OBSAH ČÍSLA

EDITORIAL

Vážení a milí čtenáři,

dobrých zpráv není nikdy dost. Socioekonomické a humanitní studie přežily nejen první, ale i druhou a třetí vlnu Koronaviru. Máme připraveno další, tentokrát už 25. (tedy jubilejní) vydání sešitu SEHS pod číslem 1/2021.

V čem se toto číslo odlišuje od předchozích? Na první pohled je viditelné zvýšení počtu odborných statí v angličtině. Mezinárodní rozměr se trochu rozšiřuje. Autoři jsou ze Slovenska i Polska, ale i čeští autoři se o toto pokoušejí. Tím se i zvětšuje geografické zaměření problematiky.

V angličtině vychází 5 článků. Kornélia Svačinová rozvíjí oblíbené téma Průmysl 4.0 na příkladu Maďarska, Vendula Hynková se věnuje politice záporných úrokových sazeb s evropským rozměrem. Autoři Siniša Mali, Lenka Maličká nezůstávají pozadu se svým tématem fiskální decentralizace a ekonomický růst v Evropské unii. No a k nim se řadí i stať Ireny Honkové zabývající se otázkami souvisejícími s evropskými finančními trhy: IFRS 9 a její dopad na stabilitu finančních institucí. A jako třešnička článek dvou polských autorek (Patrycja Żegleń, Anna Nizioł) zaměřený na sdílenou ekonomiku na příkladu turismu.

Genderovou a jazykovou vyváženost pak trochu zajišťují 2 stati, jejichž názvy hovoří samy za sebe. František Ochrana a Vilém Novotný: Využití metodologie vědeckovýzkumných programů pro hodnocení vědeckovýzkumné činnosti a Petra Tisová a Eva Ducháčková: Konzervativní odvětví pojišťovnictví: Vývoj pod zvýšeným tlakem změn v ekonomickém a finančním prostředí.

Vážení čtenáři,

Přejeme Vám hodně zdraví, příjemné léto a na shledanou u zimního vydání Socioekonomických a humanitních studií. Možná přijde, i když ne přímo kouzelník, tak alespoň milé překvapení.

S pozdravem za celou redakci

Doc. Ing. František Pavelka, CSc.
šéfredaktor

Dear Readers,
There is never enough good news. The Socio-Economic and Humanities Studies has survived not just the first, not just the second, but also the third wave of Covid-19. We have prepared a new, the 25th (an anniversary!) issue of SEHS number 1/2021.
How is this issue different from the previous ones? A brief glance reveals that the number of research articles in English has increased. The international dimension has expanded. The authors come from Slovakia and Poland, but also Czech authors want to publish in English. Thanks to this, the geographical scope of the covered issues has widened.

In total, there are five articles in English. Kornélia Svačinová develops the popular topic of Industry 4.0 using the example of Hungary. Vendula Hynková looks into a negative interest rate policy from a European perspective. Authors Siniša Mali and Lenka Maličká keep up the pace and discuss fiscal decentralization and economic growth in Europe. Next one in line is a paper by Irena Honková that explores issues linked to European financial markets – IFRS 9 and the impact it has on the stability of financial institutions. And as a cherry on top, an article by two Polish authors (Patrycja Żegleń, Anna Nizioł) focused on the shared economy using examples from the tourist industry.

Gender and language equality is ensured by two articles with telling names: The Use of Methodology of Scientific Research Programmes for Assessment of Research Activity by František Ochrana and Vilém Novotný, and Petra Tisová and Eva Ducháčková's Conservative Branches in Insurance: Development Under Increased Pressure from Changes in Economic and Financial Environment.

Esteemed Readers,
We wish you good health, an enjoyable summer and we are looking forward to our next meeting over the winter issue of the Socio-Economic and Humanities Studies. We might even have a little surprise in store for you.

Wishing you all the best on behalf of the editing staff,

Doc. Ing. František Pavelka, CSc.
Editor-in-Chief

NEGATIVE INTEREST RATE POLICY (NIRP): HISTORY AND ARGUMENTS FOR AND AGAINST

Vendula Hynková

ABSTRACT

The paper deals with the history and the main pro and con arguments of an unconventional monetary policy used by a central bank or another monetary authority that falls out of line with traditional measures. Until recently, the introduction of negative interest rates was unthinkable in the economic practice. From the point of view of economists, there is no unified opinion on this unconventional monetary policy, and there are different attitudes and policies of central banks. Thus, this paper contains not only arguments for, but also arguments against, and compares the two opposing views on the negative interest rate policy. There is a debate on effective macroeconomic policy instruments and some pitfalls can be observed also at the scientific level.

Key words: *monetary policy; negative interest rates; negative interest rate policy (NIRP); unconventional monetary policy (UMP); monetary policy instruments*

JEL classification: E43, E52, E58

INTRODUCTION

According to economic theory, the rate of interest is defined generally as the price of credit, and it plays the role of the cost of capital. Interest rates can be examined from a microeconomic point of view, where the interest rate figures as an investment cost or as an equilibrium interest rate in the loanable funds market, or from a macroeconomic point of view, in the money market, where the money supply determined by the monetary authority meets the demand for money, and how this monetary authority can, via the key interest rates setting, influence the economy (investment, GDP, average price level, and employment).

When looking for an explanation of interest, the creator of the interest theory and the author of *The Abstinence Theory of Interest*, the English economist N. W. Senior (1790–1864), explained in detail and emphasized that the money used for lending purposes is the money not used for consumption and that earning interest acquired by abstaining from spending makes the funds possible and available for potential borrowers (Medema and Samuels, 2013).

Usually all nominal interest rates are set at a certain positive level in the financial sector, while real interest rates could be negative according to Fisher's equation, where real interest rates mean the difference between the nominal interest rate and the inflation rate. Specifically, key interest rates were set by central banks at positive values until some central banks decided to cross their lower limit, the so-called "Zero Lower Bound" (ZLB), of a nominal key interest rate towards negative values during the stagnation and fading of the 2008 recession. In the near past, central banks imposed negative interest rates because they were afraid that their domestic economies could fall into a deflationary spiral, in which there is no spending which leads to dropping prices, no profits, and no economic growth.

Many economists have questioned whether such a policy could be effective and whether it would do more harm than good. This paper provides an overview of setting negative interest rates, deals with the history of setting negative interest rates, examines the arguments for and against, compares the two opposing views on the negative interest rate policy (NIRP), and opens up questions to anyone to judge negative rates setting, submit pro and con arguments regarding the NIRP,

and point to experience in economic practice when making their judgement. The implementation of the NIRP still represents a "macroeconomic policy experiment" across concerned economics and so far, there has been no consensus on the effects of negative nominal interest rates, either empirically or theoretically.

1 THE HISTORY OF NEGATIVE INTEREST RATE POLICY

Negative interest rates are not an entire novelty that has emerged in the last few years, but they were detected as early as the 1970s. Switzerland was the first country to apply this policy in the 1970s in order to prevent excessive appreciation of its domestic currency, which would in turn negatively affect exports, real product, and employment.

In 1971, the convertibility of the US dollar to gold was abolished. The US dollar experienced a devaluation and Switzerland became an investment haven. As foreign investors increased the demand for the Swiss franc, they increased its value. The strengthening of the Swiss currency disadvantaged domestic exporters, and the Swiss government first introduced mandatory reserves for non-resident deposits. As this measure did not help, they banned the payment of interest to non-residents and, while not effective, they opted for a quarterly negative interest rate (penalty) of 2% on non-resident deposits. The first oil shock of 1973 exacerbated this situation, leading to subsequent measures when the Swiss government introduced a negative interest rate of up to 12% on non-resident deposits. However, Switzerland continued tackling capital inflows that did not stop even after a 41% negative annual interest rate on foreign deposits was introduced in 1975. Between 1971 and 1975, the Swiss franc strengthened significantly against the dollar, dampening the Swiss economy, mainly through declining exports. The real exchange rate of the Swiss franc rose significantly in 1978 as well; the Swiss National Bank was compelled to purchase foreign exchange on a large scale and short-term interest rates fell to zero and turned slightly negative early in 1979 (Kugler; Rich, 2001). Negative interest rates did not discourage the inflow of foreign capital, only the intervention of the central bank and the easing of monetary policy helped. Experience during this period proved the inefficiency of negative interest rates in a country with a strong currency.

The Swiss National Bank returned to the negative interest rate monetary policy

in 2014. However, the first central bank in the world that introduced a negative interest rate after 2008 recession was the Swedish central bank, from 2009 to 2010, and then again from 2015 to 2019. The European Central Bank (ECB) joined this policy in 2014 and has continued implementing it until today (2021). Its decision related to the whole euro area. The Danish central bank applied the negative interest rate policy from 2012 to 2014, and again from 2014 until now (2021). The central bank in Norway has not explicitly adopted the NIRP, but the central bank lowered its reserve rate below zero in 2015. The central bank of Japan, which had long battled deflation in the past, decided to join the NIRP for the first time in 2016 with a negative interest rate (-0.1%) on current accounts that financial institutions held at the central bank, and in 2016, also the Hungarian central bank and the central bank of Bosnia and Herzegovina joined the NIRP (Angrick and Nemoto, 2017; Kuroda, 2016).

In June 2014, the ECB introduced negative interest rates for the first time. The ECB applied the negative rate only to its deposit rate called "Deposit Facility Rate" (DFR), through which the ECB pays short-term overnight deposits to commercial banks. The DFR climbed gradually from -0.10% with effect from June 2014 to -0.50% in September 2019. The ECB changed two other key interest rates – the main refinancing operations (MROs) rate and the rate on the marginal lending facility. The MRO rate defines the cost at which banks can borrow from the central bank for a period of one week. If banks need money overnight, they can borrow from the marginal lending facility at a higher rate. Since March 2019, the fixed interest rate has fallen to zero and has remained at zero so far, with the marginal lending facility set at a quarter of a percentage point since March 2019. The purpose of these steps was to prevent commercial banks from depositing excess liquidity with the central bank and to continue lending money to private economic entities. A negative interest rate is thus a form of tax or sanction for banks so that they no longer offer excess liquidity in the form of loans. The NIRP is thus a monetary policy, pursued by central banks to stimulate inflation and achieve its only goal of a gradually rising price level, according to about the 2% inflation target.

This argument seems logical, but negative interest rates divide economists into supporters or opponents. Alternatively, there may be those who accept negative

interest rates as an extreme, or as a short-term solution. And some economists only support "effective negative interest rates" on a certain "effective" level. Some economists emphasize that for the efficiency assessment, a distinction should be made between temporarily low interest rates and chronically low interest rates (Ruchir and Kimball, 2015).

2 SUPPORTERS OF NEGATIVE INTEREST RATES

The proponents of negative interest rates, mainly economists in central banks, justify the NIRP to fulfil the inflation target. This unconventional policy should help increase the growth of investment, output, and employment via the well-known Keynesian transmission mechanism, i.e., through lowered costs of lending. Since mainly investment and possibly also consumption financed in the capital market supports the growth of aggregate demand, this growth supports the growth of product and average price level. The arguments for keeping negative interest rates are to demonstrate the effect of falling interest rates on the growth of investment activity. Thus, the assumption is that firms will increase their fixed investment via this credit (lending) channel.

There is an ongoing debate about how this channel works and how the NIRP supports the economy, and whether firms will increase their fixed investment. It was found that mainly stable, sound banks in an economy can enhance the transmission mechanism because these banks are able to stimulate firms' investment indirectly when they are able to pass negative interest rates onto their corporate depositors without experiencing a contraction in funding (Altavilla et al., 2020). Further experience has confirmed that lending rates have tended to fall more in banking systems with a higher proportion of variable rate loans, shorter loan maturities, or higher competition among commercial banks (Vinals et al., 2016).

The development of the DFR, the level of investment activity by institutional sectors, and the growth rate of real GDP in the eurozone is shown in Table 1. As can be seen in Table 1 and Graph 1, the negative interest rates since 2014 in the eurozone have really been stimulating the growth of companies' investment activity. The share of investment activity of companies in 2019 (13.88%) exceeded the value from 2008, from the period before the economic recession (12.74%). The growth of household investment was not as significant as the growth of firms'

investment. For firms there was a vision of an optimistic scenario of the economic development.

Tab. 1 » Investment activity as a share of GDP by institutional sectors, real GDP growth rate and deposit facility rate in the eurozone during 2008–2019

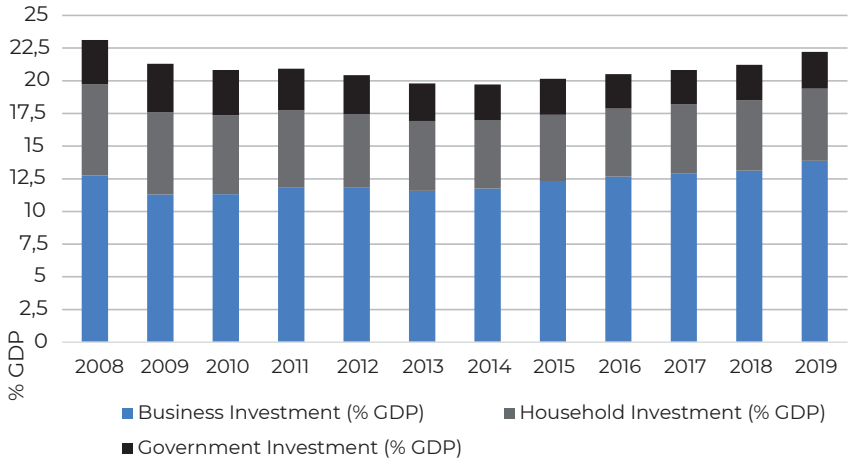
Eurozone: 19 countries/ Year	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
ECB: Deposit Facility (%)	Jul. 3.25 Oct. 2.75 Oct. 3.25 Nov. 2.75 Dec. 2.00	Jan. 0.10 Mar. 0.50 Apr. 0.25	0.25	Apr. 0.50 Jul. 0.75 Nov. 0.50 Dec. 0.25	Jul. 0.00	0.00	Jun. -0.10 Sept. -0.20	Dec. -0.30	Mar. -0.40	-0.40	-0.40	Sept. -0.50
Total Investment (% of GDP)	23.12	21.29	20.82	20.91	20.42	19.79	19.72	20.14	20.50	20.82	21.22	22.21
Business Investment (% of GDP)	12.74	11.31	11.33	11.82	11.81	11.58	11.75	12.34	12.67	12.92	13.12	13.88
Household Investment (% of GDP)	6.99	6.29	6.03	5.92	5.65	5.34	5.22	5.06	5.20	5.27	5.39	5.52
Government Investment (% of GDP)	3.39	3.70	3.46	3.18	2.96	2.87	2.75	2.75	2.63	2.64	2.72	2.81
Real GDP Growth (Eurozone, %)	0.4	-4.5	2.1	1.7	-0.9	-0.2	1.4	2.1	1.9	2.6	1.9	1.3

Source of data: Eurostat, ECB; author's processing

Graph 1 illustrates more clearly the development of investment by institutional sectors in the eurozone during 2008–2019. The focus should be on the period before and after the NIRP introduction in 2014. As can be seen in the Graph 1, since 2015 the business (corporate) investment had been growing (first column from the bottom), while household and government investment

(the second and third column) remained roughly at the same level. And because of the growth of business investment, the total investment had also been growing (until the outbreak of the coronavirus crisis in 2020). According to the Table 1 the GDP growth rate of the euro area increased after the introduction of NIRP with a peak in 2017 that was 2.6%.

Graph 1 » The development of business investment, household investment and government investment in the eurozone during 2008–2019 (% of GDP)



Source of data: Eurostat; author's processing

The ECB highlights the positive effects when considering the compensating effects of other policy innovations, such as the two-tier system and targeted longer-term refinancing operations. Thus, central banks are looking for an "effective interest rate" according to their tiered system when they exempt a portion of commercial bank balances held at the central bank from the negative rate, called the "tiering" system (Barr et. al., 2016). This means new tools are being sought to reduce the impact on banks' profitability – this impact will be discussed in the next chapter. In addition, some authors suggested various tools to overcome the zero bound just before 2004, for example, a "carry tax" on money, open market operations in long bonds, or monetary transfers (Goodfriend, 2000; Buiter and Panigirtzoglou, 2003). According to economists from the Norges Bank (the Nor-

way central bank), the central bank can use two ways to overcome the ZLB: *"Central bank can achieve negative short-term money market rates in two ways, either by setting a negative policy rate or, in some situations, supplying the banking system with excess central bank reserves, while the interest rate on the central bank's marginal deposit facility is negative."* (Bernhardsen and Lund, 2015, p. 2)

Some proponents of negative interest rates point out that this policy strengthened the incentives of investors to rebalance their portfolios towards illiquid longer-dated securities to preserve banks' profitability. Some authors have found that high-deposit banks tend to increase their holdings of high-yield securities in an environment of negative interest rates policy (Wu and Xia, 2020). And, according to an analysis carried out in Italy, these moves were proved and, moreover, it was shown that previous interest rate cuts just above the ZLB did not induce these shifts and consequently did not cause a similar portfolio rebalancing (Bottero et al., 2019).

Some economists defend negative interest rates because negative interest rates can also help weaken a country's currency by making it a less attractive investment than other currencies. A weakened domestic currency (its depreciation) because of the capital outflow causes a competitive advantage in export. A weakened currency will support exporters, particularly when the volume effect of the depreciation prevails. It means when there is an increase in the volume of exported goods that will improve the trade balance and consequently enhance the aggregate expenditures, GDP, employment and will also help meet the objectives of the monetary authority (the price level target). This example can be found in the Swiss economy. The goal of its monetary authority (the Swiss National Bank) was to discourage capital inflows and thereby counter the monetary tightening due to the Swiss franc's appreciation.

To sum up, there are three main channels and arguments for introducing and analysing the effects of negative interest rates: the credit (lending) channel allowing inflation expectations to rise and boosting the aggregate demand and product, the exchange rate channel when the domestic currency is weakened, and the portfolio rebalancing channel when high-yield securities can in turn support investment and then product. It is assumed by supporters that these channels work with the change of both positive and negative interest rates setting. *"The experience so far suggests that negative policy rates are transmitted through to money market rates in much the same way as positive rates are and it also appears that they*

are transmitted to longer-maturity and higher-risk rates, although this assessment is clouded by the impact of complementary monetary policy measures." (Bech and Malkhozov, 2016, p. 31)

3 OPPONENTS OF NEGATIVE INTEREST RATES

According to economic theory, the existence of financial market and indirect financing depends on the setting of positive interest rates. In the capital market, savings are turned into necessary investments. Savings are held by households and households are motivated by a positive interest rate to hoard loanable funds. Interest is defined as a reward for deferring current consumption in favour of future consumption plus interest. Therefore, negative interest rates seem to be an absurdity, mainly if they are set by commercial banks for interest on deposits to compensate for their eventual losses. Thus, negative interest rates can disrupt normal decision-making about interest rates.

One very common con argument against the NIRP often emphasized by its opponents is the trade-off between effective monetary transmission and a bank's profitability. A bank's incomes can be divided into three groups: net interest incomes, non-interest incomes, and banks provisions. A lot of analyses can be found into how the NIRP affects banks' net interest margins and equity. Related to this, some commercial banks decided to pass the costs on to clients with large deposits and significant transaction costs of closing an account. For example, the third largest Danish bank, the Jyske Bank, set the interest on ten-year mortgages at -0.5% per annum and charged a negative interest rate on large deposits (Campbell and Levring, 2016). Opponents point to the increase in a bank's non-interest incomes (higher fees, commissions, provisions) providing the bank's net interest margins have decreased. In Sweden, the effect of the NIRP on the lending channel was examined and authors documented that the negative central bank rates had not been transmitted to aggregate deposit rates that remained stuck at levels close to zero (Eggertsson et al., 2019). It also depends on the bank's ratio of overnight deposits to total assets, and the higher this rate is, the greater the tendency to impose higher interest rates on, for example, mortgages, and the pass-through on economic operators is not so strong (Amzallag et al., 2019). Moreover, not all clients will pay for having their money stored in a bank; they would quickly

empty their accounts, which can be identified as the first step towards the collapse of the banking system. However, in Sweden there is an issue of using exclusively non-cash payments and economists try to find the effective lower bound. "*The effective lower bound will therefore depend on how costly it is to manage cash and by how much the monetary policy impact decreases at different rate levels. In addition, risks to the financial system increase, the lower the CB´s repo rate goes.*" (Alsterlind et al., 2015, p. 1)

In Sweden and Denmark, they introduced negative interest rates at the earliest after the recent recession of 2008 and therefore have the longest experience. According to research that includes annual balance sheet data from more than 5,000 banks in the EU and Japan between 2010 and 2016, commercial banks experienced significant declines in net interest income, and they mitigated the losses from net interest income by generating significant increases in net non-interest income and provisions. Commercial banks as business entities try to find other sources of income. In addition, the impact of the NIRP on the net interest incomes of commercial banks depends on business cycle conditions and bank-specific characteristics such as size, liquidity, capitalization, and incidence of market funding (Lopez et al., 2018; Borio et al., 2015).

In a further analysis across banks in different countries, the authors found that after the introduction of negative interest rates, the volume of banks' loans was weaker in countries where a policy of negative interest rates was introduced. Smaller banks, more dependent on retail deposit financing, less capitalized, whose business models were dependent on interest income, and which operated in more competitive markets, suffered the most (Molyneux et al., 2020).

Even before the recession caused by the current coronavirus, there was talk of macroeconomic policy options that were already exhausting their instruments before the advent of the next declining phase of the economic cycle. Some economists fear ECB's extreme expansionary monetary policy can lead to an increasing money supply and rising inflation. The argument is that when ECB's key interest rates fall more into the negative, this will lead to greater losses of commercial banks and the value of their equity will fall as the share prices of large banks will continue to decline. The loss will be felt by investors. In the future, significant interest rate cuts may outweigh the benefits from higher asset values and stronger

aggregate demand, so there is a point that further monetary accommodation may need to rely more on credit easing and an expansion of the ECB's balance sheet rather than substantial additional reductions in the interest rate policy (Jobst and Lin, 2016). Based on their surveys, some economists consider the NIRP as an inadequate tool to tackle stagnation and they rather prefer to use fiscal instruments or point out that the NIRP can act contractionary due to a negative effect on bank profits (Di Bucchianico, 2020; Eggertsson et al., 2017).

Negative interest rates also change the bankruptcy situation, when the borrower is unable to repay the principal and there are no warnings that the borrower is unable to repay the interest on the loan. The lender is the one taking the risk of loan default and now there is no bond where a less creditworthy borrower pays a higher interest rate. It seems there is a greater risk in the banking sector, although the borrowers pay some special fees instead of a higher interest. Moreover, many lending institutions have adopted tighter liquidity and capital standards since the recent global financial crisis and there is a dangerous interaction between this fact and the NIRP (Angrick and Nemoto, 2017).

Interest rates set by the central banks also impact the yield of bonds. There is an inverse relationship between setting interest rates and assets prices. Now economies are experiencing a problem with zero-yield bonds or negative-yielding bonds. It was previously inconceivable for central banks that bonds could have a negative yield, and so zero-yield bonds issued pose a significant difficulty. In Swedish economy, negative policy rates seem to have had a strong and immediate pass-through to bond market yields, according to the survey (Erikson and Vestin, 2019).

4 TWO OPPOSING VIEWS

Table 2 presents briefly the two contrasting views on the negative interest rate policy. The left side of the table contains the main objectives of central banks that decided for the negative interest rates and the three channels when advocating the NIRP. The right side of the table outlines the main arguments for and the three main risks of rejecting negative interest rates.

Tab. 2 » The opposing views of the NIRP

Defending the negative interest rate policy (NIRP)	Refusing the negative interest rate policy (NIRP)
Objectives according to the central banks: • price stability and anchoring inflation expectations (eurozone, Japan, Norway, Sweden) • reducing appreciation and deflationary pressures (Switzerland) • countering inflows and exchange rate pressures (Denmark) • price stability and countering exchange rate pressures (Hungary) • price stability and maintaining the exchange rate peg (Bulgaria, Bosnia and Herzegovina)	Historical context: during the history of economic thought, nominal interest rates have never been negative (until the last decade at some central banks). Negative interest rates distort the capital market and cause distortions in the banking sector. Many laws and regulations are based on the implicit assumption that interest rates cannot be negative. CB's negative interest rates can affect the profitability of commercial banks and the banks would pass on their losses to their clients (the NIRP can be inefficient or even contractionary).
Three main channels when advocating the NIRP: - the credit channel - the exchange rate channel - the portfolio rebalancing channel	Three main risks when refusing NIRP: - excessive indebtedness of economic entities - underestimation of risk (investing in riskier assets and financial instability) - overvalued long-maturity illiquid asset prices (asset price bubbles), zero-yield bonds

Source: IMF (objectives of CBs), author's processing

The arguments of the central banks to fulfil their objectives seem to be understandable and in line with macroeconomic theory. It must be added, though, that there is no consensus among all central banks. Whether this policy it is needed depends on the specific economic conditions of each economy or the eurozone. Mr. Haruhiko Kuroda, the Governor of the central bank of Japan (The Bank of Japan), stated during his speech when defending the NIRP: *"The Bank of Japan will do whatever we can to achieve the price stability target..."* when Japan had been tackling deflationary pressures in the past (Kuroda, 2016, p. 6). Other central banks, e.g., the U.S. Federal Reserve or the Czech National Bank, have been less keen or restrained to adopt the NIRP. The usefulness and efficiency of the NIRP differs across countries due to different institutional settings and bank-specific characteristics (such as liquidity, capitalisation, funding costs, risk, and income

diversification, etc., and business and financial cycle condition [Borio and Gambacorta, 2017]). For Japan or the eurozone this policy seems to be relatively efficient, while, for example, the US sees a lower efficiency, according to the banking models (Ulate, 2019).

CONCLUSION

Negative nominal interest rates have not been entirely new in the monetary sector in the past several years but appeared in the Swiss economy as early as the 1970s. In the Swiss economy they were used as a tool for preventing capital inflows. For a long time, this instrument had not been applied in economies. In the middle of the last decade, central banks in Europe or Japan decided to introduce negative interest rates to support their economies. When a monetary authority wants to support the economy, it provides a monetary expansion policy and lowers its key interest rates. But the rates had been systematically declining since the beginning of the 2008 recession, and the central banks soon encountered the "zero lower bound" (ZLB) during the bad times. And thus, they decided to provide another monetary stimulus and lower the rates into negative zone expecting the pass--through to the economic operators and their reactions.

A negative interest rate policy divides economists into two groups – supporters and opponents. Supporters of negative interest rates argue that enhanced investment activity is followed by an increase in aggregate demand, product, and employment. Indeed, private investment in the eurozone has been on a rising trend since 2015. However, the growth rate of real output in the eurozone has been rather stagnant since the introduction of negative interest rates and has been declining since 2018 and, unfortunately, in 2020 a pandemic broke out. Due to the coronavirus crisis, the ECB was forced to help otherwise – by buying €750 billion worth of securities that helped the economies immediately (ECB, 2020). Opponents of negative interest rates have a long-term focus and see the essence of markets' functioning. When setting key interest rates, they see the limit at technical zero and in the choice of alternative economic policy instruments that do not disrupt the financial markets. The functioning of markets is more important to them, and economies may be given other stimulations to support employment and product growth in times of recession or stagnation.

To assess the choice of negative interest rates, it should be said that it belongs among unconventional policies in the market economies and if this choice is applied, it should be assessed whether the negative interest rates do more harm than good in the economy, and whether they are selected as a short-term or a long-term instrument. It is perceived nowadays that there is no homogeneous policy of negative interest rates across economies; conversely, there is relevant heterogeneity in the purpose, design, and operational specificities of negative interest rate policies, with significant consequences for capital market effectiveness, private sector funding conditions, and economic operators' expectations. Being aware of financial market failures, economies will gain experience in the future, and if negative interest rates are set again, it will be seen whether negative interest rates do more good or harm.

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IFRS 9 A JEHO VLIV NA FINANČNÍ STABILITU FINANČNÍCH INSTITUCÍ

IFRS 9 AND ITS IMPACT ON THE STABILITY OF FINANCIAL INSTITUTIONS

Irena Honková

ABSTRAKT

Tento příspěvek se zabývá povinnou implementací IFRS 9 – Financial Instrument: Recognition and Measurement, platnou od 1. ledna 2018, která mohla znamenat skokové navýšení opravných položek k pohledávkám bank a tím ohrozit bankovní sector. Toto zvýšení avizovaly předběžné průzkumy nejvýznamnějších čtyř auditorských společností. Cílem tohoto příspěvku bylo provést výzkum z reálných dat prvních možných výsledků a to z mezitímních účetních závěrek bank v průběhu roku 2018. Pomocí statistického Wilcoxonova testu byl vyhodnocen dopad tohoto standardu s cílem zjistit, zda očekávané zvýšení opravných položek zaznamenalo signifikanční změnu. Výsledky testu potvrdily hypotézu, že se nejedná o signifikantní nárůst. Povinná implementace IFRS 9 – Financial Instrument: Recognition and Measurement tedy neznamenala signifikantní změnu v hodnocení bankovních pohledávek a tedy ani ohrožení finanční stability bankovního sektoru. Vedle dopadu nového standardu na stabilitu finančních institucí poskytuje příspěvek i přehled nejzásadnějších změn v oblasti finančních nástrojů.

Klíčová slova: *Finanční nástroje; IAS 32; IAS 39; IFRS 7; IFRS 9.*

JEL klasifikace: M41, M48

ABSTRACT

This paper deals with the mandatory implementation of IFRS 9 – Financial Instruments: Recognition and Measurement, effective as of January 1, 2018, a possible result of which might have been a steep increase in loss allowance on bank receivables that could threaten the banking sector. This increase was reported in preliminary surveys of the top four accounting companies. The aim of this paper was to investigate the first factual data available from the interim financial statements of banks during 2018. Using the Wilcoxon Rank Sum test, the impact of this standard was evaluated to determine whether the expected increase in loss allowance produced a significant change. The test results confirmed the hypothesis that the increase was not significant. Therefore, the mandatory implementation of IFRS 9 – Financial Instrument: Recognition and Measurement did not result in a significant change in the classification of bank receivables and thus did not jeopardize the financial stability of the banking sector. In addition to the impact of the new standard on the stability of financial institutions, this paper also provides an overview of the most fundamental changes in the area of financial instruments.

Key words: *financial instruments; IAS 32; IAS 39; IFRS 7; IFRS 9*

JEL Classification: M41, M48

INTRODUCTION

The aim of this paper is to ascertain whether the implementation of IFRS 9 – Financial Instruments: Recognition and Measurement, mandatory as of January 1, 2018, has resulted in a sharp increase in loss allowance on bank receivables, which could jeopardize the stability of the banking sector. This paper is based around the first available data from interim financial statements, in which banks are required to disclose the impact of the IFRS 9 implementation. In the event of alarming results, the banking sector would have been able to prepare a report to justify this phenomenon and partly mitigate the overall impact.

One of the most recent international accounting standards, IFRS 9 – Financial Instruments, which has been in force since the beginning of 2018, was primarily created as a response to the latest economic crisis. IAS 39 was predicted to be less risky compared to similar issues dealt with by GAAP (Fang, 2018). A large number of unhealthy loans, which banks reported as healthy, are often cited as a possible cause of the economic crisis. The new standard imposes new classification rules on financial assets and liabilities and much higher requirements for loss allowance. IFRS 9 is generally binding for all entities whose accounting is governed by the International Financial Reporting Standards. Banking institutions are

the entities most affected by changes brought about by IFRS 9. The core area of impairment should be the most important for banks as they have a number of instruments on the active side of the balance sheet, the main essence of which is the collection of cash flows from them, or their sale. Therefore, these are receivables, both from business relations and, above all, receivables from loans. Loss allowance on bank receivables is expected to increase sharply as of the date when IFRS 9 comes into effect. The aim of this paper is to compare the existing IAS 39 with the new IFRS 9 and to determine whether the implementation of IFRS 9 has had an impact on banks' financial stability. Several researches, in particular the so-called Big Four (Deloitte Global Services Limited, 2016), (EY, 2017), have addressed the above issues. The problem is that these research studies only estimate future research; however, the research presented in this paper is based on existing factual data from the first interim financial statements of banking institutions. This paper examines the hypothesis that the implementation of IFRS 9 did not result in a significant change in the financial assets of banks. The aforementioned data is subjected to a statistical test.

METHODS

To test the hypothesis whether the implementation of IFRS 9 resulted in a significant change in the financial assets of banks, a non-parametric Wilcoxon Rank Sum test was chosen as it was more appropriate than a signed rank test that would only reveal the result we are already aware of, i.e. that the loss allowance did increase. The aim of this paper is not to conclude that there was an increase, but to verify the hypothesis that this increase was statistically significant. The Wilcoxon matched pairs test (Walker, 2013) is based on the calculation of standard deviation and the average of loss allowance differences created under IAS 39 and IFRS 9. If the value of the test criterion exceeds the critical value for this test (Walker, 2013), then a significant change is observed under IAS 39 and IFRS 9. A comparison and analogy method is used to describe the differences between the original IAS 39 and IFRS 9. Within the comparison method, it will be observed how the reporting of financial instruments of banking institutions changes when a given standard is changed.

RESULTS

1.1 COMPARISON OF IAS 39 AND IFRS 9

Now that we are aware of the actual impact of the change of standards on financial instruments, it is advisable to learn what these changes actually are.

Accounting adjustments and financial reporting for financial instruments is such a complex issue that several accounting standards regulate it. They are primarily the following standards (sorted chronologically based on the creation date of the standard): IAS 32 Financial Instruments: Presentation, IAS 39 Financial Instruments: Recognition and Measurement (largely no longer applicable except for hedge accounting rules not covered in this paper), IFRS 7 Financial Instruments: Disclosures and IFRS 9 Financial Instruments. The majority of IAS 39 is no longer in force and has been replaced by the most recent of these, i.e. IFRS 9. IFRS 9 came into effect as of January 1, 2018.

International Accounting Standard 32 (IAS 32) emerged in the 1990s and was first adopted by entities in 1995. Since then, it has undergone many modifications, but the standard is still valid today. It defines the basic concepts relating to financial instruments and is therefore the basis for any later standards that govern this area.

In 2005, the IASB amended IAS 32 and replaced the disclosure provisions of IAS 32 by the new IFRS 7 – Financial Instruments: Disclosures. It entered into force in 2007 and replaced IAS 30 – Disclosures in the Financial Statements of Banks and Similar Financial Institutions. The standard includes rules for the inclusion of information about financial instruments and, in particular, the risks associated with them in the financial statements of an enterprise. In addition, IFRS 7 defines the types of risks that must be reported in financial statements, namely credit risk, liquidity risk, and market risk. The reason for the amendment of the original IAS 39 was, among other things, the criticism the Standard received because of its excessive complexity and for being difficult to implement in practice. In order to understand the new IFRS 9 correctly, it is necessary to summarize the basic principles underlying the original IAS 39.

Categories of financial instruments under IAS 39 were: Financial assets and

financial liabilities at fair value through profit or loss (FTPL), Held-to-maturity investments (HTM), Loans and receivables (LR) and Available-for-sale financial assets (AFS) (IFRS Foundation, 2017).

Under IAS 39, financial instruments were initially measured at fair value. However, the related transaction costs were different. If they were measured in the FTPL category, transaction costs were not measured, unlike the other categories. While they were held, the value of the instruments was supposed to be reviewed at least annually. Financial instruments in the FTPL and AFS categories measured at fair value could be impaired or increased (FTPL earnings, AFS capital). Financial instruments in HTM and LR categories measured at amortized cost could only be impaired. Impairment of financial assets is an area that may have undergone perhaps the most significant changes during the revision of international standards and the transition from IAS 39 to IFRS 9. In IAS 39, impairment was carried out based on incurred losses. Expected losses that could occur in the future were not accounted for, although the prospect of a future negative event was very likely. It was only when the entity found objective evidence of impairment that it recorded this impairment in accounting – financial instruments HTM, LR and FTPL as an expense using an allowance account, AFS directly as an equity. Thus, in the event of an asset being impaired, the profit of the financial entity did not decrease and the owners of the company could divide the profit (Ercegovac, 2018).

A full overhaul of IAS 39 had been considered since 2001, when the IASB was established (ASB, 2018) and took over the standard from the former IASC. The new standard was initially supposed to be developed by the IASB together with the US FASB, which develops the US GAAP, with the intention of creating a single document. However, this collaboration was later unsuccessful due to diverging views on some important aspects, and the final version of the new IFRS 9 was issued by the IASB in July 2014. As has already been said, the financial crisis had a significant impact on the creation and the final adoption of the standard, and highlighted the urgent need for new rules and hastened the entire process.

IFRS 9 is effective for annual accounting periods beginning on or after January 1, 2018, if the accounting period does not coincide with the calendar year. Voluntary earlier application of the standard was possible. The new IFRS 9 regulates similar

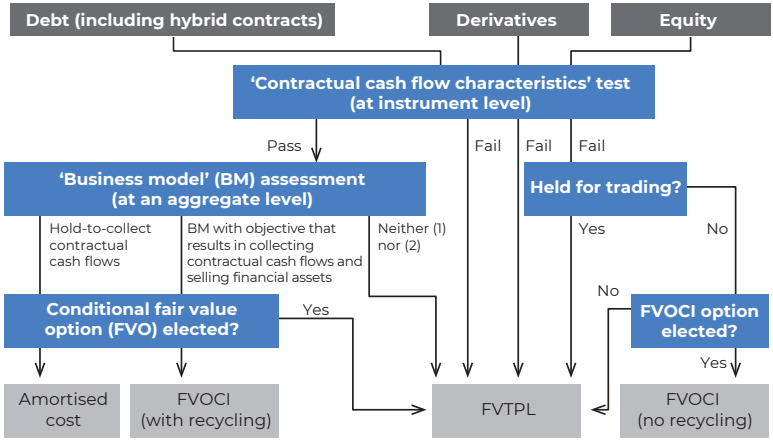
areas as those regulated by the replaced IAS 39. Above all, it governs the categorization of financial instruments and their initial and subsequent measuring and impairment. IFRS 9 also includes significant new hedging requirements. These changes are expected to have the greatest impact on financial institutions' financial reports.

IFRS 9 uses two approaches - Amortized Cost and Fair Value - to measure financial instruments, with Fair Value distinguishing between Fair Value through Profit or Loss (FVTPL) and optional Fair Value through Other Comprehensive Income (FVTOCI) with recycling and no recycling. The preferred approach is the FVTPL category with impact on profit or loss.

In connection with the classification of financial assets, IFRS 9 introduces two new terms - business model and cash flow test. A cash flow test assesses whether the financial asset give rise to cash flows that are solely payments of principal and interest on the principal amount outstanding. A business model refers to how an entity manages its financial assets in order to generate cash flows. IFRS 9 identifies three types of business models: "hold to collect", "hold to collect, and sell" and "other business models" (e.g. held for trading).

In order to determine the appropriate classification category of financial assets under IFRS 9, it is necessary to consider both the business model and the cash flow test, as well as whether the asset is a debt, equity or whether it is a derivative.

Figure 1 » Classification of financial assets under IFRS 9



Source: Aegon Asset, Management Global, 2017

Financial instruments on the liability side are not subject to the same complex classification process as assets. Mostly, financial liabilities are measured at amortized cost, same as financial assets, but an entity can use the classification of liabilities to be remeasured at fair value with an impact on profit or loss. In addition, the standard specifies exceptions where fair value measurement is mandatory, such as the measurement of derivative financial instruments where the entity is in a disadvantageous position. Almost all financial instruments are measured at fair value when recognized, same as in IAS 39. If the fair value of the instrument differs from the price at which the asset acquisition transaction took place, the entity recognizes the resulting difference in profit or loss. If a given instrument is included in the fair value instrument portfolio with an impact on profit or loss, the first fair value measurement is not adjusted for transaction costs, as opposed to other portfolios.

An entity always remeasures financial instruments at least once per accounting period, but measurement that is more frequent is usually required. Remeasuring financial instruments is done in accordance with the rules of the selected portfolio (Fig. 1). Increased attention is paid not only to change in fair value, but also to other changes and related transactions, such as changes in exchange rate differences or interest rates. Instruments measured at amortized cost are recognized through profit or loss in these situations. In the case of instruments in the FFTOCI category, such facts must be separated from the changes caused by the decline or increase in fair value and accounted for in profit or loss as well, while the change in fair value will be reflected in other comprehensive income. For the FTPL category, all changes are recognized through profit and loss.

An entity is required under IFRS 9 to recognize an allowance for each financial asset at the amount of the 12-month expected loss or expected loss for the remaining life of the financial asset. In order to determine the approach, it is necessary to distinguish the reason and the concept of loss allowance accounting. For each financial asset, the degree of impairment must be determined, from which the basis for calculating the loss allowance is determined (Figure 2). The classification of receivables is reviewed regularly, always at least as of the balance sheet date.

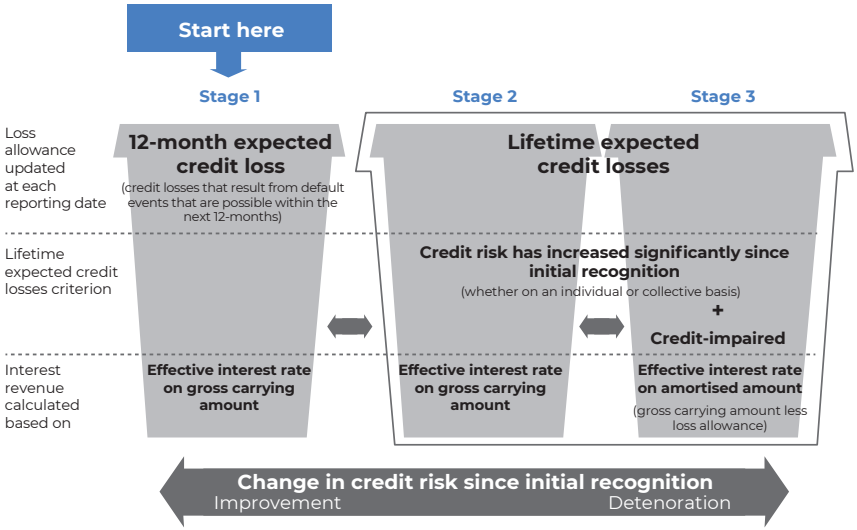
All assets at the time of recognition, with the exception of purchased or originated credit-impaired financial assets, are classified as Stage 1 until they experi-

ence a 'significant deterioration' in credit quality. The amount of recognized loss allowance (or FVOCI capital) is derived from 12-month expected credit losses. Stage 2 is recognized from the moment when the credit risk level has increased significantly, but no demonstrable depreciation has occurred. Full lifetime expected credit losses would be recognized. Stage 3 is most similar to the impairment of financial assets according to IAS 39, as one or more events that have a detrimental impact on the estimated future cash flows of that financial asset have occurred.

It is necessary to use relevant audit evidence available to assess between Stages 1 and 2, which is available without excessive costs and effort. The Standard specifies backstop indicator for credit risk assessment if contractual payments are more than 30 days past due.

In Stage 2, banks also assess loans in which, for example, loan covenant is amended or waived or the debtor's rating has changed. Seventy-two percent of banks consider the threshold for significant deterioration in credit risk to Stage 2 when the loan is 30 days past due. The overdue delay of more than 90 days is considered by the overwhelming majority of banks to be a criterion for classifying a loan as Stage 3. Allowances for purchased or originated credit impaired financial assets are recognized as lifetime expected credit loss.

Figure 2 » Three-step model of financial asset impairment



Source: (EY, 2015)

1.2 OWN RESEARCH

As already mentioned, interim financial statements of banks and financial institutions (in other text marked as "banks") for the first period of 2018 were chosen as the source of data for the statistical test. In those statements, banks reported data on loss allowance as of December 31, 2017, or the balance sheet date (under IAS 39), and as of January 1, 2018, or the date of the first day of the following accounting period (under IFRS 9). However, not all banks have interpreted the data clearly, which is a disadvantage of the somewhat more benevolent reporting methods of international accounting standards. By allowing entities to choose any form of data interpretation, i.e. either as a part of financial statements or anywhere else in its appendixes, the work of an analyst is made more difficult. In some, there is no mention of numerical orders and currencies, which then must be researched further. Three banks made a note of this change not in loss allowance but in assets. However, given the principle of balance-sheet continuity, it can be assumed that these differences were merely differences in loss allowance based on the change of the standard, as another reason for discrepancy should not be possible given the requirement for balance-sheet continuity. However, these banks were excluded from the statistical test, as only the change in total assets (less than 1%) was known, not in loss allowance. After these adjustments, eighteen banking institutions were subjected to statistical testing. Table 1 shows data about the size of the bank, as well as its majority owner. Furthermore, it indicates whether the bank is carrying out accounting according to the Czech legislation or international accounting standards. The obligation to apply IFRS 9 to financial instruments is not limited to banks that carry out accounting according to international standards, but also to banks that carry out accounting according to the Czech legislation. The last column in Table 1 shows whether the given banking institution trades its shares on the Prague Stock Exchange.

Tab. 1 » Overview of information about banking institutions included in this research, Source: modified according to published financial statements

BANK NAME	BANK SIZE	MAJORITY OWNER	LEGISLATION	PRAGUE STOCK EXCHANGE
Banka CREDITAS	Small	Unicapital a .s.	Czech Republic	No
Česká exportní banka	Small	The Czech Republic	IFRS	No
J & T BANKA	Medi-um	J & T FINANCE GROUP	IFRS	No
Modrá pyramida stavební spořitelna	Small	Societe Generale SA	Czech Republic	No
Air Bank	Small	Home Credit B. V.	IFRS	No
Česká spořitelna	Large	Erste Group Bank AG	IFRS	No
Equa bank	Small	Equa Group Ltd	IFRS	No
Komerční banka	Large	Societe Generale SA	IFRS	No
MONETA Money Bank	Medi-um	No majority share-holder	IFRS	Yes
PPF banka	Medi-um	PPF Financial Holdings B. V.	IFRS	No
Sberbank CZ, a. s.	Small	Sberbank Europe AG	IFRS	Yes
UniCredit Bank	Large	UNICREDIT S.p.A.	IFRS	No
Wüstenrot - stavební spořitelna	Small	Wüstenrot & Württembergische AG	IFRS	No
Wüstenrot hypoteční banka	Small	Wüstenrot and Württembergische AG	IFRS	No
Expobank CZ	Small	Igom Kim	Czech Republic	No
OTP Bank	Small	OTP Group	IFRS	Yes
Erste Group Bank	Large	Erste Group Bank AG	IFRS	Yes
Deutsche Bank	Large	Deutsche Bank	IFRS	Yes

Source: Modified according to published financial statements

The source material for the comparison is the content of IAS 39 (IFRS Foundation, 2017) and the new IFRS 9, which is currently only available in its original version (IFRS Foundation, 2019).

The input data and results of the Wilcoxon matched pairs test are shown in Table 2. The column "Increase of loss allowance" shows the relative volatility of loss allowance ranging from 2% (Czech Export Bank) to 36% (Sberbank CZ, a. s.). However, the statistical test revealed that the increase was not significant. The hypothesis was thus confirmed. The test criterion value of 0.09 did not exceed the critical value of 1.75. In general, the banking sector did not see any significant increase in loss allowance on receivables arising mainly from loans.

Tab. 2» Input data and Wilcoxon matched pairs test results, Source: compiled from the financial statements of banking institution

BANK NAME	ALLOWANCES IN MIL. CZK	ALLOWANCES IN MIL. CZK	LEGISLATION	PRAGUE STOCK EXCHANGE
	IAS 39 DECEMBER 31, 2017	IFRS 9 JANUARY 1, 2018		
Banka CREDITAS	198	251	53	27%
Česká exportní banka	6,627	6,759	132	2%
J & T BANKA	2,219	2,773	554	25%
Modrá pyramida stavební spořitelna	687	845	158	23%
Air Bank	696	883	187	27%
Česká spořitelna	1,082	1,233	151	14%
Equa bank	384	433	49	13%
Komerční banka	11,959	13,154	1,195	10%
MONETA Money Bank	12,757	13,592	835	7%
PPF bank	1,067	1,269	202	19%
Sberbank CZ	1,195	1,625	430	36%
UniCredit Bank	7,709	7,940	231	3%

Source: Compiled from the financial statements of banking institution

Continues on the page 34

Tab. 2» Input data and Wilcoxon matched pairs test results, Source: compiled from the financial statements of banking institution

BANK NAME	ALLOWANCES IN MIL. CZK	ALLOWANCES IN MIL. CZK	LEGISLATION	PRAGUE STOCK EXCHANGE
	IAS 39	IFRS 9		
	DECEMBER 31, 2017	JANUARY 1, 2018		
Wüstenrot - stavební spořitelna	813	991	178	22%
Wüstenrot hypoteční banka	387	414	27	7%
Expobank CZ	238	309	71	30%
OTP Bank	1,939	2,238	299	15%
Erste Group Bank	110,874	115,762	4,888	4%
Deutsche Bank	108,225	125,898	17,673	16%
Median	14,947	16,465	x	x
Standard deviation	33,671	37,162	x	x

Source: Compiled from the financial statements of banking institution

Continues from the page 33

DISCUSSION

The dreaded transition to IFRS 9 due to the steep increase in loss allowance on bank receivables that could threaten the stability of the banking sector was not confirmed.

IAS 39 was often criticized for its lack of clarity and for being difficult to implement in practice. In this way, IFRS 9 logically seeks to come up with simpler rules that are easier for businesses to understand, more uniform, and with fewer exceptions. Areas that have undergone only minor adjustments are the initial recognition and disposal of financial instruments.

During initial recognition, both standards try initially to measure the asset at fair value. IAS 39 is strict in this respect, but in some cases, IFRS respects the transaction price, such as in the case of trade receivables that contain only

a negligible financial component. Particularly in this case, however, it is unclear whether the rules are actually being simplified, since the assessment of whether a given financial component is insignificant or not is governed by another standard, namely the IFRS 15 – Revenue from Contracts with Customers.

The process of categorizing financial instruments has changed significantly with the IFRS 9. While, in accordance with IAS 39, the instrument was classified in a category that then determined the measuring method of the instrument, IFRS 9 first determines how the instrument should be measured, which then determines how the instrument should be classified. It is clear that some entities are more affected by the new standard than others; however, the process of reclassifying their financial instruments is mandatory.

Generally, IFRS 9 favours for instruments to be measured at fair value with changes being recognized in profit and loss. On the one hand, the rules can simplify and unify measuring methods for entities, as each instrument can be measured at FVPL; however on the other hand, this model will result in an added threat of volatility in profit and loss, as well as reporting unrealized profits with the risk of distributing it to owners.

The area of impairments was one of the most criticized issues in relation to IAS 39. The reason for this was the very model that the impairment or credit losses were only recognized when there was objective evidence of a credit loss event ("incurred loss model"). This model proved inefficient, as it did not allow the entity to create a sufficient financial buffer to cover future losses in the event of adverse developments. Late recognition of credit losses was, as has been said, a major problem during the financial crisis.

Another problem of the now former standard was the significant inconsistency and complexity of reflecting the impairment of the asset in accounting, as different approach was applied to each financial instrument category.

The new IFRS 9 brings a completely new perspective on the issue of instrument impairment, when the impairment of a financial instrument is not accounted for ex post, but during initial recognition or when credit risk increases – the expected credit losses model. Under IFRS 9, impairment is applied to all types of financial instruments other than FVTPL, as the fair value itself already contains possible impairment.

Before the standard came into effect, banks had to deal with a number of obligations to ensure a smooth transition to the new rules. One of the biggest challenges was certainly the development of new statistical models, possibly adjusting the parameters of existing models, and developing IT systems to determine expected losses. Furthermore, it was necessary to create a system architecture for collecting the necessary data and systems for the calculation of the increase in credit risk for individual assets. According to a survey by Deloitte, this challenge was one of the most feared during the transition to IFRS 9 (Deloitte Global Services Limited, 2016).

Although the new standard should ideally not affect the provided products, some banks believe that the implementation of IFRS 9 will indirectly affect the loan allocation conditions and pricing policies, including interest rate increases for new loans and, overall, may change the bank's business model. In many cases, banks also had to make personnel changes; more precisely strengthen both accounting departments and risk management teams (EY, 2017). On the other hand, the standard also gives entities the opportunity to use several concessions to make the transition less burdensome. One such concession is, for example, waiving the obligation to report comparative information for previous years in the first reporting period in which the entity complies with the new standard.

Nevertheless, the implementation of the new standard is a major challenge for banks and we can expect that the implementation of some of the lower priority areas of the standard, such as back testing, will be delayed and will be completed in 2018 or later. The implementation process of any new regulation is demanding not only from a technical point of view, but also from a financial perspective (Deloitte Global Services Limited, 2016).

CONCLUSION

The issue of impairment of financial assets has undergone significant changes and an almost complete overhaul compared to IAS 39. At first glance, the most significant change is the actual moment of the impairment, which, in accordance with the new standard, occurs at the time of the initial recognition of the asset and subsequently whenever there is a significant deterioration in credit risk. Therefore, the expected loss approach is applied when the losses taken into account

have not actually been realized yet. The original model in IAS 39 resulted in credit losses being recognized only after a credit loss event occurred. As a result, loss allowance was often insufficient and late. The new concept will enable financial entities to create loss allowance in an appropriate amount and thus ensure a sufficiently large financial buffer in the case of potential adverse developments in the economic situation.

In a period of stagnant or declining economic performance, banks will not be forced to reduce the availability of loans significantly, thereby preventing an even greater recession. Loss allowance created at a sufficient level will help absorb economic shocks, cover potential losses actually incurred, and thereby avoid an insolvency of financial institutions.

The actual implementation of IFRS 9 did not pose a threat to the financial stability of the banking sector.

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FIŠKÁLNA DECENTRALIZÁCIA A EKONOMICKÝ RAST V KRAJINÁCH EÚ Z PERSPEKTÍVY VEĽKOSTI KRAJINY, ŠTRUKTÚRY VEREJNEJ VLÁDY A VSTUPU DO EÚ

FISCAL DECENTRALIZATION AND ECONOMIC GROWTH IN EU COUNTRIES FROM THE COUNTRY SIZE, GOVERNMENT STRUCTURE, AND EU ACCESSION PERSPECTIVE

Siniša Mali
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ABSTRAKT

Cieľom článku je analyzovať vplyv fiškálnej decentralizácie na ekonomický rast krajín Európskej únie s ohľadom na veľkosť krajiny, počet vládnych úrovní a vstup krajiny do EÚ. Prostredníctvom panelových ekonometrických modelov využívajúcich rôzne druhy estimátorov je s využitím údajov z Eurostatu a Svetovej Banky pre vzorku krajín EÚ v období 1999-2019 odhadovaný vzťah medzi rastom HDP ako vysvetľovanej premennej a fiškálnej decentralizácie ako vysvetľujúcej premennej, pričom fiškálna decentralizácia je meraná rôznymi spôsobmi. Výsledky poukazujú na to, že model fixných časových efektov najlepšie odhaduje vzťah medzi analyzovanými premennými. Výsledky odhadnutých ekonometrických panelových modelov potvrdzujú počiatočnú výskumnú hypotézu, že fiškálna decentralizácia významne ovplyvňuje ekonomický rast, kde intenzita a smer koeficientu vysvetľujúcej premennej závisí od (1) veľkosti krajiny (2) počtu vládnych úrovní (3) obdobia vstupu krajiny do EÚ.

Klíčová slova: *fiškálna decentralizácia, ekonomický rast, panelový model*
JEL klasifikace: *E62, H77*

ABSTRACT

The aim of the paper is to examine the relationship between the fiscal decentralization and economic growth in European Union countries, with respect to the country size, the number of government level, and EU accession. The study was conducted on the basis of data from Eurostat and the World Bank. A sample of EU countries in the period 1999–2019 is investigated. Panel data models based on various estimators are employed to estimate the relationship between the growth of GDP as dependent variable and fiscal decentralization as explanatory variable, while fiscal decentralization is measured in different ways. The paper demonstrates that the time-fixed effects model best describes the dependence of GDP growth on fiscal decentralization as the main explanatory variable and other variables impacting economic growth. On the basis of estimated parameters of the econometric panel model, the original research hypothesis that fiscal decentralization has a significant impact on economic growth is proven, with the intensity and direction of impact depending on 1) the country's size; 2) the number of government levels; and 3) the period of the country's EU accession.

Keywords: *fiscal decentralization; economic growth; panel data model*

JEL Classification: *E62, H77*

INTRODUCTION

Studies of the impact of fiscal decentralization on economic growth boomed in the 1990s, which is reflected in the numerous papers presenting the results of empirical research conducted in certain countries or groups of countries. Slavinskaite, Novotny and Gedvilaitė (2020), Aristovnik (2012) or Rodríguez-Pose and Krøijer (2009) summarize the potential positive effects of fiscal decentralization on economic growth that consist in the possibility of tailoring the local public goods and services to local preferences and in enhanced competition among localities, which leads to innovative provision of public goods and services. Negative effects are mentioned in Davoodi and Zou (1998) or Maličká et al. (2017), when excessive fiscal decentralization lowers the economic growth by increasing public spending and generating additional bureaucracy costs.

In the studies, either only cross-section data or time-series data were used, or, which is most often the case, panel data representing a combination of cross-section data and time series data, while different indicators of the fiscal decentralization degree were used. Depending on the type of data (cross-section, time series,

and panel), for the purpose of examining the impact of fiscal decentralization on economic growth, different econometric models and estimation methods were used.

The results of empirical research on the dependence of economic growth on fiscal decentralization showed that this dependence is not universal and varies by country or group of countries and over time, implying that the strength and direction of impact of fiscal decentralization on economic growth depends on various factors such as country size, level of economic development, quality of political institutions, and more (Baskaran, Feld and Schnellenbach, 2016). Negative impacts of fiscal decentralization on GDP growth were found, e.g, in China (Zhang and Zou, 1998; Lin and Liu, 2000), in the US (Xie, Zou and Davoodi, 1999), in the OECD countries (Thiessen, 2003; Rodriguez-Pose and Ezcurra, 2011), in the Central and Eastern European countries (CEE) (Rodríguez-Pose and Krøijer, 2009), in the European countries (Pasichnyi et al., 2019), etc. Positive impact of fiscal decentralization on GDP growth was determined by Akai and Sakata (2002) in the US, Feld et al. (2004) in Switzerland, Qiao et al. (2008) in China, Gemmell, Kneller and Sanz (2013) and Blöchliger and Égert (2013) in the OECD countries, whereas, for example, Thornton (2007) determined that in the OECD countries there was no significant impact of fiscal decentralization on economic growth.

Regarding the impact of fiscal decentralization on economic growth, differences were found between developed and developing countries. Canavire-Bacarreza, Martinez-Vazquez and Yedgenov (2020), for example, determined, based on panel data for 70 countries in the period 1981–2010, a positive and significant impact of the share of subnational expenditure in total general government expenditure and the share of subnational revenue in total general government revenue on the economic growth of a group of developed countries, and showed that the impact of these explanatory variables on economic growth of a group of developing countries in the analyzed period was not significant.

Empirical research of the impact of fiscal decentralization on economic growth can be divided into two groups, depending on whether the impact was examined at the level of a group of countries or within one country. Most of the

research belonging to the first group refers to research at the level of the OECD countries (Thiessen, 2001, 2003; Bodman, 2011; Rodriguez-Pose and Ezcurra, 2011; Baskaran and Feld, 2013; Blöchliger, 2013; Blöchliger and Égert, 2013; Gemmell, Kneller and Sanz, 2013; Filippetti and Sacchi, 2016a; Filippetti and Sacchi, 2016b), and EU countries (Szarowská, 2014; Maličká et al., 2017; Slavinskaitė, 2017; Carniti et al, 2019; Pasichnyi et al, 2019; Slavinskaite, Novotny and Gedvilaitė, 2020).

Much more empirical research on the impact of fiscal decentralization on economic growth, especially in the last two decades, has been conducted at the country level, including the following countries: the US (Xie, Zou and Davoodi, 1999; Akai and Sakata, 2002; Bojanic, 2018), Switzerland (Feld et al., 2004), Nigeria (Cyril, 2016; Sylvester and Ade, 2017), Spain (Carrion-i-Silvestre, Espasa and Mora, 2008; Cantarero and Gonzales, 2009; Cantarero and Perez, 2012; Lago-Peñas, Fernandez-Leiceaga and Vaquero-García, 2017), Italy (Di Liddo, Magazzino and Porcelli, 2018); India (Ganaie et al, 2018), Malaysia (Hasnul, 2015), Bali (Kusuma and Badrudin, 2016), Columbia (Lozano-Espitia, Julio-Román and Lozano-Espitia, 2015; Lozano-Espitia and Julio, 2016), Slovakia (Maličká et al., 2017), Ukraine (Melnyk et al., 2018; Trusova et al., 2019), Indonesia (Nursini, 2019), Vietnam (Nguyen and Anwar, 2011; Thanh and Canh, 2020), China (Zhang and Zou, 1998; Lin and Liu, 2000; Qiao et al. 2008; Yang, 2016; Sun, Chang and Hao, 2017), Russia (Yushkov, 2015), and Germany (Baskaran, Feld and Necker, 2017).

It is obvious that the relationship between the fiscal decentralization and economic growth is examined in a large number of the empirical literature. However, observed results are often ambiguous or even opposite. Obviously, they differ according to the economic circumstances, public sector structure, administration, etc., of a concrete country or a sample of countries, while the time period is an important factor, too.

Anyway, different results have incited this research and the aim of the paper is to contribute to the existing empirical literature by providing an analysis that reflects on different conditions of the countries in the EU sample. The subject of this paper is to examine the impact of fiscal decentralization on the economic growth of EU countries in the period 1999–2019. The main goal of

this paper is to elicit the nature of the relationship between the fiscal decentralization and GDP growth of EU countries and to elicit whether this relationship varies according to the sample structure by creating various subsamples. In fact, the research has two basic hypotheses: 1) fiscal decentralization in the EU countries negatively affects their economic growth; and 2) the dependence of economic growth on fiscal decentralization is affected by the size of the country, the year of accession to the European Union, and the number of government levels. The first hypothesis stems from the heterogeneity of the EU sample (from the economic as well as political point of view), which has importantly increased after the extension of the EU caused by the accession of less developed, mainly post-communist countries in Europe. The second hypothesis is based on the findings of Horváthová et al. (2012), which point to a possible effect of different countries' characteristics including the aspects of their initial economic conditions and/or political factors leading to different government structures in terms of fiscal federalism.

1 DATA AND METHODOLOGY

The study used the Eurostat and World Bank data for 28 European Union member states[1] in the period 1999–2019. The panel data approach is employed in the research.

In line with the approach of Horváthová et al. (2012), three indicator-variables were determined for measuring the fiscal decentralization degree: 1) EXPDEC variable defined as the ratio between total local government expenditure (as percent of GDP) and total general government expenditure (as percent of GDP); 2) REVDEC variable reflecting the share of total local government revenue (as percent of GDP) in total general government revenue (as percent of GDP); and 3) TAXDEC variable representing the share of total local government tax revenue (as percent of GDP) in total general government tax revenue (as percent of GDP). On the basis of the coefficient of determination and the Akaike information criterion, TAXDEC was selected as the most adequate measure of the impact of fiscal decentralization on economic growth.

1 The study also covers the United Kingdom, which was a member of the EU at the time of the sample observations.

In order to quantify the "pure" impact of fiscal decentralization on economic growth, the following variables were included in the basic model: government consolidated gross debt (as percent of GDP), foreign direct investment (as percent of GDP), investment (as a sum of business investment (as percent of GDP) and household investment (as percent of GDP)) and government investment (as percent of GDP). Those variables represent the basic components of the GDP growth. Their selection was inspired by the relevant correspondent literature, e.g. Slavinskaite, Novotny and Gedvilaitė, (2020), Pasichnyi et al. (2019) or Maličká et al. (2017).

For testing the stated hypotheses, the pooled ordinary least squares model, fixed effects model, time-fixed effects model and random effects model were used, while the impact of the country's size, period of accession to the European Union and the number of government levels were studied. According to the year of EU accession, the countries were divided into two groups: the countries that joined before 2004 and the countries that joined the European Union after 2004. According to size, the EU countries were divided into three strata (based on Horváthová et al., 2012): small countries (up to 10 million inhabitants), medium-sized countries (countries with 10 to 30 million inhabitants) and large countries (countries with over 30 million inhabitants), while according to the number of government levels, they were classified into two groups: the countries with 1 or 2 government levels and the countries with 3 or more government levels.

Basic regression panel model is determined as follows:

$$GDP\_G_{i,t} = \beta_0 + \beta_1 F_{i,t} + \beta_2 GOV\_DEB_{i,t} + \beta_3 FDI_{i,t} + \beta_4 GI_{i,t} + \beta_5 I_{i,t} + u_{i,t}$$
$$i = 1,\ldots,N;\ t = 1,\ldots,T \qquad (1)$$

where:

$GDP\_G_{i,t}$ = Annual percentage growth rate (percent of GDP),
$FD_{i,t}$ = Fiscal decentralization,
$GOV\_DEB_{i,t}$ = Government consolidated gross debt (as percent of GDP),
$FDI_{i,t}$ = Foreign direct investment (as percent of GDP),
$GI_{i,t}$ = Government investment (as percent of GDP),

$I_{i,t}$ = Sum of business investment and household investment (as percent of GDP),
$u_{i,t}$ = Error term,
N = Number of observation units (countries) in the sample,
T = Time period covered by observations in the sample.

In the first data analysis, the stationarity of each individual variable included in the model was examined. The Levin-Lin-Chiu test and the Harris-Tzavalis test examined the stationarity of variables for which there were all observations in the panel (strongly balanced panel), while the Im–Pesaran–Shin test examined the assumption about the stationarity of variables for which data were missing for individual years of the analyzed period in individual countries (unbalanced panel). After conducting the tests of stationarity of variables included in the model, the original variables – government consolidated gross debt, government investment, and investment that did not meet the requirement of stationarity based on first log difference – were transformed into new variables DGOV_DEB, DGI and DI, so the model (1) was transformed into the following model:

$$GDP\_G_{i,t} = \beta_0 + \beta_1 FD_{i,t} + \beta_2 DGOV\_DEB_{i,t} + \beta_3 FDI_{i,t} + \beta_4 DGI_{i,t} + \beta_5 DI_{i,t} + u_{i,t} \quad (2)$$
$$i = 1,\ldots,N;\ t = 1,\ldots,T$$

where FD variable presents the selected measure of fiscal decentralization FD.

The model (2) parameters were estimated first by using the pooled ordinary least squares (POLS), which implies that the random error $u_{i,t}$ has a normal distribution with mean zero and constant variance and is not correlated with explanatory variables, i.e. there is no endogeneity in the model. As known, the consequence of endogeneity in the model, in addition to the bias and unreliability of the estimated parameters, is an unnoticed heterogeneity that has a significant systematic impact on the dependent variable (Stock and Watson, 2019). To eliminate the consequences of unobserved heterogeneity, the assumption is introduced that the omitted variable does not vary with

respect to the comparative dimension, so the disturbance term in the model was decomposed into two components:

$$u_{i,t} = \mu\_i + v_{i,t} \tag{3}$$

where μ_i denotes individual specific effects and $v_{i,t}$ remainder disturbance that varies over time and countries.

In addition, we used the fixed effects model (FEM), time-fixed effects model (T-FEM), and the random effects model (REM), which are based on three different assumptions about variable μ_i, while using the Hausman test to assess the adequacy of the random effects model in the analysis.

Since the Hausman test found that the FEM presents more adequate econometric specification than the REM, the appropriate tests were used in the analysis: the Pesaran CD (cross-sectional dependence) test, which is used to test whether the residuals are correlated across entities (contemporaneous correlation), the Lagrange-Multiplier test used to test for the existence of first-order autocorrelation, and the modified Wald test for groupwise heteroskedasticity in the fixed effects regression model.

2 EMPIRICAL RESULTS AND DISCUSSION

On the basis of calculated descriptive statistics measures, it was determined that the average value of the EXPDEC variable (the share of total local government expenditure in total general government expenditure) for EU countries in the period from 1999 to 2019 was 22.7%, similar to 23.5%, which was the average value of the REVDEC variable (the share of total local government revenue in total general government revenue), while the average value of the TAXDEC variable (the share of total local government tax revenue in total general government tax revenue) was only 12.4% (see Table 1).

Tab. 1» Descriptive statistics of explanatory variables

	EXPDEC	REVDEC	TAXDEC
Mean	0.227	0.235	0.124
Median	0.207	0.217	0.092
Max	0.663 (Denmark, 2017	0.661 (Denmark, 2010)	0.356 (Sweden, 2003)
Min	0.011 (Malta, 2017)	0.013 (Malta, 2018)	0.013 (Cyprus, 2016)
Std. deviation	0.129	0.126	0.095

Source: Own computation

In the analyzed period, the largest share of local expenditure in total government expenditure (66.3%) was recorded in Denmark in 2017 and the lowest (1.1%) in Malta in 2017. The largest share of local revenue in total revenue (66.1%) was also recorded in Denmark in 2010 and the lowest (1.3%) in Malta in 2018. The highest share of local government tax revenue in general government tax revenue (35.6%) was in Sweden in 2003 and the lowest in Cyprus (1.3%) in 2016.

There is high correlation among variables EXPDEC, REVDEC, and TAXDEC. The correlation coefficient between EXPDEC and REVDEC is 0.99, between EXPDEC and TAXDEC 0.67, and between REVDEC and TAXDEC 0.67.

The correlation coefficients between GDP growth and each of the indicator--variables are negative, with the correlation coefficient between GDP growth and TAXDEC being the highest.

Based on the estimation results shown in Table 2, we can see that of the observed three variables-indicators of the degree of fiscal decentralization, only the TAXDEC variable is statistically significant ($p < 0.05$). The calculated values of the coefficient of determination and the Akaike information criterion also indicate that POLS Model 3, which includes the TAXDEC variable, has the highest descriptive power, i.e. it represents the best analytical description of the dependence of GDP growth on explanatory variables.

Tab. 2» POLS model statistics with indicator-variables included

	POLS Model 1	POLS Model 2	POLS Model 3
EXPDEC	-1.095 (0.961)		
REVDEC		-1.051 (0.991)	
TAXDEC			-3.101 * (1.216)
DGOV_DEB	-13.077 *** (1.115)	-13.020 *** (1.114)	-12.986 *** (1.107)
FDI	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
DGI	2.909 *** (0.730)	2.901 *** (0.730)	2.948 *** (0.725)
DI	13.053 *** (1.464)	13.042 *** (1.464)	13.015 *** (1.456)
_cons	2.865 *** (0.259)	2.862 *** (0.272)	3.005 *** (0.198)
Adj. R-squared	0.506	0.506	0.512
AIC	2207.157	2207.334	2201.934
F-test	97.139	97.068	99.261
Prob>F	0.000	0.000	0.000

*Notes: Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001*
Source: Own computation

The relationship between the fiscal decentralization (TAXDEC) and economic growth is negative. The increase of the degree of fiscal decentralization leads to a decrease in GDP growth. In principle, it opposes to the idea mentioned, e.g., in Aristovnik (2012) or Rodríguez-Pose and Krøijer (2009), which states that the greater the degree of fiscal decentralization, the greater the potential for economic efficiency

and growth. In addition, Rodríguez-Pose and Krøijer (2009) observed a negative relationship between the local expenditure and shifted transfers (corresponding to the EXPDEC and REVDEC variable) and economic growth and positive relationship when taking into account local tax revenue (corresponding to TAXDEC variable). On the contrary, in this paper, a negative relationship has been observed. This might be explained by the construction of the TAXDEC variable. While Rodríguez-Pose and Krøijer (2009) have mentioned local tax revenue originating in taxes assigned to local government levels, many countries employ the system of sharing tax revenues, which results in formal tax autonomy of local governments. Due to the persistent vertical fiscal imbalance, the reliance of local governments on central government is important (Propheter, 2019) and shared tax presents a quasi-transfer (additionally with characteristics of a non-earmarked transfer) shifted to local budgets. However, the negative impact of fiscal decentralization is stressed to the effect that excessive shift of sources to sub-national levels enhances the public spending, increases the cost of bureaucracy, and thus decelerates the economic growth (Davoodi and Zou, 1998; Maličká et al., 2017).

In the next step of the analysis, the FEM and the REM were estimated, while only one statistically significant fiscal decentralization variable (TAXDEC variable) is employed in the estimations. The Hausman test showed that the FEM is superior to the REM (Statistic Chi2 of 21.96, p-value = 0.001). The Pesaran's test of cross-sectional independence demonstrated that the T-FEM is superior to the FEM (p-value =0.000). It can also be observed that the T-FEM has a higher value of the coefficient of determination and a lower value of the AIC information criterion. On the basis of the conducted Lagrange-Multiplier test (F (1, 25) = 3.247; Prob > F = 0.0836), the hypothesis on the existence of first-order autocorrelation was rejected. On the other hand, on the basis of the modified Wald test for groupwise heteroskedasticity in the fixed effects regression model (chi2= 4663.61; Prob>chi2 = 0.0000), the hypothesis that there is no residual homoskedasticity was rejected. Given this finding, the Huber-White variance-covariance matrix was used in the further analysis, which modifies the estimated variance--covariance matrix using the least squares method, thus ensuring robustness of statistical estimation in relation to heteroskedasticity in the model.

Based on the results displayed in the Table 3, we support our previous finding that

fiscal decentralization (measured as the share of total local government tax revenue in total general government tax revenue) has a statistically significant negative impact on the economic growth of EU countries in the period 1999–2019. A similar conclusion was reached by Pasichnyi et al. (2019), who investigated the impact of fiscal decentralization on the economic growth of selected European countries, including a large body of the EU members, and Thiessen (2003) and Rodriguez-Pose and Ezcurra (2011), who analyzed the impact of fiscal decentralization on the economic growth of the OECD countries. The results of empirical research conducted in China (Zhang and Zou, 1998; Lin and Liu, 2000) and by Xie, Zou and Davoodi (1999) in the US also showed that the impact of fiscal decentralization on the economic growth of these countries is significant and negative.

Tab. 3» Panel model statistics with the TAXDEC variable included as the fiscal decentralization degree measure

	POLS Model 1	POLS Model 2	POLS Model 3	POLS Model 3
TAXDEC	-3.101 * (1.216)	-11.291 (6.483)	-3.013 ** (1.073)	-3.864 (2.137)
DGOV_DEB	-12.986 *** (1.107)	-14.313 *** (1.016)	-8.831 *** (1.097)	-14.031 *** (1.019)
FDI	0.001 (0.001)	-0.000 (0.001)	0.001 (0.001)	0.000 (0.001)
DGI	2.948 *** (0.725)	-2.255 *** (0.655)	2.998 *** (0.692)	2.462 *** (0.660)
DI	13.015 *** (1.456)	11.484 *** (1.325)	9.841 *** (1.406)	11.879 *** (1.334)
_cons	3.005 *** (0.198)	4.091 *** (0.830)	2.907 *** (0.175)	3.129 *** (0.346)
Adj. R-squared	0.512	0.554	0.621	
Chi2				598.251
AIC	2201.934	2068.416	2064.163	
F-test	99.261	122.414	42.951	
Prob>F	0.000	0.000	0.000	0.000

*Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001*
Source: Own computation

To elicit whether the relationship between the fiscal decentralization and GDP growth varies according to the sample structure, the sample of 28 EU countries was divided into several subsamples. As mentioned hereinbefore, three additional variables were included in the research: the date of EU accession, the country size, and the number of government levels, which we assumed could increase or decrease the impact of fiscal decentralization on the economic growth of EU countries. The results of estimations made are displayed in Table 4.

First, the results of estimations for the two groups of EU countries regarding their EU accession are presented (for countries that joined the European Union before 2004 and for countries that joined the European Union after 2004). This classification of EU countries, inspired by Horváthová et al. (2012), partially bears on research made by Rodríguez-Pose and Krøijer (2009), Aristovnik (2012) or Slavinskaite, Novotny and Gedvilaitė (2020), who deal with the impact of fiscal decentralization on economic development in CEE countries (with the exception of Portugal in the sample of Slavinskaite, Novotny and Gedvilaitė, 2020). Based on the obtained results, even if the fiscal decentralization variable is not statistically significant, it can be concluded that there are differences in intensity but not in the direction of the impact of fiscal decentralization on the economic growth of countries belonging to these groups of EU countries. In the case of countries that joined the EU after 2004, the findings contradict those of Slavinskaite, Novotny and Gedvilaitė (2020) or Aristovnik (2012). In addition, Aristovnik (2012) mentions that the examined relation is in the case of CEE countries weak, which roughly corresponds with our findings that the fiscal decentralization variable is not statistically significant when investigating its effect on economic growth in the countries in question.

Tab. 4» Regression analysis of the impact of the date of EU accession, the country size, and the number of government levels

	Date of EU accession		Country size			Government levels	
	Before 2004	After 2004	Large	Medium-sized	Small	(1-2)	(3-5)
TAXDEC	-2.280 (1.292)	-2.466 (1.583)	15.719 ** (4.728)	3.598 (2.436)	-5.099 *** (1.281)	-3.822 ** (1.173)	6.156 ** (2.319)
DGOV_DEB	-11.018 *** (1.764)	-7.930 *** (1.293)	-11.133 ** (3.604)	-5.933 * (2.825)	-8.407 *** (1.325)	-8.405 *** (1.185)	-12.564 * (4.786)
FDI	0.003 ** (0.001)	-0.008 * (0.004)	0.612 *** (0.116)	-0.007 (0.013)	0.000 (0.001)	0.001 (0.001)	0.017 (0.022)
DGI	1.571 (1.216)	2.602 ** (0.832)	2.532 (1.883)	2.482 * (1.151)	2.714 ** (0.970)	2.787 *** (0.754)	2.787 *** (0.754)
DI	8.828 *** (1.882)	8.177 *** (1.844)	4.458 (4.422)	10.736 *** (2.886)	9.667 *** (1.833)	9.443 *** (1.520)	5.318 (4.913)
_cons	2.026 *** (0.227)	3.824 *** (0.244)	-2.128 ** (0.782)	1.835 *** (0.337)	3.651 *** (0.227)	3.273 *** (0.198)	0.800 * (0.345)
Adj. R-squared	0.557	0.743	0.690	0.548	0.691	0.654	0.532
AIC	1053.384	907.088	285.160	546.936	1100.445	1613.263	361.013
F-test	19.319	23.186	16.159	6.975	27.561	33.104	4.282
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.002

*Notes: T-FEM; Standard errors in parentheses; * p<0.05, ** p<0.01, *** p<0.001*
Source: Own computation

The next (centre) part of Table 4 shows the estimated values of panel model parameters for three groups of EU countries: large countries, medium-sized countries, and small countries. Based on the obtained results, it can be concluded that the country size variable affects the dependence of GDP growth on fiscal decentralization. Unlike the group of large countries, where fiscal decentralization has the strongest impact (significant and positive) on economic growth, fiscal decentralization negatively affects economic growth of small EU countries. The

positive impact of fiscal decentralization on economic growth of large countries has been determined by, for example, Akai and Sakata (2002) in the US and Qiao et al. (2008) in China. Large countries tend to be more decentralized due to spatial aspects. For instance, Germany is a federation and Spain and Italy are emerging federations that have been increasing the autonomy of sub-national governments. France is a unitary state, but has a three tiered sub-national government. In addition, small EU countries such as Estonia, Lithuania, Bulgaria, and many other countries usually have two government levels. In the last part of Table 4, based on Horváthová et al. (2012), EU countries were divided into two groups according to the number of government levels. The first group consisted of countries with only one or two levels of government, while the second group consisted of countries with three or more levels of government. The estimation results show that the impact of fiscal decentralization on economic growth is significant in both groups of countries – negative in the group of countries with one or two levels of government and positive in the countries with three or more levels of government. This result is consistent with the result we obtained by examining the impact of the country size on the dependence of economic growth on fiscal decentralization, given that large countries have a higher number of government levels compared to smaller countries.

CONCLUSION

The results of empirical research have shown that fiscal decentralization significantly affects economic growth of EU countries. When EU countries are viewed as a whole, the impact of fiscal decentralization on economic growth is negative. The impact of fiscal decentralization on economic growth depends on the size of the country and on the number of levels of government. Economic growth of large EU countries is positively affected by fiscal decentralization, while in small EU countries, the impact of fiscal decentralization on economic growth is negative. The factor of the EU accession does not seem to be crucial, when the division of the EU sample according to the date of the country's accession to the EU is irrelevant in terms of the impact of fiscal decentralization on economic growth. In countries with a large number of levels of government, fiscal decentralization has a positive effect on economic growth, while in countries with a small number of

levels of government, the impact of fiscal decentralization on economic growth is negative.

Although the paper contributes to research on the relationship between fiscal decentralization and economic growth, it is obvious that in the future attention should be dedicated to the expression of the degree of fiscal decentralization. Exclusion of "formal" local resources in terms of shared tax revenue from the investigation might bring different results.

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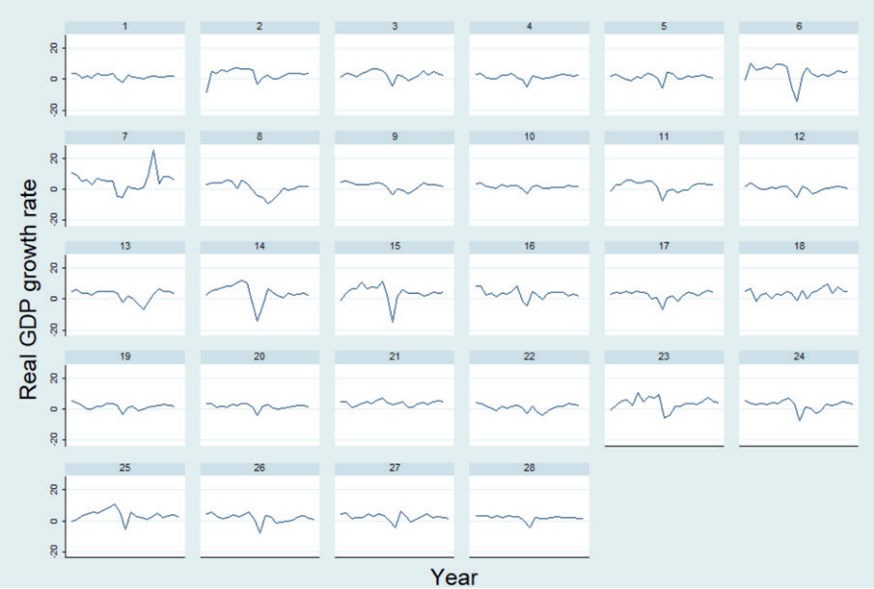
Appendix 1: »Description of variables

Variable type	Label	Description	Source
Dependent variable	GDP_G	Annual percentage growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	World Bank
Main explanatory variables	GDP_G	Annual percentage growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	World Bank
	REVDEC	Total local government revenue (as percent of GDP)/Total general government revenue (as percent of GDP)	Eurostat
	TAXDEC	Total local government tax revenue (as percent of GDP)/Total general government tax revenue (as percent of GDP)	Eurostat
Explanatory variables	GOV_DEB	Government consolidated gross debt	Eurostat
	FDI	Foreign direct investments. Direct investment in the reporting economy (flows) (as percent of GDP)	Eurostat
	I	Investment. Sum of business investment (as percent of GDP) and Household investment (as percent of GDP)	Eurostat
	GI	Government investments (as percent of GDP)	Eurostat
Transformed explanatory variables	DGOV_DEB	First log difference of variable GOV_DEB	
	DI	First log difference of variable I	
	DGI	First log difference of variable GI	
Control variables	GOV_LVL	Number of government levels. Total score for given country is calculated upon complexity of its public administration structure.	Horváthová et al. (2012) and Council of European Municipalities and Regions (2012)
	Year of EU accession	All countries from the sample were divided into two groups: 1) countries that joined the EU until 2004; 2) countries that joined the EU after 2004	Own
	Country size	All EU member states were divided by size into 3 categories: 1) small countries (below 10,000,000 inhabitants); 2) medium-sized countries (with 10,000,000 to 30,000,000 inhabitants); 3) large countries (with over 30,000,000 inhabitants)	World Bank

Appendix 2: »Graphs of real GDP growth rate

Graph 1: »Dynamic GDP growth in EU countries, 1999–2019.

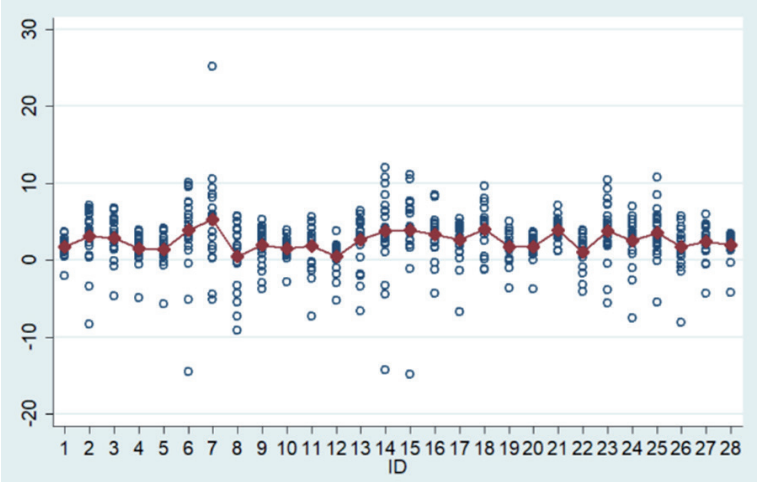


Source: Own research

Legend:

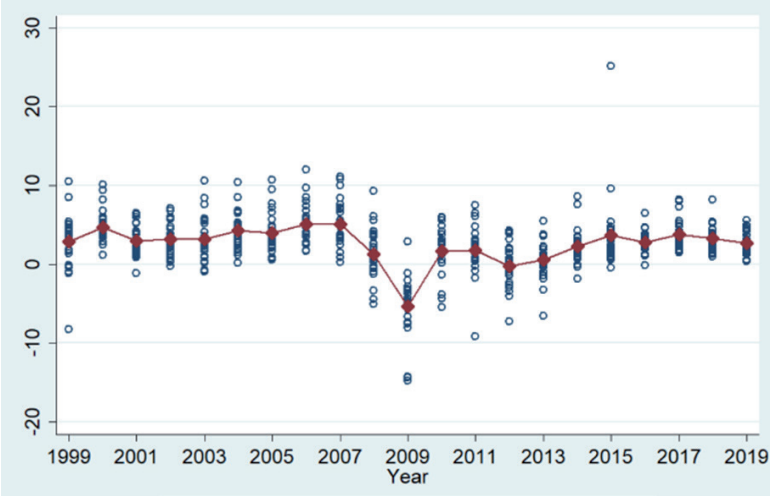
ID	Country	ID	Country	ID	Country	ID	Country
1	Belgium	8	Greece	15	Lithuania	22	Portugal
2	Bulgaria	9	Spain	16	Luxembourg	23	Romania
3	Czech Republic	10	France	17	Hungary	24	Slovenia
4	Denmark	11	Croatia	18	Malta	25	Slovakia
5	Germany	12	Italy	19	Netherlands	26	Finland
6	Estonia	13	Cyprus	20	Austria	27	Sweden
7	Ireland	14	Latvia	21	Poland	28	United Kingdom

Graph 2: »Real GDP growth rate: by country



Source: Own research

Graph 3: »Real GDP growth rate: by year



Source: Own research

VYUŽITÍ METODOLOGIE VĚDECKOVÝZKUMNÝCH PROGRAMŮ PRO HODNOCENÍ VĚDECKOVÝZKUMNÉ ČINNOSTI[1]

USING THE METHODOLOGY OF SCIENTIFIC RESEARCH PROGRAMMES FOR THE EVALUATION OF SCIENTIFIC RESEARCH ACTIVITIES

František Ochrana,
Vilém Novotný

ABSTRAKT

Článek zkoumá Lakatosovu metodologii vědeckovýzkumných programů. Tato metodologie je inspirativní i pro hodnocení efektů vědeckovýzkumných programů. Vědeckovýzkumný program je produkční jednotkou. Produkční jednotka (např. vědec, výzkumný tým) produkují výstupy a výsledky. Navržený systémový model ukazuje, jakými způsoby a formami je možné zjišťovat efekty vědeckovýzkumných programů a jak provádět jejich ex post evaluaci. Navržený postup tak může přispět k zefektivnění vědní politiky.

Klíčová slova: *Lakatos, vědeckovýzkumný program, hodnocení výstupů a výsledků vědeckovýzkumného programu, efektivnost vědní politiky*

JEL klasifikace: *A 14, B 40*

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ABSTRACT

The article examines the Lakatos methodology of scientific research programmes. This methodology is also inspiring to evaluate the effects of scientific research programmes. The scientific research programme is a production unit. The production unit (e.g. scientist, research team) produces outputs and results. The proposed system model shows the ways and forms in which it is possible to detect the effects of scientific research programmes and how to carry out their ex post evaluation.The proposed procedure can thus help to make science policy more effective.

Keywords: *Lakatos, scientific research programme, evaluation of outputs and results of scientific research programme, efficiency of science policy*

JEL Classification: *A 14, B 40*

ÚVOD

Metodologie vědeckovýzkumných programů je jedním ze stěžejních problémů metodologie vědy. Tvůrcem metodologie vědeckovýzkumných programů je filozof matematiky a přírodních věd Imre Lakatos (1922-1974), který po porážce protisovětského povstání v roce 1956 emigroval z Maďarska a působil na universitě v Cambridge ve Velké Británii. Imre Lakatos získal vzdělání v oboru matematiky, fyziky a filosofie. To vysvětluje, proč se ve svém bádání v metodologii vědy zaměřil na tyto oblasti. Nevěnoval se metodologii sociálních věd. V naší studii chceme poukázat na to, že Lakatosova metodologie vědeckých výzkumných programů může být inspirativní i pro sociální vědy, jmenovitě pro hodnocení efektů vědeckovýzkumných programů. Na základě studia Lakatosových klíčových prací věnovaných metodologii vědy (Lakatos, 1978; Lakatos, 2008; Lakatos, 2015) a vědecké diskuse inspirované Lakatosovým ideovým odkazem si stavíme za cíl prozkoumat obsah a zaměření vědecké diskuse reagující na Lakatosův koncept vědeckovýzkumných programů a pokusit se obohatit vědeckou diskusi o dosud nediskutovaný pohled na vědeckovýzkumný program jako produkční systém (jednotku). Smyslem takového přístupu je navrhnout rámcový model pro hodnocení efektů vědeckovýzkumné činnosti. V kontextu uvedeného cíle si klademe dvě výzkumné otázky (VO):

VO 1: Jaké je zaměření vědecké diskuse vycházející z Lakatosovy metodologie výzkumných programů a jaké závěry z dané diskuse vyplývají pro zkoumání v sociálních vědách?

VO 2: Jakým způsobem lze využít Lakatosův model vědeckovýzkumných programů pro sledování efektů z vědeckých výzkumných programů?

1 ANALÝZA VĚDECKÉ DISKUSE K LAKATOSOVU KONCEPTU VĚDECKOVÝZKUMNÝCH PROGRAMŮ

Pro hledání odpovědi na výzkumnou otázku 1 jsme provedli analýzu článků z vědeckých časopisů evidovaných v databázi web of science. Zjistili jsme, že největší počet článků a příspěvků na vědeckých konferencích bylo nalezeno při použití klíčových slov „Lakatos, research programmes". Celkem bylo nalezeno 146 záznamů: z toho je 116 vědeckých článků a 21 publikovaných konferenčních vystoupení (proceedings papers). Ostatní záznamy se převážně týkají recenzí. Podrobně jsme prozkoumali obsah diskuse v kategorii vědeckých článků a konferenčních vystoupení. Výsledek obsahové analýzy ukazuje následující tabulka 1:

Tab. 1: »Souhrnná analýza publikací (kategorie „vědecký článek" a konferenční vystoupení („proceeding paper")

Kategorie podle Web of Science (uváděno v původním anglickém názvu)	Počet záznamů	Procentní podíl (%)	Viz např. studie
History philosophy of science	22	15, 068	Thomason, 1992; Gonzalez, 2001; Feldbacher-Escamilla, 2019; Erdin, 2020;
Philosophy	22	15, 068	Herne and Setala, 2004; Kuukkanen, 2017; Silva and da Costa, 2019; Callaghan, 2019; Chall, 2020;
Political science	15	10, 274	Vasguez, 1997; Waltz, 1997; Elman and Elman, 1997; Lustick, 1997; Elman and Elman, 2002; Walker, 2010; Dumitru, 2020;
Education, educational research	12	8, 219	Chang and Chiu, 2008; Niaz, 1995; Han, 2014; Inglis and Foster, 2018;
Religion	12	8,219	Murphy, 1999; Lorrimar, 2017; Karaba, 2017;
Economics	9	6,164	Balsiger, 2004; Heise and Thieme, 2016; Edwards, 2001; Menarke, 2018; Togati, 2019;
Social issues	9	6,164	Turner and Sullenger, 1999; Peterson, 2002; Lorimar, 2017;
Management	8	5,479	Kilduff, Tsai and Hanke, 2006; Gold, 2014; Renner et al., 2016
Social sciences interdisciplinary	8	5,479	Cioffi-Revilla, 2010; Vannoni, 2015; Voas, 2020;

Zdroj: Databáze Web of Science. Zpracování autoři.

Pokračování tabulky na straně 70

Tab. 1: »Souhrnná analýza publikací (kategorie „vědecký článek" a konferenční vystoupení („proceeding paper")

Kategorie podle Web of Science (uváděno v původním anglickém názvu)	Počet záznamů	Procentní podíl (%)	Viz např. studie
Sociology	5	3,425	Honneland (1999); Chernillo, 2002
Ethics	3	2,055	Wettersten, 2004; Herne and Setala, 2004;
History of social sciences	2	1, 370	Niaz, 2008; Ydesen, 2016;
History	2	1, 370	Zweynert, 2014; Polyvyannyy, 2018
Social sciences mathematical methods	1	0,685	Cioffi-Revilla, 2009
Atd.	Atd.	Atd.	Autoři z jiných oborů nepříbuzných se sociálními vědami (např. architektura, evoluční biologie...). Pokud jsou tyto web of science kategorie uvedeny, mají obvykle počet záznamů = 1.
Celkem	146 záznamů	100 %	Poznámka: Bibliografické odkazy na uvedené autory jsou uvedeny v seznamu literatury.

Zdroj: Databáze Web of Science. Zpracování autoři.
Pokračování tabulky ze strany 69

Skutečnost, že Lakatos se zabýval problémem metodologie vědeckých výzkumných programů (resp. výzkumných programů) výhradně ve vztahu k přírodním vědám, se projevuje i v zaměření vědecké diskuse. Četnost záznamů ukazuje, že *formálně* přibližně jedna třetina příspěvků patří do okruhu historie filozofie vědy a filozofie. Při studiu jednotlivých článků však zjistíme, že i další příspěvky (uvedené formálně v jiných kategoriích) mají průnik s oblastí filozofie vědy. Při analýze jednotlivých studií zaznamenáváme dvě skupiny autorů majících rozdílný přístup k Lakatosovu odkazu. Jedni tvořivě navazují na koncept vědeckovýzkumných programů, druzí se vůči Lakatosovi staví kriticky.

Pokud se soustředíme na oblast společnosti a společenských věd, dojdeme ke zjištění, že . tyto vědecké články jsou obvykle interdisciplinárně řešené problémy, které svým předmětem zkoumání přesahují obvykle do jiné („exaktní") vědní dis-

ciplíny, jako např. do komputační sociální vědy (Cioffi-Revilla, 2009), informatiky (Chang and Chiu, 2008), kognitivních věd (Erdin, 2020), technických věd (Silva, 2009), 4), psychiatrie (Edwards, 2001; Ho, 2008). managementu (Gold, 2014).

Studie, jejichž výzkumný předmět je „čistě" orientovaný na sociální vědy, jsou ve zjevné menšině. Obvykle se jedná o studie, které mají nějaké aplikační „sociální zaměření". Zároveň je pro tyto studie charakteristické, že mají velmi různorodý předmět zkoumání. Tak například Honneland (1999) se zabývá interakci výzkumných programů v sociálních vědách a problémem „commons". Heinse and Thieme (2016) analyzují některé ekonomické problémy v Německu. Balsinger (2004) vytváří koncept supradisciplinární výzkumné praxe. Marček and Urbánek (2011) zkoumají filozofické a psychologické výzkumné paradigma. Jiné studie jsou zaměřeny na oblast mezinárodních vztahů a zahraniční politiky (Walt, 1997; Elman and Elman, 1997). Existují i studie kladoucí si otázku, zda lze metodologii výzkumných programů aplikovat na teologii (Lorrimar, 2017) a na náboženské vědomí (Karaba, 2017). Právě tyto studie, vykračující zjevně z Lakatosova metodologického přírodovědného obzoru, jsou pobídkou k tomu, že Lakatosovu metodologii vědeckých výzkumných programů je možné využít i pro bádání v nepřírodovědní oblasti.

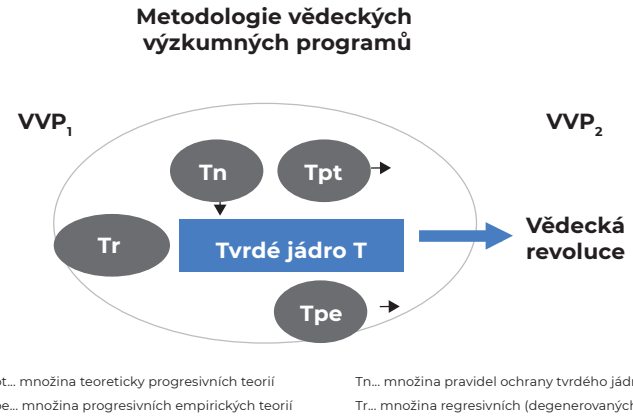
Analýza diskuse ukazuje, že využití metodologie výzkumných programů při zkoumání společenských otázek má své svízele a peripetie (Walker, 2010). Proto se setkáváme jak s kritickým pohledem na použití Lakatosovy metodologie výzkumných programů, tak s autory, kteří tvořivě navazují na Lakatosův odkaz (Elman and Elman, 2002). V naší studii se vydáváme právě touto druhou cestou. Protože jsme při analýze vědecké diskuse nenalezli ani jednu vědeckou studii, která by nahlížela na koncept vědeckých výzkumných programů ze systémového hlediska a zkoumala vědeckovýzkumný program jako produkční jednotku, a ukazovala na možnosti využití konceptu vědeckovýzkumného programu jako nástroje vědní politiky pro hodnocení efektů vědeckovýzkumných programů, posílilo toto zjištění naše předsevzetí pokusit se obohatit vědeckou diskusi o tento nový rozměr, jak jej definuje výzkumný cíl a výzkumná otázka č. 2.

2 SYSTÉMOVÝ POHLED NA VĚDECKOVÝZKUMNÝ PROGRAM A MOŽNOSTI JEHO VYUŽITÍ PRO HODNOCENÍ VÝSLEDKŮ VĚDECKOVÝZKUMNÉ ČINNOSTI

V této části stručně představíme Lakatosův koncept vědeckovýzkumných programů. Poté navážeme na ten proud Lakatosových následovatelů, kteří spatřují v jeho metodologii vědeckovýzkumných programů (VVP) ideový zdroj pro další rozpracování metodologie vědeckého výzkumu.

Nejdříve stručně charakterizujme Lakatosův koncept vědeckovýzkumných programů (VVP). Lakatosův koncept VVP je možné (s vědomím určitého účelného zjednodušení) graficky zobrazit následovně (viz obr. 1). VVP je zobrazen jako systém mající své prvky, podsystémy a procedury. Souhrnně pro jejich označení budeme používat termín „entity VVP".

Obr. 1: »Metodologie vědeckých výzkumných programů



Zdroj: LAKATOS, I. (1978). The methodology of scientific research programmes, Philosophical Papers, Volume I. Edited by John Worrall a Gregory Currie. Cambridge - London-New York-Melbourne: Cambridge University Press. 1978. ISBN 0-521-28031-1. LAKATOS, I. (2008). Mathematics, science and epistemology, Philosophical Papers, Volume II. Edited by John Worrall a Gregory Currie. Cambridge: Cambridge University Press. ISBN 0-521-21769-5. LAKATOS, I. (2015). Proofs and Refutations: The Logic of Mathematical Discovery. Cambridge University Press. ISBN 9781107534056. Obrázek autoři na základě studia uvedených prací.

Klíčovým prvkem je tvrdé jádro. Tvrdé jádro má určující místo ve VVP. Na existenci tvrdého jádra „stojí a padá" celý VVP. Lakatos vysvětluje roli tvrdého jádra na příkladu Newtonova výzkumného programu. V Newtonově výzkumném programu jsou tvrdým jádrem tři pohybové zákony a gravitační zákon. Program má heuristiku, která obsahuje soubor technik na řešení problémů. V Newtonovu

vědeckém programu jsou to diferenciální počet, teorii konvergence, diferenciální a integrální rovnice. Nakonec má výzkumný program široký pás pomocných hypotéz, na základě kterých stanovuje počáteční podmínky. Jde o ochranný pás, který chrání tvrdé jádro před vyvrácením. U Newtonova programu ochranný pás zahrnoval geometrickou optiku, teorii atmosférické refrakce, atd. Pokud se objevují anomálie, tyto nejsou na rozdíl od Kuhna (Kuhn, 1997) považovány za vyvrácení tvrdého jádra, ale jsou to některé hypotézy v ochranném pásu. Všechny VVP jsou charakterizované svým „tvrdým jádrem". Tvrdé jádro zůstává nedotknuté.

Dalšími klíčovým pojmem Lakatosova konceptu vědeckovýzkumných programů je negativní heuristika. Negativní heuristika zpřesňuje tvrdé jádro, které je „nevyvratitelné".[2] Negativní heuristika zakazuje použít ve vztahu ke tvrdému jádru modus tollens. Místo toho musíme využívat svého důmyslu na vyjádření „pomocných hypotéz", které vytvářejí „ochranný pás kolem tvrdého jádra. Tvrdé jádro chrání ochranný pás. Dalším klíčovým pojmem Lakatosovy metodologie VVP je pozitivní heuristika. Ta vyplývá z tvořivé podstaty vědeckého bádání. Pozitivní heuristika se skládá částečně z návrhů (či návodů), jak změnit, rozvinout „vyvratitelné varianty" výzkumného programu a jak měnit, sofistikovat „vyvratitelný" ochranný pás. Pozitivní heuristika programu ochraňuje vědce, aby nebyl zmaten množstvím anomálií. Pozitivní heuristika výzkumného programu může být formulovaná jako „metafyzický" princip. Pozitivní heuristika je tak více flexibilní nežli negativní heuristika[3].

Podle Lakatose je výzkumný program jednotkou zralé vědy. VVP můžeme hodnotit buď jako pokrokový nebo degenerující. Program je teoreticky pokrokový, když každá modifikace vede k novým neočekávaným predikcím a je empiricky progresivní, když některé z těchto nových predikcí jsou koroborované (viz úspěšné předpovědění návratu Halleyovy komety). Program je degenerující, pokud jen vysvětluje daná fakta, která měla být vysvětlena, a nepředpovídá

2 Postulát „nevyvratitelnosti" je dán metodologickým rozhodnutím jeho protagonistů.

3 Lze tudíž říci, že pozitivní heuristika si „razí cestu vpřed" a téměř zcela ignoruje „vyvrácení". Verifikace (n+1)- té verze programu je vyvrácením n-té verze. Jsou to verifikace, které drží program v chodu bez ohledu na vzdorující případy. VVP můžeme hodnotit podle jejich heuristické síly, podle toho, ke kolika novým faktům přivedly, jaká byly jejich schopnost vysvětlit jejich vyvrácení počas jejich růstu. Metodologie VVP tak vysvětluje relativní samostatnost teoretické vědy.

současně fakta nová. Platí přitom, že výzkumný program nikdy neřeší všechny svoje anomálie. Vzniká otázka, zda při vyvracení programu (v našem obrázku vyznačeném přechodem od VVP 1 k VVP 2) hraje nějakou roli tzv. rozhodující experiment? Lakatos na příkladech z dějin vědy dospívá k závěru, že rozhodující experiment neexistuje. Rozhodujícím experimentem se rozumí experiment, který může *okamžitě* vyvrátit výzkumný program. Lze o něm hovořit až se značným odstupem pohledu zpět, když se ukáže, že poskytl efektní koroborující příklad pro vítězný program a selhání pro program poražený.

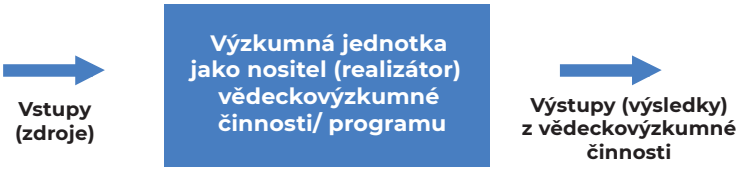
Kontinuita ve vědě, houževnatost některých teorií, racionalita určité části dogmatismu mohou být vysvětlené jen tehdy, chápeme-li vědu jako střet výzkumných programů a nikoli střet izolovaných teorií. Zralou vědu tvoří výzkumné programy, v nichž se očekávají (anticipují) nejen nová fakta, ale v důležitém smyslu i nové pomocné teorie.

Závěrem této části můžeme konstatovat, že Lakatosův koncept vědeckovýzkumných programů je zaměřen na procesní sledování výzkumu, přičemž se tak děje v rámci určitého systému daného rámcem vědeckovýzkumného programu. Tento Lakatosův pohled nazveme „makro pohledem". Na vědeckovýzkumný program však můžeme nahlížet i z hlediska „mikro pohledu". V tomto případě budeme vědeckovýzkumným programem rozumět určitý (jednotlivý) výzkumný program prováděný konkrétní výzkumnou jednotkou (výzkumným týmem). Daný vědecký tým je nositelem a realizátorem vědeckovýzkumné činnosti.

3 VĚDECKOVÝZKUMNÁ JEDNOTKA JAKO NOSITEL A REALIZÁTOR VĚDECKOVÝZKUMNÉ ČINNOSTI

V této části studie budeme nahlížet na vědeckovýzkumný program z „mikro pohledu". Uplatníme-li přitom systémový pohled na vědeckovýzkumný program, má tento podobu produkční výzkumní jednotky. Produkční výzkumnou jednotkou je např. vědecký výzkumný tým či sólo vědec. Budeme chtít zjistit, s jakými efekty pracuje daná výzkumná jednotka zabývající se daným výzkumným programem. řečeno ekonomickou terminologií, budou nás zajímat efekty VVP z pohledu relace „vstupy" (finanční zdroje, náklady) a „výstupy", které plynou z výzkumného programu (viz obr. 2).

Obr. 2: »Vědeckovýzkumná jednotka jako nositel a realizátor vědeckovýzkumného programu



Zdroj: autoři

Obrázek 2 ukazuje, že výzkumná jednotka (vědecký tým) vystupuje jako produkční systém, který v rámci daného vědeckovýzkumného programu realizuje určité výzkumné aktivity. Produkci P tohoto systému lze formálně vyjádřit následovně:

$P = f(I)$ (1)

$C = g(P) = g(f(I) = h(I)$, kde (2)

P...produkce vědeckých výstupů

I...vstupní proměnné (vstupy potřebné k produkci vědeckých výstupů)

C...náklady na výzkum

Model zobrazuje skutečnost, že k realizaci výstupů vědeckovýzkumného programu potřebujeme vstupy (definované vstupními proměnnými I). Představují je zdroje potřebné na výzkum. Zdroje jsou transformovány na výstupy z vědeckovýzkumného programu. Jsou to výsledky (produkce P) plynoucí z daného vědeckovýzkumného programu. Na produkci výstupů z VVP jsou potřebné zdroje. Ty mají podobu peněžně vykalkulovaných nákladů C. Výstupem jsou efekty z daného výzkumného programu. Protože zdroje jsou vždy omezené (vzácné), zajímá nás, s jakými efekty je daný výzkumný program realizován. To můžeme zjistit na základě relace „vstupy" a „výstupy". Informaci o vstupech (nákladech) snadno zjistíme z rozpočtu daného vědeckovýzkumného programu. Efekty z VVP pak můžeme monitorovat ve formě výstupů nebo ve formě výsledků a na základě vztahu vstupy/výstupy zjišťovat, jaká hodnota za peníze (Value for Money) byla získána. Abychom mohli takový monitoring vědeckovýzkumných programů uskutečnit, potřebujeme znát, jaké cíle si řešitelé vědeckovýzkumného

programu stanovují. Cíle VVP jsou předjímané (anticipované) stavy, které podávají hodnotitelům výzkumných programů informaci o tom, jaké efekty plánují řešitelé realizací vědeckovýzkumného programu dosáhnout. Tato informace je důležitá pro analýzu ex ante. Je důležitá pro rozhodnutí správce veřejných zdrojů, zda finančně podpořit nebo nepodpořit navrhovaný vědeckovýzkumný program. Po realizaci vědeckovýzkumného programu je provedena analýza (audit) ex post. Hodnotitelé vědeckovýzkumného programu odpovídají na otázku, zda byly dosaženy plánované cíle výzkumného programu? Pro analýzu ex ante a analýzu ex post lze použít jako ukazatele výstupy a výsledky daného vědeckovýzkumného programu.

3.1 VÝSTUPY Z VĚDECKOVÝZKUMNÉHO PROGRAMU

Výstupy charakterizují vědeckovýzkumný program zejména z kvantitativní stránky. Dávají například informaci o tom, jaký druh a množství výstupů řešitelé vědeckovýzkumného programu plánují dosáhnout (audit ex ante). V případě realizace programu poskytují informaci o tom, jaké výstupy byly reálně dosaženy. Výstupy mohou mít formu různých referenčních jednotek (Ochrana, Půček a kol., 2019). Příklad kategorizace výstupů ukazuje následující tabulka.

Tab. 2: »Příklad kategorizace výstupů z vědeckovýzkumných programů

Druhy (kategorie) výstupu	Kategorie plánované výstupy	Viz např. studie
Vědecký článek	Počet plánovaných vědeckých článků	% vyprodukovaných vědeckých článků z plánovaného počtu vědeckých článků
Kniha	Počet plánovaných vědeckých publikací	% vyprodukovaných vědeckých publikací z plánovaného počtu vědeckých publikací
Patent	Počet plánovaných patentů	% přijatých patentů z plánovaného počtu patentů
Metodika	Počet plánovaných metodik	% vyprodukovaných metodik z plánovaného počtu metodik
Apod.		

Zdroj: autoři s využitím kategorizace RIV.

Z časového hlediska rozlišujeme dvě kategorie výstupů, a to plánované výstupy, a reálně dosažené výstupy. Kategorii plánovaných výstupů sledujeme v procesu monitoringu ex ante. Kategorii reálně dosažených výstupů zkoumáme v monitoringu (auditu) ex post. Kategorie plánovaných výstupů je důležitou informací pro rozhodnutí, zda poskytnout veřejnou podporu plánovanému vědeckovýzkumnému programu. Monitoring ex post poskytuje informaci, nakolik reálně byly splněny plánované výstupy.

V případě hodnocení reálně dosažených výstupů můžeme jako ukazatel použít procentní plnění plánovaných výstupů. Kategorie „výstup" dává významnou informaci o kvantitativní produkci vědeckovýzkumných programů. Je to určitě důležitá informace, avšak kvantitativní charakteristika má omezenou vypovídací hodnotu. Kategorie „output" totiž neobsahuje informaci o kvalitě výstupu, o jejím *skutečném efektu* (dopadu). Takové rozlišení umožňuje teprve kategorie „výsledek vědecké činnosti".

3.2 VÝSLEDKY Z VĚDECKOVÝZKUMNÉHO PROGRAMU

O kvalitativních efektech vědeckovýzkumného programu vypovídají výsledky vědeckovýzkumného programu. Rozumí se jimi reálné účinky daného vědeckovýzkumného programu na rozvoj vědy a dopady těchto výsledků na společnost. Na rozdíl od výstupů, které jsou orientovány na sledování kvantitativní stránky vědecké produkce (např. počet vyprodukovaných referenčních výstupů/jednotek výstupů), výsledky vědecké produkce vypovídají o kvalitě vědecké produkce. Podstatu problému přibližuje tabulka 3. Tabulka ukazuje na monitoring ex post výsledků, tj. na dosažené reálně dosažené výsledky z určitého vědeckovýzkumného programu.

Tab. 3: »Příklad kategorizace a hodnocení dosažených výsledků z vědeckovýzkumných programů

Druhy (kategorie) vědeckého výsledku	Ukazatelé hodnotící formální efekt vědeckého výsledku	Ukazatelé hodnotící reálný dopad vědeckého výsledku
Vědecký článek	Publikování článku ve vědeckém časopise s příslušnými parametry daného časopisu (např.): SJR, IF, Q 1- Q 4	Vědecké ohlasy (např. počet citací publikovaného článku ve vědeckých publikacích);
	Publikování vědeckého článku v recenzovaných časopisech	Využití vědeckého objevu v inovační praxi (nová technologie, nové léky, nový způsob léčby, atd.)
	Formální záznam o využití inovační ideje publikované ve vědeckém (odborném) článku	Ohlasy na publikaci ve vědeckém diskursu (např. počet citací na google scholar)
Vědecká kniha	Publikovaná kniha v nakladatelství vědecké literatury v kategorii X. Kladná recenze na publikovanou knihu ve vědeckém časopise.	Ohlasy na publikovanou knihu ve vědecké literatuře a její dopady na rozvoj vědeckého poznání
Patent	Schválený patent	Implementační dopady patentu na danou oblast (s případným vyjádřením společenského přínosu – např. úspora pro státní rozpočet)
Metodika	Certifikovaná metodika	Praktický dopad metodiky na danou oblast s kvalitativním/kvantitativním vyjádřením efektu
Regule	Výsledky vědeckého poznání promítnuté do zákonných norem, podzákonných norem a nových technologických postupů	Vyšší efektivnost dané oblasti po zavedení dané regule

Zdroj: autoři (s využitím kategorizace RIV). Poznamenáváme, že rovněž u výsledků můžeme sledovat kvantitativní stránku (viz scientometrie a bibliometrie a diskuse v časopise Scientometric.

K danému přehledu poznamenáváme, že v žádném případě nejde o vyčerpávající klasifikaci možných dosažených výsledků. Jde především o ukázku, jak je možné dále vytvářet klasifikaci výsledků s ohledem na zaměření vědeckovýzkumných programů, přičemž je žádoucí vzít v úvahu specifika jednotlivých vědních

oblastí. Potenciální dopady vědeckovýzkumných programů jsou totiž odlišné v případě přírodních, technických, sociálních a dalších věd. V našem přehledu chceme především upozornit, že je žádoucí hledat způsoby, jak hodnotit *reálné výsledky* vědecké činnosti (jejich dopady) a poté nastavit systém účinný financování vědeckovýzkumných programů podpořených z veřejných rozpočtů. Tabulka ukazuje, že výsledky zkoumání lze členit do různých kategorií. V námi uváděném případě jsou to například jako vědecký článek, vědecká kniha, patent, metodika, regule. U každého výstupu z této kategorie můžeme rozlišit jejich formální efekt a reálný efekt. Formálním efektem se rozumí bližší charakteristiky (parametry), které např. udávají, v jakém druhu časopisu byl vědecký článek publikován, v jakém nakladatelství byla vědecká kniha vydána, atp. Zachycení této formální stránky je důležitou informací pro závěrečné hodnocení výsledků z daného vědeckovýzkumného programu. Žadatelé o finanční podporu z veřejných zdrojů přehledem publikovaných výsledků dokládají podporovateli, nakolik splnili plánované výsledky. Tato informace je tedy důležitá pro závěrečné hodnocení vědeckovýzkumného programu a pro závěrečné zúčtování finanční podpory, a konstatování, zda byly dosaženy plánované výsledky. Je to informace, která se vztahuje na krátkodobý časový horizont, na vyhodnocení cílů vědeckovýzkumného programu. Tento monitoring je důležitý pro hodnocení vědeckovýzkumného programu, avšak není konečným ukazatelem, jaké reálné efekty vědeckovýzkumný program přinesl. Ty je možné všestranně posoudit teprve v delším časovém horizontu, tj. až po uplynutí určité doby, kdy došlo ke zveřejnění výsledků. Takto sledovaný reálný dopad se obvykle liší v závislosti na druhu výsledku. Dopady výsledků pak můžeme sledovat v heuristické rovině a aplikační rovině. V heuristické rovině zaznamenáváme, jaké ohlasy ve vědeckém diskursu publikovaný výsledek vyvolal, jak na výsledky zkoumání navazují další vědecké výzkumy, jak rozvíjí existující vědecké paradigma či přichází s revolučním paradigmatem, které přináší převrat ve vědeckém bádání. Aplikační rovina se týká zejména vědeckovýzkumných programů uskutečňovaných v v technických, přírodních, lékařských a méně již v (některých) sociálních vědách. Můžeme sledovat, jak se vědecký objev (např. původně publikovaný ve formě vědeckého článku či vědecké knize) stává zdrojem technologických inovací, zdrojem know-how pro novou léčbu či návodem, jak provést reformu veřejné správy.

Největší *bezprostřední* společenský dopad mají obvykle takové výsledky, jejichž efekty mají přímý aplikační charakter. K takovým výsledkům patří patenty a metodiky. Patenty jsou výsledkem vynálezu, který je v současné době obvykle produktem vědeckovýzkumného programu. Jde o takové výsledky vynálezecké činnosti, které jsou nové a průmyslově využitelné. V tomto smyslu lze říci, že patenty „přetavují" výsledky vědeckého poznání do implementační roviny ve formě „materializovaného vědění", které má z formálně právního hlediska podobu zákonné ochrany vynálezu, že vlastníkovi patentu zaručuje výhradní právo k průmyslovému využití vynálezu.

V České republice je významným vědeckým výsledkem i certifikovaná metodika. V podmínkách ČR definují charakteristiky certifikované metodiky dokumenty Technologické agentury České republiky (viz https://www.tacr.cz/index.php/cz). Jde o takový výsledek, který je výstupem oficiálně stanovené procedury garantované příslušnou institucí (orgánem státní správy, resp. certifikačním orgánem). Metodika podává nové postupy navržené daným výzkumníkem či týmem. Metodika promulguje, že dodrží-li uživatel metodiky stanovené postupy a podmínky její aplikace, budou dosaženy očekávané efekty, přičemž tyto efekty je možné získat při opakovaném použití metodiky (za předpokladu dodržení postupů a podmínek stanovených metodikou).

V ČR je za vědecký výsledek považována i implementaci vědeckých poznatků do praxe v podobě nové regule. Regulí se rozumí zákonné normy či podzákonné normy. V případě nové regule formou zákonné normy se jedná o vypracování nového zákona, který svými pravidly vytváří nový rámec pro činnost příslušných aktérů. Daný zákon má pak podobu obecně závazné normy, která příslušným aktérům stanovuje, jak postupovat ve své činnosti. Očekává se, že při dodržení stanovených postupů budou dosaženy efekty, které indikují zlepšení stavu ve srovnání se stavem předchozím. Výsledky vědeckého poznání mohou být implementovány i do podzákonných norem (směrnic a nařízení), které jsou např. zveřejňovány ve věstnících ministerstev či vládních nařízeních. Jde o ty inovační dokumenty, kdy výsledky vědeckého bádání vstupují do obsahu těchto dokumentů a jejich realizace vede k zefektivnění předchozího stavu a ke zvýšení kvality. Výsledky vědeckého zkoumání mohou být promítnuty i do regulí neprávního charakteru. Jimi rozumíme například nové technologické postupy (tzv. ověřené

technologie). Obecně pro vědecký výsledek „regule" platí, že se jedná o aplikované poznání. Pro aplikované poznání je charakteristické, že svojí „materializací" přináší hmatatelné společenské přínosy. Ty je možné kalkulovat některou z ekonomických metod (např. cost benefit analysis). Tím získáme informaci o tom, jak ekonomicky racionálně byly vynaloženy zdroje.

ZÁVĚR

Lakatosův koncept vědeckovýzkumných programů se stal inspirací pro vědecké zkoumání v řadě vědních disciplín. Také v našem článku jsme se inspirovali Lakatosovým konceptem vědeckovýzkumných programů. Nahlížíme na vědeckovýzkumný program optikou „mikro pohledu" a systémového přístupu. Nositelem a realizátorem daného výzkumného programu je určitá výzkumná jednotka. Tu představuje výzkumný tým. V našem článku ukazujeme na to, že daná výzkumná jednotka má formu produkčního (input-output) systému. Vstupy, které jsou potřebné k realizaci vědeckovýzkumné činnosti, představují zdroje. Produkty z tohoto systému mají formu výstupů a výsledků (ouput and outcome). Jestliže jsou vědeckovýzkumné programy podporovány z veřejných zdrojů, potřebujeme k jejich výběru znát, jaká hodnota za peníze (Value for Money) bude dosažena. Po ukončení vědeckovýzkumného projektu chceme zjistit, jaké reálné efekty byly dosaženy jeho realizací. Námi navržený koncept takové informace umožňuje získat. Dává ex ante informaci o efektech navrhovaných projektů i post informaci o reálných efektech ukončených vědeckovýzkumných programů. Navržený postup tak může přispět k zefektivnění veřejné vědní politiky.

OZNÁMENÍ

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INDUSTRY 4.0 OVERVIEW BASED ON SELECTED INDICATORS: THE CASE OF HUNGARY

Kornélia Svačinová

ABSTRACT

The concept of Industry 4.0 (Fourth Industrial Revolution) was for the first time presented in Germany as an industrial modernization program. Nowadays, the Industry 4.0 revolution is a highly discussed topic as industrial production is one of the most important economic sectors in the European Union. Due to the lack of skilled laborers in the EU countries, industrial transformation and digitalization seem to constitute necessary evolutionary steps. Current demographic trends and projections of the future workforce composition are showing warning signals. The aim of this article is to introduce the concept of Industry 4.0 (or I4.0) in Hungary– a member of the Visegrad Group and the EU – until 2030. The article will provide the basic statistics regarding I4.0. Based on the available data, the efficiency of the I4.0 policy pillars will be evaluated. Furthermore, possible solutions to problems regarding adopting I4.0 in the Hungarian environment will be listed. .

Keywords: *Hungary; Economy; Industry 4.0.*

JEL Classification: *O14, O33, J11*

1 INTRODUCTION

The predecessors of Industry 4.0 were the first, second and third industrial revolution. The main characteristic of the first industrial revolution (which started in 1760) was the invention of the steam engine and the transition from farming to machine manufacturing. In the second industrial revolution (1900) the use of oil and electricity led to massive industrialization and production. Information technology was used in the third industrial revolution (1960) to automate production. Each abovementioned industrial revolution built on innovations and opportunities and led to more advanced and developed forms of production.

Industry 4.0 or the Fourth Industrial Revolution is a term introduced in 2015 by Klaus Schwab, founder and executive chairman of the World Economic Forum, in the article *"Mastering the Fourth Industrial Revolution"*. Although the term Industry 4.0 originated with the German government ("Industrie 4.0"), the idea of a fourth industrial revolution has resonated with manufacturers all over the world (Fluid Intelligence, 2018).

The interconnection of digital solutions and automation is already referred to in the Hungarian language as **Ipar 4.0**. However, the translation (and its English equivalent) can be misleading, since the Hungarian term clearly adds a manufacturing center to the concept. Manufacturing is an important sector, but Industry 4.0 aspirations require more general digitization efforts (Fülöp, Z., 2018). Industry 4.0 is characterized by the fact that different people and machines can interact effectively with each other with technological support (Juhász, L., 2018).

The challenges and opportunities of the ongoing fourth industrial revolution include technology, like artificial intelligence, 3D (three dimensional) printing, quantum computing, computer generated product design. In any case, the fourth industrial revolution will bring many exciting challenges and benefits, like robotics and technological innovation in general that will lead to the evolution of global industries (Xu Min, D. et al., 2018). *According to Botlíková and Botlík (2020), globalization is one of the key processes and a major feature of the development of the world economy and significantly reflects fundamental changes in the economic policies of the world's leading powers.*

Meanwhile, the estimated positive benefits that could evolve from implementa-

tions appropriate to Industry 4.0 activities may deliver a 20–30% rise in the GDP and profitability of the related industrial segments in Hungary (Haidegger, G. et al., 2016).

2 WORKFORCE, HUMAN CAPITAL AND EMPLOYMENT

According to the Hungarian Central Statistical Office, the number of employed people in Hungary was close to 4.5 million in 2017 (more than 82% of the so called "best working age of 25–54 years" were employed). With this result, Hungary was ranked among the best performing countries in the EU[1] (MTA, 2017). Workforce, human capital and employment are closely linked to labor productivity and economic growth. The skills provide an economic value and can lead to increased productivity.

In the literature, there are contradictory findings regarding the effects of 4.0 Industry technologies on productivity, employment and the reshaping of the geographic structure of value added activities. One author says that specifically in the environment of Industry 4.0 in Hungary (economically destructive) job losses can be expected (Szalavetz, A., 2016). Others claim that this can be offset by new jobs and trends and analyses predict an expected increase in labor demand in Hungary in the future (Fülöp, Z., 2018). More information about the efficiency of Industry 4.0 on employment is provided in Subchapter 2.2.

2.1 DEMOGRAPHIC DEVELOPMENT

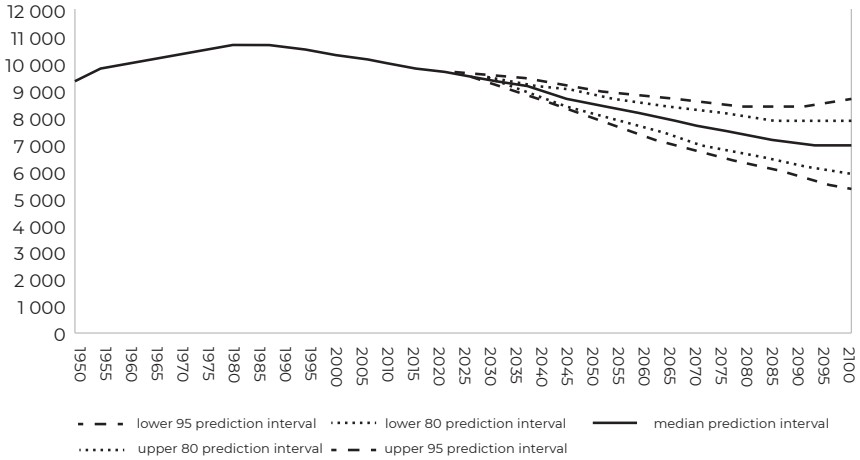
Population evolution directly influences the economic development of a country and vice versa. Because of its importance, the topic of dealing with the demographic situation is included in the article. Current demographic trends and projections of the future workforce composition are showing warning signals in Hungary.

Based on current demographic development and available data from the Population Division of the United Nations database (2019), the population of Hungary is decreasing. The country faces population ageing and increased migration. This slows down the labor supply, which in turn causes a shrinking supply in

1 EU: European Union.

response to increasing labor demand (Fülöp, Z., 2018). In the first quarter of the year 2020, the size of the Hungarian population was approximately 9.6 million inhabitants (see Fig. 1). According to the results of the median prediction interval of the population projection, only 6.8 million people will live in the country by 2100 (a difference of almost 3 million people). This will have an impact on the shrinking labor pool in the population. Based on the current demographic trends and population ageing, the lack of skilled workers in the EU may cause severe problems in the near future.

Fig. 1: »Population size, 1950–2100



Source: author's construction; data: United Nations, 2019

In recent years, the fertility rate in the region has been below the reproductive level. Hungary, together with the majority of European countries, faces population ageing (Tab. 1), which will lead to a decrease in the number of economically active people (the current retirement age was set at 64.5 years in 2020[2]). In developed countries the share of old people exceeds the proportion of young people. One demographic indicator used for expressing the ratio of economically inactive elderly people (typically aged 65+) compared to the economically active popu-

2 Officina.hu: Nyugdíjkorhatár 2020 táblázat férfiak és nök esetén: ki, mikor mehet nyugdíjba?

lation (aged 15–64) is the old-age dependency ratio. The old-age dependency ratio[3] projects increasing levels of economic dependency in European countries in the future. The case of Hungary is highlighted in Table 1. In 2019, there were almost 30 economically inactive people aged 65+ per 100 persons of working age (15–64). The most relevant data from the database of the European Statistical Office were used. The old-age ratio indicator increased in all countries in the period 2010–2019 and this trend is still ongoing.

Tab. 1 » Old age dependency ratio in EU, 2010–2019

EU-27 countries (from 2020)	26.3	26.6	27.1	27.7	28.3	29.0	29.6	30.2	30.8	31.4
EU-28 countries (2013–2020)	26.1	26.4	26.9	27.5	28.2	28.8	29.3	29.9	30.5	31.0
Czechia	21.7	22.3	23.4	24.6	25.7	26.6	27.6	28.6	29.6	30.4
Germany	31.4	31.4	31.4	31.5	31.6	32.0	32.0	32.4	32.8	33.2
France	25.6	25.9	26.7	27.5	28.3	29.2	30.1	30.9	31.7	32.5
Italy	31.2	31.3	32.0	32.7	33.1	33.7	34.3	34.8	35.2	35.7
Hungary	**24.2**	**24.4**	**24.6**	**25.1**	**25.8**	**26.5**	**27.2**	**27.9**	**28.5**	**29.3**
Poland	19.1	19.1	19.7	20.4	21.2	22.2	23.1	24.2	25.3	26.4
Romania	23.7	23.7	23.7	23.9	24.3	25.2	25.9	26.7	27.5	28.1
Slovakia	17.3	17.5	17.8	18.4	19.0	19.7	20.6	21.5	22.5	23.5
Sweden	27.7	28.4	29.2	29.9	30.6	31.1	31.5	31.6	31.7	31.9
United Kingdom	24.6	24.9	25.6	26.4	27.0	27.5	27.8	28.2	28.6	28.9
Norway	22.5	22.8	23.3	23.7	24.2	24.5	25.0	25.4	25.9	26.4
Switzerland	24.7	24.9	25.3	25.7	26.1	26.4	26.7	27.0	27.4	27.8

Source: data: European Statistical Office, 2020b

3 **Old-age dependency ratio** is the ratio between the number of persons aged 65+ (the age when they are generally economically inactive) and the number of persons aged 15–64. The value is expressed per 100 persons of working age (15–64).

the share of old people (60–69 years) is higher than the proportion of children in the youngest age categories (0–15 years). The age structure of the population reflects previous changes in the level of birth rate, mortality and foreign migration. Hungary is one of the countries with a regressive type of age structure (higher rate of older people than the proportion of children). The age structure is very irregular with many significant indentations and protrusions in the population pyramid. The changes in the population structure and the loss of human capital affect the transformation of market requirements.

2.2 THE EFFICIENCY OF INDUSTRY 4.0 REGARDING EMPLOYMENT – LITERATURE REVIEW

The focus of previous research has repeatedly been on the **manufacturing industry** in Hungary – but it has to be emphasized that this is not the only sector Industry 4.0 covers. However, based on the labor market situation, it is currently assumed that the majority of mechanizable processes occur in the manufacturing industry, and this may reduce the number of people employed there (Fülöp, Z., 2018).

According to Ray, et al. (2017), manufacturing technologies (intelligent manufacturing, IoT-enabled manufacturing, cloud manufacturing) may have impacts on manufacturing models, approaches and even businesses.

Stock and Seliger (2016) expect the following trends and developments to create value: "*The manufacturing equipment will be characterized by the application of highly automated machine tools and robots. The equipment will be able to flexibly adapt to changes in other value creation factors, e.g. robots will be working together collaboratively with the workers on joint tasks*".

In this section, the efficiency of Ipar 4.0 regarding employment will be presented in the form of literature review and research findings. Contradictory results of various research studies on the influence of Ipar 4.0 on employment are presented in the literature (see Tab. 2). Some findings are optimistic (Berger, R., 2014), others are pessimistic (Nábelek, F. et al., 2016; Arnzt, et al. 2016). In Chapter 3, the background of the past and current economic situation in Hungary, as well as the concept of National Technology Platform (IPAR 4.0) will be discussed.

Tab. 2 » Literature overview and research findings

Author	Methodology. Geographical aspect	Main results	Attitude to changes
Berger, Roland	Labor market modeling, 50% expansion of Industry 4.0 solutions until 2035. Western Europe	1.4 millions of new job positions in Western Europe. The number of people employed in industry firstly increases, then decreases by a total of 5 million. Close to 10 million of new jobs will be created (70% among service companies).	Optimistic
Arnzt et al.	Secondary data analysis. OECD countries	9% of jobs in OECD countries can be automated.	Pessimistic
Rodrik, Dani	Examining the economic role of industry. Europe	Low-skilled workers were almost completely affected by the disappearance of industrial jobs. Meanwhile, the number of highly qualified workers is increasing.	Rather pessimistic
Nábelek et al.	Analysis based on company surveys. It is based on jobs that can be created by automation. Hungary	Loss of 500 thousand jobs positions.	Pessimistic

Source: Fülöp, Z. (2018). Az Ipar 4.0 munkaerőpiacra gyakorolt hatása. Munkaügyi Szemle. 61.

3 DEVELOPMENT OF THE HUNGARIAN ECONOMY (PAST, PRESENT AND INDUSTRY 4.0 ACTIVITIES)

It is very important to highlight that currently Hungarian industrial production is mainly fuelled by car manufacturing, electronics and the food industry. Furthermore, large multinational manufacturers, which ***have the most significant weight in production,*** are able to produce more thanks to recently increased capacity, while mid- and low-level manufacturers are struggling and scaling back production. Agricultural production has always been important and traditional in Hungary's economy, although its role in the economy has steadily declined (Bozsik, N. et al.,

2018). Agriculture represented 12% of the GDP in 2018. In both of these areas (industrial and agricultural production), employment and manpower are indispensable. The efficiency of Industry 4.0 regarding employment was mentioned in the previous chapter.

3.1 PRODUCTIVITY BEFORE THE 4.0 REVOLUTION

In 2013, the Hungarian national economy emerged from recession (the economic crisis lasted 2011–2012). During the last years, industrial export has become the most important factor in the Hungarian economic system (Kormany.hu, 2016). The increase in export was affected mainly by trade in road vehicles, electric machines, food, drink and tobacco, medicinal and pharmaceutical products.

The growth in the period 2009–2015 was largely based on the output of export-oriented international companies. Germany has been the leading trade partner not only for Hungary, but also for other European countries (including Czechia). Consequently, the Hungarian economy is closely connected to the development (rise and fall) of Germany's economy. In addition to changes in manufacturing technology, the concept of Industry 4.0 defines a coherent policy framework aimed at maintaining the global competitiveness of German industry (Kovács, O., 2017).

Among the key foreign trade partners are, as formerly mentioned, Germany (27.4% in 2014) and Austria (5.5% in 2014), followed by the USA and Russia as non-EU business partners (21.9% of the total exports is realized through non-European trade partners).

The annual value of imports and exports (unit of measure in thousands of Euro) between Hungary and Germany in the period 2012–2018 is shown below (Fig. 2).

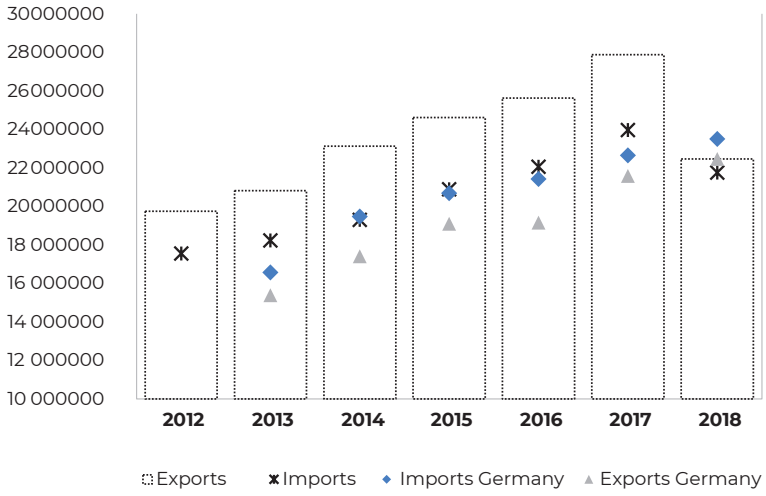
The data were obtained from the Eurostat database *(Database by themes – International trade – International trade in goods – trade by enterprise characteristics – "Trade by partner country and NACE Rev. 2 activity").*

The graph confirms the abovementioned fact that Germany is the leading geopolitical entity (partner) for Hungary in export (27,887,445 thousand Euro in 2017). On the other hand, export to Germany in 2018 (from Hungary) was only 22,460,233 thousand Euro.

In addition, simplifying the regulatory environment would help broaden the

export base. The share of exports to EU countries still lags behind regional partners.

Fig. 2: »Imports and exports between Hungary and Germany, 2012–2018



Source: author's construction based on data from Eurostat, 2020a

According to the report published by the National Bank of Hungary, the per capita productivity[4] in Hungary returned to what it was before the crisis in 2011–2012 and has been growing constantly since then. Foreign direct investments have always played a significant role in the development of Hungarian industry since the beginning of the 1990s and by now have turned into the engine of technological development. The shift of production of foreign enterprises (delocalization) to Hungary means job creation and technology modernization (Kormany.hu, 2016).

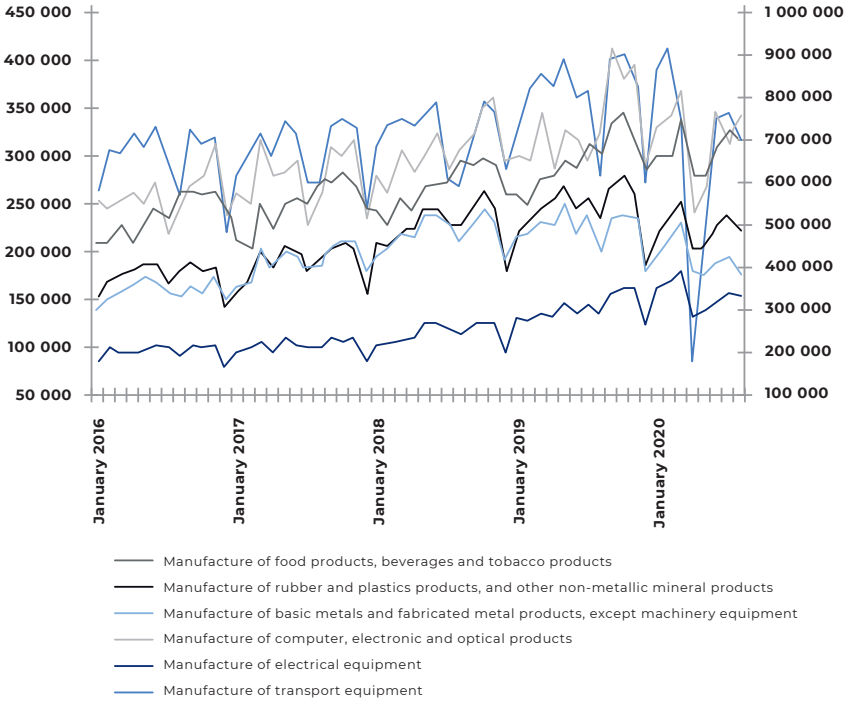
In Figure 3, the value of industrial production by sub-sections is presented. The analyzed period includes the most current values of industrial production by months (from January 2016 until August 2020). The following major subsections of manufacturing have been chosen: *manufacture of food products, beverages and tobacco products; manufacture of rubber and plastics products, and other*

4 Per capita productivity = the value of goods and services produced by one employee.

non-metallic mineral products; manufacture of basic metals and fabricated metal products, except machinery and equipment; manufacture of computer, electronic and optical products; manufacture of electrical equipment; manufacture of transport equipment. In August 2020, the volume of industrial production declined by 2.1% compared to the same period of the previous year (HCSO, 2020). In January 2020 – August 2020 compared to the same period of the previous year, industrial production declined by 11%. Export sales (representing 64% of all sales) fell by 11.6%; domestic sales (representing 36% of all sales) declined by 7.4%.

The item *"manufacture of transport equipment"* has the most weight (28% of the manufacturing output) and was higher by 6.2% compared to the previous year's production (however, manufacture of parts and accessories for motor vehicles declined by 1%). Figure 3 shows a sharp decline in industrial production in the first months of the year 2020 (this may have been affected by the COVID-19 crisis).

Fig. 3: »Value of industrial production by sub-sections, 2016-2020 (million HUF)



Source: data: Hungarian Central Statistical Office, 2020; own processing

3.2 National Technology Platform (IPAR 4.0)

Firstly, it is important to highlight that the promotion of Industry 4.0 in Hungary is primarily led by the government. Like other developed countries around the world, Hungary is also trying to meet the objectives and requirements of Industry 4.0 innovation. When translated and compared to the original "Industrie 4.0", the Hungarian expression "Ipar 4.0" highlights in itself the manufacturing industry[5].

The very first step and idea emerged from the German economy and the state of the German industry, forecasts and the need of state-level innovations in the next decade. In 2013, Plattform Industrie 4.0 (Industry 4.0 Platform) was established, followed by the publication of the industry 4.0 "Future Factories", which has become the European Union's industry-oriented and innovation strategic plan (IEC, 2015).

Implementing the National Technology Platform – a national strategy for reindustrialization of the country – was initiated by the Ministry for National Economy (NGM)[6] and the Institute for Computer Science and Control, Hungarian Academy of Sciences (MTA SZTAKI)[7].

The Industry 4.0 National Technology Platform (abbreviation I4.0 NTP) was launched in the year 2016 in order to reinforce manufacturing, industry and digital transformation (European Commission, 2017). In February 2016, the government developed a reindustrialization strategy plan (so-called **"*Irinyi Plan*"**). The plan outlines the main directions of innovative industrial development in Hungary. In October 2016, the most urgent topics led to the establishment of seven work groups together with the corresponding governmental forums and bodies, which contribute directly to the formation and implementation of the government's strategic goals: strategic planning, employment, education, training, production and logistics, ICT technologies, Industry 4.0 Cyber-physical pilot systems, business model and innovations.

In 2017, working on an assignment received from the Ministry for National Economy, the Platform created a strategic concept material for an Industry 4.0

5 IPAR (feldolgozó ipar = manufacturing industry) .

6 NGM: Nemzetgazdasági minisztérium. Ministry for National Economy.

7 MTA SZTAKI: Magyar Tudományos Akadémia Számítástechnikai és Automatizálási Kutatóintézete. Hungarian Academy of Sciences Institute for Computer Science and Control.

based industry development in Hungary. The main goal of the strategy is to boost the digital transformation in the industry that uses smart tools, and thus conform to the international trends of the Industry 4.0 achievements (e.g., the inclusion of Hungarian companies in international production networks). The pillar structure of the Industry 4.0 development strategy until 2030 is listed below. In addition to the three dimensions of the evolution process (Business, Society, Technology)[8], altogether five pillars have been defined – *digitalization and business development, production and logistics, I.4.0 labor market development, research, development and innovation, I4.0 ecosystem* (Tab. 3). According to highly optimistic scenarios, this goal seems achievable by 2030 (Nagy, J., 2017).

Tab. 3» Pillars of the IPAR 4.0 strategy until 2030

Dimension/ Pillar	Business	Society	Technology
Digitalization and business development	Renewal of SMS business models	Analysis and attitude shaping	Dedicated digitalization investment programs
Production and logistics	Enterprise development and cluster formation	Concentrated strategic projects, supplier programs	Improved efficiency and increased capacities
I4.0 labor market development	In-house company trainings	Practice and theory orientation in I4.0 labor market training from vocational training to graduate and postgraduate education	Infrastructure for I4.0 oriented training and education
Research, development and innovation	New business models, RDI[9] incubation	Reinforcing science, I4.0 RDI programs	Production and related RDI services
I4.0 ecosystem	Digital I4.0 networks	Legislation, standardization, control	Technology and infrastructure development

Source: The Industry 4.0 National Technology Platform Association, 2017

8 In the global trend of Industry 4.0, four major dimensions can be identified.

9 RDI (research, development and innovation)

The National Technology Platform (IPAR 4.0), which serves as a basis, has been expanded based on current strategy plans of the government and the Ministry of Innovation and Technology.

In the spirit of the future vision of digitalization, the Hungarian government has developed a ***"Strategy for Strengthening Hungarian Micro, Small and Medium-sized Enterprises (2019–2030)"***. MSMEs[10] represent the most important basis for the strengthening and growth of the Hungarian economy. Entrepreneurs in this sector create more than half of the added value and employ more than two thirds of Hungarian workforce. In the period 2010–2017, their productivity improvement significantly exceeded that of large companies, and even surpassed the average growth rate of the V4[11] and EU members. The aim of this strategy is the contribution of domestic companies to a sustainable economic growth and increase in the quality of life of Hungarian households.

Recent strategy has seven pillars (Ministry of Innovation and Technology, 2019):

- Creating a business-friendly regulatory and tax environment,
- Improving the business environment for MSMEs and e-government tools,
- Strengthening the development capacity, innovation and digital performance of MSMEs,
- Encouraging access to finance,
- Promoting the internationalization of MSMEs,
- Acquiring the necessary knowledge, strengthening the entrepreneurial culture,
- Supporting generational exchange.
- The Hungarian government together with the Ministry of Innovation and Technology are continuously updating strategies regarding the implementation of Industry 4.0 in the country. The most recent is the *"**Artificial Intelligence Strategy"***, approved in February 2020. *"It is expected that the use of artificial intelligence will contribute by 14% to GDP in 2030, what is about 7 billion HUF[12]. There are many possible applications, including face recognition, X-ray, lie detection, identification of fault noises on agricultural machine-*

10 Micro, Small and Medium-sized Enterprises (MSMEs), often referred to as Small and Medium-sized Enterprises (SMEs).

11 The Visegrad Group (V4).

12 Hungary Forint (HUF).

ry, the appearance of self-driving vehicles", as minister László Palkovics stated (Kormany.hu, 2020).

3.3 READINESS AND EFFICIENCY OF THE IPAR 4.0 STRATEGY

In Hungary, a breakthrough took place in 2016 with respect to the general level of knowledge about Industry 4.0 that is perceived as important or indispensable from the competitiveness perspective by 71% of industrial companies. This proportion is very favorable even if it is only 66% in the case of Hungarian companies, whereas it is more than 85% in the case of the international ones. This progress is also due to the fact that new solutions are mostly imported, first of all through the intervention of multinational companies (I4.0 Platform, 2017).

To manifest the performance and evolution in digitalization, the components of the Digital Economy and Society Index (DESI) were selected and their results between 2015–2019 shown (Fig. 4). The Digital Economy and Society Index is a composite index published every year by the European Commission since 2014, measuring the progress of EU countries towards a digital economy and society. It brings together a set of relevant indicators on Europe's current digital policy mix. The DESI is composed of five principal policy areas: connectivity[13], human capital[14], use of Internet[15], integration of digital technology[16], digital public services[17]. The index is calculated as the weighted average of the five main dimensions: connectivity (25%), human capital (25%), use of Internet (15%), integration of digital technology (20%), digital public services (15%). The score of the country ranges from 0 to 100. The majority of DESI indicators come from the surveys of Eurostat[18] (European Commission, 2019).

13 Mobile broadband, fast and ultrafast broadband and prices.

14 Internet user skills and advanced skills.

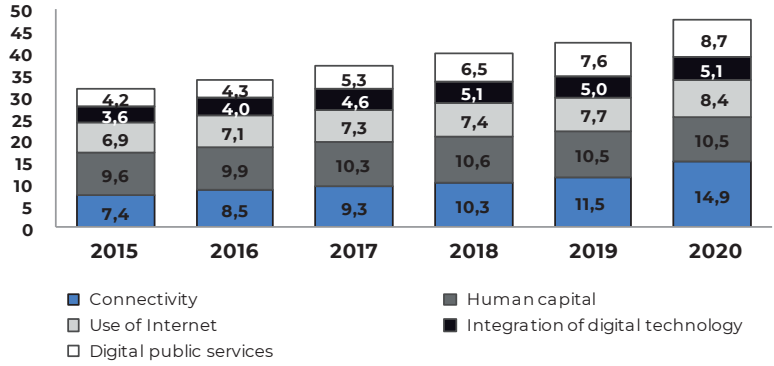
15 Citizens' use of internet services and online transactions.

16 Business digitisation and e-commerce.

17 e-Government and e-health.

18 EUROSTAT: European Statistical Office.

Fig. 4: »Development of main dimensions of DESI indicator, 2015–2019 (%)



Source: author's construction based on data from European Commission, 2019

Hungary performs best in the category *"connectivity"* (14.9 in 2020) (see Fig. 4). However, it has not managed to improve its position in the overall rating. There is still a room for improvement in *"human capital"*, although Hungary has a high proportion of ICT graduates and a close to average share of IT specialists. Hungary is unfortunately among the worst performing EU countries in *"integration of digital technology in enterprises"* (5.1 in 2020) (Nick, G. et al., 2019).

In the literature, several Industry 4.0 readiness evaluation methods can be found. In order to explore the acceptance of the Industry 4.0 concept as well as the current status of the Industry 4.0 implementation both at company and national economy level, the ***"National Technology Platform survey project"*** was implemented in Hungary in 2017. The questionnaire was developed by MTA SZTAKI, which regularly consulted the most active members of the Platform's Strategic Planning Work Group. The main goals of the NTP[19] survey project were to justify the recommendations formulated in the industry development strategy, looking at a 3–5-year horizon (with an outlook to the 2025–2030 period) and to explore the acceptance and current status of the Industry 4.0 concept by companies. The distribution of the respondents by industrial sectors is the following (in descending order): automotive, machinery, ICT, electronics, food, other industry, metal, chemical/ pharmaceutical, logistics and energy sector. Small and micro-sized

19 National Technology Platform (NTP).

companies formed the majority of the respondents by size and 100% Hungarian private ownership generated the majority of the addresses by ownership type.

Indeed, for the purpose of this article, only a selected part of the NTP survey questionnaire has been included. Focusing on the acceptance and implementation of the Ipar 4.0 strategy at the national level, the good news is that in the case of both large and small companies the Ipar 4.0 strategy with its pillars is already in progress. Two small and medium-sized enterprises (SMEs) have declared that their strategy has been implemented.

The individual Readiness Index of companies is divided into six classes (in ascending order): outsiders, beginners, intermediates, experienced, experts, top performers. No top performer was found among the interviewed enterprises[20]. The majority of companies belong to the category "*intermediates*" (38%). These categories come from the VDMA[21] study and have been kept for the sake of comparability. The scoring and weighting methodology was set up by the authors of the National Technology Platform survey project.

The **conclusions** and **main findings** from the survey are that the majority of industrial companies have no Industry 4.0 strategy so far. Although a large number of industrial companies understand the importance of data collection, the rate of those who do this in a comprehensive way is negligible. Most Hungarian industrial companies need to renew their technical infrastructure to ensure developmental scalability (I4.0 Platform, 2017). It is evident that the RDI (research, development, innovation) potential is one of the key tasks in any Industry 4.0 based development strategy. *According to study results by Moeuf et al. (2018), SMEs do not exploit all the resources for implementing Industry 4.0 and often limit themselves to the adoption of Cloud Computing and the Internet of Things.*

Losonci, D. et al. (2019) came with the same conclusions and recommendations as the NTP survey (2017): although the phenomenon of Ipar 4.0 is sprea-

20 To compare the readiness of companies with other developed regions, e.g., in Germany, the share of top performers is evident.

21 The Mechanical Engineering Industry Association (VDMA) represents around 3.300 member companies in the SME-dominated mechanical and systems engineering industry in Germany and Europe.

ding, it has not yet reached the required level in the *technological, organizational* and *human* aspects in companies. Progress is affected just by these three areas. A possible solution for Hungary may be absorbing the *technological know-how* of manufacturing companies. Another obvious tool is to encourage technology transfer by foreign companies (to create channels through which Hungarian-owned companies can learn from leading companies). Losonci, D. et al. (2019) in their survey analyzed leading road-vehicle companies using panel data and found no indication that companies would succeed in realizing one of the great promises of Industry 4.0 – namely – to significantly improve their added value capacity.

4 POSSIBLE SOLUTIONS TO IPAR 4.0 PROBLEMS

In this section, a review of recommendations and attitudes to Industry 4.0 main problems in Hungary will be presented. To provide a comprehensive overview, current experience and future suggestions from the state, companies and experts are listed below.

4.1 STATE AND GOVERNMENT INTERVENTIONS

First of all, the role and contribution of the state in shaping the Ipar 4.0 ecosystem will be examined. Again, the ranking from the "National Platform Survey Project" (2017) was used for the analysis. The survey was carried out in 2017 and no recent data are available. Among the most promising areas of efficient intervention, educational system and infrastructure development received over 80% rating of *"very important"* and *"important"*. Other areas – financing, employment policy, legal regulation, regional strategy – are also thought to be the most straightforward. Respondents' expectations in the field of financing highlight two tools – tax reduction and government funding. Supporting less developed regions by the state policy and infrastructural development are generally supported. The potential areas for state interventions and areas where the state can actively help are lack of skilled workforce and their training.

To sum up, conceivable solution for implementing Industry 4.0 could be through the **cooperation between academia** and **industry** because these activities have a strong multiplicative effect on the internal capacities of companies.

The implementation of industry-university collaboration (IUC) is increasing-

ly important for governments, policymakers, researchers and practitioners. The factors that affect the success of IUC are flexibility, honesty, clarity, awareness of current economic, legal, political and social developments. For a successful collaboration, an effective knowledge and technology transfer is important, as well as finding an adequate partner with corresponding interests and goals.

According to Rybnicek and Königsgruber (2019), these recommendations should serve as a useful framework for discussions among practitioners and researchers. Industry can participate in collaboration with academia through internships for students, technology updates, support in establishing laboratories and research projects.

Since the establishment of NTP in Hungary, many public-private partnerships and collaborations have been established between the entities representing industry (companies, universities, other academic circles). It is crucial to ensure a well-balanced representation and involvement of all relevant stakeholders covering the key I4.0 sectors in Hungary. This will bring together stakeholders from different sectors (e.g., manufacturing and ICT) and also small and large business enterprises. Overall, 47% of the surveyed Hungarian companies made use of this IUC opportunity. This may be a cause for hope for the future. Several pilot systems need to be set up in industrial firms in order to enable organizations to manage risks connected to the implementation of new ideas[22].

The tools to achieve results of I.4.0 can be summarized into four main activities (Digital Transformation Monitor, 2017):

- Private sector involvement,
- Bringing together different sectors,
- I4.0 pilot systems,
- Policy strategies.

In the case of RDI (research, development and innovation), results are not positive at all: 38% of the companies haven't launched any innovation in the past 5 years.

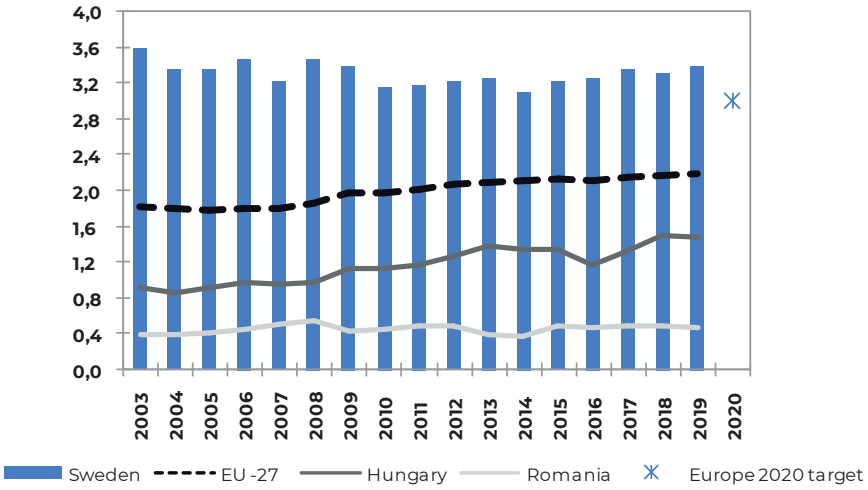
One of the Europe 2020 headline indicators is *Gross domestic expenditure on research and development (R&D)*. The aim of the Europe 2020 strategy was to

22 4.0 pilot systems across the country launched in autumn 2017.

increase public and private investment in R&D to 3% of the GDP (see Fig. 5).

Fig. 5 reflects the situation of Hungary, Sweden and Romania compared to the EU-27 average (2.2 in 2019). Sweden was selected as a country with the highest expenditure on R&D (3.39 in 2019); on the other hand, Romania has the lowest expenditure on R&D (0.48 in 2019). Hungary has significantly increased its expenditure on R&D during the period 2003–2019 (0.92 in 2003 and 1.48 in 2019). Hungary does not belong among the worst EU countries. An important consideration arises at this point – could it be that companies do not use the available financial support from the state effectively?

Fig. 5: »Gross domestic expenditure on research and development (R&D), 2003-2019 (% of GDP)



Source: author's construction based on data from Eurostat, 2020c

As already mentioned, the Hungarian government plays an important role in the development of Industry 4.0. The Ministry of Innovation and Technology supports the expansion of Industry 4.0 (through the **"*Industry 4.0 support program*"**), especially the digital transformation of the **manufacturing industry** and **ICT services** sectors based on smart devices.[23] Industry 4.0 is commonly identified with the digitization of manufacturing.

Robots, cyber-physical systems, big data, the Internet of things (IoT), arti-

23 In 2019, the Industry 4.0 support program contributed by 1.5 billion HUF.

ficial intelligence (AI) networking – all of these are concepts most commonly found in Industry 4.0. They are indeed very important, but at least as important is that digitalization should create new business models. Digitalization resulting from the Industry 4.0 strategy offers and implies various modern technologies. In Hungary, cloud-based services (e.g., for data storage or data processing) are wide-spread – one-third of the respondents that participated in the "National Platform Survey Project" (2017) were using them.

4.2 METHODOLOGY AND DATA ANALYSIS

The nature of this article is informative rather than analytical. Nevertheless, the statistical method of regression analysis was used to calculate the dependence of the variable *Y* ("*production in industry*") on two independent variables *X* ("*producer prices in industry*" and "*intramural R&D expenditures*"). The data were obtained from the Eurostat database.

The linear regression model

A regression equation of the form:

$Y = X\beta + \varepsilon$

or

$Y_i = \beta_0 + \beta_1 Y_i + \varepsilon_i$

explains the value of a dependent variable y_t in terms of a set of k observable variables in x_t.

Y is a vector of n values of the explained variable

X is a matrix of values of explanatory variables with dimensions $n*(k+1)$

β vector β contains the parameters of a linear combination of the variables in x_t

ε vector of n values of the random variable

Note that β_0 and β_1 are unknown parameters. We estimated them by the least squares method.

4.3 RESULTS

Please find below the results of the regression analysis for Hungary (Tab. 4):

Tab. 4» Results of the regression analysis for Hungary

Regression statistics	
Multiple R	0.9739
R Square	0.9485
Adjusted R Square	0.9216

ANOVA					
	Difference	**SS**	**MS**	**F**	**Significance F**
Regression	2	124.6097	62.3048	9.2179	0.001
Residual	1	6.7577	6.7577		
Total	3	131.3675			

	Coefficients	**Std Error**	**t Stat**	**P-values**
Intercept	61.9883	216.0996	22.0624	**0.000**
Price	-10.75	2.7338	-8.3863	**0.001**
R&D	0.691	0.3722	5.6755	**0.003**

Source: Author's own calculation from Eurostat data (Eurostat 2020d, 2020e, 2020f).

A linear regression line has an equation of the form $Y = a + bX$, where X is the explanatory variable and Y is the dependent variable. The slope of the line is b, and a is the intercept (the value of y when $x = 0$), where a and b are given by:

$$a = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2}$$

$$b = \frac{1}{n}(\sum_{i=1}^{n} y_i - a\sum_{i=1}^{n} x_i)$$

The regression line can be written as follows: $y = 61.9883 - 10.75 * Price + 0.691 * R\&D$. For each unit increase in price, production decreases with 10.75 units. For each unit increase in R&D, production increases with 0.691 units. Regression coefficients (dependent and independent variables) are statistically significant (P-values are < 0.05). R-Squared shows how well the data fit the regression model (the goodness of fit). R-Squared can take any value between 0 and 1. The high value of R Square (0.9485) indicates a good fit for the model.

4.4 COMPANY RESULTS AND EXPERT ANALYSIS

In Hungary, the electronics and automotive industries are at the forefront of the digital switchover. The study by **Losonci, D. et al. (2019)** came to the conclusion that for a successful digital switchover, the opportunities inherent in the technology transfer of foreign companies must be exploited, and that training of Hungarian companies in this field must be encouraged. It is advisable for domestically owned companies to turn to their customers and ask for guidance, to develop according to their needs and learn best practices from them. This process should be further encouraged. The ability of suppliers to innovate can be the key for buyer companies if they are interested in smart products and services. However, this may require taking two simultaneous steps: innovation capacity should not simply be developed, but should be done in the context of Industry 4.0 – this is the only realistic option for the near future. Study results of authors Losonci, D., et al. (2019) are in line with the main findings of the **National Platform Survey Project (2017):** although the phenomenon is gaining ground, it lags behind the desired level in the technological, organizational and human aspects in companies.

The study conducted by **McKinsey (Fine, D. et al., 2018)** came to the conclusion that policy makers could consider pilot programs that allow companies to test automation-driven innovations without risking a penalty for not complying with the existing regulations. One such initiative is the "Regulatory Sandbox" that the National Bank of Hungary seeks to implement to encourage testing in the financial technology industry. Under this scheme, financial technology startups would be encouraged to pilot their product and process ideas on real customers for a limited time – such as offering loans based on a big data-driven analysis

of customers' spending habits – without having to abide by certain regulations that would inhibit the testing and implementation of new initiatives. Another example of a program aimed at fostering development of automated products and processes is the track near Zalaegerszeg built to test and develop programming for self-driving vehicles (Fine, D. et al., 2018).

Secondly, the government can sponsor private sector innovation through the use of vouchers that provide financial incentives for research centers and SMEs to explore new ways to apply artificial intelligence, automation technologies to intensify digitization. Monetary support in the form of targeted subsidies and tax allowances for companies to invest in automation technologies and human capital (e.g., retraining programs) could improve the business case for adoption. The government might also consider using financial incentives to attract foreign investment to establish innovation hubs that feature the use of automated technologies (e.g., by providing tax incentives for companies to establish technology based research and development operations). It is also recommended to simplify the requirements for residence and visas for non-EU professionals (Fine, D. et al., 2018).

Another relevant analysis was published by **PwC (2018)**. The research had been focused on automotive suppliers who believe that key success factors are increasing added value and attracting research and development operations to Hungary. This is closely connected to an economic environment that supports innovation and offers favorable tax conditions.

Training of specialists (response to the absence of qualified labor force), supporting SMEs, efficient investments using modern technology and equity financing may also represent breakout opportunities in Hungary.

Efficiency and productivity have traditionally been areas where Hungary's automotive industry has been lagging behind in international comparison. Looking on oncoming auto industry trends, robotics is the technology that will be of strategic importance for more than 60% of automotive suppliers in Hungary within 5 years. In the automotive industry, the innovation activities of suppliers are evidently affected by legislation and social trends. New technologies and data-based operations are closely related to IT systems, so investments in this area in the near future are expected (PwC, 2018).

PwC summarizes how companies may earn extra income and save costs with cost-effective solutions (Tab. 5).

Tab. 5» The positive impact of Industry 4.0 on companies' income and efficiency

Source of income	Lower costs or increased efficiency
New digital products, services, solutions.	Flexible, customized production models.
Big data analysis as a service.	Continuous transparency of processes and product variations. Augmented reality and optimization based on big data analyzes.
Digitization of the current product and service portfolio.	Simultaneous production quality control based on big data analyzes.
Increasing market share of the main product.	Digitization and automation of processes for smarter use of human resources.
Digital I4.0 networks	Legislation, standardization, control

Source: Nagy, J., 2017. Industry 4.0: definition, elements and effect on corporate value chain.

CONCLUSION

The fourth industrial revolution is already on its way and there is no going back. Revolutions are dynamic and fast, and Industry 4.0 will be the answer to the challenges companies and economies are facing. Hungary is also a part of these changes and processes, together with other European countries. Industry 4.0 has both positive and negative impact on employment and the quality of life. As a result of technological progress, some jobs will no longer be relevant and human labor force will be replaced by technology. On the other hand, *according to Botlíková and Botlík (2020), new positions may be created that will require a continuous acceleration of technological adaptability*.

In Hungary, the proportion of industrial companies currently operating a non-upgradable technical infrastructure is significant. Research, development and innovation potential is one of the key targets in any Industry 4.0 based concept. Proactively adopting an automation agenda could assist Hungary in attracting foreign investments that would generate a shift in labor force toward higher

value-added jobs. For Hungary to remain an investment destination, it is essential to focus on infrastructure development, a strong educational background and a supportive research, development and innovation environment. The main goal of NTP is to stimulate the exchange of information and development in the key areas of Industry 4.0 and to strengthen the competitiveness position of the national economy. Unfortunately, the development of the Hungarian innovation system and the culture of cooperation are not yet fully prepared for the effective application of this type of partnership model. There is a serious problem with the lack of trust capital needed to communicate between key players.

To sum up, the most important areas business and policy makers should act in are education and requalification, as well as innovation for automation. About 60% of current jobs in Hungary have at least 30% technical automation potential. Assessing automation potential according to employment numbers also indicates that manufacturing, public services, trade and transportation will experience the greatest impact from automation. Strengthening the digital maturity of domestic companies capable of joining global value chains should also be strongly supported.

It is suggested to follow up on this study with a more thorough analysis of data from company surveys, which would provide more rigorous conclusions about the impact of various independent variables on the examined issues. Interesting and well feasible would be case studies analyzing specific companies and their approach to the concept of Industry 4.0. Another object of further research may be the calculation of the preparedness index towards Industry 4.0.

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SHARING ECONOMY PHENOMENON IN TOURISM SECTOR ON THE EXAMPLE OF UBER AND AIRBNB PLATFORMS

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ABSTRACT

The research subject was the phenomenon of the use of the Uber and Airbnb internet platforms operating as part of the sharing economy.

The research objective was to determine the platform user profile and the factors which influence the use of mobile applications related to sharing of goods and services.

The conducted research shows that a significant number of respondents are relatively young people who use a smartphone and mobile banking on a daily basis, which is necessary to operate the sharing economy applications. Most respondents live in large towns, where services offered by platforms such as Uber and Airbnb are available. Over a half of respondents have used services provided by those applications. The conducted research led to the conclusion that the participation of platforms operating as sharing economy has increased in the daily lives of individuals; according to the respondents, their general availability and the price level have the biggest effect. The applications are particularly attractive to the young generation who actively use the advancements of technology.

Keywords: *sharing economy; tourism; transport; internet platforms*

JEL Classification: *D16, A14, Z32*

SUMMARY

The paper's subject was centred on the effect of the phenomena of a dynamic development of the sharing economy detected, in particular, in two sectors of the economy: tourism and transport. The research methods applied in the study included desk research and a diagnostic survey with the use of a survey questionnaire (quantitative research). Quantitative research was conducted on a sample of 230 respondents. The questions regarded the respondents' exposure to online platforms related to the sharing economy, such as Uber and Airbnb, which are among the most popular ones in Poland. The analyses were also based on a combination of the two following research methods: CAWI (direct interview technique, where respondents receive a questionnaire to complete individually) and PAPI (a direct interview conducted with the use of a paper questionnaire completed by a trained pollster). The conducted research led to the conclusion that the participation of platforms operating as part of the sharing economy has increased in the daily lives of individuals; according to the respondents, their general availability and the price level have the biggest effect.

INTRODUCTION

While observing reality, one may notice a change in the approach of society towards consumption. With a growing frequency consumers follow the principle of rational management to achieve a particular effect with a minimum financial effort. Therefore, they are more willing to use popular shopping sites or budget airline offers. At the same time, they are more prone to use the resources they have more efficiently; therefore, the popularity of shared consumption and goods sharing is on the rise.

The sharing economy is a relatively new field that has been growing rapidly and has gained new proponents. The sharing economy involves co-sharing of goods and services and it is one of the elements of the collaborative economy. According to the Oxford Dictionary of English, the *sharing economy* is *"an economic system in which assets or services are shared between private individuals, either free or for a fee, typically by means of the Internet"* (Oxford Dictionary of English, 2015, p. 4228).

The broad scope of shared consumption covers hiring, renting, sharing, and

the joint use of goods or resources in a larger extent. This refers mainly to accommodation, transport, and catering services. Modern understanding of this alternative form of access to goods has led to the emergence of business models that facilitate and at the same time limit individual consumption. The entire process of goods exchange may be of a non-profit nature, but it can also generate profit for one of the parties.

The paper's subject was centred on the effect of the phenomena of a dynamic development of the sharing economy detected, in particular, in two sectors of the economy: tourism and transport. Moreover, this subject has been chosen since to this day only few studies on the sharing economy development in Poland have been conducted.

The research objective was to demonstrate the importance of goods and services sharing in the daily lives of consumers as well as determine the directions of development of this type of consumption. An additional objective was to define the sharing economy, indicate those aspects of life where we can observe its development, and identify consumers who are most willing to use the sharing economy platforms.

The research methods applied in the study included desk research and a diagnostic survey with the use of a survey questionnaire (quantitative research). Quantitative research was conducted on a sample of 230 respondents. The questions regarded the respondents' exposure to online platforms related to the sharing economy, such as Uber and Airbnb, which are among the most popular ones in Poland.

The analyses were also based on a combination of the two following research methods: CAWI (direct interview technique, where respondents receive a questionnaire to complete individually) and PAPI (a direct interview conducted with the use of a paper questionnaire completed by a trained pollster).

The formulated thesis assumed that the sharing economy development is the outcome of an easy access to internet platforms dedicated to the type of economy mainly used by the members of the young generation, who are incentivized by the low prices of goods and services.

1 THE SHARING ECONOMY – ESSENCE, PARTICIPANTS, BUSINESS MODELS

Shared consumption is one of the world-changing ideas (Walsh, 2011, p. 8). The sharing economy, based on a collective use of goods, is called a social innovation developing in compliance with the sustainable development idea with the application of modern information and communications technologies (Schor, 2011). The emerging network societies popularize the new form of a community based on trust and group membership instead of a property right and ownership. Community members are connected through internet platforms which enable them to use goods collectively or provide services without a necessity to grant a property right to a good or service (PwC, 2016).

A dynamic development of the sharing economy has taken place over the past twelve years, but the phenomenon occurred much earlier. The initial records featured a 1978 paper entitled *Community Structure and Collaborative Consumption: A Routine Activity Approach* authored by Marcus Felson and Joe L. Spaeth (Zysk, 2016, p. 41). The authors addressed the subject of modern consumption of particular goods within the context of behavioural theories. Also Belk and Chen were pioneers in conducting studies of consumer behaviour in the sharing formula. Their papers explained the collaborative phenomenon in the consumer-consumer relationship (Rudawska, 2016, p. 184).

The subject literature does not provide a homogenous term of the notion of the sharing economy and there is no one proper definition of this phenomenon due to the broad application of the sharing economy in multiple fields and business sectors.

Polish literature explains this term as "*wspólna konsumpcja*" (collective consumption) as well as "*konsumpcja oparta na współpracy*" (cooperation-based consumption) or "*współpraca konsumencka*" (consumer cooperation) (Burgiel, 2014). Within the field of sharing economy also other terms, semantically similar, are used that have appeared in numerous publications over the past decade. Sobiecki (2016, pp. 29–31) is of the opinion that the definitions of those terms overlap only partially and sometimes they stand in contrast. These terms include, for example:

- Collaborative economy,
- Collaborative consumption,
- Access economy,
- Circular economy,
- Peer-to-peer economy,
- On-demand economy.

Despite the differences in meaning of the individual terms, each of them refers to co-sharing, co-using resources, relations, making something available, which are elements typical of the sharing economy.

Notably, the 2008 financial crisis contributed greatly to the sharing economy phenomenon boost. Society recognized the benefits of surrendering goods and services for the benefit of access to them and effective savings. The development of new technologies at that time also enhanced the scale of interest in the economy model based on sharing (Sztokfisz, 2017, p. 98).

The emergence of new platforms, news services, reservation systems, on-line payment availability encourages to engage with a particular network community, use available information on businesses, consumers, opinions, reviews significant when selecting an individual offer directed to a customer, and also in customers' choices.

Technological evolution resulted in the emergence, within the sharing economy, of new business models based on four major elements (Poniatowska-Jaksch, 2016, p. 67):

- Internet platforms,
- Mobile applications and devices,
- Technological networks,
- Social networks.

The key dimensions of business models implemented as part of the sharing economy are addressed in more detail by Poniatowska-Jaksch, who elaborates on the examples provided by Cohen and Muñoz. Among the fundamental dimensions the author names the following (Poniatowska-Jaksch, 2018, p. 45-47):

1) Technology (used to connect users, finalize transactions, facilitate commu-

nication, such as Uber),
2) Transactions (of a market, free, alternative dimension),
3) Business approach (profit-driven, hybrid, and based on a mission, such as profit-oriented Uber; Zipcar is an example of social, ecological objectives implementation),
4) Collective resources (involves optimization of: new resources [a purchase for new operation purposes – such as Zipcar], unused existing resources [such as Rent the Runway with regards to unsold wedding gowns], and finding a new location to exploit the resources in use),
5) Management model (from corporate structures through to cooperation models),
6) Platform type (B2B, business for the "crowd", P2P).

The sharing economy business models are heterogeneous and mobility-based, their spread to further sectors of the economy is apparent. The application of the sharing economy business models features on the markets related to (Klemt, 2016, p. 122):

- Transport,
- Tourism,
- Hotels,
- Finances,
- Storage and car parks,
- Food,
- Education,
- Logistics,
- Employment,
- Media,
- Fashion.

The transport sector has seen a particularly dynamic development of the sharing economy; sharing takes various forms and it is an alternative to public transport and taxi companies (Koźlak, 2017, p. 176). The transport market includes the following platforms: Uber, Lynk, Bolt, BlaBlaCar or Otodojazd, CityCar Share

(Klemt, 2016, p. 122). These service centres offer user transport by private cars (Uber, Lynk) or a seat in a car (BlaBlaCar) or a fixed-time vehicle hire.

The following platforms operate within the tourist sector: CouchSurfing, Tripping.com, HomeAway, HouseTrip, Roomorama, and Airbnb (Klemt, 2016, p. 122). These applications allow travelling users to rent a flat or a room for a short-term stay that is made available by the hosts at attractive prices and in original tourist locations.

Sharing in the fashion sector is applied in two ways. Individuals may use the platforms to sell clothes they no longer use and that may still be used – this reflects the principle of unused material resources management (Czajkowska et al., 2019). An example of a platform that can be used to purchase and sell used clothing as well as to present one's own stylizations or share their know-how in fashion is the Clotify platform (Law Business Quality, 2018).

Examples of applications that operate as part of the sharing economy on the financial market are: Finansowo.pl, Finpoint, Walutomat, Kokos.pl, and Lendico (Klemt, 2016, p. 122). The platform intermediation enables users to complete a range of financial operations such as loans (the so-called peer-to-peer lending) or currency exchange without any bank agency.

Numerous business models based on the sharing economy principles have gained popularity along with the development of the online network, individual mobility in society as well as electronic and on-line payment methods (Schneider, 2017, p. 33). Considering the pace of life of the 21st century society, the platforms and applications are useful because they deliver goods and services according to individual requirements in a convenient, fast, and cost-effective manner.

The growth of the sharing economy is accelerating. The European collaborative economy market facilitated €27.9 billion worth of transactions between May 2015 and May 2016, with an estimated 191 million citizens engaging in at least one transaction involving a payment (European Commission, 2017). Based on the last year's EC Eurobarometer, more than half of all Europeans know about the sharing economy and one in six already uses it. By 2022, more and more sharing platforms are projected to spread and develop thanks to new innovations. Sharing will enter the mass market, and major sharing platforms will grow

to keep up with traditional markets. It will also expand to new sectors, such as insurance, health, and social care (Goudin, 2016).

Forecasts project that by 2025, the sharing economy will have caught up with the traditional rental services and it is expected to be worth $335 billion. In the UK alone, the sector is expected to be worth $15 billion in the same year (PwC, 2013).

2 THE SHARING ECONOMY USE ON THE EXAMPLES OF THE UBER AND AIRBNB PLATFORMS

2. 1 THE UBER PLATFORM

The reasons for using the sharing economy may be diametrically opposed. Two main objectives of companies emerging on the sharing economy markets can be distinguished: a social objective – the absence of a benefit-driven approach, the superior mission is the common good; and an economic objective – material profit-driven. Businesses operating as part of the sharing economy usually implement the economic and the social objectives simultaneously (Jamka, 2018, p. 167).

The Uber application and platform operate on the basis of the sharing economy assumptions, qualifies as a ride-sourcing model, and has become a cheaper alternative to the traditional local transport (Giełzak, 2016). In recent years, ride-sourcing has become ubiquitous among common types of mobility and it has revolutionized the public transport market (CIVITAS, 2016). Uber serves as an agent and it is intended for people who want to use transport services (users) and drivers (providers) who offer their vehicles and time.

The creators of the shared transport service were Travis Kalanick and Garrett Camp, while the idea to set up a company originated in Paris in 2008. The idea was accomplished a year later and Uber was created with the first transport using the smartphone application in San Francisco on 5 July 2010 (Uber, 2020). Over the recent years, the company has expanded to other countries, including Poland.

Currently, Uber operates on 6 continents, in over 70 countries, and in more than 900 towns. In Poland, the first Uber transport was recorded in April 2014 in Warsaw and currently the service operates in over 10 towns, while the company seeks continuous expansion, for example by introducing innovations such as food deliveries with Uber Eats and combining transport through Uber Pool (Uber, 2020).

The company services are available following the "Uber" application installation on a smartphone and registration as a transport services user – a passenger. Through an active GPS in the telephone the application establishes the passenger's location, then the user indicates the destination and receives a suggested route; next they may select the type of service (Toroń et al., 2017, pp. 10-11).

Uber's offer for the prospective users includes four options of services (Uber, 2020):

- Uber X – is most cost-effective, a good standard service offered by the Uber application in all towns where Uber products are available;
- Uber VAN – an offer designed for up to 6 people, facilitates group transport within a town at favourable prices;
- Uber SELECT – this product provides the travellers with a higher travel comfort with high-standard vehicles offered and access to drivers with top ratings; due to the service attractiveness, the price is higher in comparison to Uber X;
- Uber BLACK – a deluxe product directed at demanding passengers expecting the best drivers and a good class vehicle; among the listed products this one is priced highest.

Currently, in Poland the Uber VAN and Uber BLACK products are only available in Warsaw (Uber, 2020).

Once the passenger approves the product of their choice, the application selects the drivers in the vicinity of the passenger. The customer receives information about the time and cost of the required journey depending on the vehicle and driver description available and the rating received by other users. Subsequently, the passenger can choose the service provider – the driver they wish to travel with. If the driver accepts the prospective passenger's request, the order will be executed (Toroń et al., 2017, pp. 10–11).

The payment for the services rendered is automatic and the credit or debit card assigned to the user during the registration is debited directly. It should be noted that the transport services intermediated by Uber are available to adults only (Uber, 2020).

Uber's operations are concentrated in densely populated towns, the favourable prices and the possibility to rate the drivers and the journey made it

competitive to traditional taxis (Skjelvik et al., 2017, p. 37).

As a result of the amendment of the law on road transport, as of April 2020 the drivers registering with the platform are required to hold a taxi licence and appropriate vehicle marking and the Uber platform is obliged to make passenger transport available only to licensed drivers (Samcik, 2019).

Uber uses new technologies, undergoes continuous development, and introduces new facilities and services within the transport sector, thanks to which the number of customers who are not obliged to own a vehicle and bear any related costs is growing (Cicharska et al., 2018, p. 119). The application is user-friendly, fast, and intuitive, and thus Uber may be an inspiration for new applications created in other sectors and technology development (Schneider, 2017, pp. 58–59). According to an analysis by Apptopia[1], Uber was a leader in the "travel" category in 2019 as the most often downloaded application (there were 142.5 million downloads). Uber was also the most willingly downloaded ride-sharing application in Poland in 2019 (over 1 million downloads). The Uber application is used by over 1 million users in seven of the biggest cities in Poland (https://fintek.pl).

The term uberisation, derived from the name of the Uber application, refers to the operation of a company and describes a phenomenon of economic and social changes present in the sectors applying modern technologies, including internet platforms and applications (Spoz, 2017, p. 10).

2.2 THE AIRBNB PLATFORM

In response to the changes occurring within the tourism industry and in customer needs internet platforms such as Airbnb or HouseTrip emerged (Krajewska-Smardz et al., 2016, pp. 37–38). As regards accommodation in the tourism sector, the sharing economy is manifested in two forms (Koźlak, 2017 p. 177):

- Short-term rentals of own flats or other premises with the use of online platforms such as Airbnb, HomeAway, Onefinestay, HouseTrip, and Roomorama;
- Living area swap for a period of time by the users of portals such as HomeExchange or Love Home Swap.

1 Apptopia is an independent research institution analyzing data in applications, data mining or business intelligence for the mobile branch. It measures the number of downloads and ways of using of thousands of apps.

Airbnb – its original name was "Airbed & Breakfast" – is the most popular among them and is considered as one of the pioneering sites of the sharing economy. It appeared on the market in 2008 in San Francisco and its founders were Brian Chesky, Joe Gebbia, and Nate Blecharczyk. Currently, Airbnb operates almost all over the world; the site displays over 7 million offers in 100,000 towns and in over 220 countries and regions (Airbnb, 2020).

The company is an intermediary in short-term rentals of uninhabited premises. Private entities have an opportunity to rent accommodation for a fee to people who have made a booking through the Airbnb application (Spoz, 2017 pp. 9–10).

The Airbnb application or the website and registration are available only to people who have attained the age of 18. The registration is processed via an email address, Facebook, Google account, or Apple ID. Once an account is created, the application must be authorized via an email address and telephone number. The next step involves completing the profile data including an up-to-date photo, user description, and a debit or credit card assigned to the account. The assigned personal data and the user description allow the site to verify the profile validity and at the same time provide safety for the host and guests using the Airbnb application (Airbnb, 2020).

Accommodation featuring on the platform displays diversity, the user has an opportunity to rent a bed in a room, a room, or an entire flat in accordance with their needs and preferences (Jaremen et al., 2017, p. 291). Users rent a flat or other premises directly from the owner who has placed an advertising on the Airbnb platform with a detailed description and images of the premises. If a user books an offer and the host confirms the booking, then the user is obliged to pay for the rental in advance. The payment is cashless with the use of a debit or credit card, Paypal, or Apple Pay, and it does not reach the host directly but first credits the Airbnb account. The site deducts a 3% commission from the host and from 6% to 12% from the guests. The host receives their payment 24 hours following the guests' check-in. This payment system is designed to secure the transactions. Airbnb also ascertains physical ownership guarantee for owners of property amounting to USD 1,000,000. Airbnb is an option for tourists who do not want to use hotels, hostels, or guesthouses. The accommodation available in the application varies as regards the standard, location, tourist attractions, and

most of all, the price. Every traveller is able to find something suitable among the offers available on the platform.

Services consumer in the tourist sector include a customer using the accommodation a host made available through the Airbnb platform as a guest and a service provider offering their own property for rent. The platform user may be a customer as well as a service provider with an opportunity to observe the course of the transactions from both sides. Consumer, as a provider, takes an active part in particular services creation, thereby having a real impact on their quality (Kowalska, 2018, p. 18).

Attention is due to the recommendation system available on the platform, which serves as a guide for users searching for an offer. It allows both guests and hosts to give and receive a star rating and a recommendation description related to the course of the service. The recommendations provide other users with information whether the accommodation is true to the offer description or whether a guest is problematic.

The site functioning is based on the mutual trust principles and promotes tourism within the aspect of meeting the residents of visited regions. Short-term rentals with the use of the Airbnb platform have become a lucrative business for business owners in tourist regions in particular, hence numerous countries adopted measures to introduce relevant legal regulations in order to prevent hosts from avoiding settling tax obligations (Cicharska et al., 2018, pp. 130–131). An example of this are the Barcelona authorities who took legal action to reduce illegal hosts. Consequently, the Airbnb platform is regularly inspected by officers who search for unlicensed offers violating the local law. Illegal renting became a problem for the residents of Barcelona because it caused a deficit of premises for long-term rentals and it had a significant impact on the housing market price increase (Jaremen et al., 2017, pp. 80–81).

As it is observed and shown in various databases, the sharing economy has increasingly influenced our lives and financial performance. Survey results presented by Eurostat in 2019 showed that 21% of European Union citizens used websites or applications enabling short-term room or flat booking, and 8% of EU citizens used platforms enabling transport services booking (https://ec.europa.eu/, referred on 10/04/2020).

Both platforms contributed to trust building among the transaction participants, at the same time providing necessary user protection measures and security of services which they intermediate. From the business perspective, the virtual space becomes increasingly interesting and encouraging for making investments, therefore there arose a demand for the legal provisions on the sharing economy to be systematized on a global scale in order to prevent unfair procedures. Undoubtedly, the sharing economy idea will develop on many markets, especially within tourism, transport, and accommodation; therefore, innovative solutions enhancing the operations of individual platforms will be of essence.

It should be noted that the European Commission made an agreement with Airbnb, Booking, Expedia, and Tripadvisor in 2019 in the area of gathering and transferring of data concerning short-term bookings with the use of these platforms. The expected benefit for Eurostat, resulting from the agreement, is to get better data about the tourism sector in the entire European Union and to determine the scale and directions of sharing economy development. The data will consist of information about the number of overnight stays and the number of guests. They will be gathered continually on a local level and first statistical reports will be published in the second half of 2021 (European Commission, 2020).

3 METHODOLOGY OF RESEARCH

The research subject was the phenomenon of the use of the Uber and Airbnb internet platforms operating as part of the sharing economy.

The research objective was to determine the platform user profile and the factors that influence the use of mobile applications related to goods and services sharing.

A thesis was formulated that the development of the sharing economy is the result of an easy access to internet platforms dedicated to this type of economy whose users are mainly the members of the young generation motivated by the low prices of goods and services.

The research was quantitative in nature, the diagnostic survey method was applied, the technique was a survey questionnaire with 23 questions, which apart from the personal details questions concerned the respondents' experience with internet platforms related to the sharing economy. The research sample included

230 people, residents of Poland. The questionnaire referred to specific applications such as Uber and Airbnb. This was due to their popularity in Poland and their use in tourism.

4 ANALYSIS OF RESULTS

People aged 18–24 were predominant in the respondent group, and constituted 60.4% of the sample. The second most numerous group were respondents aged 25–40 (35.7% of respondents). A minor share in the study belonged to people aged 41–60 (2.6%). The smallest percentage, 1.3% of respondents, were people below the age of 18. Table 1 shows the age structure of the respondent group.

Tab. 1» Percentage structure of age in the respondent group

Age	Percentage structure
Below 18	1.3%
18–24	60.4%
25–40	35.7%
41–60	2.6%
Total	**100%**

Source: Own study

There were more women than men among the respondents. Women constituted 72.2% of the respondent group and men 27.8%.

The percentage distribution of the respondents' education corresponds to their age structure. Most respondents – 55.7% – have completed secondary education (secondary school graduates). 39.6% of people declared they had university education. Elementary education constituted 3.5% of people in the respondent group and the smallest group – 1.3% of respondents – were people with vocational education. The percentage distribution of education is shown in Table 2.

Tab. 2» Percentage structure of education in the respondent group

Education	Percentage structure
Elementary	3.5%
Vocational education	1.3%
Secondary	55.7%
University	39.6%
Total	**100%**

Source: Own study

A majority of the respondents were in work – 47% of the respondent group. The next largest group were students, who constituted 36.5% of the sample. Those who were students and at the same time they were in work represented 12.6% of the sample. The unemployed constituted 3.9% of the total number of respondents. There were no pensioners among the respondents. The results are shown in Table 3.

Tab. 3» Percentage structure of the professional status in the respondent group

Professional status	Percentage structure
Students	36.5%
Unemployed	3.9%
In work	47.0%
Students and at the same time in work	12.6%
Pensioners	0%
Total	**100%**

Source: Own study

The results regarding the place of residence of the respondents are presented in Table 4. Most people, 33.5% of respondents, live in towns with a population exceeding 250,000 citizens. Rural area inhabitants constituted 27.8% of respondents. The third place belonged to citizens of towns with a population of up to 250,000, which represented 15.2% of the total number of respondents. Towns with a population of up to 50,000 were represented by 13.9% of respondents. The smallest group were people living in towns with a population of up to do 100,000 citizens (9.6% of respondents).

Tab. 4» Percentage structure of the place of residence in the respondent group

Place of residence	Percentage structure
Rural area	27.8%
Town of up to 50,000 citizens	13.9%
Town of up to 100,000 citizens	9.6%
Town of up to 250,000 citizens	15.2%
Town >250,000 citizens	33.5%
Total	**100%**

Source: Own study

The research findings established that all respondents own a smartphone. The respondents' use of mobile banking was also reviewed. A definite majority, i.e. 96.5%, responded positively, while only 3.5% said they did not use mobile banking due to the lack of trust in this payment method and the lack of the necessity to use mobile banking.

The diagnostic survey also allowed the researchers to establish whether the respondents are familiar with internet platforms such as Uber and Airbnb and whether they use them. As many as 94.8% confirmed that they had heard about those platforms and only 5.2% reported they were unfamiliar with those platforms. Furthermore, it was established that 60.4% of respondents used Uber and

Airbnb, whereas 39.6% had no such experience.

The study also provided an answer to the question regarding the source of the respondents' familiarity with the applications such as Uber and Airbnb. For almost half of the people – 47.5% – friends constituted the source of information about those applications. A lower percentage – 22.3% – have read about the applications on social media. Advertising on website provided 21.6% of people with information on the existence of the platforms. The next group, precisely 4.3%, learnt about the applications from advertising banners. A small percentage of people heard about the platforms from their family – 3.6%. Among the respondents, 0.7% of people indicated different sources. Table 5 presents the percentage distribution of the discussed results.

Tab. 5 Percentage distribution of the respondents as per the source of information about the Uber, Airbnb applications

Source of the respondents' familiarity with the Uber and Airbnb	Percentage structure
Friends	47.5%
Social media	22.3%
Advertising on website	21.6%
Advertising banners	4.3%
Family	3.6%
Different sources	0.7%
Total	**100%**

Source: Own study

The next question was aimed at verifying which applications are most often used by the respondents who have already used online platforms. The Uber application was used by 76% of respondents and significantly fewer respondents used the Airbnb application – 24% of respondents.

The researchers also asked about the frequency of use of the selected applications operating in the sharing economy. The highest number of respondents – 46%

– use applications such as Uber and Airbnb several times a year. 27.3% of respondents use the applications several times a month. The application is used once a month by 14.4% of respondents. Those platforms are used less than once a year by 12.2% of respondents. Not a single respondent uses the indicated applications several times a week. The achieved results are presented in Table 6.

Tab. 6 Percentage distribution of responses by frequency of use of the Uber, Airbnb application services

Frequency of use Uber and Airbnb	Percentage structure
Several times a week	0%
Several times a month	27.4%
Once a month	14.4%
Several times a year	46.0%
Less than once a year	12.2%
Total	**100%**

Source: Own study

The part of the study that followed verified in what form the respondents used the indicated applications. Almost all respondents, i.e. 99.3%, were the recipients of goods and services , whereas providers constituted 0.7% of respondents.

An attempt was made to obtain information about the respondents' reasons for using particular applications. General availability of the application was viewed as the main advantage of the platform by 61.4% and its user-friendliness by 60.3% of respondents. For 53.4% the financial issues (lower prices) of the application use appeared to be the reason. Frequent promotions are convincing for 36% of respondents. For 31.7% of respondents the incentive to use the application was the quality of the services provided. 9% of respondents saw trust in the goods/service providers as a reason to use the platform, and 1% of respondents indicated other reasons for the use of the platforms. It was a multiple-choice question and the achieved response distribution is presented in Table 7.

Tab. 5 Percentage distribution of the respondents as per the source of information about the Uber, Airbnb applications

Reasons for using Uber and Airbnb	Percentage structure
General availability	61.4%
Financial issues (lower prices)	53.4%
Quality of the services provided	31.7%
Trust for the goods/service providers	9.0%
User-friendliness	60.3%
Frequent promotions	36.0%
Other reasons	10%

Source: Own study

The objective of the conducted study was also to obtain respondents' information regarding further use or first-time use of the Uber, Uber Eats, Airbnb applications. Over 80% of respondents declared further use or first-time use of the Uber, Uber Eats, Airbnb applications, whereas almost 18% of respondents do not plan to use those applications in the future.

5 CONCLUSIONS

The conducted research shows that a significant number of respondents are relatively young people who use a smartphone and mobile banking on a daily basis, which is necessary to operate the sharing economy applications. Most respondents live in large towns, where services offered by platforms such as Uber and Airbnb are available. Over a half of respondents have used services provided by those applications. Over 80% of the respondent group manifests a willingness to use applications such as Uber and Airbnb in the future. The users certainly find the price, general availability, and intuitive navigation of the applications encouraging.

In conclusion, the business models constructed on the basis of the sharing economy are developing dynamically and currently they play a significant role. The

development of technology contributes to a growing popularity of the emerging platforms and the aspect of innovation and convenience encourages new users to use the applications. In the sharing economy, trust also plays a substantial role; it increases thanks to the recommendation and opinion system. It provides platforms with an opportunity to develop in a dynamic manner and acquire new followers.

The best known examples of sharing economy services on the market are Uber and Airbnb operating in the economy that report the highest dynamics of the idea of sharing. Transport and tourism play a major role in the functioning of society and the existing platforms bear multiple advantages; therefore, they are becoming a real competition for the traditional business models.

The conducted research has led to the conclusion that the participation of platforms operating as part of the sharing economy has increased in the daily lives of individuals; according to the respondents their general availability and the price level have the biggest affect. The applications are particularly attractive to the young generation who actively use the advancements of technology.

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DISKUSE / DISCUSSION

KONZERVATIVNÍ ODVĚTVÍ POJIŠŤOVNICTVÍ: VÝVOJ POD ZVÝŠENÝM TLAKEM ZMĚN V EKONOMICKÉM A FINANČNÍM PROSTŘEDÍ[1]

CONSERVATIVE INSURANCE SECTOR: THE DEVELOPMENT UNDER INCREASED CHANGE PRESSURE IN THE ECONOMIC AND FINANCIAL ENVIRONMENT

Petra Tisová
Eva Ducháčková

ABSTRAKT

Změny, ke kterým v současné době dochází dopadají na odvětví pojišťovnictví. V řadě případů změny způsobují, že pojišťovny jsou nuceny se přizpůsobovat novými přístupy či pojistnými produkty. Úkolem pojišťoven je vyrovnávat negativní důsledky nahodilosti, ovšem charakter nahodilostí se v posledních obdobích významně mění. Vyrovnávat se pojišťovny musí s novým charakterem rizik, s vyšším výskytem rizik katastrofického rozsahu, regulací (zejména s ohledem na pravidla Solvency II) a tím se rozhodovat o limitech pojistitelnosti. Příkladem nového přístupu a specifického produktu je tzv. NewSpace. Cílem předloženého příspěvku je vyhodnotit dopad současných změn na odvětví pojišťovnictví s důrazem na uplatnění nových přístupů.

Keywords: *limity pojistitelnosti; škodové pojištění; obnosové pojištění; Solvency II; NewSpace; katastrofické riziko.*

JEL Classification: *H30*

1 Článek je zpracován jako výstup výzkumného projektu Vývojové trendy na finančních trzích, č. IG F1/46/2019 zpracovávaného na VŠE

ABSTRACT

The changes that are currently taking place are affecting the insurance sector. In many cases, changes cause insurance companies to be forced to adapt to new approaches or insurance products. The task of insurance companies is to compensate for the negative consequences of chance, but the nature of randomness has changed significantly in recent periods. Insurance companies have to cope with the new nature of risks, with a higher incidence of catastrophic risks, regulations (especially with regard to Solvency II rules) and thus decide on insurability limits. An example of a new approach and a specific product is the so-called NewSpace. The aim of the presented paper is to evaluate the impact of current changes on the insurance industry with emphasis on the application of new approaches.

Keywords: *Insurability limits; indemnity insurance; amount insurance; Solvency II; NewSpace; catastrophe risk.*

JEL Classification: *H30*

ÚVOD

Komplexita současného globálního světa, vědeckotechnický pokrok, který přináší vysoký komfort životního stylu, ovšem na druhé straně kráčí ruku v ruce s vyšší mírou technologické zranitelnosti, vysokým zadlužením ekonomik, rostoucím, ale velmi nerovnoměrně rozloženým společenským bohatstvím, vyvolávajícím diskuse o legitimitě demokratického modelu. To vše katalyzované až příliš dlouho trvající koronavirovou pandemií, vytváří zcela nové politické a ekonomické prostředí, které je navíc doprovázené zrychlením digitálního boomu a zvyšující se informační zahlceností, kterou není v lidských schopnostech pozitivně a hlavně komplexním způsobem pojmout.

V čistě ekonomické rovině jsou stavy světa silně komplikovány odtržením finančních trhů od reálné ekonomiky: současné odhady naznačují, že spekulativní kapitál překračuje ten reálný až čtyřicetinásobně a při hledání uplatnění přifukuje cenové bubliny. Roste příjmová polarita, nůžky mezi bohatými a chudými se stále rozevírají.

V tomto hektickém prostředí je na denním pořádku hroucení předchozích paradigmat ekonomické vědy, zejména v pojetí normativní a prediktivní vědní disciplíny. Tento proces se týká i paradigmat vědních disciplín souvisejících s kategoriemi pojištění a pojišťovnictví.

Přitom ještě pro přelom milénia na finančních trzích jeho hlavní sektory - bankovnictví a pojišťovnictví představovaly stabilní, konzervativní odvětví ekono-

miky. Pojišťovnictví v škodovém produktovém segmentu plnilo funkci účinně eliminovat finanční důsledky nahodilých událostí, které byly historicky deklarovány jako pojistitelné. Poslední vývoj situaci v tomto ohledu ovšem dosti zásadně mění. Vedle výše zmíněných vlivů je k nim třeba přičíst geometricky rostoucí rozsah škod z katastrofických událostí, který nutí komerční pojistitele přehodnocovat a v některých případech významně měnit obsah pojmu „pojistitelná rizika" v případě škodových pojištění. V segmentu obnosového životního pojištění je nutno v souvislosti s vývojem finančních trhů řešit nové problémy zejména v souvislosti s využíváním tohoto produktu jako investičního instrumentu.

Na druhé straně ale nezpochybnitelně stojí zájem pojišťoven na ziskovosti či ve snaze o dostání svého primátu v oblasti inovací, který s sebou ovšem přináší nutnost přicházet s novými či refrešovanými produkty, odlišovat se v dobrém slova smyslu co nejvýrazněji od konkurence a riskovat tak vstup do neprobádaných anebo nejistých oblastí. Výsledek je pak mnohdy diskutabilní a odpověď, zdali byla daná strategie správná, ukáže pouze čas. Cílem předloženého příspěvku je vyhodnotit dopad současných změn na odvětví pojišťovnictví s důrazem na uplatnění nových přístupů.

1 SPECIFIKA ODVĚTVÍ POJIŠŤOVNICTVÍ V RÁMCI PROVOZOVÁNÍ ŠKODOVÝCH POJIŠTĚNÍ

Pro odvětví pojišťovnictví ve velmi důležité a senzitivní otázce stanovení adekvátních limitů pojistitelnosti je důležitý fakt, že pojistný trh se škodovými pojistnými produkty má některá velmi významná specifika. Hned v několika významných ohledech teoretického i praktického charakteru.

Rozhodovací procesy lidí ohledně škodových pojištění nelze vtěsnat do postulátu o vždy racionální volbě. Konflikt mezi člověkem jako multikriteriálním rozhodovatelem a rozhodovatelem typu homo oeconomicus byl již v literatuře popsán se závěrem, že lidé se nemohou rozhodovat v nejistých podmínkách podle matematických doporučení (Sinn, 1989). Asymetrická neznalost volby škodního průběhu ze strany náhodného generátoru (Rotshild, Stiglitz 1976) , jejímž výsledkem může být pro potenciálního klienta finanční ztráta několikanásobně převyšující výši pojišťovnou požadovaného pojistného, vyvolává v rozhodující většině lidské populace „averzi k riziku" a vede k z hlediska teorie racionální volby k neopti-

málnímu rozhodnutí: Sjednání pojištění jako finanční řešení důsledků nahodilosti je z matematického hlediska neracionální, se zápornou „střední hodnotou výhry", kromě výplat škod musí pojišťovna uhradit své správní náklady a realizovat zisk pro vlastníky pojišťovny (Kahneman, Tversky, 1979).

S informační nedokonalostí se musí vypořádat i komerční pojistitelé, kteří musí poplatek za transfer klientovy expozice vůči riziku, tedy pojistné, stanovit dopředu, přičemž mají reálně k dispozici historické údaje o minulých škodních průbězích, které ovšem vznikly v minulých podmínkách a které budou v budoucnu platit jen omezeně. Problém prediktivního rozhýbání minulých podmínek není exaktními přístupy uskutečnitelný, což velmi silně platí o současném hekticky se měnícím světě.

Z těchto skutečností je pro ekonomiku pojišťovnictví charakteristická specifická vlastnost, která spočívá v negativním vztahu k fenoménu volatility: pojišťovnictví je ve své ekonomice limitováno výší svých možných zisků, ale potenciální ztráty ze škod generované náhodným mechanismem mohou přivést pojišťovnu k defaultu. Anticipace volatility má tudíž pro ekonomiku odvětví prvořadou důležitost. Mezi podnikatelskými riziky pojišťoven tudíž nejvýznamnější roli hraje pojistně technické riziko, které plyne ze specifik pojišťovacího byznysu spjatého s nahodilostí. Do tohoto problémového okruhu patří mimořádně významná otázka míry krytí katastrofálního rizika[2].

Pro pojišťovnictví je v těchto souvislostech obecně charakteristická vysoká páka mající původ v nízkém podílu vlastního kapitálu na pasivech, proto se aktuálně stává mimořádně senzitivním problémem progresivní růst finančních důsledků historicky pojistitelných katastrofálních realizací. Zabývat se hranicí z pozice pojistné praxe, kam až může dojít ambivalence mezi komerčním způsobem provozování pojištění, který nemůže překročit základní princip ekvivalence mezi příjmy a výdaji finanční instituce, se začali pojistní teoretici intenzivněji zabývat v osmdesátých létech minulého století a problém se začal v této době výrazněji diskutovat v odborné literatuře, v následujících dekádách se problém dále vyostřoval.

Pojistitelé se z tohoto hlediska nejvíce obávají tzv. „neznámých neznámostí", které se v minulosti zatím nevyskytly a tedy nemají ani žádné historické pravdě-

2 Otázka v tomto kontextu zní, zdali v sobě má pravidelně se opakující předem známá katastrofa stále prvek nahodilosti. Jako typický příklad je vhodné uvést každoroční podzimní sezónu hurikánů procházející přes oblast karibských ostrovů až na území Spojených států amerických.

podobnosti. Idiom se v odborné komunitě začal používat po teroristickém útoku na Twin Towers v roce 2001, kdy důsledky historicky pojistitelných nebezpečí požáru a výbuchu byly iniciovány příčinou, která se později stala většinovou součástí výluk z pojištění.

Empiričtí ekonomové v této souvislosti navíc upozorňují na aspekt praktické nepredikovatelnosti událostí tohoto druhu, pro něž se vžil talebovský výraz „černá labuť"; tyto katastrofické události s prakticky nelze zabudovat do matematických modelů, chyby modelů málo pravděpodobných jevů narůstají, tedy jinými slovy čím vzácnější je určitá katastrofická událost, tím je menší šance zahrnout ji do jakékoliv smysluplné predikce (Taleb, 2014).

Téměř geometricky rostoucí finanční rozsah důsledků katastrof v naší vyspělé, ale o to více zranitelné civilizaci, vytváří a vyostřuje rozpor v možnosti finančního řešení těchto událostí komerčním pojištěním. Pro odvětví z toho plyne imperativ důkladně analyzovat a zvažovat nabídku konkrétních pojistitelných rizik a rozsah jejich finančního krytí, v této situaci zřejmě nemají pojistitelé jinou cestu, než upravovat limity pojistitelnosti, především deklarovat výluky z pojištění a horní hranice pojistných plnění.

Klienti pojišťoven ovšem výluky a limity spíše považují za nepřátelské, situaci dále komplikuje fakt, že produkty pojišťoven obecně patří spíše mezi ty, které pro klienty nejsou právě nejsrozumitelnější. Pojistný trh je pak v odborné literatuře uváděn jako příklad tržního segmentu, který v tomto ohledu funguje problematicky. Přiměřená míra zjednodušování produktů je ovšem v případě škodových produktů kryjících důsledky katastrofických rizik problém.

2 SPECIFIKA ODVĚTVÍ POJIŠŤOVNICTVÍ V RÁMCI PROVOZOVÁNÍ OBNOSOVÝCH POJIŠTĚNÍ

Podstatně menší prostor pro demonstraci nahodilosti představuje oblast životního pojištění, kalkulační modely se opírají o stabilní modely „gaussovského" pravděpodobnostního rozdělení. Produkty kromě svého prvoplánového poslání řešit životní rizika, fungují také druhoplánově jako investiční instrument. S ohledem na délku trvání životních pojistek je subtilní otázkou dosahování výnosů z dočasně volných prostředků klientů prostřednictvím finančních trhů. Pro současnou situaci na finančních trzích je charakteristická nízká výnosnost konzerva-

tivních instrumentů, do kterých by měly pojišťovny v zájmu bezpečnosti úložek pro klienty, kteří jsou skutečnými vlastníky těchto pasiv, investovat. Aktuálně nejednoduchou situací plynoucí ze stavu finančních trhů dále komplikují např. požadavky klimatických aktivistů vytvářející tlak na investování dočasně volných prostředků klientů do „zelených" investic včetně ukončení pojišťování podniků pracujících s fosilními palivy.

Obecně obnosová životní pojištění představují stabilizační prvek v ekonomice komerčních pojišťoven, v tomto segmentu je významně omezena možnost výskytu katastrofické realizace. Z hlediska dosti těsného spojení problematiky s finančními trhy se jako velmi pozitivní jeví skutečnost, že v odvětví se prakticky nevytváří systemické riziko, bezprostředně přenositelné do reálné ekonomiky. Pojišťovny, jak se opakovaně potvrzuje, mají na typické krizové spouštěče typu runu na finanční instituce a následné potenciální rychlé ruinování z podstaty svého fungování poměrně vysokou rezistenci. Pojišťovnictví v tomto ohledu působí i proticyklicky svou schopností určité absorpce krátkodobých šoků ve finančních systémech, z historie není známa žádná významná krize, která by byla spuštěna defaultem pojišťovny nebo zajišťovny.

3 DALŠÍ VLIVY PLYNOUCÍ ZE ZMĚN EKONOMICKÉHO PROSTŘEDÍ

V souvislosti s reminiscencemi na poslední finanční a ekonomickou krizi a ve snaze snížit volatilitu ekonomických cyklů se v pokrizových letech plynule zvyšují regulatorní požadavky v celém finančním sektoru. Jednak na vyšší finanční stabilitu, jednak v rámci ochrany spotřebitelů na produktovou transparenci a obecnou informační povinnost. Tyto přístupy prosazují regulátoři „harmonizovaně" napříč celým finančním sektorem, včetně pojišťovnictví.

I do velmi senzitivní problematiky limitů pojistitelnosti v současné době silně zasahuje státní regulace ve jménu zabezpečení vyšší stability finančních trhů a zajištění klientské bezpečnosti. Mechanické uplatňování ze stejného principu vycházejících regulatorních opatření napříč trhem je pro odvětví pojišťovnictví obzvláště nekomfortní - ignoruje totiž dosavadní historií ověřenou skutečnost, že toto odvětví, ač jeho ekonomika je těsně spjata s fenoménem nahodilostí (Berliner, 1982), jednoznačně patří k nejstabilnějším finančním odvětvím.

Výše uvedené, z metodologického hlediska diskutabilní přístupy regulátorů, jsou v rámci EU pro odvětví pojišťovnictví zakotveny v regulatorním projektu Solvency II. Na území EU je pro komerční pojišťovny povinná implementace od poloviny poslední dekády. Hned jeho první pilíř, představující kapitálový požadavek na pojišťovnu ve vztahu k přijímanému riziku, je v rozporu s obecně platným axiomem o nepředvídatelnosti externího světa a o nemožnosti učinit předmětem vědeckého zkoumání budoucnost, když jako předmět ještě neexistuje. Tento kvalitativní rozpor není matematika schopna vyřešit, čímž je zpochybněna modelová konstrukce kapitálového požadavku. Odpověď zastánců projektu zní: při kvantifikování budoucího možného maximálního dopadu do pojištění přijímaného rizika potenciálního klienta se lze opřít o expertní stanovisko a na jeho základě rozhodnout o přijetí či nepřijetí do pojištění. Náš názor je, že ani tím nejlepším expertem vypracované stanovisko nemůže neřešitelný metodologický rozpor predikce překonat.

Ve třetím pilíři jsou deklarovány podle našeho názoru nadměrné a z hlediska efektivnosti sporné požadavky na pojišťovny v rámci „mantry" ochrany spotřebitelů ohledně produktové transparence a obecné informační povinnosti.

Virtualita, iracionálnost a komplexita, jako vlastnosti současného finančního světa, si nerozumí se složitou regulací. Svědčí jim maximální jednoduchost, v moderním světě se ovšem právě jednoduchost obecně prosazuje velmi obtížně a v neztenčené míře to platí i pro finanční trhy.

4 MOŽNÉ AKTUÁLNÍ PŘÍSTUPY K ŘEŠENÍ PROBLÉMŮ LIMITŮ POJISTITELNOSTI

Z dosud řečeného plyne, že komerční pojišťovnictví má zásadní problém s empatií katastrofálních škod enormních finančních rozměrů, které jsou vědeckými přístupy neuchopitelné. Pro pojišťovny, jakožto instituce s negativním vztahem k fenoménu volatility, znamená katastrofa potenciální ztrátu, jejíž možnou výši nelze z historických dat odvodit. Není tudíž ani řešitelné exaktní stanovení ekvivalentní ceny za pojistnou službu zahrnující krytí katastrofálního rizika. Finanční krytí důsledků katastrofických událostí jednoznačně vynucuje při konstrukci škodových produktů stanovení limitů pojistitelnosti. Odvětví komerčního pojišťovnictví včetně zajištění má v tomto ohledu bariéru v nutném respektování principu ekvivalence při stanovování pojistného. Trend enormního růstu finančních

ztrát při katastrofických událostech začíná narážet na bariéru komerčního způsobu provozování pojištění. Možný rozměr negativní synergie živelních škod na stále rostoucích majetkových hodnotách s křehkostí technologického pokroku v této dekádě demonstrovala v minulé dekádě katastrofa ve Fukušimě, kde došlo ke kombinaci tsunami s jadernou událostí v technologicky jedné z nejvyspělejších zemí světa.

Nutnost snižovat náklady a využívat moderní digitální technologie při současném vylepšení etického image odvětví dochází k revitalizaci myšlenky vzájemnostního pojištění peer to peer, účinnost produktů těchto pojišťoven vůči katastrofálnímu riziku je ovšem problematická, z hlediska diskuse o limitech pojistitelnosti se jeví jako irrelevantní.

Strategie komerčních pojišťoven při vyrovnávání se s negativními dopady nadměrné volatility škodního průběhu v neživotním produktovém segmentu byla historicky v zásadě dvojího druhu: buď se ve své nabídce specializovat na pojistné krytí důvěrněji prozkoumanými a z hlediska volatility více homogenními, z historie známe specializaci pojišťoven na pojištění krupobitní, požární, atd., anebo volit strategii vzájemně se vyrovnávajících pojistně-technických rizik v univerzální nabídce produktů.

Dilema, které se v posledních vývojových etapách klonilo spíše na stranu kompozitních komerčních pojišťoven, se v současné době aktuálně vrací. Děje se tak v souvislosti se závažnou otázkou: má se komerční pojišťovnictví držet svého „core byznysu" a snažit se o optimální míru finanční eliminaci dopadů i historicky pojistitelných i katastrofálních důsledků nahodilosti, anebo přijímat „nové výzvy" a pomoci řešit i finanční důsledky zatím většinově nepojistitelných katastrofických hrozeb typu škod na životním prostředí či kyber nebezpečí, atd., se všemi důsledky pro stanovování správné výše pojistného u pojistného produktu, jehož budoucí škodní průběh bude pole předpokladů co nejvíce homogenizovaný, tedy co nejméně volatilní.

Vývoj komerčního pojišťovnictví bude v blízké budoucnosti ovlivněn uplatňováním nových přístupů a technologií nejen v souvislosti s krytými riziky v rámci pojistných produktů, ale také v procesech spojených s provozem pojištění. Již v současné době lze vidět snahy u využití umělé inteligence v jednotlivých fázích pojistného procesu (při sjednávání pojistných smluv, v rámci ohodnocování rizik, segmentaci klientů a stanovení velikosti pojistného, v souvislosti se správou

pojistných smluv, při likvidaci pojistných událostí), uplatňování specifických Insurtech platforem.

5 PŘÍKLAD NABÍDKY PRODUKTU, ROZŠIŘUJÍCÍHO TRADIČNÍ ROZMĚR POJISTITELNOSTI

Jeden z alternativních konstruktivních přístupů k problému akceptování odvětvím pojišťovnictví nových výzev pro současný pojistný byznys při současném anticipování požadavku na podrobnou znalost nového rizika je v tomto ohledu aktivita některých komerčních pojišťoven v oblasti pojišťování komerčních vesmírných projektů označovaných v literatuře jako NewSpace.

Aktivity jednotlivých společností v rámci projektu NewSpace jsou velmi rozličné. Předně se historicky jedná o vypouštění satelitů na oběžnou dráhu Země. Tyto satelity mohou sloužit k různým účelům počínaje astronomickým pozorováním, experimentům s živými organismy či navigačním systémům; neopomenutelná je i vojenská oblast užití satelitů[3]. Ze zmíněného vyplývá, že důležitost vynesených satelitů na zemský orbit je natolik velká, že tyto aktivity budou pokračovat ve stejném, ne-li větším měřítku, než doposud.

Další ambice projektů NewSpace spočívá ve vybudování jakési vesmírné infrastruktury, která by měla posloužit k dokování či doplňování paliva těm prostředkům, které mají za cíl doletět do vzdálenějších míst. Toto zařízení tak poslouží jako most k překlenutí - pro mimo jiné - v současné chvíli nepřekonatelného problému s nedostatkem paliva v poměru k hmotnosti uvažovaného prostředku.

Je evidentní, kam se nejodvážnější představy projektu NewSpace ubírají… Kolonizace Marsu a příprava alternativy pro lidské pokolení, které si dříve nebo později zcela jistě vyčerpá potenciál k životu na Zemi v důsledku svého konzum-

3 Do charakteristiky NewSpace spadají aktivity soukromého charakteru. Komerční entity však dokázaly natolik optimalizovat náklady při vývoji zařízení sloužících k vynesení určeného předmětu mimo Zemi, že tím v mnohých ohledech nastavily nepřekonatelný benchmark pro společnosti pod diktátem vlád v jednotlivých zemích. V daném ohledu pak mezi veřejnou a soukromou oblastí dochází k obchodním dohodám a aliancím a tím se čistý charakter NewSpace stírá. Jako nejkřiklavější příklad ze současné doby slouží využití společnosti SpaceX ze strany NASA k tomu, aby s pomocí svých znovupoužitelných raket vynesla mimo Zemi komponenty v rámci vesmírného programu Artemis. Ve světle výše uvedeného je proto zohlednění vojenských účelů relevantní (A World Risk Forum, 2018).

ního života, se tak jeví jako „second best". K tomu však vede ještě poměrně dlouhá a trnitá cesta, protože lidstvo stále ještě naráží na limity svého technologického pokroku, detailních znalostí o principech vesmíru či o planetě Mars a co hlavně – na lidský faktor[4]. Do té doby je reálné a v rámci několika let pravděpodobné, že se jakýmsi luxusním dovolenkovým standardem stanou cesty kolem Země s případným bonusem v podobě beztížně strávených chvil na orbitální stanici.

Co se týče pojištění satelitů, specializované pojišťovny mají v tomto ohledu značnou praxi. V současné době je do krytí pojištění satelitů zahrnována totální škoda ztrátou družice, sjednat lze i pojištění odpovědnosti za škodu, většinově pro fázi vypouštění, eventuálně pro operace na oběžné dráze. Je zřejmé, že v rámci takto pojatého pojistného krytí může vzniknout škoda velkého rozsahu, dotčené pojišťovny si musejí počínat obezřetně i z toho důvodu, že z celkového počtu cca tři tisíc satelitů je pojištěna necelá jedna desetina a jen asi polovina nových startů, v pojištěném souboru je tudíž sníženo fungování zákona velkých čísel. I v této oblasti situaci komplikují některá ekologická hlediska: Roste znepokojení aktivistů nad množstvím trosek na oběžné dráze a je vytvářen analogický argumentační tlak na pojišťovny jako v případě pojišťování uhelných elektráren, tedy nenabízet satelitním operátorům, protože nezajišťují způsob, jak bezpečně zlikvidovat satelity na konci jejich fungování (Wave, Davis, Cox, Hoffer, 2019).

U dalších uvažovaných projektů v rámci NewSpace lze mezi současnými specializovanými pojišťovnami zaznamenat váhající tendence, jak dále postupovat. Oblast je to jistě atraktivní, navíc v kontextu posunu lidstva k alternativním zítřkům mohou tyto subjekty hrát velmi důležitou roli, neboť mohou velkou mírou napomoci tím, že si na svůj vrub vezmou přenos rizika (či alespoň do určité míry, neboť zde je už nutné diskutovat limity pojistitelnosti). Z pozitivního reputačního hlediska tak mohou pojišťovny teoreticky vytěžit daleko více, než kdyby se rozhodovaly jen na základě jednoho úhlu pohledu – tedy toho ziskového, neboť

4 Adaptace lidského druhu na život mimo Zemi je velkou otázkou, neboť je jasné, že člověk k životu potřebuje z dlouhodobého hlediska ještě gravitaci, která je esenciální pro správnou funkci orgánů, anebo pro vývoj lidského plodu. Do současné chvíle navíc nebylo prozkoumáno, zdali by byla reprodukce lidí ve vesmíru vůbec možná. Dalším důležitým aspektem je volná radioaktivita, která může napáchat na lidském zdraví nevratné změny. I kdyby se tyto okolnosti daly technickým způsobem vyřešit, stále zde vyvstává otázka psychiky a schopnosti člověka zvyknout si na nové a zcela odlišné prostředí, které by po poměrně dlouhou dobu bylo pouze interiérové.

v očích mnoha subjektů se z dané pojišťovny či konsorcia pojišťoven může stát důležitý článek pro budoucnost lidstva.

Vážnost této problematice dodal fakt, že do iniciativy News Space se zapojila i jedna z nejstarších institucí pojistného trhu, historicky se prezentující jako konzervativní, v poslední době se však dynamicky proměňující – společnosti Lloyds. Ze zveřejněného poměrně velmi podrobného dokumentu, vypracovaného společně se specializovanou na problémy pojišťovnictví konzultační společností London Economics, je dobře patrná relativně vysoká míra znalostí o dosavadním stavu a vývoji produktu a také zájem o tento segment pojišťovacího byznysu(Lloyds, 2019) .

ZÁVĚR

Komerční pojišťovnictví má zásadní problém s empatií katastrofálních škod enormních finančních rozměrů, které jsou vědeckými přístupy neuchopitelné, do své odvětvové ekonomiky. Pro komerční pojišťovny, provozující zejména škodová pojištění, jakožto instituce s negativním vztahem k fenoménu volatility, znamená katastrofa potenciální ztrátu, jejíž možnou výši je z historických dat odvodit, obtížné je i exaktní stanovení ekvivalentní ceny za pojistnou službu zahrnující krytí katastrofálního rizika. Finanční krytí důsledků katastrofických událostí jednoznačně spadá do diskuse o stanovení limitů pojistitelnosti, odvětví komerčního pojišťovnictví včetně zajištění má v tomto ohledu bariéru v nutném respektování principu ekvivalence při stanovování pojistného. Řešením je v tomto ohledu asi i nadále uplatňovat nástroje snižující dopady volatility potenciálního škodního průběhu, zejména limity pojistného plnění a výluky z pojištění. Při rozšiřování limitů pojistitelnosti o dosud nepojistitelné segmenty je ze strany komerčních pojistitelů nezbytná obezřetnost a nutnost získat poznatky pro snížení dopadů volatilního chování škodního proběhu u nově nabízených škodových produktů.

Výzvou pro komerční pojišťovnictví je řešení důsledků nových typů rizik, která jsou spojena s technickým a technologickým pokrokem. Příkladem těchto rizik jsou rizika spojená s projekty NewSpace. Pojištění NewSpace je spojeno s nestandardními riziky (i v souvislosti s možnostmi využíváním příslušných technologií) a tím nestandardní konstrukcí pojistných produktů a s tím spojené ocenění rizik a nastavení ceny pojištění. Dá se předpokládat, že těmito velmi specifickými pojistnými produkty se budou zabývat specializovaní pojistitelé.

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