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Editorial office

KAPOSVÁR UNIVERSITY, FACULTY OF ECONOMIC SCIENCE

H-7400 Kaposvár, Guba Sándor u. 40.
H-7401 Kaposvár, P.O.Box 16.
Tel.:+36-82-505-800, +36-82-505-900
e-mail: rbs@ke.hu

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THE EXPECTED EFFECT OF THE FOURTH INDUSTRIAL REVOLUTION ON THE HUNGARIAN TAX STRUCTURE

József VARGA, Anita ÁGOSTON, Balázs CSEH, Zoltán SIPICZKI
Kaposvár University, Faculty of Economic Science, H-7400 Kaposvár Guba S. u. 40.

ABSTRACT

In our publication we examine the process of Industry 4.0, which has led to a significant transformation of production processes from the aspect of taxation. At the beginning of the paper, we offer a brief survey of the Fourth Industrial Revolution, analysing the operating mechanism of M2M (machine to machine) and IoT (Internet of things), which are based on large data and cloud-based data storage technology. After that we examine the expected future impact of these processes. The transformation process of the domestic tax system since 2010 has been characterized by the decline in the proportion of taxes on labour and the increase in the proportion of turnover-type taxes. Our most important question is how the automation of the production processes influences the transformation of the tax system. This simulation study was carried out to compare different estimation procedures. Our new numerical results revels that the automation would result almost 6% of GDP cost reduction on live labour force in 2015 on the basis of our calculation. This process is not reversible, so in the future it is necessary to reform the tax system and to increase the tax base corresponding to the reduction of the direct cost of live labour.
Keywords: Industry 4.0, Fourth Industrial Revolution, Hungarian Tax Structure

INTRODUCTION

The publication examines some key elements of this process. The most important key issue is the taxation effect of replacing human labour with machine work. In the domestic public revenue system, the employer carries a considerable part of the human labour cost: in addition to the payment of the leave, the first 15 days of the sick pay and the 1/3 part of the rest of the sick pay. To this burden also comes the indirect carrying of the burden of disability pensions. This high tax incidence has a positive message from the point of view of our question. Our hypothesis is that automation improves the competitiveness of domestic employers, since the businesses will be set free from these cost elements, which are on the workforce.

Our second basic conception is that automation reduces unit costs for products. This, if it leads to the reduction of the sales price of the products, entails the reduction of the sales tax. Finally, in our study, we examine the process that the replacement with machine work creates open or hidden unemployment. In our work we analyse the future burdens of this replacement on the tax system, what new types of tax revenue opportunities can be made possible and necessary to offset the resulting unemployment. These new taxes will not be burdened with live labour, but will either give rise to a new consumption tax burden or some kind of taxation of the automation process.

THE OPERATING FRAMEWORK OF INDUSTRY 4.0

Industry 4.0 means the fourth industrial revolution. This process causes also a complete transformation of our economy, the ever closer interconnection of information technology and automation, resulting in a radical transformation of production methods. With the machine-to-machine technology, M2M, the machines can also control continuously more complex processes, based on the ability to communicate with each other without human intervention. Hereby the productivity can significantly increase. The automation will embrace almost the entire spectrum of economic processes.

The presentation of the details of the technical processes of automation is not intended for this publication, but it is necessary to describe the concepts. Nowadays, not only the robotization, which was considered rightly important in education as well (*Bánkuti and Paál*, 1995), spreads and eliminates jobs. The real revolution has been brought about by the development and practical application of artificial sensing, regulation technique and artificial intelligence. The educational necessity of this was evident at our university, too. The machines, not only in the industry but also in households, have more and more artificial intelligence capabilities. They measure their status and make decisions. They can make their condition properties available remotely on the internet, or sharing with others (machines or people). Actually, several machines can make decisions that depend on each other's condition - without human intervention as well.

This Machine-Machine communication process requires an information channel. This is called the Internet of Things (IoT) because it is not a network, which is not used by people, but by machines. These processes create large data files. Their storage, due to their availability in the network, should be worked out with from everywhere accessible so-called cloud-based technology, which means databases, of course with strict access, but from any physical location secure accessible technology. These data and any other information, for example sales statistics (which are available immediately and in large quantities due to barcode systems), marketing or any other large amounts of data are investigated by Data Science Engineers. This is a new job created by this development and shows that a lot of workforce releases, but beside it develops fewer but more qualified jobs.

All this brings up what will happen to human labour that is released. The process and the question are not new; they have come up already several times in history, for example in the course of the Machine Revolution. The revolution of machine workforce during the first industrial revolution brought up movements, which would have liked to protect human labour and the interests of workers. These were the 18th and 19th century machine-breaking movements. The early - and even nowadays characteristic - machine-breaking movements can be divided into two groups: one is to protect the workers livelihood against wage cuts or rising prices, and the other one to protect the livelihood against the perceived or real threat of machines. These two are often confused and called "luddism", but neither of them are limited to protests against technical innovations. Rather, the aim was to put pressure on employers with a threat to ruin or dismantle their economic interests. Luddism was linked to the name of General Ned Ludd, or General Ludd, and the main feature was the technofobic machine destruction, but it is not the equal with it. It contains the various forms of struggle of employers, such as illegal organizing, negotiation with employers, riots, and sometimes armed clashes with the

authorities and the destruction of entire factories. (*Hobsbawn*, 1952) Nowadays, neo-luddism is against the development of modern technology and its widespread manifesttation, it presents a kind of technophobe tendency. Typically it is the passive abandonment of technology, the return to simple life, but it also involves action against technology-makers and sabotage efforts against technology supporters. Nevertheless, the Neo-Luddian movements are also associated with other movements such as antiglobalization, anarcho-primitivism, anti-science and radical environmentalist movements.

At present, however, neo-luddism is based on concerns about technological impacts on individuals, communities, the human environment and its advocate the precautionary principle in respect of introducing, adopting, applying and encouraging new technologies. This is why it is against the industrial capitalism and the application of machine labour. The other paradigm is the transhumanist theory, which came into the front in our day and affects our theme. According to this, man either integrates with machines or becomes machine-friendly. Transhumanism technology seeks to eliminate illnesses, disabilities and ageing in relation to humans, so it has the most impact on taxes on labour taxation. As the most important risk, the extinction of the human race is highlighted, with complete automatism. (*Kurzweil*, 1999; *Kaczynski*, 1995) Justin Trudeau, Canada's 23rd Prime Minister, because of the spreading of the machine work, already integrates the Innovation and Skills item in the 2017 annual budget, which is based on the unemployment resulting in the development of the innovation economy (hence the development of a mechanical workforce). It allocates 132.4 million dollars for finance for 4 years, which should be spent on the maintenance of the employment of the insurance system. (*Trudeau*, 2017)

There is wide literature in economic literature as well. For example, Keynes speaks about "technological unemployment", if the potential of tools we have developed in order to save the labour force outweighs the potential of our job creation tools (*Kerekes*, 2017). Technological unemployment is mainly observed in transport logistics and office workplaces. Out of these areas, the field of the robot technology spreads in such fields, where it was hardly conceivable particularly, due the development of drones (the automation of a waiter's job).

Kevin Kelly, who also made a presentation in Hungary in 2017, said that 20 years later the development of artificial intelligence (AI) would reach the level that the automated workforce would be able to do jobs requiring more designed tasks, resulting in more job and work being superfluous, he analysed 12 types of work or other categories. (*Kelly*, 2016)

So we can say that two big "megatrends" are connected today. One is big data and mobilization (lots of data need to be efficiently analysed in such a way that it should be user-friendly and secure), or Industry 4.0. While in Web 3.0 physical production linked to IT, communication is nowadays not between people, but between machines as well. This includes Things of Internet, the Smart Factory. The background of this communication is the Internet and the intranet, the networking of systems and machines, the physical and cyber world where automation and IT are fully intertwined. Complexity is enhanced by the fact that financing and development services for production and innovation are also used on the Internet (Crowd Sourcing). The factories, and the complex of machines and software, hardware in them all regulate and optimize themselves, the value-creating process actually works

on the base of cyberspace. This intelligent factory can change the production process without human intervention or opinion, so it can create efficiency and new collaborations (*Szóka*, 2015).

In connection with the fourth industrial revolution, it is important to examine the sustainability of the process. For the next period, a number of interconnected transformation processes are expected. "The new economy will have a low-carbon emission and cyclical economy, and the workforce will have a new role, due to the automated activities the employment capacity of production activities will be radically reduced. New employment areas will be needed to keep the "bored" citizens busy. (*Kerekes*, 2017)

From the centres, which work as the hotbed of innovation, the information flows out to peripheries in time, from where people and employees are "pushed" with non-violent devices to the centre.

THEORETICAL TAXATION ASPECTS OF THE FOURTH INDUSTRIAL REVOLUTION

In the wake of automatization, the rate of live labour lapses back in a hardly estimated degree. In countries where live labour is taxed in a high degree, tax loss will be significant with the reduction of the role of live labour as a result. In this way, when investigating the results connected to taxation, we should first of all review the structure of the tax system.

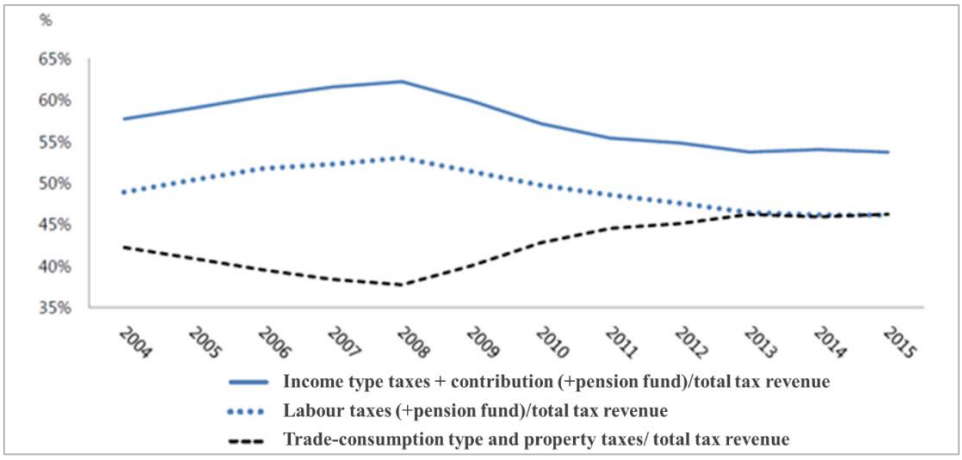
The conformation of the national tax system is adequately illustrated by chart 1. Following the depression of the year 2008, the transformation of the tax system in Hungary came to fruition with the tendency of tax reduction afflicting labour. We can observe two different turnovers during the period of 2004-2015: the first one can be found in the period of 2004-2008 when the taxes afflicting labour showed a rising tendency, while the taxes that afflicted consumption showed a declining one. At this point, the trend shifted and it became more and more clear in the period of 2009-2015 that the rate of taxes that were connected to circulation and consumption rose to a degree of 45-46% from the rate of about 36% in 2008, while the rate of taxes that afflicted labour dropped to the level of 45-46% from the rate of around 52% of the year 2008, which incorporated all revenue tariffs (*Varga*, 2017).

Regarding taxes that afflicted labour before 2010, the Hungarian tax system meant the highest rate of tax affliction and it was the most progressive tax system in the region. This type of tax system – with the relative large-scale social support system of inactive lawyers of the society – resulted in Hungary's place among the countries that had the lowest activity rate in the European Union. Therefore, the tax system of Hungary is characterized by the moderation of taxes afflicting labour. In this perspective, the Hungarian tax system is less exposed to automatization.

In recent years, significant changes connected to the tax structure took place on the level of the European Union, too. Regarding the taxes that afflict labour, there is no recognizable integrated tendency. Concerning our most important case, Germany, the level of taxes that afflict labour is high, however, it shows a declining tendency (*Takács et al*, 2014). The tax revenues of the German national budget are constituted by the incomes that stem from the personal income tax besides the incomes of the value-added tax. Being aware of this fact the question arises how the degree of the income of the German national budget can be sustained with the mass spread of future automatization.

Figure 1

The proportion of individual tax rates as a percentage of total tax revenue in Hungary



Source: *Izer,* 2016

In Hungary, tax changes that affected the burdens of live labour accelerated in 2010, when the personal income tax was changed for the flat personal income tax rate (from its former 18 and 36% level) of 16%. In order to counterbalance this, circulation was taxed to a higher and higher degree, which was realized in a 27% rate of VAT and a raised level of excise tax, not to mention the so-called supertaxes (financial institutions, energy sector). The government's politics, which was devoted to relief from taxation, proceeded in 2016, when labour afflicting taxes continued to dwindle. The degree of personal income tax was moderated from 16% to 15%. According to Domonkos, the procedure persists during which the major objectives must be the "whitening" of the economy and the increase of the effectiveness of tax collection since the gradation of the effectiveness of tax collection is not a self-interest but a means to reduce tax rates, hereby to improve the competitiveness of the economy (*Domokos*, 2016). A quintessential change occurred in 2017 regarding the effort to moderate the burdens of live labour. The rate of social contribution dropped from 27% to 22%. A further step of mitigation is predicted for 2018, to a rate of 20%.

On a macro-level, we can assert that as essential elements, the Hungarian tax changes of the years of 2016-2017 contribute significantly to the reduction of tax burdens in accordance with the rate of GDP, respectively to the abatement of the rate of taxes afflicting labour. It is a possible future vision that the degree of taxes afflicting labour will be reduced under the level of circulation-property taxes.

RESULTS AND DISCUSSION

In the last part of our publication, we estimate the reduction of the workload-burden that can be saved because of automation. The starting data are actual data, however

the degree of automation and its economic impact can only be considered with very uncertain forecasts.

Table 1

The direct burden of live workforce in Hungary (2015)

Ordinal number	Designation	Amount (billion HUF)
1.	Social security income	4489
2.	Personal income tax	1689
3.	Taxes on total wages and on number of workforce	200
	Sum total	6378

Source: Based on *CSO* data

According to the data of the CSO (*Hungarian Central Statistical Office*), the amount of social security revenue in Hungary was 4 489 billion HUF in 2015 *(Table 1*). This amount can be used as a basis for workforce-burden. The personal income tax must be added to this amounting to 1 689 billion HUF (*CSO: 3.7.2 The revenues of the central budget* (2005-)), and the taxes on total wages and on the number of workforce, which is 200 billion HUF (as shown in *Table 2*)[1]. This is total 6 378 billion HUF, which can be taken into consideration as a direct burden of labour. This was about 20% (18.5%) of GDP (34 324 billion HUF[2]) in 2015.

For this amount we can add, as an indirect burden on living labour, the amount of leave (the machines do not go on holiday), the amount of sick pay (the machines do not get sick, if they are broken down, their repair can be done generally quickly) and family support amounts. In details:

- the amount of leave,
- the amount of the first 15 days of sick pay
- the 1/3 of the amount of sick pay after the first 15 days
- the amount of disability pensions.3

The amount of workload reduction caused by automation is required to determine the size of the above workload-burden, so the amount of live work savings can be calculated from the product of multiplication of the two data. This second data "of course" moves within very wide limits, so this future impact is very difficult to estimate. *Figure 2* and *Table 3* give an estimate of the expected effects of automation (*Kerekes*, 2017). For further calculations, we use the middle data of the middle value.

[1] 3.1.16.1. Revenue from taxes and social security contributions - Government + Institutions of the European Union (1995-), D29C line.

[2] 3.1.2. The value of gross domestic product (GDP) in HUF, EUR, USD, purchasing power parity (1995-)

[3] The quantification of indirect costs is planned in a later publication.

Table 2

Revenue from taxes and social security contributions - Government + Institutions of the European Union at current prices, HUF billion

Code	Row similarity	2008	2009	2010	2011	2012	2013	2014	2015
D.61 Net social contributions	**59=60-63+66+69+77**	**3668**	**3412**	**3247**	**3686**	**3734**	**3907**	**4204**	**4489**
D.611 Actual social contributions of employers	60=61+62 =64+65	**2595**	**2375**	**2084**	**2200**	**2161**	**2236**	**2444**	**2597**
D.611C Actual compulsory social security contributions for employers	61	**2595**	**2375**	**2084**	**2200**	**2161**	**2236**	**2444**	**2597**
D.611V Actual voluntary social contributions of employers	62	–	–	–	–	–	–	–	–
D.61SC Service charges for social security systems	63	..	..	..	..	..	..	..	..
D.6111 Employer's actual pension contributions	64	..	..	..	..	..	..	..	..
D.6112 Actual non-pension contributions for employers	65	..	..	..	..	..	..	..	..
D.612 Employer imputed social contributions	66=67+68	**23**	**24**	**25**	**23**	**21**	**22**	**24**	**28**
D.6121 Employer imputed pension contributions	67	–	–	–	–	–	–	–	–
D.6122 Employer imputed non-pension contributions	68	**23**	**24**	**25**	**23**	**21**	**22**	**24**	**28**
D.613 Actual social contributions of households	69=70+71 =72+76	**1050**	**1013**	**1138**	**1463**	**1552**	**1650**	**1735**	**1865**
D.6131 Actual pension contributions of households	70	..	..	..	..	..	..	..	..
D.6132 Actual non-pension contributions of households	71	..	..	..	..	..	..	..	..
D.613C Actual statutory social contributions of households	72=73+74+75	**1048**	**1011**	**1137**	**1461**	**1551**	**1649**	**1734**	**1864**
D.613CE Actual compulsory social security contributions for employees	73	**862**	**823**	**971**	**1290**	**1428**	**1553**	**1661**	**1784**
D.613CS Actual compulsory social security contributions for self-employed persons	74	**102**	**105**	**84**	**90**	**90**	**55**	**51**	**56**
D.613CN Actual compulsory social security contributions for non-employees	75	**84**	**83**	**82**	**81**	**33**	**40**	**23**	**23**
D.613V Actual voluntary social contributions of households	76	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**
D.614 Complementary social contributions of households	77=78+79	–	–	–	–	–	–	–	–
D.6141 Additional pension contributions of households	78	–	–	–	–	–	–	–	–
D.6142 Additional non-pension contributions of households	79	–	–	–	–	–	–	–	–

Source: *CSO 3.1.16.1. table*

Table 3

Probability of Computerisation

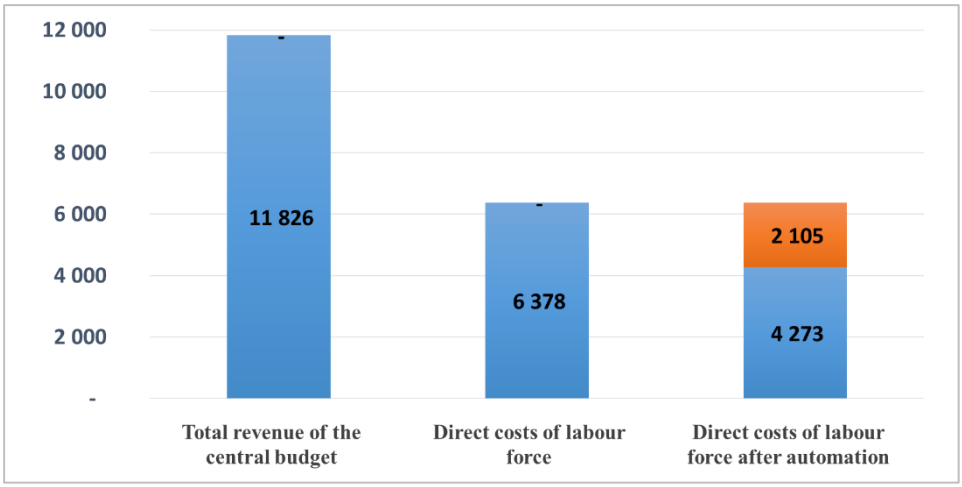
Variable	Probability of Computerisation		
	Low	Medium	High
Assisting and caring for others	48 ± 20	41 ± 17	34 ± 10
Persuasion	48 ± 7,1	35 ± 9,8	32 ± 7,8
Negotiation	44 ± 7,6	33 ± 9,3	30 ± 8,9
Social perceptiveness	51 ± 7,9	41 ± 7,4	37 ± 5,5
Fine arts	12 ± 20	3,5 ± 12	1,3 ± 5,5
Originality	51 ± 6,5	35 ± 12	32 ± 5,6
Manual dexterity	22±18	34 ± 15	36 ± 14
Finger dexterity	36 ± 10	39 ± 10	40 ± 10
Cramped work space	19 ± 15	37 ± 26	31 ± 20

Source: *Kerekes* (2017)

Estimation of the likelihood of automation is given in *Table 3*. For the accurate calculation, the total economic weight of each sector would be needed to be multiplied with the probability data. As this data are not available for Hungary broken down according to the table, in our present publication we assume a medium degree of total workflow automation. Based on the averages of the middle column of the table the mean value is 33% (with unweighted calculation).Therefore, automation touches approximately the 1/3 part of the production value.

Figure 2

The actual amount of the real and the expected reduced costs due to automation based on the direct cost of labour force in Hungary (2015)



Source: Based on *CSO*

In conclusion, we can establish that in Hungary in respect to 2015, based on the direct costs of labour force with the 6 378 billion HUF, almost 1/3, or 2 105 billion HUF derive from saving because of automation. The automation would have resulted in almost 6% of GDP cost reduction on live labour force in 2015 on the basis of our calculation. This process is not reversible, so in the future it is necessary to reform the tax system and to increase the tax base corresponding to the reduction of the direct cost of live labour.

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REFERENCES

Bánkuti, Gy., Paál, J. (1995): A robottechnika multimédia az oktatásban. A robottechnika oktatása. In: Multimédia alkalmazása az oktatásban workshop. Keszthely: PATE GEORGIKON Kar, 23-24. March 1995, 52–53. p. [online] <URL: http://www.digkep.hu/konferencia/konf/MMO95/kiadvany.pdf>

Domokos, L. (2016): Versenyképesség, állami szerep, állammenedzsment. Kecskemét: 54. Közgazdász-vándorgyűlés, 2016. szeptember 17. [online] <URL: http://www.mkt.hu/wp-content/uploads/2016/09/Domokos_Laszlo.pdf>

György, L., Veress, J. (2016): 2010 utáni magyar gazdaságpolitikai modell. In: Pénzügyi Szemle, 2016. 3. 367–388. p.

Hobsbawn, E.J. (1952): The Machine Breakers, In: Past and Present, 1. 1. 57–70. p. doi: 10.1093/past/1.1.57

Izer, N. (2016): A kormányzati adópolitika és az adóhatóság feladatrendszere. In: Kihívások és nemzettudat a modern pénzügyekben. X. Soproni Pénzügyi Napok. Sopron, 29-30 Sept. 2016. [online] <URL: http://spek.hu/index.php?page=konferencia_2016_X_soproni_penzugyi_napok_letoltesek>

Kaczynski, T. (1995): The Unabomber Manifesto, Industrial Society and Its Future In: New York Times 1995 June [online] <URL: http://editions-hache.com/essais/pdf/kaczynski2.pdf>

Kelly, K. (2016): The Inevitable: Understanding the 12 Technological Forces That Will Shape Our Future. New York City: Viking press, 336 p.

Kerekes, S. (2017): A jövő elkezdődött? A 4. ipari forradalom és a fenntarthatóság. Kaposvár: Régiók a Kárpát-medencén innen és túl konferencia. 2017.

Kurzweil, R. (1999): The Age of Spiritual Machines. New York City: Viking Adult, 400. p.

Mosberger, P. (2017): Egykulcsos társasági adó hatása. [online] <URL: http://mnb.hu/letoltes/mosberger-palma-egykulcsos-tarsasagi-ado-hatasa.pdf>

Szóka, K. (2015): Controlling kihívások és trendek 2015-ben. In: Székely Cs., Kulcsár L. (Eds.): Strukturális kihívások – reálgazdasági ciklusok: Innovatív lehetőségek a valós és virtuális világokban: Nemzetközi tudományos konferencia a Magyar

Tudomány Ünnepe alkalmából: Tanulmánykötet. Sopron: Nyugat-magyarországi Egyetem Kiadó, 149–158. p.

Takács, V., Máté, Á., Nagy, S. Gy. (2014): Adószerkezeti változások az Európai Unióban. In: Köz-gazdaság, 9. 4. 127–144. p.

Varga, J. (2017): Az adóteher-csökkentés és a gazdaság kifehérítésének pályája Magyarországon 2010 után In: Pénzügyi Szemle 62. 1. 7–20. p.

Trudeau, J. (2017): What should governments do to prepare for the technological automation of human jobs? [online] <URL: https://www.quora.com/What-should-governments-do-to-prepare-for-the-technological-automation-of-human-jobs>

Corresponding author:

József VARGA
Kaposvár University
Faculty of Economic Science
H-7400 Kaposvár, Guba Sándor u. 40.
e-mail: varga.jozsef@ke.hu

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FROM WALKING BANKERS TO BLOCKCHAIN TECHNOLOGY THE HISTORY OF PAYMENT SYSTEMS

Andrea KRISKÓ, Tibor TATAY
Széchenyi István University, H-9026 Győr, Egyetem tér 1.

ABSTRACT

The technique and technology of payment settlement systems has completed an enormous journey from the 18th century to modern times. Nowadays, we have gone from bilateral settlements to global payment systems. Numerous payment options are available to us, from paper based settlements to mobile wallets. In my study, I am primarily tracking the development of the technology on the basis of the payment systems of the USA, introducing the primary open and closed loop systems, as well as the changing customer needs which have brought the bank card and Bitcoin to life.
Keywords: payment systems, bank card, smartphone wallet, Bitcoin

THE CRADLE OF DEVELOPMENT: LONDON AND NEW YORK

Based on early accounts, the idea of creating a clearing house arose by accident in the 17th century. In the 1670s, financial institutions employed brokers walking around the City of London, walking from bank to bank to gather cheques and bills. Bankers living on opposite ends of the city then decided to meet in a cafe downtown at the same time every day. Several people considered this idea worth emulating, so consequently the bankers were renting a separate room soon enough to enable them to conduct business uninterrupted. (*Thralls*, 1916)

To avoid settlement errors and to manage a separate set of books, they had hired a man to keep an eye on the transactions. This is how the London Clearing House was born, perhaps the largest clearing house of the time. The idea of a clearing house had spread soon; in 1853, the New York Clearing House was founded. After New York, Boston, Pittsburgh, Philadelphia and Chicago also operated a clearing house each, just to mention the larger ones.

At this time, there were already registered settlement venues that were also operating on a voluntary basis, even though many believed that the solution was not a clearing house, but rather, the strengthening of legal regulations (*Thralls*, 1916). Naturally, at this time, settlement transactions were still undertaken on a paper basis, the forwarding of checks and drafts held numerous challenges and this may have had an effect on the timeliness of the transactions as well. The City Department performed general settlements and it was this unit which had issued the client codes (joining clearing partners received serial numbers in a chronological order). The settlements of the financial institutions were listed under codes, authenticated with signature and seal.

The clearing house prepared a carbon copy of the certificates summary of their transaction volume, but the blank forms were not uniform at the time and changed from clearing house to clearing house.

Back then, settlements were none other than an insane dash by the bankers to the clearing house, where numbered tables were lined up in parallel rows. Now, the exchange rooms/dealing rooms of brokerage firms are set up similarly. When every banker arrived and put down their package of drafts, settlements could begin.

At that time, the deadline for settlements was two o'clock in the afternoon, the bankers received their certificates and they went back to the bank. On the basis of the received certificate, the bank debited and credited the accounts. It significantly reduced the risk of robbery that the bankers were not walking around with money, but rather, with certificates.

Erroneous settlements were fined and bankers were levied fines as well for breaches of their obligations. The fines ranged from 10 cents to 5 dollars, depending on the severity of the offense. Additionally, the clearing house also issued loan certificates, with strict deadlines. The small banks did not participate in clearing operations through the clearing house; they settled with their partners via the framework of bilateral agreements.

The next developmental step was the founding of the Country Clearing House[1] in the USA. The objective of the Country Clearing House was the reduction of costs deriving from the distribution of checks; in addition to speeding up physical movement and clearing operations, the institution gained a prominent role in the development of the correspondent banking system. Its members forwarded the banking information, account numbers, identifiers, addresses and the data required for settlement to each other on cards, significantly simplifying the accuracy of settlements.

The clearing house prepared a carbon copy of the certificates at that time; authentication took place via seal and signature in all cases. The members of the clearing house paid a fee to the clearing house each month, based on the volume of the clearing; this also operates on a similar principle now. The speed of development shows that 233 clearing houses worked in the US in 1905 (*Thralls*, 1916).

A significant waystation along the developmental path of clearings was the introduction of the MICR system (magnetic ink character recognition) at the end of the 1950s - beginning of the 60s[2],, the MICR-code, which allowed the identification of the type of the document (check, vouchers); the bank code, the bank account number, the check number, the verification amount and a verification number/identifier could also be found. The system enables the direct entry of data into the data processing system. Contrary to other technologies, these characters were also in human-readable format (the ink generally contains iron oxide, the ratio of scanning error is under 1%).

The settlements of early clearing houses were typified by the designated-time of the settlement; clearing and financial settlement took place at a given time every day.

[1] The first large scale open loop system in the USA.

[2] Magnetic ink character recognition (MICR) – the technology was primarily developed for the banking sector, to simplify document processing and verification. (Wikipedia, n.d.)

The Belgium based correspondent bank system named Worldwide Interbank Financial Telecommunication (SWIFT) was founded in Brussels in 1973 by 293 banks, with the support of 15 countries. It began its active operations in 1977 with the utilization of telex technology and soon gained a defining role in conducting cross-border settlements. The system can be credited to this day with the application of the standardized message format, which comprises the stable foundation of international settlements today as well. Today, SWIFT connects 11,000 institutions of approximately 200 countries with its network. The message standards cover the comprehensive totality of instruments in capital and equity markets. The message protocol can be divided into the following units: SWIFTNet Realtime, SWIFTNet InterAct Store and Forward, SWIFTNet FileAct Realtime, SWIFTNet FileAct Store and Forward and SWIFTNet Brows. Continuous settlement characterizes the operation of SWIFT, the forwarding of messages is practically taking place on a continuous basis while in operation. (The frequency of the beneficiary bank's bookkeeping of transactions on the basis of received messages is a different issue.) (*Scott and Zachariadis*, 2012)

In the 1970s, settlements through the Automated Clearing House began to replace bilateral agreements gradually in domestic payment transactions (*Benson and Lofteness*, 2017). This is how multilateral settlements developed between parties. It meant a significant advancement and improvement in speed in the realm of check settlements that in the 1980s and 1990s cameras had been affixed to check sorting systems which also recorded the image of the check. The goal was the reduction of expenses; from that point onward, the parties exchanged the image of the check over the course of settlement. At this time, the transportation and long-term storage of checks were still a problem (image scanning was not yet equivalent with the paper-based check, this was only resolved by Act 21 of 2004) (*Federal Reserve Banks*, n.d.). The banks began to implement „check image clearing" en-masse in 2007, but by 2010, based on Federal Reserve data, 99% of check clearings were already undertaken in this manner. With the development of ACH and mobile payments, however, check traffic is decreasing continuously; the Y and X generations already prefer debit cards and mobile wallets, as well as online payments. The younger generations (born after 1946) do not utilize the services of bank branches as often, either; they are primarily characterized by online shopping and the search for online solutions. The users of digital currencies are also found to a significant degree among young adults, approximately 60% of Bitcoin users are under 35 years of age.

BANK CARDS AND POS PAYMENT

The need for instant payment and convenience brought to life the still rather popular bank cards. The appearance of bank cards in the United States can be placed at around the 1950s and 1960s. A common characteristics of bank cards was a standardized size and plastic material, as well as a magnetic strip or chip. Diners Club and American Express charge cards became widespread in the 1950s, followed by numerous business ventures. These are examples of closed loop payment systems, but the credit card issued by Sears also belongs to this category. The first ATM cards were also born in the 1970s; these were cards equipped with a PIN number, suitable for obtaining cash from a

checking account. This is a significant milestone because this is when we can start talking about cash withdrawals without a signature (*Schropfer*, 2010). The ATM network became truly wide-spread and accessible throughout the United States during the 1980s.

The appearance of bank cards also represented a convenience for the banks; their operational costs decreased significantly, teller traffic also consumed significantly fewer resources. It is no coincidence that the largest supporter of technological innovations is the banking sector and financial institutions, as they are the ones who are the direct and largest beneficiaries of systems that are developing there. The risks go down, the volume of settlements increases continuously, while at the same time, the processing time of transactions decreases steadily and continuously. A dominant proportion of bank card transactions operates pursuant to end of day settlements. Generally, the banks freeze the utilized amount on the client accounts until the time of settlement.

Cards issued by banks, prepaid cards and network branded cards can all be classified under open loop payment systems, with their main characteristic being that an unlimited number of users can join the network through an intermediary (bank). Another typical example of closed loop networks is the gift card or loyalty card, which is exclusively available to the customers of the given department store or store; nowadays it is available among the services of any larger retail chain. It is a disadvantage of closed loop systems that the expansion is slower here and the use of the cards is also limited.

The system of Point of Sale (POS) payments developed in parallel with the appearance of bank cards. The use of card reader terminals became widespread rather quickly, the payments became authenticated initially with signature, later via a PIN code. Nowadays, we can even pay without physical contact, with the aid of NFC technology, we can even use our mobile phone in addition to our bank card without any problems. The installation of terminals capable of non-contact payment has not taken place in many locations yet, in spite of the fact that it is essentially not expensive and does not require an extra investment.

Under the aegis of convenience and speed, in 2013, web credit services were also introduced in the United States, enabling instant web based crediting for the partner.

With regard to international settlements, the creation of the FED Global settlement system in the USA was significant. This payment system enables the performance of cross-border transactions into other countries in the case of pension payments. The payment target nations are primarily Canada and the United Kingdom. The transactions are conducted by the ACH; the payment mechanism is identical to domestic payments. The advantage of the system is its inexpensive nature and standardized format; since 2009, a separate transaction type has provided the settlement of Fed Global pension payments. (International ACH Transaction) (*BIS*, 1998)

SMARTPHONE WALLET

The „mobile wallet" application in the world of smartphones[3] appeared soon, providing/impacting numerous advantages versus traditional bank card payments.

[3] By smartphone, we are referring to devices capable of NFC (Near Frequency Communication), equipped with Trusted Service Manager function and Universal integrated circuit card and an internet browser, operating on a GSM network and supplied with an operating system.

Mobile wallet payments are fundamentally secure, as the identification of the owner of the telephone is self-evident. It is an advantage of the mobile wallet that at the time of payment, on the basis of available price discounts, it ranks payment methods (based on card or payment network); with a single device, bank cards, loyalty cards and coupons are equally accessible. The mobile wallet is an empty wallet which can be loaded with tools as the user wishes (bank card, credit card, loyalty card, coupons). In this way, the conditions of payment become easily accessible and personalized. (*National Bank of Romania*, 2016)

LARGE VALUE PAYMENT SYSTEMS

Contrary to other developed industrial nations (where the national bank operates an RTGS system), in the USA, to conduct large sum transfers, two systems are actually in operation. One of them is the FED Wire transfer system accessible to banks and financial institutions, and the other is the CHIPs (Clearing House Interbank Payment System) operated by large banks (owned by The Clearing House). The FED's system is a classical RTGS system, with guaranteed payment and performance, with an instant gross based settlement. In numerous countries internationally, financial institutions, banks and brokerage firms use wire transfers in the case of B2B transfers. Private clients only tend to use it when paying for real estate, as the payment orders are final, non-revocable and immediate. The settlement chain is rather simple, on one end of the transaction, the paying party and its bank are located, on the other, the bank of the receiving party, as well as the receiving party. Due to the nature of the transactions, however, to conduct these transactions, the banks pay particular attention to the four-eye principle in effect. The FED Wire Transfer has been in operation electronically since 1981; previously, the data were communicated among the banks by telex and fax. Contrary to the foregoing, CHIPs is working on a net basis, it is not an RTGS system. The CHIPs began its operation in 1970, thereby replacing paper based settlements.

Generally, RTGS systems are owned by national banks and they operate them, but in Canada and the United Kingdom, it is the private sector that plays its part in the operation of the payment systems.

The first RTGS system in Poland was SORB (Bank Accounts Servicing System), which was launched on 5April, 1993 (*Benson and Lofteness*, 2017). In Hungary, the "Valós Idejű Bruttó Elszámolási Rendszer" (Real Time Gross Settlement System) began its operation on 3 September, 1999. The European Union's TARGET system also began its journey in 1999, developed from the interlinking system connecting the respective national banks of member states. The ReGIS was introduced relatively late in Romania, in April of 2005; this was the first real-time payment system (*Guttmann*, 2014). Thanks to its broad bank branch network, Russia only introduced its instant payment system, the BESP, in 2007.

Nowadays, the reign of POS payments is undeniable, it has opened up new horizons without physical contact for bank cards and virtual cards. The primary factors influencing the development of payment systems were the creation of mobile applications, the Internet, the appearance of smartphones, the booming of mobile

and online commerce, the development of POS terminals, NFC technology, authentication technology and the appearance of QR codes, iPhones equipped with chip cards and chips, as well as various payment platforms. Concomitant to development in recent decades was the rapid improvement of fraud prevention and risk management. Check and document imaging technologies assisted automation, reducing shipping costs and speeding up settlement. (*Bailey*, 2015)

CRYPTO CURRENCIES - BITCOIN TECHNOLOGY

The latest generation of payments is comprised of payments performed via digital currencies. Nowadays, as many as 1700 currencies exist in virtual space and the technology of these settlements significantly varies from that of traditional money transfers. There is no actual wealth, gold or other security behind digital currencies, their use is based on trust. It is a condition for payment that the service provider or seller accepts the given digital currency as payment. It is a significant innovation of Bitcoin (hereinafter: BTC) technology that there is no centralized system, clearing house or platform where the payments are performed, but rather processing takes place on the devices of system users (PC, mobile, hardware). (*Nakamoto*, n.d.)

The existence of digital currencies is legitimized by belief; they carry higher risk than traditional currencies, as there is no central regulatory body or issuer and they are not tied to a nation or organization. BTC is supported by the database distributed by the nodes of its peer-to-peer [4] network (*Benson and Lofteness*, 2017). The infrastructure is provided by the users of the payment system; they provide the resources for the operation of the system. This is the least bureaucratic system, it does not require the opening of an account and the verification of one's identity, minors can also use the system, it is sufficient to download the application, establish a BTC address and use the private key. The settlement of Bitcoin and other digital currencies fundamentally cannot be classified under any of the classical settlement types, the settlement of transactions takes place depending on the load level of the system/network, essentially within one hour.

CONCLUSIONS

It can thus be stated that over the course of the past 200 years, payment technology has undergone continuous changes. The internet harbors unlimited opportunities in revolutionizing payment systems. Thanks to digital currencies, a new form of financial culture is beginning to emerge, one in which the young also demand a place for themselves. The development of consumer requirements assists the spread of mobile wallet functions more and more; with the spread of mobile devices, payment options are easily personalized. Nowadays, we have gone from bilateral settlements to global payment systems.

[4] By the term peer-to-peer network, a network composed of elements on an identical level; there is no superior or dominant element in the network, the network data is stored by the computers of the users.

REFERENCES

Bailey, D. (2015): Bitcoin Guide for Beginners: The Simple And Proven Bitcoin Trading Guide for Making Money with Bitcoins. Amazon, Kindle Edition, ASIN: B00U3Z4ZDU 27. p.

Benson, C.C., Lofteness, S. (2017): Payment Systems in the U.S. Third Edition, San Francisco: Glenbrook Press, ISBN 978-0-9827897-5-9. 487. p.

BIS (1998) Managing change in payment system. Policy Papers No. 4., Basle: Bank for International Settlements (BIS) Monetary and Economic Department, [online] <URL: https://www.bis.org/publ/plcy04.pdf>

Federal Reserve Banks (n.d.): FEDGlobal, ACH Payments, [online] <URL: https://www.frbservices.org/assets/financial-services/ach/fedglobal-ach-payments.pdf>

Guttmann, B. (2014): The Bitcoin Bible, Gold Edition: All you need to know about bitcoins and more. Amazon, Kindle Edition ASIN: B00I17S3CG 438. p.

Nakamoto, S. (n.d.): Bitcoin: A Peer-to-Peer Electronic Cash System. [online] <URL: https://bitcoin.org/bitcoin.pdf>

National Bank of Romania (2016) ReGIS. [online] <URL: http://www.bnr.ro/ReGIS-3305.aspx>

Schropfer D.W. (2010): The SmartPhone Wallet: Understanding the Disruption Ahead. Amazon, Kindle Edition, ASIN: B004KABBCC 142. p.

Scott, S.V., Zachariadis M. (2012): Origins and development of SWIFT, 1973–2009. In: Business History, 54. 3. 462-482. p. doi: 10.1080/00076791.2011.638502

Thralls, J. (1916): The Clearing House: Facts Covering the Origin, Developments, Functions, and Operations of the Clearing House, and Explaining the Systems, Plans, and Methods Promulgated by the Clearing House Section of the American Bankers Association, New York: Clearing house section American bankers association, 79. p.

Wikipedia (n.d.): Magnetic ink character recognition. [online] <URL: https://en.wikipedia.org/wiki/Magnetic_ink_character_recognition>

Corresponding author:

Andrea KRISKÓ
Széchenyi István University
H-9026 Győr, Egyetem tér 1,
e-mail: andrea.krisko@yahoo.com

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LOGISTIC CHALLENGES IN THE SHORT FOOD SUPPLY CHAINS

András Bence SZERB, Tamás HORVÁTH, Boglárka SZERB, Arnold CSONKA
Kaposvár University, Faculty of Economic Science, H-7400 Kaposvár Guba S. u. 40.

ABSTRACT

The aim of the Paper is to identify the types of short food supply chains (SFSCs), their spread today, and to demonstrate the advantages or disadvantages they provide, especially the logistical problems and solutions that can be identified in the chain. In order to achieve this goal, we carried out a review of international and Hungarian literature sources and secondary data. It can be stated that SFSCs can be a viable alternative to conventional supply chains pursuing a global distribution strategy. Establishing a restricted geographic range of supply provides several benefits to local producers, consumers and society. However, there are serious concerns about logistical costs and associated emissions. To overcome this, there is a need for compromises. The practical example we present shows that the use of conventional „less short" sales channels in the distribution mix is reasonable even in the case of local foods.
Keywords: short supply chain, food system, logistics

INTRODUCTION

Nowadays, there is an increasing number of articles in domestic and international literature which concentrate on local products and short food supply chains (SFSCs). The attention paid to local products has started to strengthen decades ago in Western European countries. This has led to the emergence of consumer demand for regionally-produced and traditional food products. Following the positive examples of successful local food and short food supply chains in the French regions, the European Union launched the Euroterroirs program in 1992 to bring French good practice to other countries in the community. This program was not only intended to stimulate local economies, but also to strengthen national identity through the strengthening of traditions (*Pannon.Elemző Iroda*, 2010). According to *Csonka* (2015), since the beginning of the 2000's, the number of local food production systems and the related trademark systems has increased in Hungary and internationally, as well as the volume of transactions carried out in these systems.

To solve the problem of global population growth, conventional food networks and industrialized agriculture have been seeking the answer for a long time. Global trade has been built to distribute the increased amount of food all over the world properly. However, overproduction of agricultural production and food production led to the depletion of farmland and environmental overload. Short food supply

chains are trying to find solutions to these problems locally. Their focus is on maintaining a healthy person, the environment, the local economy, and local cultural values (*Matson et al.*, 2013). The local food supply chain can cover different sales channels. Producers are typically present in several sales channels in parallel, but according to *Mácsai et al.* (2012), the traditional „market" is the most important for producers in terms of sales.

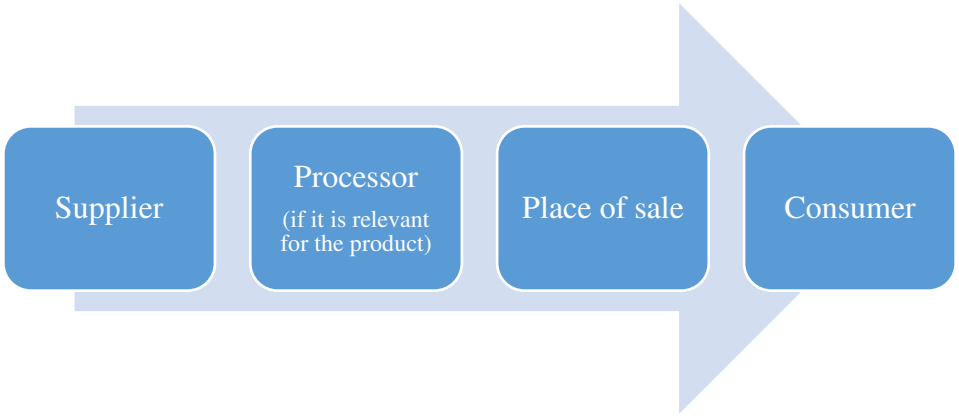
The aim of the authors in the study is to identify the types and the popularity of short food supply chains, and to demonstrate the advantages or disadvantages they provide and the logistical problems and solutions that can be identified in the system. In order to achieve this goal, international and Hungarian literature and secondary data sources have been used and analysed

SHORT FOOD SUPPLY CHAIN (SFSC)

The short food supply chain is defined in different ways by the authors in literature. According to *Renting et al.* (2003) „… [it] covers (the interrelations between) actors who are directly involved in the production, processing, distribution, and consumption of new food products". In the study, the authors defined the concept of SFSCs in the presence of the following actors as shown in *Figure 1*. The producers of the products are the farmers who follow the processing level if the nature of product justifies a higher degree of processing. The processors can be the farmers themselves. They are followed by the place of sale and the buyer of the product, the consumer. According to *Jarosz* (2008), the short food supply chain is characterized by the small size of plant, the small volume and generally the sustainability and the environmental awareness in some form.

Figure 1

Flow chart of short food supply chain



The short food supply chain was divided by *Jarosz* (2008) and *Ilbery-Maye* (2005) into the following types according to their spatial extent and sales mechanism:

Direct-Connected Sales

There is a direct contact between the producer and the consumer at the moment of sale. The condition of re-purchase is the good quality of goods and good shopping experience. The place of sale can be: roadside point of sale, home/yard of the farmer/producer, home delivery, producer's market, web store, pick yourself, guest table.

Community Marketing Based Sales

In case of the community marketing based sales, the relationship between the SFSCs actors is institutionalized. In many studies (*Renting et al.*, 2003; *Cleveland et al.*, 2014) we can read about producer or consumer cooperative shops created by community marketing, which provide an excellent opportunity for producers to appear in the markets. Various direct delivery forms are also popular in local hospitality facilities, in public catering or in local product stores. In recent years, thematic festivals and farewells have been gaining popularity, which can also be the point of appearance for producers.

Extended Supply Chain

In the case of an extended supply chain, the producer has no direct relationship with the consumer. The most important information is the exact origin of the food (eg. family-business, permaculture, organic, national park or countryside food).

BENEFITS PROVIDED BY SFSC

Supplier

According to some international studies (*Brehm and Eisenhauer,* 2008) about community-supported agricultural systems, farmer's responses indicate lower age and higher education than average. Similar demographic values can usually be found in other supply chain producers. The farms are usually small, the average farm size is less than 10 hectares. The farmers/producers of the short supply system are characterized by flexibility and openness to innovation. It is a difficult task to transform a plant to a level that will enable to participate in a community-supported farming system, as the consumers expect to provide fresh and varied food continuously. In order to achieve this, SFSCs dependent plants have to develop efficient and flexible operation and communication at the same time (*Mastronardi et al.*, 2015). This is partly due to the fact that the alternative forms are mainly dealt with by young and educated producers. It is also an advantage of the young and educated producers/farmers that joining and existing network requires a wide range of capabilities and tendency to innovate from the producers (*Benedek and Balázs*, 2014).

Trust is a fundamental condition for the development and success of the short supply system. According to *Benedek and Balázs* (2014) in Hungary, traditional markets of big settlements, and producers' markets attract different farming layers. In the case of traditional markets, higher prices, instant cash payments, and habits are more important, while in producer's markets the same factors are less

motivating. On the producer's market, the farmers who sell their products, have larger area and wider range of products and additional investment plans. Co-operative membership and the participation in informal co-operation also have an impact decisions on market sales (*Benedek and Fertő*, 2015).

Consumer

The short supply system satisfies the needs of two types of consumers. One of those types basically prefers conventional food supply, and only occasionally uses the possibilities of the short supply system. The other type is completely purposeful for health, ethical or other reasons, and specifically tries to avoid the usual solutions (*Nygard and Storstad*, 1998; *Benedek and Balázs*, 2014).

Consumers need to make a serious sacrifice and change their attitude if they want to buy only (or mostly) local food. This kind of sacrifice can be for example giving up non-locally grown fruit and other foods, or occasionally avoiding food that can only be produced locally on account of climatic conditions. In addition, the convenience of supermarkets cannot be forgotten, where everything can be purchased in one place, which is always available to consumers, and in many cases even cheaper (*Benedek*, 2014). At the same time consumers must know that in the SFSCs the quality of the food is different - probably higher than in the supermarkets - and with their purchase they support the local economy (*Brown and Miller*, 2008).

Society

Rural development also plays a significant role in short food supply chains from the point of view of local economic development (*McLaughlin and Merrett*, 2002). Local producers can become suppliers to local public institutions with the support from the central or local government. A further aim of these catering programs is to improve the health of the children of families with lower income. From the producer's point of view, the advantage of such programs is that a state order can create a predictable, secure market. Local processing increases employment, plus the multiplier effects are that they can strengthen further the local economy (*Marsden et al.*, 2000). Another advantage of the programs is that school classes can take an active part in plant visits and excursions, and that the experiences they have gained will be used in the school or even in the home garden, completing environmental education (*Benedek and Balázs*, 2014).

POTENTIAL BARRIERS AND HINDERING FACTORS IN THE SFSC

Beside the benefits of SFSCs there are authors who highlight some factors which can easily turn to barriers in the systems. According to *Galli and Brunori* (2013) these factors should be solved on different levels: SFSC actors, local administration, national government, EU level.

a. SFSC actors: Having a necessary knowledge from the beginning is very important for the SFSC actors. This knowledge is indispensable for further development or investment as well. For creating an optimum operation actors

need to invest in networking and communication as well and keep the size of the operation on the appropriate level both from social and economic points of view. Distribution is one of the key factors of the success of SFSCs, so actors should find innovative solutions in reducing these costs through collaboration.

b. Local administration: The good cooperation between SFSCs actors and local administration is required in the system. First of all the behaviour and the mindset of the different administrations should support the local food system. They can support SFSC actors with introducing retailing policies, territorial planning, offering potential market for the products (ex.: local food for children or at public catering) and also introduce a cooperation with public authorities in important questions such as hygienic requirements. Local administration can be a support or one of the biggest barriers for SFSCs.
c. National government and the EU: Rural areas face different problems and therefore they need different kinds of help to solve their problems. The EU and the different national governments have introduced several types of funded projects in the recent years and SFSCs have been able to benefit from these. National governments can use the flexibility of EU rules to help to remove the unnecessary hindrances to SFSC. They can also build SFSCs into multiple policy areas including health, agriculture, rural development and environment to provide a solution for cross departmental policy challenges on local levels.

THE LOGISTIC ISSUES OF THE SFSCS, REGARDING ESPECIALLY THEIR ENVIROMENTAL IMPACT

The environmental impacts of the short food supply chains are double-edged. It is logical and confirmed by the literature (*Soysal* et al., 2014; *Jarosz*, 2008) that short supply distances (either in livestock transport or in the distribution of finished products) associated with local food supply reduce both transport costs and emission of pollutants regarding transport processes. An important environmental advantage of local food systems based on geographical proximity is the reduction of transport distances. At the same time, this advantage can be eliminated by the extra travel cost for consumers. To realize the advantages, therefore, it is necessary to organize efficient and high-quality customer service (eg. environmentally- and user-friendly design of home delivery). Even in the case of special storage conditions (eg. refrigerated storage), there is a possibility that specific energy consumption and emission of pollutants in the SFSCs will exceed the import products. (*Benedek*, 2014). However, *Mundler and Rumpus* (2012) emphasize that the energy efficiency on the system level, well-built and managed international transport chains can be even better for small food systems with decentralized operation and smaller sales volume. The balance can clearly tilt towards local supply if the cost of delivering distance between the producer and the consumer is more to the customer, as the chances of organizing multipurpose trips are significantly better on the customer side. In this case, the resulting travel costs are not only „burdened" by the delivery of the purchased product, but also divided between the additional travel-related goals. This type of transaction can be realized

directly at the production site or a sales point close to the production site or as part of a community production program typically associated with the settlement. However, there is a serious risk of these kinds of production systems, namely that the producing capacities created for the supply of the single producer or the narrow community can be found in a significant part of the year, with low utilization and with poor efficiency.

The delivery of the product from the place of production to the designated market or to the food centres is the most complicated and cost-effective process. To ensure the smooth running of this process, careful, accurate and precise planning is required. Shipping costs are a very important aspect for the companies. Transport vehicles must be used to their maximum capacity to deliver as many products as possible at the lowest cost. Thus, even large quantities of products can be transported profitably to nearby settlements (*Matson et al.*, 2013; *Cleveland et al.*, 2014). Logistics and short supply system resources are neglected or underestimated despite the fact that logistics has for years been decisively improving the quality of traditional supply systems. There is not only one type of logistics organization in the long supply systems, as it may vary depending on the type of supply and the destination of the product. Warehouses have several main tasks in the supply system: store the product for longer or shorter periods at appropriate temperatures, or label and repackage to deliver further to the target market (*Blanquart et al.*, 2010).

The problems here are serious, but not impossible. The most important question is whether the short food supply chains are backed by the organizational and infrastructure background and the volume of production that can be used to create an efficient logistics system. A good example of this is the Székely trademark created by the Harghita County Council in Romania. The trademark system satisfies both local food system and short supply chains. The system includes food, industrially produced non-food products, handicrafts and intellectual products as well. Effective access to consumers is ensured by a multi-component sales system. The Council organizes a monthly production fair. Consumers can reach the products in concentrated time and space. The cost of travelling to the fair and emissions of pollutants are not only burdened by the purchase of SFSCs products, as other tourist and cultural attractions accompanying the fair are also an important part of the supply. The fairs are organized at regular, predictable intervals, so the purchase becomes well scheduled. Regular local fairs are complemented by the organization of domestic and international festivals and participation in trade fairs, so the products occasionally „get rid of" the local market, increasing the lifetime and competitiveness of the product. The third element of the sales mix is selling to local shops and chain stores. In addition to guaranteeing a secure market, these commercial companies have an efficient logistics system that enables fast, cheap and low-energy transportation and storage. Because of the use of such conventional sales channels, the trademark system can provide a stable market and economic development for producers. Although this is a compromise on maintaining the SFSCs character of the trademark system, it also allows local improvements for the system. In recent years, a significant amount of processing capacity has been established in Székely Land to increase the added value of the products through

self-support from the steadily growing sales volume and the inclusion of tender funds. Increasing the level of processing further improves the competitiveness of the products of the trademark system.

CONCLUSION

In this study, the authors reviewed the peculiarities of short food supply chains, their benefits and logistics challenges. It can be stated that SFSCs can be a viable alternative to supply chains based on conventional industrial production and global distribution strategy. Providing a limited geographic range of supply, with the appropriate level of planning and infrastructure conditions, it offers a lot of advantages to local producers, consumers and society. However, there are serious concerns about logistical costs and related emissions. Several sources that the study have presented show that the low level of organization and technology, the fragmentation of purchasing travels, and the economies of scale resulting from the low volume of transport and the storage capacities ultimately eliminate the benefits of short delivery distances. To overcome this, there is a need for some compromises. The practical examples the study presented shows that the use of conventional „less short" sales channels in the distribution mix can be justified in the case of local foods. The organization and efficiency provided by traditional channels and a stable market enable local development. The example also shows that the success of alternative, SFSCs sales is based on the existence of a strong, high-regulatory background organization capable of operating the SFSCs channels efficiently.

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REFERENCES

Benedek, Z. (2014): A rövid ellátási láncok környezeti hatásai. [online] <URL: http://real.mtak.hu/17217/1/Benedek%20Zs_A_rovid_ellatasi...MATUD2014.8.pdf >

Benedek, Z., Balázs, B. (2014). A rövid ellátási láncok szocioökonómiai hatásai. In: Külgazdaság, 58. 5-6. 100-120. p.

Benedek, Z., Fertő, I. (2015): Miért választják a termelők a rövid ellátási láncokat? In: Statisztikai Szemle, 93. 6. 580-597. p.

Blanquart, C., Gonçalves, A., Vandenbossche, L., Kebir, L., Petit, C., Traversac, J.B. (2010): The logistic leverages of short food supply chains performance in terms of sustainability. 12th World Conference on Transport Research 11-15. July, Lisbon, 10. p.

Brehm, J.M., Eisenhauer, B.W. (2008): Motivations for participating in community-supported agriculture and their relationship with community attachment and social capital. In: Southern Rural Sociology, 23. 1. 94-115. p.

Brown, C., Miller, S. (2008): The impacts of local markets: a review of research on farmers markets and community supported agriculture (CSA). In: American Journal of Agricultural Economics, 90. 5. 1298-1302. p. doi: 10.1111/j.1467-8276.2008.01220.x

Csonka A. (2015): A helyi sertéshús ellátás gazdasági lehetőségei magyarországon. In: Élelmiszer, Táplálkozás és Marketing. 11. 1-2. 45-52. p.

Cleveland, D.A., Müller, N.M., Tranovich, A.C., Mazaroli, D.N., Hinson, K. (2014). Local food hubs for alternative food systems: A case study from Santa Barbara County, California. In: Journal of rural studies, 35. 26-36. p. doi: 10.1016/j.jrurstud.2014.03.008

Galli F., Brunori G. (eds.) (2013): Short Food Supply Chains as drivers of sustainable development. Evidence Document. Document developed in the framework of the FP7 project FOODLINKS (GA No. 265287). Laboratorio di studi rurali Sismondi, ISBN 978-88-90896-01-9.

Ilbery, B., Maye, D. (2005): Food supply chains and sustainability: evidence from specialist food producer sin the Scottish/English borders. In: Land Use Policy, 22. 4. 331-344. p. doi: 10.1016/j.landusepol.2004.06.002

Jarosz, L. (2008): The city in the country: Growing alternative food networks in Metropolitan areas. In: Journal of Rural Studies, 24. 3. 231-244. p. doi: 10.1016/j.jrurstud.2007.10.002

Mácsai, É., Kujáni, K., Juhász, A., Hamza, E., Györe, D. (2012): A közvetlen értékesítés szerepe és lehetőségei a hazai élelmiszereke piacra jutásában. Élet a modern kiskereskedelmi csatornákon kívül? In: Juhász A. (ed.): Agrárgazdasági Tanulmányok, Budapest: Agrárgazdasági Kutató Intézet. 121. p. ISSN 1418-2122

Marsden, T., Banks, J., Bristow, G. (2000): Food supply chain approaches: exploring their role in rural development. In: Sociologia Ruralis, 40. 4. 424-438. p. doi: 10.1111/1467-9523.00158

Mastronardi, L., Marino, D., Cavallo, A., Giannelli, A. (2015): Exploring the role of farmers in short food supply chains: The case of Italy. In: International Food and Agribusiness Management Review, 18. 2. 109-130. p.

Matson, J., Sullins, M., Cook, C. (2013): The role of food hubs in local food marketing. United States Department of Agriculture (USDA) Rural Development Service Report 73 [online] <URL https://www.rd.usda.gov/files/sr73.pdf>

McLaughlin, P., Merrett, C. (2002): Community-supported agriculture: Connecting farmers and communities for rural development. In: Rural Research Report, 13. 1-8. p.

Mundler, P., Rumpus, L., (2012): The energy efficiency of local food systems: A comparison between different modes of distribution. In: Food Policy, 37. 609-615. p. doi: 10.1016/j.foodpol.2012.07.006

Nygard, B., Storstad O. (1998): De-globalisation of food markets? Consumer perceptions of safe food: The case of Norway. In: Sociologia Ruralis 38. 1. 35-53. p. doi: 10.1111/1467-9523.00062

Pannon.Elemző Iroda (2010): Helyi termékek értékesítési csatornái Magyarországon. Partial study of. „Helyi Kezdeményezésű gazdaságfejlesztési Programok

Értékesítése". 36.p. [online] <URL: http://hetfa.hu/wp-content/uploads/2010/12/Helyi-termékek-értékesítési-csatornái-Magyarországon.pdf>

Renting, H.J., Marsden, T.K., Banks, J. (2003): Understanding alternative food networks: exploring the role of short food supply chains in rural development. In: Environment and planning, 35. 3. 393-412. p. doi: 10.1068/a3510

Soysal, M., Bloemhof-Ruwaard, J., van der Vorst, J.G.A.J. (2014): Modelling food logistics networks with emission considerations: The case of an international beef supply chain. In: International Journal of Production Economics, 152. 57-70. p. doi: 10.1016/j.ijpe.2013.12.012

Corresponding author:

Arnold CSONKA
Kaposvár University, Faculty of Economic Science,
H-7400 Kaposvár, Guba S. 40.
Tel.: +36 82 505 800
email: csonka.arnold@ke.hu

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AGRICULTURAL BY-PRODUCT AS A RENEWABLE ENERGY SOURCE

Alexandra RAJCZI, Irén WICKERT
Kaposvár University, Faculty of Economic Science, H-7400 Kaposvár, Guba S. 40.

ABSTRACT

The energy consumption of the world, and thus of Hungary, is growing rapidly, and to date fossil fuels have had a major role. During agricultural production those kinds of by-products are generated the utilization of which is not organised effectively enough. The basis of biogas generation comes from agricultural by-products which could not be utilized in other cases, so its positive impact on the environment is beyond dispute contrary to fossil fuels. Alternative energy efficiency requirements in rural areas, besides the effects, have both economic and social benefits. The study looks for the answer to the question how the by-products produced in Hungarian agriculture and the sustainable development of the countryside are produced.
Keywords: agricultural by-product, energy, biogas, rural areas, sustainable development, biomass

INTRODUCTION

Among today's global challenges, the growing importance of energy supply focuses on the potential role of the agricultural economy. According to a study by Nobel Prize-winning researcher R. E. Smalley, which ranked the 10 most important challenges for humanity, places energy supply first, followed by water supply and food supply. All these challenges are affected by the agricultural economy. Hungary's agricultural economy has significant potential, in line with global challenges, in addition to the production of adequate quantities and quality of raw materials for energy recovery. This can help to promote regional development and sustainability aspects (*Dinya*, 2009). Transition to renewable energy is an indispensable condition for the energy supply of today's economy, the preservation of the natural state, the retention and further increase of occupation (*Dupcsák and Marselek*, 2013).

LITERATURE REVIEW

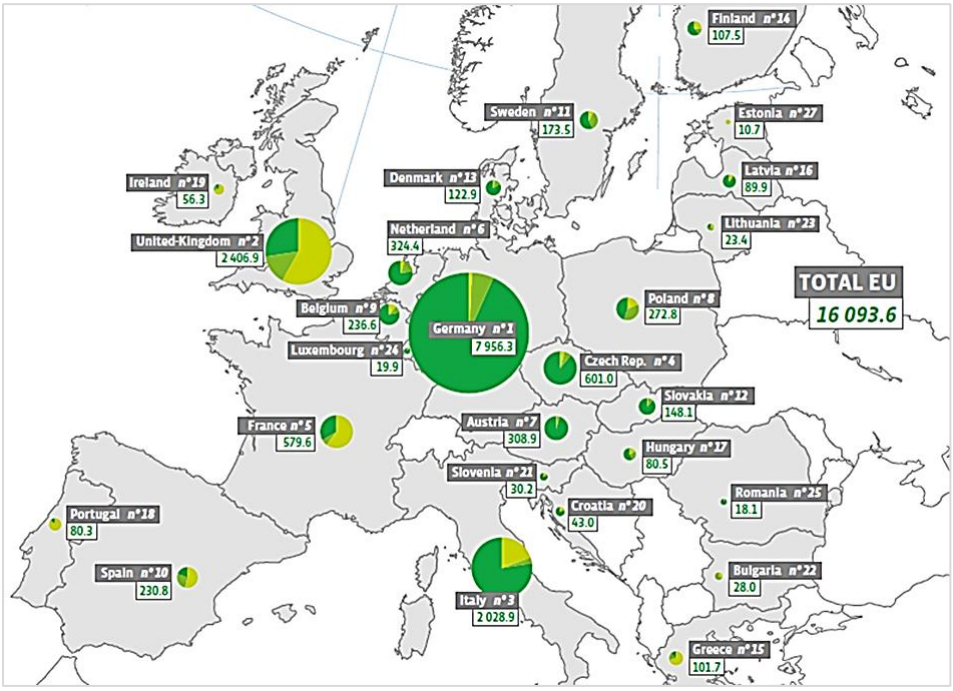
In addition to the production of raw materials for the food industry, agriculture can also play a key role in the energy sector. For this purpose, the recovery of biofuels as fuel, the production of biomass and the fuels produced from it are excellent. Global warming caused by the greenhouse effect can be justified by the use of fossil fuels. In the case of renewable energy sources, this is irrelevant as the plant develops the same amount of CO_2 into its tissues during photosynthesis as it enters the atmosphere when it is burnt (*Fogarassy*, 2001). Biogas is a gaseous substance formed

during anaerobic fermentation of organic materials, which is a good substitute for natural gas (*Bai*, 2013). It is produced by anaerobic fermentation of organic substances in a wet medium, called bio-methane development. The composition of biogas contains 60-70 percent methane (CH_4) and 30-40 percent carbon dioxide (CO_2). The advantage is that organic by-products from agricultural production are the basis of production. During the development of biogas, 50-60 percent of the organic matter can be decomposed, so the rest is solid or dilute compost, which can be utilized for nutrient replenishment in the production area (*Fogarassy*, 2001).

All Member States of the European Union have a biogas plant (*Figure 1*), but 75.8% of the total energy from this is from three countries: Germany, the United Kingdom and Italy (*EurObserv'ER*, 2017b). In Hungary, only 16 percent of biogas production per capita is the EU average. The number of biogas plants in the European Union renewable energy sector is developing the most dynamically (*Bai*, 2013). In the European Union, biogas plants, especially in Germany, have comparative advantages over domestic plants. The German state provides significant support for investments and regulates the takeover prices in a complex manner, and compliance with the regulations for the management and storage of waste is extremely costly, thus shifting their utilization towards biogas plants (*Bai ed.*, 2005). If we examine the spatial location of biomass plants, we can see that their distribution is more even than in the case of biogas plants.

Figure 1.

Biogas production in the European Union at the end of 2016

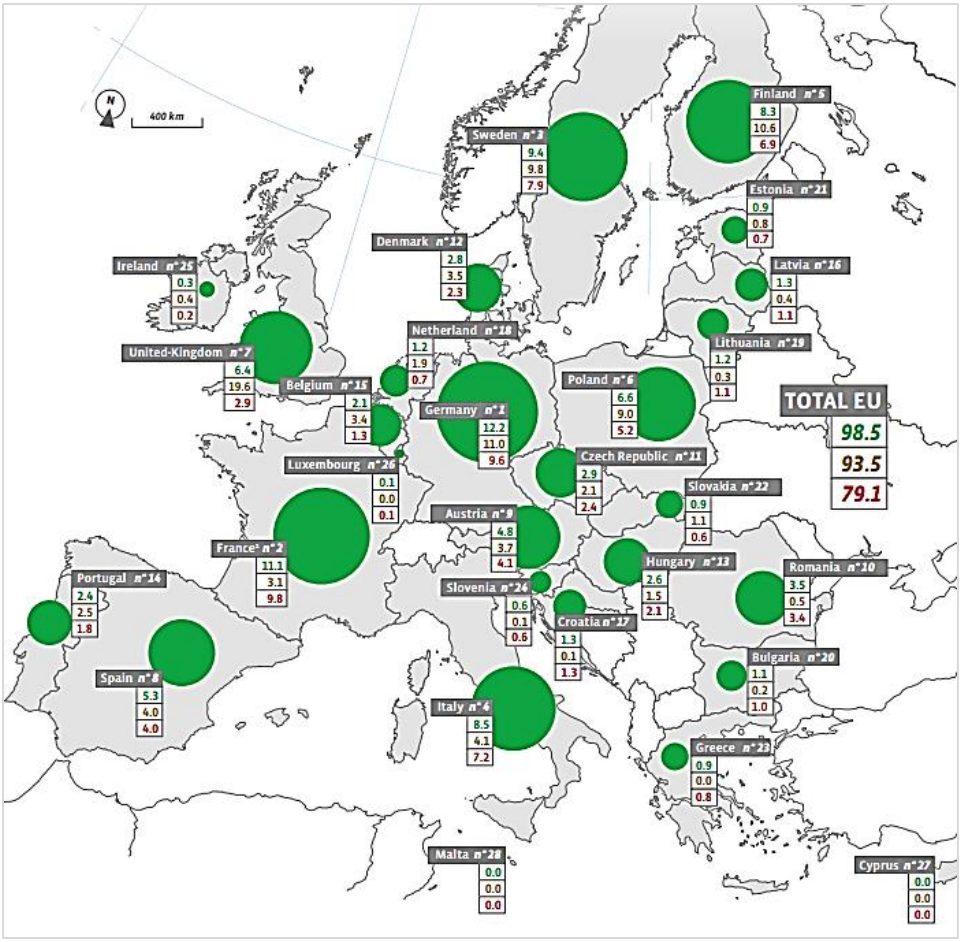


Source: *EurObserv'ER*, 2017b 12. p.

Figure 2 shows that all Member States of the European Union have biomass production (*EurObserv'ER*, 2017c). The upper value shows gross inland consumption, the middle value is gross electricity and the lower value is heat consumption. The most notable users are Germany, France and Sweden.

Figure 2.

Gross inland consumption, gross electricity production and heat consumption from solid biomass in the European Union in 2016



Source: *EurObserv'ER*, 2017c 12. p.

MATERIALS AND METHODS

The primary objective of the study is to study the complex use of agricultural by-products for energy purposes. The study looks at how an accumulated agricultural by-product can determine social, natural and economic aspects. The study is based on secondary data,

based on secondary data. It processes and summarizes national and international literature. The data is based on data from *EurObserv'ER* (2017a), *Eurostat* (2018) and the *Hungarian Central Statistical Office* (2018). Only descriptive statistics were used in the analysis and time series were illustrated. The general characteristics of the available data sets are the research results for the utilization of agricultural by-products for energy purposes in Hungary. Detailed studies of green energy production provisions, biogas and biomass plant characteristics, take into account sustainability considerations. Only descriptive statistics were used in the analysis and time series were illustrated.

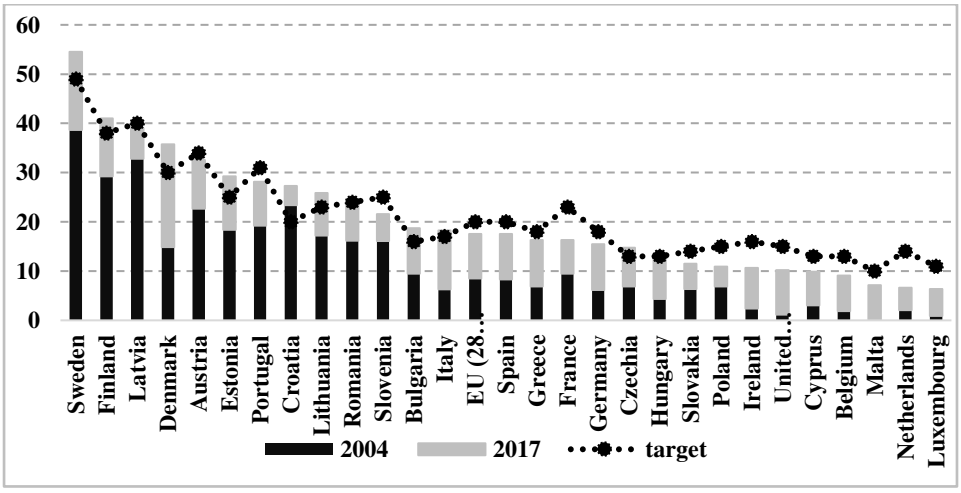
RESULTS AND DISCUSSION

In the European Union, the share of renewable energy sources in gross final energy consumption at Community level should be raised to 20% by 2020, Hungary's target is 13%. Hungary's Renewable Energy Recovery Action Plan states that it wants to achieve a higher share of 14.65%. (*Popp et al.*, 2018).

The share of renewable energy in total gross final energy consumption was 14.5% in 2015, but in 2014 it was only 9.6%. This increase is due to changes in the statistical methodology. The Hungarian Energy and Public Utility Regulatory Authority has defined a new method for the use of solid biomass for residential use. Previously, firewood use was based on forestry statistics and is now calculated from household energy consumption data. The reason for the increase may be illegal logging (*Popp et al.*, 2018). Hungary has already met its target, but it does not occupy a high position in the European Union. *Figure 3* shows that Sweden, Finland, Latvia, Denmark and Austria are outstanding, while the share of renewable energy in the Netherlands, Ireland and France is considered low and far below the target.

Figure 3.

Share of renewable energy in gross final energy consumption



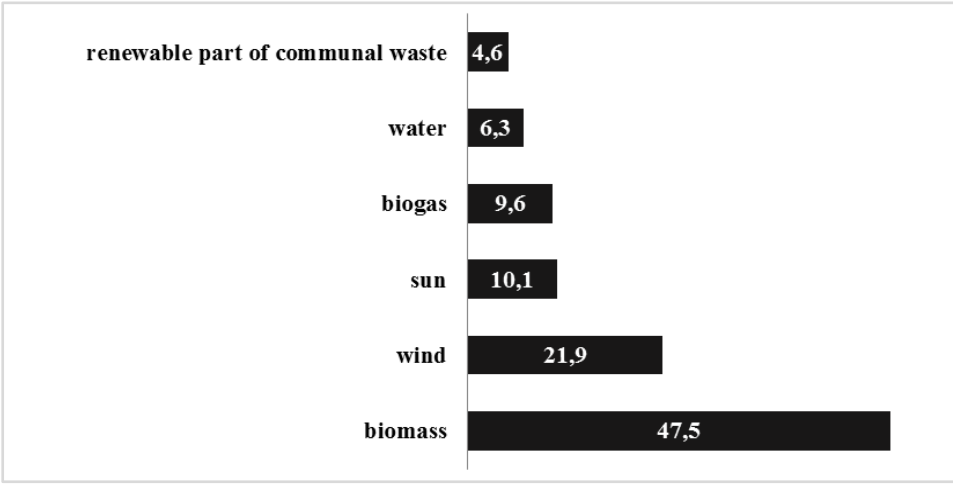
Source: Based on *Eurostat*, 2018

Biomass (47.5%) accounts for a major proportion of renewable energy sources and waste, with a share of 21.9%. The proportion of solar energy has grown dynamically in recent years, with 10.1%. The share of biogas plants is 9.6%. *Figure 4* shows that more than half of renewable energy (57.1%) comes from agriculture. Within this, biomass is the most significant one. As a criticism of biomass-based energy production, energy crops reduce food-producing areas. However, it includes not only energy crops, but all organic matter of biological origin can be considered biomass. The raw materials that can be used are forestry timber, wood by-products, energy crops, agricultural by-products and other waste. The energy use of biomass can be varied, suitable for both hot water and steam production. In order to increase the biomass value of the biomass and to make it easier to handle, agricultural products can be produced by compression processes of various sizes of low-moisture fuels (briquettes, pellets) (*Pula*, 2018). The creation of bioenergy plants has a positive impact on employment and the support of related industries. Biomass is currently a tool for promoting sustainable development. It enables the spread of energy at optimal cost, can help mitigate climate change, develop rural economies and increase energy security (*Saad and Taleb*, 2018).

The establishment of biogas plants is extremely capital intensive, and its location is determined by the availability of raw materials. In general, they are located in the immediate vicinity of livestock farms or food processing plants. This ensures the storage and disposal of the by-products.

Figure 4.

Share of electricity from renewable energy sources and waste in Hungary



Source: Based on *Hungarian Central Statistical Office*, 2018

The investment cost of a small capacity 0.8 MW biogas plant is 1,093 million HUF, while a high capacity plant is worth 2,004 million HUF based on the calculations made by *Popp* and its companions (*Table 1*). Operating costs are reduced

by increasing performance. The operation of a biogas plant is competitive only if we examine it in a complex way. The establishment of biogas plants has a direct relationship with state aid policy. In order to increase the number of these plants on the market, state aid policy must be predictable. In the European Union, there is a high dispersion in the prices of receipt, and in Hungary, subsidized takeover prices are low (*Popp et al.*, 2018). The lifetime of biogas plants is not affected by their capacity, so their expected useful life is equal to about 20 years. The labour input of raw material production is not affected by the size category of the biogas plant. The difference is in design, installation and operation. Small-scale plants require a higher workforce for planning and operating capacity per unit capacity. According to *Fogarassy*, the growing workforce is not clearly positive, because if we produce a particular product with high personnel costs, it is not necessary that the product will be market-oriented. However, this should not be an exclusive aspect, as maintaining the rural population is an important factor here (*Fogarassy*, 2001).

Table 1

Investment and operational costs of biogas plants

Denomination	Low capacity	High capacity
Technical characteristics		
Electricity installed	0,8 MW	1,76 MW
Investment costs		
Investment costs (million HUF)	1 093	2 004
Operating costs		
Changing energy costs (million HUF)	77,3	156,0
Other variable costs (million HUF)	24,2	42,1
Permanent costs (million HUF)	35,0	75,5

Source: Based on *Popp et al.*, 2011

It is worth examining the establishment of biogas plants in a complex way. Following *Magda* (2011), *Fogarassy* (2001) and *Bai* (2007), *Table 2* was compiled to summarize the advantages, disadvantages and potential difficulties of biogas plants in terms of investment and operation in three main aspects. In terms of natural effects, it is of paramount importance to reduce the amount of fertilizers applied to the nutrient replenishment of the production areas by applying the fermentation broth produced by the biogas plant and to replace it with organic material. During its production, CO_2 emissions are reduced, thus reducing air pollution in social terms. The employment of people living in rural areas is of great importance nowadays, with the creation of biogas plants it is possible to create new jobs, thus improving the income situation of rural people. From an economic point of view, the capital requirement for the investment and its operation is costly, and its return is risky due to low takeover prices. It can contribute to the improvement of regional competitiveness. Soil is a renewable natural resource that, if utilized properly, does not lose its value. Application of the fermentation broth increases the number of

microorganisms and at the same time stimulates the original micro population of the soil. The cost of fertilizing a unit area is 40-50 thousand HUF, while the cost of applying the fermentation broth is 9-10 thousand HUF. Its application has natural, social and economic benefits.

Table 2,

The natural, social and economic effects of establishing biogas plants

<table>
<tr><th>Natural effects</th><th>Social effects</th><th>Economic effects</th></tr>
<tr><td rowspan="3">Nitrogen application can be reduced</td><td rowspan="2">Reduction of air pollution</td><td>Financing (investment, operation)</td></tr>
<tr><td>Regional competitiveness enhancement</td></tr>
<tr><td>Income growth</td><td>Job creation</td></tr>
<tr><td>Eutrophication</td><td rowspan="3">Job creation</td><td>Risk of energy purchase prices</td></tr>
<tr><td>Acidification</td><td rowspan="2">The payback time is high</td></tr>
<tr><td>Falling CO2 emissions</td></tr>
<tr><td>Use of organic material</td><td colspan="2">Expansion of infrastructure</td></tr>
<tr><td colspan="3">Application of fermented juice</td></tr>
</table>

Source: Based on *Magda* (2011), *Fogarassy* (2001), *Makádi et al.* (2007) and *Bai* (2007)

CONCLUSIONS

In the world, as well as in Hungary, energy consumption has increased enormously over the past decades, which is largely based on energy recovered from fossil fuels. As a result, efforts should be made to prioritize the use of available renewable energy sources for sustainability. The use of fossil energy sources leads to the emission of significant amount of greenhouse gases, and their negative impact on the environment is indisputable. This trend may be offset by the growing production of green energy, which also has an economic stimulus effect. The depopulated rural society can have a positive impact, as production and production can take place in these areas. Renewable energies can be efficiently produced in rural areas and their recovery potential is excellent. In Western Europe, the majority of farmers produce renewable energy. The production of renewable energy in agricultural economy promotes the European Union's energy, waste, rural development and environmental policies.

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REFERENCES

Bai A (Ed.) (2005) A biogáz előállítása - Jelen és Jövő. Budapest: Szaktudás Kiadó Ház, 252. p. ISBN: 9639553395

Bai, A. (2007) A biogáz. Szigetbecse: Száz Magyar Falu Könyvesháza Kht. 284. p. ISBN: 9789637024306

Bai, A. (2013). Biogáz előállításának technológiája. Debrecen: Debreceni Egyetem. Agrár-és Gazdálkodástudományok Centruma, 79. p. [online] <URL: http://docplayer.hu/10093191-Biogaz-eloallitasanak-technologiaja.html>

Dinya, L. (2009) Fenntarthatósági kihívások és a biomassza-alapú energiatermelés. In: GAZDÁLKODÁS: Scientific Journal on Agricultural Economics, 53. 4. 311-324. p.. doi: 10.22004/ag.econ.92488

Dupcsák, Z., Marselek, S. (2013) Biogáz termelés, mint a környezettudatos energiatermelés lehetősége. In: Journal of Central European Green Innovation, 1. 1. 1-10. p. doi: 10.22004/ag.econ.170723

EurObserv'ER (2017a) 17th annual overview barometer. [online] <URL: https://www.eurobserv-er.org/17th-annual-overview-barometer/>

EurObserv'ER (2017b) Biogas barometer. [online] <URL: https://www.eurobserv-er.org/pdf/biogas-barometer-2017-en/ 2017-Baro-Biogaz-GB.pdf>

EurObserv'ER (2017c) Solid biomass barometer. [online] <URL: https://www.eurobserv-er.org/pdf/solid-biomass-barometer-2017-en/ 2017-Baro-Biomasse-Solide-GB.pdf>

Eurostat (2018) Share of renewable energy in gross final energy consumption. [online] <URL: https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_31&plugin=1>

Fogarassy, C. (2001) Energianövények a szántóföldön. Gödöllő: Szent István Egyetem GTK Európai Tanulmányok Központja, 144. p. [online] <URL: http://real.mtak.hu/29291/1/Fogarassy_Csaba_Energianovenyek_a_Szantofoldon_u.pdf> ISBN 963-9256-47-1

Hungarian Central Statistical Office (2018) Megújuló energiaforrásokból és hulladékból termelt villamos energia részesedése (2000-). [online] <URL: https://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_ui011b.html>

Magda, R. (2011) A megújuló energiaforrások szerepe és hatásai a hazai agrárgazdaságban. GAZDÁLKODÁS: Scientific Journal on Agricultural Economics, 55. 6. 575-588. p. doi: 10.22004/ag.econ.119936

Makádi, M., Tomócsik, A., Orosz, V., Lengyel, J., Biró, B., Márton, Á. (2007) Biogázüzemi fermentlé és Phylazonit MC baktériumtrágya hatása a silókukorica zöldtömegére és a talaj biológiai aktivitására. Agrokémia és Talajtan, 56. 2. 367-378. p. doi: 10.1556/Agrokem.56.2007.2.12

Póla, P. (2018). Megújuló energiák: A vidékfejlesztés egy alkalmas eszköze. Pécs: MTA KRTK Regionális Kutatások Intézete, 16. p. [online] <URL: http://www.regscience.hu:8080/xmlui/bitstream/handle/11155/1793/pola_megujulo_2018.pdf?sequence=1>

Popp, J., Aliczki, K., Garay, R., Kozak, A., Nyárs, L., Radóczné, Kocsis, T., Potori, N. (2011) A biomassza energetikai célú termelése Magyarországon. Agrárgazdasági Kutató Intézet, Budapest. 39-71. p. ISBN 978-963-491-570-6

Popp, J., Harangi-Rákos, M., Kapronczai, I., Oláh, J. (2018): Magyarország megújuló energiatermelésének kilátásai. GAZDÁLKODÁS: Scientific Journal on Agricultural Economics, 62. 2. 103-122. p. doi: 10.22004/ag.econ.272933

Saad, W., Taleb, A. (2018): The causal relationship between renewable energy consumption and economic growth: evidence from Europe. In: Clean Technologies and Environmental Policy, 20. 127-136. p. doi: 10.1007/s10098-017-1463-5

Corresponding author:

Alexandra RAJCZI
Kaposvár University
Faculty of Economic Science
H-7400 Kaposvár Guba S. u. 40.
e-mail: rajczi.alexandra@ke.hu