion.

In investigating the determinants of per capita economic growth for a large sample of sub-Saharan African countries during 1981–1992, Ghura and Hadjimichael (1996) found that an increase in private investment has a positive impact on per capita growth and that growth is stimulated by public policies that lower the budget deficit in relation to GDP – without reducing government investment.

Taking note of the above literature it is clear the situation in developing countries is quite unique. Data availability problems on other important variables used to access the inclusiveness of the growth of a country is almost non-existent in SSA. This confirms the reason why studies in the SSA area focused on the savings, investment and the growth variable. These studies however did not consider the issue of growth sustainability. They were only interested in finding the relationship between these variables ignoring its implications. In other to bridge the gap in literature, this study poses the question whether it is possible for an economy to enjoy positive growth rates by simply saving and investing in capital stock? The focus will be on lower middle-income countries in SSA for which data is available. The objective will be to identify the relationship between savings, investment, budget deficit and the growth variable. This will be expected to give an indication of whether growth in these countries are sustainable or not.

3. Data and Methodology

The clear distinction between the growth theories of the 1960s and that of the 1990s is that recent research pays close attention to empirical implications and to the relationship between theory and data. However, it still requires empirical hypothesis from the older theory, notably the neoclassical growth model's prediction of conditional convergence.

Barro et al. (2003) used a 3 Stage Least Squares method to show how growth impacts the welfare of individuals. The dependent variable in their case was the growth rates per capita GDP. The explanatory variables included the log per capita GDP, male upper leaving schooling, squared openness ratio, inflation rate and some dummies.

Other studies have used different methods to establish the relationship between savings and the growth variable. Jagadeesh (2015) applied the Harrod–Domar growth model to the economy of Botswana based on an Auto Regressive Distributed Lagged (ARDL) model to check the existence of a long run relationship between Gross Domestic Product and Gross Domestic savings. Tang and Tan (2017), Odhiambo (2008, 2009), Elbadawi and Mwega (2000) and Anoruo and Ahmad (2001) all used causality tests to establish the relationship between savings and the growth variable. They found that savings and investment both granger cause growth. In the case of Anoruo and Ahmad (2001), a vector error correction model was also used.

Using a modification of the model proposed by Barro et al. (2003) and the Harrod –Domar growth model, this study will test whether the deficit, investment and savings have any significant relationship with the growth variable. Unlike Barro et al. (2003), the models will not include other social indicators. As discussed earlier a good model will definitely have to account for many factors – R&D, labour productivity, openness ratio and etc. These other factors are hard to measure bearing in mind also how to appropriately weigh each of them. In the case of SSA countries the possibility of having verifiable data on these other social variables is next to zero. In this case the Harrold-Domar model is the suitable model to be used to show this relationship. The theory describes a mechanism by which more savings leads to more economic growth because savings leads to investment and it leads to capital formation.

We will thus assume that for developing countries to achieve economic growth, the government in that country need to encourage savings bearing in mind also the importance of other factors.

Out of a population of twelve (12) SSA countries classified by the World Bank in 2018-2019 to be lower middle-income countries, this study will focus on a sample of four (4) countries out of the 12 – data availability was a limiting criterion. Data for this study was sourced from the International Monetary Fund's (IMFs) World Economic Outlook (WEO) database released in April, 2019 and also the World Bank's Human Development index.

The regression equations to be estimated are as follows:

$$\text{LnGDP\_CAP\_PPP}_t = \alpha + \beta\text{DEF}_t + \gamma\text{LnSAV}_t + \lambda Ln\text{INV}_t + \mu_t \qquad (1)$$

$$\text{HDI}_t = \alpha + \beta\text{DEF}_t + \gamma\text{LnSAV}_t + \lambda\text{LnINV}_t + \mu_t \qquad (2)$$

where the GDP_CAP_PPP is the Gross domestic product per capita at constant prices (Purchasing power parity; 2011 international dollars) thus, GDP expressed in constant international dollars per person. Data is derived by dividing constant price purchasing-power parity (PPP) GDP by total population. DEF is the budget deficit – expressed in US$ – calculated as revenue minus total expenditure. This balance may be viewed as an indicator of the financial impact of general government activity on the rest of the economy and non-residents. SAV is the gross national savings expressed in percentage of GDP. It is gross disposable income less final consumption expenditure after taking account of an adjustment for pension funds. INV is total investment expressed in percentage of GDP. It is measured by the total value of the gross fixed capital formation and changes in inventories and acquisitions less disposals of valuables for a unit or sector.

A Johansen Fisher Panel Cointegration Test was conduct on the data set with a no deterministic trend assumption. The results showed that there were at most three cointegrated relationships between the variables in the data set. Due to this result, this study adopts a cointegrated panel regression model - Panel Dynamic Least Squares (DOLS) – which is robust in handling variables that are cointegrated.

The DOLS model used here is an extension of the models proposed by Saikkonen (1992) and Stock and Watson (1993) which was applied to a panel data settings. This can be achieved by augmenting the panel cointegrating regression equation with cross-section specific lags and leads of ΔX_{it} to eliminate the asymptotic endogeneity and serial correlation. For the pooled DOLS estimator, an OLS method is used to estimate an augmented cointegrating regression equation of the form below.

$$y_{it} = X_{it}'\beta + \sum_{j=-q_i}^{r_i} \Delta X_{it} +'_j \delta_i - v_{1it} \tag{3}$$

Where y_{it} and X_{it} are the data purged of the individual deterministic trends. The short-run dynamics coefficients δ_i are allowed to be cross-section specific. The pooled DOLS estimator may be written as

$$\begin{bmatrix} \hat{\beta}DP \\ \hat{\gamma}DP \end{bmatrix} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} W_{it} W_{it}' \right)^{-1} \left(\sum_{i=1}^{N} \sum_{t=1}^{T} W_{it} y_{it}' \right) \tag{4}$$

$$W_{it}' = (X_{it}', Z_{it}')' \tag{5}$$

Where Z_{it} are the regressors formed by interacting the ΔX_{it+j} terms with cross-section dummy variables. To estimate the asymptotic covariance matrix of $\hat{\beta}DP$, we use the following sub-matrix of:

$$V_{DP} = \hat{\omega}_{1.2} * \hat{M}_{DP}^{-1} \tag{6}$$

Where

$$\hat{M}_{DP} = \frac{1}{N} \sum_{i=1}^{N} \left(\frac{1}{T^2} \sum_{t=1}^{T} W_{it} W_{it}' \right) \tag{7}$$

And $\hat{\omega}_{1.2}$ is an estimator of the long-run residual variance.

4. Results and Analysis

The regression result is shown in Table 1 below. It shows that there is a negative relationship between the deficit to GDP; the log of savings; and the log of investment; and the log of GDP per capita. Among these, savings and investment had significant relationships with the GDP per capita. This will mean that savings and investment in these countries do not lead to economic growth as measured by the GDP per capita. This as mentioned earlier is implied in the negative relationship between the variables. The relationship between the deficit and the GDP per capita was as expected – negative – as an increase in the budget deficit hurts economic growth through expected taxation or borrowing in the future to cover the financing gap in a developing country setting. This relation was however not significant.

The HDI on the other hand had a positive relationship with the deficit and just like in the case of the GDP per capita was not significant in explaining and improvement in economic wellbeing in these countries. In the same vein there was also a non- significant and positive relationship between the HDI and investment in these countries, confirming the fact that investments in these countries were not significant in determining economic growth. Like in the case of equation 1, there is a significant but negative relationship between savings and the HDI. In this case the Harrold-Domar model cannot be substantiated as it appears more savings in these countries does not lead to economic growth or economic wellbeing. The reasons for the negative relationships could stem from the fact that the savings in these countries are not domestic in nature and also the profitability of the investments opportunity they offer may be very limited. Studies have it that the use of domestic savings for investment improves economic growth (Prasad and Rajan 2008).

Table 1 Regression output for equation 1 and 2

Independent Variable	Dependent Variable	
	LnGDP_CAP_PPP	HDI
DEFICIT_GDP	−0.00045	0.00007
	(−0.50723)	(0.24196)
LnSAV	−0.06461	−0.02042
	(−3.59771)*	(−3.70271)*
LnINV	−0.08357	0.01258
	(−3.25061)*	(1.59368)
R-squared	0.99879	0.99224

t-statistics in parenthesis (); Significance level: *1%, **5%, ***10%
Source: own construction

Adjusting at lag 2, a Granger Causality Test conducted on the variables showed that economic growth granger causes the deficit, economic growth granger causes the HDI, investment granger causes the deficit, the deficit granger causes the HDI, investment granger causes savings and investment granger causing the HDI in these countries. However savings does not granger cause economic growth, HDI and the deficit and investment. This supports the findings of the DOLS model employed in this study. The problem of unsustainable growth.

5. Conclusion

According to the Sub-Saharan Africa Regional Economic Outlook by the IMF, human development indicators have generally evolved in line with changes in the GDP per capita as shown in Figure 1 above. Countries that have experienced the largest increases in incomes and human development include those rich in mineral resources including Ghana as well as countries that are not primary commodity exporters. The question as to whether this type of development is sustainable flows from economic theory on the subject that the economy will converge to a steady state with zero per capita growth – the diminishing returns to capital problem. The consensus on this involves models that emphasizes externalities in the accumulation of knowledge and human capital respectively (Helpman 2004).

Data on these indicators is difficult to come by when it comes to SSA. As a result, this study resolved the issue of sustainable growth by exploring the assumption that economies with higher savings rate grow faster because they allocate (endogenously) more resources to inventive activities (Helpman 2004, Fujita 2016).

A DOLS model was used to test the relationship between economic growth, deficit, savings and the investment variable. The results point to unsustainable growth in these countries as there was a significant negative relationship between economic growth and the savings variable contrary to studies by Odhiambo (2008, 2009) and Jagadeesh (2015) who found positive relationship between savings and economic growth. The results were confirmed by a granger causality test which showed that savings does not granger causes economic growth and the other variables considered in this study. This conclusion is at variance with the findings of Tang and Tan (2017) and Elbadawi and Mwega (2000). If this countries want to achieve sustainable growth then primacy must be given to the savings variable – the domestic component. Through domestic savings, these countries have an option to invest in the productive sectors of their economies. As discussed in the reviewed literature above, productivity appears to be even more an important factor in explaining income differences and growth rate differences across countries. Thus, to understand the sources of economic growth, one must understand what causes productivity – the size of the coefficient that converts natural units of the inputs such as hours of labour or acres of land, into effective units of the inputs – growth.

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Appendix

Table 1 Pairwise Dumitrescu Hurlin Panel Causality Tests on Variables – Lag 2

Null Hypothesis:	Prob.
DEFICIT__GDP does not homogeneously cause LnGDP_CAPITA	0.4262
LnGDP_CAPITA does not homogeneously cause DEFICIT__GDP	0.0498
LnINV does not homogeneously cause LnGDP_CAPITA	0.0705
LnGDP_CAPITA does not homogeneously cause LnINV	0.5734
LnSAV does not homogeneously cause LnGDP_CAPITA	0.2325
LnGDP_CAPITA does not homogeneously cause LnSAV	0.9416
HDI does not homogeneously cause LnGDP_CAPITA	2.E-10
LnGDP_CAPITA does not homogeneously cause HDI	5.E-08
LnINV does not homogeneously cause DEFICIT__GDP	0.0021
DEFICIT__GDP does not homogeneously cause LnINV	0.7670
LnSAV does not homogeneously cause DEFICIT__GDP	0.5784
DEFICIT__GDP does not homogeneously cause LnSAV	0.2612
HDI does not homogeneously cause DEFICIT__GDP	0.1504
DEFICIT__GDP does not homogeneously cause HDI	0.0062
LnSAV does not homogeneously cause LnINV	0.6489
LnINV does not homogeneously cause LnSAV	0.0354
HDI does not homogeneously cause LnINV	0.2947
LnINV does not homogeneously cause HDI	3.E-05
HDI does not homogeneously cause LnSAV	0.7270
LnSAV does not homogeneously cause HDI	0.3095

Source: own construction

Good governance: does it improve manufacturing export in resource-rich countries?

Somayeh Sedighi – Miklos Szanyi

Resource-rich countries experience a slow development rate in manufacturing sectors compared to countries with scarce resources. it has been a challenge to demystify the slow development in manufacturing sectors in those countries, therefore this study aimed to develop an efficient model to estimate the effects of good governance and natural resource rents on the performance of manufacturing export in countries endowed in natural resources. In this study world bank data for the year, 2000 to 2016 and the panel data model from 14 countries rich in natural resources were used alongside the six dependent variable indices including good governance, natural resource rents, real exchange rate, and gross domestic product (GDP). The results revealed that an increase in natural resources (NR), rule of low (RL), control of corruption (CC) as well as a reduction in inflation (INF) in countries under investigation will lead to increase in Manufacturing export. As well as an increase in Real Exchange Rate (RER) will lead to a reduction in the Manufacturing export of these countries. Hence demystify the slow development rate in manufacturing sectors in resource-rich countries.

Keywords: Good governance, Manufacturing export, Resource-rich countries

1. Introduction

The study has shown the most important component of the industrial sector that has the greatest opportunities for sustained growth, employment creation, and poverty reduction is the manufacturing sector (UNCTAD 2011). The vital role of manufacturing in the economic development process can be explained by various factors. The main source of innovation in modern economies attributed to manufacturing (Gault–Zhang 2010). The research and development activities of manufacturing sectors have been an important source of technological development in the economy (Shen–Dunn–Shen 2007). Manufacturing is important for innovation and technology diffusion and spill-over effects on other economic sectors. Manufacturing firms are important consumers of banking, transport, insurance, and communication services; they provide demand stimulus for the agricultural sector.

Studies have also shown the manufacturing can offer more opportunities for employment creation when compared with primary goods, the prices of manufactured goods are less volatile and the demand for manufactured goods increases with income, suggesting that manufacturers offer more opportunities for export market growth.

Despite the aforementioned benefits of manufacturing, so far resource-rich countries' manufacturing sector performance has been disappointing. This is due to insufficient information to decipher an increase in foreign currency incomes from a natural resource, in the presence of inefficient institutional framework and dysfunction of manufacturing sectors, rather increasing industrialization and

economic growth than being natural resources curse. Therefore this study aims to aim of this study was to develop an efficient model to estimate the effects of good governance and natural resource rents on the performance of manufacturing export in countries endowed in natural resources.

The rest of this paper is organized as follows in Section 2 we present the material and methods including the data descriptive statistics, statistical universe and period for model estimation and model estimation method Section 3 we present the results which include probability test, Fix And Random Effects Test; Correlation Analysis For Relationship Between the Model Variable; Cross-Section and Period Effects Test; Overal model Estimation of Institutional Good Governance Indexes. Section 4 discusses the results and finally, we give a conclusion.

2. Material and methods

2.1. Data Descriptive Statistics

In this study, we used the world bank dataset of 14 middle-income countries (Algeria, Azerbaijan, Angola, Chile, Iran, Kuwait, Uzbekistan, Malasia, Libya, Oman, Romania, Saudi Arabia, Turkmenistan, and Turkey). World Bank and international country risk guides (ICRG) are among the most important organization's statistics and indices of which are used in different papers and for studying institutions' effects. World Bank indices were first measured by Kaufmann, Kraay and Zoida-Lobaton (1999), and annually from 2002 to 2016. For general descriptive statistics and model estimation of the panel data we useStata (11.0) and Eviews (7.0) software was used to estimate the model. Table 1: Summarise the general descriptive statistics of the world bank panel data for the year 1998 to 2009.

Table 1 Annual data: 1998–2009

Variable	Std. dev	Mean	Min	Max	Source
ME	29.50	46.50	1.20	85.23	World Bank
I	0.50	−0.09	−1.17	0.80	World Bank
GDP	5.19	5.25	−14.70	34.50	World Bank
RE	1562.30	462.10	0.03	9945.08	World Bank
INF	11.20	8.18	−1.12	84.64	World Bank

Note: ME: Manufacturing Export; I: Institutional quality; GDP: Gross Domestic Product; RE: Real exchange rate ; INF: Inflation: N= 14; Observatios=137
Source: Author's calculation

2.2. The statistical universe and period for model estimation

In the current study statistical universe used for the model, estimation includes 14 resource-rich countries. The panel data related to six indices of good governance was for the period between 2000–2016. This was based on the in which the score ranging from −2.5 to 2.5 was considered for this study.

2.3. Model Estimation Method

To examine the impact of the institutional quality indices on manufacturing export it is necessary to consider the effect of other price factors affecting manufacturing export as well. So in addition to good governance, variables of gross domestic product, inflation, and exchange rate are included in the model. Considering the theoretical bases and research background for estimating the extent of institutional quality on manufacturing export, the model used is:

$$ME_{it} = \beta_0 + \beta_1 NR_{it} + \beta_2 I_{it} + \beta_3 NR_{it} * I_{it} + \beta_4 REER_{it} + \beta_5 GDP_{it} + \beta_6 INF_{it} + u_{it}$$

Where ME_{it} manufacturing export (% of merchandise export); NR_{it} is total natural resource rents(% of GDP); I_{it} represents the six measures for institutional quality hence the interaction term of NR_{it} and I_{it} is included to examine the hypothesis of the natural resource curse ; $REER_{it}$ is real effective exchange rate; GDP_{it} and INF_{it}

$REER_{it}$ is a real exchange rate defined as the nominal exchange rate included in the difference between inflation rates of countries and can be used as an index for competitiveness among countries (Kipici–Kesriyeli 2000).

INF_{it} is the inflation rate which is a continuous and sustainable increase in the general price level or continuous and sustainable decrease in monetary value (Makinen 2003).

GDP is a measure of market size.

I_{it} is a weighted average of six indices of governance: 1) voice and accountability 2) political stability and absence of violence 3) government effectiveness 4) regulatory quality 5) rule of law 6) control of corruption (Kazi–Shah 2008). To calculate the weighted average of good governance indices, the factor analysis method was used. The method was first proposed by Karl Pearson (1901) and Charles Spearman (1904) when measuring intelligence and is a statistical method for discovering the relations between variables contracting different autocorrelated variables in the model in smaller sizes (factors). SPSS (11.5) software was used for this study.

3. Results

3.1. Probability test

The conventional F-Limer test is used for selecting the appropriate approach (panel vs. Pooled).

Test 1 The results of choosing the appropriate approach

Test	CC	RL	RQ	GE	PS	VAA
F-Limer	30.56***	31.43***	29.91***	46.16***	30.77***	17.71***

Note: ***, ** and * denote significance at **1%**, **5%,** and **10%,** respectively**; CC:** Control of Corruption**; RL:** Rule of Law**; RQ:** Regulatory Quality**; GE:** Government Effectiveness**; PS:** Political Stability**; VAA:** Voice and Accountability
Source: Author's calculation

Based on the results of F-Limer, they are significant in all six measures of good governance indexes. Therefore, individual cross effects are significant. According to this test, for all the six models individual cross effects are significant.

3.2. Fix And Random Effects Test

The Hausman (1978) test is applied to choose between the fixed and the random-effects models for each of the six measures.

Test 2 Hasman test for selection of fix and random effects

Test	CC	RL	RQ	GE	PS	VAA
Hausman Coefficient	31.83***	10.88*	49.71***	37.45***	8.32	1.71

Note: ***, ** and * denote significance at **1%**, **5%**, and **10%**, respectively**; CC:** Control of Corruption**; RL:** Rule of Law**; RQ:** Regulatory Quality**; GE:** Government Effectiveness**; PS:** Political Stability**; VAA:** Voice and Accountability
Source: Author's calculation

Based on results, in the first four models, the Hausman test is significant and therefore its null hypothesis stating the model is random would be rejected, contrary to that, it is not significant in the last two models and therefore random effects would be the estimation approach for these two models.

3.3. Cross-Section and Period Effects Test

In this study, we further conducted the numerous tests to examine if the model can predict or adopt the cross-section or period effects or both of them to establish if the proposed estimation model is a one-way or two-way model. In this case, we consider the Breusch-Pagan test, F (chow), and LR test (Baltagi 2008) where F (chow) test was considered for model evaluation. The results of this analysis revealed had probability values were Zero in the three cases thus the null hypothesis on in each case hence effects on cross-sections (countries) and periods (years) or a two-way model are supported by zero probability all cases. Table 3 summarises the results for effects in cross-sections and periods.

Table 3 Cross-Section and Period Effects Test Results

Test	Variable	Freedom	Probability
F CROSS	563.12	(13,110)	0.0000
Chi-squared test Cross	577.17	13	0.0000
F time	13.90	(9,110)	0.0000
Chi-squared time	104.05	9	0.0000
F TIME/CROSS	344.00	(22,110)	0.0000
Chi-squared TIME/CROSS	581.653136	22	0.0000

Source: Author's calculation

3.4. Correlation Analysis for Relationship Between the Model Variable

To establish the relationship between estimated model variables we used Pearson correlation method (single tail test at 95% confidence interval). The result were presented by non-mirror correlation matrix cofficients. According to the analysis there was positive and strong relationship between Institutional quality and Manufacturing Export (r=0.63; P-value = 0.05). Similarly there was positive relationship between the inflation and Manufacturing Export (r= 0.24; P-value = 0.05). Though there was positive and low relationship between the inflation natural resource rent (r=0.07; P-value = 0.05). From this analysis we establish that relationship between the I and GDP (r= –0.23; P-value = 0.05); GDP and INF (r= –0.04; P-value = 0.05); I and INF (r= –0.10 ; P-value = 0.05); GDP and ME (r= –0.28; P-value = 0.05). As well as ME and RE (r= –0.27; P-value = 0.05) had all negative correlation coefficient hence negative relationship. Supprisingly our analysis indicated there was no statistically significant relatiobship between the GDP and RE (r=0.00; P-value = 0.05). Table 4: Summarise the relationship between the estimated model variables.

Table 4 Relationship of estimated model variables

	I	GDP	INF	ME	RE
I	1				
GDP	–0.23	1			
INF	–0.10	–0.04	1		
ME	0.63	–0.28	0.24	1	
RE	–0.37	0.00	0.07	–0.27	1

Note: I: Institutional quality, **ME**: Manufacturing Export; **RE**: Resource rents; **GDP**: Gross Domestic Product; **INF**: Inflation. **Source:** Research calculations (Stata 11.0): Correlation cofficients values for weak (<0.5), moderate (0.5) and strong (>0.6). significant at 95% IC.
Source: Author's calculation

3.5. Over all model Estimation of Good Governance Indexes and Natural Resource Rents

In the current study, it was of interest to evaluate the overall model estimation of good governance indexes on manufacturing export of the investigated resource-rich countries. The results suggest that natural resource rents lead to a shrinking manufacturing export in all models. The results are in line with the finding of Rajan and Subramanian (2011) that used paned regressions at the industry level.
The results show that most of the good governance indexes have positive effect on the manufacturing export.

The interaction term between the institutional quality and the natural resource rents reveal the negative effects of natural resource rents and institutional quality variables on manufacturing export meaning that natural resource booms bring curse for these countries.

In this case, we evaluated the coefficient values of good governance indices at a critical value of 0.01, 0.05, and 0.10 (that is the confidence interval of 99%, 95%, and 90% respectively. The real exchange rate (RER), inflation (INF) had a significantly negative impact on the manufacturing export.

From the F-statistics test, we establish that Control of Corruption, Rule of Law, Regulatory Quality, Government Effectiveness, Voice and Accountability and Political Stability play significant roles to estimate manufacturing export. In summary, this analysis supports the hypothesis that an increase in natural resources (NR), rule of low (RL), control of corruption (CC) as well as a reduction in inflation (INF) in countries under investigation will lead to increase in Manufacturing export. As well as an increase in Real Exchange Rate (RER) will lead to a reduction in the Manufacturing in these countries. Table 5 summarises the results for the overall model estimation of institutional good governance indices concerning the manufacturing export of resource-rich countries.

Table 5 Model Estimation Of Institutional Good Governance Indexes on Manufacturing Export

Coefficients	I	II	III	IV	V	VI
NR	−0.03 (0.0046)	−0.02 (0.006)	−0.06*** (0.007)	−0.05*** (0.008)	−0.07* (0.004)	−0.02* (0.005)
Good Governance Indexes:						
CC	0.57* (1.398)					
RL		5.51*** (0.767)				
RQ			0.77*** (0.675)			
PS				2.43*** (0.206)		
GE					1.52*** (0.695)	
VAA						1.86*** (0.438)
Interaction terms:						
NR*CC	−0.12* (0.0109)					
NR*RL		−0.03*** (0.001)				
NR*RQ			−0.05*** (0.002)			
NR*PS				−0.03*** (0.005)		
NR*GE					−0.05*** (0.002)	
NR*VAA						−0.22 (2.44)
RER	−0.06*** (0.006)	−0.06*** (0.004)	−0.057*** (0.007)	−0.05*** (0.005)	−0.03*** (0.003)	−0.06*** (0.005)
GDP	0.02*** (0.234)	0.01*** (0.246)	0.03*** (0.298)	0.02*** (0.225)	0.09*** (0.165)	0.04*** (2.294)
INF	−0.005*** (0.008)	−0.02*** (0.006)	−0.00*** (0.0067)	−0.01*** (0.008)	−0.02*** (0.004)	−0.00*** (0.008)
F. stat	30.46***	27.86***	25.69***	23.12***	28.40***	22.95***

Note: *, ** and * denote significance at 1%, 5%,** and **10%,** respectively; **CC:** Control of Corruption; **RL:** Rule of Law; **RQ:** Regulatory Quality; **GE:** Government Effectiveness; **PS:** Political Stability; **VAA:** Voice and Accountability; **NR:** Natural resource; **RER:** Real Exchange Rates; **GDP:** Gross Domestic Product; **INF:** Inflation

Note: standard errors are reported in paranthesis

Source: Author's calculation

4. Discussion

The ultimate goal of this study was to decipher mechanisms the rentier states and rent-seeking weaken the manufacturing sector in resource-abundance countries. Studies have shown that the institutional framework is a driving factor though it deviates from production and increases the transaction costs, hence deterrent. Therefore, the institutional framework that improves rent-seeking encourages scarce resources of entrepreneurship to exit productive activities and enter unproductive ones. This is importantly complicated in oil-exporting countries, due to the rent of oil exports. Studies have shown that rent-seeking activities gain priority over the more productive ones by existing ambiguous property rights, poor law enforcement, and corruption prevents consumer awareness hence creating market uncertainty contract enforcement, and raising exchange costs.

Douglass et al. 1991 demonstrated that property rights insecurity illustrate its effects in the shape of dominant behavioral patterns in three dimensions, i.e. the firms will move toward production activities which need little capital, short-term contract, and are small in scale. This implies that firms become very small in size, and organizations' capacities shaped in this framework will be too limited and little.

The abundance of natural resources raises real exchange rates and reduces industrial goods exports, and results in the reallocation of scarce capital and labor inputs from the production of manufactured and exportable final goods to the natural resource extraction industries. This leads to an increase in the production costs of other non-resource-based sectors.

From our analysis, we establish that rising exchange rates caused by the injection of oil export revenues, will increase the money supply and liquidity and ultimately will lead to increased demand and higher commodity prices. To strike a balance excess demand, there will be an increase in imports of basic consumer commodities such as agricultural and manufactured goods. Such an increase will shift factors of production of non-tradeable and less competitive sectors as well as reduce the competitiveness of domestic producers due to the higher production costs and product prices resulting from high inflation rates. Finally, international trade deficits will negatively affect the external sector of the economy. Further, the import of tradable goods (agricultural and manufactured) will reduce their prices relative to those non-tradable goods (construction and services), and lead to the labor force and capital moving toward the production of these lower value-added outputs (Bravo-Ortega–De Gregorio 2005).

5. Conclusions

In this study, we have presented the impact of good governance indices and natural resource rent on manufacturing export in resource-rich countries. Our results demonstrated that an increase in natural resources (NR), a good rule of low (RL), control of corruption (CC) as well as reduction in inflation (INF) in countries under investigation will lead to increase in Manufacturing export. As well as an increase in Real Exchange Rate (RER) will lead to a reduction in the Manufacturing export of

middle-income countries. Model estimation established that increase manufacturing export, non-economic, and non-price factors should be considered in addition to price factors. Hence price inflations have a less significant impact on the exports thus the investigated countries must consider institutional good governance indices such as control of corruption, rule of law, political stability, and managing the windfall revenue from natural resources to overcome the cursing effects of these resources. Thus this profile will provide effective institutional good governance indices to be adopted by middle-income countries.

Acknowledgment

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Chapter III

Relations between social economic and

demographic processes in the present

Successes and failures in Hungarian family businesses

Máté Repisky – Éva Málovics – Gergely Farkas

Family business researchers widely investigated the loss or the threatened loss of socio-emotional wealth. Another growing theme within entrepreneurship is the consequences of business failures affecting entrepreneurs. However, these two fields rarely overlapped. The aim of this study was to explore different challenging events' effects on the family entrepreneurs and to identify the factors that can determine the successfulness of the coping strategies.

In this study, we present three case studies about family enterprises, which went through a challenging period and balanced between failure and success. In two cases the main challenges rooted in familiness of the enterprises and in the third case the challenge came from external regulatory change. The two inner challenges were generated by the retirement of the founder and the divorce between the two owners. We could observe both successful and partially successful coping strategies, but the common point was that all of them were strongly rooted in the socio-emotional wealth of family businesses.

Keywords: family business, copreneurship, case study, socio-emotional wealth, coping strategy

1. Introduction

Despite family businesses are treated in the literature as a special group, it is also estimated that 65–80% of firms may be owned or managed by families (Málovics–Vajda 2012). In addition, many researchers have pointed out that entrepreneurship is a risky activity as is because there is a significant chance of failure (Fang He et al. 2018, McGrath 1999, Shepherd–Patzelt 2017). This is well illustrated by the KSH (Hungarian Central Statistical Office) analysis of the year 2015, when the five-year survival rate of corporate enterprises in Hungary was 45.1%, while that of sole proprietors was only 27.1% (KSH 2017). We can assume that most enterprises go bankrupt within a few years or be closed for not meeting owner requirements.

In the field of entrepreneurship research, entrepreneurial failure and its effects on entrepreneurial decision-making is an emerging topic. The preservation of the socio-emotional wealth is an emerging topic in the family business studies, but until now these two topics were rarely connected in the literature (Shepherd 2016, Shepherd–Patzelt 2017). In case of family businesses, the financial (and even emotional) burden of entrepreneurial failure is not only taken by the entrepreneur person but also by the family. Therefore, examining the entrepreneur within the family system can provide a more complete picture of the effects of failure (Shepherd–Patzelt 2017).

Considering the above, our research questions are how family businesses are affected by different crisis situations; how family entrepreneurs choose coping methods and with what kind of results. In the first part of the study, we present the key definitions such as family businesses; used personality traits and categorization

of business situations. After that, we summarize the theory of socio-emotional wealth. In the next subchapter, we summarize the used research methodology and sample. The chapter about our results will have three parts: observed personality traits; socio-emotional wealth in the case studies and the coping strategy and its successfulness. In the end, we close our study with a brief summary with the key results, limitation and potential next steps in this research theme.

1.1. Definitions

During the research, we considered as *family businesses* the companies in which a family or family association has a decisive influence on the development of the enterprise (Wimmer et al. 2004). This is most often manifested by the facts that one family is the majority owner of the business and/or the key decision-making positions are held by one family. A special case of family businesses is the so-called *copreneurship*, where a couple trying to manage their business and personal relationships at the same time (de Bruin–Lewis 2004). The copreneurship is usually started by a married couple, but broad definitions do not require marriage, nor different gender. In practice, this means that a couple in a romantic relationship owns and/or controls one or more businesses.

One of the key topics of early entrepreneurship studies was the *personality traits* of the entrepreneurs with research questions like this: can we separate entrepreneurial personality from the rest of the society? (Carsrud–Brännback 2011) In our research, we will use traits from four different personality trait theories. One of them is maybe the most widespread one, the Big Five model. The locus of control theory was developed by Rotter (1966) and we can say that people who believe in an internal locus of control tend to be entrepreneurs (Shane et al. 2003). Another key trait of entrepreneurs can be the achievement motivation (Stewart et al. 1999, Shane et al. 2003), which was first defined by McClelland in the theory of learned needs (McClelland 1961). The last used personality trait model is the three dimensioned version of entrepreneurial orientation (Bolton–Lane 2012), which was developed to research persons contrary to the original model, which was used for organizational level (Lumpkin-Dess 1996). In Table 1 from the above-mentioned personality models, we only defined those traits that we will use in the analysis.

Table 1 Personality traits used in the research

CONCEPT	DEFINITION	SOURCE
Internal locus of control	People believe that they have somewhat personal control over the outcome of events in their lives.	Rotter 1966; Levenson 1974; Kaufmann–Welsh 1995
External locus of control	People believe that they are controlled by powerful forces (fortune, luck) or influential individuals in their lives.	Rotter 1966 Levenson 1974 Kaufmann–Welsh 1995
Conscientiousness (part of Big Five)	People's tendency to display self-discipline, orderliness, prudence, diligence and foresight in their lives.	Little 2017
Openness to experience (part of Big Five)	People who are open to new ideas, relationships, adventure, and can see the world in a creative way.	Little 2017
Achievement Motivation (Part of Learned Needs)	People who prioritize excellence, tend to choose goals with medium difficulty, display personal responsibility and planning ahead.	Lang–Fries 2006; Germak–Robinson 2014; Pardee 1990; Shane et al. 2003
Innovation (Part of Entrepreneurial Orientation)	People's tendency to display creativity, new solutions in the form of device or method.	Farkas et al. 2014, 91.
Risk-Taking (Part of Entrepreneurial Orientation)	People's tendency to deal with uncertainty (during entrepreneurial acts).	Szerb–Lukovszki 2013

Source: own construction

Fang He et al. (2018) use a simple, yet useful graph to *group business situations* based on whether the business is performing below or above expectations in one dimension, or whether the entrepreneur is continuing or interrupting the activity in the other dimension (Figure 1). Based on this approach we will judge the success of each coping strategy during the analysis. According to a widely accepted definition, failure is the closure of a business that has fallen short of its goals or failed to meet its owners' expectations (Cope 2011, McGrath 1999, Ucbasaran et al. 2010). Therefore, closing a business does not mean bankruptcy in each case (Cope 2011, Simmons et al. 2014, Ucbasaran et al. 2010), so bankruptcy is only a subset of business failure (Fang He et al. 2018). Another important distinction is that "voluntary exit" can happen when an entrepreneur leaves or closes a business that meets expectations (Fang He et al. 2018) and this is not considered as a failure, even though it may mean the end of the business. We consider a coping strategy to be successful if the business continues to live up to expectations, and in all other cases, we will categorize cases as unsuccessful or partially successful.

Figure 1 Categorizing Business Situations
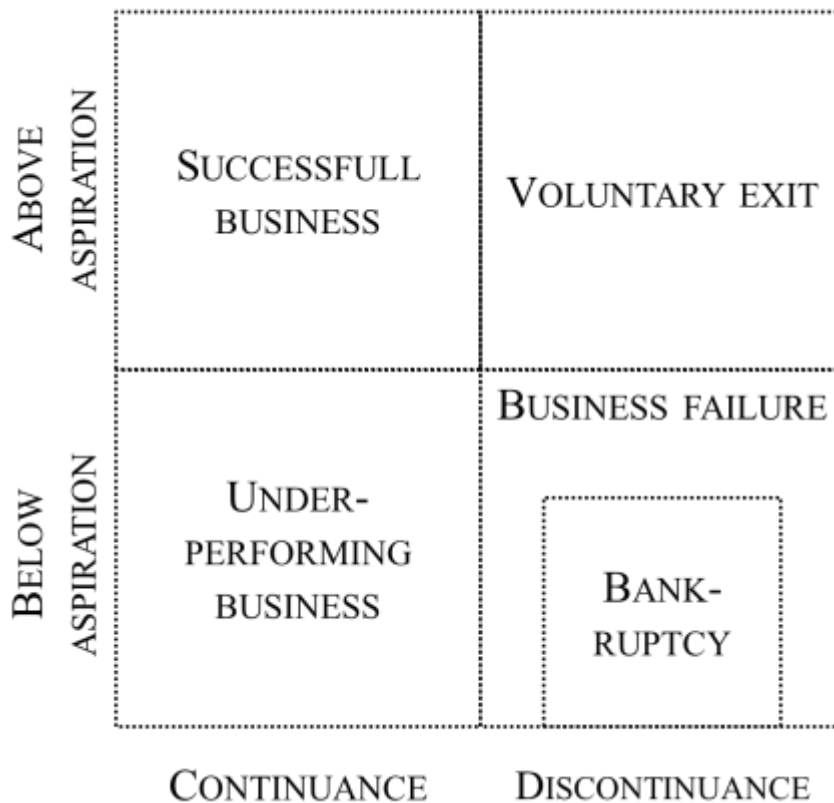
Source: own construction after Fang He et al. 2018, p. 609

1.2. Socio-Emotional Wealth (SEW)

The concept of socio-emotional wealth (SEW) is gaining popularity in cases when differentiating between family and non- family businesses is required. As Shepherd (2016) summarizes, many studies have already concluded that family businesses make decisions to preserve SEW in the long run. SEW has five dimensions discussed by Berrone et al. (2012):

1. *Family control and influence*: The extent of a family controls a business, either formally or informally through leadership and ownership.

2. *Family members' identification with the firm*: This may take the form of the company is named after the family name or they are considering the business as an extension of their family. The effect of this may be that the family is more interested in the image of the business since it also expresses an opinion about the family. At the same time, this appears as acting more frequent in a socially responsible way.

3. *Binding social ties*: This is about social relationships of the family what extends to kinship relationships and close, trusting relationships with those who work there, thus raise their level of social capital and solidarity. This attitude grants stability for the company and its employees. As in the previous dimension, this also supports community involvement and sponsorship.

4. *Emotional attachment*: If the family and the business are closely linked, emotions can pass from one system to another in case of important events (for example divorce, succession, illness, family or business loss, loss of income, etc.). The emotional attachment of the family to the business and the employees may result in altruistic acts, but negative emotions can lead to a dysfunctional group.

5. *Renewal of family bonds to the firm through dynastic succession*: it covers the intention that the founders would like to handle the business down to the future generations. In this approach, business is not only a property that they get or give away but an important part of family tradition, therefore succession is usually one of the main goals of family businesses.

Aldrich and Cliff (2003) examined the family embeddedness in the enterprise and raised the question of whether the success or failure of a new business can affect the family system more. Several studies have confirmed that business failure can lead to divorce (Cope 2011, Repisky 2018a, Singh et al. 2007) or the entrepreneur can lose the role of the head of the family (Repisky 2018a). The SEW concept supports the idea that the two systems: family and business can have strong interaction, especially in a variety of crisis situations.

Anderson (2003) emphasized that the higher the level of expected negative emotions, the more likely it is that the individual will delay an activity, so people are trying to minimize the probability and severeness of negative emotions. Furthermore, irreversible decisions only exacerbate the former effect (Anderson 2003), such as closing a business (Repisky 2018b). There may be several types of fear of failing in such situations. Conroy, Kaye and Fifer (2007) and colleagues presented five fears of failing: fears of experiencing shame and embarrassment, fears of devaluing one's self-estimate, fears of having an uncertain future, fears important others losing interest, and fears of upsetting important others.

In connection with the above-mentioned fears one of the central topics in the research of entrepreneurial failure is the stigma what the entrepreneur gets following the failure: the stigma of failed entrepreneur (Repisky 2018a, Simmons et al. 2014, Singh et al. 2015, Ucbasaran et al. 2013; Wiesenfeld et al. 2008). The stigma may arise from the fact that society penalizes the entrepreneurs who failed because they infringed social norms (Elster 1996). We can define stigma as a form of shame on a person that negatively affects their image and reputation (Cotterill 2012, Wiesenfeld et al. 2008). We have seen that several dimensions of SEW lead to a strong bond between firm and family, so the image of the firm may tend to match the image of the family. In the event of entrepreneurial failure, they may feel that not only the family members who were involved in the business but the whole family will be stigmatized by society. This further increases the tendency to do their best to save the business.

2. Research methodology and introduction of the sample

The aim of this research was to explore the impact of different crisis situations on family entrepreneurs and to find out which factors determine the successfulness of the coping strategies. Because of the chosen aim, our research is explanatory qualitative and we used multiple case studies. We chose to use case studies because this methodology is suitable to introduce the sometimes complex crisis events and coping strategies. We would like to emphasize that this is a qualitative study so we cannot generalize our results, but we can transfer them into future researches (Szokolszky 2004). Moreover, there is an exchange between reliability and validity, and in our case, the degree of validity will be higher, because of the qualitative methods (Babbie 2008).

The sample consisted of Hungarian family entrepreneurs and (potential) successors. Another important criterion was that their company went through a crisis in the recent past. The researched sample's main characteristics are summarized in Table 2. In agreement with the approach of Byrne and Shepherd (2015), we sought to gather a diverse range of cases as it was possible, to explore the researched phenomena's wider range. The focus topic of the first case was crisis in the owner married couple's personal life, this is why the case name is "Copreneurship in crisis". In the second case, we can follow a market leader company's journey during difficult period. In the third case, the owner of the company wanted to retire and to pass on the leadership to his children what caused a crisis.

Table 2 Main characteristics of our sample

Nr.	Name of the case study	Type of business	Inter-viewee	Role in the enterprise	Number of interviews
1.	**Copreneurship in crisis**	Portfolio (multiple enterprises)	Husband	Owner, idea maker	3
			Wife	Owner, implementer	3
			Son	Successor	1
2.	**Market leader**	IT	Father	Owner, idea maker	1
			Daughter	Potential successor	1
			Son	Potential successor	1
3.	**Retirement**	IT	Father	Founder, advisor	1
			Son	Successor	1

Source: own construction

We made unstructured depth interviews with the interviewees, so we only defined some key topics instead of fixed interview threads. This data gathering method is widely used in grounded theory because in this way we can get know better the interviewees perspective and they have bigger freedom to express what is important for them. The interviews were conducted at different times, and in the 1st case, we could make longitudinal interviews (before and after the crisis event) to get a more complex picture.

Two researchers made the analysis independently on the typed interviews or on the original audio files. The coding and analysis were conducted in three phases based on the principles of grounded theory:

1. In phase one, we coded the interviews nearly row to row, independently from the known theories. This is the so-called open or substantive coding (Mitev 2012). In this very opened coding method, the most important themes had the possibility to emerge from the raw data (Kucsera 2008). In this early stage of coding, we used so-called in vivo codes, which mean we cited the words of the interviewee as codes because they reflect better on the respondent's perspective (Charmaz 2006).

2. In the second phase, we arranged the existing codes into larger logical units, categories with the help of tables. As a result, these categories were on a higher level of abstractness and they can be the basic elements of the theory development (Gelencsér 2003). To make easier the theory making, we made bigger matrixes with the relevant categories case by case for each bigger topic (Byrne–Shepherd 2015).

3. The two researchers, who made the analysis, conducted the first two phases independently from each other. We discussed and integrated our personal results only in the third phase. We made this to mitigate the researchers' subjectivity.

3. Results

We divided our results into three main parts. First, we describe the observed personality traits. After that, we present the cases from the dimensions of socio-emotional wealth. Finally, we briefly summarized the process of each crisis, from the antecedents, through the coping strategies, to the successfulness of these strategies.

3.1. Observed entrepreneurial personality traits

We could infer to more personality traits of the interviewed entrepreneurs. However, this categorization should be treated with limitations because this is based on interview and not real personality tests.

In our *first case* ("copreneurship in crisis") both members of the couple have two personality traits that appeared more strongly.

1. The man believed in an *internal locus of control* in his entrepreneurial life, so he thought that he can control his life. After the crisis in his personal life, he blamed his wife for everything (external locus of control – powerful others). His other dominant personality trait was the *innovativeness*, which was confirmed by his wife. He always came up with new enterprise ideas; this why felt so comfortable in managing the strategic level of their companies. From the perspective of the Big Five theory, we can say that he is *open*, he always searches for new opportunities and ideas.
2. In the interviews with the woman, two personality traits appeared more dominantly. In her case, the *external locus of control* was more decisive. In their business life, her husband was the more dominant, and after the divorce, she blamed her husband for everything. Contrary, she is very *conscientious* and precise, she is a real implementer. Therefore they complement each other so well in their business life.

In our *second case* ("market leader") it was interesting that the observed personality traits characterizing not only the founder but his whole family and even some cases his enterprise too.

–   The most unusual trait was the *trans-generational achievement motivation*, which was learned from father to son in their family. It means that most of their ancestors were striving to excellence, to become better and better what they are doing regardless of their profession, as they are doing it now in their enterprise.
–   The whole family strongly believes in an *internal locus of control*, after such huge challenge, what their experienced, they immediately were looking for what they could do differently, how they could improve the situation of their company.
–   Moreover, the *innovativeness* was not only the family's trait, but the organizational culture of their company was shaped similarly. The past years they employ people who are innovative, which strengthen not only this trait but the market position of the company.

In our *third case* ("retirement"), all of the family members, who participated in the management of their company, have similar observed personality traits.

–   All of them are strongly *innovative*, if one of their ideas did not work, they immediately started to work on something new. This common direction change required continuous learning and this leads us our next trait.
–   They did not afraid of *risk-taking* during the introduction of their innovations. Moreover, if their family business or any family members were threatened with a huge challenge or crisis they were ready to take a significant risk.

We think that more personality traits that characterize entrepreneurs according to the entrepreneurship literature were outlined during the interviews. In the following chapter, we will see that these personality traits will be of great help for the investigated families during the challenging events.

3.2. Appearance of SEW dimensions in the researched cases

The socio-emotional wealth appeared in all cases, even if some of the dimension were stronger or weaker in each case. In this chapter, we briefly summarized this.

Table 3 SEW appearance in the 1ˢᵗ case

Family control and influence	50–50% ownership and leadership in the hand of the couple in the case of their portfolio of enterprises.
Identification of family members with the firm	Permanent communication about business decisions in private life.
Binding social ties	Strong connection with their colleagues (business trips and parties, long-term employment).
Emotional attachment of family members	They were emotionally attached to their companies.
Renewal of family bonds through dynastic succession	There is no real succession strategy or a serious successor.

Source: own construction

As we see in Table 3, in our 1ˢᵗ case most of the dimensions of SEW were strongly present in the copreneurs' enterprise portfolio, even if they don't have real succession strategy and their emotional attachment is not distributed equally among their companies. The reason behind the unbalanced emotional attachment can be they have too many firms simultaneously and in this way they have less time and energy for each one, they will have favourites.

Table 4 SEW appearance in the 2ⁿᵈ case

Family control and influence	Very centralized ownership, 100% owned by the founder.
Identification of family members with the firm	The family and business intertwined, the children were socialized in the company (they wrote their homework and lived their hobbies there).
Binding social ties	Long-term employment (in the case of more employee this means more than twenty years) and democratic, flat organizational structure (equality).
Emotional attachment of family members	The whole nuclear family works in the company and connected emotionally to it.
Renewal of family bonds through dynastic succession	Two potential successor works in the company; however, the founder does not think they will take over the family business.

Source: own construction

In our opinion, the socio-emotional wealth is more significant in our 2ⁿᵈ case, even if the succession is uncertain (Table 4). We can see that the 3ʳᵈ company has similarities with the 2ⁿᵈ one according to more dimensions of SEW. Similarly, the whole company is owned by the founder, the father; the long-term employment is important, and more family worked or still working in the company (Table 5).

Table 5 SEW appearance in the 3rd case

Family control and influence	Company-owned by the father 100%, the control totally in the hand of the family.
Identification of family members with the firm	The founder identifies himself with the successful innovation of the company.
Binding social ties	Long-term employment; the company paid the training fees not only the employees but one of their subcontractor too.
Emotional attachment of family members	Everyone from the nuclear family worked or still working in the company. Serious risk-taking for the success of the company.
Renewal of family bonds through dynastic succession	Two potential successors.

Source: own construction

3.3. Coping strategies and the results of these strategies

We will present the coping process in four steps: "wind of change"; challenging event itself; used coping strategies and the results of the whole process. In one case we will see that the challenging had more rounds and in this way, some of the steps will occur more times.

In the case called "*copreneurship in crisis*" the challenging event and the solution of it occurred as we detailed below:

1. *The "wind of change"*: Before the challenging event there was some sign of it, the couple's relationship becomes worse, so the trust between them decreased also from a business perspective. Moreover, the man initiated to start selling some of their less important assets or some of their companies.

2. *The challenge*: This distrust leads to a divorce and a hostile atmosphere between them. They blamed each other for everything. Obviously, this made the joint leadership nearly impossible, so their whole portfolio of enterprises' future becomes uncertain.

3. *Coping strategies*: Because of the binding social ties with their employees, they tried to solve the conflict between them, at least the business side of it. First, they divided their assets and companies equally. The former wife tried to save and operate the companies that became hers. Luckily one of their children appeared as a co-manager in the companies of the mother. Contrary, the husband kept only one enterprise, because of his personality traits, he was in creative and strategic tasks, but not in everyday operation.

   It was obvious, that their sought for a solution not because of the financial wealth, but the socio-emotional wealth, because if they sold everything they can get back their money with out problem (even some debt could make it a little harder). So, their decision was not led by business logic. It is more prominent in the case of the former wife, her coping strategy rooted in the SEW: she was very attached to her business emotionally; the good, trustful relationship with her colleagues helped to get through this hard period; and even one of her sons joined as a potential successor in the everyday operation of her companies.

4. *Result of the coping strategies*: From the interviews, we got to know that they had 12 companies before the challenging event. After the crisis, we can say that two of them are successful businesses because they are above the owners' aspirations. They have seven more under-performing businesses, from which in the case of four there is not even asset or revenue and in the case of the other three there are significant assets, but they are generating a loss. The fate of the last three companies was faded; they did not mention them in the interviews. The reason can be that was already sold or closed, or these three companies were not so important from emotional and/or financial aspect.

The case called "*market leader*" was a little bit different than the other two cases, because here the challenge comes from an external source and not from the family.

1. *The "wind of change"*: They did not foresee the coming challenge, but there were signs that predicted it. On their market, there was a previous powerful political activity, and the legislation mechanism was very fast in Hungary.

2. *The challenge*: As we mentioned in this case the challenge came from an external source in the form of a very fast regulatory change (3 weeks after the announcement, the new regulation came into force). This new regulation eliminated their whole domestic market and they were not prepared for this hard situation. They had only a few weeks to react and some extra time what the companies emotional and financial reserves allowed.

3. *Coping strategies*: They reaction was to change their business model as fast as they can, so they tried to develop a product for the international market. Luckily, they had a half-finished software that had the potential to become an internationally successful product.

   In this hard period, it was a key issued that not only the family members were emotionally attached to the company, but their employees too. Another important segment was they construct a very loyal and creative organization, which kept the experts there. In this way, we can say that the coping strategy rooted in the emotional attachment and in the binding social ties (two dimensions of the SEW).

4. *Result of the coping strategies*: The company was a market leader at the domestic market, but after the regulatory change it became an underperforming business. Due to the coping strategy, the company become even stronger and successful on the international market. In their case, it seems true that "what does not kill you makes you stronger".

Our last case, the so-called "*retirement*" the situation was the most complicated because after the first challenge there were other two, so they have to solve three crises in a row.

1. *The "wind of change"*: The researched company's past was full of direction changes, which needed innovativeness, frequent renewals and continuous learning. Because of the age of the founder, this continuous changing became tiring.

2. *Challenge 1.*: Because of the previous reasons the founder decided, he will retire. Parallel with this, a new business opportunity also emerged, which required completing a training programme.

3. *Coping strategy 1.*: Because none of the children seemed to apply for the role of the leader, the father gave an ultimatum to his family. So, one of them becomes the new leaders or he will close this and other two of his companies. This gave the necessary push to his sons, two successors (an IT specialist and a biologist) applied and made a deal with their father, that he will stay in an advisory role. Moreover, all three of them finished the necessary training programme to grab the new business opportunity.

4. *Result of the 1st coping strategy*: In the case of the researched organization, because of the two successors, the strategy reaches its aim, the company stayed successful. On the other hand, from the other two companies, one of them remained without successor, so the founder had to make a voluntary exit, close a company that reached his aspirations. All together the coping strategy was only partially successful. In the next point, we will only follow the company with the two successors.

5. *Challenge 2.*: With time the two successors confronted because they had different ideas about how to lead the company, which made their relationship worse.

6. *Coping strategy 2.*: This situation led to that, the IT specialist left their IT company and he moved abroad for a new job opportunity.

7. *Challenge 3.*: The remained biologist successor had fewer necessary expertise, because of his profession. This can be the reason why he led this IT company to inoperability, which was the third challenge of this family business.

8. *Coping strategy 3.*: The only solution to save the family business was that the IT specialist came back to their company.

9. *Result of the coping strategies*: As we saw from the original three companies only two survived in the researched period because of the lack of a successor, the founder had to close one of them. From the surviving two one of them faced multiple challenges and nearly bankrupted, but in the end, it got back its market position, so they coped with the core challenge, the retirement of the founder. From the perspective of the enterprise portfolio, we can say the coping strategies were only partially successful.

   For all of the coping strategies, the motivation and the solution came from the dimensions of socio-emotional wealth. For example, the successor only joined to the company because of the family ties, but after that, they get more and more emotionally connected to the company, this why they took the necessary risks to keep alive the family business (finish training programme; came back from a successful other business). However, the most obvious SEW dimension was the "Renewal of family bonds through dynastic succession" because they took over the leadership of their company.

4. Summary

The aim of this research was to explore the impact of different crisis situations on family entrepreneurs and to find out which factors determine the successfulness of the coping strategies. During the three case studies we saw successful and partially successful coping strategies, but it was common in them, that all of them rooted in the socio-emotional wealth. This research highlighted that the family involvement can have a dual role in the family businesses, it can be the root of the crisis, but at the same the solution too in the form of SEW.

Table 6 Results of the study briefly

Number of the case	The root of the challenge	Root of the coping strategy	Result of the coping strategy
1.	Family (divorce)	SEW	Partial success
2.	Regulatory change	SEW	Success
3.	Family (retirement, conflict of the successors)	SEW	Partial success

Source: own construction

As every study it has some limitation, some of them come from the research methods (cannot be generalized, using unstructured interviews) and other come from the research theme itself (reliability what the interviewees said about this unpleasant topic, limited access to the sample, time lag between the interviews and the event).

According to our results, we saw more potential next steps in this research. The most obvious is to process more cases or make new interviews with the existing three companies' leaders to get to know the long-term effects of the challenges. This explanatory study revealed the core factors of the researched phenomena, so in the following interviews, we can use semi-structured interviews.

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Climate change among the least developed – a Case study of Sarkad LAU 1 region

Dániel Erdélyi

Climate Change is a global phenomenon that has geographically varying impacts. To fulfill Hungary's climate obligations and implement effective adaptation practices, we need to understand the working mechanism of climate change in smaller territorial units. Regional differentiating is of paramount importance in regional strategy making.

As part of an on-going research that aims to identify the local impacts of climate change and the local answers against it, this paper is analyzing the local properties and opportunities of the case study of Sarkad LAU 1 region. Sarkad region is one of the most underdeveloped yet one of the richest areas in natural resources like biodiversity, landscape, and cultural heritage. This duality highlights the need to act against the negative outcomes of climate change. The local main climate effects of climate change are indicated by using the cartograms of the National Adaptation and Geoinformation System database. It is crucial to identify the local vulnerability in order to take effective measurements promoting adaptivity and mitigation.

As a result of the research, the unique properties of the LAU 1 region the ways of adaptation in connection with climate change are indicated.

Keywords: Adaptation, Climate change, Climate vulnerability, LAU1 regions, Sarkad region

1. Introduction

IPCC Special Report on the impacts of global warming of 1.5°C is the most recent and comprehensive scientific knowledge on climate change which highlights the following aspects:

- Rising of global mean surface temperature due to human activities has reached approximately 1 °C above preindustrial levels and likely to reach 1.5 °C between 2030 and 2052;
- Climate-related risks for natural and human systems are higher for global warming of 1.5°C than at present, and the magnitude and rate of warming variates the risks at different geographic locations, levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options;
- Depending on the geographical location global warming of 1.5 °C increase mean temperature in most land and ocean regions, the number of heatwave days, duration and severity of heavy precipitation events and the probability of drought and precipitation deficits;
- Climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth are projected to increase with global warming

of 1.5°C. The increase in global warming is projected to affect human health, with primarily negative consequences (IPCC 2018).

Scientific evidence highlights the need for effective mitigation and adaptation measures worldwide. The phenomenon of global climate change is now getting in the center of attention which is urging global decisionmakers, researchers, non-governmental organizations to act (Hajnal 2006). The most important stages of the fight against climate change at the international level were the Kyoto Protocol and the Paris Agreement. By ratifying the documents, Hungary along with other 191 parties have committed itself to reduce greenhouse gas emissions, thus decarbonizing its socio-economic structure. In order to meet our obligations, the Hungarian Parliament adopted a law (LX. 2007), which orders the creation of the National Climate Change Strategy (NCCS). Since the adoption of the first NCCS the climate change-related strategic framework of Hungary has been developed by the following elements:

- − Second NCCS – adopted in 2018;
- − Long-term Strategy of Hungary – adopted in 2020;
- − Second Hungarian Energy Strategy – adopted in 2020;
- − National Energy and Climate Plan – adopted in 2020;
- − National Climate Change Action Plan – adopted in 2020;
- − All the Hungarian counties (NUTS 3) established and adopted climate strategies in 2018 based on their unique properties, opportunities and obstacles;
- − 113 Hungarian settlements (mainly cities) applied successfully for creating their own climate change strategies in 2019, at this point their establishment is in progress.

The development of the strategic framework shows the importance of the subject and the need for national plans and actions to be distributed within smaller territorial units.

The scientific research of this paper also emphasizing the role of the rurality, with highlighting the statistics and local opinions in one of the least developed and most climate-vulnerable region in Hungary.

The logical structure of this paper contains three elements:

1. Describes the working mechanism of climate change;

2. Indicates the territorial climatic effects which select the most climate-vulnerable areas in Hungary;

3. Present the results of the field research in the Sarkad LAU 1 region.

The analysis zooms from the national level to a small region, from national climate effects to its local economic, social and environmental manifestation.

2. The working mechanism of climate change

Understanding the connection between the elements of climate vulnerability is the key to effective mitigation and adaptation measures. Among the various climate vulnerability models created for different purposes (focusing on the natural or human environment) this paper uses the results of an ESPON Climate project which aimed to establish a vulnerability assessment as a basis for identifying regional typologies of climate change exposure, sensitivity, impact and vulnerability (Greiving et al. 2011).

According to the ESPON Climate project climate vulnerability can be interpreted by the following element:

Figure 1 ESPON Climate Change research framework
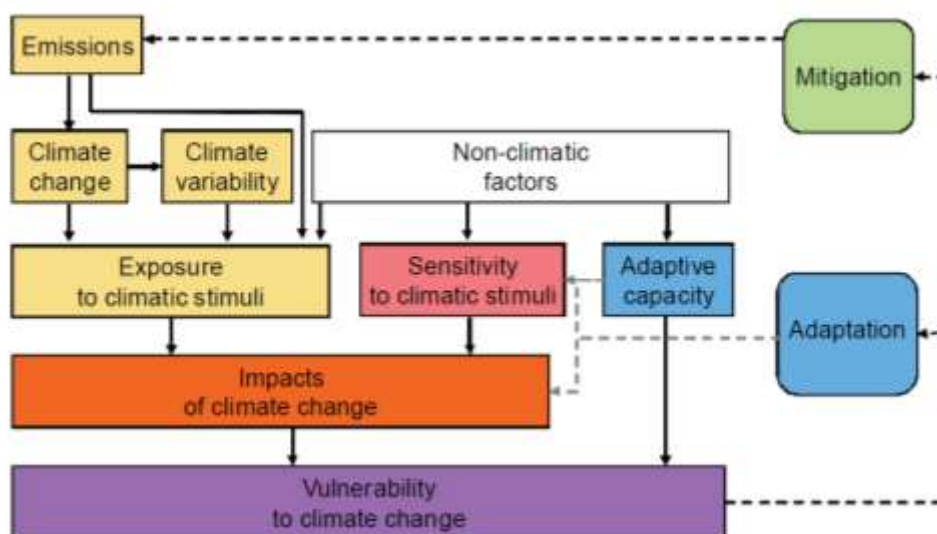
Source: Greiving et al. 2011, p. 3

The main definitions used by the model are:

Exposure: the presence of people; livelihoods; environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected. Unlike sensitivity (which characterizes the effector), the exposure is characteristic only of a geographical location.

Sensitivity: weather-dependent behavior (e.g. drought, flood risk) of the affected party (e.g. agriculture, human health). It is the attribute of the affected system, which is independent of climate change.

Vulnerability: complex indicator, combines expected effects with adaptive ability, considering that the expected impact may be more severe in a region with less adaptability (Greiving et al. 2011).

The model should be considered in the following logical sequence:

1. The anthropogenic greenhouse gas emissions contribute to the rise in global average temperature, thereby contribute to climate change;

    Changing global climate parameters affect local climate parameters (temperature, precipitation, wind), weather extremities such as heat waves (three consecutive days above the daily average temperature of 26.6ºC[1]), causing storms and floods. The appearance of these characteristics in the local geographic space is called the exposure of the given area;

2. The *effects* of the changing climatic parameters, the more frequent weather extremities, are basically due to two factors, *exposure* and *sensitivity*. In other words, the nature and volume of the climate effect affecting the affected party (such as a crop plant, a human organism or an industry) depend to a large extent on its relationship with the natural environment - in the case of a closer, more indirect relationship the effects on the effector are more frequent, stronger and thus it became more sensitive;

3. The result of climate impacts - which can be *positive* (e.g. widening the growing season) and *negative* (eg increasing number of drought days) – depends to a large extent on the so-called *non-climatic factors*. These factors together form the adaptive ability of the affected party to adapt to the negative climate impacts;

4. In summary, the affected party and the (changing) weather together make a system with stronger or weaker relations. The vulnerability of this system, the damage caused by climate impacts are determined by the potential climate impact and the adaptability to it;

5. The affected party and the weather system also strive to reach balance (equilibrium), which can be achieved by changing the agricultural structure of areas that are unsustainable due to climate impacts (e.g. the use of heat-tolerant, genetically modified plants) or even depopulation (Greiving et al. 2011).

3. Climate vulnerability in Hungary and in the Sarkad LAU1 region

Assessing the climate vulnerability of a given area accessible and reliable data is needed. Exposure, adaptation, and vulnerability related data in Hungary are collected within the NAGiS (National Adaptation Geo-information System, established in 2014, and it is operated by the Hungarian Geological and Geophysical Institute) database (Sütő, 2016). The cartograms generated by the data point to the nature of the climate effects that can be projected in Hungary and to the potential volume of damage they cause regionally. The following cartograms highlight the regionality of climate vulnerability, particularly in the Sarkad LAU1 region.

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[1] Defined by the National Directorate General for Disaster Management, Ministry of the Interior, there is currently no uniform, globally accepted terminology. Source: www.katasztrofavedelem.hu, 2020

Within the given framework of this study, it is only possible to present the most important cartograms related to the main parameters of the ESPON model, which show the regionality and inequalities of the mechanism of climate change.

3.1. Exposure

The quantity of precipitation can be both disadvantageous when the monthly amount is fell in a short period causing floods and inland waters or the time between two rainfalls extends and droughts occur. The following cartograms (*Figures 2 and 3*) highlights the changes in regional precipitation and climatic water balance. Drying of eastern Hungary can be observed which may have a severe impact on the natural ecosystem, agriculture and drinking water supplies.
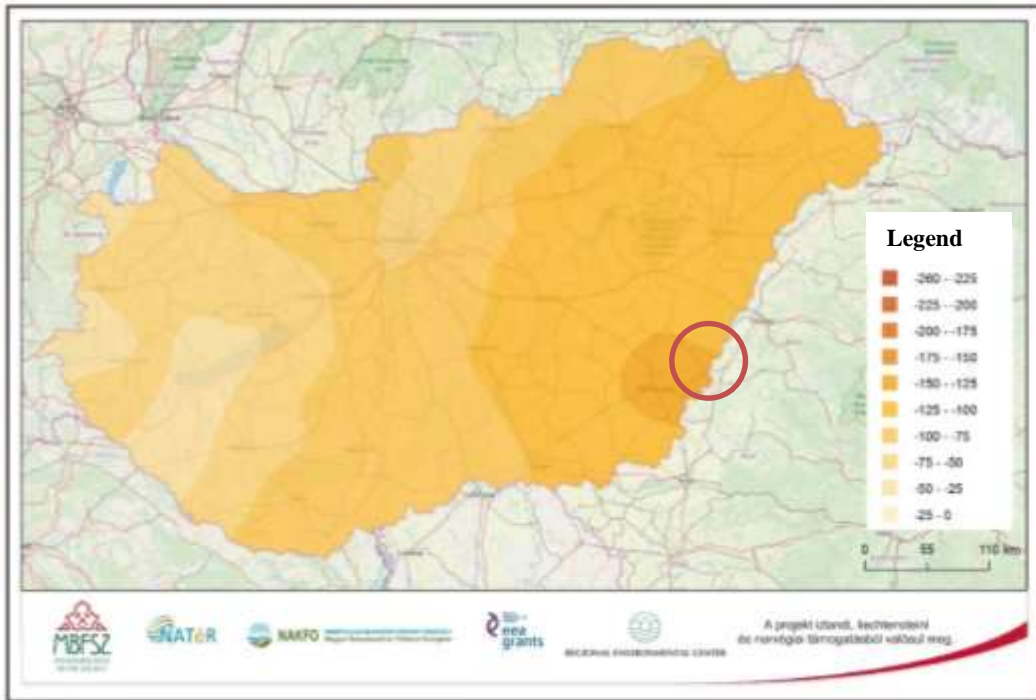
Figure 2 Exposure – Expected changes in regional precipitation in the period 2021–2050, ALADIN-climate model (mm)
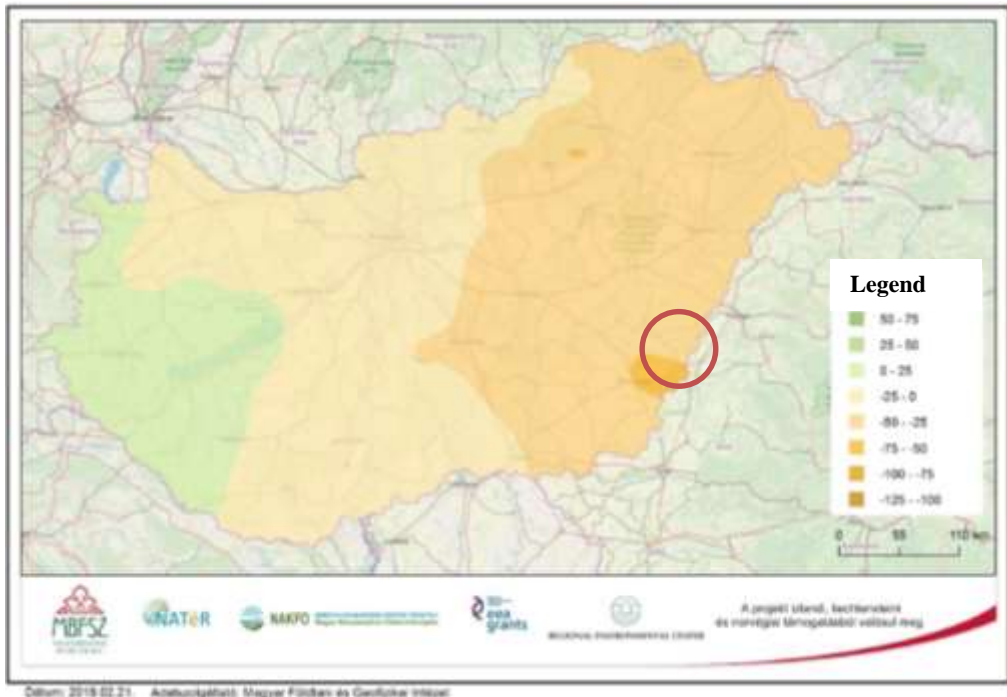
Note: the red circle highlights the territory of the Sarkad LAU1 region.
Source: National Adaptation Geo-information System, 2019

Figure 3 Exposure – Expected changes in climatic water balance in the period
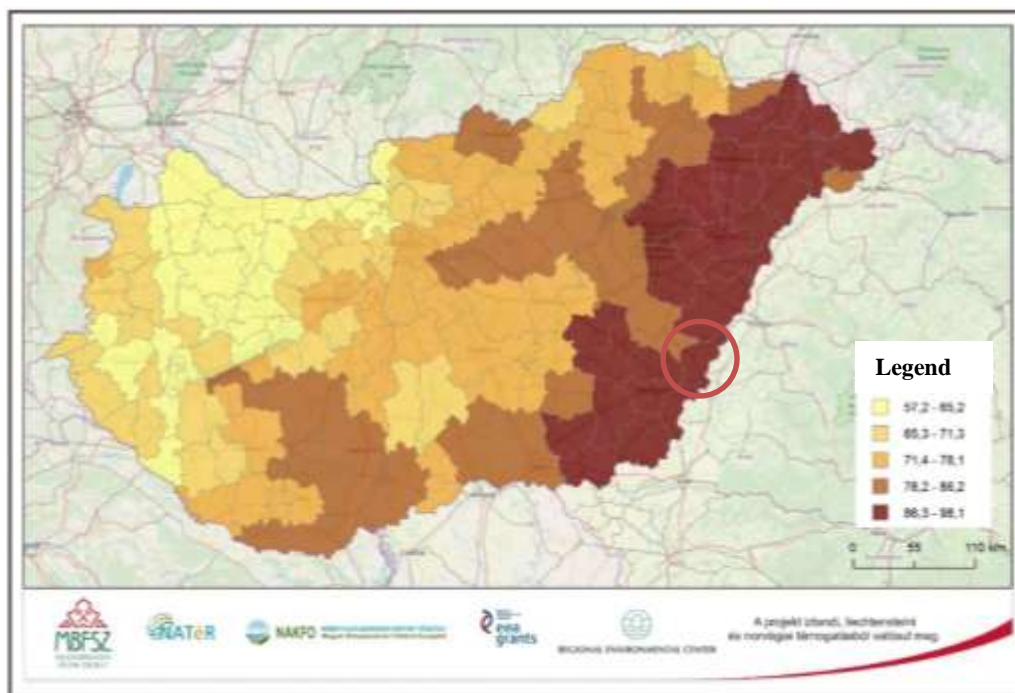2021–2050, ALADIN-climate model (mm)

Note: the red circle highlights the territory of Sarkad LAU1 region
Source: National Adaptation Geo-information System, 2019

Besides precipitation, heat stress is the other key effect that affects negatively the regional liveability. Figure 4 shows the regional distribution of heat waves which is higher in number in the eastern part of Hungary. Long-lasting high-temperature days mean a great challenge to the human organism – increasing mortality – as well as the infrastructural elements as the road network and buildings – increasing their maintenance costs.

Figure 4 Exposure – Frequency of heatwave days in the period 2021–2050, ALADIN-climate model

Note: the red circle highlights the territory of Sarkad LAU1 region
Source: National Adaptation Geo-information System, 2019

Exposure related data showed regional disparity where areas located to the east are exposed more to the decreasing yearly precipitation and the higher number of heatwave days.

3.2. Sensitivity

To understand vulnerability first, we had to identify the most exposed areas to the changing climate parameters. The next step is to take a closer look at the affected parties of the mentioned areas. The most thorough picture of sensitivity can be achieved by examining the three main areas – the natural environment, society and economy.

3.2.1. Natural sensitivity

The most climate-sensitive natural areas are identified by the 2/2002. (I. 23.) Government Decree which basically distinguishes three categories:

- − 1. important sensitive natural areas;
- − 2. highly important sensitive natural areas;
- − 3. planned sensitive natural areas.

According to the Government Decree, sensitive natural areas are "those which, through subsidized, voluntary restrictions, ensure the protection of habitats, the conservation of biodiversity, landscape, and cultural and historical values." This paper uses the category of the *highly important sensitive natural environment* for identifying areas whose natural environment the climate-sensitive (see Figure 5). These areas where "internationally outstanding natural, landscape and cultural-historical values exist, whose survival in the medium term (5–10 years) is doubtful without the promoting of environmentally friendly farming" (§ 3, 2/2002. (I. 23.) Government Decree).

Figure 5 The geographical location of the highly important sensitive natural environment areas
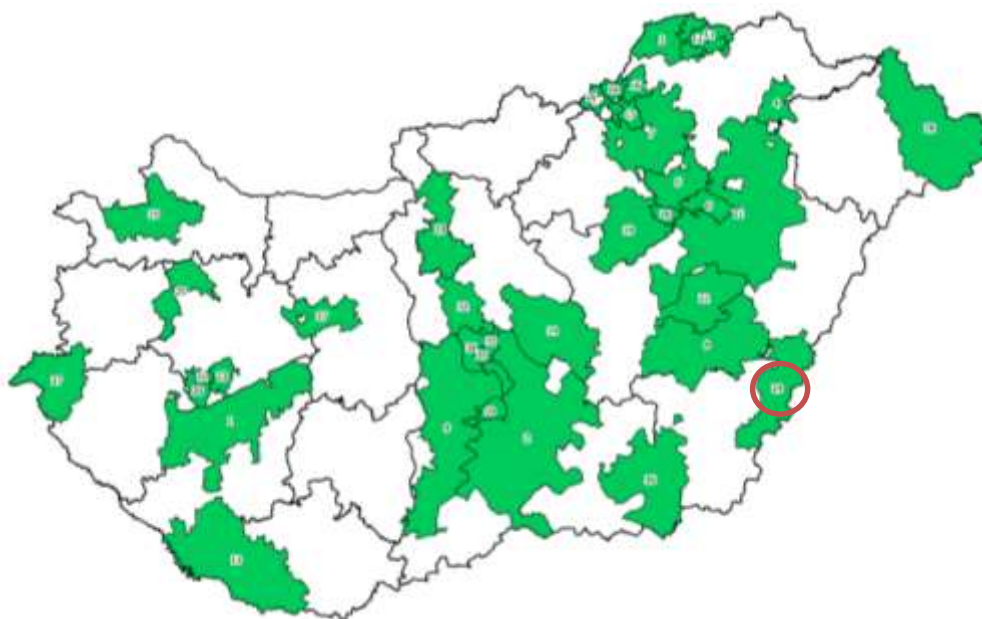
Note: the red circle highlights the territory of Sarkad LAU1 region
Source of data: 2/2002. (I. 23.) Government Decree, own editing

### 3.2.2. Socio-economic sensitivity

In order to compare the socio-economic development of the individual LAU1 regions of Hungary, (XI. 26.) Government Decree was created, which uses a complex statistical indicator. The indicator includes 24 indicators of socio-demographic, housing and living conditions, local economy and labor market, infrastructure and environment. Based on this, 3 categories can be defined:
   −   beneficiary regions: regions whose complex score is lower than the average of the complex score of all regions;

- regions to be developed: regions with the lowest complexity within the beneficiary regions, where 15% of the country's cumulated population lives;
- regions to be developed with a complex program: regions with the lowest complex indicator within the beneficiary districts, where 10% of the cumulated population of the country lives (Government Decree 290/2014 (XI. 26.), § 1, 2)

The methodology of the research uses the category of "regions to be developed with a complex program"*,* which settlements are among the least developed in Hungary. Figure 6 shows the location of these settlements which are facing serious socio-economic problems that have an extremely negative impact on their adaptability.

Figure 6 The geographical location of the "regions to be developed with a complex program" areas
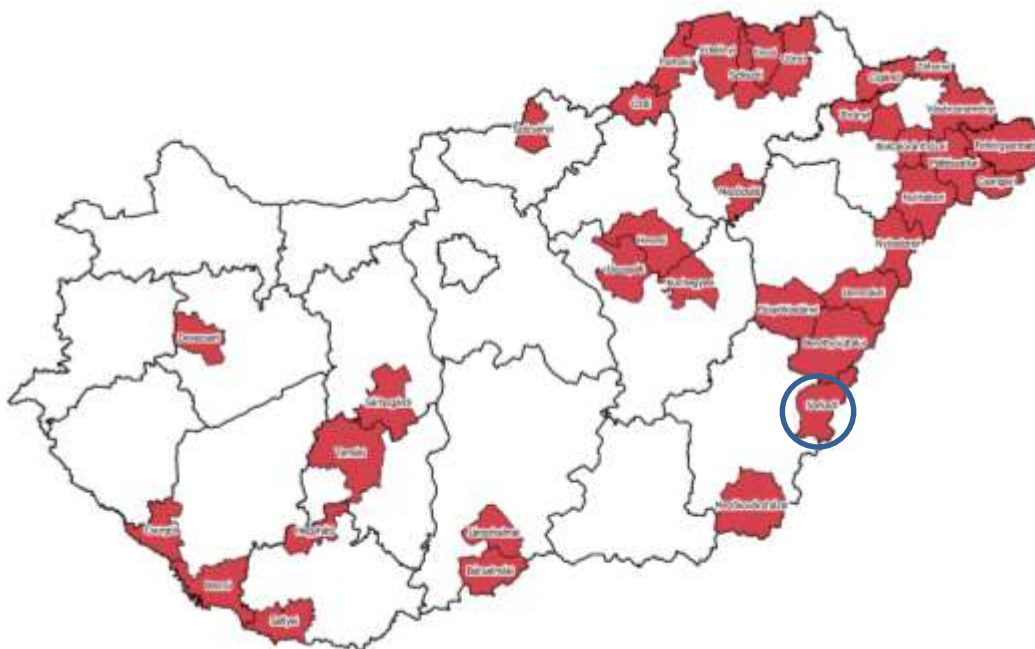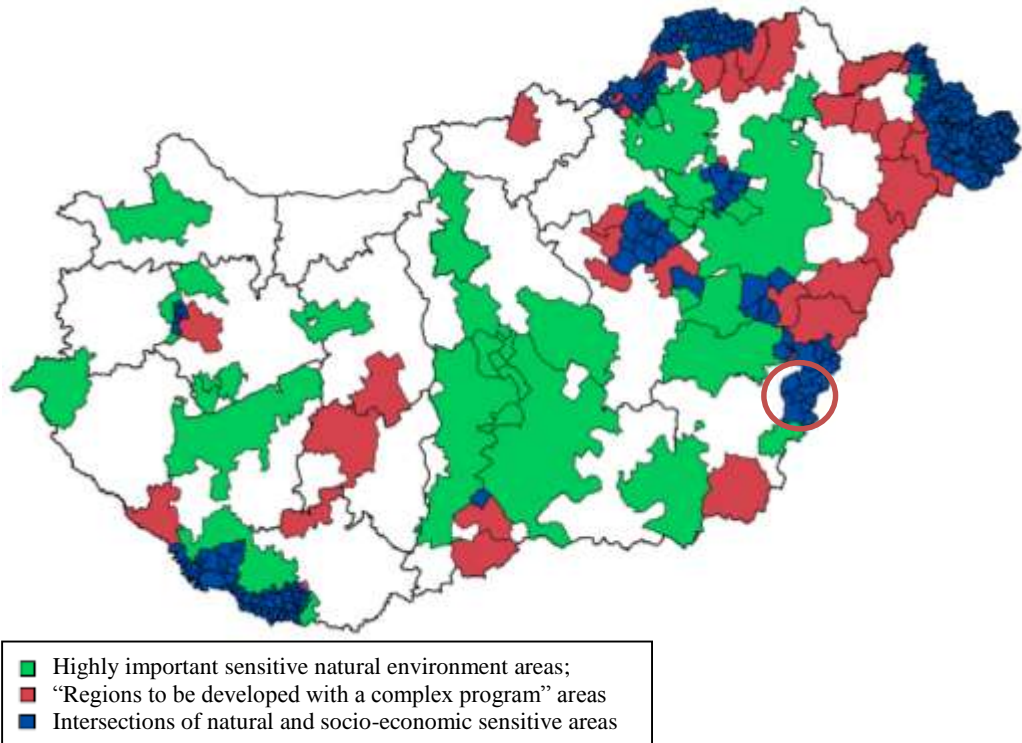

Note: the blue circle highlights the territory of Sarkad LAU1 region
Source of data: 290/2014. (XI. 26.) Government Decree, own editing

3.2.3. Overall sensitivity

In order to visualize the altogether the sensitivity of natural environment, society, and economy the intersections, figures 5 and 6 should be analyzed focusing on their intersections. Regional distribution of overall sensitivity is the following:

Figure 7 The geographical location of the most climate-sensitive areas

■ Highly important sensitive natural environment areas;
■ "Regions to be developed with a complex program" areas
■ Intersections of natural and socio-economic sensitive areas

Note: the red circle highlights the territory of Sarkad LAU1 region
Source: own editing, 2019

It can be seen that the most sensitive settlements in the border peripheral areas are Somogy, Borsod-Abaúj-Zemplén, Szabolcs-Szatmár-Bereg and Békés counties, while in the inner peripheries Veszprém, Heves, Jász-Nagykun-Szolnok, Bács-Kiskun and Hajdú-Bihar counties. These municipalities are likely to be most sensitive to the local effects of global climate change.

3.3. Vulnerability in Hungary

Figure 7 highlighted that most of the sensitive areas can be located in the eastern part of Hungary which are more exposed to climate change as well. These two elements make them the most climate-vulnerable which means that the most severe impacts – like droughts, heavy precipitation, longer and higher temperature heatwaves – meet the least adaptive socio-economic areas which have the most precious natural resources. Unless effective governmental interventions or programs for increasing the adaptive capacity, these – like Sarkad region – vulnerable settlements will face the greatest climate damages which further hinder their future development.

4. The manifestation of vulnerability – the case study of Sarkad region

4.1. Methodology

Vulnerability analysis highlighted the areas which are the most exposed to climate change, have the poorest socioeconomic conditions and have the most precious natural resources – Sarkad region is among these areas.

Understanding the true nature of climate vulnerability not only requires analyzing data or cartograms but primary research methods are also needed. Questioning local leaders, farmers, residents and other stakeholders greatly supplements and orients the research's findings and the final conclusion.

In this case, the primary research was focused on Sarkad region. The main goal of this paper was to pave the way for extensive, multi-stakeholder research that covers all of the settlements within the region. To fulfill this role a field trip was held within Sarkad – the center of Sarkad region – and one of its settlement, Kötegyán.

Four people were asked during a semi-structured interview, selected by the following criteria:

- **An agricultural advisor**: he has connections with most of the farmers within the region, moreover he is a beekeeper, hunter and has extensive knowledge about local agricultural vulnerability, and the local farmers' answers for the challenge;
- **Mayor of Kötegyán**: she was born in Kötegyán and she and her family are cultivating one of the largest agricultural lands;
- **Notary of Kötegyán**: he was born in Kötegyán as well and he is the notary of Kötegyán for 15 years which gives him a broad perspective in the changes in the settlement;
- **The local organic producer**: he lives in Kötegyán since 1953 where he was the first to use organic producing methods. Besides the agricultural production, he also maintains one of the few accommodations in the settlement. Questioning him lead the conversation in various fields, connected with Kötegyán, which highlighted his vast knowledge about the history of the settlement, changes in the composition and habits of the residents, or in the surrounding natural environment.

The semi-structured interview was suitable to keep the conversation on track and gain important side-information at the same time. Every stakeholder answered both general and stakeholder-specific questions, which concerned the following topics:

- their past and present in the region: demographic questions, profession, general opinion about their hometown;
- changes in Sarkad region – demographic, economic or environmental;
- the source climate change – for example, it is human-made or a natural process – how does it affect their life;
- specific questions about their contribution to climate change, ongoing or planned mitigation, adaptation measures as a resident or as a stakeholder.

4.2. Findings

The answers of the interviewees confirmed the less favorable socio-economic conditions which were indicated by the indicators of the 290/2014. (XI. 26.) Government Decree.

The main messages of the interviews are the followings:

1. **The greatest problem is the low number of employment opportunities**. Kötegyán has suffered one of the greatest decreases, in 1950 there were 450 workplaces today it is only 50, which is connected to 4–5 agricultural producers. Sarkad region as a peripheral location has limited opportunity to attract investments, businesses, without employment opportunities settlements, are depopulating (see figure 8) at an increasing rate.

Figure 8 Changes in population in Sarkad region, 1910–2011
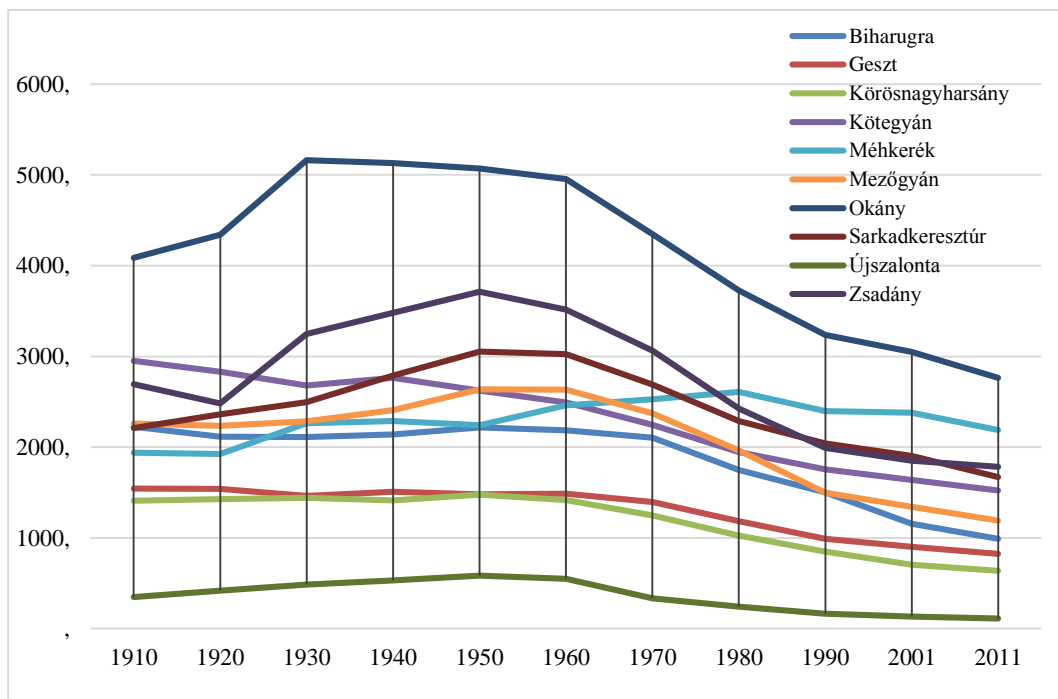
Data source: Hungarian Central Statistical Office, own editing, 2019

2. Besides the decreasing number of inhabitants and companies, the interviewees agreed that **climate change is the most serious threat to the region**. Significant dependence on agricultural production – which is one of the most exposed to climate change –, infrastructural problems (e.g. healthcare, road network, water, and electricity supply), caused by the decreasing population makes climate vulnerability palpable.

3. **The original agricultural production is less effective** – cultivating hard soils, tilling –, it is crucial for competitiveness to apply more suitable methods which more resistant to the changing climate parameters. On the other hand, both the agricultural advisor and the organic farmer agreed that conditions for beekeeping are dramatic worsening which makes almost impossible to maintain the activity.

4. **Serious infrastructural developments are needed in various fields**. In agriculture, it is getting common – due to the changes in the distribution of precipitation – that both drainage and irrigation systems are needed. The number of draught days, as well as days with heavy precipitation, is increasing which causes severe damages on the arable crops yields. The other areas of infrastructural development are road networks and public institutions (e.g. hospitals, general practitioners, schools, retirement homes), which have to face extreme weather conditions as heavy rainfalls and heatwaves. For defending human lives and property these infrastructural elements have to be revised and reconstructed with having in mind the new extremities in weather parameters.

The interviews confirmed the negative picture of vulnerability in Sarkad region and gave an inspection to the local situation. Aside from direct local effects and those consequences, interviewees were asked about the cause-effect relation of climate change which highlighted the serious lack of information and knowledge on the theme. The only idea of clime adaptation action was changing the agricultural methods in the region but apart from that, no effective solution was mentioned. Moreover, littering was named as one of the main causes of climate change, which is a piece of important misleading information.

5. Conclusion

The field research not only verified the statistics on climate vulnerability but supplemented the negative picture. Lacking financial resources and verified information both decrease the adaptive capacity of the Sarkad region which increases the severity of the future climate damages. These negative impacts may lead to the deterioration of unique swampy and reedy areas of Kis-Sárrét and increasing the migration outward to the region.

6. Summary

Climate vulnerability is composed of two elements, first is climate exposure which consists of the local effects of global climate change. The two main factors of exposure were highlighted in the analysis, distribution of precipitation and the changes in numbers of heatwave days.

The second is sensitivity which was approached from three directions: sensitivity of the natural environment, society, and economy. According to the cartograms of NAGiS and the ones which were created by the author of this paper the most climate-vulnerable areas in Hungary can be found at the borders of the country

– outer peripheries – and at a few inner peripheries, mainly in Heves, Jász-Nagykun-Szolnok, Borsod-Abaúj-Zemplén, Hajdú-Bihar counties.

These areas will have to face to most severe climate effects against which they have the least opportunities to adapt – given their grave economic and social situation.

Acknowledgments

NEMZETI KUTATÁSI, FEJLESZTÉSI
ÉS INNOVÁCIÓS HIVATAL

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Appendix

Number	Name of the area
1	Drylands at the southern reservoir of Balaton
2	Sand dunes region reservoirs of Tisza
3	Main territory of Aggtelek National Park, Galyaság
4	Bodrogköz, Kopaszhegy
5	Borsodi-Mezőség
6	Borsodi-Mezőség, Buffer zone of Hortobágy National Park
7	The buffer zone of Bükk National Park
8	Surroundings of Dévaványa
9	Plain of Dunavölgy
10	Plain of Dunavölgy, Sand dunes region reservoirs of Tisza
11	North-Cserehát
12	North-Cserehát, the Main territory of Aggtelek National Park, Galyaság
13	Wooded pastures in Baranya county
14	Gerje-perje plain
15	Hanság
16	Hills of Heves-borsod
17	Hills of Heves-borsod, Buffer zone of Bükk National Park
18	Hills of Heves-borsod, Surroundings of Ózd
19	Heves plain
20	Heves plain, Borsodi-Mezőség, Buffer zone of Hortobágy National Park
21	The buffer zone of Hortobágy National Park
22	The buffer zone of Hortobágy National Park, Surroundings of Dévaványa
23	Káli basin
24	Kis-Sárrét
25	Marcal basin
26	Surroundings of Ózd
27	Őrség-Vendvidék
28	Szatmár-Bereg region
29	Szentendre island
30	Tapolca basin
31	Tapolca basin, Káli basin
32	Turjánvidék
33	Turjánvidék, Sand dunes region reservoirs of Tisza
34	Turjánvidék, Plain of Dunavölgy
35	Turjánvidék, Plain of Dunavölgy, Sand dunes region reservoirs of Tisza
36	Vásárhelyi-Csanádi plains
37	Velence-lake and Sárvíz valley

An in-depth survey of the factors causing dissatisfaction within the group of elderly workers in South Transdanubia

Gábor Hoványi – Róbert Tésits – Levente Alpek B.

The currently still active age group (aged 50–64) faces a number of difficulties with the approaching retirement age, as their ability to work and adapt quickly to changing situations are constantly losing their effectiveness. With this, of course, we do not claim that an older worker will carry out his or her work less effectively than a younger worker, as the experience gained in a particular job can balance out the performance differences stemming from age. However, as we approach the retirement age, losing your job at an older age would pose serious challenges for those who would want to return to the group of economically active workers. It is unlikely that they will find a job that matches their qualifications, as their knowledge is less up-to-date and employers would prefer young people who could be relied on in the longer term, as opposed to those who need to be replaced within a few years. These potential difficulties are revealed by the widely distributed questionnaire, which seeks to identify the motivations and preparedness of different social strata for the changing challenges of a precarious age, based on the current economic situation and living conditions of the workers.

Results: Through the questionnaire survey, we were able to gain insight into how aging workers are preparing for their approaching retirement years and what steps they can take to preserve their current labour market position, as well as what opportunities they might have for returning to the labour market after losing their jobs as a result of possible redundancies.

Conclusion: Due to the aging national age structure, the situation of the aging workers is becoming an increasingly widespread problem, which, if we are not able to remedy in time, then will have to count on the degradation of the employability for the examined group in the near future. This will be mainly due to the constantly deteriorating health status of the individuals and the overwhelmed health care system that needs to provide for all age groups.

Keywords: aging workers, economic situation, living conditions, retirement age, employability

1. Introduction

Today, the increasing number of people born in Hungary during the Ratkó era entering retirement is becoming an increasingly serious socio-economic problem, as the proportion of recipients of state benefits is continually increasing, while an increasing proportion of active earners belongs to the aging age group (50–64 years of age). It follows from this that the number of dependents will rise even higher within a short time, partly due to those reaching retirement age and to the aging workers becoming economically inactive, which will put an even greater burden on the social support capacity of the economy.

The increasing social and health contributions are just one of the many negative effects of the aging population pyramid of Hungary. This study does not address all the negative effects; it exclusively focuses on those that apply to the 50–

64 year old active age group. Of these problems, the fast approaching retirement age is of primary importance, which puts the domestic economy in an almost insoluble situation. This in itself makes the problem urgent, but this is only the tip of the iceberg. In addition to mass retirement within a few years, another pressing problem is the decline in the adaptability of aging workers. A younger employee can more easily meet the ever-changing demands of the workplace. In addition to being less able to adapt to changing requirements, such as the use of digital technologies at the user level, their knowledge, acquired years ago or in worse case decades ago, is nowhere near up-to-date. An exception to this, of course, are the aging workforces, who are committed to lifelong learning and are constantly striving to improve their skills.

Therefore, after losing their job in old age, they have a minimal chance of returning to the labour market without help. In order to elucidate the problems of this age group, we attempted to survey the inhabitants of the favourable, intermediate and disadvantaged type settlements of Southern Transdanubia with a questionnaire survey, which spatial structure was assigned to us by the previously published rDSS-index (Hoványi–Tésits–Alpek 2019). Our aim is to shed light on connections that can complement our assumptions based on secondary statistical analysis, thus further identifying the source of the problems and suggesting possible ways to remedy them in the future. This general objective is pursued in the study through the following sub-objectives. The focus of the study is to discover the skills and abilities of our target group as well as the diseases that prevent them from working, which are essential for their success in the labour market. Other goals include exploring the target group's current labour market position, exploring their future plans, and measuring their willingness to continue training. Last but not least, we would like to know the needs of the respondents and whether these can be satisfied with the social services currently available.

2. Literature review

In setting the boundaries of the 50–64 year old age group on which the questionnaire was based, the endpoint proved to be relatively simple, as we had to look back from the last active year before the current retirement age limit. However, determining the start of old age was far more difficult. Both the gradual deterioration of health status and reports based on public opinions suggested that the onset of aging is between the ages of 50 and 60 (Dobossy–S. Molnár–Virágh 2003), therefore in order to include all individuals affected by aging we extended the target group of the questionnaire to the Southern Transdanubians from the age of 50 to 64. The area of the survey is the Southern Transdanubian Region; based on the findings of the latest TÁMOP research, which examined the modernization of social services, turned out to be one of the three most underdeveloped regions of Hungary. This region is considered under developed in the sense of accessibility to these services as every region has enough service providers; however they are not equally available to everyone due to space-time constraints (Hernandez–Rossel 2015). One of the most notable difficulties of such disadvantaged regions is the delivery system of these services, which is rather problematic to achieve in minor settlements without the necessary vehicles and adequate road system (Bakri et al. 2016).

Despite national funding not everyone receives adequate support therefore a more harmonic coexistence with nature is required for people in need to be able to meet their basic requirements (Augustine–Dolinting 2016). For the higher strata of society, this is not a problem, but as we move down the social pyramid, the number of people with social and livelihood problems increases exponentially. The increase of the differences between the social strata is not an isolated case, as the number of individuals, families and communities in need of assistance in every country of the world is growing. Many methods of assistance that are included in the collective concept of social services, which has been created to address these problems that the most disadvantaged members of society can use to improve their situation. While the pensioners have the financial background to access their requirements, families living in poverty cannot meet these so easily, therefore support must be ensured by child welfare services (Fong 2017). Although most elderly people may have serious health issues, which can have a negative effect on their social status and this needs to be compensated with state intervention (Jeon et al. 2017). Despite the fact that most elderly people may not have financial or health troubles, but those living in residential social services do have a major problem, which is depression that can greatly decrease the life quality of seniors (Jakešová 2015). The goal of the study is to gather soft information through the aforementioned questionnaire survey to give a more accurate picture of the Southern Transdanubian region in the sense of how big the target group is, where they are located and what are the services that they require to make the current social system up-to-date. This can greatly benefit policy makers in better handling the constantly changing requirements of society (Menachem 2015).

3. Methods

The present study is the result of a longer study in which we first addressed the issues related to the social welfare system, followed by an examination of the territorial distribution of people in need using statistical indicators. From the initial 34 indicators, we created the rDSS index using only 15 indicators, which brought the novelty of being able to categorize the South Transdanubian settlements into four groups based on the degree of their disadvantaged position. This has created a favourable, an intermediate, which can be further divided into more favourable and less favourable, and a lagging type of settlement where the reliance on social services is the highest. The categorization of these settlements was an indispensable step in the establishment of further surveys, whereas this provided the territorial sampling basis for the survey in the case of the 653 settlements of Southern Transdanubia.

The questionnaire survey addressed the population of the lagging, intermediate and favourable type settlements of the three counties forming the Southern Transdanubian Region - Baranya, Somogy and Tolna. 20.98% of the settlements (137 settlements in total) belonged to the group of favourable-type settlements, mainly composed of the county seats and the settlements directly surrounding them. 67.07% of the settlements (438 settlements in total) belonged the group of intermediate-type settlements, which shows that the reliance on social services in the district headquarters is not obvious, especially due to the fact that more

than half (239 settlements, 36,6% of all settlements) are part of the group of more favourable intermediate position settlements. Fortunately, only 11.94% of the settlements (78 settlements in total) were included in the group of lagging-type settlements.

The questionnaire used in the primary data collection also asks for high-sensitivity data, so it is extremely important that the questionnaire was voluntary and anonymous. The questionnaires were distributed in Hungarian and in paper format so that individuals without internet access could also fill it in. A total of 164 questions in the 10-page questionnaire cover the following topics. In addition to general socio-economic issues, it examines the role of skills and abilities, the importance of living conditions and standards of living. It highlights the role of health, social relationships, future plans and opportunities from the perspective of the need for social services. It also reveals the labour market position, the working conditions of the family members, the willingness to continue training and retraining, and asks about the shortcomings in the care system as well as development opportunities.

The general questions ask only basic information such as place of residence, marital status, and number of dependents, all of which can help determine the level of individual need. In addition to the highest level of education, the skills and abilities section of the questionnaire covers foreign language skills and computer skills, which are nowadays a basic requirement for finding and retaining a job. The third chapter is intended to reveal the living conditions such as the type, size, equipment and comfort level of residential property, as well as difficulties in living and the degree of satisfaction with an individual's current standard of living. In the health section, we were not only curious about whether the respondents struggle with disease or addiction, but also about their observations about health care institutions a well as what they themselves do to maintain their health. Social relationships are extremely important in order to avoid the problem of old age isolation; therefore here we were searching for the causes of neglect. In the sixth chapter, we asked how consciously are planning their future and what they are doing to make it a reality. In the next set of questions, we were interested in the current labour market position of individuals and how many of the occupants also have jobs in the same property / household as the respondents. In terms of financial situation, we sought answers to the questions of how much the individual earns as well as the total income of household. The question group of continuing education and retraining provides an opportunity to gain insights into the individuals' labour market motivations and prospects. In the tenth group with the most questions, we asked about the needs related to social problems that are typical of this age group, and whether they knew of institutions or organizations in their area that might be able to remedy / alleviate these. The last two sets of questions were purely elaborative, asking about the shortcomings encountered by the respondents in accessing social services and their suggestions for improvements.

Among settlements selected for the questionnaire survey by the rDSS-index, there is of course at least one of each of the four settlement types, but despite the personal visit, due to the limited willingness to fill out the questionnaire, we failed to survey the population of all the settlements that we contacted. The empirical study is currently based on the results of 460 completed questionnaires.

In terms of gender, the majority of the respondents to the questionnaire are women (58.7%), while the men represent only 41.3%. With regard to the place of residence, the urban population was overrepresented, as there was a greater willingness to fill out the questionnaires than in the villages. On the basis of age, only 8.7% of the respondents did not reach the age of 50 at the time of the survey, however, since their housing was solved only with state support, their inclusion in the study group was also considered relevant. 69.5% of the respondents do not live with dependents; most of them started their own lives, while the other respondents did not even have a child. An additional 30.5% of the respondents share their residential property with one to three dependents, most of whom are children, grandchildren and to a lesser extent other relatives. Exceptions to this are the recipients of subsidized housing services, who also belong to the target group of the study.

4. Results

4.1. Labour market skills and competences

In terms of **skills and abilities** that also determine the labour market position, the respondents range from an extremely wide scale, as we find respondents who have not even completed primary school education to those who have successfully completed a doctoral program. There is a similarly wide variation among the studied professions, therefore we can find teachers, kindergarten teachers, dealers, nurses, mechanics and administrators. Only 41.3% of the respondents have some degree of foreign language skill. However, just over one-quarter (26%) of those completing the survey have one or two language exams, with Russian, English, German and French being the most common. The situation is very similar in the case of computer skills, where only the highly qualified can use the different softwares at a minimum user level, while the respondents with low skills have not acquire this knowledge.

Considering the territorial allocation of the respondents, it can be stated that most of them with the above mentioned skills expected by the labour market settled in the county seats and larger towns in order to obtain a better labour market position, while the respondents in villages do not have these qualities or only to a limited level. This gap mainly appears in the case of computer skills, as the slowly retiring industrial society is gradually being replaced by the information society, which has the skills that the labour market expects, but less than half of the older workers, according to questionnaires (43.5 %) are able to use information technologies at a minimum level (Nemeskéri – Szellő 2017). The number of labour market opportunities is in direct proportion to the size of the settlement, so it is not surprising for us that the place of residence determines the still active workforce, rather than having a high level of education and language exams. Highly educated young people living in rural areas will leave their homes and try to find jobs in the cities in hopes of better livelihoods and higher salaries, while those remaining in the villages as less educated and less willing to move.

4.2. The living conditions of the survey respondents

Responses to **quality of life** questions indicate that less than half (45.6%) of respondents are satisfied with their current living conditions, while less than 39.1% have smaller or bigger unmet needs. In almost all cases, respondents living in detached or terraced houses, even if they could, would not change their type of residential property and consider only the amount of available monthly budget insufficient. However, more than a tenth of the respondents (10.8%) are not at all satisfied with their current living conditions, which is mainly due to the low level of amenities and insufficient financial resources. Respondents have a wide range of residential property types, ranging from a 40 m^2 apartment to a 160 m^2 detached house, while most respondents seem to be satisfied with the type of property available to them. Although it is also the case that those who live in a detached house would prefer to move into a condominium and those who live in an apartment want their own detached house. Overall, dissatisfaction causes a problem in the case of more than half of the respondents, but they do not want to change this state or they cannot. The general problem arises for those who want to move from a 40 to 70 m^2 condominium or apartment to a detached house, which however is only possible in villages farther away from the big cities or holiday houses in need of a major renovation on the outskirts of the agglomeration. In the latter case, however, they would no longer have sufficient resources for renovation work, or in a more favourable case, they would not have time to carry out such work before retirement or have it done by professionals. Respondents who have experienced the many maintenance tasks associated with detached or terraced houses would like to move into residential properties that require less house work, such as condominiums, apartments or prefabricated homes, as retirement age approaches. They have the opportunity to do so from the value of their current real estate, unless these are located in a rural area far from the metropolitan area.

After processing the questionnaires, it cannot be clearly stated that individual settlements have a favourable or unfavourable impact on the living standard of the inhabitants on the basis of their position in the settlement hierarchy, but the level of equipment of different residential properties is closely related to the level of general satisfaction. The amenities of the real estates was surveyed by asking for 22 pieces of electrical equipment in order to provide an accurate picture of the comfort level of the occupants' properties, since asking the comfort level is the subjective judgment of the respondent, which is unlikely to coincide with the criteria used by the CSO. The electrical appliances include large household appliances (e.g. cooker, ceramic hob, gas or electric oven, microwave oven, refrigerator, washing machine and dishwasher), telecommunication equipment (e.g. internet, Wi-Fi, landline, cell phone, smartphone) or consumer electronics (e.g. TV, computer, laptop, Hi-Fi, home theatre system, game console) and air conditioners. The highest number of the equipment that respondents had in their households was 18 out of 22, and in the majority of cases with up to 15 items indicated that the residents were satisfied with their living conditions. It is worth noting that there were some respondents, who even with 17 devices were only partially or not at all satisfied with their living conditions. About 30.4% of the respondents have 10 or fewer of the devices listed above. Nevertheless, only half of this subgroup

admitted that they were only partially or not at all satisfied with their living conditions due to the low number of assets. From this we can conclude that only in the case of 12 or more assets can equipment be a reliable indicator of satisfaction (Microcensus 2016).

4.3. The general health status of the survey respondents

As the **health** of workers continues to deteriorate with age, it is not surprising that only 13% of them admitted of being completely healthy. Almost half of the respondents (45.6%) report minor health problems. Slightly more than one-tenth (10.8%) struggle with the temporary deterioration of their state of health, and nearly one-third (30.4%) have a permanent, chronic condition. Only 8.7% of respondents are dissatisfied with the quality of care provided by GPs, clinics and hospitals, but the majority of respondents are satisfied with the quality of domestic health services. With the exception of nine respondents, everyone noted that preserving health, conscious nutrition and regular exercise is important, however 46.5% of the respondents regularly drinks alcohol and 26% smoke. These values may cause serious concern, as the deterioration of health with age may contribute to a significant reduction in elderly activity.

30.4% of respondents said they had a long-term illness, and that this was mostly caused by their unhealthy lifestyle and severe stress at work, regardless of their place of residence in the settlement hierarchy. Indeed, some people living in rural areas struggle with poor health, but more active outdoor life can compensate for the lack of heath service, while widespread health care can balance out the poorer health associated with urban stress. All in all, we see in the results that urban populations gave a poorer assessment of the health care systems than those living in rural areas. Gender distribution proved to be a better indicator than the place of residence, as while 47.4% of the surveyed men had a long-term illness, this was only true for 18.5% of women, which is similar to the CSO data, which also supports the higher life expectancy of women. This, in turn, leads to a shift in the gender ratio of old age, which will increase the number of elderly women living alone, who, even from their age, are more burdened by daily tasks than elderly men (S. Molnár 2004). Almost all respondents considered it important to preserve their state of health, but when asked what they were doing to achieve this; we received only few valuable answers. Overall, 58.7% of the respondents provided an answer, however most of these gave us the impression that these respondents do not know how to make the first step towards a healthier lifestyle. There are three possible causes of this phenomenon, the decline in economic activity and income as well as the decline in social relationships, all of which go hand in hand with aging (S. Molnár 2006). The latter finding is supported by the fact that more than one-third (34.8%) of those completing the questionnaire live alone and that there is no specific person for them to support or to assist them. This will eventually lead to a decrease in their general demand levels. All of these contribute to the deterioration of their health.

4.4. Social relationships

In the case of **social relations**, only 21.7% of the respondents would use help in their daily lives, which is a good result, considering that nearly 9% more have a longstanding illness and are still not dependent on their relatives or their surroundings for support. Most respondents rarely meet with their relatives, friends and acquaintances, but only 23.9% would change their current social relationships. Interestingly, 28.3% of all respondents lack emotional care in their lives, which outnumbers both those seeking help and those willing to change their social life. All of this highlights the problem of isolation and also predicts an increase acceptance of this tendency.

The inhabitants of villages and small settlements, because of their immediacy, are much more helpful to each other and even to strangers, than the inhabitants of cities and county seats. Individuals' marital status can be a good starting point for us, as 63.6% of respondents are single or divorced, which can make life very difficult at an older age when there is no one to rely on or interact with on a daily basis. The educational attainment of those completing the study is more differentiating than the place of residence, as 81.8% of those who need help have only a high school education or less. The remaining 18.2% may even have a university degree, so it is not only this or being single that determines whether or not someone needs the assistance of others. In our opinion, active lifestyles can be the key to maintaining an independent self-sustaining life despite old age (Majercsik 2004), which is independent of the type of the place of residence, but can still be greatly influenced by education and support from the immediate family.

As the retirement age approaches and the younger members of the family become more independent, this contributes to the continuing decline in occupational activity. It is natural for aging workers to perform less and less tasks as they get older. The loss of caring for the family and the other shortcomings mentioned above all add to the increased risk of social isolation, which, in the absence of external motivation, is becoming an increasingly serious problem among currently still active workers (Szemán et al. 2007).

4.5. The future preferences of the survey respondents

The main observation from the answers given in the **plans and opportunities** group of questions is that the majority of respondents (58.6%) have specific financial goals for the near future, but only 47.8% have some kind of retirement savings. However, an additional 47.8% of the respondents have no savings and only 6.5% would start saving money in order to fulfil their future plans and provide for their elderly care. There are some people who have been paying attention to the importance of saving up money for a long time, even 15 to 20 years, but this amount depends on many factors. Based on the received responses, the amount of monthly savings falls between 3 and 25 thousand HUF, which is mostly determined by the minimum salaries corresponding to the qualification level of the individuals. Saving money, despite the amount, is important not only because it guarantees financial security for a calm old age, but it also carries spiritual gains.

The vast majority (84.2%) of respondents, who do not have plans for the future live in a county seat or a large metropolitan area. Despite the fact that 63.2% of this group of respondents live in detached or semi-detached houses and only 36.8% live in condominiums or apartments. There is a slight shift in gender distribution, 57.9% of women and only 42.1% of men.

4.6. Socio-economic position

As with educational qualifications, respondents hold a variety of different **labour marker positions**, with the majority in this study having only a high school graduation or secondary qualification (63%). Slightly more than one third (34.8%) of the respondents have at least tertiary qualification or even higher educational attainment. In spite of their higher education and the resulting better socio-economic status, 37.5% of these respondents are only partially satisfied and 6.3% are not at all satisfied with their current living situation because their monthly salary is not sufficient to meet their targeted standard of living. The responses to the questionnaires showed that only 10.8% were not at all satisfied with their current job, even though they reportedly had the opportunity to change jobs. Although half of the respondents believe that they will be able to return to work after losing their current job, 54.3% of respondents would be more severely affected by the loss of their job, which could indicate a high degree of insecurity among aging workers.

19.6% of all respondents who are partially or completely dissatisfied with their jobs are in the vast majority of cases employed in county seats or surrounding big cities, and only 11.2% live in rural areas. It may come as a surprise to us that one third of these respondents (33.3%) have at least tertiary education and a good labour market position, but are not satisfied with their job. From this we can conclude that the level of education is less decisive for job satisfaction than the place of residence. However, gender proved to be a better indicator, as the proportion of women in this group of respondents (66.7%) was twice that of men (33.3%).

Nearly two-thirds (65.2%) of the respondents would be slightly or very indisposed to lose their job despite the fact that one-third (33.3%) of these respondents had tertiary education or even higher educational attainment. In spite of the fact that the vast majority of these workers live in large cities where they have much more job opportunities than the residents of rural areas. There is a shift in the gender ratio, as the loss of a job would shake men less, as the majority (60%) of the respondents were women. This is partly due to the fact that 23.3% of these female respondents are single, which in itself makes it difficult for them to sustain themselves and raise their children, so they will be particularly affected by the loss of their jobs.

4.7. The financial situation of the survey respondents

Concerning the **financial and income situation**, 32.6% of the respondents stated that they either have no difficulties at all or are able to make smaller savings. Only 17.4% of respondents live up their whole salary and the remaining 15.2% are unable to make do with the money they receive in one month. Therefore they have to make up for the shortfall from loans, which in the long run could lead to total debt and eventually

eviction. The amount of salaries supports the above-mentioned livelihood problems, as 10.8% of the respondents do not even earn 80 thousand HUF a month, and the income of 21.7% of the respondents does not reach 110 thousand HUF a month. Of course, earnings below 80 thousand HUF are due to the fact that they are not full-time employees. This means that more than a fifth of the respondents are earning below or just above the minimum wage, which in 2019 was a net 99,085 HUF. Almost half of the respondents (45.6%) earn between 110 thousand HUF and 200 thousand HUF per month, and more than a quarter (26%) of all respondents earns less than 150 thousand HUF per month. Monthly net earners between 200 and 300 thousand HUF make up 17.3% of all the respondents who have no livelihood problems, as do 6.5% who take home more than 350 thousand HUF a month. The minimum amount for which workers are willing to go to work is the same as the current minimum wage, but there are also glaring cases where employees want to earn up to six times that amount, which is unrealistic for certain qualifications. However, according to the questionnaires, there are households where the total income can reach up to 600 or even 800 thousand HUF per month. Men seem to be in a better financial position in terms of gender, as 85.7% of the respondents in this group are women.

The respondents' financial status can only be interpreted as subjective well-being (Hajdu 2015), that is, whether one considers his or her own standard of living to be satisfactory or insufficient. Based on the multiple-choice questions of the questionnaire, we can highlight the subjective well-being of the respondents and compare them with their residential appliances to determine their consumption preferences. 32.6% of all respondents felt that their financial situation was insufficient for self-preservation or only sufficient for that. However, it is worth mentioning that one fifth of these respondents live in 90 m^2 real estates and more than half of them (53.3%) have eleven or more household items, as detailed above. This leads us to conclude that although the individual may have a good financial position in an objective sense, but according to his or her subjective judgment, does not consider it sufficient.

4.8. Training and retraining potential

Based on the responses given to the questions concerning **learning and continuing training**, nearly two-thirds (63%) of those surveyed, while satisfied with their current job, would still undertake further training to gain a better position within the workplace. This kind of advancement may be related to preparing for retirement, because the higher position they reach, the higher their salary base will be from which they calculate their later pension. In the absence of motivation, only 21.7% of the respondents rejected the possibility of further training, despite the fact that most of them considered themselves able to acquire new knowledge. The willingness for retraining is already much lower, which only 36.9% of the respondents would undertake. At this age, the likelihood of a major change in professional orientation is low. However, half of the respondents clearly rejected retraining as an opportunity for advancement, despite the fact that the majority would consider themselves suitable for acquire a new profession. This is partly due to a lack of motivation and partly due

to lack of time given for training, which may also reflect employers' inflexibility in career development.

Of the factors analysed above, living conditions, health, labour market position and financial situation have proved to be the most decisive factors in judging living conditions. The majority of the respondents are dissatisfied with the type of property they are currently living in because they either find it too big and no longer need it, or on the contrary, want bigger one. Dissatisfaction with residential properties can result from an individual's health condition, which appears to be the most serious problem, as if this altered condition may prevent the individual from working, it may also have a serious impact on his or her self-preservation ability during retirement. The majority of respondents would also like to get a better job in the case of labour market position, but lack the motivation and confidence to take the first step. Last but not least, almost every individual who filled out the questionnaire wants to achieve a better financial situation for himself/herself or his/her family. These show us that the most important social services that this age group would need are motivational training, career planning and financial advice to be able to fulfil their future plans. Increasing the capacity of nursing homes and care homes for those with poor health could contribute to reducing future overload.

4.9. Social needs and vulnerability

Depending on age characteristics, this age group needs little **assistance** from social welfare institutions, despite the fact that 60.8% of respondents have access to information on various services and only 18.3% are unaware of the fact that their municipality has institutions specialized for such services. However, almost one third (32.6%) of the respondents have no information about their existence, which shows that the necessary information is not available to everyone. Most surprising is that, none of the respondents answered that they would use social services, whether they were aware of them or not. In addition, more than a quarter (28.2%) clearly refused to use social services. This may be partly due to the low level of awareness and the fact that those in a better financial position do not want to use these services. More than 93.4% of respondents do not have housing problems; do not need home or household assistance, or job placement assistance, which clearly shows that members of the surveyed age, despite lesser or greater health complaints are still live an active and almost fully self-sufficient. The only exception that we can find to this is in the case of special services, as 6.5% of the respondents would need financial advice for investments and savings, 10.8% would need help with retirement planning, and 13% would need help with interpreting or filling out official documents.

5. Conclusion

The purpose of this study was to survey the population of all settlement types with a questionnaire according to the spatial structure created by the rDSS-index to complement the previous secondary statistical analysis with primary data in order to reveal real socio-economic problems that threaten aging workers, not only in rural but

also in urban areas. We have partially succeeded in achieving this goal by identifying the most serious challenges facing aging workers. The majority of respondents want to live in better conditions, regardless of educational level, labour market status or financial situation, but many of them do not have the motivation to do so. 58.7% of the respondents have specific goals and plans for the future and their years of retirement, and this is closely related to their level of education. Every respondent who makes plans for his or her seniority has at least intermediate, but most of them tend to have tertiary education. In addition, it is also clear from the data that the respondents who are in good health set goals for themselves, so that their inactivity in the labour market does not mean a decline but maintenance of their activity. Another important aspect with the progress of age was maintaining health, which includes both physical and mental health. As long as the aging people feel that they are needed and there are people that they can rely on, the process of physical and mental decline is a bearable discomfort. However, the more isolated and ineffective they become, the quicker it will lead to their decline, which will eventually make it indispensable for them to use retirement homes and nursing homes as they become unable to provide for themselves.

On the positive side, many of the respondents have plans for the future, but have few concrete ideas on how to fulfil these. The problem of low-value answers also arises when it comes to meeting needs where the majority of those filled out the questionnaire either do not really need help or do not know how to solve their problems due to lack of awareness. There is no significant difference in terms of territorial distribution, depending on whether the respondents live in a county seat, a district seat or in small villages. Similarly, no significant shift can be detected based on the gender of the respondents. Their level of awareness is much more influenced by their level of education. 45.5% of those with only primary or vocational qualifications (21.7% of all the respondents), regardless of their place of residence, did not have information on the existence of an institution providing social service in their municipality. The financial situation may somewhat obscure this picture, as among the respondents unaware of social services, there were none who reported their financial situation as being problematic, although nearly one-fifth of them said that they live up their total monthly earnings, which could be as high as two hundred thousand HUF. However, the vast majority are capable of making minimal or greater savings; therefore it is likely that they are unaware of the existence of these services, because they do not need them according to their own discretion.

Unlike awareness, the lack of conscious planning for the future is clearly influenced not only by the level of education, but also by other factors. 38.8% of respondents did not have or did not share their plans when completing the questionnaire. Barely one-third (31.6%) of these respondents have higher than tertiary education, indicating that more highly qualified individuals may not have long-term plans either or simply did not wish to share them. In fact, 21% of those who do not have any future plans have a certain amount of pension savings and more than half of them have at least a basic university degree.

However, in addition to sharing more information about their socio-economic situation, highly skilled respondents are much more conscious about planning their

future and come up with practical solutions to their problems in life. Therefore, we consider it important that in addition to improving access to social services, it is inevitable that a proper information network be set up to make the services available for a wider range of people in need. In addition, changing the current perception of aging is of particular importance. A shift would be needed to draw attention to the fact that aging is a natural process. The older an employee is the more experience they have gained in a given job or jobs, which would be essential for the better preparation of new generations. Aging should therefore be seen as a new socio-economic role that can contribute to the successful integration of entrants into the workplace.

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Socio-demographic trends and their macroeconomic context affecting the public sector

Tamás Szabó

Demand concentrates space and vice versa with regard to the principle of rational public services: concentrated space broadens the needs in relation to task fulfilment and the possibilities of organizing public services. The theoretical question concerning the goodness of decentralised and centralised task fulfilment gets exciting when we compare the level of the provision of public services to social trends, and we examine the unintended functions of the applied practice and the latent impacts of these functions. Based on cross-sectional data, present study examines – with public education and health care focus – how access to public goods influences the social competitiveness of the resident population of each district in space. Furthermore, the study also addresses the direction in which the differentiated level of provision of each regions of the country exerts its migration and demographic impact.

Keywords: public services, education, health care, cluster analysis, thematic map, spatial categories, administrative level, competitiveness

1. Introduction

Numerous studies (Alekseeva–Nikonova–Yusupova 2014, Foucart–Wan 2018, Gómez–Knorringa 2016) show that consumers can be excluded from the consumption of private goods. Theoretically (!), the members of the society get equal share from the consumption of the public goods. Therefore, the scarcity or the abundance of public goods affects the population of an area to the same extent.

Regions within a nation state differentiate and attract newcomers in numerous ways, or on the contrary, they become a deserted area due to their position. The reason of the differentiation of each region, delimited also by administrative concepts may be for instance the low concentration of business associations (Szerb et al. 2019) or the lack of provision of public services (Szabó 2019). At the same time, the approach to competitiveness is decided on the basis of the competition for limited goods (Chikán–Czakó 2012, Lentner 2007). This statement also applies to public services. Territorial competition 'is a process between territorial units with the aim of enhancing the prosperity of the region's or the town's population through the promotion of the development of regional and local economy. Certain groups try to influence that development explicitly or often implicitly via local policies while competing with other regions' (Lengyel 2016).

Competitiveness therefore can be measured in territorial relation as well, thus the competitive position of areas within the same nation state can also be measured and compared to each other. As a consequence, Lengyel's definition that 'territorial competitiveness can be considered as the competition of areas for resources' also

applies to the accessibility of public services in the population retention relation of administrative units and territories within the nation states.

Based on the typing of resources (Lukovics 2008) it can be stated that the renewal of human resource is the engine of an area's ability to renew (Kónya 2015, Simonyi 2000). The fact that the population stays in place can be defined as the guarantee of the ability to renew. The provision of public goods is a necessary, but obviously an insufficient condition of staying in place.

Transport – including public services – is a complex system that not only integrates passengers and consumers, but it is a complex aggregation of synergistic elements built on one another and maintains the well-being of an area's resident population (Siska–Szabó 2015). Thus, public transport and the provision of mobility connects urban functions with rural functions in the different areas. But if permanent transport connection is not provided between these two types of functions within an area, the inhabitants of rural areas will receive less from the goods of certain groups of public services than their fellow citizens from the more mobilised area. Thus, the quality of their life – their well-being – deteriorates, moreover, they lag behind the population of that rural area (Campos Ferreira et al. 2017).

This process facilitates social erosion as well through the change in the given area's cohort structure. Rural areas which are cut off from urban areas by transport policy, become ageing areas (Samu 2019, Kollai 2019), because they lose access to services related to well-being. These services also facilitate the competitiveness of the given area and its population, therefore, the scarcity of these services foster the process of outmigration.

2. Centre and periphery with regard to public services

The greatest difficulty in defining the concept of public services is caused by the complexity of the concept. The concept of public service has played a significant role in several disciplines, so the concept can be explained from several aspects. (Hoffman 2013) As several Hungarian literatures point out (Hoffman, Horváth), the common feature of public services is that:

- − it can be used equally by all members and groups of the community;
- − their use is passive: so there is no need for agreement or active involvement of stakeholders;
- − there is no competition between consumers in terms of access to the service.

As can be seen from the definition of public service, public involvement aims to eliminate the negative effects of market mechanisms and to create a kind of equilibrium in order to achieve these public goods.

From a fiscal perspective, economic centre and periphery can be defined on the basis of efficiency and profitability. Geographically, centres can be identified with the developed, while peripheries with the underdeveloped areas and municipalities. The core concept of this relationship system is the equality of values. There is an interdependency between centres of power (administrative centres) and peripheries;

the power elite represents the centre, while the vulnerable mass represents the periphery. Geographically, the centre can be linked with administrative institutions (e.g. parliament, court). This may also mean that the better an area is provided with institutions, presumably the higher the concentration of the resident population is. In Hungary, as the consequence of the 2011 public administration reform,[1] these centres are the district centres. Since the beginning of 2015 there have been 174 district centres. In Hungary, a district is a territorial public administration unit of a county comprising a certain group of municipalities. According to the 2013 data of the Hungarian Central Statistical Office, district centres can be reached on public road within 10 minutes, which can be considered a good level of provision from the viewpoint of the public administration. The access to public services however, are not that homogeneous: with special regard to education (Velkey 2019) or public health care (Tóth–Bán–Vitrai–Uzzoli 2018).

Figure 1 Number of general practices per district (2015)
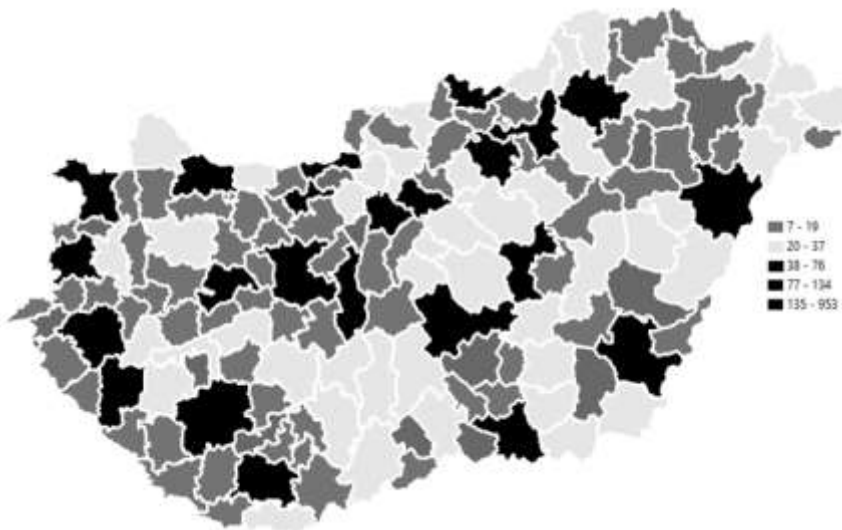
Source: own elaboration based on TEIR database

Performance of districts can be divided into several well-separable elements or dimensions (such as the status of technical infrastructure, the performance of the economy, the quality of human and social capital, the standard of living, the status of the environment) which are complex concepts on their own and they can be characterised by more kinds of indicators (Uzzoli 2015, Csath 2002, Pusztai 2009). In addition, the elements that make up each dimension are not always measurable or not

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[1] The latest reform of the Hungarian public administration system was implemented in the framework of a programme which was named after Zoltán Magyary and was funded by the European Union. This programme covered all areas of public administration and induced a number of sub-programs in the spirit of efficiency and simpler, broader administration.

available in appropriate quality. The latter – given that it is a legal act –provides mostly homogeneous quality in terms of administrative tasks, and as the map shows, it is evenly accessible.

The introduction of electronic administration[2] further improves this picture. The situation is different however, with regard to the examined public services, as Figure 1 also reveals. In previous works, the definition of centres and peripheries was carried out with the simplest method possible: in general, border areas were considered to be the periphery, while areas close either to the geometric centre of the country, Pusztavacs, or – probably due to the relative proximity of the two points – to the capital city were considered to be the centre.

A Hungarian author's (Horváth 2007) article went into more detail on the theoretic and practical possibilities of definition, since the periphery by definition can be approached not only from the direction of the border, but also from the centre. By following the logic, the macroeconomic thesis can be reversed as well, according to which the demand concentrates space in public services (H1), however, the lack of public services defragments space and erodes the society. This hypothesis can be verified by the cohort structure, the level of qualification, the health condition and the change in the number of the permanent residents of the examined areas. The coherence among the concepts listed above provides opportunity to formulate a further sub-hypothesis, according to which (H2) in areas where industrial output is higher, the level of outmigration is lower. A related sub-hypothesis (H2a) is that within the same county, the number of people with higher education degree is higher in regions with higher output than in areas with lower output.

During the examination of data related to public finances, Koós found that in the field of educational basic services (human public services), the optimal headcount required to the efficient and economical operation differs from each other. The author remarks at the same time, that besides optimal operation, other aspects such as fairness should also be taken into account. A study on the centralisation of public services (Kovács–Somlyódyné 2009) confirms this, by pointing out that the centralisation of potentials burdens not only peripheral areas but also central areas, since the former ones suffer disadvantage because the lack of access to public goods, while the latter ones feel the same as the consequence of the division of their resources. Therefore, when it comes to decentralisation, it should also be taken into account that the difference among the municipalities in the field of potentials – in present case in public education – may further distort the picture. Besides, the key for the permanent resident population to stay in place is the provision of human public services. In Hungary, areas comprising tiny villages are inadequately provided with human public services (Szörényiné 2005), which directly leads to the outmigration of the qualified and/or mobile layer from the municipalities of these areas (Obadovics–Bruder 2017).

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[2] As part of the Digital Hungary programme, the 'electronic public administration framework concept' was introduced in Hungary, with the aim of digitalising a wide range of public administration services. With the adoption of resolution No. 1743/2014 (XII. 15.) on the tasks related to the extension of electronic public administration, the government made a decision on the implementation and on the cornerstones of the development of electronic public administration.

Figure 2 The distribution of permanent resident population by qualification (2015)

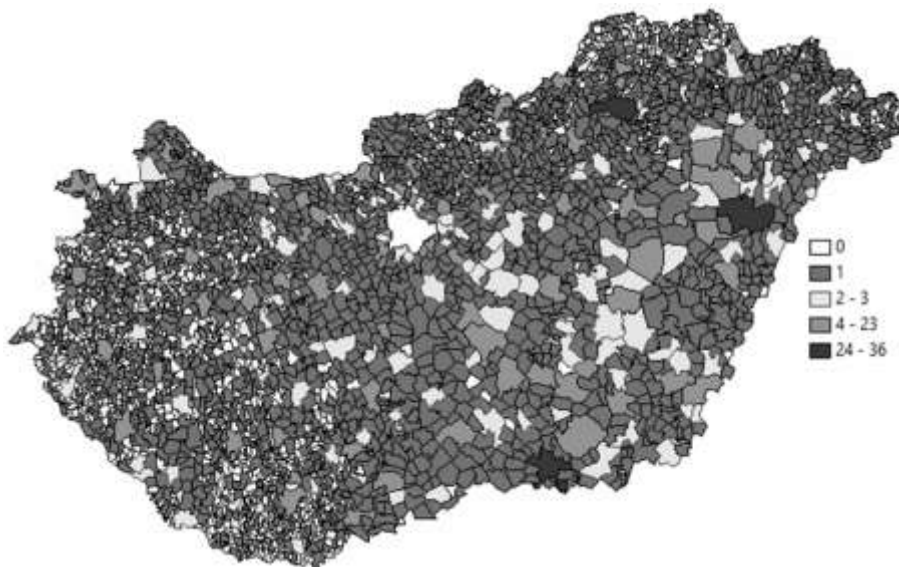*Source:* own elaboration based on TEIR database

This process is also shown by figure 2, since within permanent resident population, people with secondary qualification or university degree are apparently concentrated in the agglomeration of the capital city or of other big cities. This is clearly the consequence of the pull effect of the labour market (Forray–Híves 2009).

One important driving force, cause and effect of territorial differences is the lack of human public services, which is one of the reasons and manifestations of inequalities, furthermore, it is also the basis and at the same time consequence of social, economic and power dependency, subordination, superiority, and imbalance (Nemes Nagy 1998). A research conducted with the involvement of the permanent resident population (Koltai 2016) reveals that when people decide whether to settle down in or move from a municipality, the second most important aspect that they consider after public safety is the accessibility of public services. Thus, it can be assumed, that (H3) in the examined counties, where output per capita is higher, the district-level GP and public education services are more intense.

With regard to public education services, in tiny villages the core problem is access, since public transport opportunities are rather limited – typically three or four bus rotations per day (Hungarian Central Statistical Office 2013) – therefore, it often takes the customer a whole day to arrange a few minutes of administration. The extent to which people are provided with cars has significantly increased compared to 1990, but it is still hardly a solution for the inhabitants of ageing villages, or of villages that are turning into ghettos, since barely a third of the households possesses an automobile (Siska-Szabó 2015). In the first phase of the spatial rearrangement process of the elementary level public education – between 2004 and 2007 – in the course of the

negotiations among local governments of different size and lobbying power, centres of micro areas and of local government associations were forced to act (Radó 2007). Associations for maintaining institutions have been set up for institutions that have actually been jointly maintained for decades, and the centres of local government associations have begun to fight to increase the number of students and to persuade the schools of the small municipalities that insisted on their independence, to join the associations. Mostly, when concluding the association agreements, the centres of local government associations made concessions to the associating municipalities in order to keep their institution and to further strengthen their role as centres of micro areas (Lányi 2008).

Figure 3 Municipal-level distribution of elementary schools located in the territories of local governments in 2015 (pcs)[3]

Source: own elaboration based on TEIR database

Finta (2013) pointed out in his analysis, that funds for the development of sub-areas comprising tiny villages are spent for the prompt resolution of acute social problems instead of real development. According to Finta, the main reason for that is the tendering system chosen by the associations, which may be the consequence of the outmigration of the intelligentsia from the mentioned sub-areas (Szabó–Kovács 2018, Obadovics–Bruder 2017) mainly to the capital city or to other Hungarian cities (Lux 2012), or to their agglomerations. The non-intended function of the reforms is the depopulation and ageing of the areas comprising tiny villages. As Figure 2 reveals, municipalities of these areas in Western Hungary, Southern Hungary and Northern

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[3] Data of the capital city is not included

Hungary were left without elementary school. Youngsters migrate from Western Hungary to regions close to the Austrian border. They also leave the regions comprising tiny villages of Northern Hungary and the ageing tiny villages of Southern Hungary (Obádovics 2018), to find good labour market opportunities, mainly in the agglomeration of bigger towns or cities. This process brings about a deterministic social phenomenon, according to which the number of active people decreases to a level within the given area, that the permanent residents are not able to compensate. As a consequence, the micro society erodes which suggests that (H4) where the number of recipients of social allowances is higher, the volume of industrial output is lower as well. This reasoning, in turn, justifies the examination of the territorial competitiveness of different public administration units within a nation state in the relevance of public services.

3. Spatial analysis

According to the results of research interpreted by the Hungarian authors (Nemes Nagy 1998, Lukovics 2008, Zám 2019), the difficulty in measuring territorial competitiveness lies not so much in its measurability, but rather in the unequivocalness of the quality of the chosen indicators.

In my analysis, I used the variables which were mentioned in the hypotheses formulated above. I included four counties[4] in the empirical examination, and I examined these counties in pairs (2<=>2) because the area, the permanent resident population and the population density of these counties approximates the most in the area conditions of Hungary. Thus, the emerging error value is the lowest in the mentioned dimensions (area and population). I use the volume of industrial output of the examined territory as independent (explanatory) variable, not GDP per capita. I used data reduction procedure as statistical method, which is a *K-means* clustering procedure. For this – considering the variables – I created a *z-score* value according to the following formula: $x_{i,l\sigma} = \frac{x_i - x_s}{\sigma_{x,s}}$; where X_i indicates the standardised *z-score* value. During the operation, the average of the data series is subtracted from every observation data item and the remaining amount (difference) is divided by the standard deviation. The average of the data series which is equal with the resulting scale value will be zero, while its standard deviation will be one unit. As a result, the comparison of data series (variables) measured in different units and published accordingly, becomes possible according to uniform criteria.[5] The aim of the grouping procedure often used in economic analyses is to group the observation units into homogeneous groups with the help of standardised variables.

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[4] Komárom-Esztergom, Heves, Nógrád, Vas.

[5] It was necessary also because the outlier filtering revealed that while the normal distribution test of domestic migration was completed properly, the histogram image of industrial output did not draw a normal distribution curve. There were two outliers in the two examined counties, the towns of Esztergom (Komárom-Esztergom county) and Szombathely (Vas county). In these towns, the car factories (Opel and Suzuki) skewed the distribution curve with their added values.

Elements recorded into the database are considered points of the space, where each point is represented by vectors. The values of these vectors are represented by variable values related to the given case. The resulting blocks comprising vectors can be classified into groups. The purpose of the procedure performed on a specific data series is to classify sub-areas of the counties into groups according to the volume of outmigration and industrial output. K-means cluster analysis has its own limitations. One of the most important limitations is that the unification of two clusters is irreversible, i.e. it cannot be modified afterwards. Furthermore, hierarchical cluster analysis is highly sensitive to noise and outliers, and it has difficulties in handling convex clusters and significant differences in size and it also tends to chop big clusters (Jánosa 2011). The latter problem in the present analysis does not occur, because I used the procedure on only one set of cross-sectional data.[6] I summarised the municipality-level data of the migration balance sheet to the district level, and I proportioned the county-level data of the volume of industrial output based on the number of the permanent resident population of the districts Kukely 2008. Among public services, primary and secondary schools and medical service located in the territories of local governments are mentioned as basic indicators of social competitiveness. During the creation of data blocks, I set the following three categories in SPSS:

1. centripetal area, which is the cluster of 'attractive areas';
2. static area, which is the cluster of 'neutral areas';
3. centrifugal area, which is the cluster of 'ejector areas'.

The names of the clusters show the population retention ability, which – by comparing to economic output – may be a litmus paper in the context of social competitiveness.

The results of the statistical test which included 26 standardised sub-areas are shown in table 1. After the classification of the values from 2015, the summarising table reveals that 20 sub-areas belong to the cluster of centrifugal areas. These are unstable areas in the context of the examined data. Compared to the proportion of examined areas, a low number of sub-areas (two altogether in two counties) can be qualified as socially and territorially competitive. Both of them are agglomeration centres, where car manufacturers pay the highest business tax to the towns. The table shows that two towns (Tatabánya and Salgótarján)[7] which once had the same industrial structure ended up in different clusters. That is because after the system change, different companies settled down in the towns in different numbers, and because Tatabánya is located on a transit route, near the country's busiest motorway (M1) (Árva–Szabó 2014).

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[6] Outmigration data and relevant industrial output data from 2015.

[7] See table 2

Table 1 Spatial categories

	centripetal	static	centrifugal
Heves county	0	2	7
Vas county	1	0	6
Nógrád county	0	0	4
Komárom-Esztergom county	1	2	3

Source: own elaboration based on TEIR database

It is important to note that the 2018 data – of which a lot are not accessible regarding the data included in the examination – would presumably paint a different picture of the examined areas: in my own point of view, the proportion of the centripetal (1) and centrifugal (2) groups would be higher in the counties, which is the result of the current considerable, but territorially unbalanced economic expansion in the country (Lengyel–Varga 2019).

Table 2 The results of cluster analysis*

Source: own elaboration based on SPSS output *'járás' means district

A previous study found that the concentration of resident population leads to an increase in the extent to which the different areas of Hungary are provided with public services (Szabó 2019). But that concentration means different dynamics on each level of public administration. Inequalities show a different picture at NUTS 3 level than at district or at municipal level. Figures 2, 3 and 5; reveal how spatial potential (see the change in colour) influences the practice of using social allowances:

Figure 4 Social allowances in cash provided by the state and allowances in kind
provided by local governments in Hungary (2015)
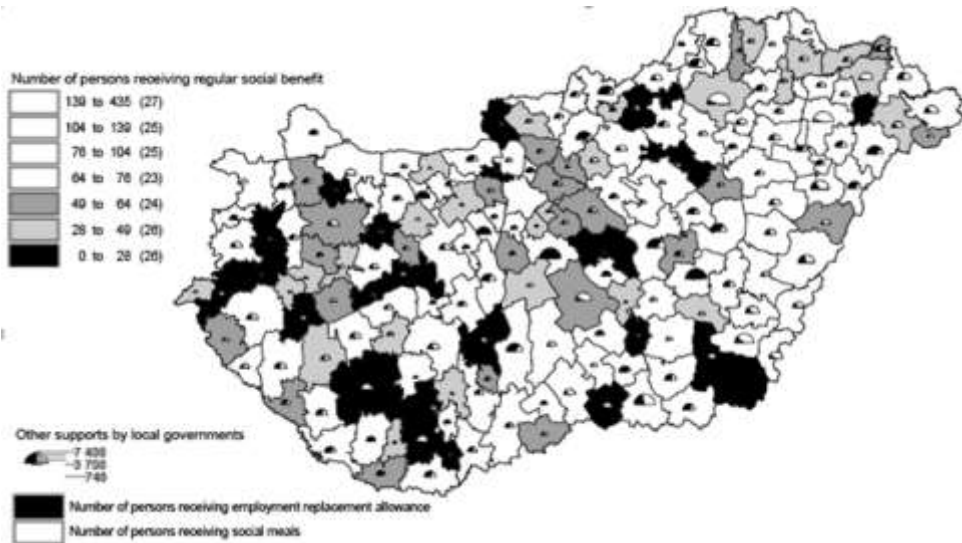
Source: own elaboration based on TEIR database

   The recipients of social services are evenly distributed at the level of sub-areas: the data in the brackets in the legend are the numbers of sub-areas, classified according to the number of people who receive social allowance. On the other hand, however, with regard to allowances provided by local governments, it seems that where the government decree defined a higher level of general social allowances (see colour scale), it is more difficult there to find a job. Furthermore, the expenditure on the wage of public employees is also higher (considering that their number is higher) than the number of recipients of social catering, which is also regulated by local government decree. The map on the data presenting the volume of the industrial output of the examined areas (the districts of four counties) shows the intensity of the sub-areas of the counties:

   In the context of industrial output (regarding the four examined counties), the hypothesis according to which higher industrial output results in a lower intensity of social provision (H4) cannot be confirmed. That is because the comparison of the two figures reveals that the number of recipients of social services in the affected areas is intensive (highly intensive in the sub-area of Hatvan, and moderately intensive in the sub-areas of Komárom and Tatabánya). Moreover, out of the sub-areas of counties, which were not subject to the examination, local governments of the sub-areas of Győr, Miskolc and Debrecen are also significantly affected by the constraint of providing social allowances.

Figure 5 Industrial output per district and the level of qualification of the permanent resident population in the examined districts (2015)
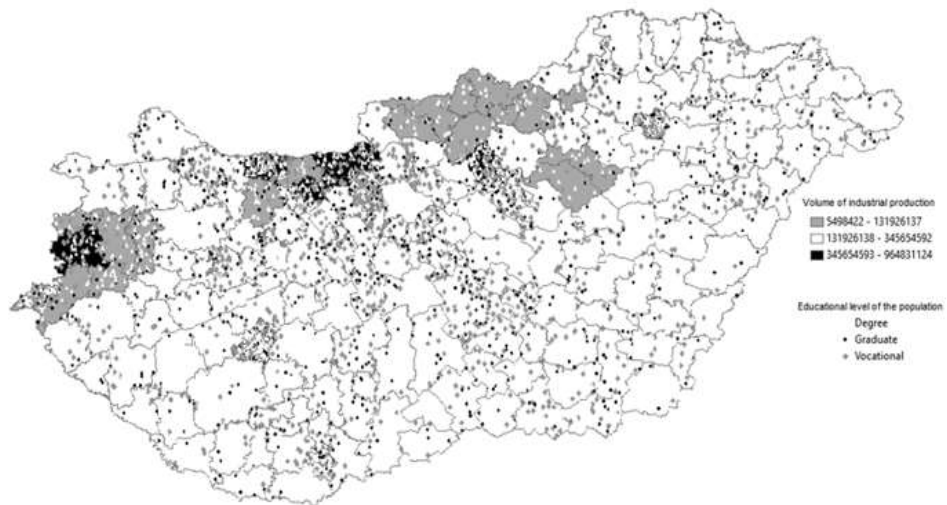
Source: own elaboration based on TEIR database

Figure 5 shows that sub-areas with higher industrial output concentrate employees with higher qualifications (sub-areas of Hatvan, Esztergom, Tatabánya, Komárom and Szombathely). Therefore, hypothesis H2a has been verified. Figure 6 presents outmigration at the level of municipalities:

Figure 6 The number of outmigrants within the permanent resident population (2015)
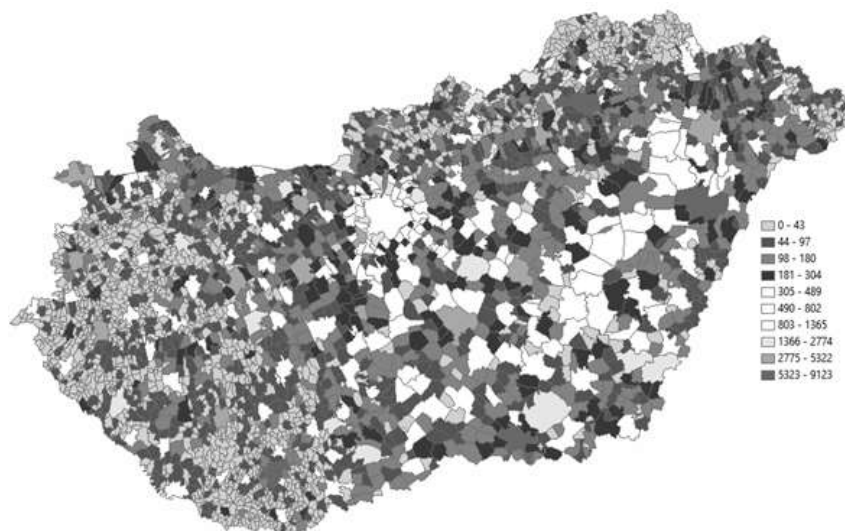
Source: own elaboration based on TEIR database

Let us not forget that the volume of outmigration from areas comprising tiny villages – mainly in the villages of Western Transdanubia and Northern Hungary, where social reproduction level is low due to ageing (Obádovics 2018) – is high. At the same time, outmigration examined on the municipal level shows (figure 6) that in sub-areas with considerable industrial output, a high level of outmigration occurs in towns with the most added value (Hatvan, Tatabánya, Esztergom and Komárom as well). Therefore, hypothesis H2 saying that 'the level of outmigration is lower where industrial output is higher' has been disproved. An explanation for that may be the accession to the European Union in May 2004, through which the free movement of labour distorted the previously typical Hungarian labour market and social and family structures (Nagy–Fodor 2015, Bessenyei 2016).

In the developed districts, the concentration of the economy and of the resident population expands the provision of public services. On the contrary, districts full of tiny villages – after the dismantling of agriculture – not only witness a deterioration of their infrastructure and services, but also a decline in their reproduction level and economic competitiveness.

Qualified youngsters outmigrate from, or do not return to areas comprising tiny villages due to the lack of livelihood opportunities (figure 5). This selective mobility contributes to the distortion of the demographic and social structure of tiny villages, and at the same time – as Éva G. Fekete points that out – erects an important barrier to local developments (G. Fekete 1997). Experts, developers and mayors often consider tourism to be the key to the survival and even to the development of tiny villages.

In parallel, the intensity of education and medical care have drastically declined in these areas compared to the previous decades (Kiss 2016). That is partly justified in terms of sustainability, but while the deterioration of education can be explained with the low number of live births (Obádovics 2018), the decreasing number of GP services in areas comprising tiny villages is due to the lack of experts. The part of hypothesis H3 concerning GP services is based on opinions published by media outlets, stating that GPs seek to practice in prosperous places. In order to test the hypothesis, figure 3 should be compared to the map in Figure 1.

If we compare Figure 1 to Figure 3 which shows the intensity of provision illustrating primary schools in the territory of the municipality, it becomes clear that provision with respect to education concentrates around towns with high level of output. Nógrád is the only county among the examined counties, where one can find a municipality that does not have a primary school. At the same time, these local governments are all located close to towns of high output level. Therefore, the provision is available, but not locally. In order to surely verify this hypothesis, visual comparison is insufficient, the examination of the school-age resident population is required.

As for GPs, the characteristic of the volume of industrial output and of the number of GPs are the same. However, in the case of hypothesis H3 only the statement concerning medical provision can be accepted, since the number of primary schools and the proportion of industrial output are not comparable to each other because of their different public administration levels. Thus, this hypothesis has just partly been verified. Regarding the situation in Northern Hungarian areas, the result is partly

latent considering that the number of areas comprising tiny villages is higher, thus, that the number of areas comprising tiny villages is higher, thus, the number of medical services per capita is lower, since the population density is lower, which at the same time confirms the statement formulated in hypothesis H3.

Hypothesis H4 partly referred to hypothesis H1, according to which 'the lack of public services defragments space and erodes the society'. The data presenting the intensity of the access to public services involved in the examination, have been visualised above.

The concept of social erosion means the ageing of the resident population and the loss of social reproductive capacity in the areas of the nation state. I examined the related hypothesis with the help of the following thematic map:

Figure 7 The number of people over the age of 60 in the permanent resident population (2015)

■	13 000 to 470 000
■	12 000 to 13 000
▨	11 000 to 12 000
▒	10 000 to 11 000
□	9 000 to 10 000
□	8 000 to 9 000
▨	7 000 to 8 000
□	6 000 to 7 000
■	5 000 to 6 000
▨	0 to 5 000
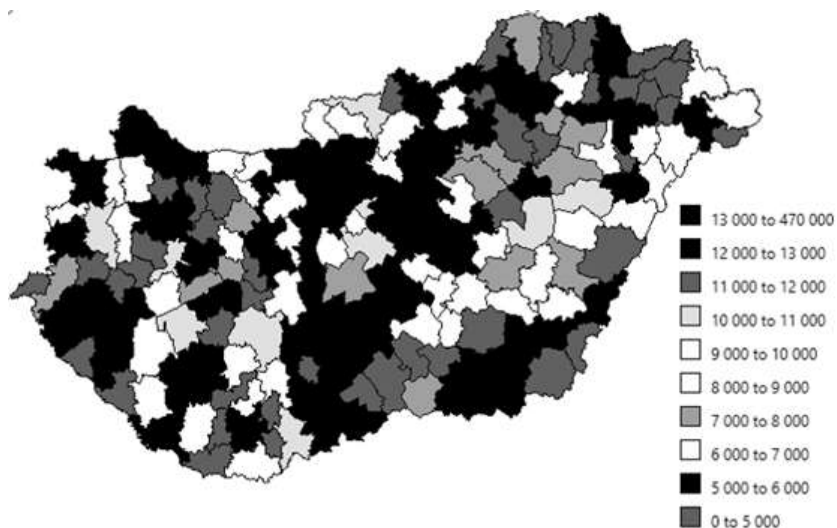
Source: own elaboration based on TEIR database

When examining the colour codes on the map, it becomes clear that the number of pensioners in the districts of the examined counties are high, even in districts with high industrial output like the Hatvan, Tatabánya, Komárom, and Esztergom districts. Namely in the areas, where people over the age of 60 are overrepresented – mostly areas comprising tiny villages in the examined counties –, the provision of public services is lower and outmigration is higher (figure 6), accompanied by high demand for social services and low number of live births (Obádovics 2018). If we take into consideration the areas comprising tiny villages around the sub-area of Hatvan, and the colour code of Szécsény district, plus the characteristics of all these in figures 3 and 6, then it will be easy to accept that this hypothesis (H1) is verifiable.

4. Conclusions

As the summary of this study, I would like to raise attention to some emphatic conclusions. During the analyses it has been found that the concentration of the resident population leads to the enhancement of the provision of public services. At the same time this concentration means different dynamics at the different levels of public administration. Inequalities show a different picture at NUTS 3 level than it does at district or municipal level. When the analysis is made in the context of public services, the social characteristics and the economic output of the public administration levels below NUTS 3 in a nation state are not equivalent to NUTS 3 level aggregates. There are centripetal, static and centrifugal areas also below NUTS 3 level (municipal and district levels), because the lack of public services defragments the space and erodes the society. Employees with secondary or tertiary qualifications are concentrated in districts with higher industrial output. Thus, they often leave the areas comprising tiny villages, which, in the absence of the initiatives of the intelligentsia, become incapable of economic and social renewal.

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Engaging students – Is co-creation the answer?

Anita Kéri

Consumer satisfaction has long been a question of great interest in a wide range of fields. Existing research recognizes the critical role played by student satisfaction in higher education. It has been noted that students have changing and variable needs. A considerable amount of literature has been published on the fact that higher education institutions have to react promptly and satisfy students' needs in order to keep their students and rankings. As student satisfaction is highly dependent on teaching quality, it is essential for higher education institutions to implement new teaching methodologies. Therefore, the aim of this paper is to analyze the concept of a teaching methodology, namely co-creation, and to examine its applicability in the field of economics. With the methodology of co-creation, teachers are able to involve students into the creation of curriculum, which might enhance student involvement and increase student satisfaction.

Keywords: co-creation, higher education, teaching methodology, quality, curriculum

1. Introduction

Student satisfaction has been in the center of research interest in the past decade. Many key aspects have been identified to have an effect on the satisfaction of the students. Teaching quality has been named as one of the most crucial determinants of student satisfaction (Ribes-Giner 2016). However, teaching quality is a notion involving many different aspects, one of which is teaching methodology.

Teaching methods can have a high influence on students perceived teaching quality, which might also affect their satisfaction. Therefore, it is essential to investigate how different teaching methods influence the classroom and the engagement of students, who represent a younger and younger generation with constantly changing needs for development. The new generation, namely the millennials have different characteristics, and according to the International Education Advisory Board, they have certain characteristics that differentiate them from other generations (Chemi–Krogh 2017, p. 2). They were born into the technological world, so they use and adapt to new technology easily, they are likely to take risks, they are inclusive, accepting and like to take control and share information with others, so they collaborate easily. New teaching methodologies have to adapt to the needs of this new generation, while preparing them for a future with yet unknown problems (Chemi–Krogh 2017).

One of the newly emerging topic in higher education methodologies is co-creation, which – in education – means the co-creation of curriculum to a certain extent. There have been numerous studies appearing in this topic in education (Chemi–Krogh 2017, Dollinger et al. 2018). Therefore, the aim of the current study is to provide a review of already existing definitions and applications of co-creation,

both in other research fields and in education, with special emphasis on the field of economics. The paper also aims to investigate the different methods, steps and phases of co-creation to provide a theoretical basis for educators who might use this concept in their classroom.

This paper is comprised of five chapters. After the introduction, the second chapter investigates the notion of co-creation and its different theoretical implications. In the third chapter, co-creation is studied from the viewpoint of education and tertiary education, while in the fourth chapter co-creation methodologies are reviewed. Chapter five concludes the paper and implies practical recommendations.

2. Co-creation as a notion

The concept of co-creation first appeared in the business world and was detailed by Prahalad and Ramaswamy (2000). They highlighted the role and active participation of the consumer in the value (product and services) creation process. As consumers require a growing amount of information, they also demand better value. Therefore, companies have recognized the need to involve their customers actively in the creation process of their products and services (Ribes-Giner et al. 2016).

Prahalad and Ramaswamy (2004) were among the first to realize the importance of co-creation. They initially recognized its importance in the field of business and applied it for value creation by strengthening the relationship between the customers and the market. They found out that if a consumer was included in the process of making the products, it could enhance customer experience. They created a 'DART' (dialog, access, risk, transparency) model, in which they regarded dialog, access, risk and transparency as the most crucial factors of co-creation (Prahalad–Ramaswamy 2004).

Since its first appearance in literature, co-creation has had different approaches and definitions. After Prahalad and Ramaswamy (2000; 2004) defined it as an active participation of consumers in creating products and services and new value creation, other definitions surfaced. Consumers become increasingly important in the value-creation process and companies have to collaborate with them to absorb competence (Lusch et al. 2007). According to Witell and colleagues (2011), the customer is an active agent in the co-creation process, as co-creation involves 'activities in which customers actively participate in the early phases of the development process by contributing information about their own needs and/or suggesting ideas for future services that they would value being able to use' (Witell et al. 2011, p. 9). Based on an extensive literature review, Ribes-Giner and colleagues (2016) defined co-creation to 'allow final product/service to be obtained according with consumer requirements' (Ribes-Giner 2016, p. 73). Additionally, co-creation can be characterized by keywords such as customer participation and involvement, precise communication, and transparent feedback (Ribes-Giner 2016, p. 73).

Chemi and Krogh (2017) grasped the essence of co-creation as it is the process of creative (original and valuable) generation of shared meaning and development. According to them, co-creation means the following: 'the concept is intuitively perceived and understood, as is the experience of shared values across different

stakeholders.' (Chemi–Krogh 2017, p. ix). Iversen and Pedersen (2017) stated that co-creation engages stakeholders in a collective learning process, which requires facilitation (Iversen–Pedersen 2017, p. 17), and 'co' means it is a social process, 'creation' means that something new appears as a consequence (Iversen–Pedersen 2017, p. 22).

Since its earlier appearance, co-creation has already emerged in numerous fields of life and has proven to be applicable in many of them. The fields in which co-creation has been used include design thinking (Sanders–Stappers 2008), product innovation, organizational development (Camargo-Borges–Rasera 2013), social innovation/management research (Voorberg et al. 2014), student direction and conceptual research. One of the most recent field of co-creation application is education, as it could be used as a pedagogical tool (Chemi–Krogh 2017, Dollinger et al. 2018).

All in all, we can conclude that co-creation has been widely researched in the previous decades. Numerous approaches appeared regarding the conceptualization of the notion and it has been broadly applied in numerous fields, including higher education and creation of curriculum together with various stakeholders. Therefore, in the next chapter, the concept of co-creation is introduced from the viewpoint of higher education.

3. Co-creation in education

In today's global economy and education, a continuous need for educational and pedagogical development has appeared. As the technological environment changes quickly, education has to prepare students to be able to adhere to changes. The new trends in higher education include focusing more on research, teaching methods and effective learning, while the central aim is to create a curriculum that brings innovation and is creative. It can also be observed that students and teachers are both motivated to help each other create an experience that enhances study experience (Dollinger 2018). However, the increasing number of HEI students does not make it easier for educators to apply new methods. Even though we would like a change in the education system and the way of teaching, most of the education takes place exactly the same as how it took place years ago. Taking a look at the classrooms, the furniture that is turned towards the teacher's podium implies that students need to listen to the lecturer only (Iversen–Pedersen 2017). With each new method comes the challenge to get it accepted by students, as new teaching methods can either engage them or deter them. If used wisely, these new methods can prepare students for future challenges and teach skills instead of factual knowledge (Chemi–Krogh 2017).

The most current application of co-creation is in the field of higher education, in which it is widely applied, sometimes together with different other methodologies. Co-creation in higher education has numerous approaches. Among others, it is defined by Chemi and Krogh (2017) as the 'process of creative (original and valuable) generation of shared meaning and development' (Chemi–Krogh 2017, p. viii) and as an 'experience of shared values across different stakeholders.' (Chemi–Krogh 2017, p. ix).

Relevant methods for effective co-creation include collaborative approaches, such as Problem-Based Learning, which includes students having a great

responsibility in working on problematic situations, while the teacher only has the role of a facilitator or a supervisor. Similar methods can make students more engaged and involved (Bovill et al. 2011). Chemi and Krogh (2017) also enlisted learner-led teaching, student-centered approaches, assessment, art-based methods, collaborative dynamics, interconnection of cognition/emotion, and creativity as closely related fields to co-creation. Though the concept and definition might be intuitive and easily understandable, it is still not clear how it could be interpreted in practice and whether it can be viewed as a separate pedagogical tool (Chemi–Krogh 2017). In the current paper, due to restrictions of length, only the concept of co-creation is detailed.

The current changes in society and labor markets, and the shift from industrial to information and learning economy have had a serious effect on the jobs people have and will have in the future. These changes require people to have different approach to educating the future workforce (Jensen–Krogh 2017). The early definition of Prahalad and Ramaswamy (2000) is applicable to higher education in some respects. Jensen and Krogh (2017) take three characteristics (or we can also call them criteria for successful co-creation) from the definition for education, which are respect for students, importance of students' active participation and their openness to contribute and create value in the educational process. According to Dollinger et al. (2018), 'the process of co-creation can allow for institutions and students to work together to improve student experience and enhance students' ability to act as partners' (Dollinger 2018, p. 210).

Numerous benefits have been found as a result of co-creation in education. Students could be a crucial source of information and additional input to certain classes. However, their importance is often overlooked. Many schools opt for teaching practices that have been used for decades and lack novelty in terms of curriculum. Teachers and faculty staff could be more open to challenge and engage students in a classroom (Bovill et al. 2011).

Student engagement is considered an important aspect when learning enhancement is discussed. Bovill et al. (2011) defines engagement as 'serious interest in, active taking up of, and commitment to learning' (Bovill et al. 2011, p. 2), where students actively participate in the learning process and teachers act as facilitators. This concept does not only let students offer their opinion of the education system and methodologies, but they can become the ones who are going to change based on their own needs (Bovill et al. 2011).

4. Co-creation methods in higher education

As we could see in the previous chapters, co-creation is widely used in education and in other respects of life too. In the current chapter, different methods of co-creation in higher education are discussed to find out how the concept could be used in the field of economics.

In an educational context, co-creation is the strengthening of relationships among teachers, students and staff, to enhance learning experience (Ribes-Giner 2016, p. 74). This way, students gain more responsibility in the creation of their own curriculum and might result in more positive outcomes.

4.1. Types of co-creation in higher education

We can differentiate between different types and applications of co-creation. Degnegaard (2014) makes a distinction between different applications of co-creation, which are the following:
- Co-creating shared meaning
- Co-creating user experience and shared value (marketing and service perspective)
- Co-creating technological solutions (ICT perspective)
- Co-creating ideas and new products and services (related to the concept of innovation)
- Human-centered co-creation (settings for design and research)
- Bovill et al. (2011) differentiated between three types of student co-creators:

- co-creators of teaching approaches
- co-creators of course design
- co-creators of curricula

In a program called Students as Learners and Teachers (SaLT), which initiative took place in four different universities in the USA and in the UK, students provided feedback on teaching approaches. This program was comprised of two parts. Firstly, students participated in a semester-long seminar and they wrote weekly blogposts and gave two feedbacks during the semester. Secondly, they had a partnership with a student consultant to volunteer their ideas for development. It is crucial that students who had consultants did not participate in the classes they observed (Bovill et al. 2011).

Bovill et al. (2011) also looked into student co-creators, who were responsible for course design at Elon University. Their method was to create groups of five or six students with one academic developer, who would be motivated enough to work on course designs. First, they defined their goals and then started the discussion about learning assessment and pedagogical strategies. Students can also act as co-creators of curricula, which can include 'some or all the aspects of the planning, implementation and evaluation of the learning experience' (Bovill et al. 2011, p. 4). Students at University College Dublin resigned a new virtual learning context for first-year students, which enhanced their learning process and professional conversations online and in class too.

4.2. Application methodologies

When approaching co-creation from a research perspective, methodology and documentation of results seem to vary study by study. This implies that there is no common understanding on how co-creation should take place. As different types of co-creation exist, the methods how it is applied also differ. In this chapter, the different methods for co-creation are discussed and evaluated.

In the studies of Degnegaard (2014), they implemented PBL (problem-based learning) with certain co-creation elements in the classroom at a BA level. Their methodology followed a certain order and rules:
- Talked to experienced students from BA program on meetings
- Collaborated with these experienced BA students to work with new students on the course
- Created principles for co-creation participants
- Created principles they used for co-creation

Principles for participants of co-creation included rules of how the process should go. It involved the respect of students and the establishment of an environment in which students could act as the leaders of their own learning process. Moreover, students are also responsible for creating an excellent study environment, where they are responsible for other students as well. Learners have to choose an interesting and relevant topic in which they would like to work and co-create. However, Degnegaard (2014) stated that the concept might not be successful in every classroom, due to the number of students and mindset of students.

They also differentiated between principles of co-creation, as they defined what co-creation meant for them. In their case, co-creation is the creation of knowledge and peer-to-peer production. Additionally, students have to provide feedback to each other and also lecture each other. The role of the teacher is rather supplementary if at all necessary. The teacher has the opportunity to add material that has been left out by the students beforehand and also has the chance to rely solely on student material (Degnegaard 2014).

Iversen and Pedersen (2017) defined key components of co-creators (students and teachers) working together. They stated that these steps have to be included in the process of co-creation, otherwise it might not be successful. Firstly, there has to be an open communication between students and teachers. Their cooperation must include the teacher's willingness to listen and understand students' needs. It is not only the mutual understanding, but also a co-creation of new ideas. This process might be harder than it seems, as the teacher has to be consciously communicative, flexible, has to balance viewpoints and handle potential conflicts. Co-creation requires full attention from both teachers and students, as those students who are involved in this process not only volunteer their own ideas, but also potentially make their own coursework harder.

Iversen and Pedersen (2017) identified certain characteristics of teachers which make them suitable to be co-creators with students. Teachers who are willing to take on co-creation have to be able to handle failure and success, eager to develop, flexible and handle arguments.

Previous results have shown that students were much more satisfied when a co-creation method was applied in the classroom, so the methodology could be deemed a success in most cases. Therefore, Jensen and Korgh (2017) think that the pedagogical strategy of co-creation can be further strengthened. Though, this is a huge challenge for teachers, as their role changes extremely and they have to rethink the whole curriculum (Jensen–Korgh 2017).

All in all, we can state that co-creation is applied in many different ways, as there is no common understanding of it regarding its methodology. As stated in the previous chapter, its definition declares that 'the concept is intuitively perceived and understood' (Chemi–Krogh 2017, p. ix.), and this can also be observed in the case of methodology. Each study is different, each method has its own application depending on the researcher. Most researchers are the facilitators of co-creation in education. Therefore, they are intuitively working together with their students to co-create knowledge. In most of the above-mentioned studies, the study field is less relevant regarding applicability. The most important factors of co-creation are the co-creators themselves, as the studies put the emphasis mainly on them. Consequently, co-creation could be used as a method for co-creating knowledge in the field of economics too.

4.3. Co-creation phases

Researchers also found that co-creation methods were usually divided into different phases, which are identified in certain studies. However, there is also lack of consistency. Similarly to the definition of co-creation, the phases of co-creation are also determined arbitrarily and are not similar in different studies.

In the study of Degnegaard (2014), they identified three different phases of co-creation. The phases can be seen in Figure 1.

Figure 1 Co-creation phases
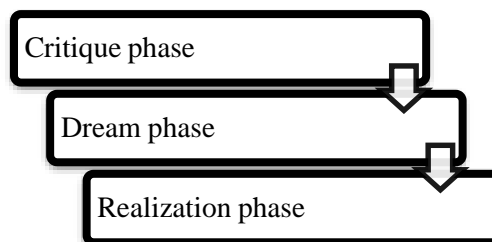
Source: own construction based on Degnegaard (2014)

In the critique phase, co-creators identify the challenges and problems they have with education and they are likely to hold a 'future workshop' to see what might happen in the future. In the second phase, which is called a dream phase, co-creator students state what they wish to do and study throughout the co-created course. This is the phase when they can tell their ideas about the most ideal learning environment without any restrictions. However, in the third phase called the realization phase, co-creators have to face the reality and find out what solutions they can actually implement for the problems that they found.

Additionally, they also determined key success factors in the realization phase, which are the following:
- noting down on paper
- discussing the issues
- writing notes on classroom observations
- meeting student representatives

In another study, Ribes-Giner et al. (2016) found that co-creation has many challenges, but most of all, it has certain phases. The first is exploration, when possible ways of co-creation are explored. The second is creation, when the process of co-creation happens. The final step is evaluation, when the process is assessed and evaluated (Ribes-Giner et al. 2016). The process of co-creation can be seen on Figure 2.

Figure 2 Another differentiation of co-creation phases

Source: own construction based on Ribes-Giner et al. (2016)

In their studies, Iversen and Pedersen (2017) enlisted several steps that are used quite frequently in the case of in-class co-creation of curriculum. These steps include dialogue, field studies, interviews, narratives, and log-writing. In their own research, they put the emphasis on a 5-step design model of co-creation that can be seen on Figure 3.

Figure 3 5-step design model of co-creation: The co-creative learning process wheel
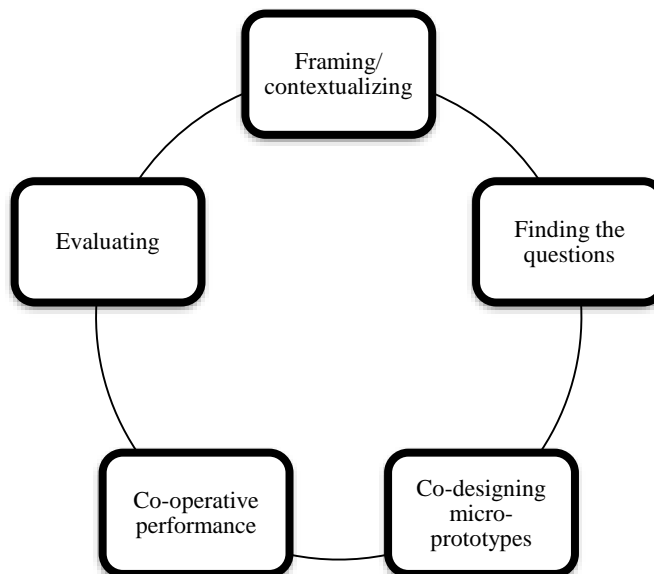
Source: own construction based on Iversen and Pedersen (2017)

In this learning process wheel we can observe five steps. Framing or contextualizing is considered to be the first step, when the parties involved define their intention and understand the field in which they would like to work together. In other words, they define the where and why. The second step is finding the questions, which means finding those challenges that the co-creators would like to work on and

potentially solve. The next step is co-designing micro-prototypes (in this case knowledge production), which involves finding out how the co-creators are going to overcome the determined challenges. Then a co-operative performance follows, when the co-creators carry out their co-created plans, after which they evaluate the results and the process.

Taken together, these studies suggest that similarly to its definition and methodology, there is no common practice on what phases co-creation has. Researchers determine the phases based on their own primary research and experience. Therefore, the previously mentioned stages can be used as an example for co-creation in higher education and in the field of economics.

4.4. Challenges, advantages and opportunities

Previous research has also identified the challenges and opportunities that co-creation brings to the classroom in a higher education context. These factors have to be taken into account when applying co-creation, as they provide an initial insight into what the co-creation process might look like, and researchers and co-creators can prepare in advance.

Challenges of co-creation can be viewed from two different viewpoints, from the teacher's and from the student's. Teachers face the challenge of maintaining less control over pedagogical aspects of their classes. They cannot plan ahead, as the control slightly shifts to students, who also act as co-creators of the course. Co-creation also requires a serious time investment, as teachers have to rethink curricula and work together with students to supervise them and act as a facilitator. By shifting the control partially over to students, another challenge arises. Even though classes are co-created, professional requirements have to be met, the students have to acquire the potential learning outcomes that would enable them to successfully complete the course and have the skills required. Another challenge is choosing who to involve in the co-creation process, as students could be quite different and have different abilities (Bovill et al. 2011).

Additional challenges arise from the viewpoint of students. They have to feel as partners, otherwise they might not be willing to volunteer their ideas (Bovill et al. 2011). The collaboration should be open, students must be taken seriously so that they would be meaningful partners in the whole process. Students, similarly to staff or teachers included, have to be diverse, as ideas and new suggestions can come from any of them. It is also crucial that the process of co-creation has to be repeated, as it might not necessarily be an instant success. Most importantly, students and staff have to be valued for their efforts in co-creation and they also have to evaluate the process themselves (Degnegaard 2014).

Ribes-Giner and colleagues (2016) analyzed the concept of co-creation as a new and innovative approach in teaching methodologies. They determined certain advantages and opportunities co-creation can bring, such as increased communication among stakeholders, growth in productivity and cost reduction at the organization. Moreover, Bovill et al. (2011) found that with co-creation, the commitment of both staff and students could be enhanced and a bridge could be created between students and staff.

The investigation of challenges, advantages and opportunities of co-creation have shown that even though there are numerous challenges that co-creators face, there has been a rising number of educators who turn to this method, as its advantages and opportunities outweigh the challenges. Co-creation has proven to be successful in the field of higher education, so it could also be successful when applied in the field of economics. This application field is further discussed in the conclusion chapter of this paper.
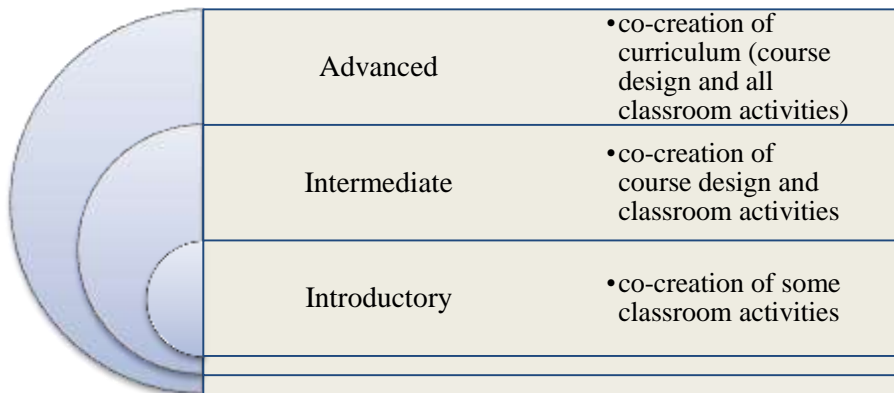
5. Conclusion and discussions

This paper aimed at investigating the notion of co-creation with special emphasis on economics in the field of higher education. It also provided an overview of co-creation's applicability and methodology. The paper also sheds light on how and based on what levels and phases this method is applicable in education.

The issue of co-creation has received attention in the academic field, after first appearing in the business world. As pointed out above, co-creation has many different definitions in general, while its educational notion has only been researched in recent years. Therefore, co-creation in education can be considered a relatively new research direction in higher education. This might be the reason why there is no common understanding regarding the methodology researchers and educators apply. Consequently, co-creation is mostly used intuitively in education.

As we could see from the studies above, co-creation has certain limits regarding its application. However, in contrast to the previously anticipated limits, it is not the field of studies that presents a barrier, but rather the co-creators themselves. In the papers reviewed about the applicability of co-creation, the study field was not taken into account. Researchers mostly concentrated on the ability of co-creators to produce knowledge together. Therefore, one conclusion of this paper is that if the conditions for co-creation are present (students are viewed as partners, there is an enhanced communication, collaboration and dialogues between the teachers and students (Bovill et al. 2011), it can be applied in any field, including economics.

When applying co-creation, many researchers determine phases or steps to be followed throughout the process. These steps are useful for those scholars who intend to start co-creation and do not solely rely on intuitive methods. However, based on evidence from the literature and the lack of co-creation levels determined, I suggest to differentiate between levels of co-creation on the basis of how deeply a teacher involves their students in the co-creation of classroom activities, course design or curriculum. I believe that co-creation can be understood in many different levels similarly to its usage and due to its intuitive nature. Therefore, the proposed levels of co-creation can be seen on Figure 4.

Figure 4 Proposed levels of co-creation

	Advanced	• co-creation of curriculum (course design and all classroom activities)
	Intermediate	• co-creation of course design and classroom activities
	Introductory	• co-creation of some classroom activities

Source: own construction

According to this differentiation, introductory level involves those co-creation activities which are relevant to planning one or some classroom activities of one course. This only includes students in a less intensive way. The second level is intermediate, which involves co-creation of course design and some classroom activities. This way, students help with classroom tasks and they are to determine study rules and codes of conduct of the chosen course. The third and most complex type of co-creation is the advanced level. At this level, students and teachers work together (often without even starting the semester in which the course is held) for a long period of time (one or two semesters) on the whole curriculum to design all classroom activities and course design.

I am convinced that this differentiation could be further detailed. However, at this point of the research regarding co-creation activities in education, these levels might help educators to understand the concept better before trying to apply it in their own classes.

All in all, this paper provided an overview of the concept of co-creation, its notion, methodology and application in education. One of the aims of this paper was to shed light on co-creation's applicability in the field of economics. However, no evidence has been found to prove that this method is only applicable to certain study fields. Another finding of this study is the differentiated levels of co-creation that might provide further insight for those professionals who might incorporate this method into their classes.

Acknowledgments

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Overcoming methodological issues in measuring financial literacy of companies, a proposed measurement model

Éva Kuruczleki

In the past decade, individual and company financial literacy measurement methods went through substantial changes. To investigate factors contributing to financial literacy of both individuals and firms, scholars needed to reach out for new measurement methods other than the traditional knowledge tests widely used previously. This paper provides a synthesis of the most recent studies concerning both individual and company financial literacy regarding the dimensions of financial literacy and methods available for measuring and modelling financial literacy. The results highlight new emerging trends in the assessment: qualitative methods (e. g. interviews and case studies), for getting insight into very special segments of financial literacy, and more elaborate and complex models, such as OLS regression, bivariate and multivariate logit and probit models, which provide effective ways to get a deeper understanding of the interaction of factors forming and determining financial literacy both at the individual at company level. However, even though the toolkit of measuring financial literacy is getting richer and richer, the connection between the individual and firm-level models seem to be nonexistent. This paper proposes a measurement model with the help of which company financial literacy can be measured through the assessment of individuals and their relationship contributing to firm-level financial decisions.

Keywords: financial literacy, assessment, statistical methods

1. Introduction

Financial literacy, even though not being a completely new research area, gained momentum around the 2008 financial crisis. Many were blaming individuals for their inadequate level of financial literacy, making decisions that yielded no future benefits, but gave rise to the crisis. In recent years then focus shifted from the individual to the company level as academics realized that these groups, such as micro–businesses or small and medium enterprises (SMEs), face the same difficulties and the consequences of poor company financial literacy can be such as grave as of individuals.

The content and dimensions of financial literacy depend greatly on whom we try to analyse. We need to distinguish individuals and business entities from each other, as the dimensions of financial literacy are in most cases vary based on the aims of a given target group: even among individuals, different age groups need to face different financial challenges, meaning that the dimensions that are relevant for assessing financial literacy at firm level are also going to be different. Therefore, studies addressing different groups investigated an array of different factors contributing to both individual and company financial literacy using a wide variety of analysis methods, which makes it hard to compare and generalize results.

Many measurement models exist for assessing financial literacy at firm level, and most of these identify firm–level financial literacy with the financial literacy characteristics of the main decision maker. However, we cannot simplify our analyses to the application of individual tests at a business–related setting. Therefore, the main questions of my research are:

- Who are those actors and to what extent they contribute to company–level financial decision–making?

- How can we measure the outcome of company financial decisions?

- How can we link individuals contributing to the decision–making to the outcomes of the financial decisions?

As an attempt to bridge the gap between individual and company level, a proposed measurement model has been created. In the upcoming chapters I first introduce briefly the notion of financial literacy in firm setting and the already existing measurement models and then I attempt to provide a different view of assessing company financial literacy.

2. Defining financial literacy at firm level

Financial literacy as a notion raised many debates even regarding its name, not to mention its content. For both individual and company financial literacy exists an extensive variety of literature defining the notions many different ways, the aims of financial literacy being fairly similar, while the elements and assessed dimensions differing from paper to paper. The most widely adopted definition for both notions come from the OECD (Atkinson–Messy 2012, OECD 2015), but the interpretation of these definitions also differs for each paper using it.

In the case of company financial literacy, a good concept still awaits to be created. The definition of OECD (2015) even though mentions a few dimensions of SME financial literacy, such as knowledge, skills, experience and some key knowledge areas, what it fails to describe is the role of the different agents, such as leaders and subordinates in forming company financial literacy:

> „*SME financial literacy is a combination of **knowledge, skills and practice** of financial products, concepts, risks and regulatory and legal matters **to take the most appropriate finance–related decisions at every stage of SME life – cycle** to ensure further business development, growth and profit generation of the firm*” (OECD 2015, p. 11)

In recent years many surveys were published related to the financial literacy of either micro–entrepreneurs or small and medium size enterprises. One regularly appearing aim of these studies is to map the competences of companies in handling different financial issues and recovering their strengths and weaknesses in order to formulate training programs or recommendations on how to improve these faults. Another very common aim of these studies is to assess the effect of financial literacy on financial growth or firm success (in some cases equating these two terms, see

Abebe–Tekle–Mano 2018, Dahmen–Rodríguez 2014, Drexler–Fischer–Schoar 2010, Eresia–Eke–Raath 2013, Fatoki 2014, Hakim–Oktavianti–Gunarta 2018, Limpek–Kosztopulosz–Balogh 2016, Sucuahi 2013). In general, these studies succeed at determining if financial literacy has an effect on firm performance (the common answer is that it does, higher financial literacy levels contributing to higher performance and greater success).

Another similarity of these studies is the emphasized role of education and training in improving financial literacy, and as well many claim basic mathematical skills should not be ignored either (Brown–Saunders–Beresford 2006, Dahmen–Rodríguez 2014). Even though the results are mixed concerning what and how needs to be taught, the consensus is that financial literacy can be improved through training and that companies usually ignore the importance of continuous learning and development. Financial literacy of firms, beyond general and financial knowledge or education, can be affected by various other factors, as a few example, culture or trust towards company actors or even the use of technology at the company, as summarized in *Table 1*.

Table 1 Dimensions and determinants of company financial literacy

Study	Dimensions/determinants of financial literacy
Agyei (2018)	culture, religion, company governance, savings, investment
Brown–Saunders–Beresford (2006)	perceptions of financial awareness and literacy, business knowledge (e.g. finances, accounting, planning, sales, marketing etc.), financial education/training, confidence in own personal skills, basic literacy
Dahmen–Rodríguez (2014)	quantitative literacy, business management, general business practices, marketing, sales and revenues, business products and/or services, competition, inventory, accounting practices, employee policies and procedures
Eresia-Eke–Raath (2013)	perceived knowledge, financial training/education, records kept at the company
Fatoki (2014)	financial planning, book–keeping, understanding of funding sources, business terminology, finance and information skills, use of technology, risk–management (insurance)
Hakim–Oktavianti–Gunarta (2018)	SME age, age, gender and education of main decision–maker, credit access
Ország–Kosztopulosz–Kovács (2015)	*Remund* (2010) dimensions, trust towards company actors, information sources, family and company assets
Sucuahi (2013)	record keeping, savings, budgeting, financing

Source: own editing

Financial literacy at firm level is slightly more difficult to describe and, in many cases, relies heavily on individual characteristics. Studies concerning micro–businesses showed that the smaller the business the more it can be described by individual financial literacy, and financial literacy of these entrepreneurs can be improved the same way as of individuals, through any financial training (Abebe–Tekle–Mano 2018, Drexler–Fischer–Schoar 2010, Fatoki 2014, Sucuahi 2013).

The above summary of *Table 1* shows it well that firm level financial literacy thus is based on individual characteristics and financial literacy of its agents and is

expanded with a wide range of business–specific notions, such as accounting, marketing, technology usage or even employee policies. Therefore, even though one might think that company financial literacy might be a notion even more complex and hard to define, we might regard it as an extension of individual financial literacy: at firm level, personal characteristics of company agents and business related knowledge and experience form company financial literacy together.

2.1. Financial decision–making in the company

One major comment regarding the original model –as later described– was that financial literacy as the independent variable of the model was not clearly defined. Financial literacy as such –as seen in the above chapter– embodies many elements, knowledge, skills, attitudes, behaviour, thus both cognitive and emotional elements, some of which are easier to measure and some are not. However in this chapter I would like to take a look at another element of financial literacy, which often gets forgotten by those adopting the OECD definition of SME financial literacy which is the notion of taking „*the most appropriate finance–related decisions at every stage of SME life–cycle*" (OECD 2015, p. 11). Financial decision making process is something I have included among my research questions, however, never took a look at how the process of financial decision making really works.

Financial decision–making has been in the spotlight for many decades, even before financial literacy has been, as sound financial decisions can influence competitiveness, sustainability and profitability of any company. As Buchanan–O'Connell (2006) and recently Szántó–Zoltayné (2019) described it in detail, the study of decision–making dates back to way earlier than economics itself, and is an interdisciplinary field including ethics and philosophy, economics, statistics and mathematics, psychology and sociology as well. Studies focusing more on the economics point of view of decision making usually try to address questions such as *what makes a good decision* or *how rational decision–making processes look like*? Apart from that, essential elements of the study of economic decision–making are multi–dimensional (or multi–criteria) decisions, risks and uncertainties, as one important aspect of decisions is mitigating risks and facing future uncertainties (Szántó–Zoltayné 2019).

Buchanan–O'Connell (2006) in their study distinguishes between two main types of decision–making: one based on deliberation and gut decision–making. The latter occurs when decision–makers are faced with urgent decision–making situations, with little information provided and no precedents known, usually in crisis situations:

> "*Gut decisions testify to the confidence of the decision maker, an invaluable trait in a leader. Gut decisions are made in moments of crisis when there is no time to weigh arguments and calculate the probability of every outcome. They are made in situations where there is no precedent and consequently little evidence*" (Buchanan–O'Connell 2006, p. 39).

Gut decision–making happens in unexpected situations and is generally unpredictable. Some support it while others argue against it. Because of its unpredictable nature, most studies do not focus on it but on deliberation–based

decision–making which roots from the theory of rational behaviour (Buchanan–O'Connell 2006). According to mainstream economic theory, individuals act so that they satisfy their needs and make optimal (or suboptimal) choices along their preferences. In mainstream theory decisions are only and exclusively influenced by our preferences and individuals always seek to maximize their utility and always make optimal choices. Behavioural economics challenge the rational human's image, claiming that human decisions are by far not made along optimization criteria and through lengthy deliberation, as human beings face several cognitive and other limitations, such as the lack of time, information of knowledge to make any rational decisions. On the contrary, even though in most cases humans try to optimize, these decisions are only boundedly rational and even though they seem to be a purely rational and optimal decision along certain circumstances, they are rather suboptimal decisions, as argued by such psychologists and economists as Simon (bounded rationality), Gigerenzer (heuristics, bounded rationality) or Kahneman and Tversky (prospect theory).

The image of the rational human has been dominating mainstream economics for hundreds of years and the appearance of behavioural economics is assumed to be the invention of the second part of the XXth century. It is in fact true that the majority of papers studying the behavioural aspects of decision–making appeared after Simon's 1960 resurgence of the study of human behaviour as a contributor to decision–making, however, even the earliest economists like Adam Smith or John Maynard Keynes acknowledged that emotions or psychological factors both have a prominent role in explaining the outcomes of economic decisions (Szántó 2011). Hence behavioural economics have made their way into the study of decision–making and provide useful help in understanding how and why financial decisions are made at not only individual, but company level as well (McFall 2015).

Swami (2013) provides an overview of decision–making in company setting with special focus on managerial functions. As described by the paper, decision making is part of the executive functions of a company leader together with information processing (working memory and recall), motivation (self–motivation), emotional control, leadership (controlling one's behaviour), complex problem solving, thinking ahead, planning and monitoring. Decision–making, as defined by Swami (2013), "*refers to the mental (or cognitive) process of selecting a logical choice from the available options. In other words, it implies assessing and choosing among several competing alternatives*" (Swami 2013, p. 204). The paper describes many errors and biases in managerial decision–making and the use of heuristics such as the rule of thumb as common practice (and common source of error in decision–making) and as well sorts the four main practical aspects of executive decision–making, which can contribute to sound business–related decision–making, and which are the following:

- Intuition: similar to the above introduced "*gut feeling*", intuition–based decision–making can yield excellent outcomes if the decision–maker has enough professional experience and expertise, however can be greatly distorted by external factors (i. e. to make the same intuitive decision again, circumstances should be identical, which are usually not)

- Rules: when companies follow a pre–defined set of rules, they can make generally more accurate decisions than if they were following their intuitions. Both intuitions and rules are fast and easy to use when a decision–making situation arises, however if circumstances change, rules need to be updated, otherwise the decisions won't be that accurate anymore.
- Importance weighting: is a less intuitive but more analytical tool to use when making decisions. After identifying the most important factors (criteria) of a decision, their relative importance needs to be weighted, then alternatives can be evaluated along these pre–defined criteria. However, as a shortcoming of the importance weighting model, we can never be free of biases as the relative importance of each factor might be different for decision–makers.
- Value analysis: is a complex and realistic way of deliberation, when analysing the value of possible outcomes, analysis is done along multiple criteria and is less based on personal impressions of the decision–maker but on an outcome's value added. Value analysis ultimately leads us closer to what is called an optimization problem in economics (Swami 2013).

According to Swami (2013) then these four methods are generally used when making executive decisions at a company, including financial decisions as well. Linking these findings to the definition of financial literacy and what is the aim of financial literacy (contributing to sound financial decisions) we can easily acknowledge that the above techniques are similar to the elements of financial literacy: skills and knowledge are needed to conduct more elaborate deliberation methods, while attitudinal and behavioural elements play a greater part in intuitive decision–making.

2.2. Prior measurement models for measuring financial literacy at firm level

Financial literacy at firm level, as the previous chapters have introduced, can be approached from several different aspects, concerning either individual or firm characteristics, knowledge, skills, behaviour or specific topics. These different approaches require different measurement models. The toolkit for measuring financial literacy has grown greatly in the past decade, and focus shifted from simple knowledge tests to more intricate models using which even the effect of nominal variables (such as gender or attitudes) could be considered. However, these studies focus only at some sub–groups of the population or certain sized businesses and are not applied widely.

The most used methods for measuring financial literacy –or in most cases only financial knowledge of the respondents– are surveys and questionnaires that solely contain knowledge test questions, for which two attributes are available: correct or incorrect answer. Assessments carried out by OECD and Standard and Poor's Global FinLit Survey set a minimum amount of correct answers that respondents have to reach to identify them as having "good" or "high" level of financial literacy (see e.g. Klapper–Lusardi–van Oudheusden 2015), the former dividing the assessment to three key areas: financial knowledge, behaviour and attitude. The Standard and Poor's assessment, however, chose a much simpler methodology: the questionnaire

respondents had to fill in was rather short, comprising of four topics (risk diversification, inflation, basic financial concepts and compound interest) and one question for each topic, two for compound interest. Researchers set the minimal required level to 3 correctly answered questions out of five. In my opinion, it is not possible to deduce someone's financial literacy level with the help of such a short questionnaire but is neither useful to go towards the other extreme and embody several areas and dozens of questions.

At the very beginning, when turning towards business entities, assessing sole entrepreneurs and self–employed seemed a safe option, as in their case, personal and business assets were not really separated and as long as decisions are made by one person, financial literacy could be measured using more or less the same methods as for individuals. Studies assessing African micro–businesses and small enterprises used the above mentioned descriptive methods, complemented with rather simple hypothesis testing to assess financial literacy levels and found high levels of financial illiteracy, which had a seemingly negative effect on firm profitability and business growth (Eresia-Eke–Raath 2013, Fatoki 2014). Assessment became more complicated with larger companies where the original models that focus on one person could not be used, therefore, descriptive methods and knowledge tests could not be used anymore as the only methods to assess financial literacy, that gave rise to new, more polished assessments, which, even though are much complicated that the simple knowledge test, still utilize these methods to some degree, by using e.g. a simple knowledge test to determine financial knowledge levels.

With the appearance and spread of more sophisticated measurement and analysis methods financial literacy assessment became more refined as well. Even though most studies still use simple descriptive statistics methods or count the number or share of correctly answered knowledge test questions, some experimented with using inferential statistics and more complex modelling methods, such as OLS or logit regression models, ANOVA and ANCOVA, crosstabs analysis, rank correlation or even principal component analysis, just mentioning a few examples, without the need for completion. One might mistakenly assume that these methods only exist because of the rapid development of today's information technology, however there are a few earlier studies that employed e.g. clustering and bivariate probit models already at the end of the previous century (Alexander–Jones–Nigro 1997).

These methods generally aim at finding the most important determinants of financial literacy and use it as a dependent variable along with such explanatory variables as demographic variables, financial knowledge scores or even cultural determinants. *Table 2* contains a summary on the most commonly used methods. Correlation, analysis of variances and some Chi–Square test are generally used to uncover the relationship of pairs of variables, however, regression models are more widely used as they are not only able to show whether a significant relationship is prevalent between variables but can also describe causal relationships and can handle multiple variables in one model.

What immediately catches the eye on *Table 2* is the high number of studies using OLS regression: 17 studies in the below table utilised some sort of an OLS regression to analyze which factors influence financial literacy or to study the effect

of financial literacy on other factors, such as financial well–being (Bannier–Schwarz 2018) or business success (Limpek–Kosztopulosz–Balogh 2016). OLS regression is undeniably a popular method to use, thanks to it being easy to use and interpret, and its ability to cope with dummy variables which can account for such demographic variables as gender, education, employment status, or even cultural factors, such as religion (Brown–Henchoz–Spycher 2018).

Table 2 Analysis methods for assessing financial literacy

| Study	Analysis methods
Abebe–Tekle–Mano (2018)	OLS regression, ANCOVA
Agyei (2018)	OLS regression, logit regression, ANOVA
Alexander–Jones–Nigro (1997)	bivariate probit model, clustering
Ali et al. (2018)	correlation, OLS regression
Bannier–Schwarz (2018)	OLS regression, principal component analysis
Bianchi (2018)	OLS and IV regression
Brent–Ward (2018)	OLS regression, logit regression (mixed, latent class, generalized multinomial)
Brown–Henchoz–Spycher (2018)	OLS regression, correlation
Carraher–Van Auken (2013)	OLS regression, correlation, logit regression
Drexler–Fischer–Schoar (2010)	descriptive statistics, OLS regression
Hakim–Oktavianti–Gunarta (2018)	descriptive statistics, OLS regression
Henager–Cude (2016)	ordered logistic regression
Hsiao–Tsai (2018)	OLS regression, principal component analysis, bivariate probit regression
Huzdik–Béres–Németh (2014)	Chi–Square test, ANOVA, t–test
Karakurum-Ozdemir–Kokkizil–Uysal (2018)	OLS regression
Koropp et al. (2014)	ANOVA, correlation, structural equation modelling
Limpek–Kosztopulosz–Balogh (2016)	descriptive statistics, Chi–Square tests, correlation, hypothesis testing, principal component analysis
Luksander et al. (2014)	OLS regression, ANOVA, correlation
Lusardi–Mitchell (2011)	multivariate probit
Lusardi–Tufano (2015)	clustering, multinomial logit analysis
Lyons–Rachlis–Scherpf (2007)	descriptive statistics, quantile regression, OLS regression
Romano–Tanewski–Smyrnios (2000)	principal component analysis, structural equation modelling
Sarpong-Danquah et al. (2018)	descriptive statistics, Chi–Square test
Servon–Kaestner (2008)	OLS regression *(and content analysis for the qualitative part)*
Stolper (2018)	logistic regression (probit, Tobit model)
Sucuahi (2013)	descriptive statistics, OLS regression
Ward–Lynch (2018)	dyadic–factors regression, OLS regression, factor analysis
Wise (2013)	principal component analysis, structural equation modelling
Ye–Kulathunga (2019)	principal component analysis, structural equation modelling

Source: own editing

Apart from OLS regression, logistic regression models are also quite popular among academics in this field. Logit and probit models have that advantage over OLS regression models that the dependent and independent variables in the models need not be solely metric or dummy variables but can be categorical variables as well. These models can be used to e.g. categorize individuals to a specific level of financial literacy as a function of their multivariate demographic characteristics, like educational attainment level, marital status or even profession (Hsiao–Tsai 2018) or to assess financial planning behaviour of elderly US citizens as a function of financial literacy dimensions and demographic variables (Lusardi–Mitchell 2011).

Another method which served as inspiration for formulating my own proposed model is the application of principal component analysis and then building a structural equation model using the obtained components. Many studies (e.g. Romano–Tanewski–Smyrnios 2000, Wise 2013, Koropp et al. 2014 or Ye–Kulathunga 2019) have applied this methodology to assess the effect of financial literacy on firm outcomes. The earliest study of the above, by Romano–Tanewski–Smyrnios (2000) was sought to examine financial decision–making processes, financial antecedents and outcomes in Australian family businesses and even though does not refer to the assessment of financial literacy explicitly, its aim is similar to what has already been explained by the OECD definition as the goal of financial literacy, namely sound capital structure decision–making.

As the authors explained it well, the study went *"beyond traditional finance paradigms by incorporating elements from divergent perspectives, including family businesses, finance, economics and management"* (Romano–Tanewski–Smyrnios 2000, p. 295) to explore how decisions are made at firm level. The model also included such parameters as the size and age of the firm, the industry it is operating in, objectives of the firm and whether it is planning to achieve growth or not. Their measurement model can be seen on Figure 1, the signs indicate the hypothesized relationship between the elements of the elements, e.g. plans to achieve further growth correlates positively with equity, hence firms planning to achieve growth are more likely to have more equity. This study proposes an excellent example on what methodology to follow, however what might make it unlikely to be used in the setting of my research is the fact that the input for building the model was a 250–item questionnaire, which is not likely to yield a huge response rate (neither did their survey, the response rate of that study has been around 29% of the 5000 item random sample they addressed the questionnaire at).

Figure 1 Model for family business financial decision making by Romano–
Tanewski–Smyrnios (2000)
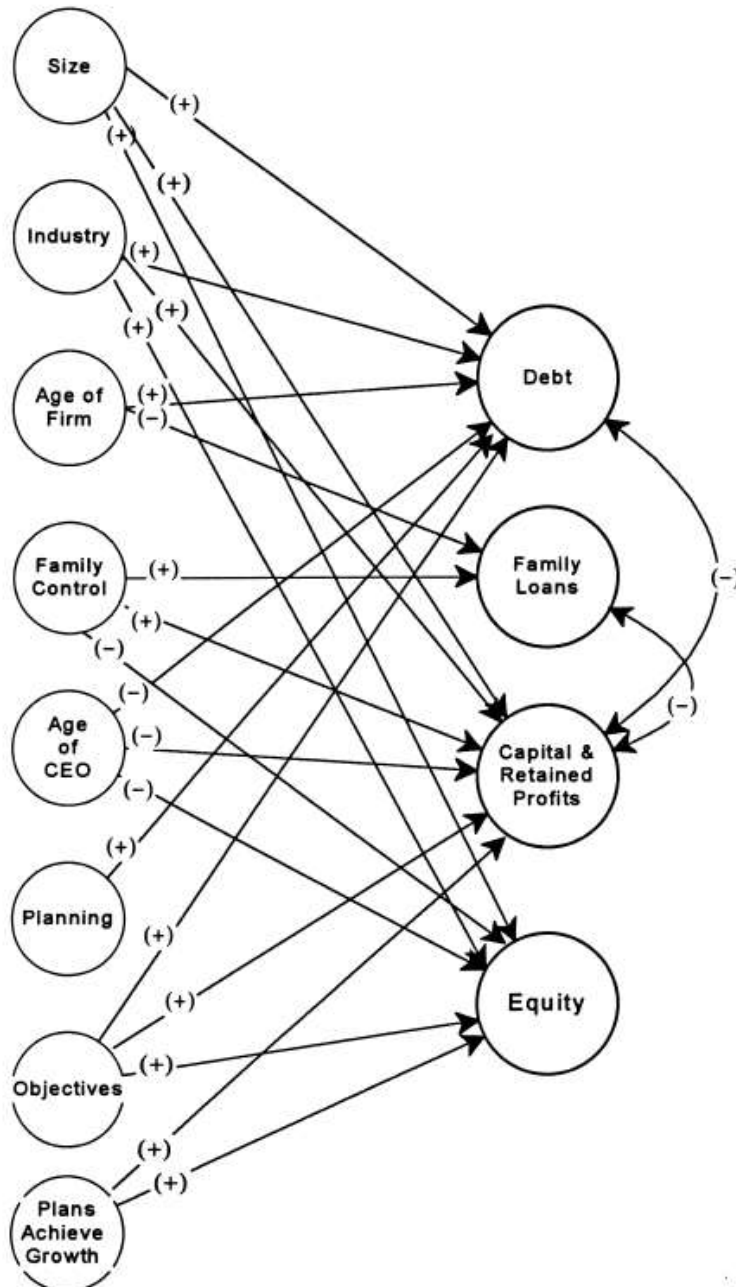
Source: Romano–Tanewski–Smyrnios 2000, p. 296.

The second example for the application of structural equation modelling is by *Wise* (2013). The paper assesses the effect of financial literacy on the survival of new ventures founded by young Canadian entrepreneurs and proposes a financial literacy framework (see *Figure 2*). According to their model

> "*an increase in an entrepreneur's familiarity with financial statements financial and ratios leads to an increase in financial literacy. An increase in financial literacy leads to less loan default and less involuntary business closure. Defaulting on a loan is impacts the chance that the entrepreneur will have to close the business.*" (Wise 2013, p. 32)

The paper investigated financial literacy of young entrepreneurs taking part in a microcredit program using a questionnaire which consisted of questions about the respondents' financial knowledge, and their use of financial statements and ratios and whether they repaid the obtained microcredit and whether they had to close down the business following the credit program. The results of the structural equation modelling confirmed a positive relationship between the elements of the model, thus an increase in the use of financial statements and ratios (which indirectly indicates a more positive attitude by the entrepreneurs and an increase in their financial knowledge as well) leads to better financial literacy levels and better chance in repaying the loan, and as expected, in a less likely occurrence in having to close down the business.

*Figure 2* Proposed financial literacy model by Wise (2013)
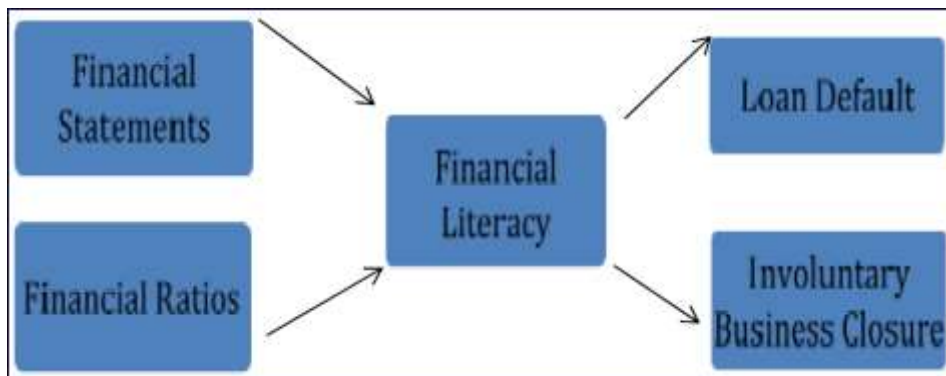
Source: Wise 2013, p. 32

The third paper using structural equation modelling introduced here is fairly similar to the first paper as it focuses on family firms as well. The paper by Koropp et al. (2014) is applying the theory of planned behaviour to assess financial decisions of German firms. The aim of the study is to prove that financial decisions at firm level are largely affected by family norms, behavioural elements, attitudes and intentions and are not based entirely on the business perspectives. The input to the study has been again a questionnaire, however in this survey items were mostly measured in a Likert–scale to indicate whether respondents more agreed or more disagreed with given statements. The resulting model consists of much more elements than the previously introduced study, as it can be seen on *Figure 3*.

Figure 3 Model of financial decision making in family firms by Koropp et al. (2014)
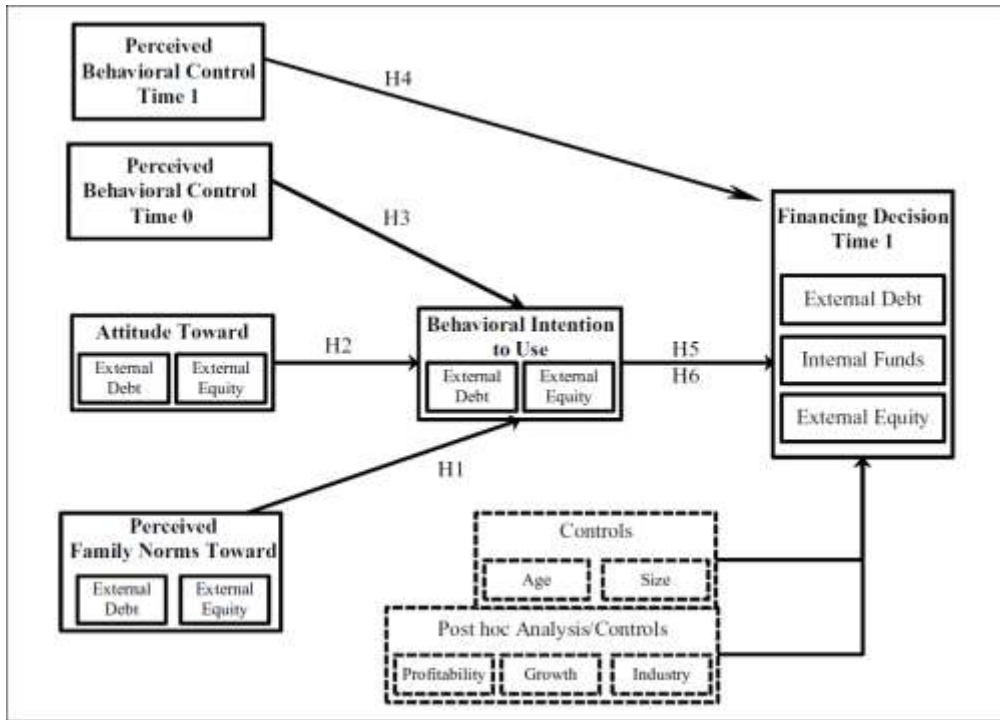

Source: Koropp et al. 2014, p. 310.

The elements of this model resembles the closest the above explained OECD (2015) definition as it embodies attitudes and behavioural elements in the model and as well has some links to behavioural economics as well, as one important element of the model is perceived family norms, which are nonetheless the most important elements of the planned behaviour theory as well, stating that agents might be more likely to make a certain financial decision of family norms are in support of that decision, otherwise less likely (Wise 2013).

The fourth and most recent example for the application of SEM models in assessing financial literacy is by Ye–Kulathunga (2019) and assesses the effect of financial literacy on the sustainability of Sri Lankan small and medium enterprises. The model is built from 4 main elements whose relationship is then analysed: financial literacy, access to finance, financial risk attitude and sustainability (see *Figure 4*). Financial literacy acts as the starting point of the model and is expected to have a positive effect on each elements of the model, hence the development of financial literacy (again similarly to almost all previous models) is expected to improve the chances of the firm. Each elements of the model are measured along several Likert–scale items which serve as the input variables for the latent variables of the model following a confirmatory factor analysis. This model is fairly similar to the model I am about to employ in my own research, however this model targets only one agent of the companies, the chief financial officers, as this study assumes that CFO's are the most involved in SME–level financial decision making.

Figure 4 Conceptual framework of financial literacy on sustainability by
Ye–Kulathunga (2011)
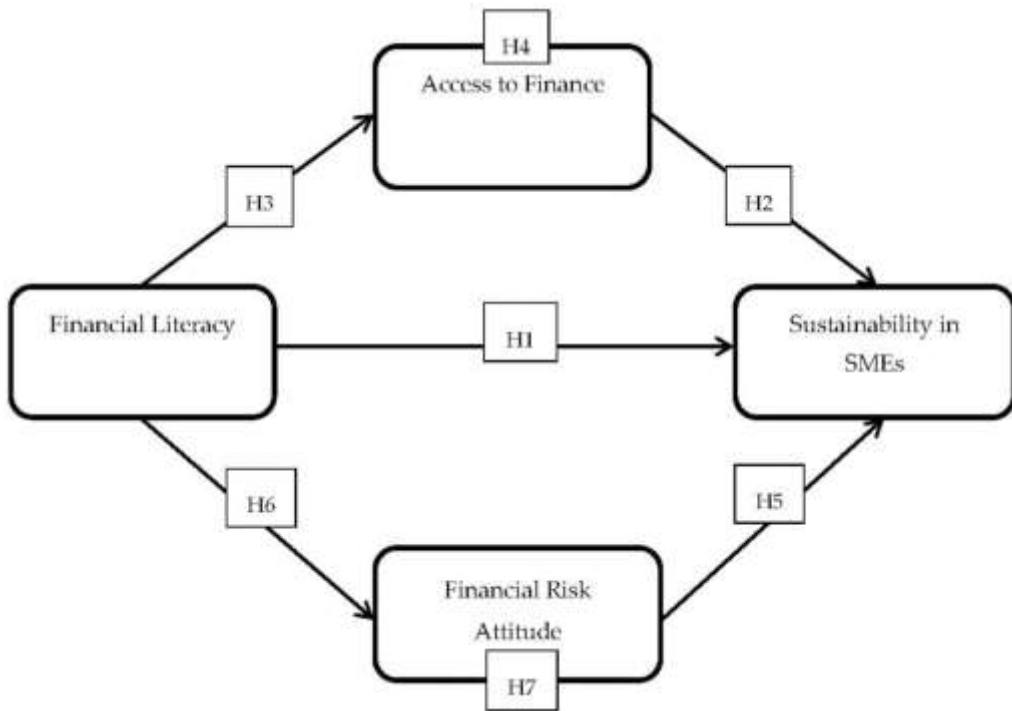
Source: Ye–Kulathunga 2011, p. 7.

The results of the study underpin the positive effect of financial literacy on firm sustainability, which might impose that this model could be useful when applied to assess financial decision outcomes (assuming that more financially literate firms make better financial decisions). However, as this model only focuses on one agent of the firm, the application of this model might jeopardize my aim of discovering whom and to what extent can influence financial decision–making.

We can conclude that financial literacy research has evolved greatly in the past decade, and the trends show that scholars turned from simple descriptive methods to such model that are capable of a deeper analysis of financial literacy and its interactions with either individual or company traits. Financial literacy research today possesses a very rich toolkit; however, the introduced papers all focus on different societal or geographical sub–groups, therefore their findings can not be generalized and gives room for further analyses to be carried out. One major problem with this rich selection of available methodology, which has always made the comparison of results problematic, is the lack of harmonization between the methods, which is also a question and a problem to be solved in the future.

3. Planned measurement model for measuring company financial literacy

The first and most important shortcoming of models measuring financial literacy is that financial literacy as a notion itself is not defined. If I am about to run a PLS model, I would need to have indicators to describe the latent variable of financial literacy, without it the model would not be able to run. As explained above, the target of financial literacy is that companies should be able to make underpinned and sound financial decisions from which the firm can benefit.

Another main problem with financial literacy measurement models is that many models are expected to address the surveys at several agents of each surveyed companies. Can we really ensure that the survey will be answered by the proper person? Even when someone addresses a survey at just the main decision–maker of a company, one can not be sure that the main decision maker themselves will answer the questions, not to mention if someone is about to ask several agents of the company. Another limitation or boundary of these models is that even if we can ensure that the proper person will answer the questions, how can we find these persons, do companies even have all the roles separated (as it is quite common for SMEs for just a few persons possessing many roles at the same time) and if so, how can we know personally whom to address the questionnaire at? Such analysis therefore not only poses GDPR concerns but faces other limitations as well. This leads us to an important modification in the empirical study: should we really ask several agents, or should we just address the major financial decision–maker of the company? Because of these concerns I now find it more feasible to address the questionnaire at just one decision–maker, like all the other SEM–based measurement models did (Romano–Tanewski–Smyrnios 2000, Wise 2013, Koropp et al. 2014, Ye–Kulathunga 2019)

The earlier chapters introduced models that applied the PLS SEM methodology in their analyses. From these I want to highlight the study by Ye–Kulathunga (2011) as this study resembles the most what I would like to achieve in my research as well. The model is rather simple, the input variables consist of Likert–scale items and financial literacy is measured along a previously validated set of items, meaning that this subset of questions could be applied in the setting of my analysis as well. The statements used by Ye–Kulathunga (2011) in their analysis were the following, the respondents had to answer that on a scale of 1 (strongly disagree) to 5 (strongly agree) how much their companies comply with the following statements:

- "*We have the ability to analyze our financial performance periodically.*
- *My firm prepares monthly income statements.*
- *I have received training on book–keeping.*
- *My firm has bought formal insurance for our business.*
- *The management of this firm can compute the cost of its loan capital.*
- *My firm has a savings account.*
- *The entrepreneur can prepare basic accounting books.*
- *The firm is aware of the required documents to get a loan from a bank in order to fulfil our financial needs.*
- *I am aware of the costs and benefits of accessing credit.*

- *The firm is able to calculate interest rates and loan payments correctly.*
- *We have the skills required to assess the financial outlook for the firm.*
- *We have skills for minimizing losses by minimizing bad debts.*
- *The managers of this business have basic accounting knowledge.*" (Ye–Kulathunga 2011, p. 10)

The above statements even though not provide measures of actual knowledge (only about perceived knowledge), with simple modifications and the addition of question from earlier analyses (e.g. OECD 2015), actual knowledge (even though with the simplification of including only of the main decision maker or financial decision maker of the company) could be included in the measurement model as well.

Many models simplify their analyses by making the assumptions that agents of a company are "*just humans*" by themselves, therefore individual financial literacy measurement tools can be used to assess their financial literacy in company setting. Even though agents contributing to financial decisions are indeed "*just humans*", their financial literacy in the firm setting can not and should not be measured along individual dimensions, as employees and owners of companies are behaving and deciding differently when it comes to their everyday finances or company financial issues, not to mention their different motivations in both settings. As it is evident from the assessment of family firms (see above), sometimes individual traits can influence firm level decisions, however we can not generalize this for all companies. Such dimensions as attitudes, behaviour, norms –as seen before– can and therefore should be included in the measurement model, but not necessarily that way as introduced in the proposed model. To overcome this contradiction between individual traits and company norm, I am suggesting the introduction of the latent variable called company traits which could be measured along similar Likert–scale questions as for the financial literacy element. Attitudes are expected to influence behaviours and as well both are –following the OECD (2015) definition– are determinants of financial literacy, thus as a synthesis of the above introduced models, the following model could be drawn up as seen on Figure 5.

The above model merges the OECD (2015) definition with elements of the previously introduced SEM models (Romano–Tanewski–Smyrnios 2000, Wise 2013, Koropp et al. 2014, Ye–Kulathunga 2019) and is modified so that financial literacy factors influence financial decisions, whose outcome can be measured directly. Attitude, behaviour and knowledge and skills form together financial literacy of the company which is accompanied in the model by further two latent variables, organizational characteristics, such as norms or rules the company follows (the notions organizational culture or organizational behaviour is avoided intentionally, their assessment is way beyond the scope of my research) and as well company demographics and such measures as profitability or growth rate.

Figure 5 Model for measuring the effect of financial literacy on financial decisions
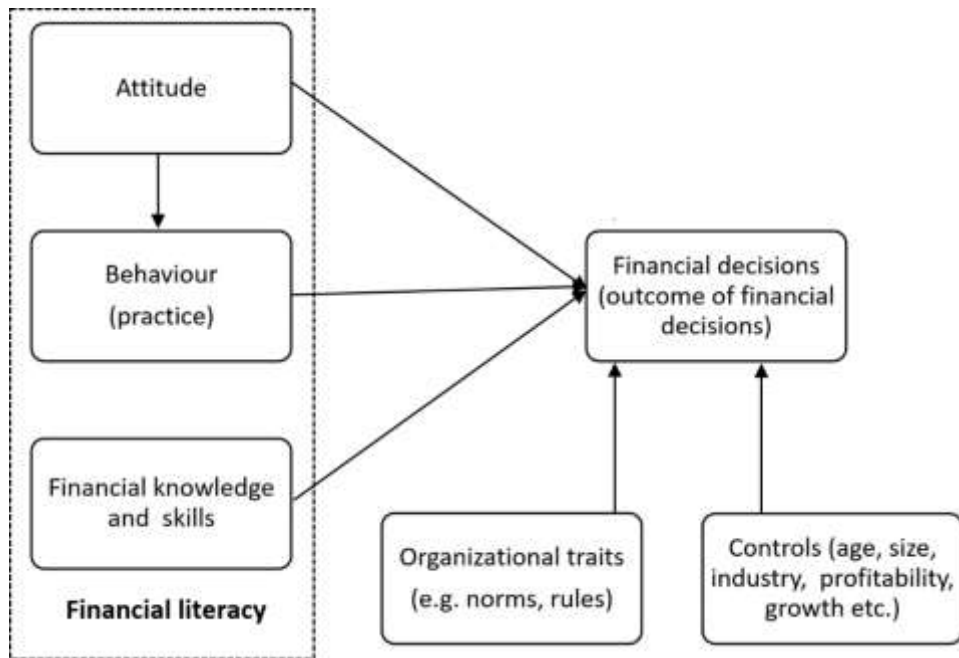
Source: own editing

4. Conclusion

Assessing financial literacy has accelerated in the past few years, dozens of new papers presented more and more complex analyses on either individual or financial literacy of companies. In this paper, I gave an overview of studies (mostly) of the past decade and found that –fortunately and unfortunately– today we face an immense selection of definitions and measurement models. Scholars described financial literacy in dozens of ways, and even though some elements (e. g. knowledge, behaviour, attitude, savings, inflation, investment, mathematical skills) appear in almost all studies, with the papers focusing on different subsets of financial literacy (e. g. credit literacy or debt literacy), harmonizing measurement models and comparing results is rather problematic.

This wide variety of measurement methods led me to the formulation of a proposed measurement model, which tackles some of the weaknesses of the reviewed methods. The proposed PLS SEM measurement model takes into account not only perceived and actual knowledge, attitudes and behaviour of agents, but introduces company traits in the model, considering that the way financial decisions at company level are made differently depending on the characteristics of the companies.

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Chapter IV

Marketing-Management trends, challenges

New pricing models in the era of industry 4.0

Gábor Rekettye

This conceptual study would like to draw attention to the effects of industry 4.0 on the pricing policies of the disruptor companies. The study concludes that the zone of pricing decisions is growing due to the impact of Industry 4.0. The different technologies offered by the digitalization makes it possible for the disruptor companies to use new pricing methods or use the old ones differently. Pricing has become, in most cases, the core element of the new business models the disruptors have created and practised. The study points out that besides new products and technologies, even new pricing models can be the primary constituents of the disruption. The study tries to categorize and describe the most exciting new pricing policies used by disruptor companies.

Keywords: the elbowroom of pricing, categories, and characteristics of disruptive pricing methods

1. Introduction

Digitalization is the core driving force of the fourth industrial revolution. This new era will result in a paradigm shift in the production and marketing of products and services. The smarter production can make value creation easier with reducing the cost of manufacturing and producing better quality (Rüβman et al. 2015, Monostori 2015). It will enable a more customized, even personalized production. The digitalization driven paradigm shift will make it possible to personalize also the marketing tools, like pricing, distribution, communication, customer management, and customer experience.

The fourth industrial revolution is characterized by the clutter of disruptive innovations in the economy and society. When discussing the driving forces of disruptive innovations, most of the time, new products or new technologies have been mentioned. New products that offer a different, better way in satisfying the needs of customers and new technologies which make it possible for the disruptor companies to outperform with lower costs the disrupted incumbent companies.

This conceptual study would like to draw attention to the effects of industry 4.0 on the pricing policies of the disruptors. Pricing has become, in most cases, the core element of the new business models the disruptors have created and practised. It has to be emphasized that besides new products and technologies, even new pricing models can be the primary constituent of the disruption.

## 2. The environment of pricing in the era of digitalization

Two borders limit companies pricing decisions; the costs of products they produce and sell constitute the floor while customers' willingness to accept the price represents the ceiling of the elbowroom of pricing decision (Rekettye–Liu 2018). If the price is

set outside of these borders, the product will either produce a loss or cannot be sold in sufficient quantities. Both limits are powerfully touched by Industry 4.0.

There is a common understanding among scientists and practitioners that the Cyber-Physical Systems (CPS) of the fourth industrial revolution will result in a radical decrease in the costs of production. It means that the floor of pricing decisions is shrinking.

The effect of Industry 4.0 on the upper border is not so clear-cut. There is also an unambiguous opinion that the cyber-physical system of production will be able to manufacture products with higher customer benefits; more personalized, better quality, performance, design, more trouble-free, more convenient and safer usage, etc. (Porter–Heppelmann 2014). The first assumption is the customers will be ready to accept higher prices for better products. There is, however, a contradicting effect of digitalization in this matter: customers purchasing decisions are becoming smarter. They have an ever-growing arsenal of means to get informed and compare competing products, companies, costs, and performances. Their bargaining power is growing. This power will not let the upper border increase sharply. Despite this, it is rather safe to conclude that the scissors are opening; the zone of pricing decisions is growing (figure 1). The size of the gap is, of course, different in the various industries; its future value is difficult to judge.

Figure 1 Development of the elbowroom of pricing in the era of Industry 4.0
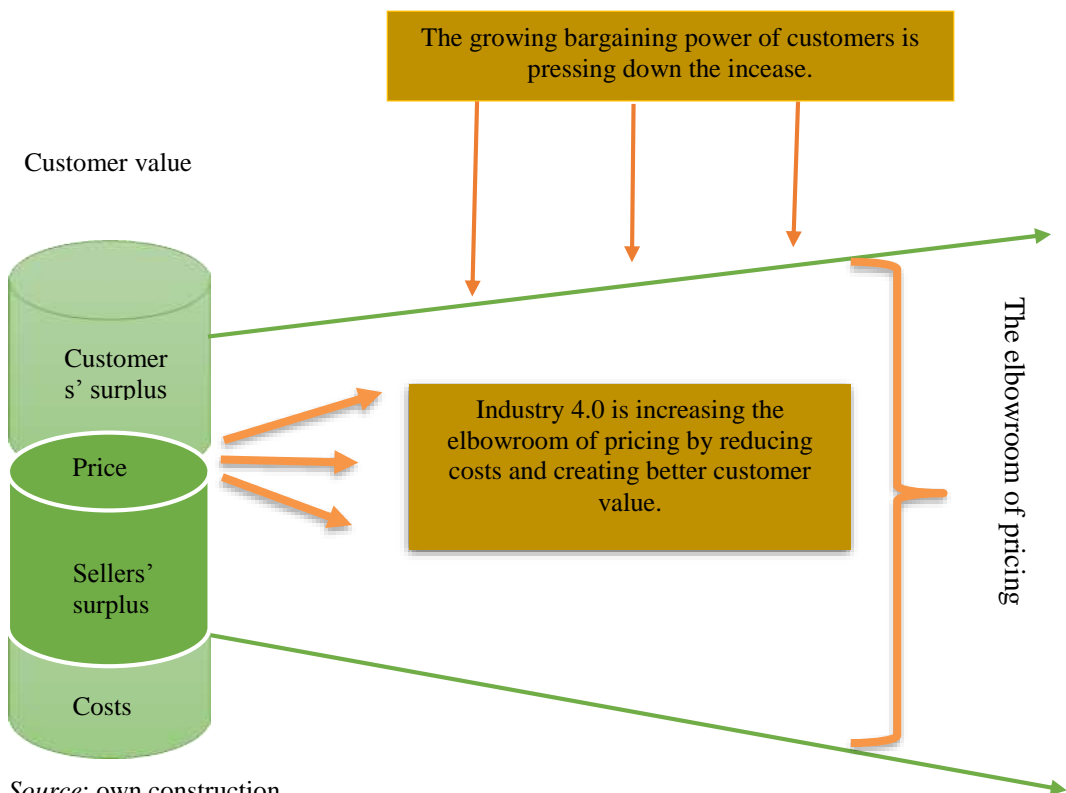
Source: own construction

How prices will develop in this growing zone depends on many things; among others, the following factors will influence the movement of prices:

- How will the *bargaining power of the participants (*customers, manufacturers, and intermediaries) take shape in the given industry?

- How large is the *share of the disruptor organizations* in the industry?

- What *pricing models* will disruptors use?

- With what pricing models will incumbent organizations react to defend their position on the market?

- How significant is the *state's intervention* in the given industry?

One thing is sure: the new instruments of Industry 4.0 (like advanced information technology, Big Data analytics, artificial intelligence, augmented reality, etc.) are providing, and the increasing room of pricing decisions makes it possible for disruptor innovators to create new pricing methods and technologies or use the existing ones differently. At the same time, these developments make it obligatory for the incumbent organizations to rethink their present pricing practices to defend their market positions.
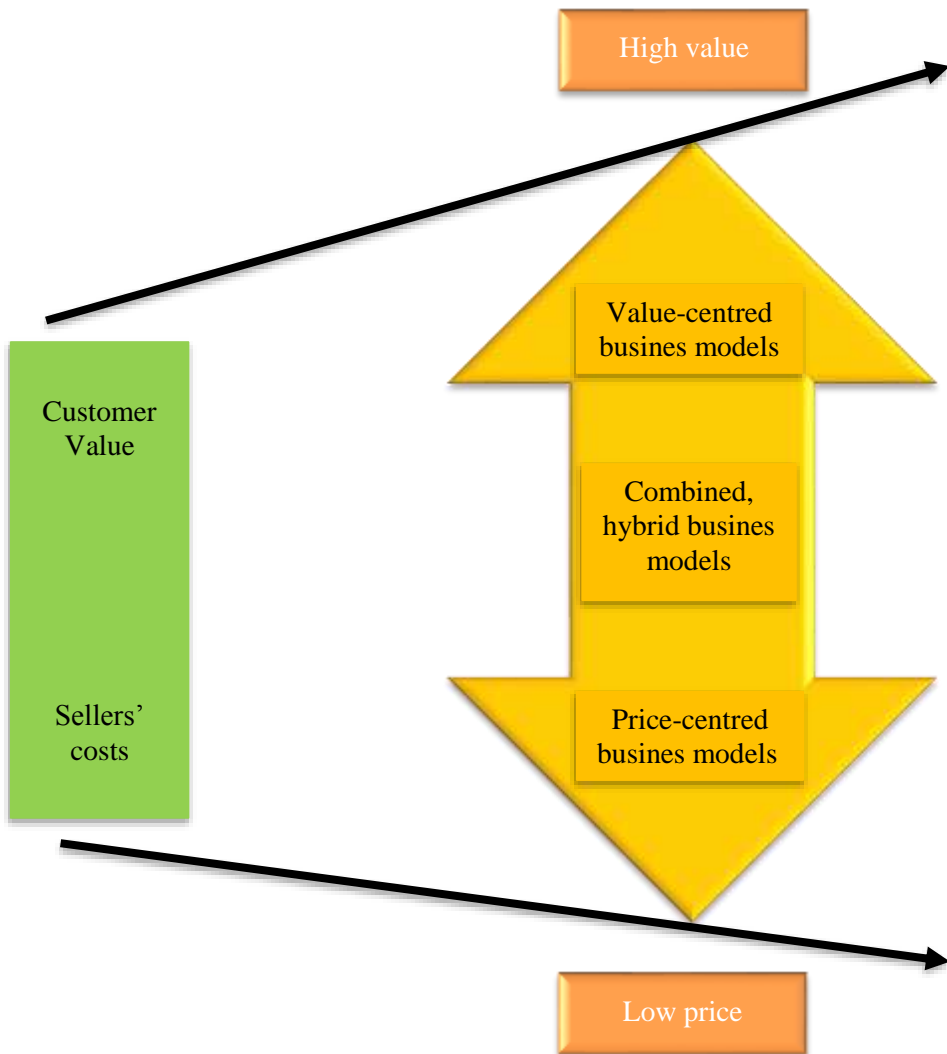
3. Categories and characteristics of the disruptive pricing models

The diverse movement of the two borders of pricing decisions offers the possibility to categorize business models using pricing policies according to their relation to these boundaries. In this sense, two groups of organizations could be differentiated:

- The first group consists of those organizations, which build their business models on the trend of shrinking costs and want to disrupt incumbent companies by low prices.

- The second group includes those companies, which are on the other end of the gap focusing on the growing customer value that is on the upper limit of pricing decisions. They try to disrupt the others by providing high customer value and customer experience. This group of companies may use premium pricing.

The reality, however, is not so cut and dry. There are many companies, which belong to the great in-between category; they want to make a competitive advantage from both ends at the same time, using very sophisticated, combined pricing strategies. It is hard to separate the disruptors' business models into clear groups; they constitute more like a continuum from the price-centred models until the high value-centred models (Figure 2).

Figure 2 The continuum of business models – from the price-centred
to the value-centred

High value

Value-centred
busines models

Combined,
hybrid busines
models

Price-centred
busines models

Customer
Value

Sellers'
costs

Low price

Source: own construction

The following part of the study wants to discuss the main characteristics of pricing methods used in the era of digital disruption.

4. Disruptive pricing models focusing mainly on low prices

Some of the disruptive pricing models operate at *low prices* — in extreme cases with free offerings. It was mentioned that the floor of the pricing decision is the unit costs of the offered products or services. While discussing the bottom line of the zone of pricing, a difference should be made between the long and short term. In the long run, these unit costs have to cover all the expenses of the company; in the short term, however, it is enough if they cover only the variable costs. Many services – especially the online and electronic ones – have rather low, sometimes zero, variable cost. In that case, they can set low prices, which will increase the demand for their offerings, and so even low prices will produce high profits for them.

That is the reason why disruptive businesses try to dematerialize tangible products and convert them into services. Handy examples are e-books. Let us take the Project Gutenberg (gutenberg.org): they offer over 59,000 free eBooks. Since it is a foundation, they cover their costs by raising donations. Amazon, with its Kindle, also lives from the dematerialization of books. There are other examples for dematerialization; the online webshops dematerialize the brick and mortar stores. The online programs of Universities dematerialize the classrooms and educators, the D2C (direct to consumers) webshops of manufacturers dematerialize the intermediaries, the online banking partly dematerializes the banking administrators. And, in the future, the distributed ledger with its blockchain technology will dematerialize some of the banks themselves.

4.1. Free and freemium pricing models

In the software businesses, some companies use *free-models*. Free pricing means that they offer services free, which should be otherwise paid by the users. The best examples are Google, Facebook, Twitter, Instagram, Whatsapp, etc. The free model seemingly contradicts the rule discussed at the beginning of this study: the bottom line of pricing cannot be zero since in this case, the companies costs are not covered. They can do it still since their real business is different. With free pricing, they can build a large customer base; the information about the members of this customer pool and their attention can be sold to other customers (like advertising agencies). "Google and Facebook generate 88% and 97% of their revenues respectively through advertising thanks to their ability to shape the way we use the internet" (Ghotgalkar 2017). Behind the free model, in most cases, there is cross financing.

The next model mostly used also by online businesses, is called the *freemium* model. The expression comes from the conflation of the words free and premium. In this trendy model, the basic version of the service (usually software) is offered free while the upgraded version costs money. There are plenty of examples for the freemium pricing: Spotify, Grammarly, Academia, Skype, to name some of them. The rationale behind this pricing is to get as many as possible users for the free version, who through the use of the service, become attached to it and sooner or later, some of them (usually some percents) will upgrade to the premium plan. The freemium business model is rather popular among both users and suppliers. Users prefer it since it gives the possibility to try the software free; suppliers also like it since it provides

them access to a large number of prospects with cheap acquisition costs. Therefore, when entering a competitive market, the freemium model seems to be a reliable way to get the critical mass of users.

The prices for the premium users are not high, and in most cases, the premium users pay a monthly fee, so this part of the model is belonging to the group of *subscription* models, which will be discussed later.

4.2. Sharing economy model

The sharing economy, or as it is also called the collaborate consumption defined by Hamari et al. (2015, p. 1) is "the peer-to-peer-based activity of obtaining, giving, or sharing the access to goods and services, coordinated through community-based online services". Sharing economy is on the rise in the transport industry (Uber, Lyft, BlaBlaCar, Oscar, etc.) in tourism and hotel industry (Airbnb, CouchSurfing, etc.), in the financial sector (KickStarter, etc.) and other services (TaskRabbit, WeTasker, etc.) (Basselier 2018, Choe 2016).

It enables people to share goods, services, and infrastructures, which are not utilized by them totally with the help of a digital network. In these transactions, there is no change in ownership. The prices used in the sharing economy compared with those of the incumbent companies are very competitive (sometimes 30–50% lower). Besides, the Hungarian Oszkar.com (a shared transportation company) claims that it is tremendous save in resources, which foster the environment-friendly behaviour of people.

4.3. Tiered pricing models

The *tiered pricing*, mainly used in the software industry, shows some similarities with the freemium pricing methods. In this case, the seller usually creates three – in some cases, more – packages with different pricing tags. Mohammed (2018) calls it the GBB (Good – Better – Best) pricing. Mohammed uses the example of Allstate, an American insurance company. They discovered already in 2005 that drivers were afraid of paying premium prices in case of participating in some accidents, and the clean ones wanted to be rewarded. So, they introduced beside their Standard plan a Value plan priced 5% below Standard and introduced a Gold plan 5 to 7% above Standard (this offered immediate forgiveness and a reward deductible). This strategy proved to be a big success. This three-(or more)pronged method is prevalent in the so-called SaaS (Software as a Service) and IaaS (Infrastructure as a Service) businesses. A good example is the accounting services offered by the QuickBooks Company. It is interesting to see on their pricing page that the difference between the prices of the better and best package is much higher than the difference between the good and better (Emmer 2019).

The tiered pricing is advantageous for both providers and users. For the users, it is not a significant risk to try with the 'good' package, so the customer base is quickly increasing. Upgrading to the 'better' also seems not a very expensive move, the best, however, shows as an anchor the real value of the offering.

4.4. The market place model

Among the pricing models, which focus on low prices, the *market place model* has to be mentioned. Disruptor companies like eBay, iTunes, AirBnB, Uber, Trivago present danger for the incumbents by providing a digital marketplace where suppliers and customers of a given service or product can meet each other. In this marketplace, with their hard bargain, they press the prices of the service providers down. The increasing number of customers they attract with the low prices makes it possible that the amount of these companies' commission and their profit is continuously growing.

5. Known pricing methods used in a new, disruptive way

The free and the freemium pricing models are rather new inventions of the digital era. There are, however, many pricing methods, which are already known for many decades, and now, innovator companies use them in a new, disruptive way giving significant headaches to the incumbent organizations. Among these methods, we can list, for example*, the hypermarket model with its everyday low prices formula, the subscription model, the so-called price bundling and unbundling, the 'pay as you go' method, the yield, or revenue management, the price discrimination*, etc.

5.1. The hypermarket model

The *hypermarket pricing model* is used mainly by online traders. They take advantage of their market power and want to destroy their competitors by setting low, predatory prices that sometimes go even below the costs. The best example is Amazon, which was established in 1994. According to some writers, the company is selling more than five hundred million items, from clothing to foodstuffs (Jullien et al., 2019). Amazon has been so successful with this strategy, that, according to BandZ ranking, it became the most valuable brand in 2019 with its brand value of 315 billion dollars. (http://www.millwardbrown.com/brandz/rankings-and-reports/top-global-brands/2019).

5.2. The subscription model

Subscription is a well-known pricing model used earlier mainly by newspapers and magazines. Users pay a flat fee in advance to get access to the offered service or product. Today, in this digital era, this model has become extremely popular first by online businesses, but nowadays, its use is visible also in the case of tangible products. The best example of the implementing subscription is Netflix, the market success of which is well known. The pattern of Netflix shows that a company can go at the same time for the low prices and high customer value. It has continuously evolved and improved the customer value of its offering. And could do it due to the increasing numbers of its subscribers at decreasing unit costs.

Most disruptors using the subscription pricing combine this pricing model with others. Netflix, for example, combines the subscription with tiered (GBB) pricing: it offers three plans (basic, standard, and premium) for their customers to

satisfy the different needs of them. Another combination is when, as it was mentioned earlier, freemium pricers offer their premium plans as a subscription. This combined solution could be named as *hybrid pricing*.

The most striking example of using this pricing model for tangible products is Volvo. In October 2018, Volvo introduced a nationwide program in Germany, with subscriptions to virtually all of its models – with an advertisement saying "Don't buy this car!" (Nikola 2018). Subscription offers a better deal for customers than buying, renting, or leasing; besides, it gives a better understanding of customers driving habits to Volvo.

Other examples in the transportation industry are Flexdrive or Zipcar. In the case of Zipcar subscription means membership, this is also the case of Renttherunway clothing company. The subscribed customers can rent well-known high fashion clothing brands for free periods at a fraction of the price of a new piece of clothing. This solution, which offers advantages for clients and the company as well is disrupting retailers and traditional renting companies.

5.3. "Pay as you go" model

Paying for the product or service according to their use is not new. Roll Royce, for example, introduced it already in the 1980s with the name "Power by the Hour," according to which customers had to pay for uptime and availability of the engines (Hagel et al. 2016). This method became disruptive now, with the digital technology that with IoT and data analytics provides an in-depth insight into how, when, and for how long-time customers use products and services. A good example is the "pay as you drive" car insurance (Progressive Snapshot). Aligning price with the use provides advantages for customers since they do not need to make substantial investments in infrastructures (IaaS) or software (SaaS), primarily if they use them infrequently. Still, it is also advantages for the sellers, since it encourages customers to try the services or products, and it ends up in an increased customer base.

Rent the Runway Company, for example, sends out several thousands of high-end fashion items every day to its network. The five million subscribers of Rent the Runway do not have to invest in a high-end fashion suit to say a graduation party, and the company is making a profit out of the approximately 30 customers who will use the same outfit for one or two days each.

5.4. Dynamic pricing — price personalization

Industry 4.0, as mentioned earlier, makes it possible to personalize products. At the beginning of the 20th century, Henry Ford produced his car the model T in one version. Today the BMW Mini has more than 14 million variations. The Big Data analytics makes it possible to get real-time information about customers' habits, about the differences in their willingness to pay. Price setting can move on a large scale of variety, and modern means of technology like artificial intelligence can help to explore this possibility.

Price personalization is a kind of price discrimination (Krugman 2000), which has been already used for more than a century. The newness of the present price

personalization is that it is nearing to the first-degree price discrimination, which was considered by scientists earlier as a theoretical category, which cannot be executed in the real world (R. Steppe 2017).

5.5. Disruptive unbundling of products and services

Bundling is a well-known technology: it means selling products together at a price, which is lower than the sum of the costs of the components of the bundle sold individually. Unbundling is the opposite move: dividing products and services, considered earlier as one, into sellable pieces and offer to customers only that part, which they need. New entrants using unbundling may disrupt incumbent companies. For example, Craigslist unbundled classifieds from the newspaper, improving value for buyers by offering a more extensive array of free searchable content and for sellers, low-cost access to more buyers (Hagel et al. 2019).

This method is popular in the media, but it is also used in the tangible world. That is what the low-cost airlines or low-cost hotels are doing. They dematerialize parts of the service (reservation, ticketing, etc.) and offer the core service/product and the additional services separately.

Some of the unbundling technologies may lead to confusion in the customers' minds; since customers who need the complete product, meet several parts with several prices. This pricing method is also called multidimensional pricing. Many customers cannot handle multivariate numbers; they listen only to one or two elements of it. Travel agencies, in most cases, unbundle, for example, the travel costs to ait travel and airport taxes and promote cheap airline costs. Those clients who decide according to the competitive airline costs may be disappointed by the additional expenses they have to pay.

6. Business models focusing on providing higher customer value

Teixeira wrote in the title of his article in the Harvard Business Review: "Disruption starts with unhappy customers, not technology" (Teixeira 2019). It means that if a disruptor company starts to deliver higher customer value can outperform incumbent companies. It is, however, not easy to define what makes customers happy. Rekettye (2019) argues that maximizing the perceived customer value needs three things: to increase attractiveness, the high quality needs satisfaction of the offer, and deliver an outstanding customer experience (CX). Offering customers more convenience, better quality, and customer care, as Bradley et al. (2015) call it high *experience value*, has been the central strategy of many disruptor companies.

All the business models and their pricing policies discussed so far besides focusing on lower prices provided at the same time high customer value. That is the reason why it is difficult to separate those models, which concentrate first on delivering high customer value. Their price position may vary: there are many models, which, while offering low prices, strive to improve the value of their offerings. Those disruptor companies which have the improvement of the customer value in the centre of their business policy may also use low or medium prices. The most successful

companies with their high-value products and outstanding customer experience can use premium rates that are accepted by their loyal customers. The best example is Apple for that business policy.

Here are some best practices used to provide high experience value for customers:

−   *Personalization:* making customers feel that the offer is just for them. The clients of eSalon can, for example, personally try out their hair colouring to match their style perfectly, and the product is delivered to them directly, so they do not need to search it in the drugstores. FitBit and its applications provide personalized fitness and health information for their clients.

    Mapping the decision journey. The age of digitalization has wholly changed the customers' decision journey (Court et al. 2009). The best practice companies regularly map the touchpoints of the decision journey, and they use all methods provided by modern technology to be there at all touchpoints and deliver real-time and personalized information to the prospects.

−   *Removing* those *intermediaries* from the marketing channel, which does not add enough value to the products. D2C (Direct to Customers) is getting more and more popular, and it helps manufacturers to understand and serve their customers better.

−   *Make the purchase easy, smoothly, even enjoyable*. A good example is ZipFit, which, with its app rescue men from the problem of not finding the matching size of jeans. It prepares the required brand in the necessary size for them and delivers it. IKEA makes the purchase easy for young families by providing a place for children and restaurants for families. That is why visiting IKEA on the weekend days is a pleasant excursion for young families.

6. Conclusions

The study intended to prove that pricing policies have gained in importance in the era of digitalization. In many cases, pricing has become the core element of the business models of the disruptor companies. The analysis of the pricing models used by the disruptors showed that it is not easy the categorize the pricing methods used. Most models include and use the different technologies simultaneously, making the categorization even more difficult. The groupings offered by this study are, therefore, rather vague. This fuzziness is one of the limitations of the study. The other limitation comes from the fact that this analysis was built on the results of desk research. Further direction of the investigation could be, therefore, the field research of the pricing policies used in the different industries and regions and the comparisons of their efficiencies.

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Investigation of eating behaviour among primary school children with Dutch Eating Behaviour Questionnaire (DEBQ)

Dalma Pető

There are many factors that influence children's eating, and the role of parents is outstanding. During our research, we studied children's eating behaviour and were also interested in parents' attitudes towards their children's eating behaviour. In the course of our investigation, we used a part of the already validated questionnaire, DEBQ. Our sample was made up of primary school children and their parents. A total of 172 children and their parents completed the questionnaire. The results show that parents consider the child's nutritional characteristics differently than the child itself. We found that parents overestimate their children's self-control about delicious food.

Keywords: healthy nutrition, DEBQ, eating

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 the highest proportion 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 the evolvement of proper eating habits from children's early age (Huszka–Dernóczy 2015).

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 often contain high calories and fat. The spread of nutrient-poor fast foods contributes to the increasing rate of obesity starting in childhood, and its treatment is a growing challenge all over the world (Khatoon et al. 2017, Vazquez–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 (Vazquez–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 (Vazquez–Torres 2012).

Based on this it can be claimed that it is extremely important to deal with nutrition. It is particularly true from the aspect of children since they are the future's consumers and employees, and therefore their health is a high priority. Young people's nutrition can be affected by several factors, one of them is the influence of parents. In the course of our research, we studied children's eating behaviour with a novel approach. We were interested in finding out whether parents assess their children's nutrition characteristics in the same way as their children, or, in other words, whether they are able to identify the nutrition characteristics their children consider about themselves. To examine this we conducted a questionnaire survey among primary school children and their parents, and the results are presented in the following.

2. The factors influencing children's eating

Parents' influence is determining from the perspective of children, they affect long-term eating behaviour as early as infancy. The more a parent prohibits and restricts the child's independent decisions related to eating, the bigger the chance is that the child will start eating unhealthily later on. As soon as they can make an own decision about their diet, they will choose a prohibited alternative, even if they are not hungry (European Food Council 2012). There is a strong connection between the parents' and their children's nutrition attitude, as the children of parents who pay attention to healthy nutrition are more health conscious themselves and they are more interested in the topic (Kiss–Szakály 2016). In their research, Kiss and Szakály (2016) found that the mother's role is much stronger, they consider her as the person supporting a healthy lifestyle, while the father's role is much weaker, yet positive. Despite this, only 1/3 of children believe that they get reliable answers to their questions regarding lifestyle and nutrition from their parents. For them health visitors and doctors represent a credible source of information. Besides, the internet is the third most important information channel for the young (Kiss–Szakály 2016). The more say parents have in the eating habits of their children, the more balanced diet the children have (Böröndi et al. 2010).

It is an important question how we can influence children's eating in the early stage of their development. As in this age the family stands in the centre of children's life, convincing the parents is an inevitable step for the purpose of educating to sustainable and healthy nutrition. According to related research, the nutrition programmes focusing on the family and providing information for the parents about nutrition have proved to be much more successful than the programmes based on schools. In the case of the former, fat intake significantly decreased, and the consumption of vegetable and fruit increased, while in the case of the latter there was only a moderate increase in vegetable and fruit consumption (Black et al. 2017). It is also important to note the effect of the media, since it can easily influence the food

choice behaviour even at this age. Children spend more and more time in front of the screen, whether it is a TV or computer. It entails encountering more and more advertisements promoting fast food (Vazquez–Torres 2012). The techniques advertisers use have an influence on children's preferences related to food and encourage them to consume fast food (Boyland–Whale 2015). Children's brand preferences develop already at this early age, which can affect their life later on (Kásler 2017).

3. Studying 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). The eating behaviour studies mostly take three theories as a basis: psychosomatic theory, external theory and the theory of restraint. 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 (Kaplan– Kaplan 1957). 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). 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 into 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).

A lot of research is concerned with eating behaviour and attitudes, several measuring methods have been developed for their investigation (based on the theories above). Garner and Garfinkel's (1979) *Eating Attitude Test* (EAT) is mainly used to study eating disorders. Herman and Polivy's (1980) *Restraint Scale* measures how consciously an individual restrains food intake in order to restrain their weight. This questionnaire provided the basis for the *Three Factor Eating Questionnaire* (TFEQ) (Stunkard–Messick 1985) and the *Dutch Eating Behavior 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 main difference between DEBQ and TFEQ is the external eating (DEBQ) and the uncontrolled eating (TFEQ) scale. In case of uncontrolled eating, the individual loses control over her eating behavior for some reason, he/she is disturbed by something, so eats more. *External eating* is a special form of uncontrolled eating behavior associated with loss of control which occurs from a response to food-related (external – smell and internal – hunger) signals (Heaven et al. 2001). In our case, the external eating scale – based on Schachter and Rodin's (1974) external theory – is a better choice for our research purpose, because of the young target group.

In our present research we used the Dutch Eating Behavior Questionnaire (DEBQ). 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. 2014, Bailly et al. 2012).

The 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. Methodology

Our paper-based questionnaire was given to the pupils in 3–6th years of a primary school in Szeged, as well as to their parents with the help of the school director. Altogether we asked 172 children and 172 parent. Responding to the questionnaire was not anonymous, each pupil and parent had an identification number. For this reason, we asked the parents to fill in a consent form before responding, so only those who agreed for them and their children to fill in the questionnaire were included in the sample. The questionnaires of the related parents and pupils had the same code so they could be matched. It allowed us to compare the children's and the parents' opinion with each other. The data collection took place in the fall of 2018. The research was carried out on the basis of the medical ethics permit 62/2018-SZTE.

In the course of our investigation we used a part of two already validated questionnaire, the Dutch Eating Behavior Questionnaire (DEBQ) (van Strien et al. 1986), and a version of DEBQ-C (van Strien–Oosterveld 2008) developed for the study of children. A total of nine statements from the original and child-adapted versions were used for both the child and parent questionnaires. The adapted questionnaire is specifically designed to assess children's eating habits as it measures the same three eating styles with shorter, i.e., fewer questions than the original DEBQ scales. For each of the three factors of the model (emotional eating, restrained eating, eating for external influences), three 1–5 Likert scale statements were selected based on our research team's previous investigations with the DEBQ. According to that these 3–3 statements described best the three factors (Lipták–Huszár–Buzás 2018). On the scale, respondents had to indicate how much they agreed with the statement. In the case of children, the statements were formulated considering themselves, while in the case of parents the questions concerned the children (Table 1).

Table 1 The DEBQ statements included in the child and parent questionnaire

Statements included in the child questionnaire	Statements included in the parent questionnaire
1 When I'm sad, I have a desire to eat.	1 When my child is sad, he/she has a desire to eat.
2 When I feel lonely, I have a desire to eat.	2 It is hard for my child to resist delicious dishes.
3 If I eat a lot, I pay attention to eat less on the following days.	3 My child pays attention to eat low-fat food.
4 I intentionally eat less in order not to gain weight.	4 When my child feels lonely, he/she has a desire to eat.
5 I often desire food when I see other people eating.	5 My child often desires food when he/she sees other people eating.
6 It is hard for me to resist delicious dishes.	6 When bad things happen to my child, he/she has a desire to eat.
7 I pay attention to eat low-fat food.	7 When my child sees good-smelling or delicious food, he/she gladly has a taste.
8 When bad things happen to me, I have a desire to eat.	8 When my child eats a lot, he/she pays attention to eat less on the following days.
9 When I see good-smelling or delicious food, I would gladly have a taste.	9 My child intentionally eats less in order not to gain weight.

Source: own construct based on DEBQ

Based on the original model, in the case of the child questionnaire the 1st, 2nd and 8th statements belong to emotional eating, the 3rd, 4th and 7th statements to restrained eating, while the 5th, 6th and 9th statements to external eating factors. In the case of the parent questionnaire, 1st, 4th and 6th original variables belong to emotional eating factors, the 3rd, 8th and 9th original variables to restrained eating factors, while the 2nd, 5th and 7th original variables to external eating factors.

5. Results

In the course of our research, we used IBM SPSS statistics software and the Microsoft Excel programs to analyse data and test the hypotheses. During the analysis, besides descriptive statistical analysis, we tested principal component analysis, scaling, median tests and correlation coefficients. In our study we call the artificial variables created as a result of the principal component analysis factors for the sake of simplification and easier understanding. In the course of analysis, we were interested to find out whether the original DEBQ model factors can be identified for the parents and children included in the sample, i.e. whether emotional eating, restrained eating and external eating factors can be replicated from the original variables. We also examined if there is a significant difference between the parents and their children in the case of each factor, and if yes, in what ways the responses differ. Thus, our hypotheses we tested were the following:

- H1.: The 3 factors of the DEBQ model (emotional eating; external eating; restrained eating) can be identified on the sample.

  o H1a.: The 3 factors of the DEBQ model (emotional eating; external eating; restrained eating) can be identified on the child sample.

  o H1b.: The 3 factors of the DEBQ model (emotional eating; external eating; restrained eating) can be identified on the parent sample.

- H2.: There are differences between the children's and parents' responses.

  o H2a.: There is a difference between the children's and parents' responses in the case of emotional eating factors.

  o H2b.: There is a difference between the children's and parents' responses in the case of external eating factors.

  o H2c.: There is a difference between the children's and parents' responses in the case of restrained eating factors.

5.1. The characteristics of the sample

The questionnaire was filled in by 172 children and related parents in total. 46.8 per cent of the children were boys, while 53.2 per cent were girls. 26.9 per cent of them were in third, 35.1 percent in fourth and 28.1 per cent in sixth year. The proportion of fifth-year pupils was lower compared to the other years, they comprised only 9.9 per cent of the sample. The majority of the children (86%) were town-dwellers, while 12.3 per cent lived in a village, and only 3 persons in a cottage. 83.1 per cent of the children lived in a household of 3-4-5 people. 8.2 per cent of them lived in a household of two, while the remaining 8.7 per cent lived in a household of more than 5 people. 91.1 per cent of the parents included in the sample were mothers, 0.6 per cent were foster mothers, while the fathers were represented in the sample in a proportion of 8.2 per cent. 82 per cent lived in partnership (10%) or marriage. The remaining 18 per cent include single (4.7%), divorced (11%) or married parents but living separately from their spouse (1.2%), and 1 parent of the sample was a widow.

5.2. The results of hypothesis analysis

Regarding the first hypothesis we tested whether the DEBQ factors can be identified in the sample in the case of both children and parents. For its examination we carried out a primary component analysis. In both cases we applied the same settings (Varimax rotation procedure). Table 2 summarizes the results of the principal component analysis run on the child and adult samples respectively. The KMO (Kaiser-Meyer-Olkin) index, indicating if it is sensible to search for background structure between variables, takes a value below 0.7 in the case of both the child (0.685) and the adult (0.644) sample.

Table 2 The results of the principal component analysis on the child and adult samples

	Child	Adult
Value of KMO index	0.685	0.644
Sig. value of Bartlett test	<0.05	<0.05
Cumulative variance ratio	64.338	65.688
Number of created factors (pc)	3	3

Source: analysis based on own data collection

In this case it is practical to examine the Bartlett test, and look at the correlations in the matrix of the artificial variables and the original variables. The significance value of the Bartlett test was below 0.05 in both cases, which suggests a correlation between the variables. It justifies that it is practical to examine the results of the principal component analysis further. Based on the Kaiser-criterion (eigenvalue>1) the analysis created 3 artificial variables in both cases from the original 9 variables respectively. Furthermore, the cumulative variance ratio, meaning the level of information content preservation, was above the threshold of marketing research (60%) in both cases, thus we only had to examine whether our variables condensed in the factors correspond with the original DEBQ model. We found that both samples corresponded, thus we could identify the three factors of the original DEBQ model.

Based on this, the first hypothesis saying that the factors of the original DEBQ model can be identified on the samples has been verified in the case of both the parent and the child sample, thus we accepted it overall for H1.

Regarding our second hypothesis, we wanted to test whether there is a difference between child and adult responses by factor studying the created artificial variables. In order to examine this, first we conducted scaling with the help of minimum-maximum method for making our values comparable. We designed it in a way that all our data took a numeric value between 1 and 5, similarly to the original variables. Thus, the lowest of the original factors took a value of 1 and the highest took a value of 5, and the intermediate values were transformed into a (not necessarily a whole) numeric value between the two numbers. It led to obtaining comparable variables. We compared the values of children and adults by factor with a two-sample independent median test, and we also analysed the correlation coefficients. The results of our analysis are summarised by Table 3. Before carrying out the median tests, however, we looked at the distribution of differences between the values of related parent and child factors for all three factors by individual. We considered it important to study the proportion of outliers, where the parent and child responses largely differ, since a high proportion may cause bias in the result of the median test. Fortunately, we received a result showing that in the case of all three pairs of factors more than 80% of the child and parent responses differ with a maximum of 1.5 (for a scale of 1–5). The proportion of respondents differing with a maximum of 1.5 for emotional eating factors was 88.5%, for external eating factors 82.1%, and for restrained eating

factors 84.6%, which results imply that the proportion of outliers was minimal. As in all three cases the proportion of "well behaving" responses was above 80%, a median test can be applied, the results are not biased.

Table 3 The results of the median test and correlation coefficients for the analysis of child and adult factors

Name of factor	child median	parent median	median test t value	median test sig. value	correlation coefficient
Emotional eating	1.47	1.74	–3.29	0.001	0.298**
External eating	3.32	2.87	4.55	<0.001	0.384**
Restrained eating	2.20	2.52	–3.01	0.003	0.362**

Source: analysis based on own data collection

The results indicate that there was a significant difference between the parents' and children's responses in the case of each factor, thus we accept the H2 hypothesis, with all its sub-hypotheses. The correlation is significant and positive in each case, showing a weak connection between related factors. In the case of emotional eating and restrained eating, the parents overall agreed more with the statements than their children, at the same time, the children gave higher points to the external effects compared to their parents. It means that the parents are more likely to think that their children pay attention not to eat fatty food or not to eat too much, furthermore, they believe their children are more prone to eat when in a bad mood, while they are less likely to think that their children cannot resist an appetising and good-smelling dish. On the other hand, it should be noted that the children and parents gave higher points to the same factors. Both groups agreed that the external effects have the greatest influence on children's consumption, restrained eating has a smaller role in children's nutrition and both the parents and children think that a bad mood has no significant influence on eating.

6. Conclusions

In the course of our research, we studied children's nutrition characteristics with the help of the DEBQ method. Our central objective was to confirm the usability of the scale adapted to children, as well as to point out that parents assess their children's nutrition characteristics in a different way than children themselves. Overall, we managed to achieve both aims. There was a significant difference in all three studied dimensions in the assessment of the parents and their children. The most significant difference was in terms of external eating, which suggests that the parents overestimate their children's self-control, they believe that they are less enticed by delicious food. In parallel, the parents overestimate their children's nutrition characteristics regarding restrained eating factors, i.e. they think their children are characterised by higher self-restraint. This result can be drawn in parallel with Hong

et al. (2019) findings that 48.5% of the surveyed parents underestimated their child's weight, which may lead them to judge their eating behavior more positively than real. In terms of emotional eating, both the children and their parents were dismissive, i.e. they believe that the children are not likely to eat because of sadness.

Self-control is an important factor in rejecting unhealthy nutrition and choosing a healthier lifestyle. Therefore, our results raise awareness because parents seem to (falsely) overestimate their children's self-restraining ability in terms of nutrition, thus we can also assume that they perceive the risk of obesity less dangerous regarding their children. Based on this, it would be sensible to place more emphasis on raising the awareness of parents about reconsidering their position regarding their children's self-control in the communication targeted at children's healthy nutrition.

A limitation of our research was that too many children with normal body weight were included in the sample, and we did not examine other influencing factors such as financial status or parent's eating attitudes. Our future plans include extending the research to more elementary schools and examining the differences between eating behaviors split by BMI category.

Acknowledgments

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Motivations of brand avoidance

Dóra Tamasits

Present study demonstrates the widely known and debated consumer-brand relationship, particularly focusing on the phenomenon of brand avoidance. However, the traditional consumer researches focus predominantly on the consumer loyalty, the examination of negative consumer-brand relationship is actual. The extant literature on the field brand avoidance is scarce. It is important to discover which factors are the those key elements that cause the brand avoidance. Firstly, if we know these factors we can prevent for more losing consumers. Secondly, nowadays the opinion of consumers is critic for the brand successful, because the negative word of mouth (WOM) might be harmful. Based on my previous suppositions the motivation of the brand avoidance are caused by symbolic consumption (self-expression) which means consumers avoid certain brand because of the brand personality, brand image and the typical brand user. Partly, the results of the qualitative research certifies my previous suppositions, but the functional factors and the message of the advertisement are important elements for the brand avoidance as well.

Keywords: consumer-brand relationship, brand avoidance, anti-consumption

1. Introduction

A number of researches focus on the symbolic nature of brand loyalty, manifesting that consumers tend to insist on brands which they can express their personality with and which they can reach benefits through (Aaker 1997, Belk 1988, Levy 1959, Sirgy 1982). However, a few researches point out to the source of the motivations why consumers switch from one brand to the other one and why they avoid certain brands or products. It is also fundamental to reveal why individuals develop antipathy against a brand since if we know the reasons of brand avoidance it can be prevented to loose further consumers. Moreover, prevention and effective management of negative world-of-mouth might be essential for a successful brand. It is relevant to unravel experiences and motivations which are responsible for individual's negative attitude against the brand. After knowing this, solution could be found in order to shift the revulsion against the brand into a more favorable direction.

In a broader sense, current study aims to analyze the relationship between the consumer and the brand. Although it is researched both at theoretical and practical level nowadays, there is still a lack of clear framework of that. In the wide variety of different standardizations and methods, researchers and especially practitioners find it difficult to unravel those. It might be the reason why the consumer-brand relation is a less known approach both at theoretical and especially practical level in our country. In the narrow sense, the goal of current research is to examine the negative consumer-brand relation in depth which is less common in academic writings. Beside the academic overview, the study also contains exploratory research which aims to reveal

the inducement of negative consumer-brand relation. The purpose of the primary research is to uncover the reasons which have an important role in negative consumer-brand relation, provided that consumer can afford to purchase a certain brand, it is available for the consumer but he deliberately chooses to avoid the brand and purchases one (or any) competitor of the certain brand.

2. Anti-consumption as the theoretical background of brand avoidance

A small variety of negative consumer-brand relation can be found among academic writings; therefore, this phenomenon is discussed within the field of anti-consumption. In case of negative consumer-brand relation, researches about anti-consumption are considered important which affect consumer's dissatisfaction, consumer's resistance and self-image (Lee et al. 2009a, Lee et al. 2009b, Iyer- Muncy 2009). In the researches of anti-consumption there is an attempt to reveal why consumers do not purchase certain brands or why they tend to decrease the purchase of a certain brand. In the field of anti-consumption one of the most important achievements is the standardization of anti-consumers that is connected to Iyer-Muncy (2009). The authors distinguished four different types according to the subject and purpose of their decreasing consumption. Based on that, chart No. 1 shows the consumer categories of anti-consumption.

Table 1 Four categories of anti-consumption

		Purpose of anti-consumption	
		Societal Concerns	*Personal Concerns*
Object of anti-consumption	*General (all consumption)*	Global impact consumers	Simplifiers
	Specific (individual brand or products)	Market activists	Anti-loyal consumers

Source: Iyer–Muncy 2009 p. 161 self-edited

The table shows that there are consumers who tend to decrease or stop their consumption in general for all products, however, there are consumers who do this only for a few brands. Another important factor in distinguishing whether individuals consider social and environment issues (sustainability) or there is rather a personal motive of decreasing or stopping their consumption. One of the groups of anti-consumers is the group of activists protesting against global problems. In their point of view, the consumer society and the current level of the consumption have a negative effect on our environment. The over-consumption generates several problems and causes irretrievable damage in the ecosystem of the Earth. In order to draw attention to the negative effects of the over-consumption today and to how over-consumption influences our society and environment; an initiative was formed under the name „Buy Nothing Day" which can be considered as the opposite of Black Friday. The second group of the consumers against purchasing is „Simplifiers" (Holt 1998). They

give up the lifestyle of the consumer society and choose a simpler, less consumption-oriented lifestyle. They think that the negative effect of the consumer society is the stress, fatigue and disillusion so the turn away from consumption-oriented lifestyle is based on an inner commitment. The activists of the market avoid a certain brand since according to them the brand or the company causes social problems. They are supported by several media in order to widespread the information regarding the negative effect. At last, the group of anti-loyal consumers intentionally do not purchase certain brands because in their opinion the brand is „incompetent" or they have negative experience with the brand (Iyer–Muncy 2009). Based on the standardization of anti-consumers it is clear that the research of brand avoidance becomes multidimensional therefore it is worth to examine the phenomenon in a broader perspective. However, within this study the most relevant category is the group of the anti-loyal consumers since in my primary research I focused on the motivations of brand avoidance concerning one given brand.

3. Motivations of brand avoidance

There is no generally accepted definition of brand avoidance, there is usually an attempt to reveal behavioral patterns and motivations behind the phenomenon (Hogg 1998, Lee et al. 2009a, Lee et al. 2009b, White et al. 2012). The phenomenon of brand avoidance is formulated by Lee and the co-authors (2009b) when consumers deliberately refuse the purchase of a brand. The phenomenon suggests that consumer can financially afford to purchase the brand and it is physically available but he does not buy it. In an exploratory research Lee and the co-authors (2009a) classified the motivations in four main categories which may have a central role in brand avoidance. In furthers, Knittel el al. (2016) defined a fifth category also in an exploratory research. The motivations of brand avoidance are shown in figure Nr.1.

Figure 1 Motivations of brand avoidance

Experiential avoidance	**Identity avoidance**	**Moral avoidance**	**Deficit-Value avoidance**	**Advertising**
• Poor performance • Inconvenience • Store environment	• Negative reference group • Inauthenticity • Deindividuation	• Anti-hegemony • Country effect	• Unfamiliarity • Aesthetic insufficiency • Food favoritism	• Content • Celebrity endorser • Music • Response

Sources: by Lee et al. (2009a); Lee et al. (2009b); Knittel et al. (2016); Nenycz-Thiel–Romaniuk (2011); White–Breazeale–Webster (2012) self- edited

Experiential avoidance means negative experience associated with the use and dissatisfaction of the brand. Experiential avoidance comes from the fact that promises of the brand do not match with the expectations of the consumer. He compares the

expected and desired performance of the brand with the actual performance and if expectations do not match with the performance of the brand, it leads to dissatisfaction and brand avoidance (Lee et al. 2009a, Szántó 2003). Dissatisfaction includes the dissatisfaction associated with the performance of a certain brand and with the environment of the purchase itself.

Identity avoidance refers to factors which are associated with symbolic meanings of the brand and with the self-concept. The image of the brands mainly influence which brand is purchased by consumers since they can identify themselves based on the personality and symbolic meanings associated with the brand. The congruency of the individual's identity and the image suggested by the brand is called self-image congruence in academic writings (Sirgy 1982, Kressman et al. 2006, Grzeskowiak–Sirgy 2007, Gyulavári–Malota 2014). This is the phenomenon when the decision of consumer depends on how much the product image matches the self-concept of the consumer. It was laid down by Grubb And Grathwohl (1967) that self-concept has a value for the individual and his behavior, consumer's attitude is aimed at his defense and at the emphasizing the self-concept. The incongruence between the image suggested by the brand and the individual's identity leads to brand avoidance as there is a rejection of an undesired self-image behind the motivation of rejection. Identity brand avoidance includes the negative reference group, lack of authenticity and deindividuation. Negative reference group is a group where the consumer does not want to belong, that he refuses and whose values the consumer does not share (Lee et al. 2009b). The results of exploratory research of White–Breazeale–Webster (2012) show the difference from the classic brand user as the motivations of the brand avoidance. According to their views, brand avoidance is occurred partially in order to defense „self", furthermore the aim is the preserve of the social self-concept where opinions of others might be dominant. Brand avoidance where the aim is to preserve social self-concept determined by White–Breazeale–Webster (2012) might be motivated by that consumers do not want to communicate towards other consumers that they belong to a lower social class by using a certain brand so they rather avoid them. In this case it is worth noting that there might be brands which are suitable to be used at home (where it cannot be seen by others), but they are not good enough to be seen that it is used. This perception of public feedback – the opinion or reaction of others – distinguishes consumers avoiding a certain brand in favor of their social self-concept from those who avoid brand because of the defense of 'inner-self" (White–Breazeale–Webster 2012). Moreover, there are consumers who refuse certain brands in order to emphasize their personality since by consuming they do not intend to belong to those who follow the trends. They refuse certain brands since they prefer to be separated from the other consumers who follow the taste of the mass (Kovács 2009). Through this line of thought it is clearly seen that social interactions have an important role in researches of choosing brands and avoiding them.

In standardization of brand avoidance, the next category is the moral or ideological avoidance which can be based on the lack of corporate responsibility, country effects or power imbalance that is associated with imbalance between the power of a brand/company and the consumer (Lee et al. 2009a).

The fourth category of brand avoidance is the deficit-value avoidance. Before consumer even could try a certain brand, he refuses it since the brand is perceived as bad because of the packing or because it is a new brand so the consumer is mistrustful. The quality that the consumer gets for a certain price, does not worth to him. Consumer goes through a pre-judgment whereby he decides not even to try it because it does not match his expectations. Deficit-value brand avoidance occurs when the price of the brand is not acceptable compared to the benefits deriving from the brand (Lee et al. 2009b). Consumers might avoid brand which reflect low quality therefore they have deficit-value (Lee et al. 2009b). Extending the four categories laid down by Lee et al. (2009b), Knittel (2016) and his co-authors revealed brand avoidance due to advertisements. In their researches they point out that brand avoidance can be triggered by less attractive content or advertisement message, celebrities in advertisements whom the consumer does not like, the music that evokes negative emotions in the consumer and the answers given to the advertisements which reflect to the subjective perception of the message recipient (Knittel 2016).

White–Breazeale–Webster (2012) have already highlighted the above-mentioned motivations of brand avoidance. According to the three authors a brand can be active or passive trigger of phenomenon of brand avoidance. Brand is the active trigger of brand avoidance in case the consumers perceive ethnic or any other kind of discrimination or they think that the brand is responsible for social or economic problems. However, according to White–Breazeale–Webster (2012) the brand can also be the passive trigger of brand avoidance. Consumers usually associate the brand with a previous event from the past which the consumer has bad memories about. By refusing those brands which consumers have bad memories about, they try to avoid an undesired association. In this case individuals commonly have deep-rooted bad experience with the brand. It is worth to note that these negative experiences may be totally independent from the performance of the brand, for example a person who played a negative role in consumer's life, liked this brand (White–Breazeale–Webster 2012).

The above-mentioned conclusion shows that several reasons can lead to brand avoidance and these can be caused by social interactions, the subjective interpretation of the consumer or previous negative experiences. Memory also plays a central role since negative experiences may have a long-term effect in choosing a brand.

4. Methodology

The main goal of current research was to explore if the motivations of brand avoidance well known in the international academic writings can be also identified in domestic environment. I desired to reveal which behavioral and emotional manifestations alongside the negative relations to the brand can be defined. The topic of brand relationship is a highly emotion-driven field which requires a profound, exploratory research. So there is a reason why the experts of this field (Aaker 1997, Fournier 1998, Aggarwal 2004, Lee et al. 2009a, Lee et al. 2009b) also choose the qualitative methods. To reveal the motivations of brand avoidance I carried out the research in two steps. Firstly, I conducted the research as a two focus groups research, among a smaller but worldwide the mostly studied group (Rapp–Hill 2015) overall with

participation of 15 university students. After that I prepared three in-depth interviews among people aged 28-38. The two different kinds of target groups were aimed to get a more complex picture of the motivations of brand avoidance. Both the in-depth interviews and focus group survey were carried out within half-structured frameworks so that participants could open up more. The methodology of the in-depth interviews and focus group survey slightly differ from each other. Due to the feature of both methodology I made some minor changes. During the focus group survey participants had to name one brand that they refuse, furthermore a product category and an emotion the brand makes him to feel. Within the in-depth interviews I asked the participant to list at least three, maximum five brands they could afford to purchase and it is available for them but they deliberately reject to purchase them. Moreover, if there are no other available products in that category in the store, they would buy rather nothing in that category if only that one product is available that they do not like. Participants of the in-depth interviews could freely choose three or five product or service brand. The only criteria were to choose only one brand from one product category. The goal of both the focus group survey and the in-depth interview as well was to reveal the attitude, experience and feelings of the individuals concerning the brand avoided. A screening questionnaire was also included in the interviews in order to avoid cases when there is a general rejection of the brand as the research of brand avoidance is not possible in this case. These were taken out from the analysis.

5. Results

In general, participants of both in-depth interviews as well as focus groups found it difficult to speak about the topic and the questions I have asked were considered too personal. Typically, clothing, smartphones, food, beverage, cosmetic articles and car brands were listed among rejected brands. In category of food there were cases when the product itself was rejected because of allergies so consumer does not purchase it or it does not fit into the lifestyle he tries to follow. In this case I ignored this brand in my research. In the followings, I will present the findings of my primary researches which makes it possible to reveal the motivations of brand avoidance of the participants. Result are summarized along the following 6 findings (F).

Finding 1: Most of the participants have previous experience with the brand.
With one exception, participants mentioned brands which they had used, whether they purchased it or received it as gift. In this case the performance of the product researched in academic writings turns out as motivation of brand avoidance. The performance desired by participants did not match the real performance experienced. In some cases, their revulsion manifested in negative word-of-mouth.

'I used to buy and love this brand but now I cannot find any clothes for me. There are problems with the quality, style and size as well. I simply do not enter this shop.' (Viki)
'Yes, I got it as a gift but I would not buy clothes for me there.' (Adri)
'I was really disappointed with my last phone and since then I have been telling everybody not to buy it.' (Anna)

It is also important to note that brand avoidance can also be triggered by indirect relation between individual and brand, in this case brand avoidance is not directly triggered by use of the brand.

'I was sitting in the car only as a passenger.' (Linda)
'I have not driven this type of car but I have already sat in such a type. It was not comfortable and I did not feel safe.' (Viki)

The above findings belong to the category of experiential avoidance well known from the academic writings since the reason of brand avoidance results from previous experience or actual use of the brand.

F2: Brand avoidance does not develop necessarily due to real consumer-brand interaction.
It is a key finding that antipathy against the brand can develop in the individual even before trying the product. This is due to the brand image evolved in the individual and to the image developed about the typical user of the brand.

'Personally, I have never had this type of dress but it has a really poor quality and it is expensive only because celebrities wear them. This really annoys me.' (Brigi)
'I have never used it and I do not intend to.' (Linda)

F3: The incongruence between individual's identity and the image suggested by the brand may trigger the brand avoidance.
Typically, the negative manifestation against the chosen brand derives from the fact that the suggested image of the brand is not attractive for people surveyed, in fact, the brand is repulsive for them and they do not intend to identify themselves with typical users of the brand.

'The product itself is good but I do not like it because of those who use it.'(Csaba)
'I do not want to became a user of mass products because people using this are boring, ordinary people of the middle-class.' (Linda)
'It is typical American; you meet it everywhere like a brainwashing mainstream. It is like they want to force it, moreover, if you do not have an iPhone, you may feel you are nobody. I do not want to belong to this medium.' (Adri)

Brand avoidance is also motivated by the desire to be separated from those following the trend. People surveyed do not intend to increase the mass by consuming that product.

'It is so fashionable and it is so much popular that everybody wants to purchase it. If there still were button mobile phones, I would definitely use that.' (Péter)

It is an important observation that participants know people who buy the brand they are avoiding. In most cases people living in participant's immediate environment (family members, friends) are those who use the mentioned brand.

'The ones I know suffer from lack of confidence. They want to present something outwards, would like to stand out in the crowd, I look at them as buddies.' (Adri)
'Many people use it around me. They want to keep pace with the trends, they are interested in new things and do not want to miss anything new. I do not judge them.' (Viki)
'He is my sibling but he buys it because it tastes better.'(Linda)

F4: If the rejection of the brand is emotional then it is quite intense.
Moral avoidance appears intensively which can be associated with negative personal story as well. Participants described the issued brand as repulsive, repellent, anxious and frustrating.

'I was a child, you could mainly travel to the Easter European countries and you had to wait a lot at the borders where there were these cars. There remained a memory with me that you had to be afraid of border control because on the way there you were afraid what if they took the money you have with you. On the way back home we were afraid what if they took what we bought there. There were always Skoda's around us. I have an anxious feeling of Skoda which I would like to avoid.' (Linda)
'It is terrible, I hate it, it freezes, it keeps crashing, the battery drains fast – maybe just this model but everybody I know and uses this model hates the phone, it is impracticable.' (Viki)

In light of the above mentioned opinions it is to conclude that brand avoidance may have different levels which can be caused by dissatisfaction due to poor quality or a previous personal negative experience.

F5: Advertisements are significant in brand avoidance.
It was observed that participants were generally satisfied with the products but they do not purchase them due to the advertisements. However, it should be noted that in this case it is not totally an avoidance since if participants do not have a choice, they would purchase that brand. First of all, the mentioned brands were avoided by the interviewees due to their content and to the message they suggest.

'I would definitely not buy Pepsi. I do not like the advertisements, at most I would only chose it if there is no other option in a restaurant. It is lagging behind and does not see what is going on all around the world. It is trashy what Pepsi is doing in the world we live in. Advertisements should not approach from such a perspective; they should be more socially conscious. Pepsi does not perceive anything happening around them.' (Linda)
'It is pretty sneaky because they communicate how great it, how good that it is everywhere, whereas it is a trash. Advertisements do not suggest this and even children can afford to buy them' (Adri)

F6: The purchase of the avoided brand may happen in the future.
The interviewees do not isolate themselves from the purchase of the given brand, except in case of some brands. However, it is noteworthy that they would not buy the product for personal use. For personal use they would purchase it only either if disincentive factors disappeared why they are currently avoid the brand or if they were forced in such a situation.

' I would definitely not buy it for myself, maximum as a gift.' (Adri)
'I would buy it under compulsion, if there is nothing else in the restaurant' (Linda)
'Yes, if there is something in his size what he likes' (Viki)

The above-mentioned findings are diverse in the view of the motivations of brand avoidance. According to the findings, the reason of brand avoidance is usually a previous negative experience with the use of the brand. At the same time, it is an essential finding that antipathy against the brand may evolve in the consumer even before testing the product. The reason of this is the brand image emerged in consumer's head and the image of the typical user of the brand. It also needs to be emphasized that results are strongly restricted by the size and content of the pattern so researches only show the opinions of those participating in the survey, these cannot be considered generally applicable.

6. Conclusion, recommendation

Despite the fact that the current research was carried out to a small group (2 focus groups with 15 university students, and 3 in-depth interviews between the ages of 28-38) are not suitable for generalizing the results, but the findings show well the relevance of researching brand avoidance. The motivations revealed in the qualitative research are in accordance with those demonstrated in academic writings. From the types of the motivations for brand avoidance, identity avoidance and experiential avoidance were the most significant ones in my research while brand avoidance caused by advertisements is less remarkable. It is important to highlight that based on the findings participants do not close themselves off to purchase of the mentioned brands, however, they would not buy them for personal use or just in case if disincentive factors disappeared why they do not purchase them. Brand avoidance mostly results from a previous negative experience which may be related rather to the use of the brand than to some negative experience. Emotions were less outstanding in connection with a brand avoided, but in case they appeared those were extremely intense.

The practical use of researching brand avoidance is particularly relevant for brand management. If consumers consider a brand negative, it is worth to focus on another field from marketing aspect. Experiential brand avoidance can be effectively addressed with developing a proper complaint handling or repositioning the brand may be also a possible solution. Moreover, negative attitude to the brand can be changed positively if the brand or the company takes actions for corporate social responsibility and this has a press coverage. However, in case of experiential brand avoidance, improving the product quality might be advisable for companies.

7. Summary

Understanding how consumers perceive the benefits of the brands, how they interpret the message of the brand and the brand personality contributes to the development and function of consumer-brand relation. The goal of current research was to point out to the motivations of negative consumer-brand relation and I aimed at revealing those motivations which are significant in brand avoidance. Findings show that brand avoidance has diverse, subjective reasons and it was outlined that brand avoidance may appear in different levels. Table 2 displays these findigs.

Table 2 Findings

Findings	Explanations
1. *Most of the participants have previous experience with the brand.*	*Participants mentioned brands which they had used, whether they purchased it or received it as gift.*
2. *Brand avoidance does not develop necessarily due to real consumer–brand interaction.*	*Antipathy against the brand can develop in the individual even before trying the product.*
3. *The incongruence between individual's identity and the image suggested by the brand may trigger the brand avoidance.*	*The negative manifestation against the chosen brand derives from the fact that the suggested image of the brand is not attractive for people surveyed.*
4. *If the rejection of the brand is emotional then it is quite intense.*	*Brand avoidance appears intensively which can be associated with negative personal story as well.*
5. *Advertisements are significant in brand avoidance.*	*The mentioned brands were avoided by the interviewees due to their content and to the message they suggest.*
6. *The purchase of the avoided brand may happen in the future.*	*The interviewees do not isolate themselves from the purchase of the given brand, except in case of some brands.*

Source: self-edited based on my qualitatitve research

Negative emotions and bad experience with the brand might be relevant in the brand avoidance therefore it is worthwhile to reveal what kind of roles these factors have in developing and continuing negative attitude towards the brand. The finding that participants would purchase the avoided brand in most cases - even if not for personal use – raises further questions. Future researches may focus on cases whether an influencer can persuade the consumer to buy the brand which is avoided due to some reasons. Moreover, based on the dynamic of consumer-brand relation, it may be an exciting research field, towards which brands consumer change their opinion and due to what. Another point is strongly related to this, specifically if there is a brand in consumer's life which they previously claimed not to purchase but later on they did. Current research examined the brand avoidance in a qualitative way, however, it would be worth carrying out quantitative researches in this field.

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Quantitative and qualitative methods in economic research in the 21st century

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Economic research has always applied both quantitative and qualitative methods ever since it came into being. However, the emphasis and the dynamics of interaction between these methods have been constantly changing, following the dominant approach in social and economic sciences. From time to time either quantitative or qualitative perspectives became more accepted meanwhile few attempts were made to truly join and reconcile their results. In this study I summarize the most important features of the quantitative qualitative debate and survey some good examples of application of quantitative and qualitative methods together. The aim of this paper is exploring opportunities and possible scientific advancement in their joint usage in macroeconomic research. The development of scientific research needs the appreciation and co-operative application of both methods.

Keywords: Quantitative research methods, Qualitative research methods, Mixed research methods

1. Introduction

Development of economic research nowadays unfolds through serious methodological debates. As Economics is a social science, methodological issues of social sciences in general should have a sizeable impact on it, though its special characteristics make even the general methodological considerations problematic. Still, the outcome of these discussions, though often called much too academic, shapes progress of economic research, even if it is hard to produce true novelty amidst the ambiguous methodological environment.

One of the most widely discussed topics of methodology in social sciences is the dichotomy of quantitative and qualitative methods (Horsewood 2011). Though both of them have their role and place in scientific thinking, the emphasis put on each of them and the specific methods applied have been varying throughout the last decades. These trends and the debate going on about them are especially important for economic research, since Economics is a heavily quantified social science by its very nature.

In this paper I would like to give an overview of the quantitative versus qualitative debate and apply it to economic research, within that specifically to macroeconomic research. Qualitative and mixed methods are applied in a growing number of economic topics, still these are mostly in the microeconomic field. Is it possible and useful to apply qualitative and mixed methods also in macroeconomic research? This main question of this study is about the implications of the quantitative-qualitative debate on economic, especially macroeconomic research. I would like to find answers to what kind of qualitative, quantitative or mixed methods could fit for

macroeconomic research by both the discipline itself and the broader spectrum of social sciences. In the first part definitions and content of quantitative and qualitative research concepts is discussed. In the second part I examine the methodology of some economic articles published in the last decades. In the last part the opportunities of macroeconomic applications are demonstrated in an attempt to answer the reseach question.

2. The quantitative -qualitative dichotomy

The distinction between quantitative and qualitative concepts can be made for different phases of a research project. Different methodological works distinguish a varying number of phases, which can be judged as quantitative or qualitative (Hanson et al. 2019, Cameron et al. 2019). Among these research questions, types of collected data, data collection methods, research design, scientific approach, analysis methods and language of interpretation can be mentioned. Table 1 shows the characteristic features of different research phases from the quantitative and qualitative point of view. Their application, however, in different approaches is by no means exclusive.

Table 1 Quantitative and qualitative concepts in different research phases

Phase	Quantitative approach	Qualitative approach
Research questions	Verification of a well specified model	Exploration of operation of processes
Data types	Numerical	Textual
Data collection methods	Statistical	Interview, observation
Research design	built on models, formulas	iterative task repetition
Scientific approach	aims at objectivity	is aware of subjectivity
Analysis method	Mathematical, Econometric	Categorization, Logical
Language, interpretation	Mathematical, more formal texts	more quotations, more informal texts

Source: own construction, parts based on SAGE (2015)

In this article I would like to highlight and discuss only two of these phases: the type of collected data and methods of analysis.

2.1. Type of data and information

Quantitative data are those, which take a numeric form (Goertzen 2017). Qualitative data are mostly textual, non-numeric (in fact they should rather be called information). Most of the research papers, either quantitative or qualitative, use both types of information, though the importance of these different types of information is rarely equal in them. This has consequences on data handling and ultimately on the results of the applied research method. The very simple definition given above, includes some obscure points. It is very frequent and most of the times easy to convert different types of data into each other.

Qualitative information or data can be simply quantified, ie. rendered a number to them. A well-known example for this is coding the sex of persons in a data base as 1 for males and 2 for females (numeric values can be varied, of course, for econometric purposes the usage of 0 and 1 codes is more applicable). In this case originally qualitative data are converted into quantitative and called dummy variables in Econometrics. However, dummy variables do not possess all the properties of truly quantitative data, which we have to take into consideration when analyzing them. On the other hand, quantitative information is also possible to convert into qualitative, for example when numerically calculated trends are described textually as increasing, stagnating or decreasing (an example for this can be seen in Doubravsky–Dohnal 2018). However, in some cases such conversions may involve high losses of information.

It is very hard to answer, which type of data, quantitative or qualitative is more informative. Some approaches would view quantitative data containing less information, therefore see quantification as a process with information loss. This is understandable if we take into consideration that mostly the context and circumstances of collected data are not reflected in the numeric values registered in the data base. Still, if all context and circumstances can be written down as text, in principle they also could be quantified. Such quantification, however, would be too complex and incomprehensible, therefore we perceive these contexts and circumstances as unquantifiable, still important for a detailed study. Those quantitative data bases, which simply ignore more sophisticated qualitatively observed data (statistics are mostly fall into this category) will definitely lose important information.

On the other hand, quantitative data are always more punctual than qualitative data. With numeric values it is possible to measure proportions and exact distances in values, ie. it is possible to establish metric scales. We can measure the strength, and significance of correlations, frequency of phenomena and make punctual comparisons. If it is true that the World is not black and white, then the punctual measurement of the greyness of each of its characteristics will provide information, upon which prudent decisions can be made. Qualitative data do not allow the measurement, comparison and judgement of phenomena in a similar way, only in those cases, when the decision would not be on the margin, and a well-based judgement is self-evident for just a first sight.

In summary, on the basis of the above reasoning, quantitative data would always give more information if they were always available. However, some of the most important phenomena of our World are too complex for us to measure and when we attempt to obtain numeric values for this purpose, the resulted quantified data may lead to wrong decisions based on our distorted estimations. In such cases qualitative data, no matter how approximate and subtle they are, can provide a better base for a faster decision.

2.2. Research methods

The concept of quantitative methods refers to mathematical calculations with numeric values, mostly called statistic calculations. In Economics the most widely accepted quantitative methods are termed under the heading of Econometrics, which comprises

of sophisticated, still well formalized, easily automated mathematical tools. These are mostly used to measure average, general or generalizable relationships. In addition to them, lots of papers use more simple calculations of percentage growth or proportions, averages and rates only. Quantitative econometric methods are used mostly for deductive purposes, explaining or rather falsifying, confirming hypotheses.

Qualitative methods include textual analyses and descriptions, mapping, coding and categorizing concepts, identifying relations and emphasize the process of building theories. Their range is wide, almost impossible to list, as almost all those methods, not using explicit calculations, can be conceived as qualitative. Qualitative methods are flexible and informal, allowing for researchers' creativity and intuition, as they are often used for inductive research, generating new ideas. Qualitative research often uses numerical data and statistics, as well, however, the purpose of application of quantitative data mostly remains illustrative in this approach.

Regarding research methods, it is observable that the type of method is mostly aligned to the type of data used for analysis. Quantitative methods are used for analyzing quantitative or quantified data, while qualitative methods are applied in the case of qualitative data (Cameron et al. 2019). In quantitative research qualitative thoughts are either preset in the model or regarded as the researcher's intuition and are not part of the methodology. Their validity is reinforced or rejected exclusively on the basis of quantitative methods. In qualitative research, on the other hand, aggregated numeric data are used mostly only for illustration, the conclusions are made on the basis of non-measurable or hardly measurable information. Thus, results derived from numeric data by qualitative methods are regarded in both approaches as inconsistent. Is this research practice truly justified? Is not it possible to arrive at sensible and novel results by mixing these approaches?

There are some analyzing research methods, which are difficult to categorize either as quantitative or qualitative. Among them the most widely known is the method of grounded theory (Finch 2002). This method has multiple phases and is well applicable for both quantitative and qualitative data. Categorizing concepts and building up theories with their help is in the core of this method. Working with primarily logical concepts and not with numbers this method is categorized as qualitative, however, categorizing, making comparisons are exercises, which can be done equally well with numbers, as well.

Coding is a process, which is fundamental in qualitative research (Saldaña 2016, Elliott 2018). Though it is included in grounded theory, it is widely used with other methods, as well. As coding is an analytical tool compressing information and leading to categorization, it can be used both for quantitative and qualitative data applying quantitative or qualitative codes. However, notwithstanding the often numeric outlook and statistical application, coding remains an essentially qualitative process, because a lot of computations can not be done with codes. Even if we deal with numeric codes, averages, summaries do not have sense to calculate. Metric comparisons can not be done either, because we can not anticipate that a coded respondent person (e.g. a male coded as 1) is less than or prior to another, differently coded person (e.g. a female coded as 2). Numeric codes are therefore not truly quantitative, though often used in quantitative research.

Another interesting aspect of coding is its application to qualitative or quantitative information. In case of qualitative information the usage of both qualitative and quantitative codes are well documented in the research literature. However, codes and classifications applied for quantitative data are less researched. This is not for this phenomenon is rare, statistics use classifications all the time, still, these classifications contain mostly standardized, a priori codes in a preset system developed by statisticians and not the researchers. With qualitative information, on the other hand, qualitative researchers prefer emergent codes constructed by themselves in an iterative way (Elliott 2018). This aspect draws attention to that quantitative research does need qualitative elements even in its apparently pure form.

It is also true for all social sciences that the most important types of inferences can not be made with the help of only quantitative or only qualitative methods. Taking causation as an example, empirical co-movement between variables is a necessary precondition of a causative relationship, similarly and independently, logical connection of the concepts is also inevitable (Babbie 2001). As quantitative methods can not tell everything about the causes of co-movement, they in themselves may be misleading. Also, apparently logical inferences can be false, if empirical facts do not reinforce them. For drawing scientifically relevant conclusions both preconditions should be fulfilled, therefore quantitative and qualitative methods can not stand alone in finding causation.

As an answer to the above issues, there is a growing literature of the mixed methods, which use quantitative and qualitative methods and data together (Cameron et al. 2019). There are different ways to adopt such a method and its methodology is more and more canonized (SAGE 2015). However, mixed methods are still not widespread in social sciences and mostly if they are used, it is not indicated explicitly and the quantitative and qualitative research parts are kept separately. Still, this direction of scientific development emphasizes that scientific novelty can be brought only through using quantitative and qualitative methods together.

3. Quantitative, qualitative and mixed methods in contemporary economic research

Although the application of quantitative and qualitative methods in a mixed way has never disappeared completely from the Economics literature, the explicitly stated usage of mixed methods started only lately. Economics apparently makes use of it only in specific subfields. Partly on the basis of the research conducted by SAGE researchers in counting and analyzing papers with mixed methods (Hanson et al. 2019), Table 2 gives an overview of the numbers of publications written since 2000 in Economics related fields.

Table 2 Quantitative, qualitative and mixed approaches in economic papers 2000–2019

Keywords	-	research	methods	research methods	data	analysis	data analysis
Quantitative	94 980	13 647	17 468	8 190	7 156	19 404	1 584
Qualitative	64 545	17 129	13 909	9 122	8 260	16 377	1 867
Both	20 108	2 789	3 221	1 225	2 881	3 524	528
Mixed	565	150	420	106	127	70	23

Source: EBSCO data bases accessed on 20th September, 2019

In Table 2 the number of publications were taken from the results of keyword search in EBSCO data bases. The basic keywords searched are given in the first column. Additional keywords used are added in the subsequent columns. Though this inquiry is very superficial, as explicitly stated nature of research methodology does not necessarily cover the truly applied methods, the difference between the figures is so large that it can demonstrate the low prevalence of explicitly stated mixed methods in Economics related papers.

Mixed approaches in the field of Economics are concentrated on just a few disciplines. Many of the papers with mixed methods were written to examine the effect of health regulation decisions (Dansereau et al. 2017, Gorham et al. 2017) and poverty research of household economics (Thomas 2008, O'Sullivan–Howden-Chapman 2019), labour market research (Kwok 2019), marketing and project management (Cameron et al. 2019) also take significant proportions. Within macroeconomic fields policy monitoring (Dansereau et al. 2017) and cost-benefit analysis (Chen 2018) can use mixed methods at best.

3.1. Mixed research in Economics

Research in Economics, especially in Macroeconomics remained much more quantified than in other social sciences, even though some good examples of mixed research inevitably exist. It has to be remarked, however, that most of the good examples are the result of a lengthy work of research groups employing numerous researchers also as authors of the papers. This indicates that mixed research requires a lot of work and is hard to conduct it alone. On the other hand, now it is hard to imagine any well based research purely from a quantitative or qualitative point of view. In fact, also single author articles contain some elements of both approaches, even if only one of them is emphasized and elaborated in the article itself.

Good examples provide information on why the usage of mixed methods is so important for researching economic problems. Both quantitative and qualitative methods have their advantages, which can be exploited using a mixture of them. Qualitative methods are always important in building up a model for research. No matter, whether we derive the underlying logic of a tested equation from empirical observations (though this is more desirable) or speculate it from researcher's intuition, the prudent selection of variables is always the result of a qualitative process. It is also prudent if quantitatively tested models are verified through some interviews, which can reinforce the causal logical relationship, anticipated by the model. Quantitative

methods on the other hand are important in the generalization of some explored processes. Once we understand, how certain variables caused each other in a specific case, we can use statistics to verify, how universal the co-movement of the variables is (Horsewood 2011). Qualitative methods as researcher intuition is always applied, similarly to quantified or estimated trends. Without quantification and tests it is simply not verifiable, whether a phenomenon is truly important and widespread or it is only a random exemption.

3.2. Examples for mixed methods in economic research

In this section some selected articles are summarized to demonstrate, how quantitative and qualitative methods can be mixed in the research of economic issues. The articles were written in different economic fields in different countries, still they use a delicate mixture of quantitative and qualitative methods, implicitly or explicitly. The existence of such articles indicates that mixed methods do have a good place in economic research.

We can see the application of mixed method in an article, which was written on the irrigation practices and aricultural development in Ghana (Owusu 2016). Here the costs and benefits of irrigation were calculated with the help of a production function formula and statistics, meanwhile the variables were refined (irrigation types applied, working hours spent, labour types applied) with the help of interviews conducted with randomly selected farmers. Clearly, the model itself would not have been possible to build up without the empirical information of the interviews, just as the numerical information of statistics and the calculations prompted by the production function equation were also inevitable. In testing the hypotheses, quantitative testing, generalization is just as important as verifying through interviews. Only the combination of all these methods could result in a well based conclusion, which finally recommends the spreading of small-scale private pumps in irrigation as means for achieving higher incomes and productivity. Without qualitative methods it would not have been possible to reinforce that this irrigation method is really profitable under the circumstances, without quantitative analysis it would not have been possible to demonstrate that it could work for a substantial number of farms and is not only an isolated case.

Another interesting example of applying mixed methods is the research of an Austrian research group on the familiness of family businesses (Frank et al. 2019). They developed a measurement for familiness, which represent the impact of the family and its social characteristics on the business the family owns or manages. The components of familiness constitute clearly qualitative information, therefore the data collection started with qualitative methods. After a qualitative phase of selecting and formulating important dimensions an exploratory factor analysis was conducted on the quantified data to obtain a more clear picture of the factors in work. Exploratory, ie. inductive research is usually termed as qualitative, still, using factor analysis did add more insight into the issue with helping to streamline the model and reduce the number of factors, quantifying the significance and co-movement of characteristics examined. Without qualitative methods this research could not have been even started.

Still, quantitative methods were of great help already in the inductive phase and also later on, when the developed measurement was tested and refined on a larger sample.

Research using quantitative methods often utilizes qualitative information or previous results of qualitative research. For example, Farkas (2019) provides a cluster analysis of EU countries from the point of view of quality of governance. The basis for characterization of the quality of governance is qualitative by nature. In this article, this factor is measured by indices, which provide the data base for quantitative cluster analysis. Both of the two indices (WGI and WEF GCR indicators) are put together at least partly on the basis of different people's opinion, which requires the application of qualitative elements. It is also concluded in this article that a previous categorization of capitalist economic systems (liberal versus coordinated) is not relevant from the governance quality point of view (Farkas 2019). A quantitative method helped here clarify the distinction of countries and categorize them in a qualitative approach.

Notwithstanding good examples, the explicit application of mixed methods in economic research is still not customary. The quantitative tradition is very strong, especially in the macroeconomic field (Posel 2017). Though there are attempts to apply qualitative or mixed type techniques (Doubravsky–Dohnal 2018), these are not in the classical toolkit of qualitative methods. Qualitative research is mostly critical to the whole of the economic point of view (Horsewood 2011), therefore it is sometimes argued whether Economics as a basically quantitative discipline can be reconciled with qualitative methods, at all.

4. Possibilities of using quantitative, qualitative and mixed methods in macroeconomic research

In the narrower field of Macroeconomics most research is conducted on quantitative basis. Though the practical applied studies of large scale project management or cost benefit analysis of government measures can make good use of qualitative methods (Chen 2018), Macroeconomics as a more descriptive, positive basic science rarely can apply anything outside the world of numeric values. It is possible to describe trends and consequences without equations (Doubravsky–Dohnal 2018), still it seems that economic analysis of entire countries or regions based on statistics can not have too much in common with pure qualitative methods. At the highly aggregated levels it is almost impossible to comprehend processes without measurements and numeric data. Growing differences in the welfare and well-being of the countries of the World, however, have made it inevitable that traditionally applied quantitative methods cannot provide a satisfactory basis for solving the problems of social and economic development. How can we address then the issues raised by alternative qualitative approaches? Poverty research at the level of countries and the need to find causes and remedies for the World's more and more serious development problems necessitates an answer.

One way of benefiting from the advantages of qualitative approach in macroeconomic research can be the application of grounded theory to specific macroeconomic problems. Categorization of concepts and collection, quantification

of qualitative variables are among the core tasks of statistical offices. Still, statistical and macroeconomic approaches to economic phenomena are not the same. Selection from and recategorization of the aggregated data put together in statistics remains an exercise for economic researchers. Secondary data (both qualitative and quantitative) also can be obtained from different articles. Putting together information from all sources and finding patterns in it can be a truly qualitative macroeconomic exercise.

Quantitative methods are natural and inherent parts of macroeconomic research. However, facing the immediate lack of research possibilities through qualitative methods, conclusions drawn from this type of neoclassical research can be rather shaky. Due to the big number of possible causes, it is hard not to omit some relevant variables from our regression equations and the calculated correlations and coefficients are too often insignificant. It seems that rigorous application of all the assumptions needed for the validity of models lead us to theoretical speculations and oversimplifications or statements, which do not show strong connections to reality.

Empirical research is hardly interpretable for Macroeconomics. Interviews can be made only with country or region experts or leaders, who themselves may be in the trouble of secession from reality. Country analysts sometimes suggest to take long walks through the streets of an analyzed country or region, but impressions obtained within reasonable time in such a way, will definitely not provide much information even if we know the country very well (Calverley 1990). The only source of data with relatively good reliability remains national or regional statistics, which happen to be numerical and aggregated.

It seems that also macroeconomic research needs qualitative approaches, while the possibilities for using them are much narrower than in the case of other disciplines. However, there are some qualitative methods, which can be applied in macroeconomic issues, as well. Macroeconomics would benefit especially well from a more flexible conception of research methods than is customary nowadays. Qualitative methods could be applied to numeric data, as well. If countries or regions are regarded individual units with special characteristics and "behavior", which can be described or examined through statistical data, supplemented by qualitative information, like the knowledge of their respective culture, society and economic policy effects, we may gain a more punctual and logical picture of the causes of perceived phenomena and the ways to influence them in desirable directions. Some of the effects can not be seen directly in the statistical figures, still social processes operate logically and their knowledge can be important indeed, when changing the structure of economy. In order to gain deeper insight into the structure of economy both qualitative methods (virtual mapping) and less widespread quantitative calculations (accounting methods) can provide useful tools.

In summary, macroeconomic research is in an especially hard situation today, when it is questioned whether abstract, aggregated relationships exist at all. Still, at micro levels of the economy and society a progessive mixing process of different approaches is taking place slowly. If these mixed, quantitative and qualitative methods could be extended to regional and country levels, Macroeconomics also could provide more contribution to our common knowledge.

5. Conclusion

Quantitative and qualitative methods represent two different approaches and paradigms in respect of scientific research. Their differences are mostly interpreted as logically exclusive, in spite of their combined use in earlier research. Still, scientific research in the fields of social sciences need both quantitative and qualitative methods in order to draw the best possible conclusions. Qualitative methods are necessary to build up models, quantitative methods can justify generalizability, sometimes simultaneously.

What can be the direction of future development of research methods in economic fields? The answer is mixed research, finding the way of applicable combinations of quantitative and qualitative methods. However, in spite of existing good examples of its application, a need for further mixed methods in economic research still exists, because it remains a problem that most of these research projects require a great amount of resources both in time and in researchers' work. Observing research methods from the point of view of the quantitative-qualitative dichotomy, at certain points it is not clear whether scientific research phases can be characterized as quantitative or qualitative. In my opinion, these are the points, though not yet proved, where scientific methodology can advance most, finding new methods. Among these may be the application of logical qualitative methods (categorization, causation relationship, grounded theory) to quantitative data, as these may not be too demanding, still methods can be mixed in several phases of the research process.

In summary, the quantitative-qualitative debate seems to be more and more fruitless. Though it seems to be a difficult advancement, scientific thinking has to cope with the task of reconciliation of this two opposing approaches. If it is successful, the so far mathematized and mainly quantitative economic and macroeconomic scientific fields will benefit the most.

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