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Roland Keszi

Earthquake in the Labour Market

The Effects of the Artificial Intelligence in the Shadow of the Coronavirus Armageddon

In the coming decade, the jobs of many hundreds of millions of people worldwide, and those of approximately 900,000 people in Hungary, will be transformed by the effects of artificial intelligence. It may also be formulated that the occupation and work of such a mass of people may be endangered by the labour market consequences of forthcoming developments in artificial intelligence. Although the original aims of this study did not include thematising the effects of coronavirus pandemic, other emerging processes that also have a radical impact on the open labour market must be taken into consideration. My hypothesis is that the impact of both artificial intelligence and the coronavirus on the labour market will occur together in the world of work, and that their impact will be mutually reinforcing.

The partial purpose of this paper is to outline data-based megatrends and forecasts. In particular, I consider it important to indicate this in advance, even in the absence of information until the closing date of this manuscript. The lack of information is twofold. On the one hand, it refers to the epidemiologically and virologically unknown nature of the new pandemic, Covid-19, and on the other hand, to the narrow range of central government information sources. At the end of April 2020 in Hungary, the first 'science-like' data release was held, in which researchers specialising in epidemiological statistical analyses presented results calculated from mathematical models of the epidemic curve (see ITM, 2020). However, due to the limited availability of databases, scientific verification / falsification did not become available, so researchers who were omitted from the data releases were pushed to the brink of guesswork. Data on labour market effects (eg number of unemployed persons) at the end of this study is also limited, both in Hungary and internationally.

This study examines the economic and labour market trends and underlying sociological megatrends that should be highlighted with regard to the processes related to the spread of artificial intelligence, and I expect their impact to be marked. I will illustrate the intertwining of sociological and economic processes with the emergence and intensifying effects of new technologies, including artificial intelligence, on the labour market, by presenting some economic and social dynamics trends as well as recent empirical research findings. I will therefore review those trends in the open labour market that are embedded in the historical framework of the economy and the labour market. I will also indicate which trends may be expected in relation to the effects

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of artificial intelligence. In my study, I use the data on the American and Hungarian labour markets as a 'desk study field', intended as a case study.

Introduction: Machine, man, economy, economic shock

Since the beginning of the 21st century, artificial intelligence has once again emerged as a new, subversive technology and as a hope for the future of the open labour market. The coronavirus appeared as a brutal, unexpected invader, eliminating innumerable livelihoods. The impact of subversive (disruptive) technologies has long been felt in all major economies around the world. Various predictions have been made about these technologies, including practical initiatives that are associated with prophecies and reviews that envision dystopian visions, underscoring uncertainties surrounding predictions about these subversive technologies. For example, the European Union has initiated the EUROPA 2020 strategy for economic and social development, which launched the Grand Coalition for Digital Jobs (EU, 2013). At the same time, a 'Startup Europe' programme was launched through the European Commission to support online businesses.

Numerous smaller, larger economic and social research projects have been launched, in which EU member states, in some cases with associated partners, have worked on research issues brought to the surface by the new economy. Some of these, in which the author has had the opportunity to participate, include the following: EMERGENCE, TEDIP, EGAP, E3WORK, STILE.

At the same time, dystopian ideas conveying negative visions have appeared, drawing attention to the fact that new types of technologies will eliminate numerous jobs [for example, Ford (2015), Brynjolfsson, E. & McAfee, A. (2016), on embedding ideas about the future of work in a historical framework, cf. Rimler (1999)].

In the shadow of these two conflicting visions, empirical sociological analyses of the social impacts of technological innovations, and the risks and opportunities associated with their emergence have also emerged [cf. Nitto, H., Taniyama, D. & Inagaki, H. (2017), Arras, K. O. & Cerqui, D. (2005), Wike, R. & Stokes, B. (2018)].

The above two completely opposite visions, as well as the empirical sociological analyses that have been conducted, are embedded in various, longer-term technological, economic and sociological megatrends. In this study, I would also contend that these trends may only be interpreted in the light of each other's effects, and that interpretations of individual phenomena alone can lead to false conclusions.

The two entirely opposite visions described above, as well as the empirical sociological analyses that have been conducted, are embedded in various, longer-term technological, economic and sociological megatrends.

The defining microelectronic revolution that followed the development of the transistor and then the microprocessor, the basis of the subversive technologies

that are the subject of the present study, has been ever-present in the technological-economic literature since the 1970s. In this paradigm, the labour market and the potential dangers associated with technology appear from the outset [cf. eg. Friedrich, G. & Schaff, A. (1984)]. The global system of international division of labour, i.e. *globalisation*, which also has a separate literature base, discusses the related trends from the perspective of the internationalisation of production chains. Embedded in the above two articles analysing groups of indirect phenomena is a megatrend, directly related to human relations, a canon of literature discussing *demographic changes* related to the changing age of modern societies. The articles discuss the growing gap between those entering the labour market (new entrants) and those leaving (retiring) and the growing burden on the active age group through retirement. The new IT trend has been described by some as a fourth industrial revolution (Schwab, 2016), and by other authors as a third IT revolution, Bojár, 2018).

The long-term effects of the above megatrends erupted in the first quarter of 2020 from a health-related economic shock with a significant impact in the short term. The new type of coronavirus (Covid-19) has been the greatest health risk in world history since 1918, representing a 'bolt out of the blue' on the world economy and on societies. According to forecasts available at the time of writing, the European Union, for example, is facing the deepest recession in its history. There is extreme uncertainty about the predictions. For example, the Hungarian government predicts an economic downturn of around 3%, while EU experts predict an economic downturn of around 7%, and analysts of the Hungarian Central Bank predict a 3% expansion for Hungary. This signifies extreme differences of opinion, even if we disregard the distorting factors arising from the political background of the forecasts and the interest groups on the side of investors.

The first, marked appearance of the economic shock caused by the coronavirus, unsurprisingly, started from the side of the money and capital markets. The SPX index, an indicator developed by Standard & Poors that represents the value of the largest U.S. companies, fell more than 35% in one month from its peak at the end of February 2020. Regarding market fluctuations, the VIX jumped more than eight-fold shortly after the outbreak (from 11.42 to 85.47), closing higher than at any time during the 2008 crisis, thus setting a serious historic peak.

The VIX index is also called the panic index. The higher the value of the VIX index, the more nervous the market sentiment, the greater the expected (implied) volatility and fluctuation of the markets.

This market rift occurred far more rapidly than during the 2008 economic crisis, which arose in the US money and capital markets. It is conceivable that the total shock will also have a considerably more significant impact than that of the 1929–33 world economic crisis.

Regarding the initial state of the labour market, a survey conducted by the CSO reveals that more than half the number of employees who lost their jobs during the coronavirus epidemic have fallen victim to redundancies in the workplace: 39.7% of employees refer to curfew restrictions, a further 51.7% to redundancies within the workplace, and 7.4% to permanent job closures (KSH, 2020).

Employing mathematical and statistical procedures, Kónya & Köllő (2020), taking into account the relationship between the registered unemployed and Google searches, estimated that the number of registered unemployed in Hungary exceeded 400,000 in April 2020, which represents an increase of roughly 120,000 compared to February.

* * *

In the present study, using the American and Hungarian economies as case studies, I aim to highlight a number of clearly evident economic and sociological processes, as well as a latent tendency regarding the not too distant future of the labour market. At the time of writing, dozens of virological and epidemiological research reports are being received daily from around the world. Hundreds of analyses are published on the economic, sociological and psychological aspects of the pandemic, which, similarly to medical analyses, often draw contradictory conclusions. Over the next few years, it will be the task of the scientific community to confirm or negate these conclusions, so the present study does not intend to add further clutter to the jungle of published information. Our study merely attempts to describe the labour market consequences of developments in artificial intelligence, in the shadow of the impact made by the coronavirus pandemic on the labour market. I therefore consider the coronavirus situation a significant factor that could exacerbate the labour market consequences of earlier developments in artificial intelligence. In this regard, I strongly emphasise three interrelated facts.

Firstly, the effects of the coronavirus pandemic are compounded by significant pre-existing industrial and economic megatrends, thus exacerbating the labour market implications of the pandemic. *Secondly*, I would like to emphasise that those who stand to lose the most due to the coronavirus, in terms of labour market processes, will be workers with low labour market status (for the interest of readers of this scientific journal, these may include workers of altered working capacity).

Thirdly (without any political implications), I would also like to highlight that while world governments are making significant efforts to mitigate the negative effects of the pandemic on the labour market in the short and medium term, the Hungarian government is once again pursuing one-special path solutions, that could result in 'purgatorial' conditions in the economy, including the labour market.

We would refer here to critical positions on crisis management, cf. Petitions signed by leading American and Hungarian economists: Economists Statement (2020) and MKL (2020)

In economic terms, the crisis situation is most frightening because, at the time of writing, there are no established sets of macroeconomic solutions that can deal with the economic and monetary effects from a health and fiscal perspective. As previous crises derived from economic situations, macroeconomic analyses could provide the tools to model economic effects, develop means of intervention and fiscal / monetary stimulus packages. The 2008 crisis, for example, started in the US money and capital markets and then spread to a crisis of confidence that spread throughout the world. The health crisis that originated in China in 2019 will freeze the entire world economy by radically endangering other human lives and blocking international production

chains. There has never been such a crisis in world history, so there are no options for the world's central banks or governments to resolve it. The situation is thus similar to groping in complete darkness, as the equations of macroeconomic models are uncertain, without having any precedent. The most important of these uncertainties is the question of its timespan. We have no idea how long the pandemic or the resulting crisis will last, or what form the economic recovery will take, whether it will be L-shaped, V-shaped, W-shaped, or U-shaped, nor do we know how many waves the virus will have. So we do not know what course of the crisis will take, but one thing is certain: The process will go hand in hand with unemployment. Thus, two main processes, namely the increase in the intensity of artificial intelligence developments and the coronavirus pandemic, both have a significant impact on labour markets. The coronavirus has a direct and a gross effect, and developments in artificial intelligence have an effect in the medium term. Both processes point in the same direction, that is, a process that generates unemployment. Related to this, I intend to share some data-supported interpretations of the effects of long-term unemployment in the rest of this study.

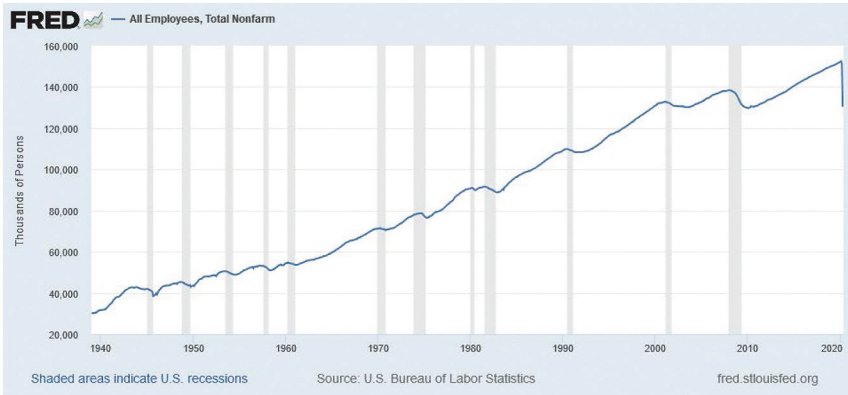
1. Economy and society in the light of macro data on work: A data based interpretation

The labour markets of modern economies, regardless of pandemics, economic downturns or geopolitical factors, have been characterised by an increasing trend since the dawn of artificial intelligence research (approximately after World War II). This megatrend is shown by the data in *Figure 1*. It is clear from this figure that in 1970, for approximately 6 months, during the economic crisis of 1974–75 (conceptualised as recession) for approximately 14–15 months, while, during the last major crisis before Covid-19, in 2008, after the crisis that began with the bankruptcy of the Lehman Brothers investment bank, it took an average of 80 months for the labour market to regain its pre-crisis health. It took so much time for the U.S. economy to recover in terms of employment. This longitudinal data set alone is somewhat alarming. Clearly, as the table shows average data, there were strata of workers who were forced to live without work for considerably longer periods of time, even without any income.

Regarding the economic impact of the coronavirus, it is typical that data on the March downturn was not officially available even on May 4, which is unprecedented in the United States, where data is updated on a weekly basis. According to market opinions, the processing of incoming unemployment claims has reached such proportions that the official bodies have been unable to process the applications of persons applying for unemployment benefits.

The labour market of the world's largest economy is a good illustration of the trends in the labour markets of modern economies, on the other hand, with small time differences – moving in step with modern labour markets through the impact of global production chains.

Figure 1. U.S. employment data from the dawn of artificial intelligence to 2020, May
Source: FRED (2020)



The relative loss of space for the U.S. economy is not the subject of the present study, however, we can say that the U.S. is still the strongest economy in the world to this day, and will continue to be so for a long time to come, both in world politics and artificial intelligence developments. Our above baseline data set is therefore relevant if we want to address any of the modern economies.

The function, in the economic sense (until the spring of 2020), clearly shows an increasing trend, since declines in employment were always followed by employment recoveries, that is, the lowest points were followed by increasingly high peaks.

Clearly, the requirements of the monotonically increasing function in the mathematical sense are not met by the data set, however, employing one of the methods used in money and capital market analyses, it can be seen that, from a technical analysis point of view, the trend shown in the figure is clearly increasing until the spring of 2020.

The figure therefore shows continued growth until the spring of 2020. It can also be traced in the figure that during periods of economic recession (symbolised by the grey zones in the figure) employment falls. All this is a natural process, and there is nothing surprising in it, as, since the spread of modern monetary theory, every macroeconomic analysis in economics takes it into account.

By monetary theory, I refer to the foundations laid down by J. M. Keynes in the 1930s [see Keynes, J. M. (1965)].

The graph in the figure is therefore rising, which, at first glance, may be a cause for joy, as employment growth is a welcome process for modern capitalism, with the hope that sooner or later things will turn out well, we will recover from recessionary periods, and that sooner or later unemployed persons will be re-employed. At the same time, the medium and long-term trends mentioned involve more than just drawing positive conclusions. What will happen to those of us who, unfortunately, happen to be born

in the periods marked by the ominous shadows of the grey bars shown in the figure, during our 'labour market life', or even if, as career starters, we try to enter the labour market at the beginning of a recession? In terms of employment, first, at the level of the data, it is important to examine what lies behind the ominous shadows indicated by the grey bars in *Figure 1* above.

Figure 2. Time required for labour market recovery as a function of recessionary periods (months)
Source: FRED (2020), Ford (2015)

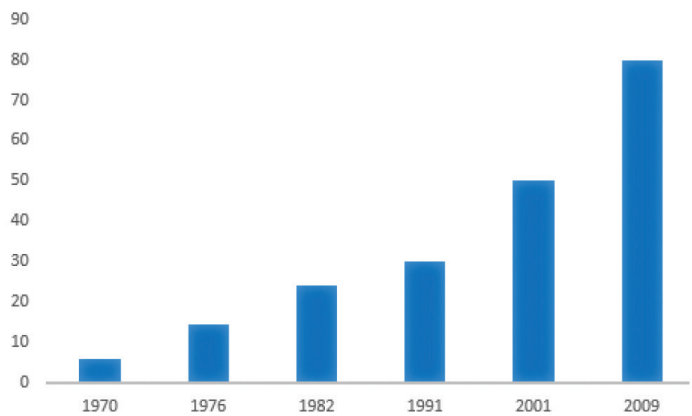


Figure 2 illustrates how long the labour market needed to recover, i.e. to return to pre-crisis employment levels. It is clear from this figure that in 1970 it took an average of *6 months* for the labour market to recover. During the economic crisis of 1974–75 (conceptualised as recession) it took approximately *14-15 months*, while, during the last major crisis before Covid-19, in 2008, after the crisis that began with the bankruptcy of the Lehman Brothers investment bank, it took an average of *80 months* for the labour market to regain its pre-crisis health. It took so much time for the U.S. economy to recover in terms of employment.

This longitudinal data set alone is somewhat alarming: Clearly, as the table above shows average data, there were strata of workers who were forced to live without work for much longer periods of time, even without any income. At the time of writing, the economic impact of Covid-19 is intensifying. There are 20.5 million people who lost their jobs in May, with an unemployment rate of 14,7%.

The first stage of unemployment is the loss of a job, which in itself is accompanied by extraordinary mental processes, an emotional roller coaster.

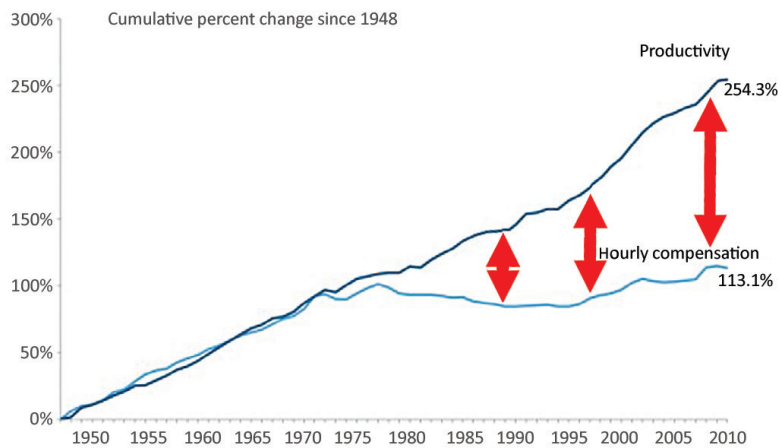
For the psychological dynamics of unemployment, see e.g. Amudson, N. & Borgen, W. (1987). For empirical research on a process involving a large company facing radical organisational changes and collective layoffs, see Keszi (2002)

Nor is it difficult to imagine the life of a long-term unemployed person or the examples of those around us, who will be increasingly numerous in the coming months. Negative mental processes arise due to constant rejections: feelings of worthlessness and

depression, as well as possible hospitalisation, which represents an unemployment trap for workers at an individual level. Yet there is also an organisational level (causal level) and an overall societal impact (cause) of the unemployment trap. The entire causal chain is embodied in a phenomenon called labour market polarisation.

We should examine the causal process from two sides. Firstly, we should observe the productivity indicators of organisations (companies) at the macro level, comparing them with the compensation indicators of employees in companies (*Figure 3*).

Figure 3. Macroeconomic causes of labour market polarisation: The productivity-compensation gap
Source: Mishel, L (2012), Ford (2015)



Hourly compensation is of production/non-supervisory workers in the private sector and productivity is for the total economy. For data see: Mishel, L (2012), for the quote and other calculations: Ford (2015), Original data: Bureau of Economic of Labor Statistics, Labor Productivity and Cost program and Bureau of Economic Analysis, National Income and Product Accounts public data series. Data visualization: Keszi.

Figure 3 indicates that there is a significant and widening gap between productivity and wages, symbolised by the increasing length of the red arrows. It also follows that the profits of companies do not flow mostly to the stratum of employees. The question arises as to where they do, in fact, flow. As a first hypothesis, we can state that this profit remains with the companies, which they transpose into other asset stocks, and further developments in order to increase their productivity. It is important to note that any trend indicated here may only be interpreted in parallel with technological change / development. For an overview of the links between artificial intelligence developments and economic development, see Keszi (2019).

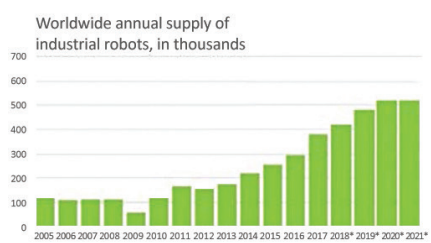
2. Where do companies' profits flow? Artificial intelligence developments and robotisation trends

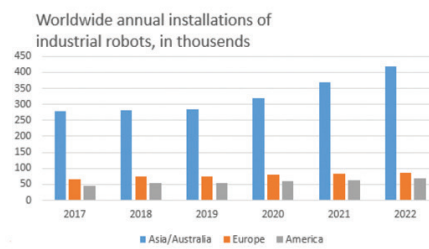
Figure 3 illustrates the characteristics of the growing corporate profit flow at the macro level. Let us now examine the organisational-level trends appearing among the reasons for the widening gap between profit and wages. To check our hypothesis (that the profits of companies flow into developments), we first note that the latest phenomena within the technological changes related to companies are provided by developments related to artificial intelligence (AI). A review of the following longitudinal data on the deployment of industrial robots may shed light on the effects on the labour market.

Data cf. IFR (2019). Robotics and artificial intelligence are related, but they do not mean the same concept. There is no uniform definition of the concept of artificial intelligence, in the present study we use the following conceptualisation scheme: Artificial intelligence is an entity that is able to receive, interpret, and learn from its environment (INPUT), perform relevant, flexible behaviour (OUTPUT) to achieve a specific goal.

Figure 3.1. Meso-level causes of labour market polarisation #1: Artificial intelligence and robotisation (international data): Worldwide annual supply of industrial robots, in thousands Source: IFR (2019)

Figure 3.2. Meso-level causes of labour market polarisation #2: Artificial intelligence and robotics (continental comparison) Source: IFR (2019)





Automation and robotics will result in obvious redundancy in certain strata of workers, which, translated into the language of the labour market, will result in unemployment for certain strata of workers.

The opinions of labour economists and work sociologists are divided on how many and what types of new jobs will be created through the increased use of artificial intelligence and automation. For the two positions, see Autor, D. & Handel, M. (2013), Frey, C. B. & Osborne, M. A. (2013), Ford (2015), Brynjolfsson, E. & McAfee, A. (2016). In this study, we do not take a stand on any of the positions, but we would like to emphasise that unemployment is to be expected in the short term, in which certain sections of the labour market are at increased risk.

In the later part of our study, the data will also illustrate the exposure, extent and characteristics of the endangered workforce, regarding the Hungarian labour market as a case study.

3. First sociological interpretation experiment: Organisational sociological causes of long-term unemployment and the modern job market billog phenomenon

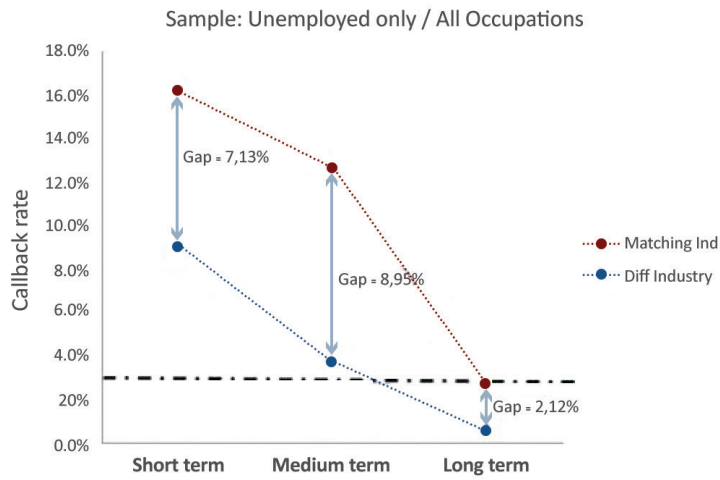
In order to illustrate the significance of the unemployment period in this regard as well, let us take a comparative set of data describing the relationship between the duration of unemployment and the return to the labour market.

In this connection, a labour market experiment with a number of 4,800 items was conducted by Rand Ghayad. See reviews: Ghayad, R. & Dickens, W. (2012), O'Brian, M. (2013), Lahart, J (2014), Krolft, K., Lange, F. & Notowidigo, J. (2012), on the consequences of long-term unemployment: Crabtree, S. (2014).

The data and further research results show further patterns based on organisational attitudes lying behind the phenomenon in this field. The Beveridge curves shown in *Figures 4.1* and *4.2* illustrate the relationship between the chances of returning to the labour market and the duration of unemployment (*4.1*). The curves also illustrate the overall relationship between the chances of returning to the labour market and previous work experience (*4.2*). At the same time, the meso-level (organisational) causes of the curves partly explain the protracted processes occurring in the recovery periods of the macro-level labour market. The presented phenomenon contributes to an explanation of the extension of the recovery periods, thus refining our understanding of the phenomenon from the point of view of organisational sociology. Prolonged processes may be seen in the HR policies of companies and may be explained by organisational sociological factors that feed on the attitudes of HR managers. *Figure 4.1* illustrates the relationship between the duration of unemployment and the duration of return to the labour market. The data indicates that the long-term unemployed person has almost no chance of returning to the previous local labour market. The longer someone has been unemployed, the less likely they are to return to the labour market, whether they want to return to the same sector in which they already have work experience or want to be mobilised in another sector. Compared to the newly unemployed, the long-term unemployed (older people, without work for over six months) have a 1/8 chance of returning to the labour market depending on their previous work experience (16% vs. 2%).

Figure 4.1. The chances of returning to the labour market as a function of the duration of unemployment

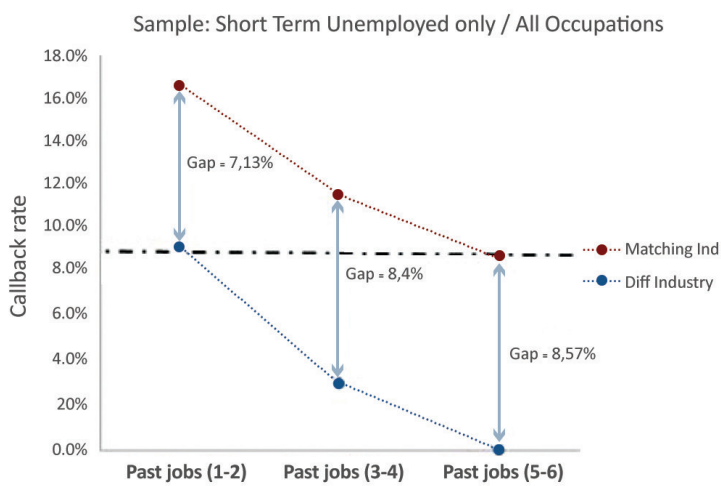
Sources: Ghayad, R. & Dickens, W. (2012), O'Brian, M. (2013)



The Beveridge curves also show that workers with significant work experience (five or six previous jobs) are almost as unlikely to re-enter the world of work if they have been unemployed for more than six months. Neither the jobs relevant to their previous work experience nor the job transition will help them reintegrate. The relevant data is illustrated in *Figure 4.2*.

Figure 4.2. Chances of returning to the labour market as a function of previous work experience

Sources: Ghayad, R. & Dickens, W. (2012), O'Brian, M. (2013)



In short, the trap of long-term unemployment is an impression of the modern labour market stamped on the supply side of the labour economy, which leads to the long-term oppression of people and households. For the HR practices of companies, which are also embedded in recruitment procedures, see Győri & Csillag (2019a,b).

It is clear that long-term unemployment, which is an extreme threat facing a vulnerable workforce, also presents a macroeconomic problem for national economies, as falling wages on the demand side lead to declining consumption, first and foremost for companies in the short and medium term.

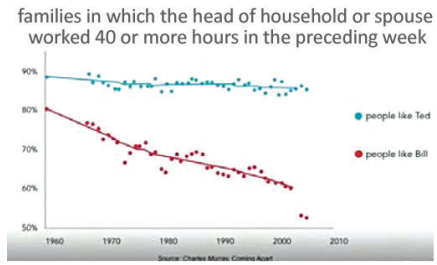
In the above, we have reviewed some data, mainly from the point of view of economics and labour economics, making a first attempt at a sociological interpretation, accounting for the development of the labour market from an organisational sociological perspective.

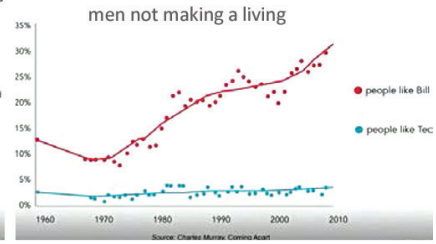
4. Second interpretation experiment: Some eociological and social psychological consequences of labour market polarisation

We should consider what awaits us, why long-term unemployment is a threat to society as a whole, and whether or not we are individually affected by job loss. Let us examine some trends based on the analyses of Murray and McAfee, who have been following social processes in parallel with the above-mentioned economic trends since the beginning of artificial intelligence developments in the 1960s (Murray, 2012, Brynjolfsson & McAfee, 2015). Murray's original analyses did not relate to automation or the rise of artificial intelligence, but the data tends to draw some conclusions from the trends identified in relation to the world of work as well. Since we still consider U.S. economic data to be an 'ideal-typical analytical framework,' we shall continue in the same vein. Murray (2012a) outlined two ideal-typical cases, two employee models. In this study, somewhat differently from Murray, implementing McAfee's outline, we use the concept of ideal type in the Weberian sense (cf. Weber, 1970a,b, 1987).

The first (HIGH: 'people like Ted') are, for example, managers with a higher level of education, doctors, lawyers, engineers, persons conducting some scientific activity, or university lecturers. These are shown on the graphs by the parts of the diagramme marked in blue. The second type (LOW: 'people like Bill') typically includes non-tertiary blue-collar workers, non-managerial workers in the service sector and white-collar non-managerial workers. Their data is shown on the graphs by the chart sections marked in red. *Figures 5.1-6* show depressing labour market trends arising since the early days of automation (that is, the cradle of developments in artificial intelligence). Longitudinal data indicates an increase in social divisions that is hidden from the perspective of macroeconomic data. Here we can see the issue of labour market participation and livelihoods (*Figures 5.1* and *5.2*).

Figure 5.1. Proportion of families with at least one employee with a permanent (min. 40 hours/week) employment
Source: Murray (2012a), McAfee (2013)
Figure 5.2. Proportion of workers with persistent livelihood problems
Source: Murray (2012a), McAfee (2013)

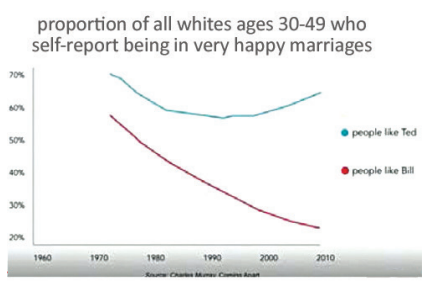


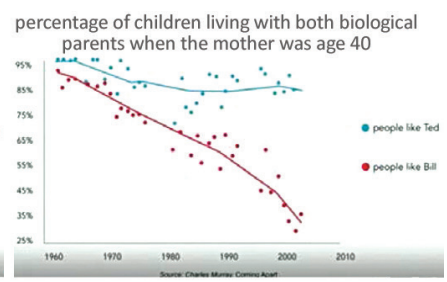


It is already clear from these two figures that since the 1960s low-skilled workers have been steadily excluded from the labour market, while the situation of higher qualified workers has in fact stabilised, with almost 90% in permanent employment. So, despite the steadily growing levels of employment that we see from macro-level statistics, the labour market has split in two, and low-skilled people are increasingly cast out of the world of work. Hence, it is not surprising to find that the lower group is constant and faces increasing difficulties in daily living (*Figure 5.2*).

Not only has the division related to livelihoods increased, it is clear from the data that interpersonal relationships such as the proportion of people living in a happy marriage (*Figure 5.3*) or the so-called situation of the lower strata is also giving increasing cause for concern in terms of the proportion of children growing up in a truncated / matrix family (*Figure 5.4*).

Figure 5.3. Proportion of happily married people as a function of time
Source: Murray (2012a), McAfee (2013)
Figure 5.4. Proportion of children living with both biological parents as a function of time
Source: Murray (2012a), McAfee (2013)

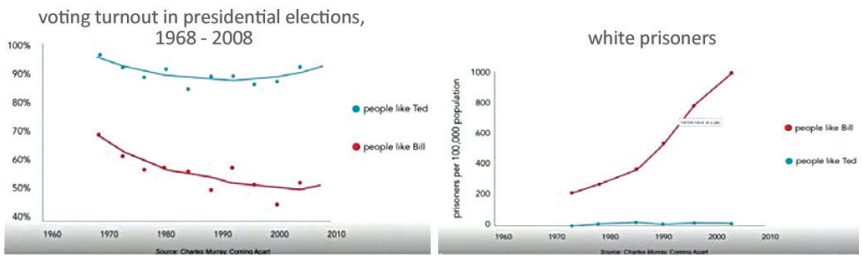




The trends shown in *Figures 5.3* and *5.4* are also evidenced in family sociological research, in which we also find data consistent with conclusions drawn from perspectives of work and organisational sociology.

Due to the polarisation of the labour market, increasing differences also appear between the two ideal-typical layers of the labour market in other areas. Members of the lower group participate in political elections to a lesser extent, while the rate of crime among them constantly increases. These phenomena are illustrated in *Figures 5.5-6*.

Figure 5.5. Voting turnout in presidential elections Source: Murray (2012a), McAfee (2013)
Figure 5.6. White prisoners per 100K population Source: Murray (2012a), McAfee (2013)



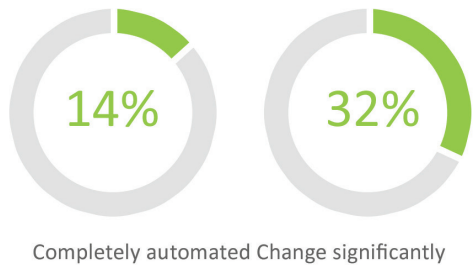
The growing disparities seen in the above data not only pose increasing problems for workers in the lower strata, but also envision a challenging future for society as a whole. One of the most dramatic patterns relates to crime rates, which represents an extremely unfavourable trend requiring sociological analyses that cannot be identified by analysing simple macroeconomic data. The above-mentioned factors are related to the effects of automation and, in our current circumstances, to developments in artificial intelligence, so it can be assumed that further intensification of the mentioned processes can be expected.

5. A case study of the following decades: Factors determining the polarisation of the Hungarian labour market in the age of the explosion of artificial intelligence

The Hungarian labour market is also embedded in global trends. In relation to these trends, almost half of all jobs worldwide are affected by developments in artificial intelligence: 14% of jobs are directly at risk, with a significant change expected for a further 32%. What is more, extremely important global data indicates that 60% of the adult population does not have adequate IT background knowledge of the use of the latest technologies (see OECD, 2019, 9). The above global data primarily sheds light on the operational difficulties of artificial intelligence besides underscoring the key role of adult education. In addition, the ongoing processes are likely to further deepen the polarisation of the labour market discussed above. For international reviews and

theoretical backgrounds on occupations at risk, see Autor, D. H., Levy. F. & Murnane, R. J. (2003), and Autor, D. & Handel, M. (2013), and Frey, C. B. & Osborne, M. A. (2013).

Figure 6. Adequate IT background knowledge (grey zone) and change in work tasks
Source: OECD (2019)



Overall, in light of the overall global data, the Hungarian labour market can be said to be better prepared among developing countries. However, it is also true that Hungary lags significantly behind certain former socialist deficit economies in Central and Eastern Europe (for deficit economies see: Kornai, 1980). Such a comparison is not the purpose of this study. Nonetheless, it can be said that, due to the unpreparedness of the labour market, in Hungary a number of challenges appear. The labour market will undergo radical transformations in terms of both occupations and jobs over the next ten to fifteen years and beyond. On the one hand, occupations will disappear or transform, in line with international trends, and on the other hand, significant changes can be predicted in terms of the number of people employed, in terms of jobs.

In Hungary, the work of approximately 900,000 people will be transformed by the effects of artificial intelligence (Price Waterhouse Coopers [PWC], 2018, 2020). In other words, the jobs and occupations of almost one million people are potentially jeopardised by the labour market consequences of forthcoming developments in artificial intelligence. In the case of individuals or social groups, imminent changes should be classified as a 'threat' if the social group in question does not possess certain IT skills (hard skills: basic knowledge of network infrastructure, database management, programming, etc.) and the skills needed to work, or tacit skills (see Polányi, 2009) required for collaboration, teamwork, activities in automated work environments and activities in human-machine collaboration, which will comprise the necessary requirements for working in ecosystems represented by the new artificial intelligence. It is important to note that it is not only the classic varieties of IT knowledge that will be increasingly appreciated. Human capability groups that have long been mentioned in management literature, especially in terms of leadership skills, will also be exponentially valued in the labour market. At the same time, among the current economies, which are underdeveloped similarly to the Hungarian economy in terms of artificial intelligence, there are also types of occupations in which these skills play a key role. These are the occupations in which human collaboration, empathy, emotional intelligence and creativity are needed to solve tasks at a high level, such as teachers, doctors, social workers and designers. For professions at risk in the Hungarian labour market, see Nábelek, F. & Vági, E. (2019).

The effects of artificial intelligence are still being felt in the economy, and its impact is growing stronger. Its effects on the labour market, which will be more significant than at

present, will be wave-like. According to recent research (see PWC, 2020), the spread of artificial intelligence in the Hungarian labour market will take place in three cycles and waves. In each wave, different industries and different layers of workers will be affected. At the same time, it can also be seen that the impending waves may overlap, thereby further increasing the polarisation of the labour market. We do not have suffficiently reliable research data on the latter, but I assume that the wave-like course of the effects of artificial intelligence on the labour market will pose prominent and increasing risks for certain strata of workers. At the time of writing, these risks are unpredictable, but I believe it is certain that the economic effects of overlapping trends, in addition to the coronavirus crisis, will lead to a stronger polarisation of the labour market.

The Hungarian labour market will be most affected from the 2030s onwards, due to the effects of artificial intelligence, and the current developments will have an impact to such an extent that they will affect a significant number of populations, causing visible social changes. One of the effects in question may certainly be the phenomenon of long-term unemployment, as analysed above, for which we have long-term research findings on its detrimental effects on society as a whole. Some of these have been reviewed above. As for the three waves in which artificial intelligence will exert its effect on the Hungarian labour market, the expected trends are summarised in *Table 1*.

Table 1. The effect of artificial intelligence by several independent background variables and automation waves on the example of the Hungarian labour market
Source: Summary made by Keszi based on the following data: PWC (2018), PWC (2020)

Automation Waves	Time	Work Tasks/Activity	Sectors	Gender	Age
Algorithm wave	2020–2025	Automation of simple computational tasks and analysis of structured data, affecting data-driven sectors such as financial services	Data driven sectors such as finance and insurance, information and communication, and professional, scientific and technical services	women	young
Augmentative wave	2025–2030	Dynamic interaction with technology for clerical support and decision making. Also includes robotic tasks in semi-controlled environments such as moving objects in warehouses	The financial and insurance sector will continue to be highly impacted, along with other sectors with a higher proportion of clerical support, including public and administration, manufacturing, and transport and storage	women & men	middle
Automomy wave	2030–	Automation of physical labour and manual dexterity, and problem solving in dynamic real-world situations that require responsive actions, such as in transport and manufacturing	Sectors such as construction, water, sewage and waste management, and transport and storage with the advent of fully autonomous vehicles and robots	men	middle & old

Of the diverse industrial activities, manufacturing is considered to be the sector with the highest exposure in terms of labour market supply over the next ten to fifteen years. According to an estimation from current data, 384,500 jobs will be affected here through the impact of artificial intelligence. I consider all this to be a particularly harmful and deadly process for the Hungarian industrial structure. I am referring here to the fact that the automotive industry, which accounts for a large share of Hungarian industrial production, barely contains any added value. There are no innovations in Hungary, thus the added value in these sectors is extremely low. In fact, Hungary is able to operate as an assembly plant for foreign, mostly German, multinational companies in the automotive industry. It is not enough to attribute the cause of this phenomenon to the traditionally intensive trade relations between Germany and Hungary. The rise of low value-added workflows is also supported by policy-making. The fate of the younger strata of workers, who are on the verge of entering the labour market and who imagine their future as remaining in Hungary, will become even more dangerous, and the polarisation of the labour market will become even sharper. From the 2030s onwards, these jobs will be triggered at a rapid, accelerating pace, by robots backed by artificial intelligence, rendering the position of mass labour redundant.

Hungary's competitive advantage in the cheap labour market is being lost. The workforce represents masses of people who will not be able to mobilise in any other sector, and they face a serious threat of long-term poverty. If, however, they are able to change jobs, the horror of long-term unemployment, as seen in the Beveridge curves presented earlier, may weigh on younger generations. During an automotive wave, the more experienced strata of the labour market (after 10-15 years) are beginning to be increasingly weighted by the process of job shortage. Among them, the risk of further deterioration of poor health, which is typical of the Hungarian population, must be taken into account. Regarding the deteriorating health status of the Hungarian population, see WHO & Dr. Gaál, P. et al. (2016).

Increasing mortality rates will have to be expected, and health care expenditure on the population may soar, and the social sector will not be able to address the resulting additional tasks. From a societal point of view, the negative trends presented above due to the increasing polarisation of the labour market are expected to intensify. An increase in the poverty trap, a deepening of political divisions, rising crime rates and a deepening increase in health and mental problems are all expected to occur.

Conclusions and discussion points

As every aspect of human life will be affected by the labour market impact of artificial intelligence, several facts and tendencies, which have so far been interpreted as evidence, should, in the near future, be considered and discussed not only as scientific questions but also as social issues. Some of these debates have already begun, among them issues raised in this article, while others have not yet been proposed as the subject of debates in the near future.

In the above study, regarding the American and Hungarian economies as case studies, some economic and related sociological processes were examined. The analyses were framed by the labour market effects of developments in artificial intelligence, which were compounded by the general, unprecedented economic

processes caused by the new coronavirus, which we expect to have a decisive presence in the foreseeable future. Each trend will be accompanied by an accelerating increase in social inequalities. The presented processes – also in connection with the not too distant future of the labour market – will be given priority, as half the work activities will disappear or be transformed. We expect processes to begin, for which there are currently no established solutions. As most occupations will be involved in the emerging processes, we can expect comprehensive societal changes in which all subsystems and actors in society will be involved.

(1) In connection with the rapidly increasing polarisation of the labour market, we raise the question of the feasibility of introducing a general basic income, which has already occurred in many places and forms in the world, its long-term applicability and effects being unclear.

(2) It is important to rethink and revise the review of education systems, especially in countries with a similar level of economic development to that of Hungary, as current education models have limited consideration of the rapid inflation of knowledge. In knowledge-based economies, rather than providing 'longlife learning,' the emphasis should be on teaching learners how to learn effectively and quickly.

(3) It would be of paramount importance for each state to develop specific state strategies in which artificial intelligence, the labour market and education systems coexist, and policy activities related to them coexist in parallel. In addition to the above, of course, we need to rethink a number of other issues in the coming years. The above three issues raised arbitrarily take place in parallel with the popularisation of political systems in the world, which further increases the vulnerability of social systems, and the risk level and vulnerability of social groups with low advocacy capacity.

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As Seamus Hegarty elaborated: 'In an ideal world there would be no special schools since every child would receive an appropriate education in a local community school. No country is near achieving that goal, apart perhaps from Italy, and it has to be assumed that special schools will feature on the map of special education for some time to come. But that does not mean they can continue unchanged. Special schools have many advantages – concentration of expertise in teaching pupils with various disabilities, modified curricula and programmes of work, adapted buildings and equipment, training opportunities for staff, and links with local employers and post-school training agencies. These are the very things whose absence from ordinary schools makes them ineffectual in educating pupils with disabilities. The challenge to special schools then is to find ways of sharing their expertise and resources, and of embedding them in a wider educational context. Some special schools have already begun to develop outreach programmes. This can entail setting up working links with neighbourhood ordinary schools where staff and pupils are shared.'

'Some special schools act as resource centres, providing information and consultancy to local schools, organizing support services for families and contributing to in-service training activities. Discharging these functions successfully requires considerable changes within special school staff. New skills must be developed and new attitudes fostered. Transmitting a skill to others is not the same as exercising it oneself, and operating across several schools or in the community is very different from working in the closed confines of a single special school.'

'The most important changes required are attitudinal: staff who are jealous of their autonomy and intent on maintaining lines of professional demarcation will not set up effective collaboration. There must be a willingness to move beyond existing institutional bases and any status that may go with them, and to work co-operatively in whatever new structures may be advised. The upshot of all this is that special schools of the future could be very different from now. Emphasis would move away from educating limited numbers of pupils in relative isolation towards acting as resource centres. The latter could encompass curriculum development, in-service training, the collection and evaluation of equipment and computer software, and specialist assessment, as well as advice and consultation on all matters relating to the education of pupils with DISABILITIES. These resource-centre functions are important in improving the standard of special educational provision regardless of where it is provided. By capitalizing on available experience and establishing a bank of information, materials and expertise, this offers a powerful model for making best use of frequently limited resources. If special schools have to make changes, ordinary schools have to undergo revolution. Ordinary schools have generally failed pupils with DISABILITIES and major school reform is necessary before they can make adequate provision for them.'

'This reform must operate at two levels: the academic organization and curriculum provision of the school and the professional development of staff. The former requires rethinking the ways in which pupils are grouped for teaching purposes, the arrangements that schools can make for supplementary teaching and the modifications to the mainstream curriculum that teachers can make so as to give pupils with DISABILITIES access to it. All of this forces major changes in teacher behaviour. Attitudes, knowledge and skills must all be developed to create and sustain a new kind of school where those previously disenfranchised are given an equal say and narrow concepts of normality are discarded.' (Hegarty, 1994, 16). Hegarty continues: 'Preparing pupils with DISABILITIES for adult life is a particular challenge for ordinary schools that run integration programmes. Many special schools have devoted great efforts to this area and have well-established leavers' courses. They also benefit from the greater control they can exercise over pupils' environments and exposure to the outside world. Ordinary school staff have to find ways of ensuring that pupils do not miss out on the systematic preparation they would receive in a good special school, and they must often do so with fewer resources and in contexts that allow for less control.' (Hegarty, 1994, 45)

The debate persists and has gained new impetus fuelled by the controversial findings of follow-up research conducted on current experience of integration in schools. A UNICEF Innocenti Insight study of 2005 highlights the situation in CEE/CIS countries and the Baltic States: 'The education debate is still very active. There are arguments that integration of children with disabilities into mainstream classrooms can be a drawback for some students, both disabled and non-disabled persons. That may be a question of adequate resources – a persistent and important issue. There is a case in the CEE/CIS region for linking special education schools with local mainstream schools to help to break down the tradition of segregation.

'In some Western countries, there is a trend to co-locate special schools on the same site as mainstream schools in the belief it provides the 'best of both worlds'. Serious efforts towards integration are being made in some countries, notably Bulgaria, Hungary, Romania and Macedonia.

'Where integration has occurred, it is largely accomplished by being at the same location as and/or mixing with mainstream students, rather than integrated or inclusive classrooms. Curricular integration, where children with disabilities learn together in the same classrooms with the general student population, is still seldom seen in the region – and where it is, it is often unplanned and, therefore, unsupported. In Albania in 1996, as the Country Report notes, for the first time 'the integration of pupils with disability in regular school' became a declared policy goal – although the details of how to do this were not specified. A recent survey by the Albanian Disability Rights Foundation found that the integration of children with disabilities was quite limited and done largely in response to pressure from parents of children with moderate disabilities. In Hungary, where the special school system was retained, enrolment of children with

disabilities in mainstream schools started spontaneously in the mid-1990s. However, schools 'did not have the technical, pedagogical and conceptual conditions necessary for the integrated education' of children with disabilities.

'The resistance of attitudes against the integration of children with disabilities in mainstream schools cannot be underestimated. In echoes of the 'charity' treatment of children with disabilities, parents and others may support integration only conditionally, e.g., the proviso that including children with disabilities in a regular classroom does not detract resources from non-disabled students. Additionally, there is substantial passive resistance incumbent in existing education systems and other social services.' (UNICEF, 2005, 20).

In the literature we can find several examples: 'Although parents were happy with the progress of their child at the school, they were disappointed about social outcomes. This was in part due to the fact that many children with disabilities came by bus from out of catchment: they had to make a new friendship base, a[illegible]portunity for carrying it on out of school hours.' (Avramidis, Bayliss & Burden, 2002, 150)

The UN[illegible]ntinues with a quote from the Lithuania Country Report of 2002: 'Policy, law and practice have been linked in Lithuania to make strong progre[illegible]needs education. The 1991 Law on Education recognized the right of children with special needs to be educated in schools closest to home. S[illegible]ees started using more restrictive criteria for accepting children into special schools – a crucial gatekeeping function. Amendments in 1998 g[illegible]definitions of the role of pedagogical-psychological services in assessing special education needs and gave parents and children the right to choose the form and place of education. The law stresses integrated education and the right of persons, even those with complex or severe disabilities, to be educated.' The UNICEF study then refers to staffing issues: 'The lack of teachers who are adequately trained to work with children with learning