Composite Contracts in Supply Chain

TAMÁS FALUDI
PhD STUDENT

UNIVERSITY OF MISKOLC
e-mail: szvft@uni-miskolc.hu

SUMMARY

Supply chain coordination is very important nowadays because of the increasing number of cooperating partners. Contracts can be used in order to provide a framework for the partners' cooperation. In this paper, two contract types are analysed. Take-it-or-leave-it contracts are often used by decentralized supply chains, but include some attributes from centralized settings. The quantity discount can be used in any type of supply chain. Centralized and decentralized settings of supply chains are also discussed in the paper. A numerical example compares the rates which determine the coordination power of the contract types. The paper suggest some other composite contracts to enhance the performance of supply chains.
Keywords: Supply Chain Management, Supply Chain Coordination, Contract Types, Quantity discount, Take-it-or-leave-it

INTRODUCTION

Contracts are one of the most popular forms for coordinating supply chains. As a hard tool, contracts give a framework for the cooperation, determining the conditions of risk and benefits-sharing in the case of uncertainty in either the supply or the demand (Coltman et al. 2009). Therefore, the contract minimizes the number of the possible conflicts, bringing balance in the chain, and this can decrease the level of different dominances.

Nowadays a number of researchers deal with contracts – for example they analyse the coordination power of the different types, creating numerical examples to determine the advantages and disadvantages of use. There are different types of traditional contracts and some authors try to mix these contracts to create some hybrid or extremely complex types, because these solutions can be relevant to the coordination issue (Katok & Pavlov 2013; Zhang et al. 2013; Molnár 2017).

This paper introduces one non-traditional composite contract and one traditional; the take-it-or-leave-it contract and the quantity discount contract. Take-it-or-leave-it contracts use the advantages of a centralized setting, which is the preferred setting for supply chains. Both types can be used in decentralized supply chains. The aim of this paper is to determine which type is better in terms of supply chain coordination.

POSSIBLE SETTINGS OF THE SUPPLY CHAIN

There is a significant question in terms of coordination – the setting. It is important what kind of setting is used by the chain. Two possible settings are identified; a decentralized setting is preferred by companies, because they can act in their own interest, but according to the studies of many researchers, a centralized setting can be better (e.g. Chakraborty et al. 2015).

Decentralized Setting of the Supply Chain

This is the classical approach. The level of cooperation between the partners is minimal, they do not share all information – for example about the demand – with each other, and the chain members are interested in maximizing their own profit. The decentralized setting exists because the companies deal with their short-term goals. But this approach is not profitable for the supply chain members in the long term.

The members can maximize their profit, but only in the short term. This process is at the expense of the others' performance. These companies will decrease the quantity of the orders, therefore the profits of all members will also decline. Consequently, the total profit will decrease.

We can realize the biggest problem of the decentralized setting if we analyse the behaviour of two side-by-side

chain members. The goal of the customer is to purchase the largest quantity at the lowest available price. But the second member would like to sell its products at the highest price possible, because of profit maximization. Thus, the chain members have conflicts of interest. In the beginning, member one can maximize its profit, but later, because of the higher prices, member two is going to reduce the needed quantity from order to order, and in the worst case it will search for another partner. Neither of the members can maximize the profit, thus the total profit of the whole chain will not be satisfactory. This phenomenon leads to double marginalization (Li et al. 2013). This is the major disadvantage of the decentralized setting.

The Vertical Integration of Supply Chain

Coordination mechanisms try to eliminate the negative effects of double marginalization. For this, it is necessary to enhance the cooperation and the level of information-sharing (Giannocaro 2018). The first and the most important step for the chain members is to strive for long-term cooperation instead of short-term profit maximization. It helps to increase the level of vertical integration, which means the totally cooperation between the members. Actually, the vertical integration of supply chain means the centralized setting.

This kind of centralized setting is difficult to implement, but it leads to more efficient operation than the decentralized setting. The members prioritize the goals of the whole supply chain and they operate in a way that will reach these goals. The level of information-sharing and cooperation is higher than in the decentralized setting.

Usually, this setting has a leader – called the 'supply chain leader' – who is a relatively dominant member in the chain. The leader makes the strategic decisions to maximize the total profit and increase the efficiency of the supply chain (Pibernik & Sucky 2006). Because of this leader, this setting is called centralized.

The operation of the centralized setting assumes long-term planning. The chain members do not focus on maximizing their own profit in a short-term period, because they can realize a higher profit in the long term.

The prices in the case of the centralized setting are lower, which stimulates the quantity sold. The higher the quantity sold, the higher the realizable profit. So this means that the total profit of the chain can be also higher. In the case of a decentralized setting, members want to maximize just their own profit, meaning higher prices. As a result the quantity sold is lower and this undermines the overall profitability – and of course the performance – of the decentralized supply chain (Simchi-Levi et al. 2003).

According to the literature, centralized supply chains are preferred, because with vertical integration the cooperation of chain members can be improved, which is one of the major prerequisites for supply chain coordination.

CONTRACTS

Contracts are a rewarding area for researchers because they are a method to help in the coordination of supply chains. To make coordination better and more successful we can use soft tools and hard tools (Szegedi 2017). Coordination with the help of the different types of contracts belongs to the group of hard tools, which controls the transactions, the production volumes and manages the financial actions for the economic operation.

Contracts try to form relative equality between chain members because a framework is provided for the cooperation. It is determined how partners are to share risks and benefits (Coltman et al. 2009). According to the research of Wang et al. (2013), contracts are used to enhance the performance of the whole supply chain.

Cachon (2003) determines the requirements that have to be fulfilled by contracts to be successful in the long term. First is feasibility: the conditions must be reasonable, otherwise contracts will put all of the partners at a disadvantage. Contracts need to be flexible to adapt to the dynamically changing environment and also to the needs of the parties signing the agreement. A contract can be successful if it satisfies the needs of both parties, especially in terms of making profit. There will be maximum satisfaction when this process is fair. Thus, the most important task of the contract is to reduce the inequity caused by a difference in the dominance level of the chain members. With this the profit can be divided more equally and fairly between the members.

There are many types of contracts to help coordination. Traditional types are relatively simple, while a composite contract has more complicated conditions. The hybrid ones use at least two contracts to mix their parameters (Arani et al. 2016).

Here one example of each type of contract will be presented. The paper also includes a numerical example to analyse the coordination level of concrete contracts.

Take-it-or-Leave-it Contracts

The name derives from the essence of the contract: first step, supplier offers the price, second step, customer accepts or refuses this offer. If the price is accepted, the customer can take the ordered items for the same price during the pre-agreed interval. If the price is not accepted, the customer leaves the items and the agreement is not concluded (Polo & Scarpa 2013). This could be risky for the customer, because a new offer from a different partner may include a higher price.

Because of the fixed prices and the fixed payment, the supplier is protected against non-payment. The customer will receive the ordered quantity, because in the case of the take-it-or-leave-it contract, there is a delivery threshold, which is determined by the customer. This assumes that the customer will define a high enough threshold to satisfy its needs in any case. The customer orders this quantity and

pays for it, but there is no need to deliver the entire shipment at the same time. The conditions allow the customer to control the quantity of each delivery in the pre-agreed period. This means that the customer can increase or decrease the actual quantity of certain orders up to the threshold. Therefore, the customer is also protected against non-delivery (Polo & Scarpa 2013).

Quantity Discount Contracts

This is probably one of the most popular contract types. The contract can be used in both centralized and decentralized settings. The unit price depends on the ordered quantity. This means that if the retailer increases the quantity ordered, the supplier can give a lower unit price. Thus the retailer is motivated to buy higher quantities. If the demand is uncertain, the customer can overstock, while the supplier may run out of stock. This is definitely a disadvantage of the quantity discount.

To avoid this problem, some research tries to find an optimal quantity of order. If the quantity sold is the same as in the centralized setting, the best performance is available. Any other option of the discount results in worse rates (Molnár & Faludi 2019). So the quantity discount can coordinate the supply chain, if members use the optimal quantity.

COMPARISON WITH NUMERICAL EXAMPLE

I would like to present the coordination power of the contracts analysed before. To measure the efficiency, I compare the total profits, the individual profits, the unit prices and the market prices. The symbols of analysed rates, the notations and the available economic parameters are shown in Table 1.

Table 1
Notations and economic parameters

Constant (1)	v	115
Constant (2)	w	1.8
Market price	P_{MD}	$115 - 1.8*OQ$
Revenue-sharing rate of Member #1 (Supplier)	$M_1\alpha$	0.6
Revenue-sharing rate of Member #2 (Retailer)	$M_2\alpha$	0.4
Cost of Member #1 (Supplier)	M_1C	28 EUR
Cost of Member #2 (Retailer)	M_2C	13 EUR
Total cost of the members	$\sum MC$	41 EUR
Unit price	UP	*depends on the contract type*
Ordered quantity	OQ	*depends on the contract type*
Individual profit (Member #1 - Supplier)	$M_1\Pi$	*depends on the contract type*
Individual profit (Member #2 - Retailer)	$M_2\Pi$	*depends on the contract type*
Total profit	$\sum M\Pi$	*depends on the contract type*

Source: own construction
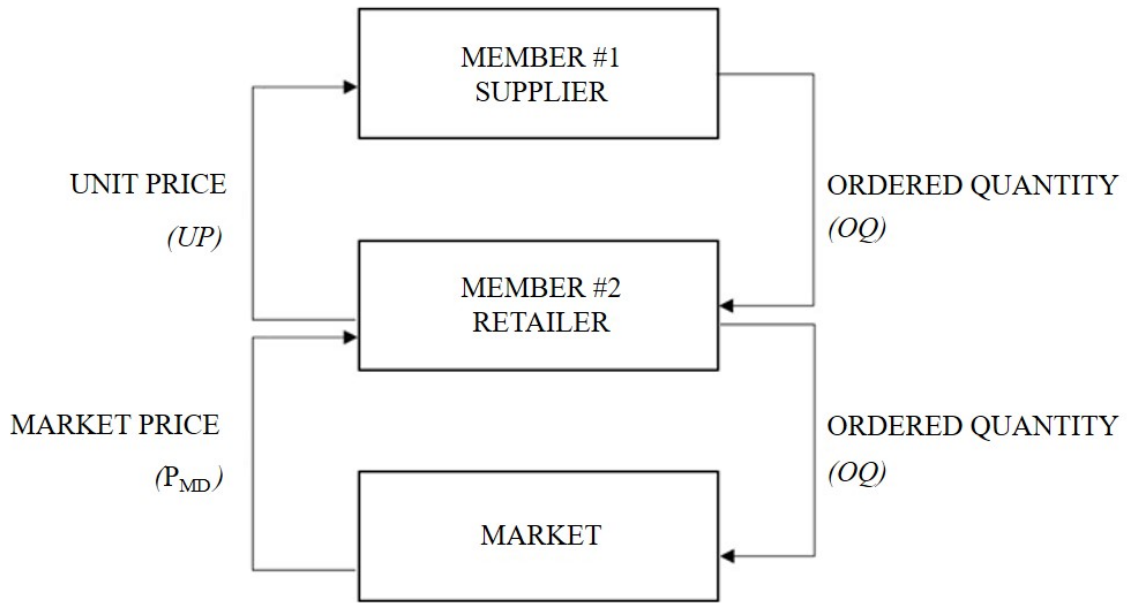
Source: own construction

Figure 1. The structure of model

The market price (P_{MD}) is determined by the simplified market demand function. This function includes the retailer's ordered quantity (it is the real market demand), and v and w, the market constants. The model assumes that all members are aware of this information and all of the chain members know that the other members are aware of this knowledge.

Some calculations are the same in the case of every contract type. However, the unit price, the individual profits and the total profit have different calculations, and these depend on the contract type. The revenue-sharing rate must be determined because it is needed to calculate some rates of the quantity discount contract. A simple supply chain with two members is used here (Figure 1).

The take-it-or-leave-it contract type mixes the characteristics of the centralized and decentralized settings. The calculation of the ordered quantity belongs to the centralized setting, so with this quantity the total profit can be maximized. But the unit price maximizes the individual profit for the supplier, which is typical of decentralized supply chains.

The reason for this is found in its extreme nature. The ordered quantity is determined with the help of the total profit function of centralized setting. The total profit of the supply chain (Equation (1)) is maximized on the basis of

the market demand, which will be the partial derivative of the quantity. If the equation is equal to zero, the ordered quantity can be expressed (Equation (2)).

$$\sum\Pi = (v - w \cdot OQ - \sum MC) \cdot OQ \qquad (1)$$

$$\frac{\partial \sum\Pi}{\partial OQ} = 0 \rightarrow OQ = \frac{v - \sum MC}{2 \cdot w} \qquad (2)$$

To determine the unit price, it is needed to use the profit function of the supplier (Equations (3)-(4)). Because the profit maximization is on the basis of the unit price, using the decentralized setting calculation for the ordered quantity is necessary (Equation (3)).

The supplier's profit depends on his cost and the unit price that he gets from the retailer, each of which is influenced by the ordered quantity. In the case of the retailer, calculations start with the market price paid by the customer, this is the income. This value will be decreased by the unit price paid to the supplier, and the retailer's own costs – of course the ordered quantity will influence the profit. The calculations are given in Equations (3) and (5).

$$M_1\Pi = (UP - M_1C) \cdot OQ = (UP - M_1C) \cdot \frac{v - UP - M_2C}{2 \cdot w} \qquad (3)$$

$$\frac{\partial M_1\Pi}{\partial UP} = 0 \rightarrow UP = \frac{v - M_2C + M_1C}{2} \qquad (4)$$

$$M_2\Pi = (P_{MD} - UP - M_2C) \cdot OQ \qquad (5)$$

$$M_1\Pi = \frac{(1 - M_2\alpha) \cdot (P_{MD} \cdot OQ)}{OQ} + M_2\alpha \cdot \sum MC. \qquad (6)$$

$$M_2\Pi = (P_{MD} \cdot OQ) - (UP \cdot OQ) \qquad (7)$$

While the take-it-or-leave-it type allows the customer or retailer to refuse the contract, the quantity discount type does not allow this. But a quantity discount offers more flexible conditions than the take-it-or-leave-it contract.

According to the literature, the quantity discount performs at its best if the ordered quantity is the same as in the centralized supply chain (Molnár & Faludi 2019). For this reason, I analyse this case to test whether this is indeed true. To determine this value, Equation (2) must be used, which means that the ordered quantity will be the same in both contracts.

The supplier's profit is the total profit and the right-hand portion of the revenue-sharing rate Equation (6)).

At this point, we must take into account the connection between the quantity discount type and the revenue-sharing contract. A revenue-sharing contract allows us to divide the retailer's profit among the chain members by the predetermined revenue-sharing rate. In case of the quantity-discount type, this rate appears only in the supplier's profit, while the retailer does not gain any extra profit from the revenue-sharing.

The profit of the retailer is influenced by the prices (Equation (7)).

The results of the calculation are included in the next section.

RESULTS AND RECOMMENDATIONS

The results of applying the formulas and the data in the previous chapter are shown in Table 2.

Table 2
Results of the calculation

	OQ	P_{MD}	UP	$M_1\Pi$	$M_2\Pi$	$\sum M\Pi$
	100 pcs	*EUR*	*EUR*	*100 EUR*	*100 EUR*	*100 EUR*
Take-it-or-leave-it	20.56	78	65	760.72	0	760.72
Quantity discount	20.56	78	63.2	456.33	304.288	760.62

Source: own construction

The results of the two types are very similar. The market price is the same, and because the contracts partly use the centralized settings, the ordered quantities are equal in both cases. The total profit of the whole chain is almost equal – because the quantity discount offers somewhat lower prices, the total profit can be slightly lower in this case. But there is a very important difference between the analysed types: the profit-sharing mechanism.

As shown by the table, there is no profit for the retailer if the supply chain uses the take-it-or-leave-it contract. The total profit goes to the supplier. This creates inequality between the members, so using this type is recommended if the chain has very strong members with very strong bargaining power. The Supply Chain Management needs the members to implement the supply chain orientation which is based on cooperation, loyalty and trust – so the goal is to make a win-win situation. The results of take-it-or-leave-it contract do not show that this type is the right choice for a supply chain. Not all kinds of supply chain can handle this contract, but the gas industry usually uses this type (Polo & Scarpa 2013). For example take-it-or-leave-it contracts are used by Central and Eastern European gas suppliers MOL and Gazprom (Ostrowski & Butler 2018). In this industry there are not very many suppliers but there are more customers. This means the customers have just a few choices to choose the right partner. In the case of the take-it-or-leave-it contract, the suppliers take advantage of this situation and that is the reason why this contract needs strong suppliers but weaker customers. Customers need the required volume of gas, so they are only interested in the quantity and not in profit. Suppliers, to maximize their profits, determine the unit price; their profit maximizing factor is the unit price. The take-it-or-leave-it contract allows these conditions. Therefore the take-it-or-leave-it contract is a good solution for both parties in the case of the gas industry.

The quantity discount contract shows fairer profit values. The supplier realizes higher profit than the retailer and this is realistic. However, a centralized setting is less typical than a decentralized setting. As a consequence, the ordered quantity shifts from the optimal level and this will decrease the performance of the chain member and the whole supply chain as well.

To enhance the performance of the supply chains, one potential solution can be a quantity flexible contract, which can be combined with a quantity discount (Chung et al.

2014). The simple quantity flexible contract first appeared at the end of the 1990s. Then – and unfortunately now as well – the proportion of supply chains in the decentralized setting was higher than centralized chains. This could be the reason why the quantity flexibility contract is often used by decentralized supply chains. The recommended type is a mix of the quantity discount and the take-it-or-leave-it contract.

The higher the quantity the buyer orders, the greater the rate of discount that he gets if the quantity discount type is used. It is also good for the seller, who can realize better profit because of the higher quantity sold and can sell the accumulated inventory. But this is a disadvantage for the buyer; he overstocks because of the higher ordered quantity and it increases the costs and decreases the efficiency of his supply chain as well as of the whole supply chain.

One goal of the members, especially the one who is the closest to the market and thereby the customers, is to always have a sufficient supply to meet fluctuations in demand. Using a quantity flexibility contract avoids these problems. The contract allows the ordered quantity to be changed in real time, so the buyer can refresh his orders and can adapt to the demand in a better way. Similar to the take-it-or-leave-it type, there are limits for the ordered quantity. A maximum and minimum threshold need to be determined. Between these values the buyer can change the quantity ordered (Tsay 1999). Mainly, the contract allows both parties to share the risks and the costs – it protects against shortage and overstock (Heydari et al. 2019).

The take-it-or-leave-it type of contract is usually used by some decentralized supply chains – especially in the gas industry – but its applicability has limitations. The quantity discount contract is used in both decentralized and centralized settings. The optimal case is if the quantity sold is equal with the centralized setting; then the coordination power is the strongest (Molnár & Faludi 2019). Actually, the quantity flexibility contract uses the positive attributes of the quantity discount and the take-it-or-leave-it types.

Further research directions can be to analyse the recommended contract types, such as the quantity flexibility contract or the revenue-sharing contract, since it has some features in common with the quantity discount contract.

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Using Multivariate Statistical Methods for Analysing Financial Literacy, as a Possible Appearance of Social Innovation

KITTI FODOR
PhD Student

University of Miskolc
e-mail: fodor.kitti@uni-miskolc.hu

Summary

Financial literacy is an interesting research area. In this paper my aim is to answer three important questions about financial literacy with help of statistical methods. Can it be predicted whether a country has an appropriate level of financial literacy? Can homogenous groups be identified among the observed countries? Does the income group influence the level of financial literacy? For the prediction of financial literacy I used membership logistic regression. The two independent variables were the Human Development Index and Government expenditure on education (GDP%). I was able to achieve a classification accuracy of 88.5%. To answer my second question I created clusters and used Ward's method to create five homogeneous groups. I identified one group with an extremely low level of financial literacy. To answer my third question I used the Chi-square test for Independence. During the analysis I came to the conclusion that financial literacy and income group are not independent of each other.

Keywords: financial literacy, cluster, statistic, logistic regression

Journal of Economic Literature (JEL) codes: G53, C12, C13, O35

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SOCIAL INNOVATION AND FINANCIAL LITERACY

There is no generally accepted definition of social innovation and there are several approaches. For example, the definition of social innovation of Hazel & Onaga is focusing on the solving social problems. (Hazel & Onaga 2003; Mulgan et al. 2007; Béres 2013; Karajz et al. 2019). In another definition "social innovation provides new or novel answers to problems in a community with the aim of increasing community well-being" (Kocziszky et al. 2017: p.16).

The question is whether we can talk about social innovation in finance and lending. The answer, I think, is clearly yes. Events in recent years have highlighted the need for innovation in this area, because over-indebtedness of the population and credit defaults are not beneficial to society. Legislative measures have been taken in recent years to keep loans under control, such as the introduction of the payment-to-income ratio (PTI, in Hungarian JTM) in 2015. From 2006 the trend of the outstanding defaults had been increasing, but after the introduction of the PTI

the number of defaults began to fall. The Central Credit Information System (KHR) reported in 2018 that in the 32–55 age group 20% of the people who have credit agreements are over-indebted. In addition, legal regulation may provide a solution to the problem of the development of financial literacy, financial awareness and financial intelligence of the population, which I identified as a possible manifestation of social innovation (MNB 2006; Kovács & Kuruczleki 2017; KHR 2018).

Financial literacy, like social innovation, is a concept that has no generally accepted definition. According to the MNB (Hungarian Central Bank) definition, financial literacy is "a level of financial knowledge and skills, with the help of which individuals are able to identify the basic financial information necessary for making conscious and cautious decisions. Then after obtaining this information, they are able to interpret it and on its basis they are able to make a financial decision and assess its possible financial and other consequences for the future." (MNB-PSZÁF, 2008: 1)

A great deal of research has been carried out in recent years about financial literacy in both the Hungarian and international literature. Kovács and Terták (2019) explained in detail some of them in their book. In the book

these studies have been explained in detail. Some of these surveys are the following:

➢ Econventios's surveys,
➢ Survey of the State Audit Office of Hungary among college students,
➢ Diákhitel's survey,
➢ Survey of Money Compass – Foundation for Financial Awareness among adults
➢ Survey of financial personality types (Kovács-Terták 2019)

One of the most important studies for this paper is the S&P survey, which has been described as "the world's largest, most comprehensive global measurement of financial literacy" (GFLEC). More than 150,000 adults in over 140 countries participated in the survey. The map in Figure 1 illustrates the level of financial literacy in each country. Of the survey's results I would like to highlight only a few. Women have a lower level of financial literacy globally; while only 33% of the adult population are financially literate, this ratio is 30% for women and 35% for men. and 46% of the Hungarian population is considered financially illiterate. (GFLEC, Lusardi et al. 2015)

ANALYSIS OF FINANCIAL LITERACY AT THE UNIVERSITY OF MISKOLC

In the second half of 2019, I conducted my own survey of students' financial literacy with 5 questions in 4 areas. The concerned areas were compound interest, risk diversification, inflation and numeracy (interest). 124 undergraduate students majoring in economics participated in the survey. For the analysis I applied descriptive statistical methods and cluster analysis. Out of the 5 questions asked, the biggest problem was with the 4th and 5th questions, which received the lowest number of correct answers. Question 4 surveyed inflation awareness and 58% of the respondents answered correctly. Question 5 focused on numerical skills and 69% of the respondents answered correctly. Overall, the survey found that 67% of respondents were financially illiterate, meaning that they answered the questions in fewer than three areas correctly. They have to answer all of the questions in one area correctly to be considered financially literate in that area.
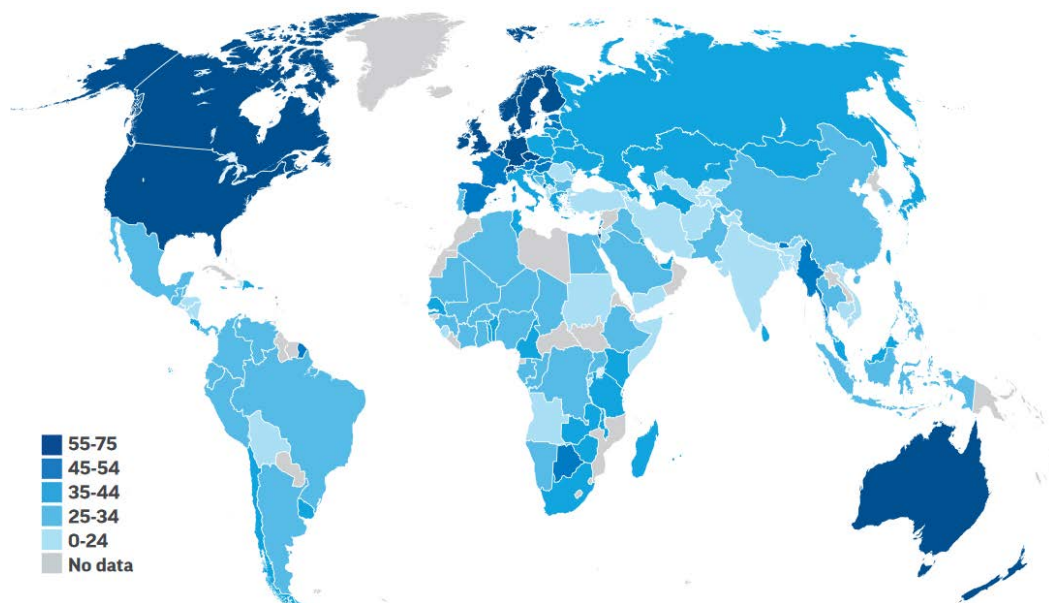
Source: Lusardi et al. 2015, p. 7

Figure 1. Global variations in financial literacy
*(percentage of adults who are financially literate)*

The second part of my research focused on the examination of financial attitudes, to which I applied cluster analysis. I chose 3 variables:

➤ How do you rate your financial culture? (Likert scale, where 1 means very poor and 7 means excellent)
➤ Are you a risk taker when it comes to finance? (Likert scale, where 1 means strongly disagree and 7 means strongly agree)
➤ Do you plan how much you spend (budget)? (Likert scale, where 1 means never and 7 means always)

From my analysis I came to the conclusion that creating 4 clusters would be ideal. The name of the first cluster, which is intended to broadly describe it, is "common single women". The level of the financial literacy in this group is good, and they are satisfied with their own financial situation, that means they have enough money and live comfortably, and can save up, too. Budget making and risk taking is not characteristic of this cluster. The ratio of single respondents was the highest in this group and the ratio of women was high, too. The second cluster is the "rich planners". This people are dissatisfied with their own financial situation, they are financial risk takers, but they spend time planning their budget. The members of the third cluster have low financial self-esteem and are dissatisfied with their own financial situation. These people are the highest risk-takers, and budget planning is least characteristic for this group. They were the least familiar with the concepts of lending and finance, so they deserved the title "distracted ignorant". In the case of the last cluster, it can be stated that they are most satisfied with their financial situation, they are not risk-takers and budgeting is typical for this group. They have the lowest income. In addition to the above, they are well-informed in the field of finance and lending. The group was named "informed rural women". As the 3-D scatter in Figure 2 shows, the groups are nicely separated.

More information on this survey can be found in Fodor (2019).
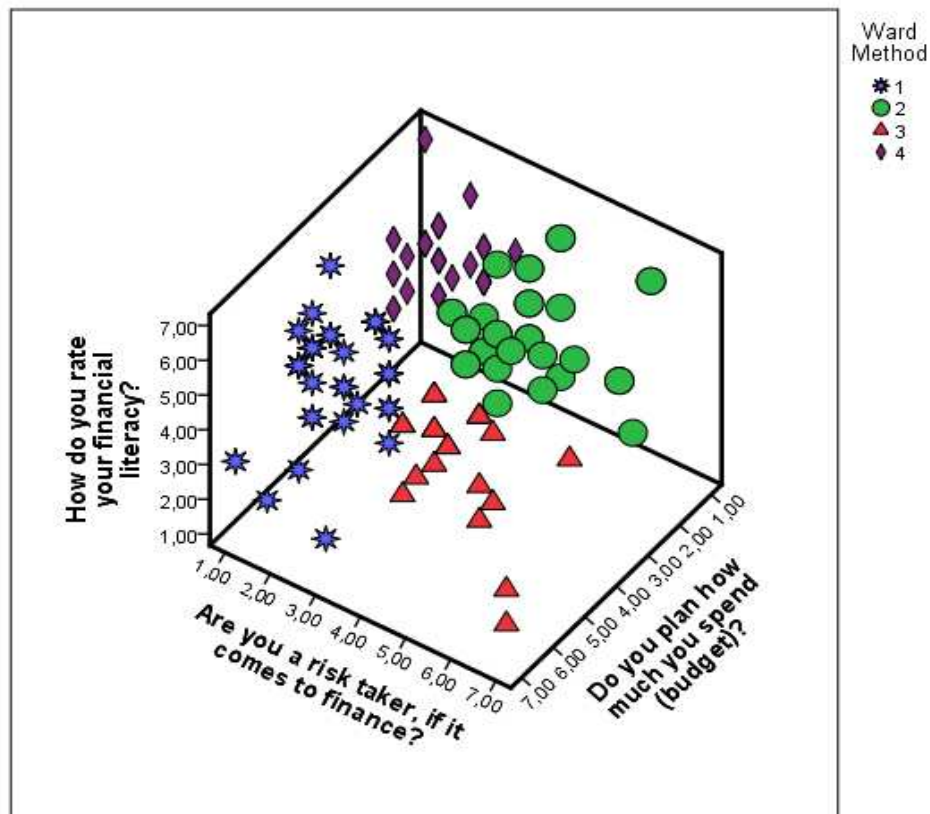
Source: SPSS output

Figure 2. 3-D scatter about clusters for identifying groups by shape and color

DATABASE AND METHODOLOGY

For the purpose of this study, I created my own database and analysed the financial literacy of each country using statistical methods.

Database

For the analysis I established a new database. For my database I used the results of the World Bank, WHO and S&P financial literacy surveys. The S&P survey covered 140 countries, which limited my analysis, so the database included only the 140 countries for which the financial literacy index was available. Most of the variables are high level measuring metric variables. The variables were the following:

➢ Name of the country
➢ Employment to population ratio (age group: 15+)
➢ Fixed telephone subscriptions per 100 people
➢ Bank nonperforming loans to total gross loans
➢ Commercial bank branches per 100,000 adults
➢ ATMs per 100,000 adults
➢ Renewable energy consumption of total energy consumption
➢ Ratio of urban population to total population
➢ GDP per capita (current USD)
➢ Access to electricity of population
➢ Government expenditure on education (% of GDP)
➢ Unemployment total of total labour force
➢ Military expenditure of general government expenditure
➢ Population density
➢ Current health expenditure (% of GDP)
➢ Population
➢ Life expectancy at birth
➢ Alcohol consumption per capita (litres of pure alcohol)
➢ BMI (Body Mass Index)
➢ Income group of the country
➢ HDI (Human Development Index)
➢ Financial literacy (value from the S&P survey)

Methodology

Several statistical methods have been used in recent years to examine financial literacy. These methods include, for example, regression, logistic regression, cluster analysis, descriptive statistical methods, ANOVA, and the Chi-square test. I choose some of these methods for my analysis. I thought I would choose of these methods for my analysis. In this section, logistic regression and cluster analysis are presented.

Logistic regression

In logistic regression, the goal is to classify observation units into predefined groups of dependent variables. In this case, the dependent variable has two categories, so I applied binomial logistic regression. The value of the dependent variable is 1 if at least 40% of the adult population in that country is financially literate, otherwise the value is 0. The value is an arbitrarily chosen value, it is above average. In logistic regression, the analysis is based on the "odds", which determine the probability of a country having an appropriate level of financial literacy or not. The odds can be expressed by the following formula:

$$odds_x = \frac{P_x}{1-P_x}.$$

In the logistic regression, we assume that the logarithm of the odds can be defined as a linear function of the independent variables, which can be written as follows:

$$\ln(odds_x) = logit(P_x) = \beta_0 + \beta_1 x_1 + \ldots + \beta_p x_p.$$

The other central element of the analysis is the so-called cut point value. This value can be chosen arbitrarily, but it is important to keep in mind that the losses resulting from a false classification are kept to a minimum. (Hajdu 2003; Sajtos & Mitev 2007; Malhotra 2008; Varga & Szilágyi 2011)

Cluster analysis

Cluster analysis involves the systematic organization of observation units into homogeneous groups. Basically, this is a technique for exploration. We can choose from a hierarchical and non-hierarchical method, or we can combine the two. During the analysis, I chose hierarchical cluster analysis because I needed to determine the number of clusters, which I did with the Ward method. (Hajdu 2003; Sajtos & Mitev 2007; Malhotra 2008; Sajtos & Mitev 2007; Varga & Szilágyi 2011)

Chi-square test

The Chi-square test for Independence is a type of Nonparametric Test. It can be used if we want to test the relationship between two nominal variables. The null hypothesis is that there is no relationship between the two variables, so the two variables are independent of each other. The value of the test statistic is based on the difference between the observed and the expected frequencies, so we can calculate the value of the test statistic by using the following formula:

$$\chi^2 = \sum_{i=1}^{s} \sum_{j=1}^{t} \frac{(f_{ij} - f_{ij}^*)^2}{f_{ij}^*},$$

where fij are the observed frequencies and fij* are the expected frequencies.

EMPIRICAL RESEARCH

During the empirical research I searched for an answer to the following questions:

➢ Can it be predicted whether a country has an appropriate level of financial literacy?
➢ Can homogenous groups be identified among the observed countries?
➢ Does the income group influence the level of the financial literacy?

In answering each question, I tried to choose the most suitable statistical analysis, so I chose logistic regression, cluster analysis, and the chi-square test.

Logistic regression

Of the 140 countries included in the database, the logistic regression analysis covered only 78 countries, due to the fact that in several countries there were no values for each variable, so I discarded them from the analysis. 34.6% of the countries have an appropriate level of financial literacy, that means at least 40% of the adult population is financially literate. In the logistic regression, the dependent variable indicated whether the financial literacy of a country was good or not. Among the variables included in the database, HDI and Government expenditure on education (GDP%) were included in the

analysis as independent variables. The model is significant, and based on the Hosmer and Lemeshow Test it can be stated that the model fits well, and the Nagelkerke R^2 value is 70.3%. However, it is important to look at the classification accuracy, which is 88.5%. Table 1 shows the classification table.

The variables included in the model are considered significant. In the case of HDI, if the index increases by 0.01 then the odds of being a country with good financial literacy is higher by 25.4% on average, all other things being equal. If a country increases the spending on education by 1% of GDP, then the odds of being a country with good financial literacy is higher by 138.9% on average, all other things being equal.

Cluster analysis

I performed the cluster analysis along three variables:
➢ Employment to population ratio
➢ Government expenditure on education (GDP%)
➢ Urban population (% of total population).

During the analysis, I identified 2 outliers, Tunisia and Bahrain, using the Nearest Neighbour method. Then I made further analyses of the data. In this case the database includes 82 elements. As a result of the analysis, I created 5 clusters using the Ward method. As the 3-D scatter in Figure 3 shows, the groups are nicely separated.
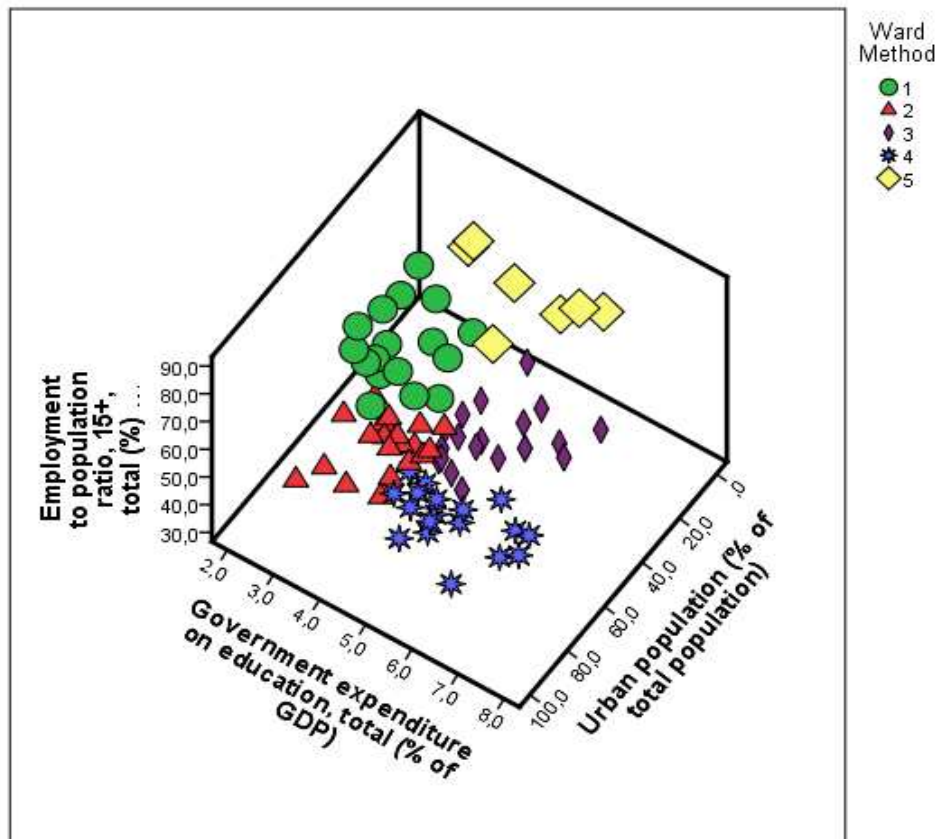
Classification Table[a]

			Predicted		
			\multicolumn{2}{c}{Fin_lit}	Percentage Correct
Observed			,0	1,0	
Step 1	Fin_lit	,0	45	6	88,2
		1,0	3	24	88,9
	Overall Percentage				88,5

a. The cut value is ,450

Source: SPSS output

Figure 3. Classification table

Source: SPSS output

Figure 4. 3-D scatter about clusters

In the case of the first cluster, it can be stated that in this case the value of government expenditure on education is the lowest and the urban population is 45% of the total population, which can be considered as a medium level. In technical terms, the value of fixed telephone subscriptions is low, 2/3 of the population has access to electricity, but 50% of the energy consumption comes from renewable energy. In the field of banking services, the ratio of non-performing bank loans is medium, the number of branches per 100,000 people and the number of ATMs is low. In these countries the life expectancy at birth is 66 years, and these countries are among the middle-developed countries. Countries in this cluster have a low level of financial literacy. Members of this group are for example Afghanistan, Kazakhstan, Pakistan and Haiti. The cluster was named "countries needing innovation".

The second cluster has the lowest employment to population ratio and a high urban population ratio. The proportion of GDP spent on military expenditure is the highest in these countries. A large part of the population has access to electricity, but renewable energy is not typical. The banking network is well established and the proportion of non-performing loans is moderate. Life expectancy at birth is 76 years, but the level of financial literacy is not high: only 35.65% of the population is financially literate. Developed countries with a low population density are in this group, for example Italy,

Spain, Ireland and Luxembourg. The cluster was named "not good, not terrible".

The third cluster is similar to the first cluster in many aspects, but in this case the fixed telephone subscriptions rate is higher and more than 90% of the population has access to electricity. The ratio of non-performing loans is low and the incidence of bank branches and ATMs is higher than in the first cluster. In financial literacy, these countries performed second best. Developed countries belong to this group, where the life expectancy at birth is 73 years. These countries spend the least on military expenditure as a percentage of GDP. Such countries are Austria, Hungary, Poland and the Slovak Republic. The cluster was named "innovation is in progress".

In the fourth cluster, more than 80% of the population belongs to urban populations. These countries spend the most on education and the lowest on military expenditure. The countries in the fourth cluster are the most developed, 99.87% of the population has access to electricity, but they do not favour renewable energy. The banking network is well established and the proportion of non-performing loans is the lowest in this case. These countries have the highest value for financial literacy, and the people who live in these countries have the longest life expectancy, they live for 80 years. The average GDP per capita is USD 34,051.05. Countries are more densely populated. Such

countries are Belgium, Germany, Netherlands and the United Kingdom. The cluster was named "wise wealth".

The last cluster contains the lowest number of countries, the group of the least developed countries. They spend moderately for education, but still have the lowest level of financial literacy, and these people have the lowest life expectancy at birth. Only 1/3 of the population has access to electricity. The ratio of non-performing loans is very high and the banking network is poorly developed. The average GDP per capita is USD 539.84. This group includes densely populated countries such as Rwanda, Nepal and Malawi. All countries except Nepal are located in Africa. The cluster was named "lacking knowledge".

Chi-square test

With the help of the Chi-square test for Independence, I examined whether a country's payment category has an effect on a country's level of financial literacy. I had the data to analyse all 139 countries. In an independence test, I tested the assertation that the two variables are independent. During the analysis I came to the conclusion that the two variables are not independent of each other (Chi-square = 62.561, p = 0.000). C-measure (0.671) shows that there is a medium-strong dependence.

CONCLUSION

In previous international research, 46% of Hungarians were considered financially illiterate, but other studies have concluded that the financial literacy level of the younger age group is lower; this may be reflected in the less favourable values found in my survey of university students (Fodor, 2019). The level of financial literacy of these students is disappointing, especially considering that they are economics students. I think that in the future this area must be given special attention, as today's young people will be the decision-makers of the future. However, the financial literacy requires innovation.

And what is the situation with the countries? Unfortunately some indicators are unavailable in some countries, therefore, I had to work with a smaller group of countries. I have come to the conclusion that logistic regression can be used to group countries using HDI and Government expenditure on education (GDP%) variables. I think this can be true in real life. Other studies have found that people with a higher level of education have a higher level of financial literacy (Béres, 2012). This may be true of countries, too, so if a country spends more on education, it can lead to a higher level of financial literacy.

Another finding reported that wealthier people have higher levels of financial literacy. This statement holds true for countries as well. This was supported by two analyses. On the one hand, the financial culture of countries with the highest GDP per capita was the best, with over 50% of the adult population in these countries being financially literate. In contrast, in the case of countries with the lowest GDP per capita, the proportion of these people was less than 30%.

Overall, I believe that improving financial literacy can be a potential manifestation of social innovation. Financial literacy must be an important part of our daily lives. It can be important for avoiding financial and credit problems. If we will have a higher level of financial literacy, I hope that we can make better financial decisions. Developing the financial literacy of Hungary and other countries is not only an individual issue but also a social issue.

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Evaluating Social Innovation Tools: Process-Oriented Approach

GABRIELLA METSZOSY

PHD STUDENT

UNIVERSITY OF MISKOLC
e-mail: szvmg@uni-miskolc.hu

SUMMARY

The aim of this paper to analyse the success factors of efficiency of social innovation and indicate the variables associated with the success factors in order to aid in decision making A number of success factors play an important part in adjusting to reach the optimal solution. The personality of the innovator, level of the innovation or the place of implementation can influence the choice and prioritizing of these factors. Identifying the forms and level of decisions in connection with success factors is the main focus of the paper, determining the presence of linked variables. A suggestion is formulated to increase the efficiency of decision making taking into consideration the applied decision methods and special features of the situation.

Keywords: social innovation, process-oriented framework, decision support

Journal of Economic Literature (JEL) codes: D83, O35

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INTRODUCTION

Various types of conceptual framing are becoming identifiable regarding innovation. This general phenomenon emerges from the impossibility of exact interpretation. Innovation is impossible to describe as a simple process (Saad 2004). The definition of social innovation is not uniform; some definitions come from a development of the orthodox innovation definition, while in other cases an entirely new definition was created. Murray et al. (2010) described social innovation as innovation where the tools and goals are societal, new relationships or cooperation are created and social needs are being satisfied simultaneously. According to the European Commission description (2014), social innovation includes the ideas, models, products, and services which satisfy social needs and create new social interactions. The Centre for Social Innovation highlights the importance of supporting the social progress by providing solutions for social and environmental problems. New problems arise as time wears on, and the solutions for these problems are hardly manageable without the participation of social innovation. The difference between the common sense of innovation and social innovation is determinable by the difference in goals. The aim of social innovation activities is to improve people's well-being and decrease the disadvantages of the peripheral areas using different tools (Shantz, 2015).

Based on the literature (Zapf 1991; Simms 2006; Pol & Ville 2009; Angelidou & Psaltoglou, 2017; Edwards-Schachter & Wallace 2017; Kocziszky et al. 2017; Misuraca & Pasi, 2019;), it is possible to distinguish eight different areas of social innovation where the critical factors required different types of evaluation and consideration.

➢ To do good for society: innovation for reaching defined social goals; new or novel, efficient and sustainable solution for social problems.

➢ Changing the social structure: new configuration of social practices for a specific purpose.

➢ Changing social practices: new combination of social practices in a specific field or social contexts for better answers to social needs.

➢ Contribution to regional or community development: reaching the community level progression (such as empowerment).

➢ Digital world, community presence in the innovation: possibilities are related to innovation in the digital connection of social network such as crowdsourcing or crowdfunding.

➢ Endowing different type of innovations with social importance: giving different types of attributes for type-specific innovations – such as technological innovations – which exert socially beneficial impact.

➢ Process reengineering: renewing and restructuring the intra-organizational processes in favour of more effective community work.

➢ Social work: developing the sensitivity in favour of social work and developing the process of social work to reach the societal goals.

During the process of social innovation, differentiation among the types helps for choosing the right supporting tools.

SOCIAL INNOVATION AND ITS INFLUENCING FACTORS

The general steps of process illustrative of all types of social innovation can be described in eight steps (Sanders et al. 2007; Tohidi & Jabbari 2012; Rajapathirana & Hui 2018; Soma et al. 2018; Metszosy 2019):

➢ Preparation: defining the territorial limits, scope and required basic knowledge for implementing social innovation. Mutual understanding is essential to describe the actions related to each phase, so applying the tools for shared thinking is required. Defining the goals is necessary for the continuous revision.

➢ Specifying the directives: formulating the challenges related to goals and the developing area, defining the activity to be improved. Understanding the target group is necessary for the success, and adopting idea generation methods is useful tool for understanding the presented needs and determining potential solutions.

➢ Conception: designing the expected outcome and feasibility, selecting conceptions. Evaluating sustainability with potential cooperatives using proper communication tools.

➢ Prototyping: defining the value-adding elements and decreasing barriers. Analysing the current situation and carrying out a resource audit to specify or reformulate the goals.

➢ Sustainment: defining the strategy and achieving actions in small steps for longer sustainability. Continuous assessment is based on feedback and monitoring, which requires knowledge and relationship management.

➢ Adjustment, measuring: measuring the performance of society and evaluating financial sources such as grants, donations, crowdfunding and benefits. Several types of financial indicators and statistical methods can be expedient.

➢ Systematic changes: mobilising participants for the development of a social movement.

➢ Learning and developing: new knowledge development and knowledge transfer occur during the process as a result, and with a knowledge bank the information will be available for further processes of development.

The success of social innovation process is influenced by several factors which may carry variant weights in each phase and level of implementation. Most of the hard factors can be measured on the basis of existing data; its impact on implementation can be directly determined with different types of analysis such as sensitivity analysis. In contrast the soft factors are more difficult to measure and their impact is hardly detectable by direct means, although the weights of these are important in the process.

In order to evaluate the process of social innovation at different levels, defining the indicators is necessary to measure the effect of each phase and applying different approaches for decision support. Various characteristics include quality, satisfaction, acceptance, understanding and cost reduction, which can all be measurable variables during the assessment (Kaderabkova & Saman 2013). It is noticeable that various success factors were identified in connected to different types of social innovation. Success factors cover a limited number of areas where satisfactory results ensure the improvement of well-being through the success of process (Rockart 1979). A Success factors approach allows us to focus on critical decisions of process, because achieving goals is highly dependent on proper and accurate evaluation of success factors (Anand et al. 2009). Based on my systematic literature review, the most cited success factors are:

➢ Collaboration, integration: should include individuals, organizations and communities involved in the action in any way. Lack of support and common thinking are impediments during implementation, so an open-minded, innovative approach, empathy and patience are needed to conduct the process (1).

➢ Culture: being part of a social innovation action requires different attitudes and routines in comparison to everyday work or volunteering. Different values and attitudes are necessary to support the confidence and commitment in an underprivileged community; the results of social innovation are not developed at once in most cases. Maintaining the community cohesion is essential for developing the supporting culture (2).

➢ Experience: successful earlier activity by the innovator or participants. Previous experience helps to determine the way to develop the necessary knowledge and reduces the number of possible mistakes in the initial stages. Previous activities can be participation in start-up activities, volunteering, participation in non-governmental organizations or participation in previous innovation activities (3).

➢ Sustainability: implementing the right action is hardly enough for a successful social innovation process; long-term sustainability is the key for improving the quality of life. Financial support is temporary in most cases, so the process should become self-supplying in order to sustain it (4).

➢ Replicability: successful actions can be good practices if the realization of process is reproducible. Because of the singularity of each action, all circumstances cannot be repeated, therefore it is worth analysing the necessary conditions for possible further actions in different places (5).

- Social learning: the learning process is presented in every stage of the social innovation process. Knowledge sharing can happen between implementers and participants in all contexts. In initial stages extending the available knowledge and transferring it are necessary for integration in the process. Internalisation of knowledge is one of the high priority actions. Lack of knowledge can be one of the most critical risk factors during the whole process (6).
- Financial resources: one of the most critical points in the implementation process. Community contributions and searching for funding opportunities can contribute to gain the opportunity for success. Grant applications and cross-border support also can be options, but the most effective way is self-financing (7).
- Communication: the basis for knowledge sharing. Communication can be accomplished in person or using ICT tools, the main determinant is that there are regular opportunities. The top-down and bottom-up approaches are equally important, and the lack of either can lead to an inadequate response to needs. Integrating the underprivileged people from the communication point of view should be a priority during the social innovation process (8).
- Non-financial resources: financial resources are considered one of the most critical points of the action, but without humans, ideas and recognizing the advantage of local abilities, the process of social innovation will take a long time and be difficult to sustain (9).
- Leader, innovator: a person, group, or organization who helps to hold together the whole process, involving and encouraging people to take actions step by step for improving the quality of life (10).
- Infrastructure: in a small town the implementation of innovation practice affects the small community within it. Effective implementation and results require the consideration of local abilities. In this level the supportive attitude of local government is essential to involve individuals. In addition, the state of development of existing infrastructure is a leading question in choosing the proper activity (11).
- Applied techniques: it is necessary to analyse the impact, sustainability and optimal functioning of tools, techniques and technology used in the process. Implementation often requires the use of machines, equipment, and other tools; knowledge is essential for their usage (12).
- Expectations: some of the expectations come from the regulatory environment, the indicators required by subsidies and grants such as maintenance time, employment, and utilization rate, other expectations come from participants and are related to concrete applicability and improvement of well-being. If the results of the social innovation are unable to reach the expected level, its long-term sustainability will be at risk (13).
- Novelty: new or novel practices are implemented when the activity has not been conducted elsewhere. If the same conditions are not available, necessary to consider the possibility of fulfilment of other conditions and modifications of practice (14).
- Networks: during the implementation process of social innovation activity, different types of relationships are formed, and this network supports long-term sustainability and knowledge sharing. Networking is possible in a supply chain, which involves not only the direct supplier and buyer; investigating the entire chain and supporting contact with stakeholders can be crucial during establishing further partnerships. In addition, the community can be developed into a network involving small community, residence of township and other participants such as foundations. Cumulative knowledge is created in the network which can be used for further activities (15).

Each success factor is mentioned in several sources. Table 1 summarizes the literature review.

Table 1
Success factors for social innovation process

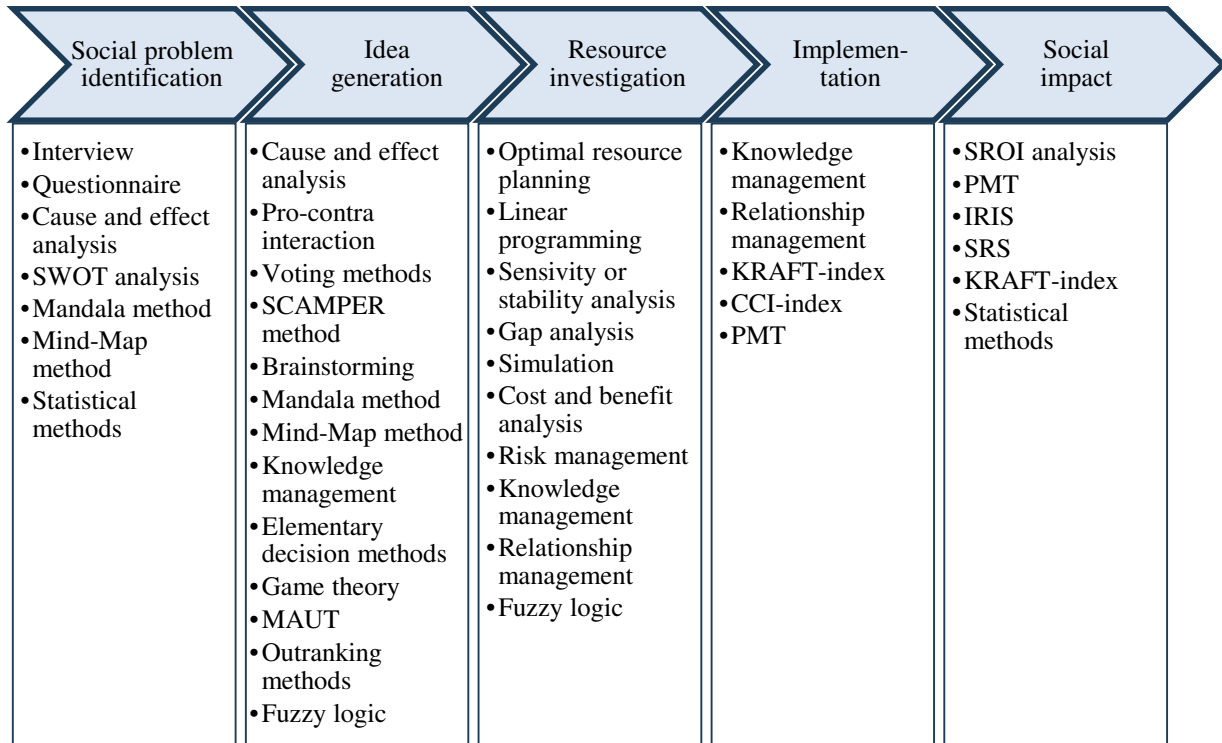|	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
Dziallas & Blind (2019)		✓				✓	✓								✓
Carvache-Franco et al. (2018)	✓	✓		✓	✓	✓									
Rodriguez et al. (2018)						✓				✓		✓			
Wilde et al. (2018)	✓			✓	✓		✓		✓	✓				✓	✓
Neumeier (2017)	✓	✓				✓	✓	✓							✓
Repo & Matschoss (2017)	✓			✓		✓	✓		✓						
Vasin et al. (2017)	✓					✓					✓				✓
Brandsen et al. (2016)	✓			✓							✓				✓
Unceta et al. (2016)	✓					✓									
Dainiené & Dagiliené (2015)	✓		✓			✓									
Dobele (2015)	✓	✓				✓				✓					
Bekkers et al. (2013)	✓	✓				✓				✓	✓		✓	✓	✓

Source: Own edition based on the references

Success factors are evaluated using different weights in each phase of the process- Their prioritization is not constant, everything depends on the time, the environment, the situation and many other factors influencing the social innovation action (Jooste & Vlok 2015). Implementing the social innovation action means changes in routines that affect the whole community. For this reason, the implementing action should be carefully selected, reviewing the existence or developmental possibilities of critical factors.

DECISION METHOD FOR EVALUATING THE INFLUENCING FACTORS

Applying multi-criteria decision-making methods is significant in every aspect of life. However, complicated procedures are less well known. Making a decision is made more difficult by the number of variants, the existence of objective and subjective criteria, inconsistencies, etc. For this reason, several decision supports methods have been developed, but one single adequate method cannot be applied in all cases; choosing the possible right method is influenced by many criteria, situation and the individual decision maker. Multi-Attribute Utility Theory and Outranking relations are the two main lines of multi-criteria decision techniques. Applying Multi-Attribute Utility Theory means the aggregation of criteria into a function, and the examination of mathematical conditions of aggregation by maximization of the function. The compensation between criteria is allowed by the theory of method, consequently the profit of one criterion compensates for the loss of another (Pratt et al. 1976). In Outranking relation an alternative comes forward in preference order if it is at least as good as the follower while there is no essential reason to disconfirm the statement (Bouyssou, 1996). Based on the preference of the decision maker, multi-criteria decision-making method can be selected to determine the importance of success factors and its preference order.

The techniques that can be used during the social innovation process are limited by reason of variety of social innovation problems and range of available data. Different approaches are needed in each phase of the process for exploiting the social knowledge and supporting individual decision-making. The basis of choosing the appropriate method is provided by the complexity of problem, range of participants and other influencing factors. Figure 1 illustrates a non-comprehensive range of decision support methods that can be used during the process of social innovation.

Social problem identification	Idea generation	Resource investigation	Implemen-tation	Social impact
• Interview • Questionnaire • Cause and effect analysis • SWOT analysis • Mandala method • Mind-Map method • Statistical methods	• Cause and effect analysis • Pro-contra interaction • Voting methods • SCAMPER method • Brainstorming • Mandala method • Mind-Map method • Knowledge management • Elementary decision methods • Game theory • MAUT • Outranking methods • Fuzzy logic	• Optimal resource planning • Linear programming • Sensivity or stability analysis • Gap analysis • Simulation • Cost and benefit analysis • Risk management • Knowledge management • Relationship management • Fuzzy logic	• Knowledge management • Relationship management • KRAFT-index • CCI-index • PMT	• SROI analysis • PMT • IRIS • SRS • KRAFT-index • Statistical methods

Source: Own edition

Figure 1. Possible decision support methods for the social innovation process

The process of social innovation can be supported and its impact can be measured with a properly chosen method. Both qualitative and quantitative information are required for social innovation related decisions, though making a constant priority order among influencing factors is impossible, and for this reason a procedure is needed to manage priorities involving non-numerical correlation in the evaluation.

In this paper a simple ranking method is used to analyse the success factors. The goal is to determine the importance of success factors from the perspective of decision-makers by means of hierarchization. The clarity is provided by representing the success factors in a hierarchical structure. The success factors are at the top of the hierarchy, categorization occurs in three categories at the second level: internal factors, external factors, and functional factors. The third level shows the classified success factors (Figure 2).
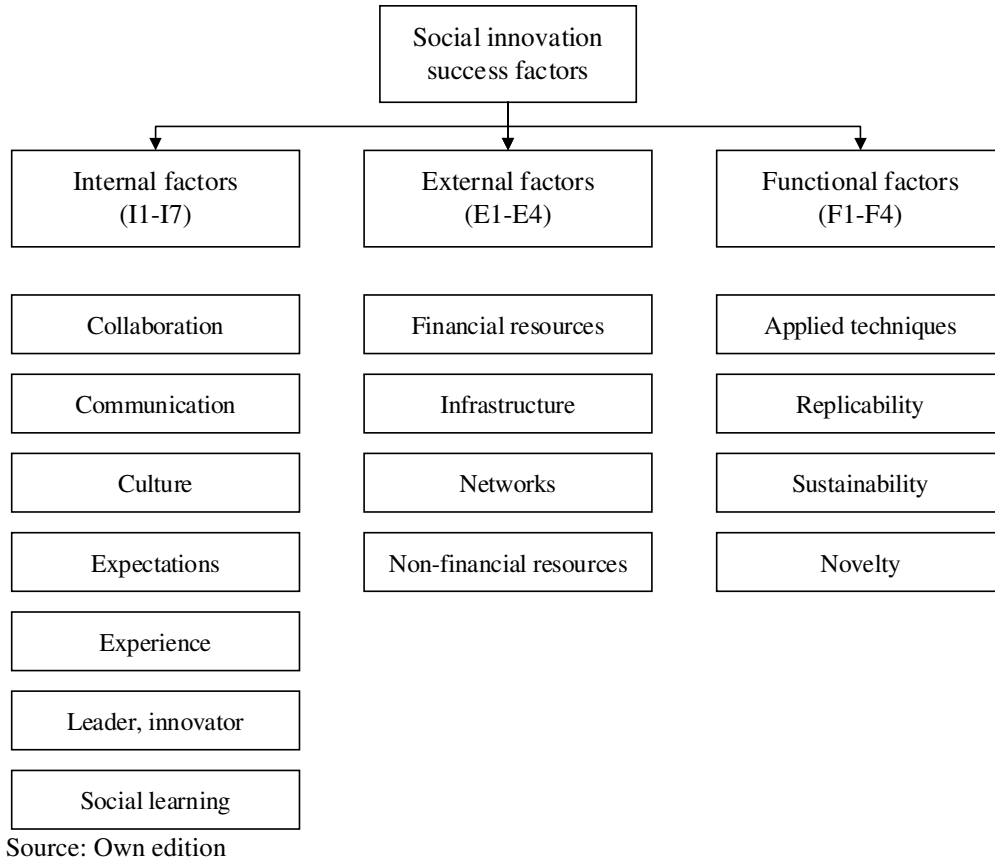
Source: Own edition

Figure 2. Hierarchy model of success factors

Doing pairwise comparisons and calculating factor weights are the next steps. This phase consists of three steps: determining the relative importance of the factors by pairwise comparisons, determining weight vectors, and determining the consistency.

The pairwise comparisons were done in individual structured interviews, categorizing the interviewees into four categories: individual as innovator (I), local government as innovator (L), foundation as innovator (F), organization as innovator (O). The scale developed by Saaty (1977) provided the values 1-9 for the comparison. The participants had to indicate the preferred factor from pairs and determine its importance with a number from a scale, where the minimum (1) means equally important and maximum (9) means the most important factor. The result matrix shows the relative preference of each factor based on Formula 1.

$$a_{ij} = \frac{w_i}{w_j}, \tag{1}$$

where a_{ij} is the j. element of matrix in line i. The expression is equal to the quotient of two values from a pairwise comparison, consequently it shows that factor importance i against factor j. The matrix is come directly from the pairwise comparisons as in Formula 2.

$$\begin{bmatrix} 1 & \cdots & a_{ij} \\ \vdots & 1 & \vdots \\ \frac{1}{a_{ij}} & \cdots & 1 \end{bmatrix} \tag{2}$$

The relative importance of factors is represented by the elements of the matrix.

Determining the consistency ratio (CR) is required to measure consistency. If the value of CR converges to zero, the consistency is presumable.

$$CR = \frac{CI}{RI}, \tag{3}$$

where the consistency ratio is equal to the quotient of the consistency index (CI) and the empirical average of consistency index (RI). Its value is considered satisfactory if it is not greater than 0.1. Eliminating inconsistency does not have to be the goal of decisions as it is not a sufficient condition for making good decisions. Furthermore, the value 0.1 is an empirical limit and it can be varied depending on the decision situation.

Table 2
Weight vectors

Internal factors (I1-I7)	External factors (E1-E4)	Functional factors (F1-F4)
$\mathbf{w}_I^T = [0.27\ 0.25\ 0.13\ 0.11\ 0.19\ 0.03\ 0.02]$	$\mathbf{w}_I^T = [0.51\ 0.14\ 0.09\ 0.26]$	$\mathbf{w}_I^T = [0.32\ 0.12\ 0.28\ 0.22]$
$\mathbf{w}_L^T = [0.15\ 0.10\ 0.09\ 0.18\ 0.32\ 0.11\ 0.05]$	$\mathbf{w}_L^T = [0.67\ 0.11\ 0.04\ 0.18]$	$\mathbf{w}_L^T = [0.27\ 0.08\ 0.49\ 0.16]$
$\mathbf{w}_F^T = [0.28\ 0.24\ 0.23\ 0.03\ 0.02\ 0.02\ 0.18]$	$\mathbf{w}_F^T = [0.36\ 0.20\ 0.32\ 0.12]$	$\mathbf{w}_F^T = [0.22\ 0.23\ 0.41\ 0.06]$
$\mathbf{w}_O^T = [0.11\ 0.04\ 0.01\ 0.07\ 0.40\ 0.23\ 0.14]$	$\mathbf{w}_O^T = [0.38\ 0.05\ 0.47\ 0.10]$	$\mathbf{w}_O^T = [0.35\ 0.14\ 0.15\ 0.36]$

Source: Own edition

RESULTS

Four people participated in the study, one from each specified group (individual as innovator, local government as innovator, foundation as innovator, organization as innovator). Due to the limited number of responses, the paper is merely illustrative of the preferences of individuals at different levels of involvement.

The consistency ratio is appropriate for the external and functional factors, the values are less than 0.1 (CR_E equal to 0.074 and CR_F equal to 0.092), but higher for the internal factors (CR_I equal to 0.185). The absence of mind or lack of experience of participants can be the reason, but the final results are unaffected by its value, during a pilot check – some of the data was filtered to reduce inconsistency – no significant influence on the final order was detected.

Based on the result of pairwise comparisons done by participants, the values of normalized matrices can be determined and their weight vectors can be calculated. The elements of weight vectors can be calculated with Formula 4.

$$\mathbf{w} = \frac{\sum_{i=1}^n a_{n_i}}{\sum_{i,j=1}^n a_{n_{ij}}}, \tag{4}$$

where the elements of weight vector w are defined as the quotient of aggregated sum of rows of the normalized matrix and sum of the elements in the whole matrix. Table 2 illustrates the weight vectors for the three categories.

The ranking of factors within categories is determined based on the calculated weight vectors (Table 3). In internal factors *collaboration* was the most cited success factor, ranked in the first place by the valuation of individual and foundation based on the weights (0.27 and 0.28), but for the local government and organization *experience* was the most important, which is one of the less cited factors. In almost all cases the individual and foundation had similar valuations, factors which connected to cooperation and participation are the most important. Factors which help in the implementation such as *experience* (0.32 and 0.40) and *leader, innovator* (0.11 and 0.23) were preferred by the representative of the local government and the organization. In external factors *financial resources* are in the first place for individual (0.51), local government (0.67) and foundation (0.38), but for the organization *networks* (0.47) were considered the most important. The importance of financial elements was expected, in small communities the most challenging task is putting up the necessary financial background for the action. Different judgments are eventuated in the functional factors. For the local government and foundation, the *sustainability* was the first (0.49 and 0.41), while the most important factor for the individual was the *applied techniques* (0.32) and for the organization it was the *novelty* (0.36). The factors that can help the practical implementation are the priority for organizations, while cohesion is top for the individual and foundation, and the exploitation of available opportunities is most important to the local government.

Table 3
Rank of success factors

Category	Success factor	Rank			
		I	L	F	O
Internal factors	Collaboration	1	3	1	4
(I1-I7)	Communication	2	5	2	6
	Culture	4	6	3	7
	Expectations	5	2	5	5
	Experience	3	1	6	1
	Leader, innovator	6	4	6	2
	Social learning	7	7	4	3
External factors	Financial resources	1	1	1	2
(E1-E4)	Infrastructure	3	3	3	4
	Networks	4	4	2	1
	Non-financial resources	2	2	4	3
Functional factors	Applied techniques	1	2	3	2
(F1-F4)	Replicability	4	4	2	4
	Sustainability	2	1	1	3
	Novelty	3	3	4	1

Source: Own edition

Significant difference can be discovered between the priority rank of the individual, foundation, local government and organization. Kendall's coefficient of concordance was calculated (Formula 5) for testing the rate of accordance adding correction factor for the adjustment of distortional effect (tied values):

$$W = \frac{\Delta}{\Delta_{\max}} = \frac{\Delta}{\frac{1}{12} * k^2 * (n^3 - n) - k * \sum_L L} , \qquad (5)$$

where Kendall's coefficient of concordance is equal to the quotient of Δ quadratic variation and $\Delta_{\max}$ adjusted by maximum correction factor (it shows the 100% correlation). W is equal to 1 in the case of full agreement, and W is equal to zero if ranks show contrast. Table 4 shows the calculated coefficient values.

The W significance test is necessary to determine the correlation between the ranks. The fundamental assumption is the lack of agreement among the participants, therefore W greater than zero refers to a random effect, while the alternative hypothesis assumes agreement between participants. Significance test is possible to achieve with the value of $\chi 2$ distribution (Formula 6.) and its comparison to the threshold.

$$\chi^2 = k * (n - 1) * W , \qquad (6)$$

where the value of distribution is equal to the value of multiplication of number of evaluation factors (k), degree of freedom (DF equal to n-1) and coefficient of concordance.

The calculated coefficient of concordance and values of $\chi 2$ distribution are presented in Table 4. The critical value of $\chi 2$ at 1% significant level is 16.8 for internal (k equal to 4 and DF equal to 6) and 11.3 for external and functional actors (k equal to 4 and DF equal to 3). The concrete values of $\chi 2$ are always lower than the critical values, this involves the acceptance of the H_0 hypothesis, the W greater than zero values refer to random effect, the highest value of $\chi 2$ is less than half of its critical value.

Lack of concordance can be a problem during common activity. The social innovation process would be managed with different approaches and priorities being set between activities, which can inhibit the effectiveness of collective work. Increasing the concordance among the involved participants is essential from the beginning of the process.

Table 4
Coefficient of concordance

Category	Success factor	Coefficient of concordance (W)	Value of χ^2
Internal factors (I1-I7)	Collaboration	0.110	2.649
	Communication	0.002	0.054
	Culture	0.036	0.857
	Expectations	0.002	0.054
	Experience	0.056	1.351
	Leader, innovator	0.009	0.216
	Social learning	0.056	1.351
External factors (E1-E4)	Financial resources	0.446	5.357
	Infrastructure	0.161	1.929
	Networks	0.013	0.158
	Non-financial resources	0.013	0.158
Functional factors (F1-F4)	Applied techniques	0.053	0.632
	Replicability	0.286	3.429
	Sustainability	0.118	1.421
	Novelty	0.013	0.158

Source: Own edition

EVALUATION

Choosing the appropriate method helps us to understand the nature and needs of participants and the process of social innovation. Different phases of the process require different tools and techniques to support the implementation. Success factors must be considered during the whole process; this is essential to attain the expected result. In this study data were provided for the comparison of success factors by four participants. The comparisons were performed with the method of pairwise comparison, which gives easier structure and is more manageable for the participants. After the comparisons are done, weight vectors can be calculated to show the importance of the factors, which gives the basis of the ranking. It was expected that different type of factors will be more important for the innovators at various levels of involvement.

Financial resources were highlighted during the entire process. This external factor received the highest values of the weights, except for the organization, where the networks factor was the most important. This information shows the priority and thinking of participants. Social innovation requires cooperation during the process and the lack of supporting attitude can lead the essence of it in the wrong direction. In this case the weights are well-balanced, just the financial factor indicates highlighted priority, which shows the necessity of financial elements for the implementation according to the innovators.

In most cases a group or community works together during the innovation process. Participants often come from different fields of action with various experiences and decision levels. Mutual understanding and accordance are needed for effective work. If the priority of participants is diverse, the social aspect becomes de-emphasized. The calculated W values show the low rate of accordance in this case, and the significance level confirms the assumption of theH0 hypothesis, the predominance of random effect. Participants are recommended to increase the level of accordance before the main steps and decisions in the process, otherwise different ideas can decrease the efficiency of social innovation action.

CONCLUSION

Using different tools and decision support techniques at each phase of the social innovation process is needed to explore possibilities and choose the right option. Exploring available resources and future opportunities is essential for proper evaluation. A flexibly developed decision support system is needed to support each step of the process. Involving the participants is essential for using common knowledge during the process; its formation has to respect their concepts about increasing the quality of life. Knowing the influencing factors of social innovation helps to identify the critical points of the process and plan the right actions for manage them.

Prioritizing the success factors related to social innovation by participants' point of view was adequately assisted by using a ranking method based on pairwise comparisons. However, there are limitations and the preconditions should be known for proper use of these results:

➢ The sample is not representative.
➢ Lack of information can affect the final rank.
➢ The absence of mind or lack of experience of participants can provide misleading results.
➢ The real world is often inconsistent.

> ➢ Potential reluctance to use the method because of the time it takes and its heavily mathematical background.

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Development of Rural Areas and Improving Their Resilience with Smart Solutions

PÉTER ZSOLT, Ph.D.
ASSOCIATE PROFESSOR

UNIVERSITY OF MISKOLC
e-mail: regpzs@uni-miskolc.hu

SUMMARY

Rural development is increasingly demanding the use of advanced technologies as a growing number of new challenges must be solved. While the main tasks in cities are to develop the quality of life of a significant number of people and to solve increasingly complicated tasks, in rural areas – in many cases – aging, the migration of the youth and the more difficult access to services (and in many cases their higher costs) are the most important problems.

Basic IT infrastructures are usually available in the most rural areas (e.g. broadband Internet access), and the cost of Internet-connected devices has fallen compared with decades ago, so in theory it is easy to access for everyone, but the existence of 'hardware' is sometimes accompanied by a lack of necessary 'software'. I believe that one of the potential opportunities of rural areas can be the widespread use of smart solutions developed by densely populated areas but adaptable with inevitable modifications. In this study first I will examine the current situation of the 'smart solutions' in rural places and then I will discuss how such solutions can contribute to the development and resilience of rural areas.

Keywords: smart cities, smart rural areas, rural development, territorial differences, resilience

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INTRODUCTION

Spatial development can no longer ignore the use of advanced technologies. While in urban areas the management of the masses in different areas is one of the most common problems (transport, administration, health services, education, etc.), in rural areas the aging society and the decrease of available services and jobs are the biggest challenges. In this study I am looking for an answer as to whether ICT tools, mobile and computer applications can make a significant contribution to mitigating and preventing the sometimes shocking effects on the economy, the environment and society. First I will review the national and international literature on smart solutions and resilience and then I will identify their meeting points with smart settlement and rural models. I will also collect a few best practices of 'smart' developments in rural areas that are making a significant contribution to improving their resilience.

LITERATURE REVIEW – SMART CITIES

The smart city concept appeared in the literature in the 1980s and became widespread in the '90s thanks to the use of information and communication technologies (ICT). In the 2000s, the increasing use of the Internet has helped the cities to provide more and more IT services to their citizens (e-governance, e-education, etc.), while today the revolution of the Internet of Things is going on.

While we use the term 'smart city' more and more often, no uniform concept has been developed yet in the literature, as there are often unique solutions for each settlement. Many definitions of smart city have been created in recent years, but there is no one-size-fits-all definition. Some definitions say that

➤ a smart city excels in six areas: economy, people, governance, mobility, environment, living conditions (Giffinger 2007),

➤ the concept of the smart city is a place where citizens, objects, utilities, etc. are perfectly combined with the use of everyday technologies that significantly improve the urban experience (Northstream 2010),

- a smart city is a product of the combination of the digital city and the Internet of Things (Su & Li & Fu, 2011),
- a smart city monitors and integrates all critical infrastructures (roads, bridges, tunnels, railways, subways, airports, ports, communications, water, energy, and major buildings), optimizing its resources, planning activities with safety in mind, maximizing the services provided to the population (Hall, 2000).
- the concept of smart villages is encouraged by the promotion of economic and social development, sustainable energy, health, education, water and hygiene infrastructures, leading the places to increased incomes, improved security, greater gender equality and democratic values (Holmes, 2017).

One of the most important tools of these intelligent approaches is digitization, no matter whether urban or rural. Especially in rural areas, better internet access can help in decreasing distances between settlements and solve logistical, mobility and care problems for elderly or healthcare (Prause & Boevsky, 2015).

In recent years, many similar names have appeared in the case of villages, such as 'smart village', 'intelligent village', 'knowledge village', 'sustainable village', 'talented village', 'wired village', 'digital village'. I supposed that 'smart village' is the most popular expression but I have found that other expressions as 'knowledge and sustainable villages' are more widely used.

LITERATURE REVIEW – RESILIENCE AND ITS CONNECTION WITH RURAL AREAS

I have reviewed the concept of resilience, its appearance and its use in different sciences, with special regard to economics in the Hungarian and international literature.

The concept of resilience first appeared in 1973 in relation to the resilience of ecosystems. Recently it has become an extremely fashionable scientific expression, which is almost universal in describing systems and solving problems (Gardner & Dekens 2007).

Resilience – which in a time of shock ensures functional survival – has become a hot research topic in many scientific disciplines, particularly ecology and psychology. In the context of socio-economic 'sustainability', resilience is particularly concerned with adapting to climate change and the survival of disaster-affected communities (Bahadur et al., 2010). Holling's approach seems also logical to me, as he says that after shocks resilient systems will return to equilibrium, whether it is different or not from the original state (Holling, 2001)

Table 1
The mention of "Smart Village" and similar terms in Internet search engines

EN	google EN	%	google scholar	%
'smart village'	383 000 000	11.00	347 000	3.87
'intelligent village'	61 700 000	1.77	458 000	5.11
'knowledge village'	458 000 000	13.15	3 120 000	34.80
'sustainable village'	147 000 000	4.22	1 100 000	12.27
'talented village'	74 500 000	2.14	169 000	1.89
'wired village'	26 700 000	0.77	72 400	0.81
'digital village'	712 000 000	20.44	498 000	5.56
'information village'	1 620 000 000	46.51	3 200 000	35.70
sum	3 482 900 000	100.00	8 964 400	100.00

Source: own compliation
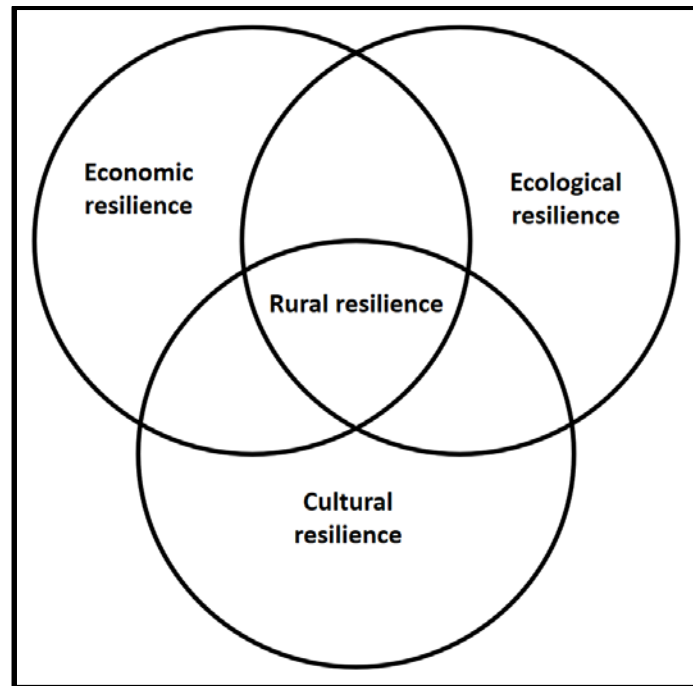
Source: Heijman et al. 2019

Figure 1. Components of rural resilience

Only a few examples of the relationship between the concept of resilience and the countryside can be found in the literature. This is probably because rural areas typically lack the resources needed to mitigate and prevent shock effects. Some sources suggest that this is because the majority of researchers currently focus directly on rapid changes in agriculture, forestry, landscape protection or social problems (Colding, 2007; CSIRO, 2007).

Only some authors try to circumvent the definition of this relationship. The resilience of the rural areas is the ability of the countryside to maintain an acceptable standard of living for the members of the community despite the rapidly changing external conditions. Figure 1 shows that the resilience of rural areas can be quite well defined as some common intersection or combination of the resilience of certain areas (especially economic, ecological, and cultural) (Heijman et al. 2019).

During the examination of the phenomenon of resilience, it should be borne in mind that rural areas have several functions at the same time. While agriculture is feeding humans and animals, at the same time it serves other areas (tourism, cultural heritage, and the conservation of water, landscape and nature). Occasionally resources may be limited, e.g. taking into account natural values or food safety considerations. Another multifunctional approach incorporates the concept of economic, social and natural capital to model rural resilience issues (Wilson, 2010).
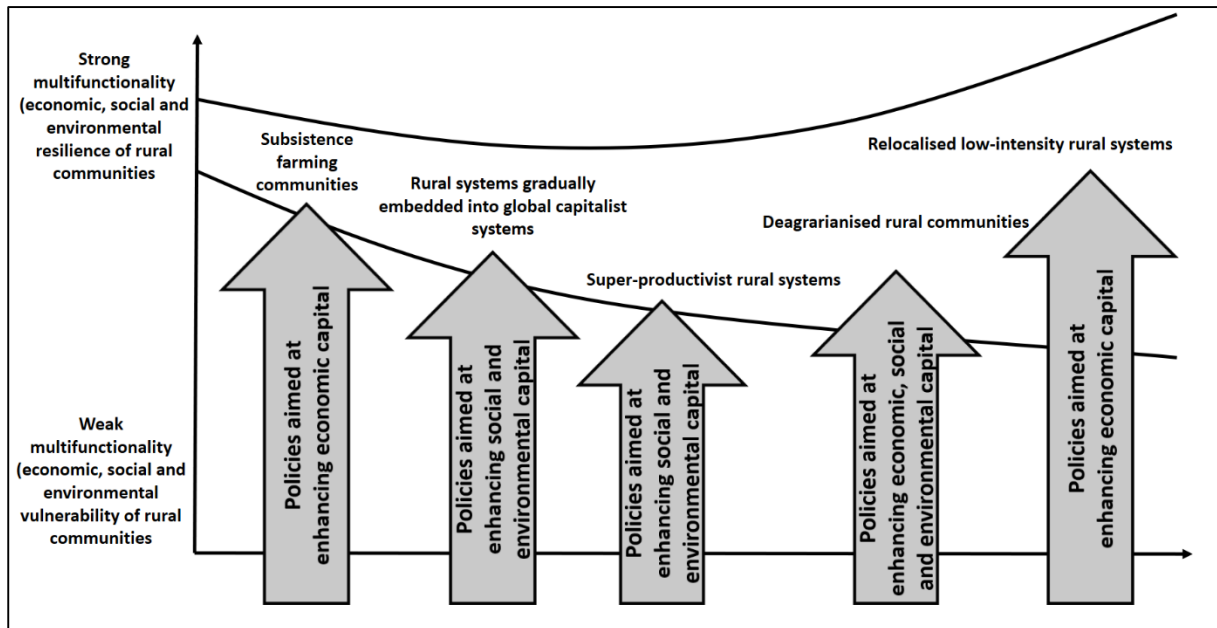
Source: Wilson, 2010

*Figure 2. The relationship between the possible development
paths of rural areas and the main goals of rural policy*

Rural areas were historically self-sufficient, although such areas still exist in distant areas. Thanks to the industrial revolution and the advent of modern societies, rural areas are also taking part in the economy of global capitalism. Some rural areas are highly capable of increasing the efficiency of certain agricultural activities (e.g. the greenhouses of Almería, Spain), enabling them to become market leader or dominant players on a global scale for certain products or product groups.

Less favorable conditions or the proximity of larger cities leads certain areas to reduce agricultural activity while at the same time ideally they can expand industrial or service activities. Some rural areas of developed economies, especially those close to big cities, have undergone a change of function over the last decade, providing comfortable living conditions, decent work opportunities, and many functions similar to cities in many areas (e.g. services, shopping). Typically, areas remote from large cities are characterized by low agricultural productivity, which can only bring benefits if it is of high quality and at the same time, it is coupled with high prices

accepted by the market, otherwise it can be sustainable only with a certain degree of foreclosure or with significant external funding. Wilson's approach (Figure 2) also incorporates the decision-making dimension of the different development pathways (Wilson, 2010).

Increasing economic capital is a priority for self-sufficient rural areas. They should reduce the number of people living in poverty, improve living standards, diversify the economy, reduce dependence on agriculture, develop infrastructure and increase the volume of products sold in the region.

Slowly integrating rural areas into the global economy should improve their culture of cooperation, improve health and social care, improve the quality of services and encourage women's economic empowerment.

Highly productive rural/agricultural areas identify most of the abovementioned objectives for themselves. However, in their case, over-specialization can entail serious dangers (e.g. ecological risks, environmental pressures, major landscape changes).
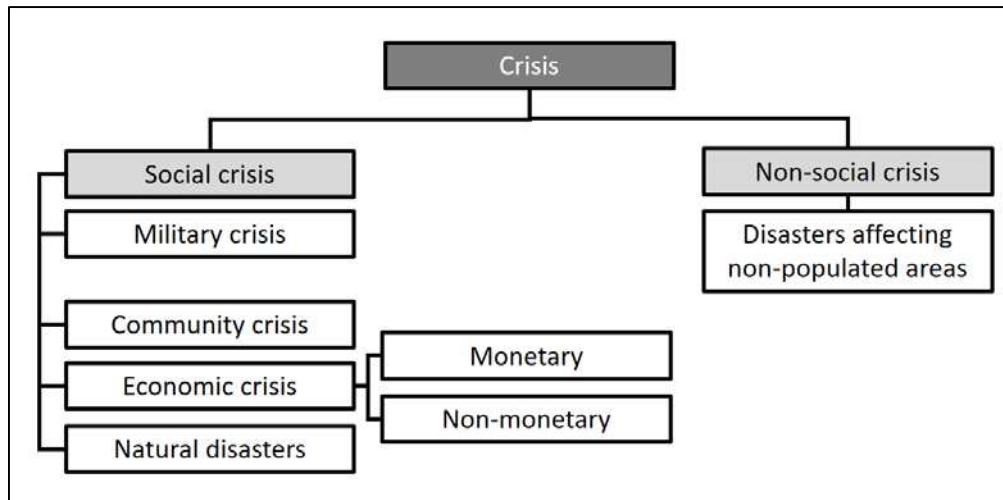
Source: own compilation

Figure 3. The typology of crises

In rural areas, which are typically located around urban areas, agriculture is losing ground, which may be due to competitive disadvantages and the expected higher income from non-agricultural land use. In areas of the country where productivity is lower than expected levels of production, the issue of increasing and preserving economic capital may once again be at the center of development policy; as population decline, the expected increase in absolute and relative poverty, external dependence and outflows are key challenges (Szendi, 2017).

When examining the resilience of rural areas, we cannot ignore the literature on crisis, crisis prevention, crisis management and management (Boin et al., 2005). A crisis is a situation in which society is affected by some significant adverse physical, economic or community negative effects. In the event of a crisis, it is the responsibility of the crisis management organization to make decisions, often in very difficult circumstances or with potentially adverse consequences for certain groups in society (Sayegh et al., 2004). A crisis is a disorder of a system characterized by some degree of insecurity and discontinuity, and requires special treatment to avoid unwanted consequences and to establish a new stable state (Bénaben & Frédérick, 2016).

Crises often occur unexpectedly and decision-makers are confronted with the fact that information often unreliable from previous crises will not help solve current problems. In many cases, the involvement of external consultants in crisis management is also required.

As a result of the 2008 crisis, resistance studies have also come to the forefront in rural areas.

There have been developed many specialized literature dealing with crisis and crisis management, but an overall typology of crises can be difficult to find covering all possible areas. Crises can be societal or non-societal (e.g. natural disasters affecting wildlife in uninhabited places). Crises with a major impact on society can also come from

natural sources. Since armed conflicts are fortunately less common in developed countries (from internal or external sources), many authors refuse to include them as causes. In my opinion, this is a poor choice, as it damages the completeness of the possible causes (and unfortunately, there are still armed conflicts in many parts of the world). The third important group of crises is economic, due to financial or other reasons (Figure 3).

Based on an overview of crisis concepts, I have come to the conclusion that resilience, which is becoming more and more popular as a research topic today, deals with many similar issues. Perhaps the most significant difference is that while crisis management focuses primarily on mitigating and managing the negative effects, resilience is not exclusively concerned with unfavorable factors but focuses more on the development of equilibrium at the same or possibly different levels.

In this study I would like to propose the main areas of smart solutions for rural areas. We can review and the 'smart improvements' that are already available, draw conclusions based on previous experience, and make predictions by the help of the ideas currently under development. There is only limited scope for this activity due to the fragmentation of the information available.

In this research, although we cannot speak for completeness or representativeness in the case of Hungary, we can come to the conclusion that most of the domestic developments were made from EU sources, without real 'business' or long-term economic 'sustainability' planning. Many times, IT developments are made that do not have 'real' users. Quite often similar domestic or even global alternatives already exist (for example, I find it unnecessary to develop a tourist application for a village when Google Maps or Tripadvisor, for example, provide a much more efficient service for the same purpose).

To precisely define the areas to be developed, the tasks and goals of the rural areas can help us.

In my opinion a globally applicable classification is needed. The horizontal axis shows the economic development of the rural area (country). The vertical axis shows the distance from important economic centers (big cities). According to the two dimensions (although these are, of course, not discrete categories), four groups are created:

➢ areas close to a (large) city (or cities) of developed countries,
➢ peripheral rural areas of developed countries,
➢ areas close to a (large) city (or cities) of underdeveloped countries,
➢ peripheral rural areas of underdeveloped countries.

Giffinger's model is the most widely used in the literature and is commonly used to determine the development areas of smart solutions (Giffinger 2007). People living in rural areas near urban areas in developed countries tend to have similar lifestyles to urban populations, and agriculture in these areas is no longer dominant even if they have gained extraordinary productivity in some areas (e.g. vegetable production),

since alternative land use income can easily be higher. The keywords in these areas are: development, further development, optimization with particular emphasis on the following areas (innovation, businesses environment, productivity, international relations, competitiveness, NGOs, e-government interfaces, community, social services, public transport, health services, improvement of public security, energetics).

The technology available can help projects to improve the natural environment. Often it can be a problem that significant tourist values fade in the shadow of the nearby big cities, so it is important to increase domestic and international visibility and achieve the necessary market positioning (Kuttor, 2008).

The remote peripheral areas of developed countries (e.g. near the Arctic Circle in northern countries) face quite different challenges. In these places, the focus should be on creating an innovation environment, attracting businesses to the area, stimulating atypical forms of employment, and branding the area to attract foreign tourists.
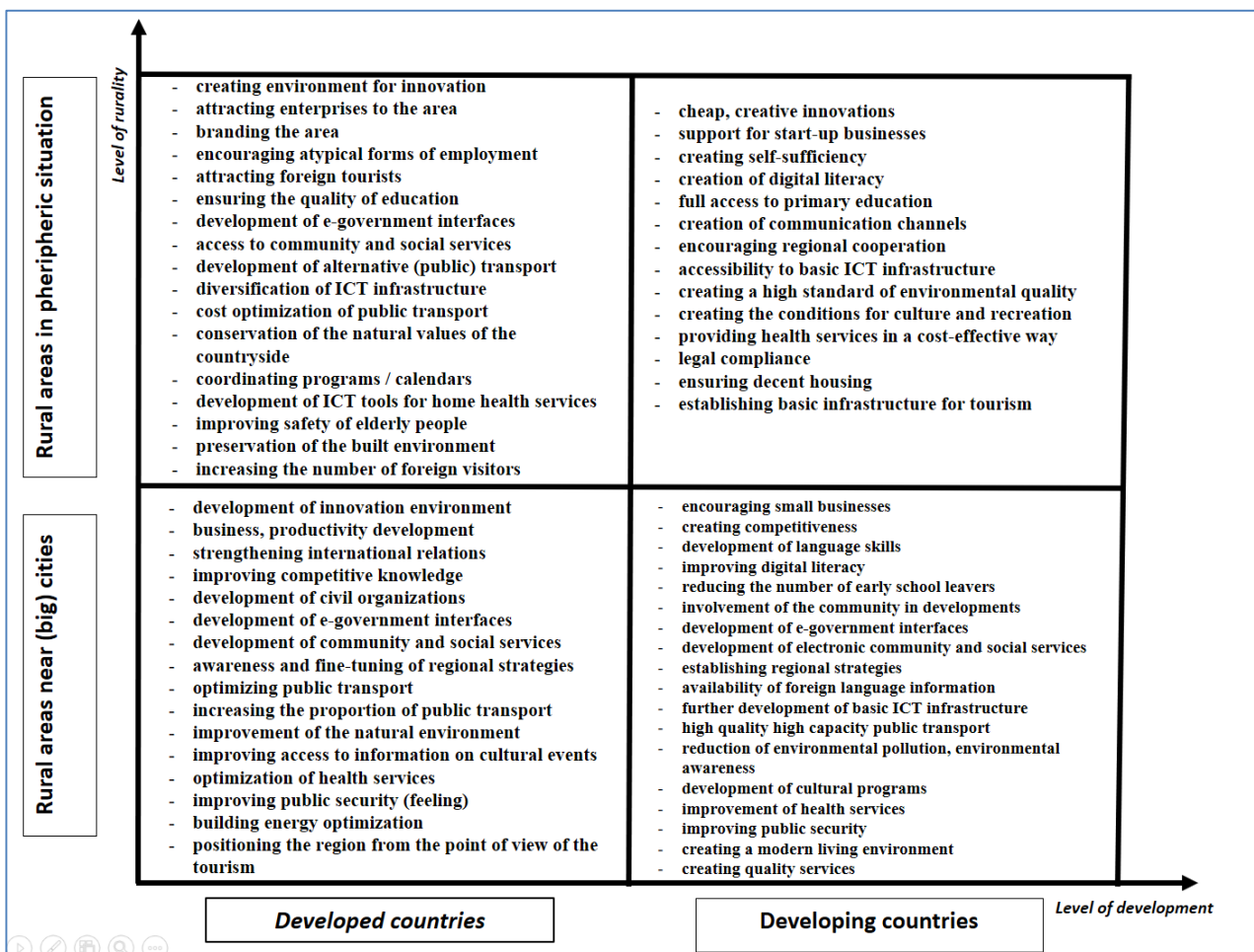
Source: own compilation based on Giffinger's model (Giffinger 2007)

Figure 4. The main development areas for smart solutions in regions depending on their countries' level of development and level of rurality

If the low population density requires distance education techniques, ensuring the quality of education can be challenging. E-government interfaces are often inadequate, and the community and social services may require special IT-supported solutions, especially because of the high costs per capita of the traditional solutions. In my opinion, the main focus points could be the development of alternative (community) transport, the cost optimization of public transport, the preservation of the natural values of the countryside, the coordination of community programs and calendars, the development of home health ICT tools, and the safety of the elderly..

Often massive population growth can be observed near major cities in developing countries as part of strong urbanization processes. In these areas, we can use smart tools to encourage small businesses, improve competitiveness, develop foreign language skills, improve digital literacy and reduce the number of early school leavers. It is important to involve the community members in the development process. The development of e-government interfaces and electronic community-based social services can reduce congestion. Access to foreign language information is a typical shortcoming. Breakthrough points could be the further development of basic ICT infrastructure and the development of high-quality, high-capacity public transport (metro, high-speed rail, metro, tram, etc.). Pollution is a major problem, and reducing it can help to improve life expectancy and quality. The development of cultural programs, the improvement of health services, public security, the creation of a modern living environment, and the creation of high quality services may be the main areas of development.

In the peripheral areas of underdeveloped countries, cost effectiveness and creativity must be the hallmarks of development. It is important that under-educated people be able to use the applications, too. It is interesting that some forced innovations (such as payment without a bank account) were first created in poor countries. The keywords in this rural group are support and creation. We need to help start-up businesses with IT or other 'smart' tools, to ensure the self-sufficiency of the population, and we have to make the Internet available for everybody: we have to help creating digital literacy, full access to primary education, and basic communication channels. Regional co-operation should be encouraged and the quality of environment and environment consciousness should be improved. In these areas, it is necessary to create the conditions for culture and recreation, to provide cost-effective health services and decent housing, and to establish the basic infrastructure for tourism (Figure 4).

THE ROLE OF SMART SOLUTIONS IN IMPROVING RESILIENCE IN RURAL AREAS - CASE STUDIES

During the process of gathering smart solutions in rural areas, we will face the fact that the information available is very fragmented. While in Hungary, the Lechner Knowledge Center operates a website (http://okosvaros.lechnerkozpont.hu) that collects smart solutions from Hungary and European countries, with special regard to urban development, I was unable to found a collection of smart solutions specifically developed in rural areas. Sites for smart solutions typically exist in some major cities (e.g. Amsterdam).

Due to information gaps, I would like to outline some good practices that can provide guidance for other rural communities.

Source: google.com

Figure 5. Location of Großschönau, Austria

First I would like to introduce the developments of the small Austrian settlement of Großschönau, with around 1,200 inhabitants, located at a distance of 30 km from the Czech border (Figure 5). In this village smart solutions were launched with the help of 'smart' people many years before the concept became widespread. In the 1980s, the mayor and his brother (headmaster of the school) were confronted with the fact that the population of their settlement was decreasing and their room for maneuver was slowly but surely diminishing. With the involvement of the locals, they reconsidered their situation and concluded that they needed to become a settlement that could offer competitive, low-cost but excellent quality of services to the population, potential settlers and tourists. The developments were concentrated in the field of energetics. When the heating system of the school needed to be modernized the mayor of the village convinced locals to join the newly developed district heating system, which can save significant costs. Step by step the buildings of the municipality and the residences have been modernized, with special regard to their insulation. In a new part of the settlement, passive houses have been built, which have been sold and also serve as a model for those interested in their architecture and design. An interactive exhibition site called 'Sonnenwelt' was built in the town, with the aim of promoting energy consciousness. The museum of the settlement receives more than one hundred thousands of visitors each year, generating significant revenue for the municipality. The building functions not only as an exhibition space. There are also conference rooms and rooms suitable for indoor activities. They recently have hosted one hundred programs each year, which are provided to the local population and visitors. All this significantly boosted the turnover of hosts and other tourism service providers.

The municipality has implemented a number of developments (e.g. sewage treatment plants) which use the workforce in a very efficient way and also provide profit-oriented services to other municipalities. These revenues contribute to the implementation of new developments. The attitude of the population has also changed in recent decades, which is embodied in private initiatives launched without the participation of the municipality (e.g. local district heating systems in the peripheral parts of the settlement).

Due to complex, consistent developments, the resilience of the settlement has increased significantly. The dependence on the outside world has significantly decreased in the area of food supply thanks to the quality and variety of services offered.

Another example is ReGen Village, which is located in the Netherlands, approx. 20 km from Almere and is still under construction. The essence of this project is to make the village completely self-sufficient. The concept is to develop a village where resources are used in a closed system. This means that waste and water recycling, food production and energy production in the village is done in a way that minimizes the burden on the environment and serves all household needs, and the excess is redistributed to households (https://iut.univ-amu.fr/).

The ReGen Village project is based on five pillars:
➢ water and waste recycling,
➢ high-yield organic food production,
➢ multi-source renewable energy production and storage,
➢ buildings with a positive energy balance,
➢ strengthening local communities.

The resilience is clearly high for such a fully self-sufficient settlement, but some fears have been identified during the design process:
➢ although the Netherlands is a rainy country, rainwater may not be sufficient to meet the full needs of the population,
➢ high costs may result in an over-concentration of high-income owners,
➢ since the village is 100% self-sufficient, a kind of sense of isolation may occur,
➢ while the project focuses entirely on meeting basic needs (food production, housing), it may not provide enough entertainment for its residents,
➢ it can also be a problem that the houses are too close to each other and do not give their residents adequate intimacy (www.iut.univ-amu.fr).

As mentioned above, in the peripheral areas of underdeveloped countries, affordability and creativity must be the main drivers of development. It is important that non-skilled people can use the newly developed applications. A very good example of this is the Rwandan development called TRACnet, which connects residents and health facilities through an online platform. Physicians in peripheral areas of the country will have access to any previous medical report within a few seconds, and the system will tell them what and how many medications they need. This solution was created primarily to reduce HIV infection (https://sustainabledevelopment.un.org).

Rimbunan Kaseh in Malaysia is a 30-hectare rural village near Kuala Lumpur, which can serve as a good example of addressing rural poverty by promoting environmental sustainability through technology. A closed agricultural system is the greatest asset of the community, providing food and income to the population. In this system, everything is connected to everything. It also has everything like an usual settlement, schools, playgrounds, workplaces, and even 4G internet, while eHealth and eLearning work parallel in the community (Holmes, 2017).

CONCLUSION

Beyond the topic of energy networks the term 'Smart Rural Areas or Regions' and their synonyms are rarely found in the literature. Most of the sources deal with smart settlements (cities, villages).

During my research I have realized that there must be significant differences in terms of the tasks to be performed and the tools available, depending on how a

rural area and its country developed and how peripheral its position is.

I concluded that Giffinger's model of a 'smart city', though with significant rethinking, can provide an appropriate framework for the tasks, goals and objectives that can be achieved through the use of smart ICT tools (Nagy et al. 2016).

I have created a model for the main development areas for smart solutions in regions depending on their countries' level of development and level of rurality based on Giffinger's findings.

I have collected a few good examples of smart concepts of rural areas. I found that the good and sustainable examples are almost never based on mainly on European Union funds but on the real needs of the communities and their will to work for them. Based on my experience, I can state that the majority of local governments' projects in many countries are implemented mainly through European funds. Their sustainability after the expiry of the contractual obligations is usually doubtful. Thanks to the 'easy money', sustainability issues are very rarely included in the design of the projects. Often smart applications are not commensurate with the size of the settlements, and often focus on developments that already exist at national or global level. Sometimes the developed applications are already available from free or very affordable sources from already existing service providers (Szlávik et al. 2016; Orosz & Péter 2018; Péter & Orosz 2019;).

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Novel Solutions in Poverty Alleviation in Hungary, with Special Regard to Regional Differences

SIPOSNÉ NÁNDORI ESZTER, Ph.D.
ASSOCIATE PROFESSOR

UNIVERSITY OF MISKOLC
e-mail: stsne@uni-miskolc.hu

SUMMARY

The paper examines Hungarian social innovations in the field of poverty. Besides describing their main features, it examines empirical linkages between the rate of social innovations and economic growth. It uses the database of the SozialMarie prize and its methodology includes graphs and Pearson's correlation. It concludes that the main target groups of the projects coincide with the groups most exposed to poverty. It also finds that economic growth and the rate of social innovations are not significantly related. This implies that more social activism would be needed to alleviate poverty in the less developed regions.

Keywords: social innovation, poverty, regional differences, SozialMarie

Journal of Economic Literature (JEL) codes: I3, O35

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INTRODUCTION

The connection and relationship between economy and society have long been investigated and examined by researchers. Among other things, social innovations are good examples of the strong relationship between the two disciplines. They are created to promote the satisfaction of human needs of different levels (Kocziszky et al. 2017). Social innovations to fight against poverty are intended to satisfy the first-level human needs of the Maslow pyramid, including physiological needs like access to water, air, food, shelter, sleep, clothing or reproduction (King 2010).

The paper examines the quantitative and qualitative features of Hungarian social innovations in the field of poverty, homelessness and indebtedness between 2008 and 2019. As for quantitative aspects, the number of social innovations and their changes over time are examined. As far as the qualitative aspects are concerned, the target groups and the main activities of the above described social innovations are analyzed. It is examined whether the main target groups and activities of social innovations coincide with the groups most exposed to poverty. Moreover, the paper focuses on any regional differences in the number of social innovations in the field of poverty. Finally, the paper examines empirical linkages between the rate of social innovations and economic growth.

LITERATURE REVIEW

First I review the literature dealing with the groups most exposed to poverty in Hungary. Then, after a brief summary of social innovation definitions, I describe the details of SozialMarie, the oldest prize for social innovation in Europe.

Groups most Exposed to Poverty

The oldest data about poverty in Hungary – which were not really accurate yet – are from the 1930s. Sociographers called Hungary the country of "the 3 million beggars" at that time (Andorka 2006), which refers to a poverty rate of more than 30%, since the country's population was around 8-9 million at that time (Dövényi et al. 2011).

In the period of socialism, data collection on the financial situation of the population became more accurate and regular. Although poverty did not officially exist in Hungary (it was considered taboo), information on income inequalities was already public at the time. During the period of socialism, there were no significant changes in the extent of poverty, but its composition changed significantly (Table 1).

Table 1
Changes in the characteristics of the poor in the socialist era

	Early 1960s	**Late 1980s**
Area	villages	towns
Economic sector	agriculture	industry
Age group	pensioners	children
Situation of the pensioners	poorer than the average	average

Source: own compilation based on Andorka (2006)

Migration due to urbanization led to a shift in the territorial concentration of poverty from villages to towns. Accordingly, by the end of the 1980s the social groups most affected by poverty were no longer physical workers in agriculture, but unskilled workers in factories in cities. There was also a change in the age composition of poverty: the situation of the old improved and thus reached the average level by the end of the period, while child poverty increased (Andorka 2006).

The political transition in 1990 increased the number of the poor. This is due, on the one hand, to the emergence and soaring rise in unemployment and, on the other hand, to accelerated inflation. Besides poverty, income inequalities also rose: the income share of the upper decile increased, while that of the lower decile and the middle class fell (Andorka 2006).

After the sharp increase of the extent and depth of poverty at the beginning of the 1990s due to the economic and political changes, the extent of poverty remained largely unchanged, although it slightly decreased at the end of the 1990s and at the beginning of the 2000s (Branyiczki & Gábos 2018). Gábos and Szivós (2002) revealed the objective determinants of poverty. They examined the effects of the following indicators: age of the household head, his/her educational attainment, his/her labor market position (unemployed or inactive), his/her ethnic origin, type of dwelling and the number of household members. They concluded that the rate of those at risk of poverty was influenced by the following factors:

➢ labor market position;
➢ education attainment;
➢ regional characteristics;
➢ demographic factors.

Darvas and Tausz (2002) found that the number of children in the household, dwelling circumstances and Roma ethnicity were the most important risk factors of poverty.

The global economic crisis had social effects in Hungary earlier than in other countries (usually between 2009 and 2012) and therefore increased the extent of not only income poverty but also of income inequalities and of severe material deprivation. (Branyiczki & Gábos 2018) Since 2012, however, the extent of income poverty and of severe material deprivation has fallen (Gábos et al. 2016). Győri (2017) found that since the millennium, the rate of the Roma and the rate of people with an over average number of children large families have increased among the homeless people. This implies that housing crisis, ethnic origin and having a large family are usually closely related, creating multiple disadvantages.

The rate of people living on begging, panhandling or collecting unwanted household items among the homeless increased significantly from 12% in 2002 to 26% by 2006. Since then, it has slightly fallen to below 20% (Győri 2019). Győri (2019) measured the rate of beggars and the homeless people collected unwanted household items in some major towns of Hungary. Based on his data (Figure 1), no remarkable regional differences can be found.
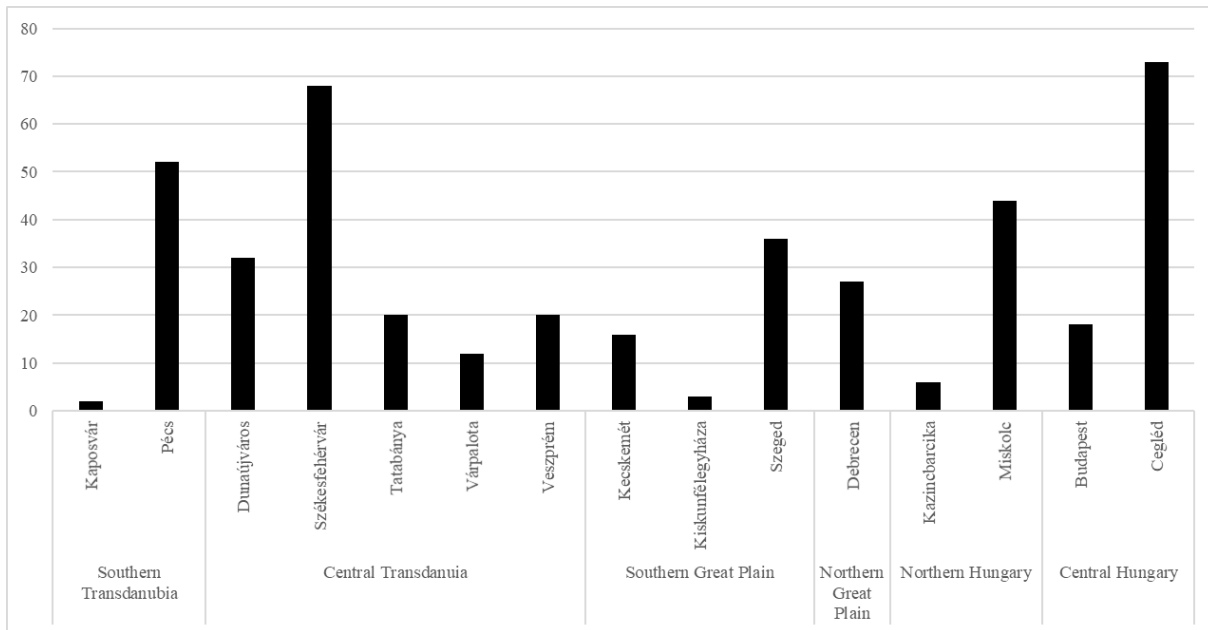
Source: own compilation based on Győri 2019, 35.

Figure 1. Rate of people living on begging, panhandling and collecting unwanted household items among homeless people in some towns in Hungary, 2018
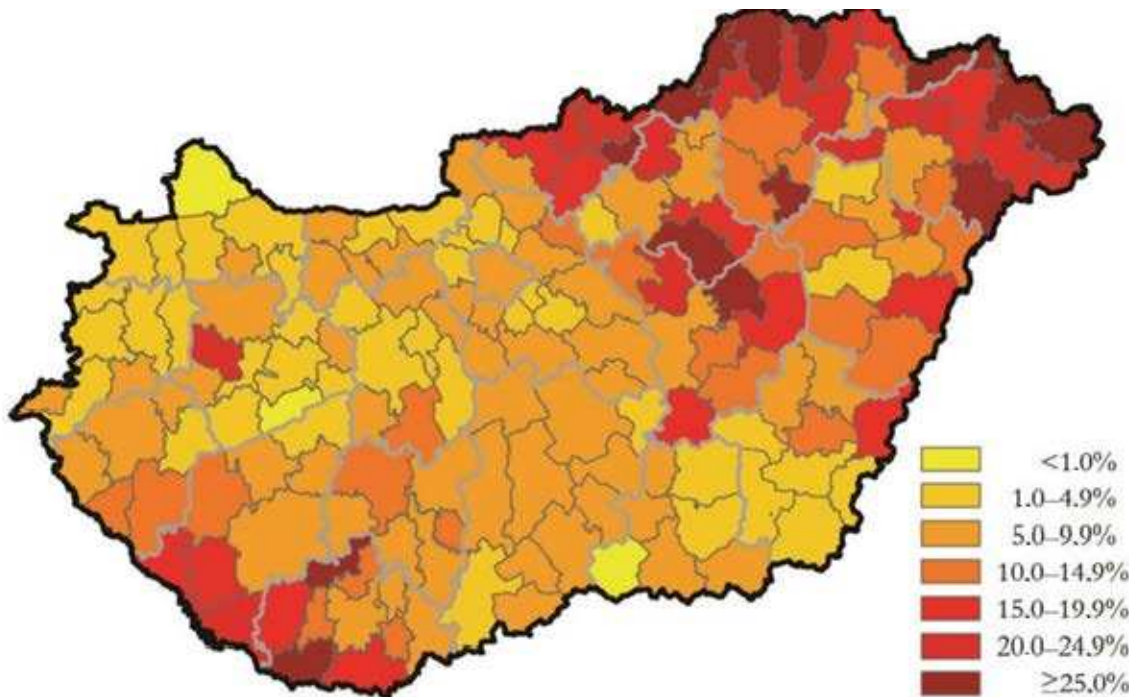
Source: Pénzes et al. (2018, p 18)

Figure 2. The ratio of the Roma population in districts of Hungary according to surveys of the University of Debrecen (2010-2013)

A further social group most exposed to poverty is the Roma population, which makes about 6-7% of the total Hungarian population. It is the poorest and most excluded part of the population. Their low education level and low employment level have led to their deep poverty (Bernát 2014). In 2012, TÁRKI conducted a survey that revealed that while 12% of the total Hungarian population lives below 60% of the median equivalized income, this rate is 76% for the Roma population (Gábos et al. 2013). The regional distribution of the Roma population is unequal in Hungary, with the highest concentrations in the

northeastern and the southwestern parts of the country (see Figure 2).

Besides the homeless and Roma people, families with children also experience an increased risk of poverty and social exclusion. TÁRKI Household Monitor Survey revealed that at-risk-of-poverty levels have persisted among children since the beginning of the 1990s in Hungary (Gábos – Tóth 2019). The differences between households with at least one dependent child and households without any children by work intensity (referring to how much of their total work potential the adults worked during the past year), with some exceptions, point out that households with at least one dependent child have a greater probability of becoming poor (Figure 3).

Social Innovations and SozialMarie

The concept of innovation was first used by Schumpeter (1934) who defined its five types: production of new goods or goods with new quality; introduction of new methods of production or sales of a product; new markets; creation of new forms of

organizations; new sources of supply of raw material or semi-finished goods. The concept of social innovation is newer and has no single definition. It was first mentioned by Drucken (1985), who drew attention to the importance of social innovations. Whyte (1987:45) defined social innovations as "social intentions to solving human problems". G. Fekete (2015: 282) says that social innovation, on the one hand, may refer to the involvement of social resources to the economy (which is a new idea compared to the previous practices). On the other hand, it refers to new solutions elaborated and disseminated by innovative organizations with mainly social goals, aiming at satisfying social needs. The latter one practically incorporates the previous one. The current interpretation implies that an innovation is considered social when: it is driven by social value; the idea is at least partly derived from the civil society and social movements; new forms of social cooperation and new forms are used in its development and realization; it reacts to the society.

Kocziszky et al. (2017:16) define social innovations as giving "new or novel answers to a community's problems in order to increase the community's wellbeing".
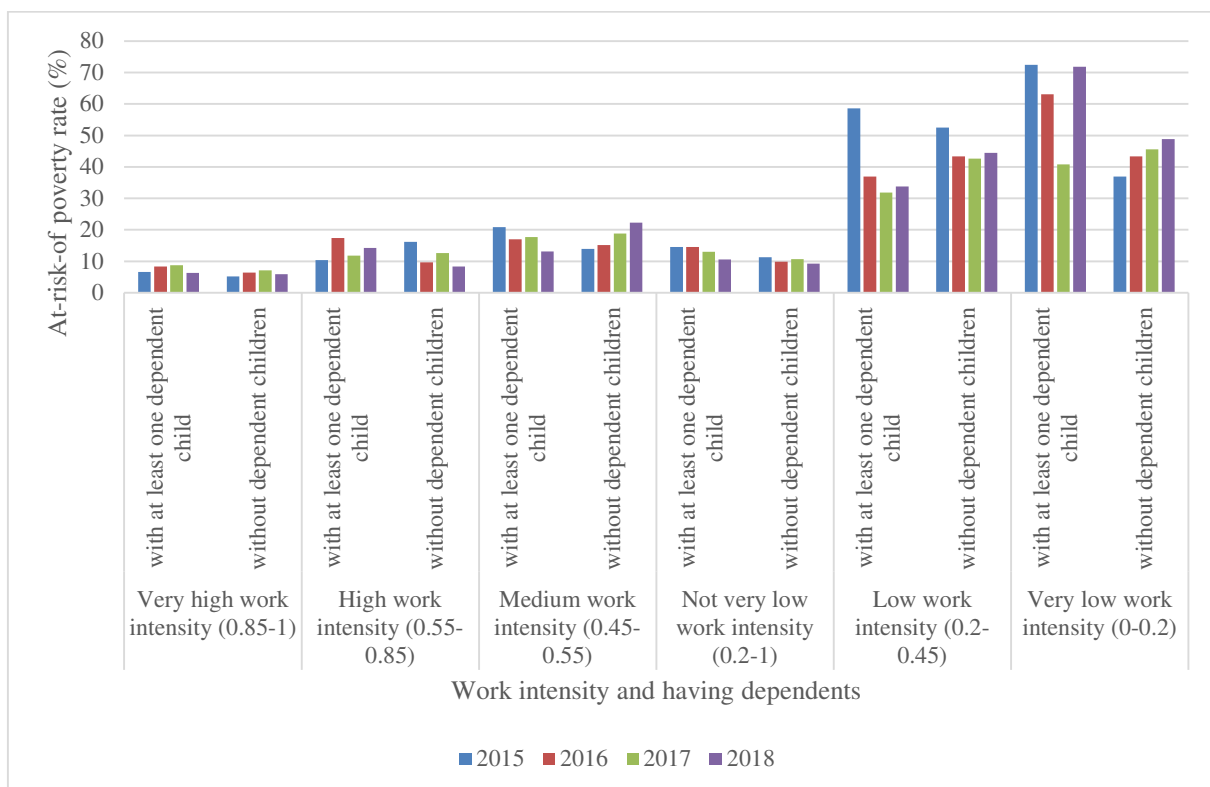
Source: own compilation based on Eurostat SILC database (https://ec.europa.eu/eurostat/web/income-and-living-conditions/data/database)

Figure 3. At-risk-of poverty rates of households with at least one dependent child and without any children by work intensity, 2015-2018

SozialMarie, Prize for Social Innovation

SozialMarie is the oldest prize for social innovation in Europe and has honored 15 projects each year since 2005. Application for the prize is possible from Austria, Hungary, Czechia Republic, Croatia, Slovenia, Germany and Poland. The organizers of the prize use the following definition of social innovation:

"Social innovation drafts solutions to pressing social challenges. It provides room for new approaches, gives innovative answers and lays news paths. Social innovation either reacts to a new social question or it solves a known problem by a new practice. Action can be taken by the affected social group itself, it must in any case be appropriated and co-implemented by those concerned. In this manner, social innovation creates sustainable, exemplary solutions that inspire others." (SozialMarie. (n.d.))

The submitted projects are evaluated based on the following four criteria:

➢ *Innovation in the project idea:* the novelty of the project can be the identification of a new social problem or a new way to solve an already known social problem;
➢ *Innovation in accessing target groups:* projects that involve the target groups are evaluated more highly;
➢ *Innovation in implementation:* the effectiveness of the projects are evaluated as well as the cooperation they can create among different groups;
➢ *Innovation in public perception:* the extent to which the projects are integrated into the local and regional environment and their cooperation with other institutions is examined (SozialMarie. (n.d.)).

HYPOTHESES, DATA AND METHODS

The first hypothesis states that the most common target groups and activities of the innovative projects in the field of poverty coincide with the groups most exposed to poverty in Hungary nowadays, based on Győri (2017). This hypothesis implies that the main target groups of innovative projects are the Roma, the homeless and children.

My second hypothesis is that in the less developed regions (where per capita GDP is lower), the rate of social innovations in the field of poverty is higher because in these regions there is an increased need for poverty alleviation.

Hungarian social innovations aiming at the alleviation of poverty are examined based on the database of the SozialMarie prize. Up to October 2019, all of the submitted innovations between 2008 and 2019 were available at sozialmarie.org including their short description and their main characteristics. For this period, the database included 147 Hungarian projects in the field of poverty, homelessness and indebtedness.

The number, main activities, main target groups and regional characteristics of social innovations are analyzed with relative frequencies and graphs. The relationship between regional distribution and economic growth is tested with Pearson's correlation.

MAIN FINDINGS

Number and Regional Distribution of Hungarian Social Innovations in the Field of Poverty, Homelessness and Indebtedness

The main aim of this section is to describe the number and regional distribution of poverty- related social innovations to highlight whether there are any regional differences and to examine whether economic growth and the per capita rate of social innovations are related. As a result, the second hypothesis can be tested.

Between 2008 and 2012, the number of projects in the field of poverty, homelessness and indebtedness applying for the SozialMarie prize kept increasing, except for the year 2009, when no projects from Hungary applied for the prize in the field of poverty. The peak in the number of the examined projects was between 2012 and 2014. With the exception of a slight increase in 2017, the number has been decreasing since 2014. As for the number of the prize-winning projects, the best years were 2014 and 2017, when out of the three nominated projects in the given field, two were awarded each year (Figure 4).
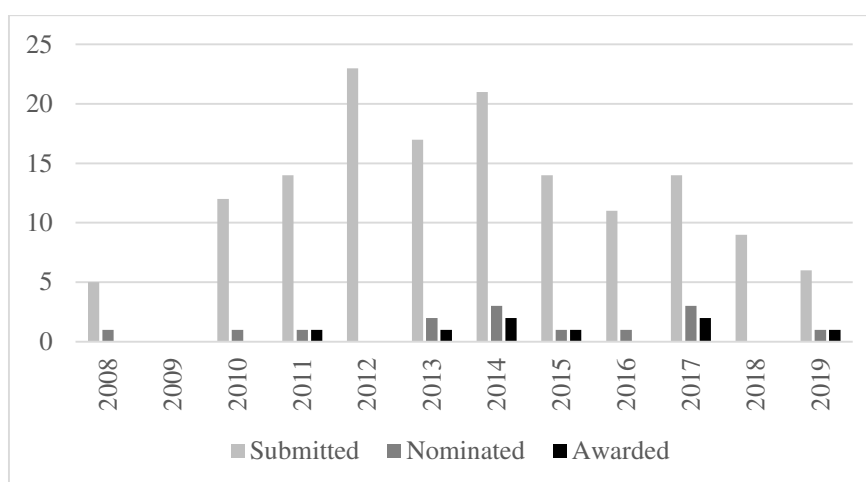
Source: own compilation and own calculation based on SozialMarie database

Figure 4. Number of awarded and submitted Hungarian projects in the field of poverty, homelessness and indebtedness for SozialMarie, 2008-2019

Table 2
Number of innovative projects in the field of poverty in the Hungarian regions, 2008-2019

	Northern Hungary	Northern Great Plain	Southern Great Plain	Central Hungary	Central Trans-danubia	Western Trans-danubia	Southern Trans-danubia	Total
2008	0	0	0	0	0	1	0	1
2009	0	0	0	0	0	0	0	0
2010	1	1	1	1	0	0	0	4
2011	2	2	0	2	0	0	0	6
2012	2	1	0	4	0	0	2	9
2013	4	3	1	5	0	1	0	14
2014	3	3	1	6	2	1	1	17
2015	1	0	0	4	0	0	0	5
2016	0	1	0	2	0	0	1	4
2017	1	0	0	3	0	0	1	5
2018	2	0	0	5	0	0	1	8
2019	1	0	0	3	0	0	0	4
Total	**17**	**11**	**3**	**35**	**2**	**3**	**6**	**77**

Source: own compilation and own calculations based on the SozialMarie database

The regional distribution of the Hungarian innovative projects in the given field is analyzed based on the area of its activity. About half of the examined projects perform their activities throughout the country, therefore the analysis of the regional distribution is only possible for projects operating in a specific settlement/county/region of Hungary. Based on their regional distribution, it can be concluded that even though most of the innovative projects in the field of poverty, homelessness and indebtedness are found in the Central Hungarian region (Table 2), the Northern Hungary region is at the top of the list when their number is compared to the population. The rate of

innovative projects is the lowest in the Southern Great Plain, Central Transdanubia and Western Transdanubia (Figure 5).

Social innovations in the field of poverty applied for SozialMarie from the Central Hungarian region between 2010 and 2019 every year. The same applies to the Northern Hungarian region, with the exception of 2016. Projects from Northern Great Plain were active mainly between 2010 and 2014 with the exception of Debrecen Bike Maffia, which applied for SozialMarie in 2016 from Debrecen (Northern Great Plain). Projects from Southern Transdanubia applied for SozialMarie between 2012 and

2018. The fewest social innovations in the field of poverty could be found in Central Transdanubia, Western Transdanubia and the Southern Great Plain. Interestingly, almost all of the projects from these three regions applied for SozialMarie in 2013 and 2014.

As for the counties of Hungary, Budapest has a similar position to that of the Central Hungarian region, as the capital has a dominant role within the central region. Pest, the other county belonging to the Central Hungarian region, has much lower GDP per capita (less than half that of Budapest) and a slightly higher rate of social innovations. The county-level breakdown also reveals that the high rate of social innovations in the Northern Hungary region is due to Borsod-Abaúj-Zemplén County, which has 0.85 social innovations in the field of poverty per ten thousand inhabitants, while the rate is only 0.07 in Heves and 0.14 in Nógrád, the two other counties belonging to Northern Hungary. There are five counties where there were no social innovations in the field of poverty submitted in the examined period (Figure 6).
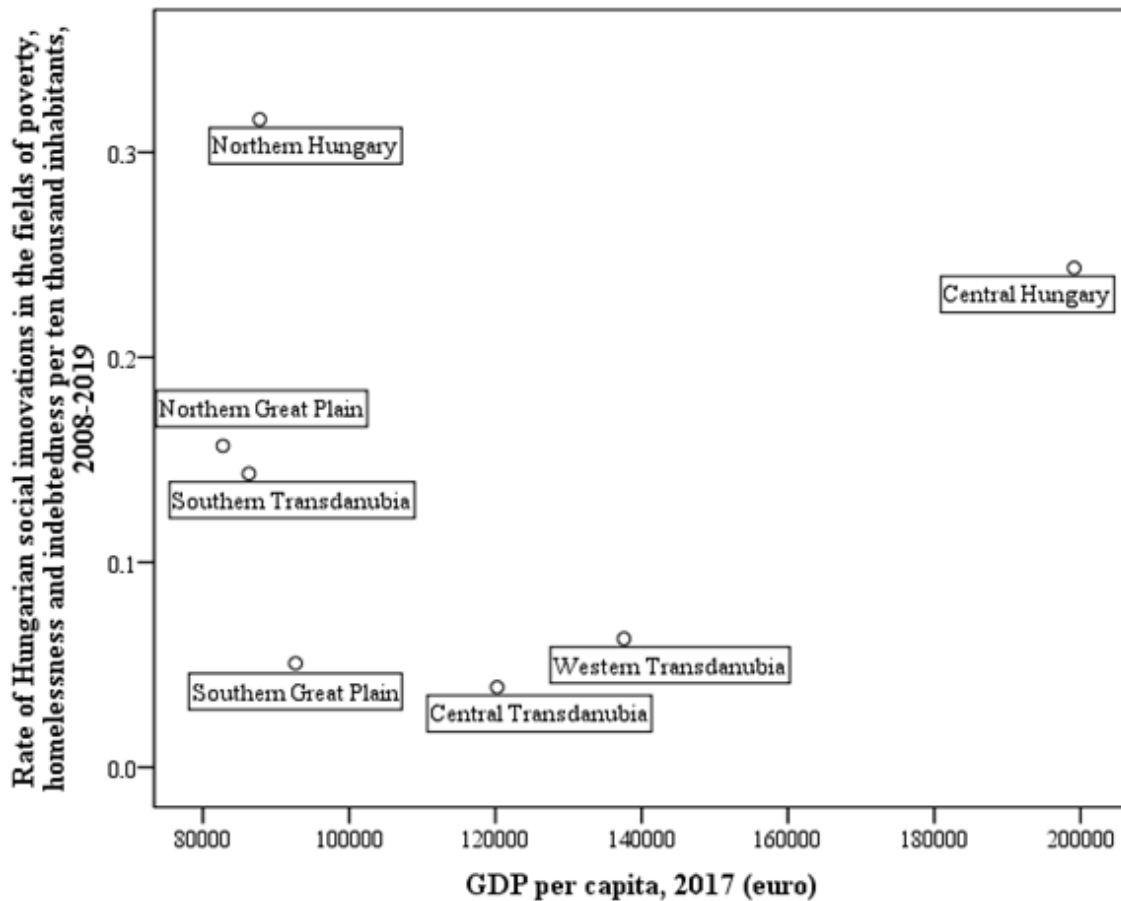
Source: own compilation and own calculations based on SozialMarie and HCSO databases

Figure 5. Relationship between the rate of Hungarian social innovations in the field of poverty, homelessness and indebtedness to ten thousand inhabitants and GDP per capita at the regional level
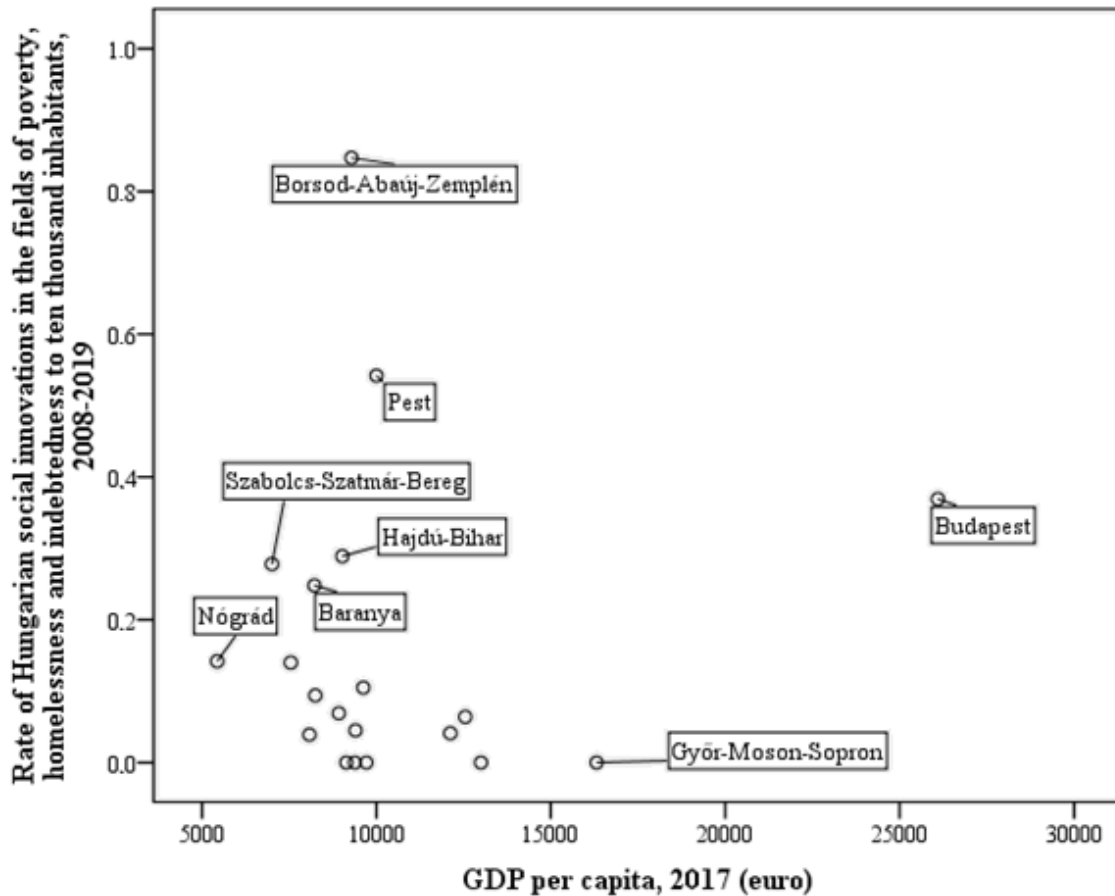
Source: own compilation and own calculations based on SozialMarie and HCSO databases

Figure 6. Relationship between the rate of Hungarian social innovations in the fields of poverty, homelessness and indebtedness to ten thousand inhabitants and GDP per capita at the county level

In order to test the hypothesis regarding the relationship between the rate of social innovations fighting poverty and economic growth, the number of such innovations per ten thousand inhabitants is calculated for the 20 NUTS3 level counties (including Budapest) and the 7 NUTS2 level regions of Hungary. To do so, the population data published by the Hungarian Central Statistical Office (HCSO) are used. The rates are then compared to the per capita GDP of 2017 (published by HCSO) and Pearson's correlation is calculated.

Table 3
Linear correlation between per capita GDP and the rate of Hungarian social innovations per ten thousand inhabitants

	Pearson correlation	**Sig. (2-tailed)**
County level data	0.064	0.790
Regional data	0.113	0.810

Source: own compilation and own calculations based on SozialMarie and HCSO databases

Pearson's correlations (Table 3) show that the relationship is weak between the rate of social innovations and economic growth both for regional and county level data. The relationship is direct, implying that a higher level of economic growth is usually associated with higher rates of social innovation. The relationship is not significant, though. The second hypothesis is therefore rejected as in the less developed regions, the rate of social innovation in the field of poverty is not significantly higher.

Activities and Target Groups of Hungarian Innovation in the Field of Poverty, Homelessness and Indebtedness

To test the first hypothesis (about the relationship between the groups most exposed to poverty and the main target groups of the poverty related social innovations), the activities and the target groups of the social innovations in the field of poverty are examined.

Innovations against poverty aim at helping the poor in many fields. Children are the main target group for innovations (17% of the examined innovations), but projects often focus on the homeless, the Roma and ill and

disabled people. Only a small part of the projects aim at helping the elderly and immigrants (Figure 7).

The activities of the examined social innovations often correlate with the target groups. Twelve percent of the projects provide housing for the poor and another 12 percent provide education. Projects in the field of housing aim at helping the homeless, while projects in the field of education mainly aim at helping children and youths. Distributing food to poor people, which contributes to the satisfaction of a basic human need, accounts for 11% of the activities of the projects. Sensitization (making the members of the population more sensitive to social problems) is also a common activity (9%), but usually in conjunction with other activities. Involvement of the target group is also an important element of some (8%) of the projects, which may be partly due to the fact that this is a criterion of the evaluation of the prize. Providing assistance for the poor (6%) and development in the field of health (6%) are also listed among the relevant projects. Other targets are the increase of employment (5%), giving support for underdeveloped regions (3%) environmental protection (3%) of the projects and help people involving animals (2%) of the cases (Table 4).

The first hypothesis therefore is failed to be rejected, as the most common target groups (the Roma, the homeless and children) and activities (providing housing, education and food) of the innovative projects against poverty coincide with the groups most exposed to poverty in Hungary.
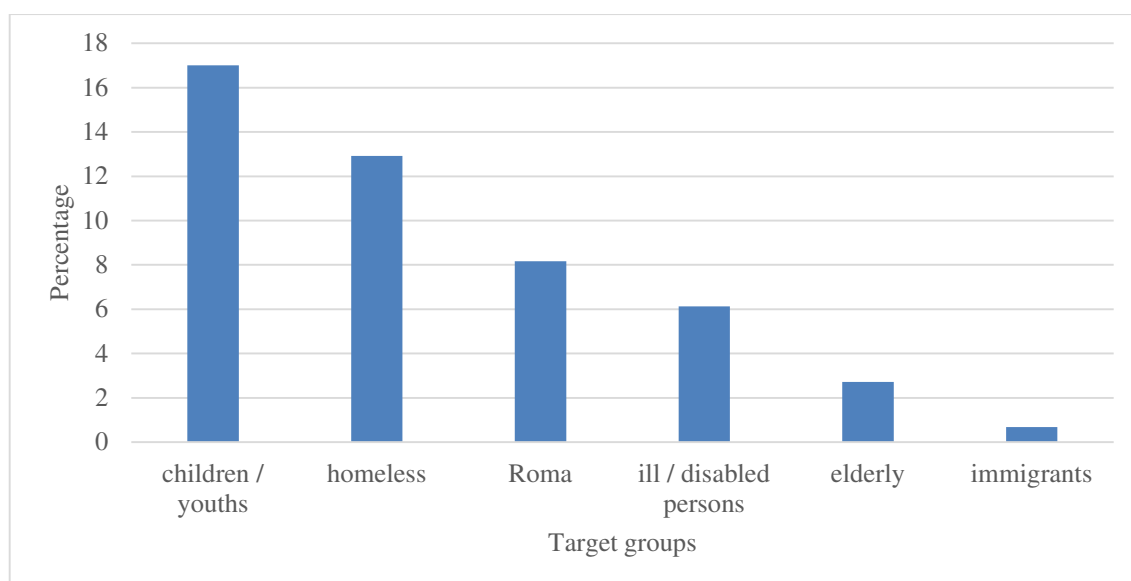
Source: own compilation and own calculation based on SozialMarie database

Figure 7. Most common target groups of Hungarian social innovations created to help the poor, 2008–2019

Table 4
Main activities of the Hungarian social innovations created to help the poor, 2008-2019

Activity	*Relative frequency*
Housing	12
Education	12
Food distribution	11
Sensitization	9
Involvement of the target group	8
Assistance	6
Development in the field of health	5
Employment	5
Regional development	3
Environmental protection	2
Involving animals to help people	2

Source: own compilation and own calculations based on SozialMarie database

Some Examples of Successful Social Innovations in the Field of Poverty in Hungary

In this section, I describe two examples of innovative social projects fighting against poverty: one ("When is the time to act if not now?") from the most developed Central Hungarian region and the other one from a least developed region.

"When is the time to act if not now?"

The project called "'When is the time to act if not now?' Participatory action research about housing movements in Budapest" received a 2000 euro prize from SozialMarie in 2017.

The project seeks to help resolve the housing crisis in Hungary and therefore to contribute to the satisfaction of the basic human need of shelter. It is carried out by gathering the "best practices" of the good old days. It focuses on the examples of mobilizing people to help those living in shelters or in the streets in the past (Csécsei et al. 2017).

As a result, a mobile exhibition has been created, the final location of which wasin Kassák Museum, Budapest. Moreover, some workshops have also been organized to publish the results. The good examples are intended to inspire struggles for housing today and in the future.

The project is organized by the School of Public Life. The need for this research emerged in 2009, when researchers of the School, taking part in the foundation of the "The City is for All" (A Város Mindenkié) advocacy group, realized how difficult it was to find examples of the struggles for rights of homeless people or people living in housing poverty. They believed that Hungarian housing activists would need good examples, like the example of their colleagues in the United States. Their good practices could be adopted in Hungary to solve current problems. The advocacy group has become a movement by now, cooperating with other organizations to find system-level solutions for housing problems.

The project "When is the time to act if not now?" was realized between January 2015 and July 2016 and involved two trained researchers and nine persons living in housing poverty. It therefore realized the principle of the involvement of the target group in the project. In the first twelve months, participants were trained and the data collection and data analysis were carried out. From January to July 2016, dissemination was carried out: the gathered materials were exhibited in several social institutions and community centers.

The project aimed at making a difference in four different areas:
➢ It aimed at developing the researchers' skills;
➢ It tried to deliver the message of the project to as many individuals living in housing poverty as possible;
➢ It also aimed at making the members of the whole population, including those who can make a different

in poverty alleviation, more sensitive to and aware of the housing crisis in Hungary;
➢ It is to call the attention of the academics to pay more attention on research methods that involve the target group in the implementation process. (www.sozialmarie.org)

"Steps For István akna"

The project called "Steps for István akna" was nominated for the SozialMarie prize in 2016. The project 'Small Steps for István akna', implemented between October 1 2014 and November 30 2015, aimed to develop István akna, one of the most underdeveloped parts of Pécs, the capital of Southern Transdanubia. This district, situated about six miles away from downtown Pécs, is in a disadvantaged position for multiple reasons. The apartments there are in poor condition and public transportation does not work properly, which makes health care and appropriate education hardly available for the bulk of its population. For many years, the primary goal of the municipality of Pécs was to eliminate this district. However, due to the fact that this is difficult to implement (because of the low number of state-owned homes or low willingness to move), the municipality has involved the development of the district into the development plans of the city (SozialMarie. (n.d.).

As the proportion of children in the population is higher than the average here, the project seeks to take the first steps to lift poor people out of poverty by developing poor children's skills (www.sozialmarie.org).Duncan et al. (2011) conclude that childhood poverty has substantial effects on the adult labor market success, since they found that poverty early in childhood has harmful effects on adult earnings and work hours. Unicef concludes that malnutrition and poor hygiene practices often accompanying poverty prevent the children's healthy development. (Unicef (n.d.) Early development (ages 0-5) has a goal to minimize and eliminate these gaps. Within the framework of the project between 2014 and 2015, the early development of 33 toddlers (more than 60% of all the toddles living in István akna) was realized with individual development plans. In the framework of the project, action days and baby-mother days were organized which, besides helping the children's early development, drew the parents' attention to how to ensure the healthy development of their children.

The project was realized with the cooperation of the Roma Education Fund, which provided a significantfinancial help (EUR 30,000). Besides the Fund, the municipality of Pécs also helped the project by elaborating and implementing a comprehensible and integrated development plan. After 2015, however, because of the lack of the necessary financial resources, the project was temporarily cancelled and is unable to restart its operation without further investments. (SozialMarie. (n.d.)

CONCLUSION

In the last dozen years, many innovative projects were established in Hungary in the field of poverty, which is well reflected by the fact that a total of 147 Hungarian projects fighting for the alleviation of poverty applied for the SozialMarie prize between 2008 and 2019. The main target groups of these projects are children, the homeless, Roma, the disabled, the elderly, and immigrants. The most common target groups of the projects well reflect the composition of the most disadvantaged people in Hungary. Research on poverty has revealed that the number of children, housing conditions and Roma minority are risk factors of poverty (Darvas & Tausz 2002). The three factors that have become strongly associated with poverty since 2000, namely belonging to the Roma minority, having a large family, and living without shelter (Győri 2017) also coincide with the most common target groups of the examined social innovations.

In conjunction with the target groups, the most common activities of innovative projects are providing shelter, food, or education and the sensitization of the society. Many projects focus on the involvement of the target group. For instance, the project "When is the time to act if not now?", described above in detail, enhances the awareness of the general public to the housing crisis in Hungary and highlights the importance of providing shelter for everyone.

Analysis using county level and regional data revealed that the highest number of social innovations in the field of poverty can be found in the capital and in the Central Hungarian region. The proportion of the examined social innovations compared to the population, however, is the highest in the Northern Hungary region, one of the most underdeveloped regions of Hungary. In the other Hungarian regions with similarly low per capita GDP (Northern Great Plain, Southern Transdanubia and Southern Great Plain), however, the proportion of such social innovations is much lower. The project "Steps for István akna" is a project from Southern Transdanubia, which, unfortunately, has not been able to perform its activity since 2015 because of the lack of the necessary financial resources. It can be concluded that in the less developed regions of Hungary, more social activism would be needed. More innovative projects or the adaption of existing social innovations could contribute to the alleviation of poverty.

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Analysis of the Asset Structure of Hungarian District Heat Suppliers, with Special Regard to the Fixed Assets, Based on the Companies' 2009-2017 Accounts

GÁBOR BÉLA SÜVEGES
MASTER INSTRUCTOR

UNIVERSITY OF MISKOLC
e-mail: suveges.gabor@uni-miskolc.hu

SUMMARY

Nowadays in Hungary, district heating has 677,000 fee payers in 93 settlements, for the provision of which 89 companies are responsible. There are, however, differences in the ownership background, in the technical structure, in the activities carried out by the district heat producers and in the number of the consumers supplied. This paper examines the asset structure of the Hungarian district heat suppliers, with special regard to their fixed asset ratio. The research aims to explore whether the companies' activities have an effect on their asset structure on the one hand and whether there are any significant differences between some special characteristics (pipeline length, number of fee payers) of the district heat suppliers and the tangible asset ratio. Using the data derived from the accounts of the Hungarian district heat suppliers and from technical and economic data, information from nine years (2009-2017) were analyzed.

Keywords: District heat supply, District heat producers, account analysis, asset structure

Journal of Economic Literature (JEL) code: K32

DOI: http://dx.doi.org/10.18096/TMP.2020.01.06

INTRODUCTION

The bulk of the literature dealing with district heating examines the sector from its technical aspect. In this field, the research of Németh (2008) and Kádárné Horváth (2010), who examined the pricing of district heat suppliers, are outstanding. In their dissertations and the related research, they described in detail the regulatory environment and the theoretical and practical basics of the formation of pricing. As district heat suppliers are public service companies, the analytical research of Illés (2010) about the management of public service companies is essential regarding this field. One of the novelties of the current research is that there is no analysis in the literature that has examined the management and operation of heat supply companies in a comprehensive way with report analysis tools. The other novelty is that this research fills the gap that no summary study has been prepared whose data could be used as a benchmark for industry experts for the comparative analysis of the performance of their industry and their company. The aim of the paper is to reveal any operational specificities that significantly influence the asset structure and to reveal whether there are any technical or economical characteristics that have an important effect on the asset structure.

LITERATURE REVIEW

I begin the theoretical review with describing the most important technical characteristics of the district heat sector in two steps. I examine the Hungarian companies dealing with heat supply and reveal their characteristics, since this provides the opportunity to define qualitative criteria necessary for subsequent variance analysis (Domán et al., 2009). The tools to characterize wealth position used in the empirical analysis are also described in the literature review.

CHARACTERISTICS OF HUNGARIAN DISTRICT HEAT SUPPLIERS

Although the beginning of district heating in Hungary dates back to 1899, when the district heating system responsible for supplying the Parliament was put into operation, the real beginning of district heating can be traced back to the 1950s, when residential communal district heating began. Later, in the 1960s, it was the state housing program that led to its spread (Cselédes, 2009). At the time of the establishment of Hungarian district heating, the role of industrial district heating was dominant (Lázár and Orbán 2011). Then, between 1960 and 1990, a total of 1.2 million homes were aimed to be built within the framework of the housing programs I and II (Kádárné Horváth, 2012). In the case of the prefabricated buildings built at the time, one-pipe internal heating systems without connecting sections were constructed to ensure the fastest and most "economical" construction (Egedy, 2003). Experts did not consider it feasible – or justified – to regulate the heating of apartments individually (Cselédes, 2009).

"In order to complete high figures of the plans for housing projects, solutions with a minimal investment need were preferred in both home construction and the creation of district heating systems. This was also supported by the prevailing architectural concept at the time that panel flats had a steady heat demand. The option of differentiated heating of the flats was not considered acceptable due to the different degrees of thermal expansion. In addition, Hungary received Russian natural gas extremely cheaply so there was no need for savings." (Kádárné Horváth, 2010, p. 30).

Since in many municipalities district heating services were used to remove waste heat from an industrial facility, such as the Lenin Metallurgical Works in Miskolc, there was no need to insulate the pipes in order to perform the task "more efficiently".

Experts consider the period from the change of regime in 1990 to the millennium to be one of the most difficult periods in the history of district heating, as consumer prices rose in addition to rapidly increasing energy prices and the cost disadvantage of heat supply became increasingly apparent also to consumers (Orbán, 2016), and there were significant changes in the operation and maintenance of these systems. In practice, this meant that with the introduction of market economy conditions, the energy management of the country was also transformed. The possibility to procure previously inexpensive sources of energy was eliminated, prices and operating costs increased significantly and the ownership structure of both the heat producers and consumers changed (Vadász, 2015). Pipe systems formerly considered "efficient" waste heat exhaust became loss sources of the system because previously many cities used district heating to remove waste heat from the heavy industry, but after the decay of these industries, heat production and the inefficient insulation became a serious problem. Similarly, the lack of regulation of individual heating in homes became a bottleneck and a source of loss, as without it, the excessive temperature in the homes could be decreased only by opening the windows, which, although acceptable in the previous period, became a major factor of inefficiency with the change in market conditions.

INDICATORS OF THE FINANCIAL SITUATION ANALYSIS

An analysis of the financial position of a company is possible by studying its balance sheet. Depending on the depth and approach of the analysis, the overall analysis of the balance sheet and the detailed examination of the certain/different balance sheet items can be distinguished (Pucsek, 2011).

The analysis of the assets and finances using the balance sheet data can be carried out in a number of ways. Based on the methodology of the analysis of deviations, the following methods can be distinguished:

➢ the method of absolute differences, when the difference between the absolute data of two or more years/periods is calculated and this is to be explained by exploring causal relationships,

➢ in the case of the method of relative differences, absolute data are only starting points as ratios and indices are calculated from them (Kardos et al., 2007). In some areas of research, it might be important to analyze some of the key assets in detail. In such cases, the method of relative differences can be used.

The balance sheet may be analyzed:

➢ vertically, when the source of information is either the asset side or the liability side,

➢ horizontally, when information is used for the calculation of the indices from both the asset and the liability side (Siklósi and Veress, 2016).

Table 1 shows the most important indicators and their calculation methods.

Table 1
Key indicators of assets and capital structure based on the methodology of vertical analysis

Focus of the analysis / Indicator name		Calculation of the indicator	
		Numerator	Denominator
Indicators of asset structure	**General way of calculating the indicator**	Asset item	Asset group
	Examples	Fixed assets	Total assets
		Tangible asset	Total assets
		Current asset	Total assets
Indicators of capital structure	**General way of calculating the indicator**	Capital item	Capital group
	Examples	Equity	All liabilities
		Debt	All liabilities
Intensity indicators	Tangible asset intensity	Tangible asset	Tangible assets + Current assets
	Equity intensity	Equity	Equity + Debt

Source: Own compilation

In vertical analysis, we can understand the asset structure, the capital structure and their changes by calculating different distribution ratios. A number of indicators can be constructed from them. Based on the underlying methodology, the following ratios can be distinguished:
➢ the rate of the main balance sheet group to the total assets or liabilities,
➢ the rate of the balance sheet group to the main group,
➢ examining the structure of the given asset or liabilities group using ratios calculated from rows within the group,
➢ other vertical ratios that are (distribution) ratios calculated by aggregating several asset or liability items (Pucsek, 2016) -

There are no generally accepted values of the assets. They can be different in different industrial sectors and may vary from time to time. According to Illés (2000), at the end of the 1990s the district heating system was "the most valuable asset of heat supply companies, accounting for 67% of the total fixed capital in the case of Budapest District Heating Works" (Illés, 2000, p. 25). Moreover, by examining the asset composition of a company, conclusions can be drawn regarding the industrial sector where it operates. Moreover, asset structures of the companies of a given industrial sector can serve as a benchmark for the companies operating in the given sector.

Similarly, no general proposal can be given about the optimal capital structure, but "according to the bulk of the professional literature, it is desirable that the equity should not be less than one third of the liabilities…., in the case of Hungarian companies, the rate of equity to the total liabilities is 30-40 % "(Béhm et al., 2016, p.32; see also Szemán, 2017; Musinszki, 2016).

Vertical and horizontal analyses include the formation of specific indicators of the financial situation and of the financing structure.

THE AIM OF THE EMPIRICAL RESEARCH AND THE APPLIED METHODOLOGY

The objective of the empirical research is the analysis of the asset structure of the companies providing district heating in Hungary. According to previous studies focusing on these types of companies operating in the country (Németh, 2008; Kádárné Horváth, 2010), there is a significant difference in the ownership background and operating structure of the companies. Accordingly, the following research questions were asked: do these factors affect the asset structure of the companies, is there any significant difference based on these characteristics, what additional factors can have a significant effect on the companies?

The *database* of the research includes the 2009-2017 financial reports of the companies. Currently in Hungary, 89 companies provide heat in 93 settlements. At the beginning of the research, the aim was to conduct a full-scale analysis, but the population had to be truncated later. This was partly due to the lack of data, partly due to preliminary statistical research results showing that some companies with outstanding values would have distorted the values of the indicators. There are two reasons for the lack of data and the existence of outliers. Firstly, some companies were transformed several times or changed

their owners over the years. In the case of some of these companies, it was not possible to identify the predecessors and successors and they were therefore excluded from further analysis. It is justified to exclude these companies from an accounting point as well since the termination with legal succession is not part of the "normal" business process and the management information of the years before and after the termination would not have contributed to a realistic and faithful picture of the examined population. Secondly, there were companies whose data could not be obtained. After the truncation, 72 companies became part of the examined population. It is important to highlight the representativeness of the examined population to the whole population; this was tested from several aspects like the amount of heat sold, the territorial or regional distribution or the number of customers.

The amount of heat sold by the 89 companies and the number of customers serviced by them varies widely; the amount of heat sold and the number of customers belonging to the 72 companies of the examined population exceeds 95% of the total amount of heat sold and the total number of customers of the 89 companies. It follows that the conclusions drawn from the examined population adequately describe the position and condition of the whole population.

The calculation of the indicators of the asset structure required the annual reports of the companies, which is considered the first type of data. Currently no database with data at the balance sheet item level is available in Hungary[1] therefore manual data collection was required. The other type of examined data includes the technical and economic data that companies have to provide yearly according to the Annex 4 of Government Decree no. 157/2005 on the implementation of Act XVIII of 2005 on District Heating Services. Since 2012, district heat suppliers have had the obligation to disclose these data to the public.

The availability of the necessary data was ensured by several data sources, which were:
- Ministry of Justice, Company Information and Electronic Company Registration Service (https://e-beszamolo.im.gov.hu)
- Websites of companies in the case of the parts of the reports that were made public and for technical and economic data[2],
- Direct contact with the companies by letter to obtain technical and economic data[3].

Act XVIII of 2005 on District Heating Services, Chapter 3, Article 18/A requires "that cogeneration shall be published broken down by premises, that district heat supply shall be published by settlements separately and that other activities shall be published in the supplement of the annual report as if it was carried out within the framework of an autonomous company". This implies that besides their regular balance sheet and profit and loss account, these companies have to prepare a balance sheet and a profit and loss account at the activity level (broken down by premises for district heat production and by settlements for district heat supply). Databases including the companies' annual reports were not relevant for my research because they do not include the data separated at the balance sheet group level or main group level.

The tools of the analysis were the Excel program of the Microsoft Office 365 ProPlus package and SPSS 24 software. The data of the companies' annual reports were uploaded into an Excel file. The final Excel file included 648 rows (72 companies and 9 years) and 640 columns (representing variables).

As for the methodology of the analysis, Excel provided the opportunity to carry out descriptive statistical analysis and the SPSS software package made it possible to carry out more complex analysis (like analysis of variance, univariate analyses, panel regression).

The purpose of the empirical research of the study is to test the following hypotheses:

H1: Fixed assets represent the greatest part in the asset structure of district heating suppliers, while other companies (performing non-heating activities to a greater extent than the average) are characterized by a lower rate of fixed assets.

H2: The fixed asset ratio of district heat suppliers is significantly affected by the size of district heat supplier: higher produced heat volume is associated with a higher fixed asset ratio.[4]

H3: There is a relationship between the number of consumers supplied, the pipeline length and the tangible asset ratio. Higher tangible asset ratios belong to companies with more consumers and with longer pipeline networks.

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[1] Several databases summarizing data and companies were examined before the manual data collection, but the breakdown of the available data was not deep enough, not even in one of the best-known databases, Opten.

[2] According to the Annex 4 of the Government Decree no. 157/2005 (August 15), companies have to publish management and technical data on their website for three years. In order to extend the time horizon of the analysis in the case of these special cases as well, I used the recovery function of the stored versions of Google's search sites to gain access to data for further years.

[3] Although the Government Decree requires the publication of data, there were shortcomings in the case of many, typically smaller, businesses; therefore, I needed to contact the companies by phone or by email.

[4] The fixed asset ratio and the tangible asset ratio of district heat suppliers can be determined by further factors like the age or the amortization rate of the assets. There were no available data for the age of the assets and there is no significant difference among the applied amortization rates based on the supplements (the rates defined by the Act on corporate tax are mostly applied); therefore, the current research does not include the examination of these factors.

RESULTS OF THE RESEARCH

To test the first hypothesis, the asset structure of the 72 examined companies was analyzed.

Data of the reports of nine years show that the average rate of fixed assets of the examined 72 companies exceeded 60% every year, which is as expected. The bulk of the corporate assets is indeed made up of properties that serve the activity in the long run.

The deeper analysis of the rate of fixed assets to total assets provides further information. Figure 2 shows the fixed asset ratio in the entire district heating sector in Hungary at the 95% confidence level. It implies that there have been some changes in the value of the ratio over the examined nine years. The average value of the ratio steadily declined up to 2013, indicating that the replacement of fixed assets lagged behind their depreciation. The trend reverse might have been influenced by the Decree of the Minister of National Development no. 50/2011 (September 30), as this decree specifies a profit limit for district heat suppliers. It implies that the profit before tax derived from activities covered by the Act on District Heating Services may not exceed the product of the gross book asset value taken into consideration in the pricing process and the profit factor, which is set as 2% by the Decree. The Decree also provided that "the profit above the profit limit is to be spent by the company on investments to increase the energy efficiency of the district heat production and district heat supply or to decrease their costs" . Accordingly, the investment of the amount above the profit limit began and its effects became visible in the balance sheets after the activations.
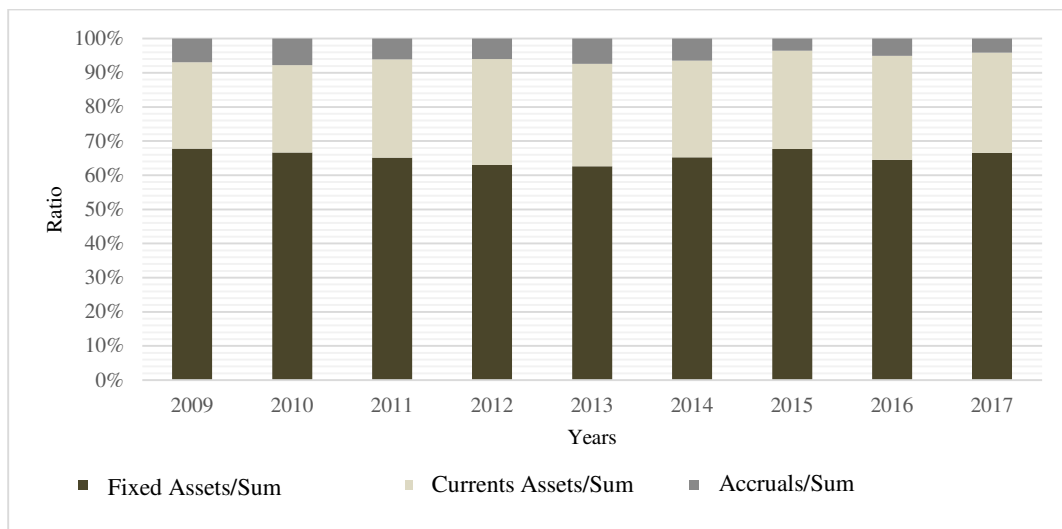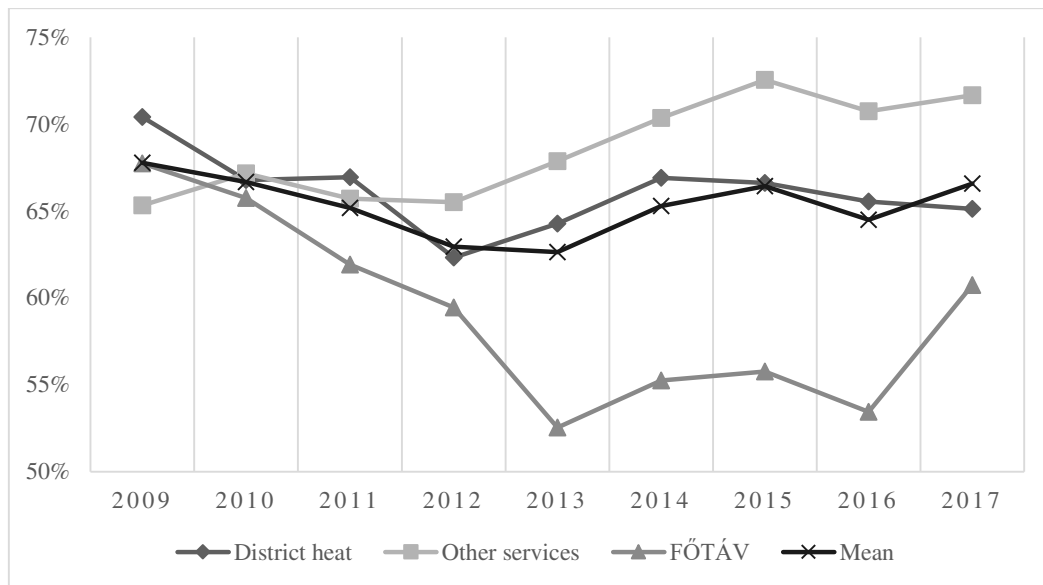

Source: Own compilation based on annual report data

Figure 1. Asset structure of district heat suppliers, 2009-2017
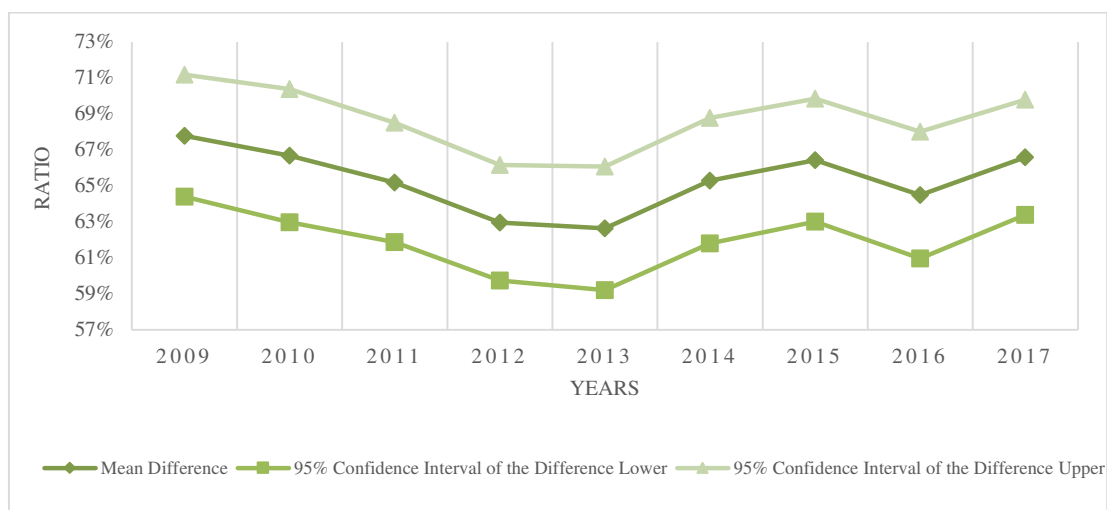
Source: Own compilation based on annual report data

Figure 2. Average fixed asset ratio of the Hungarian heat suppliers at the 95% confidence level

Source: Own compilation based on annual report data

Figure 3. Average fixed asset ratio of district heat suppliers based on activities

The second part of the hypothesis is related to a different law. Act XVIII of 2005 on District Heating Services defines district heating as follows: "A commercial public service provided by the licensee, which supplies consumers with energy intended for heating or other heat utilization. The service is provided from a district heat producing facility through a district heating pipeline network". The Act and the related decrees do not prohibit that companies providing these activities from engaging in other activities as well. Accordingly, besides district heating, the bulk of the 89 Hungarian district heat suppliers carry out other activities, including district heat production, electricity production, waste management, water utility supply and other activities related to urban management. The above-mentioned Article 18/A of the Act provides that the balance sheet and the profit and loss account have to be prepared at the activity level as well. This provided me with the opportunity to examine the rate of the total assets related to district heating and other activities and to examine what percentage of the net receipt of sales comes from performing district heat supplier activities. In the case of the examined population in 2017, the average rate of turnover from other (not district heating service) activities was 28%, while this rate was 33% for the assets. On this basis, I divided the district heat suppliers into two categories. Companies with an asset or turnover rate exceeding the average are labeled by "other services", while other companies are labeled by "district heat". The annual averages calculated based on this classification are reflected in Figure 3.

Although classification by activity would justify the creation of only two groups, preliminary calculations and statistical analyses (including the box-plot shown in Figure 4) justified the separate analysis of Hungary's largest heat provider (FŐTÁV Private Co. Ltd.), which supplies Budapest. There is a difference in magnitude between this company and the other providers, which is reflected in the quantities of heat sold and in its asset position, since 26% of the total assets of the 72 companies belong to FŐTÁV Private Co. Ltd. Based on Figure 3, it can be concluded that:

➢ the decrease in the asset structure of FŐTÁV Private Co. Ltd. played an important role in the decline of the fixed asset ratio of heat suppliers up to 2013,

➢ contrary to previous expectations, it is the 'other' companies (providing non-heating service to a greater extent than the average) are characterized by a higher fixed asset ratio; it was higher on average by 5 percentage points than for companies providing mainly heating supply. The difference can be explained by the fact that even though district heat supply requires a large asset lockup, the other tasks that can be classified as other activities operate with an even higher asset lockup.

It is also important, however, to consider whether the activity breakdown is an appropriate grouping criterion in the case of this indicator. The result of the analysis of variance is shown in Table 2.

Table 2
Significance levels and the analysis of the strength of the relationship over years

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sig	*0.007*	0.441	0.272	0.083	*0.001*	*0.001*	*0.000*	*0.000*	*0.019*
Eta	*0.367*	0.153	0.192	0.264	*0.423*	*0.417*	*0.460*	*0.470*	*0.330*

Source: Own compilation based on annual report data

Table 3
Results of the Post Hoc Tests in the significantly different cases

|	(I) Activities		Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
2013	FŐTÁV_ (district heat)	District heat	-.12668*	0.04199	0.004	-0.2105	-0.0429
		Other activities	-.14539*	0.03941	0.000	-0.2240	-0.0668
2014	FŐTÁV_ (district heat)	District heat	-.11667*	0.04242	0.008	-0.2013	-0.0320
		Other activities	-.15107*	0.04033	0.000	-0.2315	-0.0706
2015	FŐTÁV_ (district heat)	District heat	-.10856*	0.04135	0.011	-0.1911	-0.0260
		Other activities	-.16791*	0.03927	0.000	-0.2463	-0.0895
2016	FŐTÁV_ district heat)	District heat	-.12103*	0.04173	0.005	-0.2043	-0.0378
		Other activities	-.17309*	0.03968	0.000	-0.2523	-0.0939

Source: Own compilation based on annual report data

With the exception of three consecutive years (2010-2012), there is a weak or middle strong relationship among the groups. In order to reveal the groups among which differences can be found, Post Hoc Tests had to be performed, which I examined for the four periods when the relationship was the strongest (2013-2016).

Post Hoc Tests show that the reason for the differences among groups is the significant difference in the asset structure of FŐTÁV Private Co. Ltd. from that of the other groups. However, it should also be taken into account that FŐTÁV Private Co. Ltd. belongs to "district heat" companies regarding its activity, so in this aspect there is a significant difference between the average values of the two groups.

The second and third research questions aim to explore further relationships. The Association of Hungarian District Heat Suppliers (Magyar Távhőszolgáltatók Szakmai Szövetsége) and the Hungarian Energy and Public Utility Regulatory Authority (Magyar Energetikai és Közmű-szabályozási Hivatal) classify district heating suppliers into four groups according to their size. The above mentioned problem of magnitude regarding FŐTÁV Private Co. Ltd. can be observed here as well.
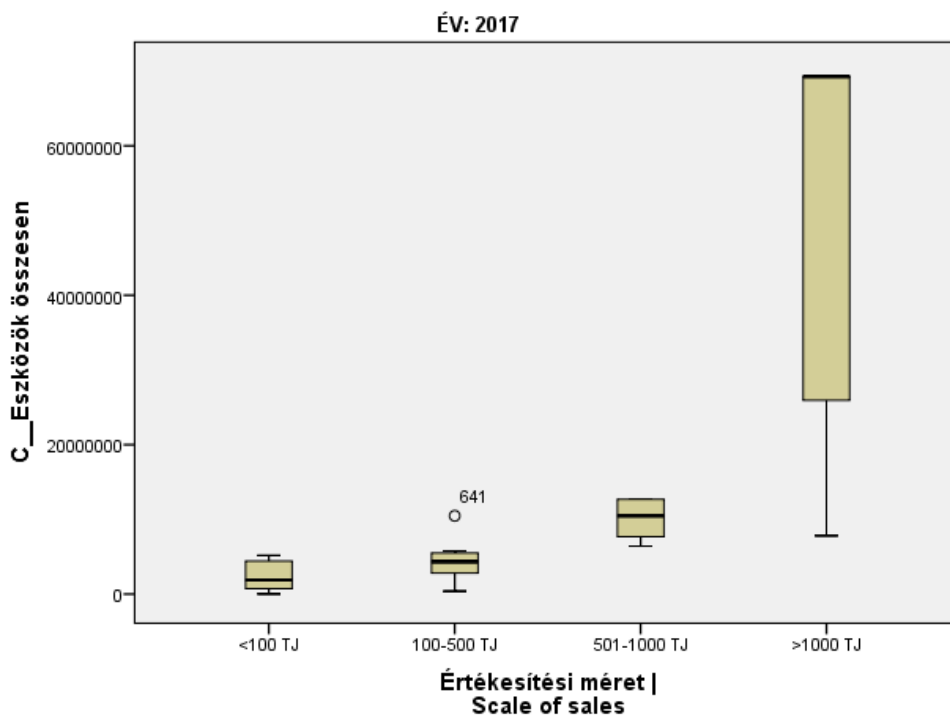
Source: Own compilation based on annual report data

Figure 4. Distribution of the asset value of district heat suppliers (four size classes), 2017
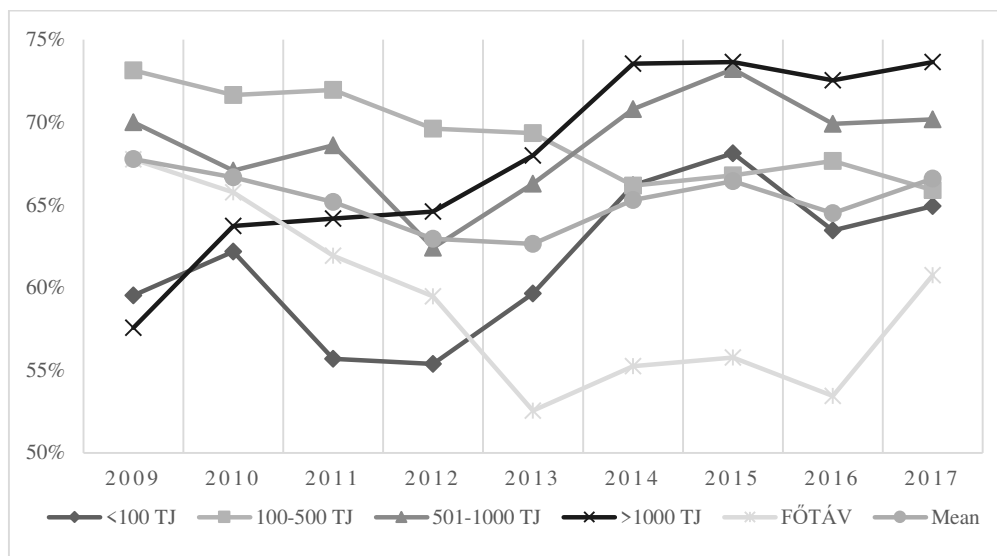
Source: Own compilation based on annual report data

*Figure 5. Distribution of the asset value of district heat suppliers based on size classes
(FŐTÁV Private Co. Ltd. treated separately)*

While the companies falling into the first three class intervals form a homogenous category on the basis of distributions, the last group, made up of companies performing at the highest level, clearly shows the difference in magnitude of Hungary's biggest district heating company, FŐTÁV. Therefore, it is justified to treat that company separately in this case, too, and to create a separate size class as a consequence of which groups will

be more homogeneous. This permits calculation of group averages and allows me to draw conclusions.

The averages of the examined companies clearly point out that the fixed asset ratio of FŐTÁV Private Co. Ltd.is significantly different from that of other companies. Not only the degree of the differences is of interest, but also their changes over the years, because the changes for FŐTÁV Private Co. Ltd. were often completely different

from those for other companies. Since 2013, however, companies with higher emitted heat quantities have more assets and also the variation of the asset value was the highest for those companies. It is also interesting to examine the years in which sales volume influenced the dependent factor. Figure 6 shows the significance levels and the strength of the relationships.

Compared to previous studies, classification by sales generates a greater difference than classification by activity since there were only two years when there were no significantly differently groups at the 5% significance level. The classification by sales is also characterized by stronger relationships. Post Hoc Tests were carried out in

this case, too, highlighting that the main reason for the differences is the different value of fixed asset ratio of FŐTÁV Private Co. Ltd., while there were significant differences between the two groups with the lowest emissions in several years (2011-2013).

Annex 4 of Government Decree no. 157/2005 (August 15) defines the technical and economic data that heat suppliers must provide each year concerning their operation. The third research question focuses on the relationship between two of these indicators – the operated pipeline length and the number of supplied household consumers – and the tangible asset ratio.

Table 4
Significance level and strength of the relationship, 2009-2017

Year	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sig	0.046	0.493	0.024	0.040	0.002	0.004	0.002	0.001	0.077
Eta	0.364	0.221	0.390	0.370	0.475	0.447	0.464	0.483	0.341

Source: Own compilation based on annual report data

Table 5
Correlation among the tangible asset ratio, the value of tangible assets and some selected indicators

		Pipeline length		No. of fee payers		Tangible/Total		Tangible	
		Pearson Corr.	Sig.	PearsonCorr.	Sig.	Pearson Corr.	Sig.	Pearson Corr.	Sig.
2013	Pipeline length			.976**	0.00	-0.03	0.88	.898**	0.00
	Number of fee payers	.976**	0.00			-0.03	0.88	.915**	0.00
	Tangible/Total	-0.03	0.88	-0.03	0.88			0.23	0.05
	Tangible	.898**	0.00	.915**	0.00	0.23	0.05		
2014	Pipeline length			.976**	0.00	0.00	1.00	.891**	0.00
	Number of fee payers	.976**	0.00			-0.01	0.94	.902**	0.00
	Tangible/Total	0.00	1.00	-0.01	0.94			.233*	0.05
	Tangible	.891**	0.00	.902**	0.00	.233*	0.05		
2015	Pipeline length			.974**	0.00	0.00	0.99	.879**	0.00
	Number of fee payers	.974**	0.00			0.00	0.98	.884**	0.00
	Tangible/Total	0.00	0.99	0.00	0.98			0.20	0.09
	Tangible	.879**	0.00	.884**	0.00	0.20	0.09		
2016	Pipeline length			.975**	0.00	-0.03	0.83	.895**	0.00
	Number of fee payers	.975**	0.00			-0.04	0.81	.902**	0.00
	Tangible/Total	-0.03	0.83	-0.04	0.81			0.17	0.15
	Tangible	.895**	0.00	.902**	0.00	0.17	0.15		

2017	Pipeline length			.975**	0.00	0.01	0.93	.920**	0.00
	Number of fee payers	.975**	0.00			0.00	1.00	.921**	0.00
	Tangible/Total	0.01	0.93	0.00	1.00			0.17	0.16
	Tangible	.920**	0.00	.921**	0.00	0.17	0.16		

**. Correlation is significant at the 0.01 level (2-tailed)

Source: Own compilation based on annual report data

Contrary to preliminary assumptions, the companies' tangible asset ratio is completely independent of the pipeline length and of the number of fee payers. This implies that when a district heat supplier serves more customers or provides services in a greater area, besides the increase in items that contribute to the assets in the long run, other asset items (like the amount of current assets) rise proportionately. The analysis also reveals that serving a wider group of customers is possible only with a significantly higher value of asset lockup and longer pipeline length.

CONCLUSIONS

The aim of the study was to analyze the fixed asset and tangible asset ratios of Hungarian district heat suppliers.

Based on the analysis, hypothesis H1 can partially be accepted and the following conclusion can be drawn regarding the companies' fixed asset ratio:

Fixed assets represent the highest portion in the asset structure of district heat supplier companies. Its average value for the whole population was 59%–71% (at the 95% confidence level) between 2009 and 2017. Other companies (performing non-heating activities to a greater extent than the average) have a higher ratio, while the fixed asset ratio of FŐTÁV Private Co. Ltd. causes a significant difference between the indicators of "other" and of "district heating" companies.

Hypothesis H2 can be accepted with some modifications: The fixed asset ratio of district heat suppliers is significantly affected by the size of district heating and this effect is stronger than the classification based on activities. Since 2013, higher heat emission performance is associated with a higher fixed asset ratio, except for the case of FŐTÁV Private Co. Ltd.

Hypothesis H3 is not supported by the results of the regression analysis. No relationship was found between the indicators describing business performance (pipeline length and number of supplied consumers and the tangible asset ratio of district heat suppliers. Higher corporate performance is associated with a higher tangible asset ratio, but it is also associated with the increase of other asset items. In the further part of the research, it would be interesting to examine whether there is a relationship between network density and orography facilities and between fixed asset ratio and tangible asset ratio.

The findings of the study provide opportunities for further research, including the further analysis of the asset and liability structure.

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Examination of Social Innovation Potential Characteristics in the Example of Borsod-Abaúj-Zemplén County[1]

KRISZTINA VARGA
ASSISTANT LECTURER

UNIVERSITY OF MISKOLC
e-mail: varga.krisztina@uni-miskolc.hu

GÉZA TÓTH, Ph.D.
ASSOCIATE PROFESSOR

UNIVERSITY OF MISKOLC
e-mail: geza.toth@uni-miskolc.hu

ZOLTÁN NAGY, Ph.D.
ASSOCIATE PROFESSOR

UNIVERSITY OF MISKOLC
e-mail: regnzozo@uni-miskolc.hu

SUMMARY

This study defines a process-oriented framework for measuring social innovation. The paper presents a practical example of measuring social innovation potential. We introduce the indicator groups used and their contents. Through a map interpretation we demonstrate the spatial representation of the input, output, impact and complex indicators. The objective of this approach is to draw attention to the settlements/groups of settlements where the socio-economic bases of social innovations can best be found in Borsod-Abaúj-Zemplén County.

Keywords: social innovation, indicator system, spatial inequalities, spatial autocorrelation, population change

Journal of Economic Literature (JEL) codes: O35, R11, R14

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INTRODUCTION

The European Union is facing a serious dilemma. On the one hand, it is important to maintain or strengthen its international competitiveness, which requires economic innovation. On the other hand, due to growing social disparities, it has raised the issue of social cohesion to the level of community policies (EC 2013a). Particular emphasis has been placed on addressing the consequences of the economic crisis of 2008. Although the European Union does not have competence in this area, since the issue is essentially a Member State competence, it does try

to encourage them to pay more attention to social innovation through guidelines and subsidies.

Social innovation in the economic sense is result-oriented (as opposed to a process-oriented approach focusing on social practices) and its impact can be measured by examining new ideas, services and systematic transformations. The measurement is supported by definitions of social innovation related to international organizations, which identify social innovation as a means of development, focus on the process of new ideas (product, service, model), meeting social needs, and mobilise novel social relations and cooperation (OECD, 2000, 2012; EC, 2013b, 2014; Sabato et al., 2015).

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[1] *The study (based on several years of research by the authors) is based on the article Z. Nagy - G. Tóth: Measuring Possibilities of Social Innovation Potential in Borsod-Abaúj-Zemplén County, published in Észak-magyarországi Stratégiai Füzetek, 2019 (2). This examination is a revised, expanded version of the mentioned study.*

The concept of social innovation has been widely used in the literature since the 2000s (e.g. Bradford 2003; Phills et al. 2008; Pol &-Ville 2009; Mulgan et al. 2007; Nicholls-Murdock 2012; etc.). The concept tends to be widely debated because it is often considered too general. In this regard, Pol and Ville (2009) note that the concept of social innovation is very important if it is well defined. In contrast to economic innovation, the authors suggest using the term social innovation for social and historical paradigm-changing innovations. It is problematic that there is no generally accepted definition of social innovation (Varga 2017), and some people emphasise the 'rubber bone' characteristic of the concept (Pankucsi 2015) which means that some targets of social innovation are only repeated goals until boredom. In addition, social innovation and technical (economic) innovation are closely interrelated. As a result of economic changes, social changes also take place (Varga 2017).

Based on a structured research of the literature, it can be stated that each author defines the concept of social innovation efforts along different interpretative domains. Many authors consider social innovation as a previously non-existent solution to social problems (Mulgan, 2007; Phills et al., 2008; Stewart & Weeks, 2008; Weerawardena & Mort, 2012; Kocziszky et al., 2017). Social innovation offers new answers to social issues while enhancing social interactions. Efforts can be extended to address environmental, health, education, housing and many other societal challenges. Other authors suggest that social innovation is a new form of governance and decision-making (Mulgan et al., 2008; The World Bank-EC, 2015; García et al., 2015; Lessa et al., 2016; Varga, 2017; Majorné Vén, 2018; Radecki, 2018). In this interpretation, initiatives seek to engage individuals and offer solutions to various social problems through novel collaborations.

Taking into account the history of literature, we consider the following definition of social innovation to be guiding: 'Social innovation provides new or novel answers to problems in a community with the aim of increasing the well-being of the community. Social innovation potential is the set of skills that create opportunities for social innovation.' (Kociszky et al. 2017, p. 16)

The conceptualisation of social innovation and the determination of its measurement levels are relevant challenges; however, these issues are only partially covered by the sources on the topic. The concept of social innovation focuses on meeting the needs of the community, emphasizing the social benefits of problem-solving innovative ideas that can be interpreted locally, at the community level. The measurement process of micro-level social innovation is complicated by several factors. The starting point for measuring innovation is determining appropriate indicators and their identification as input, output or impact indicators, referring to the process of systemicity. Indicators that help measure micro-level social innovation initiatives can be identified as preconditions, conditions for achievement and sustainability conditions, defining the structured conditions of the innovation process per phase (Veresné Somosi & Varga, 2018). Preconditions make it possible to define the innovations that appear as a starting factor in the convergence process. The conditions for achievement are factors that play a key role in the catch-up process in the realization of successful social innovations In the short term, the innovation process is effective when as its result social transformation and community response to social problems occur. Sustainability conditions ensure the long-term success of the catching-up process as a means of renewing and transforming society.

An approach to social innovation potential leads us to the issue of social resilience (Kozma 2017). In this context, we get to the phenomena of social resilience. The practitioners of this research area analyse the responses related to the environmental, social, and economic disaster as well as the community responses to it.

In the light of the available statistical indicators, our goal was not about the implementation of social innovation or its socio-economic effects. Based on our possibilities, we can only measure the basis of the realization of social innovation, the potential of the ability to do so, and we tried to compile an indicator system for this. Our results must be evaluated within these limits, i.e. we do not talk about the potential for social innovation in our work, even if we do not indicate it separately.

DATA AND METHODS

Development of an Indicator System

Based on Benedek et al. 2015, we developed an indicator system for measuring social innovation potential. The source of the data is the Hungarian Central Statistical Office. The indicator system consists of three parts: input, output and impact indicators. In our study 8 indicators were assigned to each of the three groups. The indicators were compiled for the settlements of Borsod-Abaúj-Zemplén County for the period of 2014–2017, and in some cases data from 2011 census were taken into account. To filter out year-on-year fluctuations, we took the four-year average into account when developing the system, so that we can conduct a valid test of the ability to innovate.

When developing the system of indicators, it had to be taken into account that the indicators do not point in one direction. For example, a lower value of unemployment rate is a positive (favourable) result, while in terms of project payment per capita the higher the value, the more positive the situation is for social innovation. For those indicators where low values are favourable, reciprocal indicators were calculated.

In each indicator set, the indicators were normalized in order to make our data of different scales comparable. The average of normalized data for each set of indicators was calculated. We calculated a complex indicator measuring social innovation from the average of the three indicator sets.

The input indicators are the following:
1. Number of non-governmental organizations (NGOs) per 10,000 inhabitants
2. Number of active companies per 1,000 inhabitants
3. Number of non-profit organizations per 1,000 inhabitants
4. Proportion of children in the population
5. Number of elderly per 100 children
6. Dependency ratio: children (aged zero to 14) and elderly (age 65 and above) as a percentage of the total population aged 15 to 64)
7. Activity rate (taxpayers/population * 100)
8. Average number of completed years of education, 2011

The output indicators are the following:
1. Payout per capita (2007–2013)
2. Proportion of the public employees compared to the population aged 15–64
3. Number of participants in cultural events per thousand persons 1,000 inhabitants
4. Proportion of people living in segregation
5. Number of persons receiving social catering service per 1,000 inhabitants
6. Number of recipients of home care assistance per 1,000 inhabitants
7. Unemployment rate
8. Average patient turnover per GP and pediatrician

The impact indicators are the following:
1. Annual average income per capita (thousand HUF)
2. Percentage of population with primary education over 7 years (including early school leavers)
3. Proportion of one-person households
4. Proportion of families with three or more children
5. Number of registered crimes per 1000 inhabitants
6. Number of beds in institutions providing long-term residential care per 1000 inhabitants
7. Proportion of taxpayers earning in the 0 HUF to1 million HUF income band
8. Proportion of regularly cleaned public areas.

For describing each of the indicators, we presented a general map and map of spatial clusters.

During the study we used the local method of spatial autocorrelation, Local Moran I statistics. Local Moran statistics are suitable for illustration areas that are similar or different from their neighbours (Tóth, 2014). In the calculations, the result of Local Moran can be compared with the absolute data and thus it can be examined whether a high degree of similarity is the concentration of high or low values of the variable, and vice versa. The higher the value of Local Moran I, the tighter the spatial similarity, however, in the case of a negative value, it can be stated that the spatial distribution of the variables is close to the random one.

Local Moran I statistics define 4 clusters:
1. High – high cluster: territorial units with a high value, for which the neighborhood also has a high value.
2. High – low cluster: high value area units for which the neighborhood has a low value.
3. Low – low cluster: low value area units where the neighborhood also has a low value.
4. Low – high cluster: units with a low value for which the neighborhood has a high value.

The neighborhood was defined as rook contiguity, when only common sides of the polygons are considered to define the neighbor relation.

RESULTS

Spatial Context

Figure 1 displays the input indicators for each of the settlements in the county. The highest values can be seen in some small villages in the county (Tornakapolis, Tornabarakony, Teresztenye). These settlements stand out as islands, as the settlements with the lowest values are directly adjacent to them. In general, it can be seen that the settlements with the lowest values are located near the county or country border, that is, on the periphery of the county.

Out of the eight settlements with more than 10,000 inhabitants (Miskolc, Ózd, Kazincbarcika, Mezőkövesd, Tiszaújváros, Sátoraljaújhely, Sárospatak, Sajószentpéter), Tiszaújváros is in the most favourable position, and six towns show values above average. In contrast, Ózd and Sajószentpéter are well below average in terms of the average of input indicators.
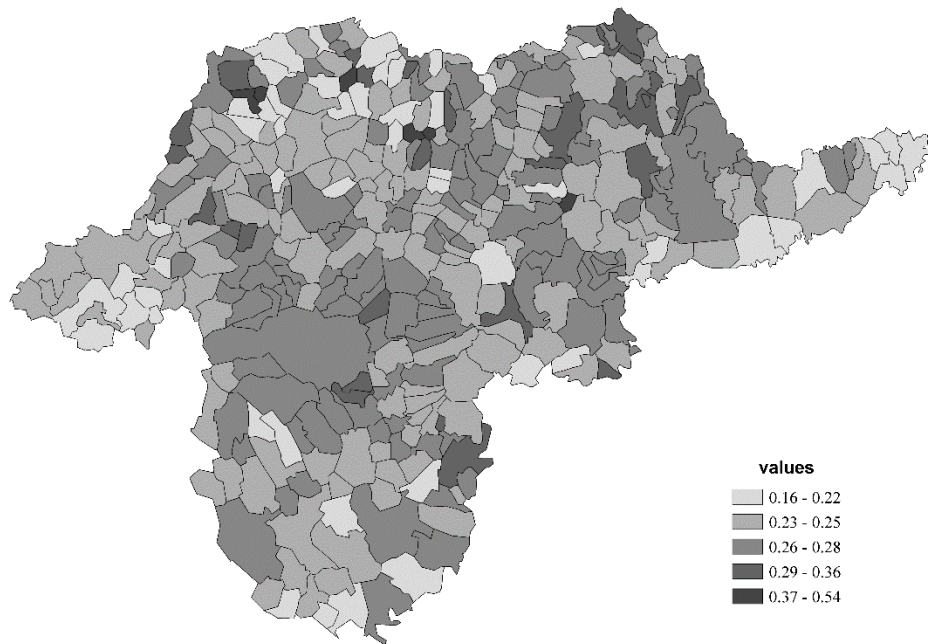
Source: own compilation

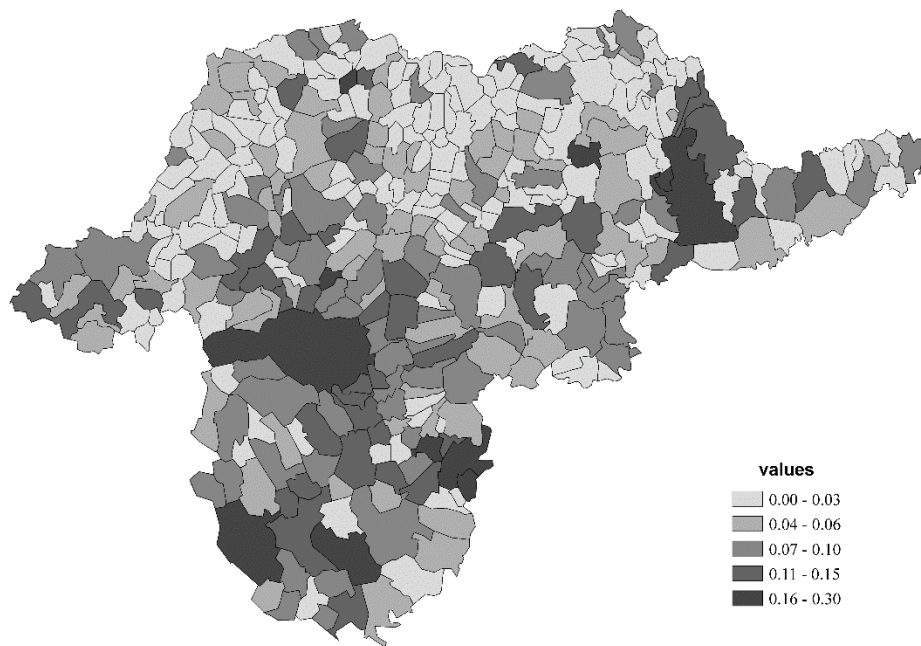*Figure 1. Input indicators in Borsod-Abaúj-Zemplén county*
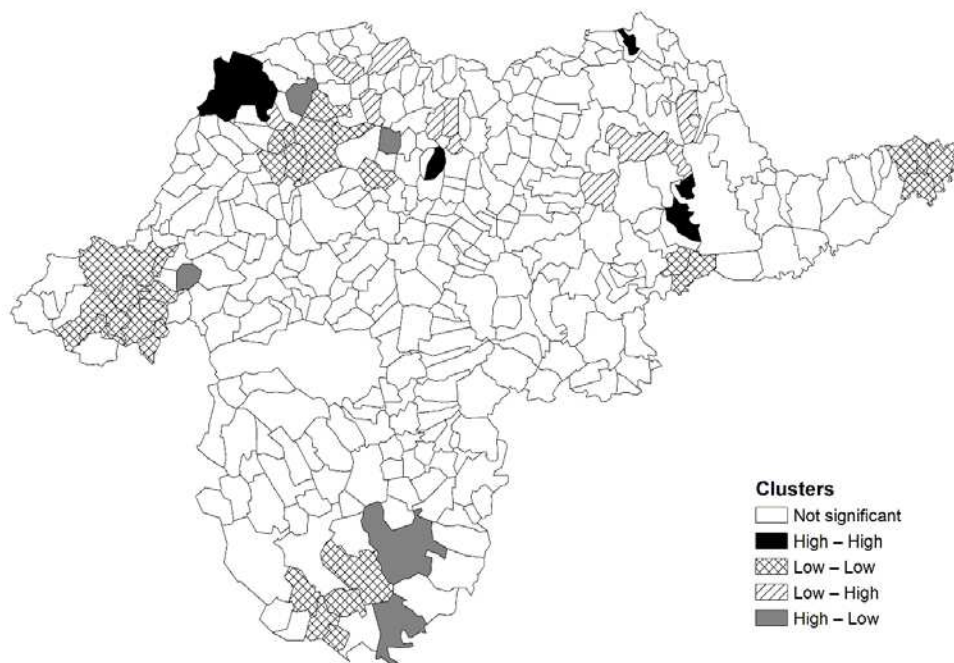
Source: own compilation

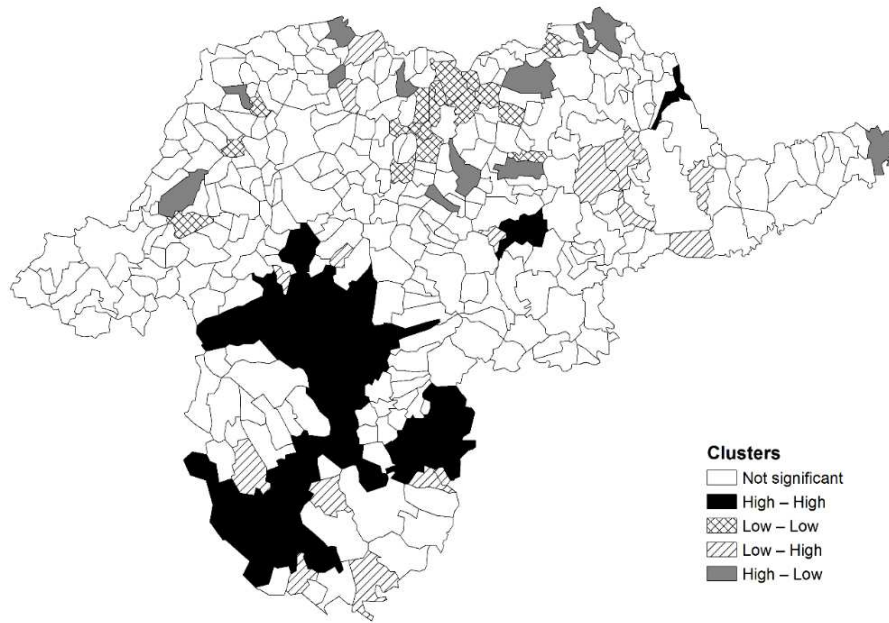*Figure 2. Local Moran I of input indicators in Borsod-Abaúj-Zemplén county*

Only a few spatial clusters can be detected in the county (Figure 2). Only the area of Aggtelek-Jósvafő can be clearly classified as the most favourable high-high cluster. Apart from them, we can observe only some smaller clusters spatially. The low-low cluster stands out even more: it is mainly limited to the peripheral settlements of the county. In some cases, so-called outliers are drawn that are different from their environment in a positive or a negative direction, but little regularity can be observed in their location.

With a few exceptions (Figure 3), larger municipalities are in the best position with regard to output indicators. The highest values can be seen in the case of Tiszaújváros, while the lowest values are in the northern periphery of the county (Pusztaradvány, Szászfa, Hernádcéce). In the case of the larger cities, Ózd is in the most unfavourable position, though still with a higher value than the county average.
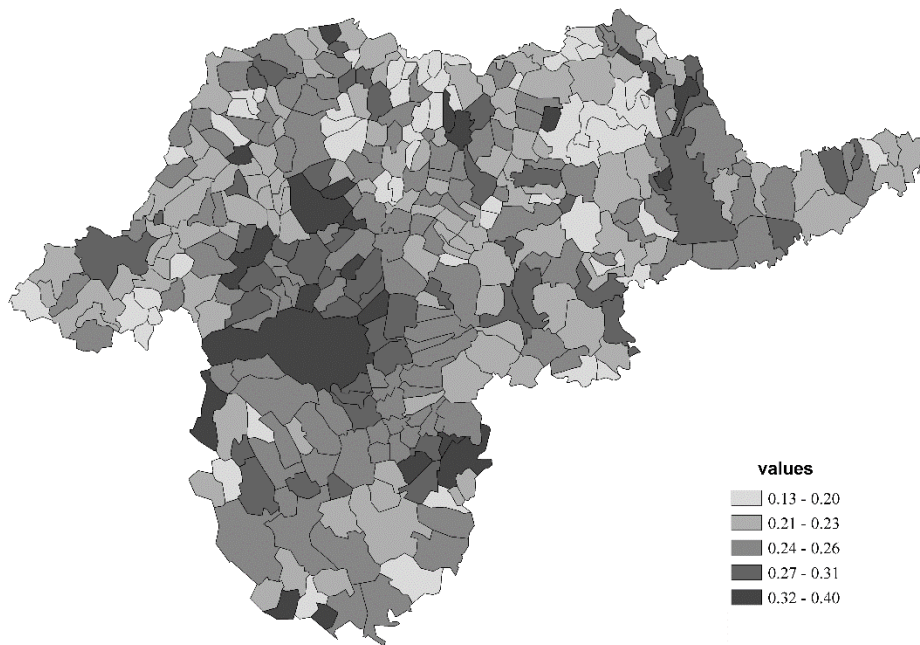

Source: own compilation

Figure 3. Output indicators in Borsod-Abaúj-Zemplén county

Source: own compilation

Figure 4. Local Moran I of output indicators in Borsod-Abaúj-Zemplén county
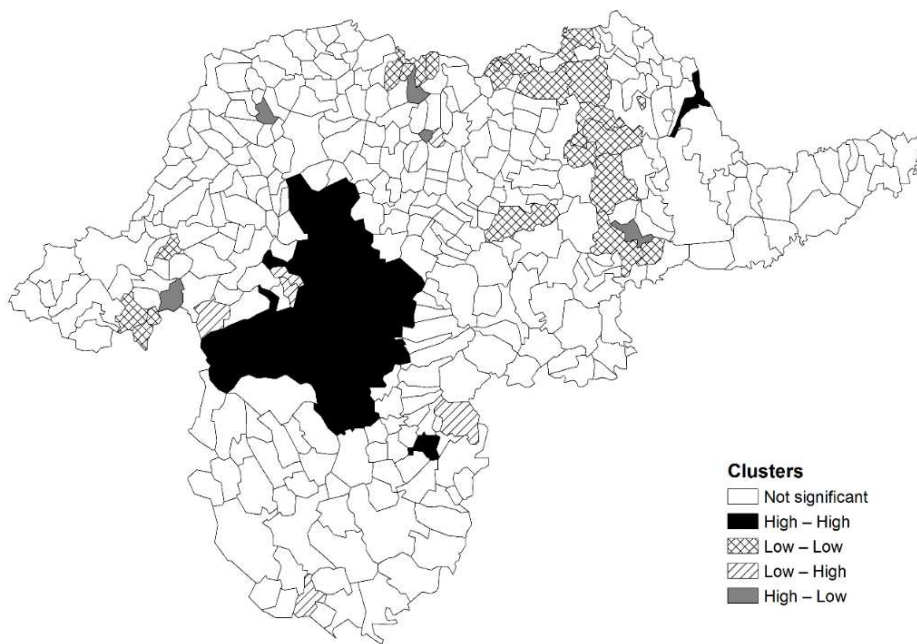

Source: own compilation

Figure 5. Impact indicators in Borsod-Abaúj-Zemplén county

In terms of output indicators, spatial clusters are much more prominent than we have seen with input indicators (Figure 4). The Miskolc agglomeration and the surroundings of Tiszaújváros and Mezőkövesd were placed in the high-high cluster. The low-low cluster of unfavourable position includes the settlements of the Encs district.

In case of impact indicators (Figure 5), the settlements with the highest values are relatively sporadically located within the county. The highest values can be seen in Hercegkút, while the lowest values can be seen in Galvács.

Among the settlements with more than ten thousand inhabitants the highest values can be seen in Miskolc, while the lowest values can be seen in Mezőkövesd. However, the value of Mezőkövesd is lower than the county average.

The high-high cluster is limited to the Miskolc agglomeration and the neighbouring settlements to the north in terms of impact indicators. The low-low cluster, which is quite spectacularly connected spatially, appears along the Hidasnémeti-Zalkod axis in the spatial structure of the county (Figure 6).
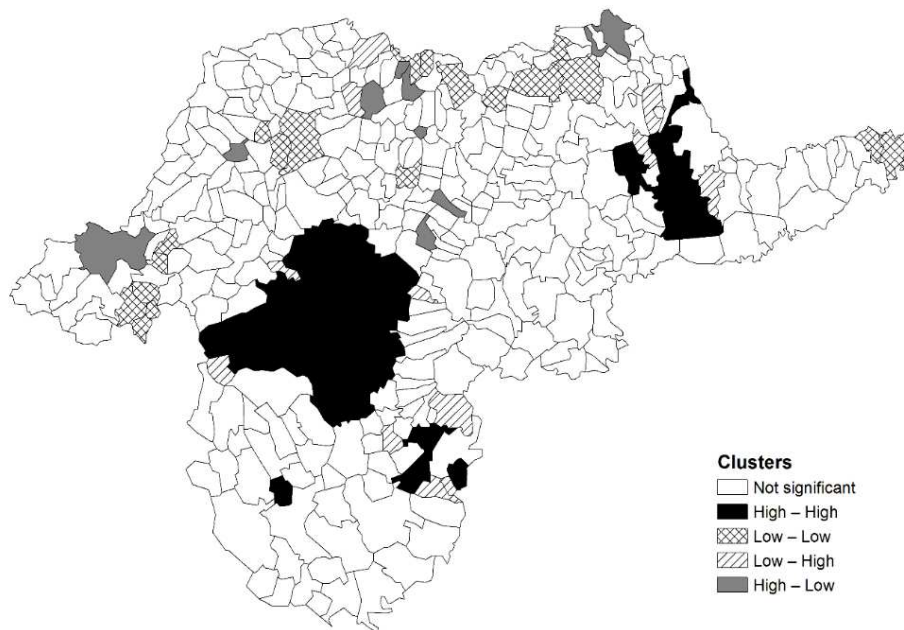

Source: own compilation

Figure 6. Local Moran I of impact indicators in Borsod-Abaúj-Zemplén county
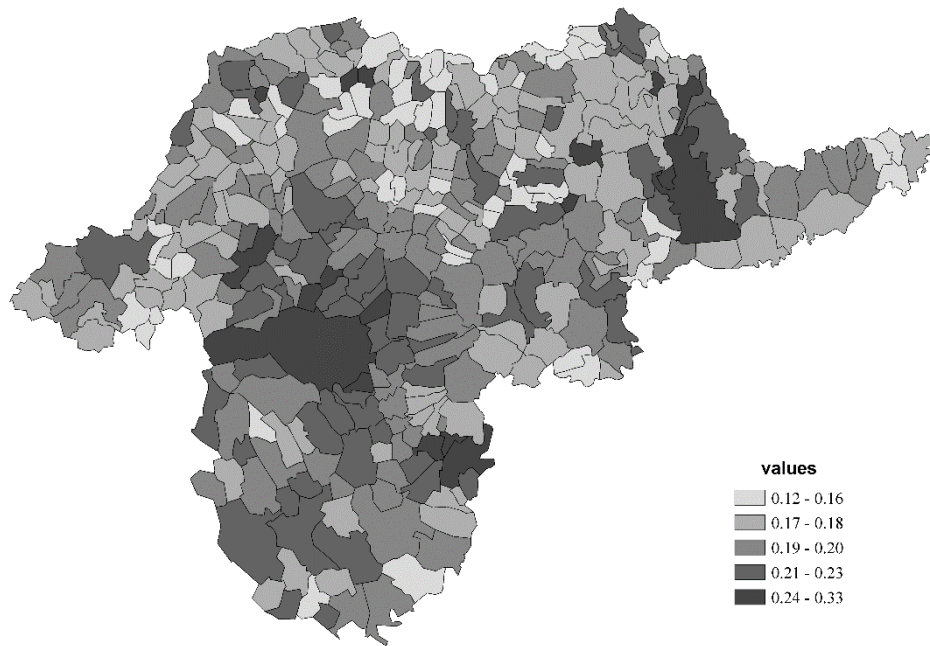
Source: own compilation

Figure 7. Complex indicator measuring social innovation in Borsod-Abaúj-Zemplén county

Source: own compilation

Figure 8. Local Moran I of complex indicator measuring social innovation in Borsod-Abaúj-Zemplén county

Looking at the complex indicator in total (Figure 7), it can be stated that although the settlements in the most favourable condition are relatively scattered in the county, the role of proximity to the most important cities is clear (Miskolc, Tiszaújváros, etc.). The highest values are seen in Tornabarakony, the lowest values in Pányok. The value of all cities with more than ten thousand inhabitants is above the county average. Of these, Tiszaújváros is in the best situation, while Ózd is in the most unfavourable.

The high-high cluster is basically connected to the Miskolc agglomeration and to the surroundings of Sárospatak and Tiszaújváros (Figure 8). In contrast, several groups of settlements with small villages belong to the low-low cluster in the worst position near the country border.

Spatial Differences of the Complex Indicator

Theoretically, it would follow from our method that each group of indicators determines the complex indicator and its territorial differences to the same extent. To investigate this, we analyzed the spatial differences of the complex indicator and its components using basic descriptive statistics as well as using the Gini index. Our results are reported in Table 1 and 2.

$$G = \frac{1}{2\bar{x}n^2}\sum_i\sum_j|x_i - x_j|$$

where xi = area characteristics in natural units in the area unit i; xj = area characteristics in natural units in the area unit j;
$\bar{x}$ = average of xi, n is the number of area units.

We found that in the case of the output indicators, there is an extremely high spatial difference between the examined indices, while the spatial image is much more balanced with regard to the input and impact components and the complex indices.

That is, in summary, we can state that the spatial differences of the complex indicator are mainly determined by the output indicator. Thus, in the development of the social innovation potential, in our opinion, this area should be paid the most attention in order to make effective developments.

Table 1
Statistical characteristics of the complex indicator and its components

Indicators	Input	Output	Impact	Complex
Max	0.54	0.33	0.40	0.33
Min	0.16	0.01	0.13	0.12
Average	0.25	0.06	0.24	0.18
Relative standard deviation %	14.34	79.38	18.19	15.73

Source: own calculation

Table 2
Spatial differences of the components of the indicator

Indicators	Input	Output	Impact	Complex
Gini index	0.07	0.40	0.10	0.08

Source: own calculation

CONCLUSION

Based on the examined measurement methods of the literature, it can be stated that a number of experiments can be identified, which focus on measuring the social innovation process and determining social innovation potential; however, there is no uniformly accepted methodology. As in the case of the concept of social innovation, the examination of social initiatives and the definition of its measurement indicators require a comprehensive analysis. The predominance of the examination of macro-level initiatives is typical, but the methods aimed at quantifying the process and effects of local-level efforts are appearing with increasing intensity. A significant part of these calculations attempts to fit the indicators involved in the macro-level study to the local measurement.

In our study we try to measure the potential for social innovation in the example of the settlements of Borsod-Abaúj-Zemplén County, Hungary. With the help of input, output and impact indicators, we mapped the socio-economic indicators that examine the basis of social innovation potential. We have shown that Miskolc and its agglomeration, Sárospatak and Tiszaújváros are in the best position in terms of social innovation potential within the county. We found that the regional differences of the complex indicator are mostly determined by the output indicators.

Our further research questions in this area are the relationship of income distribution and territorial development disparities to social innovation potential and the relationship between population change and social innovation potential. These issues, in addition to the above studies, will be presented in further studies.

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