OPPORTUNITIES AND OBSTACLES FOR HUNGARIAN ECONOMIC PLAYERS ALONG THE ROADS BEING PAVED BY 4TH INDUSTRIAL REVOLUTION

M.Sc. Megyeri E. PhD.[1], M.Sc. Somosi S. PhD.[1],
Faculty of Economics and Business Administration – University of Szeged, Hungary[1]
emegyeri@eco.u-szeged.hu, somosi@eco.u-szeged.hu

Abstract: *The objective of the study is firstly to show the start of the spreading of the new technologies and solutions related to the 4th industrial revolution in Hungary. Although Hungary was considered among the more traditionally driven economies (Dujin et al, 2014), there are positive signs in the adapting knowledge-intensive technologies, advanced manufacturing and production solutions, improvements in the interconnectedness of the activities and in the other fields of digitalization, and finally the developed upgrading potential of local actors within a Global Value Chain. The study also introduces recent economic policy developments, policies and plans which were/are targeted to have a multi-level impact on Hungarian industrial/economic performance and of course should comply with present EU-level strategic thinking considering industry. These positive achievements in connection with latest technological revolution can be observed in each segment from primary to tertiary sectors, at companies from all size categories (start-ups, SMEs, large enterprises) and from both local and foreign ownership types. Despite the several positive signs on micro level, we still cannot project the whole economy with all its players in Hungary to dynamically move and develop along the IR 4.0 path in an integrated manner. There is about an average 20 years fallback in the level of technology and human capital readiness. Furthermore, we cannot project the observed success stories or the positive macro level short term impacts to be sustainable in stabilized way. However, the cohesion process of Hungary is undoubtedly on its track, appropriate policy-level answers still will be required.*

Keywords: 4th industrial revolution, technology development characteristics, SMEs, MNEs,

1. Introduction – objectives

In times of profound transitions based on knowledge, technology and thus transforming business models, adaptability and responsiveness are both integral elements of future success of micro players, private or public actors and even of countries. On a supranational (i.e. European Union) level the relevant indicators – like the DESI, The RB 4.0 Readiness Index (Dujin et al. 2014), or the 'Industry 4.0 Readiness indicator' (Kuruczleki et al. 2016) – show an acceptable average performance, but when the performances are measured on Member States level the differences become visible and remarkable. Beside the unfavorable macro data of Hungary, the case studies and interview from the field, from all segments of the Hungarian economy show a remarkably different situation. There are evidences for the beginning of the improved adaptation of knowledge-intensive technologies, advanced manufacturing and production solutions, improvements in the interconnectedness and in digitalization, and finally the developed upgrading potential of local actors within a Global Value Chain (GVC).

Despite these positive micro level signs there should be an overall, macro level improvement induced in Hungarian performance in adapting and moreover developing Industry Revolution 4.0 (IR 4.0) related activities. In the following the most significant and relevant legs, fields of IR 4.0 will be highlighted. Later on, the relevant Hungarian performance will be presented, which shows approximately 20 years lag compared to the better performing Western-European states. As a necessary response to the macroeconomic facts we summarize the policy actions so far driving the development in the domestic IR 4.0-related performance. They vary from public actions to targeting/supporting private strategies of business players from all – multinational (MNE) and small and medium sized enterprises (SME) – levels.

2. Industry 4.0

In general, we can speak about an industrial revolution when due to new technology solutions the effectiveness of production systems increases considerably. Prior to IR 4.0 there were 3 other industrial revolutions; however, the length of time elapsed between two revolutions decreased (Nagy 2017). While between the 1st and 2nd ones there was about one century elapsed; but between the 3rd and 4th ones just about one decade passed. It is clear that innovations and technologies affecting economy to a great extent evolve at a incresing pace (Megyeri, Tabajdi 2019).

There are numerous discussions regarding the 4th Industrial Revolution both among academics and practitioners. The occurrence of this revolution can be partly devoted to the expansion of globalization and to the technology changes that affect all the spheres of life (Sniderman 2016). We do not know how long this will last; what milestones have we already passed and what others are in front of us. But it is sure that due to this new industrial revolution the global economy and society is going to change intensively. This is why it is inevitable to organize these changes and processes and to identify them in the different aspects of practical economic life.

BCG (Rüßmann et al. 2015) defined IR 4.0 along the following pillars or characteristics autonomous robots, Big data, Augmented reality, Industrial Internet of Things, Additive Manufacturing, Cloud computing and storing, Simulation, System integration and Cyber security. These parameters were identified as unique selection of technology related items which together create a special competitive edge for leading and progressive companies at time of the study (Rüßmann et al. 2015).

3. Industry 4.0 – current status in Hungary

Before analyzing the preparedness of Hungary in advanced technologies and IR 4.0-related activities it is worth examining the overall economic performance. Though Hungarian *real GDP per capita* fluctuated in recent years, it tended to increase lately and thus maintaining an average level (EUR 12500) within the CEE region. The GDP growth rate peaked above 4% in the second half of 2018 and the projections accepted by the European Commission for 2019 are again over 3.5%. Hungary is an export-oriented market economy with a high emphasis on foreign trade producing high trade surplus. Machinery and equipment, transportation related products, chemical products, plastics and rubbers are the main exported goods. Major industries include motor vehicles, information technology, chemicals, metallurgy, machinery, electrical goods, pharmaceuticals and food processing. Both domestic and foreign companies are interested in these sectors. The *FDI* inflow to the country shows an increasing tendency in the post-crisis period (Hungarian National Bank Statistics). However, since Hungary appears both as an FDI receiver and an FDI donor country, so the 'FDI flows intensity' (the average of yearly inward and

outward FDI flows divided by GDP) reflects a better picture about the country's international embeddedness (Eurostat). In the latest years it was between -24,2% (2015) and 37% (2016) in relation to Hungary's GDP. When a country's preparedness for the new age is under investigation, the potential to put value into all activities are of highest importance. Based on the "RB 4.0 Readiness Index" the industry/manufacturing value added will be shown to get a better picture about Hungary's "industrial excellence" and "value network" (Dujin et al. 2014). In the first few years of the post-crisis period there has been a slight decrease in the gross industry value added in Hungary, but it was in line with the EU-average performance. This shows the high level of reliance of Hungarian industry appearing as a "factory economy" on the overall German economy, which on an international level take the role of a so-called "headquarter economy" (Baldwin 2012, Szalavetz 2017, Vladimirov 2017, Stöllinger et al. 2018). Recently the Hungarian data in the % change of gross industry value added overperforms the EU's average but remains under the other countries' performance of the region. This weaker result can be explained by the followings.

On a European Union level Hungary belongs to those that are lagging behind with its 23rd position in the overall *Digital Economy and Society Index*[1]. In partial indicators like the "Integration of Digital Technology by Businesses" (showing the general digital preparedness of Hungarian economic actors) Hungary obtained only the 25th position. Furthermore, if we see the "Business digitization Index" Hungary's position was even worse, only the 27th among the MSs in 2018. The *RB 4.0 Readiness Index* also put Hungary into the fourth group, which consists of the countries of the CEE region called "traditionalists", having a sound industrial base, with a few of them launching certain initiatives for IR 4.0 (Éltető, 2019). These are totally in line with the findings of Kuruczleki (et al. 2016) which also put Hungary into the lowest performing cluster of the EU with Bulgaria, Estonia, Croatia, Italy, Malta, Romania, Slovakia. This performance was evaluated based on indicators like GERD, Community trade mark applications, total R+D personnel and researchers, tertiary education, ICT specialists, etc. So, Hungary is not performing good in an average in those fields where value could/should be added within the industrial activities.

These numbers also reflect the – rather missing or sled aside – recent transform of *workforce mix* ranging from Creative (CRE), controlled problem solving (CPS) and Taylorian (TAYL). Meanwhile the EU average, Estonia (which is usually called best performer from digital perspective), Lithuania and Slovenia improved their occupation structure in favor of creative workforce, the Hungarian (with Latvia and Poland overtaking it) transform in occupation structure showed lately an increase in the Taylorian-type occupations (Makó et al, 2016). These macro data should however be further detailed by numbers from other sources, like the Hungarian Chamber of Commerce and Industry, because they registered a 16% increase in those, who are active in scientific and engineering sector from 2010 to 2017.

The lag in technological advancements, the missing investments into digitalization, and the above-mentioned transform in the workforce mix altogether explains the recent changes in real labour productivity of Hungary, especially its fallback compared to other MSs from the region. Hungary (5.5%) has not even performed the EU-average increase (6.5%) in *real labour productivity per person* compared to the performance of 2010. With this level of increase the absolute lag in the *nominal labour productivity per person* is still only 67.3% of the EU28's performance and it is recently declining from a peak of 74% in 2011. In the meantime, some countries from the CEE region are trying to close their gap in the nominal labour productivity compared to the EU with a real labour productivity increase higher than 20%. So, even if Hungary has still a better position, the tendency is not promising regarding the changes in labour productivity.

All these above-mentioned factors contribute to the local and national conditions of entrepreneurial conditions. The index of the GEDI (The Global Entrepreneurship and Development Institute) called GEINDEX (or recently GEI) gives a more complex, but in the same time detailed picture by adding a mix of further factors: attitudes, resources, and infrastructure summarized as entrepreneurial "ecosystem"[2]. In their yearly report it is possible to see the transform of state capabilities, which in case of Hungary is not promising. Compared to 2014, the recent (Ács et al. 2018) health of Hungarian entrepreneurial ecosystem shows a worse picture. Only 'opportuntiy perception', 'human capital' show a slight improve and the partial indicator called 'opportunity startup' kept its earlier position. All the other fields of entrepreneurship, like 'risk acceptance', 'networking', 'technology absorption', 'product and process innovation' worsened in the recent 4 years. So, in our view not only the market but the state should also be involved in developing the attitudes, abilities and the absorption capacities of economic actors to improve their future productivity and thus competitiveness.

4. Policies driving 4th Industrial Revolution in Hungary

During 2014-2020 the European Structural and Investment Funds (ESIF) made 100 billion EUR available to Member States to finance investment in innovation, in line with industrial policy priorities guided by the concept of "Smart Specialisation" (originally from Foray et al. 2009) to concentrate investment on their comparative advantages across European value chains (EC 2014). The recent years have brought not only the renaissance of industry, but also the broader interpretation of innovation, research and development driven economy. At the same time, the European Union made efforts to move forward from the era of "recommendations" to a real integration on a strengthened common industrial policy (Voszka 2019). Hungary, even with its Traditionalist position fits into this integration picture. Traditionalist country means that the share of manufacturing in GDP is high but the countries readiness for the 4th Industrial Revolution is low (Dujin et al. 2014, Pelle – Somosi 2018). It is inevitable that Hungary's position regarding Industry 4.0 should be improved: there are several kinds of actions and plans that aim at the development. Triggers are partially coming from policy makers; but also from the business actors. Large multi- and transnational companies have their own internal special programs which are incented by external funds to participate in IR 4.0 development programs. These programs aim at the integration of SMEs and start-ups to the supply chains and value chains of MNEs by improving their readiness for technological changes and increasing their adaption ability so that they will be able to conform the new technologies and enhancing their competitiveness. SMEs and start-ups must have strong external, institutional triggers and funds to be able to take part and implement technological and digitalization related developments (Megyeri – Tabajdi 2019). It is challenging to overcome, therefore several strategies were implemented to boost developments in this field. In February 2016 a strategy for industrial developments initiated by the Ministry for National Economy was introduced which is called the Irinyi Plan, including the most important directions for economic development 2016-2020.This plan acts also as a framework for the development of an Industry 4.0 strategy in all key sectors concerned (Nick 2017).

The Irinyi Plan specifies the Hungarian economic development strategy to increase the share of industrial value-added in GDP from 23.5 % in 2016 to 30% in 2020. The automotive industry is called

[1] https://ec.europa.eu/digital-single-market/en/desi

[2] https://thegedi.org/global-entrepreneurship-and-development-index/

out as a leading part of the growth; beside the healthcare, tourism, food industry, the IT sector, the green economy and the sector of shared service centers (SSCs) are named as focus development sectors (Nick 2017). There is a goal of improving the processing industry as well which target should be achieved by the use of new technologies, the improvement of energy and material efficiency and the higher use of Hungarian resources (Megyeri – Tabajdi 2019).

The main aim of the Irinyi Plan brings the re-industrialization to the local environment which is in line with the EU directions. Funds to deliver the Plan gains funds to fuel the support and incentives in the Hungarian environment. Although, the Hungarian policies prefers traditional manufacturing activities and industry support methods, it can predict a vulnerable and lagging economy, which is different from European declarations, but paradoxically required to be maintained or strengthened by both the EU's developed areas and multinational companies (Voszka 2019).

To reach the set strategical targets several organizations were set-up. One of them is the Excellence in Production Informatics and Control (EPIC) (Fülep et al. 2017). The goals of EPIC are to improve innovation culture in Hungary, to speed up the innovation process and to introduce and promote new technologies and methodologies addressing many fallbacks identified in the DESI index. EPIC specifically supports the improvement of SME competitiveness and the strengthening of industry relations and knowledge transfer from a practical point of view. Among its objectives are: improving high-quality trainings and constructing and promoting sample solutions for the 4th Industrial Revolution (Nick 2017). All economic actor changes their development system from extensive to intensive developments. This is particularly true for SMEs that in many cases are using traditional methods. SMEs are affected negatively by both their lack of knowledge and lack of capital which are critical in the realization of high value-added production methods.

The IR 4.0 development plans in Hungary have a special focus on SMEs and the help and support given to them. Several programs give the opportunity to SMEs to implement their own development ideas, while others help them in conversion (Ritter et al. 2016). One such program, called the Program of Modern Entrepreneurs, is organized by the Hungarian Chamber of Commerce and Industry (HCCI). This program supports the IR 4.0 developments of SMEs with professionals and consulting. Moreover, the Industry 4.0 Model Smart Factory program was established also, the aim of which is help Hungarian suppliers of multinational companies to meet the growing needs of MNEs regarding the quality of products and services. Five sample factories were set up to familiarize and prepare SMEs for the use of IR 4.0 technologies. The representatives of SMEs can see these technologies in their real-life operation in functioning factories. As a part of this program, the participating SMEs can test their readiness for Industry 4.0 but also can find firm specific ideas to foster and motivate their aspiration to improve. On these events, SMEs can meet new technologies and the overall IR 4.0 concept presented for them in a relevant customized way. This helps achieve an important national goal of increasing SMEs readiness for IR 4.0 so that they would have better chances to become suppliers of multinational companies (Megyeri – Tabajdi 2019).

In our empirical study we wanted to find out how SMEs respond to IR 4.0 challenges. We used a quantitative method as we used questionnaires distributed among Hungarian SMEs. 21 selected SMEs were asked to evaluate the importance of the attributes of the 4th Industrial Revolution on a 1-5 Likert scale. We used 14 IR 4.0 characteristics as evaluation aspects: During an empirical study of Hungarian SMEs, we observed that SMEs capture the basic, traditionally developed elements of IR 4.0 such as collecting large amount of data; being prepared for small scale customization; and work closely with partners in the supply chain to improve responsiveness while reducing cost. It also means that the newest technologies resonate to all respondents as less important factor during their operations. Robotization, 3D printing or additive production were among their least preferred area of IR 4 development. SMEs were also less sensitive toward improving energy efficiency through intelligent energy utilization methods due to its limits on investment returns. Concerning SMEs, we also found that all standard deviation above 1.1, which indicates that there is no alignment and agreement across the respondents. Companies in this size face a variety of challenges which have a diverse link to the fourth industrial revolution. SMEs consider 3D printing and additive production among the least important but with high standard deviation, which indicates, that there are some companies, who are impacted and involved in the use of technologies.

5. Opportunities in policy development in light of IR 4.0

In case of Hungary, a traditionally FDI-relying country, the shift from earlier policy should start with the re-thinking of FDI-attracting policy. Based on earlier experiences in the digital age Hungary may still consider FDI to be an important engine/factor of development. Thus, beside other FDI-hosting countries, Hungary also tries to diversify its position as a destination country for outsourced activities of production. These locational decisions can be based on capabilities of local actors; complete supplier ecosystems may evolve around the local affiliates of global companies; increased knowledge-intensive activities of local affiliates are seen after global innovation-oriented companies enter the market (Szalavetz – Somosi 2019). Nevertheless, if FDI is still considered to be the main engine of development, the policy should react and change the traditional way of "FDI-related development". If countries like Hungary – with the intention of catching-up – lose their earlier wage advantages and attract investments only by reaching a certain level of development, the economic policy should act like a developmental state (Csáki, 2009; Ricz, 2016) to further strengthen those factors – education, ICT infrastructure, readiness to adapt to advanced technologies, etc. – that are necessary in attracting FDI. These support the earlier findings of Ács and Szerb (2009), about the role of state: *"institutions need to be strengthened before entrepreneurial resource can be deployed to drive innovation" (pp. 6.).* But innovation and digital development is not solely about (or for) the industry. The economic policy which is traditionally placing manufacturing in the center should be somehow transformed. The potentials of upgrading from the digital-based servitization of manufacturing should be emphasized more (Szalavetz – Somosi 2019). This would also fit the aforementioned "smart specialization" concept of the EU, which brings in the scope and thus the tools of cohesion policy as well.

At this point, the usual question appears. What should the state focus on: domestic industry or rather the potential to attract FDI? Strengthening locational advantages of Hungary requires more efforts since advantages that determine the hosting of outsourced manufacturing activities presumes higher development level than ever. If this is accepted, then it is unambiguous that supporting the digital maturity of companies – be them SMEs or local affiliates of MNEs sometimes through their workforce basis – that are capable to join a global value chain is necessary. In case of an upcoming location decision from the part of a multinational company, the existence of a strong and digitalized supply background appears as a strong advantage. So, *improving the digital preparedness of local firms, subsidies appearing as later suppliers and the overall society can attract more FDI.*

6. Conclusions

As we presented the latest performance of Hungary in relation to certain indicators of economy, adaptability and entrepreneurial

health, we saw that despite some best practices and pieces of evidences from the field, the recent situation is not promising in general. If FDI-related development targeting further investments made by MNEs is still considered important in Hungary, the governance should focus on improving the overall environment and the overall digital preparedness of the country and the society as well. We consider this as the only solution in future upgrading: building upon digital-based servitization in manufacturing. Reaching a certain level of overall development thus requires strengthened institutions.

Such improvements and changes on the policy and institutional level concerning servitization of manufacturing focus and digitalization impacts large and small players as well. However, SMEs are facing scarce resources and capital to focus on, and drive IR demanded changes. To encourage their development, custom specific programs need to be able to assure their competitiveness on the long run. While multinational enterprises have their internal drive for continuous improvement, they appear to have different specificities in thus strategies based on the decisions of their headquarters. In the meantime, SMEs rely on a greater extent on their partnerships and any additional external support and programs to stay competitive which is a must considering the overall economic development of the country. At this point the whoever government has the responsibility to decide whether to appear as a developmental state, but of course always within the relevant but constantly changing international framework.

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