STUDY ON FACTORS INFLUENCING HUNGARIAN COMPANIES' INNOVATION ACTIVITIES

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Authors: Palócz, Éva

Vakhal, Péter

Matheika, Zoltán

Gebei, Tamás

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KOPINT-TÁRKI
Konjunktúrakutatási Intézet Zrt.
1112 Budapest, Budaörsi út. 45.
1518 Budapest, Pf. 71.
Telefon: 309-2695
Fax: 309-2647
E-mail: info@kopint-tarki.hu
www.kopint-tarki.hu

Content:

Short summary

Hungary's position in various innovation rankings of the EU (European Innovation Score-board, Community Innovation Survey, Investment Survey of the European Investment Bank) roughly corresponds to its level of development: out of the 28 EU Member States, Hungary occupies the 4th-7th place from behind.

The survey conducted in the framework of our research demonstrated that

- 80 percent of firms surveyed conducted smaller or larger innovations in the past three years or at present. That is a much higher rate than that in the CIS survey. One explanation of this difference might be that more attention was given to the concept of innovation in our survey which raised respondents' awareness.
- 60 percent of *product or service* innovation was virtually completely the same as products already on the market, while only 5 percent was completely new. Thus, only a small portion of companies conduct innovation to overcome competitors, most innovation are of a 'follower' type.
- Only about 10 percent of respondents introduced any changes in their production *process* or/and *marketing* activity, and almost one-third of the respondent companies implemented organisational innovation.

A slightly different picture emerges in the light of the question of how companies perceive the need for innovation. *Small entrepreneurs* (less than 19 employees) *tend to believe that the market is not interested in any innovation*, while larger firms are convinced that to stay on the current market, innovation is definitely required.

- Not surprisingly, respondents identified skilled labour shortages as by far the biggest barrier to innovation (82%). This is followed by market uncertainty (50%) and problems of funding (44%).

The survey was supplemented by interviews with corporate managers. The interviews largely supported the results of the survey and provided a wealth of additional information.

Based on the survey results and the conclusion form the interviews, the top three barriers to innovation in Hungary could be identified (not in hierarchical order):

- Most companies which are not innovative have the belief that innovation is not needed at all. This comes from management reluctance, lack of knowledge and from the lack of a long-term strategic approach. Although the macroeconomic environment of innovation cannot be ignored, the innovation capacity of companies is highly dependent on the professional skills and approach of the firm managers.
- Lack of relevant skills: although labour shortage is a severe factor in Hungary, which innovation should in theory alleviate, proper knowledge on this subject is often missing. This is rooted in the anomalies of the education and training systems. A weak competitiveness is also a relevant factor, as it contributes to brain drain, while the economy struggles to attract modern expertise. A large part of the growth relies on cheap labour, regional disparities are high, particularly in productivity.
- Unpredictability of public innovation management and support institutions: The public institutions aiming at support of conducting firm innovation (and/or R&D) have frequently changed in recent decade. Not only the name and organisation of these public institutions have changed, but also the concept has often gone through significant changes.

1. Introduction and Summary

Without innovation there is no prosperity. Innovation has always been a major driver of development throughout history. Its importance is clearly evident, since innovation is now a key element of political discourse and economic literature. Renewal of products, production, organization and sales have always been important prerequisites for maintaining or improving competitiveness. However, in the last two to three decades, development of digital technology has accelerated to such an extent that it poses a constant challenge that companies cannot meet without innovation. Thus, not only the development of digital technology but also the pressure to innovate is accelerating. Every company that wants to keep its market in the longer run, must carry out smaller or larger innovations and use new digital technologies. Anyone who does not do so will sooner or later fall out of competition.

The purpose of the study is to provide detailed insight into the key factors and components of innovation activity at Hungarian companies. How can Hungarian companies keep up with the accelerating renewal of technology, business solutions and basically with adapting to the constant challenges to innovation?

In the study we apply the traditional Schumpeterian approach to innovation embodied in the Oslo Manual (2018) which is the "bible" of innovation research. It makes a distinction between product innovation and business innovation. The latter includes production process; distribution and logistics; marketing and sales; information and community systems; administration and management. These types of innovation are obviously not homogeneous. Product innovation, especially creating a brand-new product, even a revolutionary new product, requires much more effort, knowledge and funding, than e.g. a minor change in administration or marketing. Yet, this concept is based on the consideration that every company should implement the appropriate innovation that is needed to improve or maintain its market position.

Four sources and methods have been used in the study in order to map the innovation performance of Hungarian firms, their motivations, attitudes and capabilities.

Section 1 provides an overview of international literature, in particular those parts of innovation theory that are relevant to Hungarian businesses. Is innovation a *linear* or a non-linear process; what is the role of *firm-specific knowledge* and the *attitude of the management,* as well as *macroeconomic and institutional conditions in innovation?* An important concept is that of Freeman (1987), who found that the innovation system of a given country is directly related to the *complexity of the network of participants* and any policy measures that have an impact on the introduction of new technologies. Since in the follower countries new technologies are usually introduced not by creative but by adaptive innovation, the broad definition of innovation system includes the policies aimed at attracting FDI and intellectual property protection legislation.

It should be noted that the notion of innovation and R&D is often confused in the literature, which may lead to different conclusions.

Section 2 processes different statistical data which show the innovation performance of Hungarian firms in regional and European comparison. According to the European Innovation Scoreboard (EIS) which measures the macro economic conditions to innovation, Hungary belongs to the *moderate innovators*. The European Community Innovation Survey

(CIS), based on a corporate survey, shows Hungarian companies in a worse position: the fourth place from the bottom in the EU28.

The Investment and Financing for Investments survey of European Investment Bank *(EIBIS)* also provides valuable information on the innovation performance of European companies. It shows that investments of Hungarian companies focus less on *intangible investments* (R&D, IT and software, training of employees and organizational improvements) than the other V4 countries.

Concerning the expenditures on *research and development*, Hungary's position in the region is better than its rank in innovation. However, this relatively better position served as a base to a large extent to the research and development positions of multinational companies (about 60 percent of total business R&D). The dominance of foreign companies in Hungarian R&D is far from unique in the region: it is rather strong across the whole Central Eastern European (CEE) region.

Since digitisation is the major driver in present innovation trends, the Digital Economy and Society Index (**DESI**) is an important indicator of innovation. Hungary stays in the 6th lowest position out of 28 in the rankings. This position can be explained mainly by two components: the rare utilisation of digital technologies in the operation of Hungarian firms as well as by the ineffective public digital services. Thus, Hungarian companies are under double pressure in information technology: they themselves are less likely to use digital technology solutions, while state bureaucracy is placing a greater burden on them due to poor public e-services in administration.

Section 3 analyses the data of our company survey, conducted in the framework of this study. The main conclusions of the survey:

- 80 percent of firms surveyed conducted smaller or larger innovations in the past three years or at present. That is a much higher rate than that in the CIS survey. One explanation of this difference might be that more attention was given to the concept of innovation in our survey which raised respondents' awareness.
- 60 percent of *product or service* innovation was virtually completely the same as products already on the market, while only 5 percent was completely new. Thus, only a small portion of companies conduct innovation to overcome competitors, most innovation are of a 'follower' type.
- Only about 10 percent of respondents introduced any changes in their production *process* or/and *marketing* activity, and almost one-third of the respondent companies implemented organisational innovation.
- Concerning the *regional aspect* of innovation, no evidence of a regional divide was found. This suggests that firms are rational, and their views coincide on the exogenous factors. This implies structural problem government policies affecting innovation like as education, infrastructure etc. As these factors are locked for every actor on the market, it is not unanticipated that all firms evaluate them similarly. Companies which are not innovative have the belief that innovation is not needed at all. This comes from management reluctance, lack of knowledge and from the lack of a long-term strategic approach.
- A slightly different picture emerges in the light of the question of how companies perceive the need for innovation. *Small entrepreneurs* (less than 19 employees) *tend to believe that the market is not interested in any innovation*, while larger firms are convinced that to stay on the current market, innovation is definitely required.

- Not surprisingly, respondents identified skilled labour shortages as by far the biggest barrier to innovation (82%). This is followed by market uncertainty (50%) and problems of funding (44%).

Companies have a negative opinion on how supportive the government is towards innovation, because the average score is 2.51 (scale between 1-5). However, innovative enterprises are rather neutral to the institutional environment, not satisfied, but not discontented either. This suggests that innovative and successful companies can decouple themselves from policy influences. **Section 4** summarises the results of the deep interviews conducted with company executives from different sectors, regions and representing different firm sizes. Although company executives were rather critical towards institutional framework and public policy on R&D and innovation as well as on the frequent changes of the education system, they emphasised the importance of *firm management* in innovation. They were of the opinion that nowadays no company can rid itself of the need to innovate, mainly due to the challenges of *digitisation*. The general view was that the application and continuous renewal of IT solutions is not essentially a question of financing, but a function of the *attitud*e of the manager. Digital innovation is not an opportunity but a must for every firm. From this point of view, the emigration of young generations with a much greater affinity for digital technologies has dramatic consequences for companies' ability to innovate. Thus, firm managers who think that "innovation is not needed by the market" are seriously mistaken.

Labour shortage and rising wages are additional forces to innovate. Current trends pose severe challenge for firms, mainly SMEs. They can keep up with rising market wages only if they increase productivity through innovation. The last years brought an end to the era in which non-innovative companies were able to vegetate in some way. Innovation became a watershed between the existence of the firms in the future. The existence of non-innovative companies has become dubious. And the key words in this respect are knowledge and continuous trainings. Companies that do not invest in training the workforce are also lagging behind in innovation.

At present, the lack of *funding* is only rarely the sole cause of the failure of a product initiative. Rather, the *lack of market knowledge* and strategic approach causes the abortion of ideas, which makes the funding of those ideas impossible, too.

The recent institutional changes of public R&D&I management were unfavourable from the point of view of the predictability and stability of innovation management. The public institutions aiming to support innovation usually disappear after a few years and are replaced by new ones.

Executives evaluated the *level of knowledge* of new graduates from universities as 'moderately satisfactory' and have been definitely critical towards the qualifications of VET students. They judged the level of knowledge of VET students as constantly deteriorating, especially as regards their IT skills. Typically, managers can hardly follow the constant changes in the VET system.

Executives of both *multinational companies* and domestic firms had the view that foreign subsidiaries established in Hungary were an important driving force for the entire supplier network. Foreign companies do not hinder the innovation of domestic companies in any way, on the contrary: their business relationship with them requires continuous innovation, for the following reasons.

On the one hand, the high-quality requirements of foreign companies pose a challenge for suppliers that can only be met through continuous innovation. Most multinational companies employing domestic suppliers provide regular training in various areas such as: the concept of innovation, innovation project management, innovation self-audit, etc.

On the other hand, foreign companies are outsourcing more and more development tasks to their suppliers. Nowadays it is not necessarily true that MNCs keep core research tasks at the headquarters and outsource only lower-level subtasks. Multinational companies' research activities are now organised around a global network and network centres, often involving the transfer of knowledge from one subsidiary to another. These research and innovation tasks are often outsourced to domestic suppliers.

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Top three barriers to innovation (not in hierarchical order):

- Awareness of innovation necessity: most companies which are not innovative have the belief that innovation is not needed at all. This comes from management reluctance, lack of knowledge and from the lack of a long-term strategic approach. Although the macroeconomic environment of innovation cannot be ignored, the innovation capacity of companies is highly dependent on the professional skills and approach of the firm managers.

  Hungary has a very small number of domestic-owned companies operating with significant innovations, strategic planning and advanced technical solutions. Most of them are strongly linked to the multinational companies, as supplier, others are independent firms. The latter are led by highly motivated managers being capable of recognising the importance of continuous renewal.

- Lack of relevant skills: although labour shortage is a severe factor in Hungary, which innovation should in theory alleviate, proper knowledge on this subject is often missing. This is rooted in the anomalies of the education and training systems. A weak competitiveness is also a relevant factor, as it contributes to brain drain, while the economy struggles to attract modern expertise. A large part of the growth relies on cheap labour, and the economy is not knowledge-based, regional disparities are high, particularly in productivity. The rapid rise in wages in recent years will be a watershed in this regard. Firms based on low wages and low productivity, i.e. low innovation activity, may fall out of the competition. The global crisis caused by the COVID 19 epidemic could exacerbate this process.

- Unpredictability of public innovation management and support institutions: The public institutions aiming at support of conducting firm innovation (and/or R&D) have frequently changed in recent decade. Not only the name and organisation of these public institutions have changed, but also the concept has often gone through significant changes.

  Because of the shortage of knowledge of markets, management, business and juridical knowledge, a stable public body would be needed to advise on the realisation of innovation ideas. The interviewees clearly expressed their opinion that the frequent changes in the institutional environment of Hungarian innovation did not create favorable conditions for domestic corporate innovation.

2. The concept and motivations of innovation in the light of international literature

There is no prosperity without innovation. Innovation was always the primary driving force of economic growth throughout history. In our times, strengthening innovation has become a recurring theme in political discussions and policy proposals. This is clearly exemplified in the Europe 2020 strategy, about to be concluded this year: one of the core objectives of this strategy was to create a *smart* Europe. According to a 2011 research by the World Intellectual Property Organization, about two-third of global economic growth is a result of technological development, and half of corporate profits comes from innovation. (WIPO, 2011) Finally, regarding the oft-cited rise of China, it should be pointed out that lately this rise has been based not just on the availability of cheap labor but at least as much on the large number of technological innovations, research projects and patents, a fact that increasingly poses a challenge to the technological superiority of Western economies.

From the 1980s, the **ICT sector** was the main domain of innovation, Information technology innovation has entirely transformed the way the economy operates (industry 4.0). The boundaries of space and time have been reduced and economic agents react to each other more and more instantly.

What is more, the organizational structure of firms itself has changed markedly due to organizational innovations like outsourcing. Virtual space has become a new field of economic flows and contemporary firms never stops innovating. These changes generate several innovation trends:

- Innovation activity becomes a continuous process in the high-growth sectors.
- The services sector takes over as the primary area of innovation, which makes the distinction between products and services more difficult. As a result, joint product and service innovations are gaining prominence. Today innovation materializes not only in an industrial product but innovative solutions are incorporated in services (for example, in software and applications).
- The share of SMEs in innovation is on the rise: in the first decade of this century one-third of all patents came from small and medium enterprises.
- Innovation has become a multi-actor process where the cooperation within the university-government-business *triple helix* is the primary driver (Inzelt, 2006). In this cooperation-driven process, virtual spaces become the new vehicle of innovation.

2.1. The concept and main elements of innovation

The original source of the concept of innovation is Joseph Schumpeter (although he did not used this word) who presented a five-point list to outline what innovation actually means: 1) Introduction of a new, formerly unknown product 2) Introduction of a new production method, not necessarily based on new scientific knowledge 3) Obtaining market share in other countries 4) Obtaining new sources of basic materials or semi-manufactured products 5) Creation of a new market position in a given sector, for example creation or destruction of a monopoly situation (Schumpeter, 1934).

This approach proved robust enough: institutions relevant to innovation research (e.g. OECD) follow the Schumpeterian logic in their definition and in their classification regarding the types of innovation.

The Oslo Manual of 2018, by the OECD, is an important starting point for innovation researches. According to the Manual, business innovation is a new or improved product or business process (or combination thereof) that differs significantly from the firm's previous products or business processes and that has been introduced on the market or brought into use by the firm. (OECD, 2018) Based on this definition, two main types of innovation can be distinguished:

- Product innovation – new or improved good or service that differs significantly from the firm's previous goods or services. The possible improvements include quality, technical specifications, reliability, durability, economic efficiency during use, affordability, convenience, usability, and user friendliness. This category of innovations applies both to new knowledge and technologies and to a new combination of existing knowledge. Design changes mean product innovation only if, through a new appearance or "look" of the product, they enhance the user's utility.
- Business process innovation – novel or more efficient production or distribution processes, marketing, sales and after-sales services, administration and management, etc. The possible aims of such innovation include reducing costs, improving product quality or working conditions, or meeting regulatory requirements. There are six subcategories of business processes that are distinguished in the 2018 Oslo Manual:
    - Production of goods or services – The implementation of such innovation usually leads to reduced production costs or an improvement of product quality.
    - Distribution and logistics – here innovation includes improved transportation and service delivery, warehousing and order processing.
    - Marketing and sales: innovation results in new or improved marketing methods (including advertising, packaging, market research), improved pricing strategies and methods, improved sales and after-sales activities.
    - Information and communication systems – innovation includes new hardware and software, improved data processing, improved maintenance and repair activities, improved web-hosting.
    - Administration and management – innovation aims at establishing new kinds of organizational processes in the firm's strategic and general management, in the legal, planning and PR functions, in accounting, auditing and financial activities, in human relations management, in procurement, or in the management of external relationships.
    - Product and business process development processes – improving activities to scope, identify, develop, or adapt products or a firm's business processes.

Although the Oslo Manual provides a very detailed explanation of the characteristics and modalities of innovation (what is innovation and what is not), the literature tries to specify further the concept of innovation. In many cases, it is difficult to determine *how much* or *how big* change in the production, sales, etc. of a company should be considered as innovation. This can cause problems in interpreting the data, since innovation can only be

measured by company surveys in which the respondents themselves have to decide whether the change applied by the company is innovation or not.

It is important to make a distinction between **invention** and **innovation**. The former can be seen as an idea, a „prospective innovation" not yet implemented, while the latter is already applied at scale. To arrive from the former to the latter may take considerable time, while in certain areas (e.g. in biotechnology) the two may blend together. Invention primarily occurs at universities and research institutes while innovation is mostly a domain of business firms. This is not surprising, considering that in most cases turning an invention into practical innovation requires massive capital investment (Fagerberg, et. al., 2006).

It is also important to conceptually distinguish between **radical** and **incremental** innovation. Radical innovations bring about disruptive changes that usually occur after scientific or technological breakthroughs, rather than as a response to shifting market demand. Incremental innovations, on the other hand, aim at improving existing procedures. The latter can be regarded as a response to market impulses since it is a modification of products and services in line with market demand (Derecskei et. al. 2012). While the most spectacular changes are brought about by radical innovations, the cumulative macroeconomic impact of incremental innovations is larger than that of radical innovations (Fagerberg, et. al. 2006).

Radical innovation includes **research** findings and inventions turned into market **patents**. Research and development on the one hand and innovation on the other constitute two distinct sets that have intersection areas. A research will not be translated into innovation unless the practical applications of the findings are devised and utilized. Conversely, research is not always needed for innovation. Innovation may originate from an idea, from the adoption of the experience – or even research findings – of other producers, or from obtaining a technology that is novel for the particular firm but not for the industry as a whole.

Research and development can be considered to be the **basis** for innovation, however; in the long run, essentially all innovation comes from some form of R&D. It is no coincidence that in both literature and economic policy, the two groups are often mixed up or amalgamated with the label R+D+I, or R+D and Innovation – the boundary between the two concepts is often porous. However, the confusion between the two concepts often leads to misunderstanding in the literature. Sometimes a title of a publication mentions "innovation", but in fact it deals with "R&D", so it comes to different conclusions than if it had analyzed the innovation activity of firms (Knell, 2018).

Literature also distinguishes between **creative** and **imitative** innovation. *Creative* innovation is the development and successful introduction of something genuinely novel. In contrast, *imitative* innovation is the copying of a product or process, etc. which exists on the market but new for the firm. Imitative innovation is essential to keep up with technological changes on the market, but it relegates the firm to a follower position instead of a leading position. At the same time, a company that is considered imitative by global standards (e.g., copying international best practice) may still play a leading role in the domestic market.

2.2. Innovation: firm-specific or personality-driven

Schumpeter describes innovation as a *competition of renewal* between entrepreneurs that aims at solving specific problems. The innovator is driven by the wish to be the first to present the market a new (or cheaper) product and to fully benefit from being the first. Innovation is achieved by the entrepreneur – conversely, the entrepreneurial activity is innovation itself.

This description highlights the personal character of innovation and the importance of an innovational attitude. But innovation activity is typically conducted within business organizations, which calls the importance of personal attitudes into question. Most studies describe the capacity and willingness to innovate as a firm-specific phenomenon and theorize two different business attitudes: an innovation-oriented and an innovation-averse attitude. But the management and the productive activities are all performed by persons, hence the attitude toward innovation is ultimately the personal attitude of the manager.

Hence, the willingness to innovate is a basically firm-specific phenomenon that mostly depends on the attitude of the management, but it is also shaped by more random and specific factors as well. The innovation process – from the invention to the market application – is a long process with many actors where the original creator of the idea does not necessarily attend to the whole process to the end. While invention is a result of cognitive processes within an individual, innovation comes from the interaction between individuals. (Anderson-King, 1993) Accordingly, not just professional skills but the ability to constructively contribute in the interpersonal field of innovation is important too. Any individual who is able to push forward innovation in a given organization and to combat the various kinds of impediments is a formative player in the innovation process. Roure (1999) called these individuals *innovation champions*. These individuals take on the role of overcoming obstacles within the organization as well. The impact of culture is present here as well: societies averse to uncertainties or not sufficiently interested in innovation tend to pressure its members to adhere to the organizational norms and established procedures. Societies that are more tolerant to novelties, on the other hand, prefer enablers of network cooperation and organizational flexibility and also organizational freelancers who are not averse to conflict and who think rationally.

Innovation champions tend to push ahead with innovation within or outside the firm. The merit of such proclivity is, however, dependent on the situation. Such persons help the innovation process in certain situations while may become an impediment to it in others. An extroverted personality is more suitable in the early phase of innovation when the management needs to be convinced about the strategic decision (Rank, et.al, 2006). An individualistic personality is less convenient during the phase of placing of the new product on the market because here the cooperation with colleagues and external partners becomes the priority. (Rosenbusch, et. al, 2011)

Hence having one innovation champion within the firm and within a given innovation project is not enough: several people with different qualities are needed.

The **motivation** to innovate is, according to András Vedres, the secretary-general of the Association of Hungarian Inventors, threefold: passion – pressure – interest. Although Vedres discussed researchers and inventors, a somewhat different group from that of innovators, basically the same triad can be applied to innovators and innovator enterprises as well. Passion – the innovative drive – is mostly a personal trait while pressure and

interest are rather firm specific. This approach harmonizes with Nelson and Winter (1982), a study already mentioned above, in which the authors emphasized the importance of organizational traditions which are partially shaped by personal traits and managerial attitudes. The personal attitude of the CEO leaves its mark on the innovation activity of the staff that in turn shapes the organizational attitude.

On the other hand, innovational efforts are marred by *uncertainty* (Dunning et.al, 2010). Firms do not know how to conduct innovation to succeed. This makes firms cautious when deciding upon a new innovation project since they may suffer losses if a completely novel innovation is launched prematurely. Therefore, openness is essential. Several relevant studies describe the business innovation process based on Schumpeterian uncertainty – an overview is provided by Fagerberg et.al. (2006).

2.3. The external environment of firm-level innovation

As regards the **macro**-level approach, several authors address the public policy management of innovation, the macroeconomic conditions and the spillover effect of innovation, or the barriers to the international diffusion of innovation. In terms of the discussion of public policy, intellectual property rights, ways to alleviate the problem of external financing of innovation, human resource policy are standard themes. Another prominent topic is how to facilitate the development of an innovation ecosystem and foster collaborative innovation with the participation of firms and non-firm agents – or, in other words, how to create an open innovation system.

Firms do not conduct innovation in a vacuum but in a given social environment with certain economic realities. This environment greatly affects the performance of firms. To achieve higher output on a macro level, firm-level innovation is key. Hence economic catch-up and innovation are closely related: the countries with outstanding innovation performance are the ones that can achieve economic convergence. At this point, the study of innovation reaches the domain of development economics.

(Neo)classical economists has regarded new technologies as something that everyone can access to, every country can benefit from. Economic historians, on the other hand, found that technological knowledge is embedded in the specific conditions of the firms and their environment, hence new technologies do not diffuse automatically, they are impossible to simply be copied from one environment to another, as neoclassical approach envisions. (Hall-Rosenberg, 2010)

Among major economic historians, Gerschenkron (1962) serves as a preeminent starting point for this strain of research. Some countries are forerunners in the technological race while others fall behind – but according to Gerschenkron, the latter may be able to catch up as they do not have to bear the cost of the development of cutting-edge technology. The catch-up, however, is not automatic and can run into hurdles. Gerschenkron uses the example of how the German Empire managed to catch up with Great Britain, highlighting the successful efforts of the former to adapt to the contemporary capital-intensive economic structure by an overhaul of its financial sector. Gerschenkron deems this example adoptable for other countries as well. Shin (1992) interprets Gerschenkron's conclusions as an attempt for a general explanation of economic catch-up in which the public and private spheres need to deploy the necessary tools and capacities to succeed.

He also highlights that different historical and sectoral contexts and different development levels warrant the deployment of different capacities.

Moses Abramovitz also studied the differences between the catch-up process of different countries. He proposed two theoretical concepts: technological overlap and social capacity. The former refers to the size of the market. An example is the technological emergence of the United States during the 19. century, a feat that could not have happened without the enormous US market. Such a market size was not available in contemporary Europe, which explains why innovation spread at a slower pace here. The latter concept refers to capacities like an efficient education system, the quality of business infrastructure and the social capability. Social capacity includes the following elements: technological capacities (quality of education), long experience with organizing firms, the ability of financial institutions to mobilize large amounts of capital, trust in public institutions, stable government that is able to make and enforce regulation. (Hall-Rosenberg, 2010)

A related concept, widely used in economics, is absorption capacity, a concept referring to the capacity to absorb new knowledge. Rostow (1980) squarely linked economic growth to the application of newly acquired knowledge. This theory has been applied to the firm level by Cohen and Levinthal. According to their interpretation, firm-level absorptiveness is the ability of the firm to recognize the value of new knowledge and to adopt and put it into commercial use. (Cohen-Levinthal, 1990) The authors think absorption capacity is closely linked to the formerly existing knowledge within the firm, coming from firm-level R&D. The authors also emphasize that the path dependence of firms may hinder the adoption of new knowledge. Through their in-house development firms heavily specialize on their own area, to a degree that they become unable to absorb new knowledge. To avoid this, they need to diversify their information sources, including building links with outside actors. Cohen and Levinthal's rethinking of the problem of absorptiveness leads to a unified framework that regards research, the adoption of new research and market application as parts of a single process. The authors justify this approach by arguing that the capacity to apply existing knowledge and the capacity to create new knowledge are not that different. Other writers disagree with this theoretical approach and treat the application and the creation of knowledge separately. (Zahra-George, 2002), (Muchi et. al. 2003), (Viotti, 2002)

Another emerging interpretative framework regarding innovation and its environment is the concept of national innovation system, first adopted by Christopher Freeman. (Freeman, 1987) The theory soon became popular in the professional discourse. In this framework the innovation system of a given country is the totality of the network of participants and any policy measures and institutions that have an impact on the introduction of new technologies. Since in the follower countries new technologies are usually introduced not by creative but by adaptive innovation, the broad definition of innovation system includes the policies aimed at attracting FDI and intellectual property protection legislation. Besides, the innovation system is in great part determined by the cooperation of private and public actors, the diffusion of technology and the strengthening of human capital.

2.4. Does firm size matter?

Firm specific literature typically finds that firms tend to have different motivations to innovate according to their size class. On the one hand, size matters regarding the financial, organizational and cognitive capabilities to innovate. This is especially important in Hungary where large multinational companies account for a substantial proportion of

large firms. On the other hand, research suggests that newly established start-ups tend to be more innovative than incumbent firms, even though – naturally – start-ups are typically small.

Schumpeter (1942) asserted that large firms are the major engine of economic growth and that market structure matters. The most important advantage of firm size is scale economies - at a minimum, larger scale amortizes the fixed cost of innovation over a larger number of units. Accordingly, the returns from innovation should be greater for large firms.

The recent literature raised some doubts for this theory, and some others came even to the opposite conclusion. Symonidis (1999) states, summarizing the empirical literature, that there is little evidence in support of the Schumpeterian hypothesis that market power and large firms stimulate innovations: R&D spending rises more or less proportionally with firm size after a certain threshold level has been passed, and there is little evidence of a positive relationship between R&D intensity and concentration in general. However, positive relationship between size and innovative activity can occur under certain conditions, including high sunk costs per individual innovation project, economies of scale and scope in the production of innovation rents. R&D intensity and market structure are jointly determined by technology, demand, the institutional framework, strategic interaction and chance.

It should be noted that this overview focuses mainly on „R&D" activity and not on „innovation", although the title promises the evaluation of „innovation" (an example of conflating innovation and R&D in the literature). In addition, the study identifies large companies with companies in a monopoly or oligopoly position that is a special subset of large firms. Most of the large companies, even multinational firms, are typically not in the position to close out sharp competition. Large firms are strongly pressed to innovate. If they do not innovate (and research) continuously they can easily lose their market position.

Furthermore, multinational companies play a crucial role in the internationalization of R&D and innovation. Due to internalization tendencies, strategies of multinational firms have changed significantly since the late 1980s (Mattes, 2009). Though multinational companies generally prefer to keep their R&D activities close to their headquarters, they sometimes locate R&D activities and other technical support in their subsidiaries with the intention of adapting existing technologies, resources and products to local market conditions.

2.5. The role of multinational companies in innovation

Most of the literature focuses on the role of multinational enterprises in the global transfer of knowledge. In the strongly dual Hungarian economy these researches are particularly relevant.

Over the few past decades, multinational enterprises (MNEs) have disaggregated their value chains and relocated their activities to subsidiaries in diverse locations in order to withstand increasing competition. This activity has even led to the internationalization of activities such as research and development (R&D) that were previously co-located with headquarters in proximity to the core competencies of the MNE. With this disaggregation, R&D has become an activity that is commonly mandated to foreign subsidiaries in resource-rich foreign locations around the globe. The host countries can extract more benefits from the presence of foreign subsidiaries; the support from regional and national

development agencies, research institutes and local universities has been paramount in helping to develop a local knowledge network (Gilmore et. al, 2018). The development of a knowledge network, together with foreign subsidiaries, has a strong influence on the economic growth and prosperity of a region, too.

There are two core reasons for internationally dispersed innovation processes. International subsidiaries are either channels that allow companies to draw upon dispersed knowledge – so called capacity-augmenting subsidiaries – or they concentrate on using existent knowledge and are therefore capacity-exploiting subsidiaries. In the former orientation, explorative learning is crucial, whereas the latter strategy concentrates more on exploitative learning (Mattes, 2012).

Multinationals may also locate foreign R&D activities in specific locations with the target of creating new technology and products. These asset-augmenting or competence-creating activities mainly reflect local supply conditions, including whether the multinational company recognises the technological skills of the workforce, the relative cost of high-tech labour, proximity to universities and R&D laboratories and to potential partners (Knell, 2018).

3. The innovation and R&D activity of Hungarian firms in the light of the international statistical data

There are two main statistical sources about the innovation activity in the European countries. The European Innovation Scoreboard (EIS) adopts a macroeconomic approach, while the Community Innovation Surveys (CIS) is based on the primary data of firms.

The European Innovation Scoreboard (EIS) provide a comprehensive and comparable database about the *factors* of innovation of European countries from a *macroeconomic perspective*. It focuses on the institutional conditions and indicators of innovation, like human resources, intellectual property rights, export of knowledge intensive services (KIS), public-private cooperation in innovation etc. The EIS relies on the indicators of other statistical sources, i.e. it is not based on a primary data compilation. The EIS doesn't contain statistical data on the innovation activity of firms. The latest EIS is available for the year 2018.

The Community Innovation Surveys (CIS) is based on microdata and designed to provide information on the innovativeness of sectors by type of *enterprises*, on the different types of innovation (product and/or process innovation) and on various aspects of the development of an innovation, such as the objectives, the public funding, the innovation expenditures etc.). The CIS provides statistics broken down by countries, type of innovators, economic activities and size classes. This survey is carried out with two years' frequency by EU member states, the latest survey available has been conducted in 2016.

3.1. The Hungarian position in the European Innovation Scoreboard

The European Innovation Scoreboard consists of 4 main pillars:

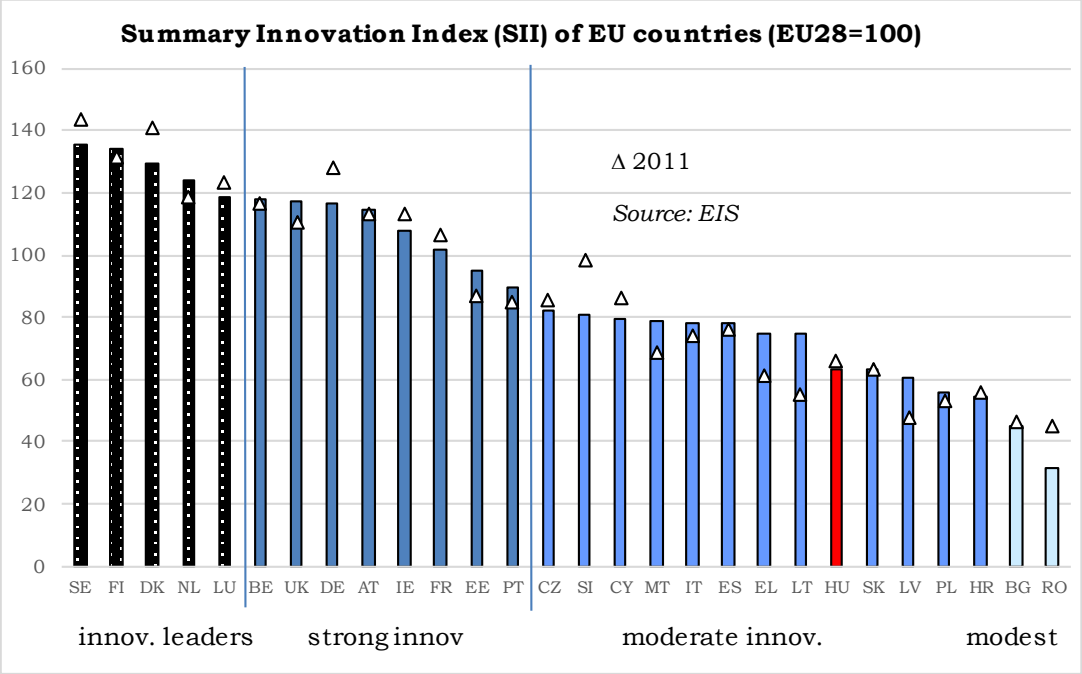
- Framework conditions,
- Investments
- Innovation Activities
- Impacts indicators

The 4 main pillars are further divided into 10 sub pillars and 27 factors. These factors strongly focus on human resources, on research infrastructure and innovation friendly conditions as well as on IP rights.

The 2019 EIS shows that in 2018 Europe has overtaken the United States for the first time. Improvement remains regionally uneven where the eastern and south member states still lag behind Western Europe.

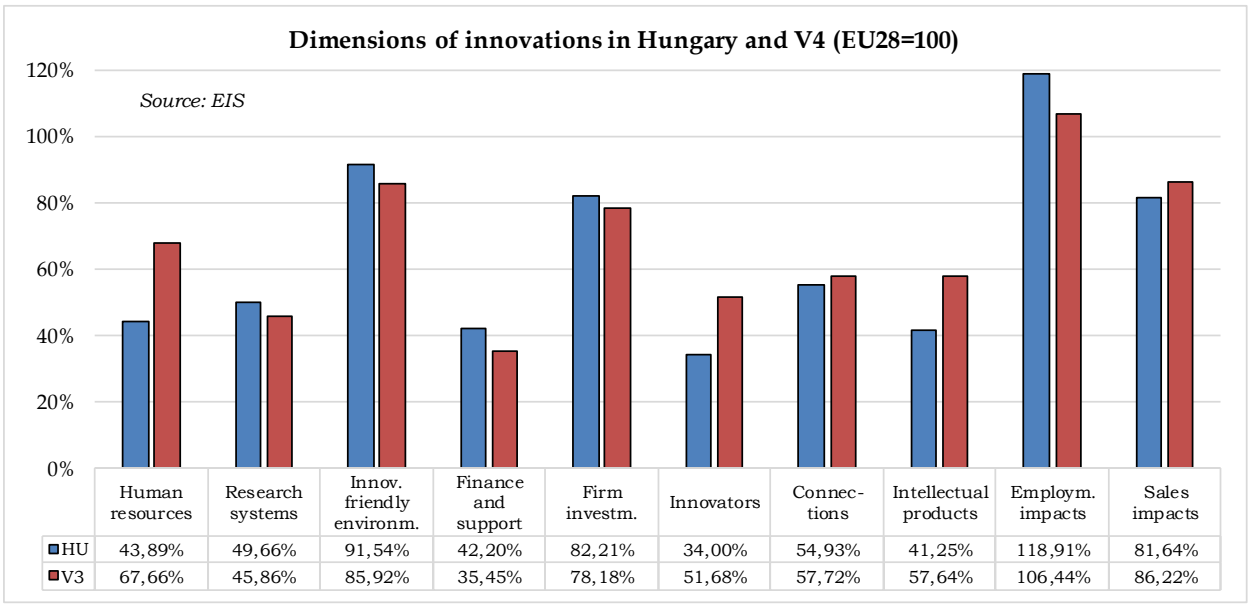
The Summary Innovation Index is the unweighted average of 27 dimensions. Countries are classified according to their scores, which was compared to the EU's 2011 average innovation development level. Four clusters were formed: modest innovators, moderate innovators, strong innovators and leading innovators. All the Visegrad countries were rated as moderate innovators (50-90% of the EU average) with slight improvement or decrease. The Czech Republic is in the lead by far, while Slovakia, Hungary and Poland are in the back of the cluster (Figure 1). Only two states shown regression in the group: Bulgaria and Romania which are in the modest innovators group. The latter was the worst performing country in the scoreboard.

Figure 1



Hungary's Summary Innovation Index (SII) has always stood within the moderate innovator group with relative constant performance. The country's SII relative to 2011 EU average was between 63-69 percent, which is far from the category's upper threshold, 90 percentage.

Figure 2



	Human resources	Research systems	Innov. friendly environm.	Finance and support	Firm investm.	Innovators	Connec-tions	Intellectual products	Employm. impacts	Sales impacts
HU	43,89%	49,66%	91,54%	42,20%	82,21%	34,00%	54,93%	41,25%	118,91%	81,64%
V3	67,66%	45,86%	85,92%	35,45%	78,18%	51,68%	57,72%	57,64%	106,44%	86,22%

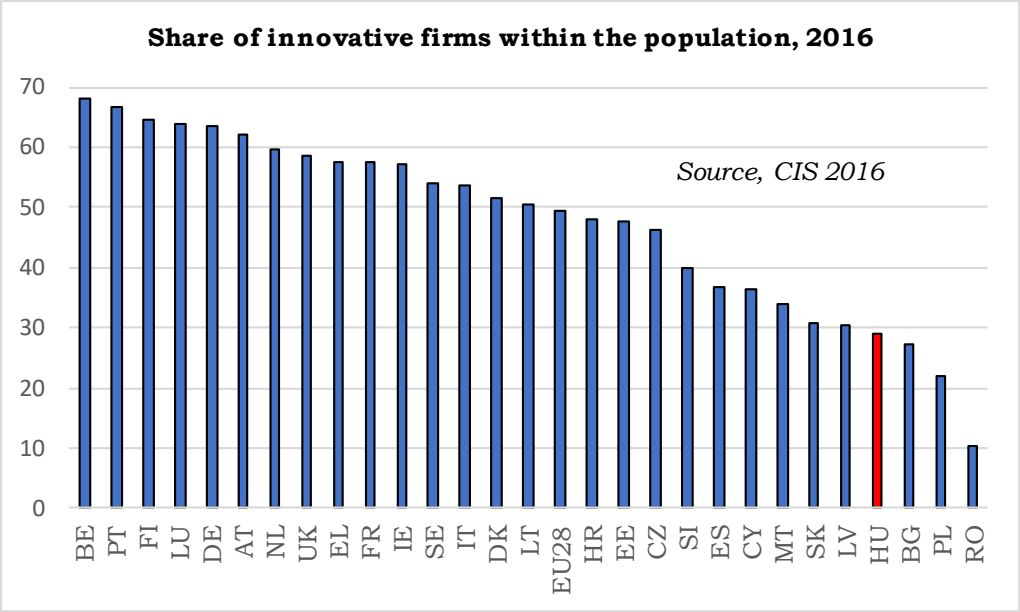
In comparison with the EU's 2018 average, Innovation-friendly environment (notably Broadband penetration 105,6 percent), Employment impacts (notably Employment fast-growing enterprises 157,4 percent), Sales Impacts (notably Medium and high-tech product exports 129,5 percent) were the highest-scoring dimensions. At the other end of the spectrum, Human resources, Innovators, Intellectual assets and Finance support were the

worst-performing dimensions. The component "human resources" reflects the relatively low rate of university students and graduates in the population as well as the low number of scientific publications. This suggests that while some of the technological and macroeconomic supporting factors are in place in Hungary, they cannot translate into actual innovation activity because of limited intellectual capacity.

3.2. The position of Hungarian firms in the Community Innovation Survey

Community Innovation Survey is conducted among the EU member states' companies, in two years interval. The survey identifies the innovative and non-innovative firms in member states, more specifically, the number and share of firms which conducted product and/or process and/or organisational and/or marketing innovations.[1] This statistics records not only the number of firms (innovating and not innovating) but also the number of their employees.

Figure 3



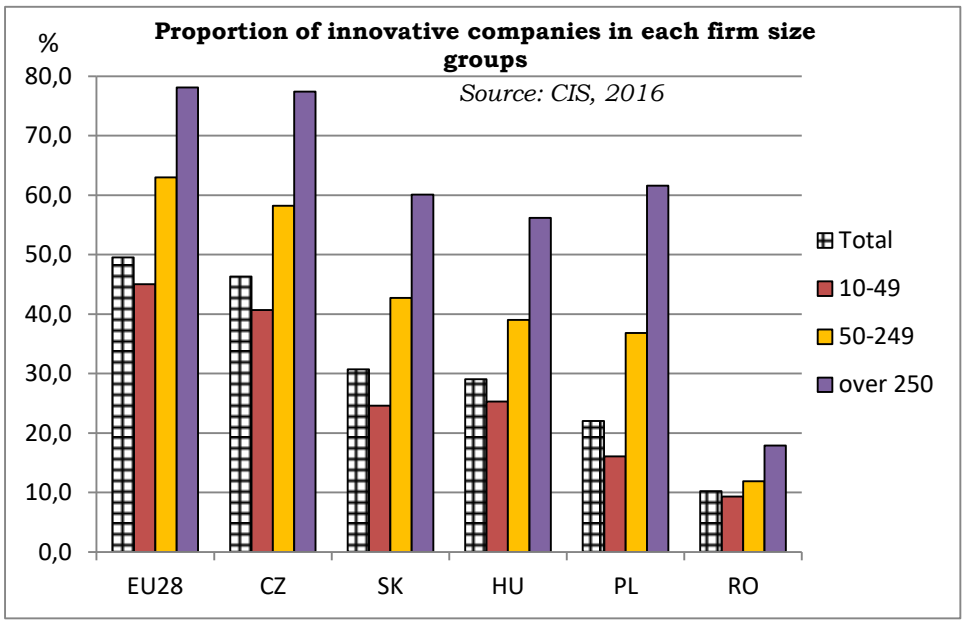
According to the CIS survey, the Hungarian firms are definitely less innovative than the Czech firms, while they are roughly on par with Slovakian firms (Figure 3). This result is approximately in line with the EIS macro-assessment. Poland is well behind the other V4 countries. It should be noted that the innovation intensity of Romanian companies in the CIS rankings is remarkably low. Not only is Romania the last in the rankings, but it is far behind all the other countries, including Bulgaria. It is hard to believe that only 10 percent of firms have any type of innovation in Romania, a very rapidly growing economy. Concerning these results, we might have some doubts.

The survey provides data on innovation activity of different **firm sizes, too**. The results imply that the innovation activity is growing parallel with the firm size, in every country without any exception. Thus, large firms, over 250 employees are much more innovative

[1] The latest CIS survey was conducted before the publication of the fourth edition of the Oslo Manual (2018), hence it is based on the classification of types of innovation outlined in the third edition. The classification of the fourth edition is briefly presented in Chapter 2.

than smaller firms (Figure 4). In this group, the share of enterprises that have any kind of innovation activity (including enterprises with abandoned/suspended or on-going innovation activities) is typically the double of that of the small firms. These numbers obviously don't give any information about the size and type of the innovation: a revolutionary innovation has the same weight as a smaller innovation of imitative type.

Figure 4



3.3. The position of Hungarian firms in the Survey of the European Investment Bank (EIB)

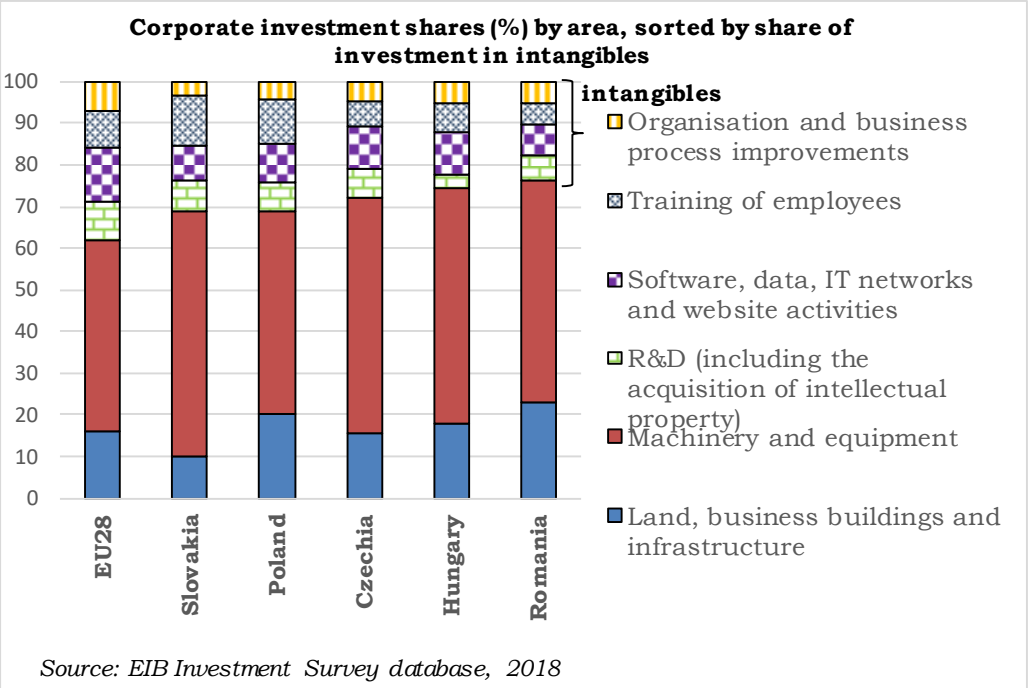
In addition to the EIS Innovation Index and the CIS Innovation Scoreboard (presented in Sections 3.1 and 3.2), there is a third important source of survey on firms' innovation performance in the EU. Although the EIB Survey (EIB Group Investment and Financing for Investments: EIBIS) focuses not on innovation but on the investment activity of companies and its motivation, this detailed survey also provides valuable information on the innovation performance of European companies.

An important difference between the EIBIS and the CIS Survey is that EIBIS only measures product or production process innovation ("product" here includes both goods and services), while CIS considers all types of innovation. This is because the EIBIS Investment Survey only looks at innovations that involve investment. And in this sense, administrative-managerial or marketing-sales innovation typically does not involve significant investment.

Another difference between the two survey methodologies is that EIBIS also includes micro-enterprises, whereas CIS only covers companies with a staff of more than 10 persons. Although micro-companies are typically more oriented toward administration-management and marketing innovation (except for start-ups) and less keen to engage in product or production process innovation, their high share in the sample can influence the survey results.

The EIBIS survey provides a valuable contribution to the assessment of importance of innovation in corporate investments in EU countries.

Figure 5



Source: EIB Investment Survey database, 2018

As shown in Figure 5, the share of intangible assets in investment in V4 + Romania (25-31%) is well below the EU average (38%) and is particularly low in R&D (Figure 5). Investments in intangibles can be interpreted as investment in *knowledge* (R&D, IT development, training of employees) which is the key to innovation.

In this sense, Hungary is in a bad position (26%). Hungarian companies spend much more on land and machinery than the other EU-countries, and less on intangible assets. R&D rates are particularly low among Hungarian investments, even lower than in other V4 countries. On the other hand, IT investments (software, data, IT networks and websites) are higher in Hungarian companies than in other Central and Eastern European countries, almost as high as the EU average.

The relatively high share of machinery and equipment in CEE investment can also be explained by structural effects, i.e. by the share of manufacturing in the CEE region, higher than the EU average. However, this does not fully explain this large difference, as the structural difference between CEE and the EU-28 is not as large as the difference in share of investment in intangible assets. This is probably a reflection of the fact that the CEE economies the relative share of knowledge-intensive activities is lower than in the most developed EU member states. Accordingly, in foreign-owned subsidiaries, the share of labor- and capital-intensive production phases is relatively high in the region. (This is also why the value added content is often very low in the manufacturing sector.) Less knowledge-intensive activity means less investment into intangible assets.

The EIBIS survey provides interesting insights into the types of innovation activities of EU members, in terms of the importance and novelty of innovation by companies.

Figure 6 ranks the countries according to the innovation profile of their firms. The lower two sections of the columns contain the share of basic (simple) and adaptive (imitative) firms – that is, firms neither spending on R&D or developing new products (basic) and

firms that do not have substantial R&D expenditures and develop products that is new only to the company). The upper three sections show the share of "developers" or their innovation activity, incremental innovators, and leading innovators. "Developers" do not yet develop any new product but already spend on R&D; incremental innovators do spend on R&D but only develop products that are new to the firm; leading innovators do spend on R&D and also create innovation that is new to the world or at least to the country.

Figure 6

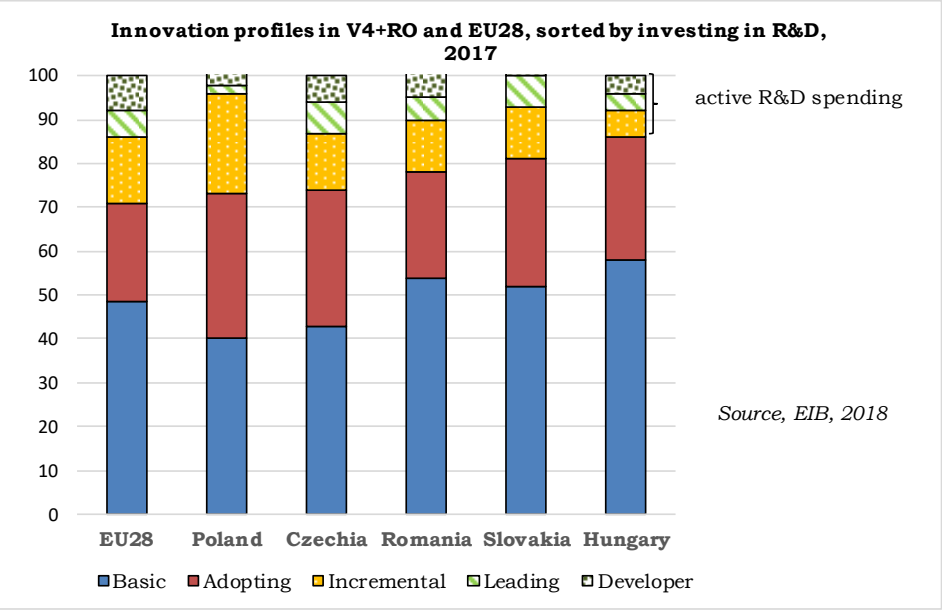


Figure 6 shows that the general innovation activity of Hungarian companies, which – as we saw in Figure 1 – is not bad at all in regional comparison according to the CIS survey. The EIBIS survey, on the other hand, suggests that the Hungarian performance is not good even in regional comparison when product innovation and R&D spending is in question. The share of firms that do not have any substantial R&D expenditures is strikingly high in Hungary, according to the EIB. Conversely, the share of companies with a more advanced innovation profile (developers, incremental and leading innovations) is only 15%, which is the lowest rate in the region. This suggests that the product innovation activity of Hungarian companies is subpar within the region, while the Hungarian firms' R&D profile is simply pitiful.

Now, as we shall see, this picture sharply contradicts with the R&D profile provided by the Eurostat, shown in the next section. It should be noted, however, that the EIB survey measures something different from the Eurostat: instead of R&D expenditures, it shows the relative number of companies that invest in R&D. The likely conclusion is that in Hungary relatively very few companies spend relatively high sums on research and development.

3.4. The position of Hungary in R+D ranking

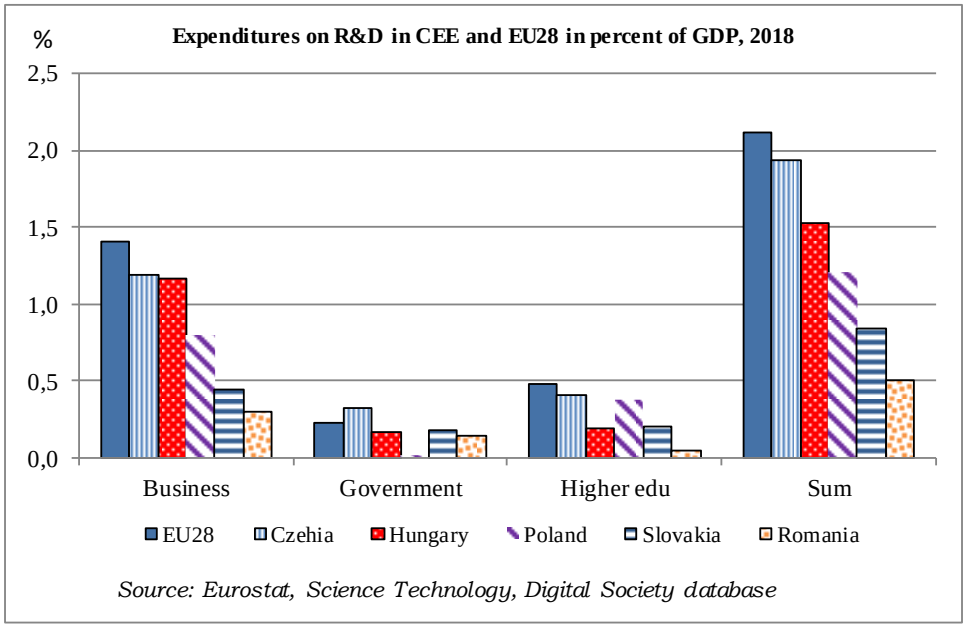
Not only the measurement of innovation but also that of research and development activity is problematic. R&D is measured by input and output indicators. The most frequently used measures of inputs into the innovation process are R&D expenditure and personnel involved in R&D. There are serious problems with all these measures, however. These data

are subject to errors and biases caused by financial reporting and accounting practices. In addition, some R&D activity takes place outside a firm's formal R&D operation (Symoneidis (1999). Since many small firms do not have R&D departments, even though informal R&D is carried out within the firm, the amount of small firm R&D may be underestimated in some data sets (Kleinknecht 1987).

The output data of R&D, i.e. the number of patent applications and patent grants, are so called „hard" indicators. However, the main problems with patent counts are that patents differ greatly in their economic value and that the propensity to patent varies significantly across industries. Attempts to count the number of significant innovations, on the other hand, are subject to some arbitrariness and possible biases in the evaluation procedure; in addition, some innovations are objectively more important than others.

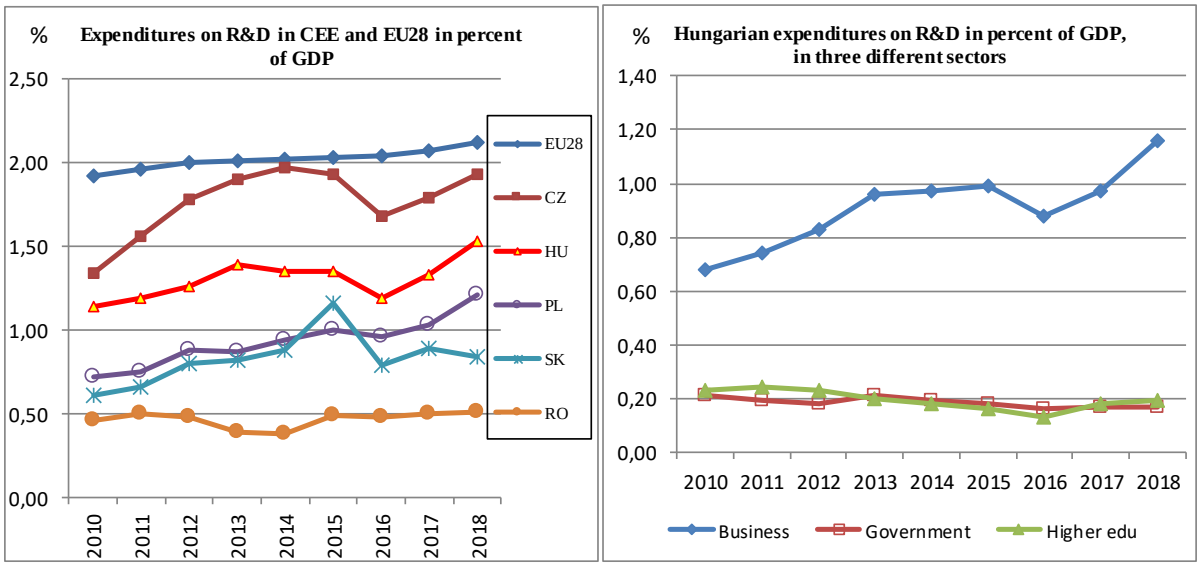
In terms of R&D spending, Hungary is not in a bad position in CEE. In 2018, behind the Czech Republic (1.93 percent), the proportion of R&D in Hungarian GDP was the second highest (1.53 percent). As for R&D expenditure in the corporate sector, the Czech and Hungarian ratios are the same, 1.2% of GDP (Figure 7).

Figure 7



As shown in Figure 8 left hand graph, although the order of the countries in R&D expenditure did not change between 2000 and 2018, in three countries, in Czechia, Hungary and Poland, R&D spending increased significantly between 2016 and 18, while in Slovakia and Romania the extremely low rates persisted (left graph). When evaluating the data, it should be borne in mind that, from 2018 onwards, R&D expenditures include intangible asset purchases, in line with international methodology. This pulls the 2018 figures up slightly, but growth has already begun in 2017.

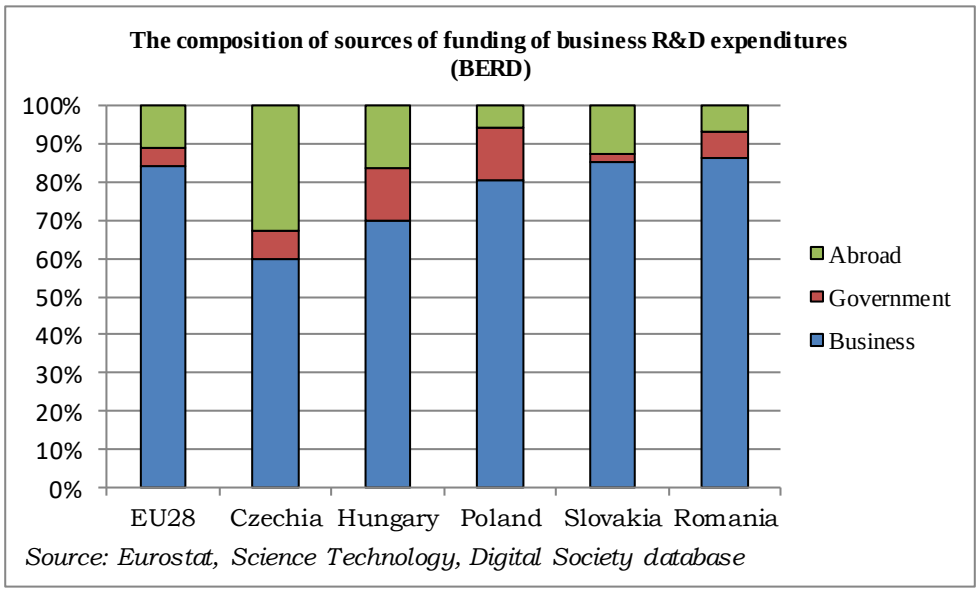
Figure 8



Source: Eurostat, Science and Technology database

The sectoral distribution of Hungarian R&D expenditure is shown in the right-hand graph of Figure 8. It proves that the increase in Hungarian R & D spending is solely due to the increase in corporate research performance in recent years. Meanwhile, both public and higher education research expenditure stagnated at a very low level of only 0.2% of GDP. As we have seen in Figure 7, the share of business sector in national research spending in Hungary is not outstanding compared to the EU average, but the low level of Hungarian public and particularly university research spending is remarkable.

Figure 9



As far as sources of financing for business research and development (BERD) are concerned, in the EU-average, 85% of the R+D expenditures of firms is financed by their own resources (Figure 9). In the CEE countries the proportion is lower, 60-80%. Exceptions are Slovakia and Romania, where self-financing rates are similar to the EU average. However, in these countries, as we have seen, total R&D costs are well below those of CEE

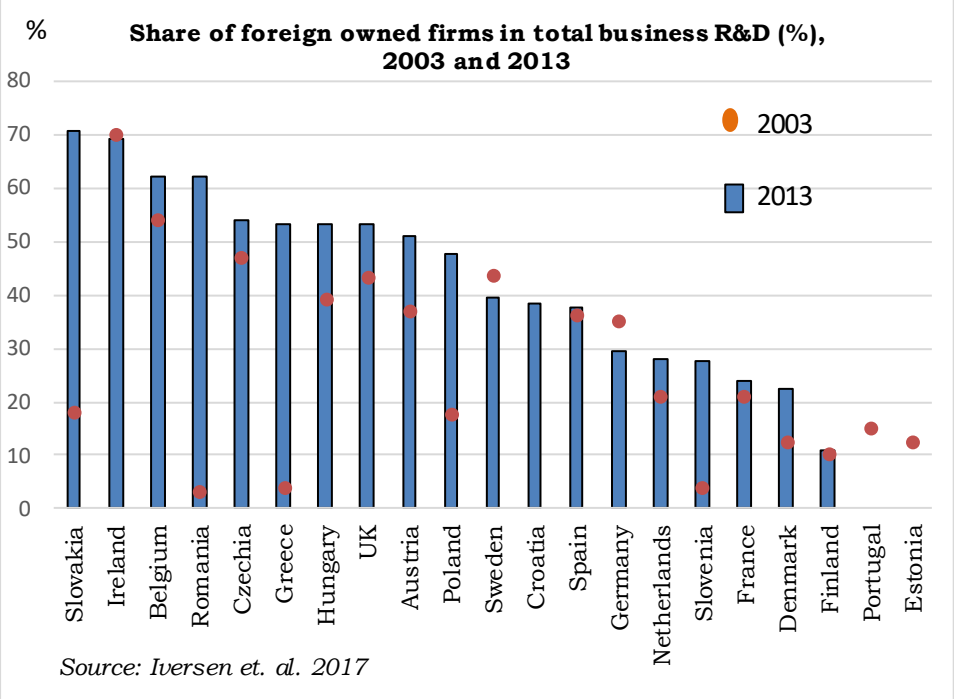
countries. In Hungary, 70% of corporate R&D expenditures are covered by the firms' own resources, the role of state resources is relatively high (and increasing) and the share of foreign, primarily EU, resources is the second highest in the region (after the Czech Republic).

From the point of view of our topic, the distribution of corporate research by owner deserves special attention. According to CSO data, in 2018 more than half, 58% of Hungarian R&D spending was carried out by foreign-owned companies. Although their share declined slightly in 2018 (up from 63% in 2017), their decisive role in R&D cannot be questioned. Foreign-owned companies financed their R&D expenditure mainly (71%) from their own (local) corporate sources, and 25% from foreign sources that obviously might be the mother company resources. In this group, public funding of R&D is only 3.4%, which is significantly lower than in the corporate sector as a whole. Thus, foreign companies used public research funding to a much lesser extent than domestic companies (KSH, 2019).

To add another nuance to the picture, the R&D activities of foreign companies are also highly concentrated. According to balance sheet data, 13 large foreign companies (automotive, chemical, pharmaceutical, mechanical engineering and IT multinationals) accounted for almost half, or 46.4%, of R&D expenditure by foreign companies. Among Hungarian-owned companies, Richter alone has significant R&D activity, accounting for 14.6% of total business R&D expenditure (BERD) and 11% of total Hungarian R&D (Bucsky, 2018).

The dominance of foreign companies in Hungarian R&D is far from unique in the region. According to Iversen et.al (2018) calculations, the share of foreign companies ("Inward BERD") is rather high across the whole CEE-region (Figure 10).

Figure 10



Source: Iversen et. al. 2017

The last year of this calculation is 2013, but since then, these ratios could not have changed significantly as the massive FDI inflow has basically closed; new foreign investment could change these ratios by only a few percentage points. The rate of inward BERD in Hungary (53 percent in 2013) is not outstandingly high in the EU at all. However, it is very high in Slovakia where 70 percent of BERD was carried out by foreign firms. The high ratio of inward BERD, compared to the low ratio of total BERD to GDP leads to the conclusion that domestic Slovak companies are practically barely performing R&D (about 0.2-0.3 percent of GDP). This is not the case in Hungary: total BERD accounted for 1.3 percent of GDP in 2013, about 60 percent of which was linked to foreign corporates, what means that local firms' R&D expenditures represented 0.5-0.7 percent in GDP.

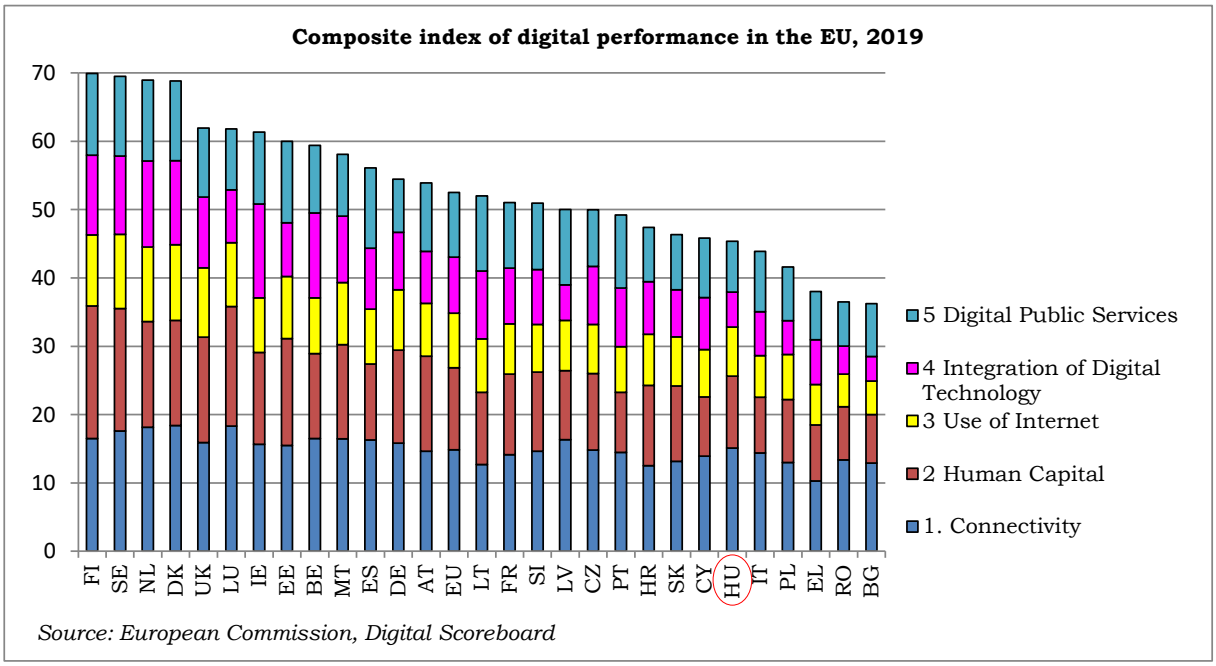
3.5. The extent of digitization as the key to innovation

The Digital Economy and Society Index (**DESI**) is a composite index that summarizes relevant indicators on Europe's digital performance and tracks the evolution of EU Member States, across five main dimensions: Connectivity, Human Capital, Use of Internet, Integration of Digital Technology, Digital Public Services. As digitalisation is central to innovation, it is a very important factor for our topic.

Hungary is ranked 6th in the digital scoreboard from behind, an unenviable position, even if interestingly ahead of Greece, Poland and Italy (beside Bulgaria and Romania) (Figure 11). Connectivity (the level of internet infrastructure, like broadband network), the Human Capital (internet Users Skills) and the Use of Internet (online activity and transactions) do not lag behind regional competitors; these indicators are broadly in line with the European average. The unfavourable overall position of Hungary is mainly explained by the low level of Integration of Digital Technology and the underdevelopment of Digital Public Services. The former refers to the low level of business digitalisation and e-commerce, the latter indicates the poor scores in e-Government and e-Health in Hungary.

The low level of digitalization of companies shows that Hungarian firms take less care on adopting digital technologies than their competitors, although through digitalization they could enhance efficiency, reduce costs and better engage customers and business partners. Furthermore, they lag behind in the utilization of e-Commerce. Low usage of information technology in Hungarian companies indicates that digitalization plays a limited role in innovation, too (Figure 11).

Figure 11



As for the low score for Public digital services, this is primarily a matter of weak performance of public administration and bureaucracy, since E-Health solutions in Hungary are highly developed. As a result, Hungarian companies are under double pressure in information technology: they themselves are less likely to use digital technology solutions, while state bureaucracy is placing a greater burden on them due to poor public e-services in administration. The two are obviously related.

4. Results of the survey on the barriers of innovation among Hungarian businesses

In the framework of the study, a questionnaire was conducted among firms which aimed to have a detailed insight into the innovation activity. The selected survey method was Computer Assisted Telephone Interview (CATI). This method allows direct access to a competent person in the company.

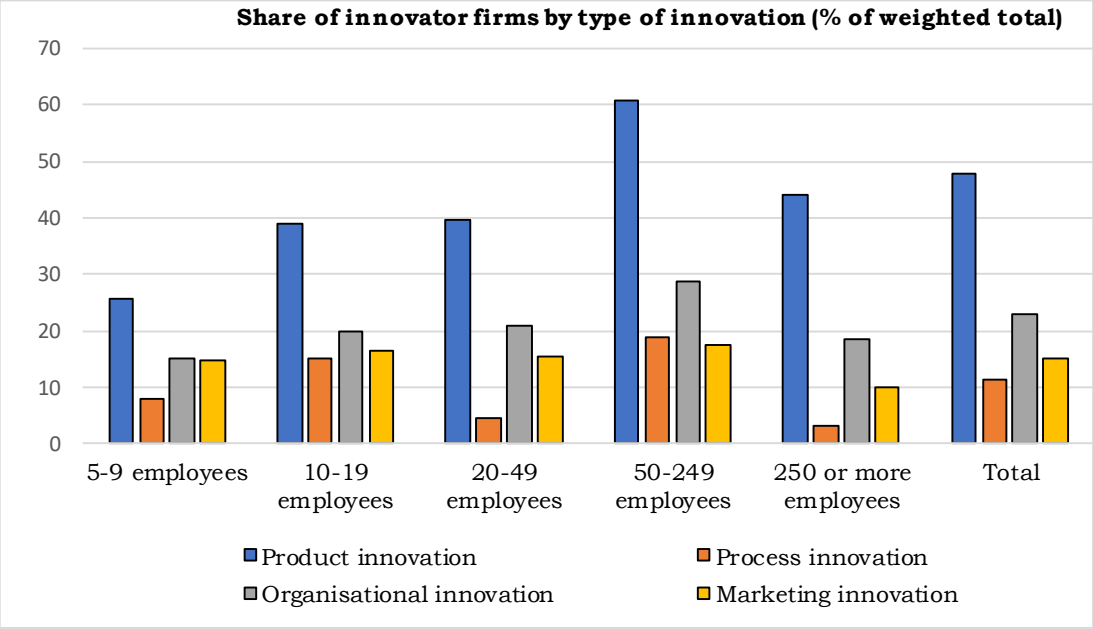
Technical details of sample frame, sample size and sample adjustment of the survey are given in Annex 1.

4.1. Sample results concerning different types of innovation

In our sample, we found altogether 90 firms which did not have any innovation activity in recent 3 years or at present. Compared to the total number of respondents, it represents 20 percent, consequently, 80 percent of firms surveyed carried out some innovations.

That is a much higher rate than that of the CIS survey (see Figure 3, point 3.2.) One plausible explanation of this difference might be that we explained very thoroughly to the respondents what innovation means. Thus, it is assumed that respondents also listed changes in product, production process and mainly organizational and marketing activity that they would not have thought of in the case of less accurate information.

Figure 12



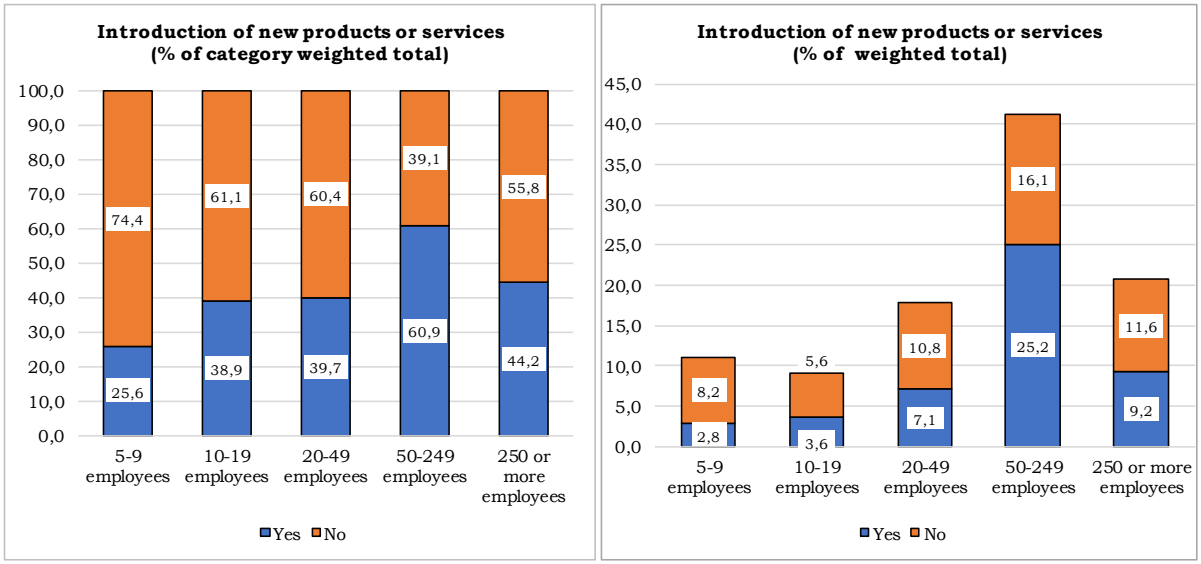
4.1.1. Product innovation

Fully 52.2 per cent of the surveyed companies have not introduced any new products or services in the past few years. Out of those who did implement such innovations were mainly the medium-size companies (50-249 employees), as 25 per cent of all new product introductions were carried out by them. Large companies (250+ employees) are responsible for 9 per cent, while smaller firms only have 6.4 per cent share of the total.

Among firms who introduced a new product or service most conducted market research on the domestic market (65%). Other types of preparations were not so common. It is also

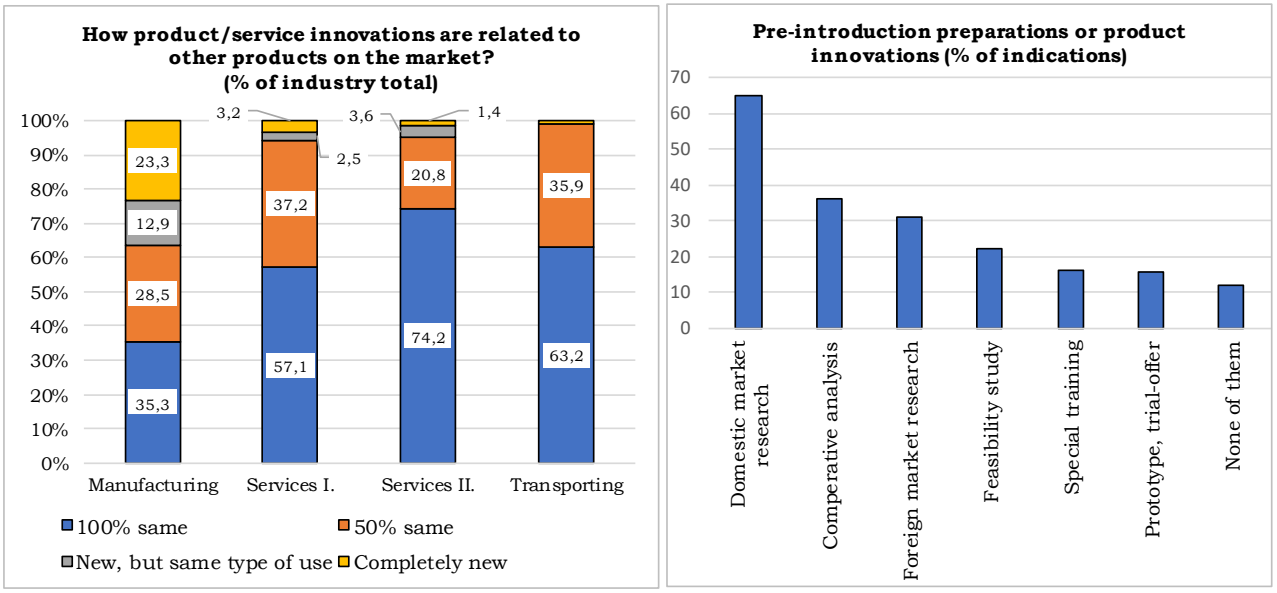
interesting that among those who carried out domestic market research only 27 per cent cooperated with a consulting firm or a research institute. This result suggests that most probably the majority of market research was implemented without any professional assistance or expertise, hence some product developments relying on market knowledge.

Figure 13



It is quite telling that 60 per cent of product or service innovation was virtually completely the same as products already on the market, while only 5 per cent was completely new. That is, most developments were new for the company, but not new for the market. Some 45 per cent of market-new products or services are developed by small enterprises (5-19 employees) and the other half is produced by medium-sized firms (50-249 employees). It is interesting that large companies (over 250 co-workers) mostly introduced already existing products or services.

Figure 14



No difference was found by *ownership* concerning product innovation; the ratio of innovating Hungarian firms is 40 per cent only, although companies in foreign ownership have similar proportion. There is also no association between ownership and type of innovation (new to the market or to the company only).

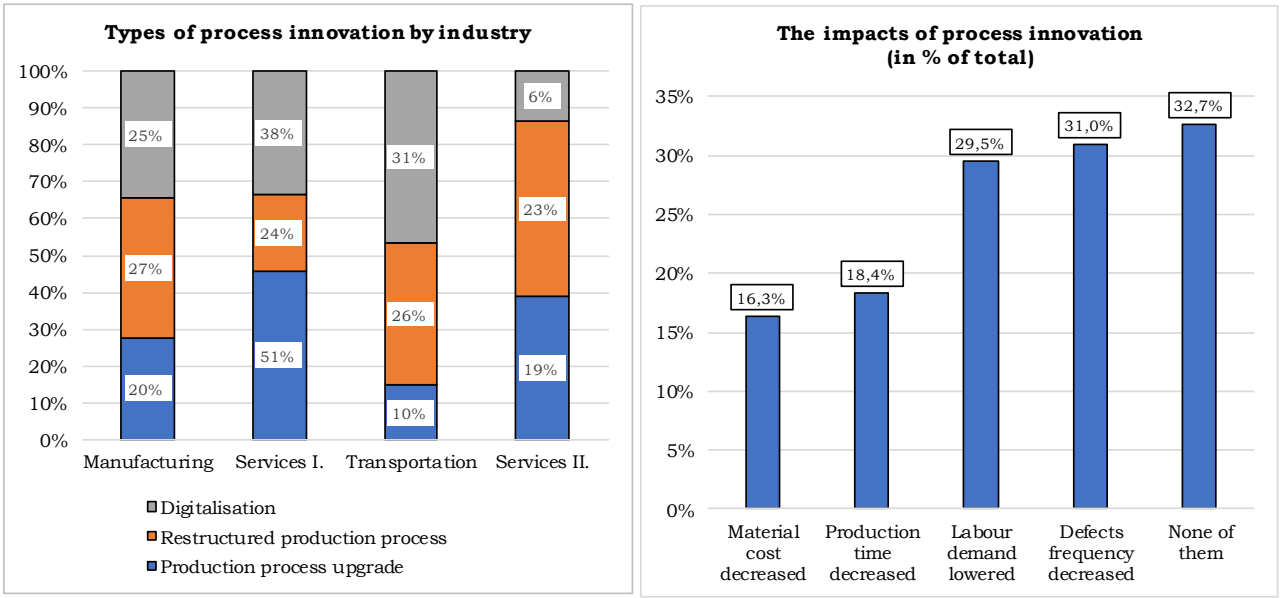
According to the survey, product innovation is mainly conducted by medium-sized and large companies, although a majority of the developments are not really new for the market. This, of course, does not detract from its significance, as innovations are essential parts of all business models. Companies upgrading to an existing technology or product are intensifying market competition by which productivity soars. However, only 32 per cent of the innovating enterprises employ a developer or researcher. This also suggests that innovations in the business economy are most probably mainly market led. In other words, Hungarian companies are more likely to be *market followers* than market creators. Still, this also produces value-added, although the volume is presumably much less than it would be with a market leading innovation.

4.1.2. Process innovation

Process innovation was much less common in the past years, compared with product innovation. Only about 10 per cent of respondents introduced any changes in their production process and the small proportion was mainly conducted by medium size companies (50-249 employees). The prevalence of this kind of structural transformation among smaller firms is relatively rare, although around 25 per cent of the enterprises that upgraded their production process came from the small-size group (under 20 employees).

In case of production process upgrades, companies from *service sector I* (that is, retail trade, R&D, consultancy etc.) dominate the group (around 50%). In the case of the other two forms of process innovation (restructured production process and digitalisation), firms are more or less uniformly distributed by sector and size. The low frequency of process innovation in the manufacturing is conspicuous, not surprisingly, though, that sector is more product innovation oriented.

Figure *15*



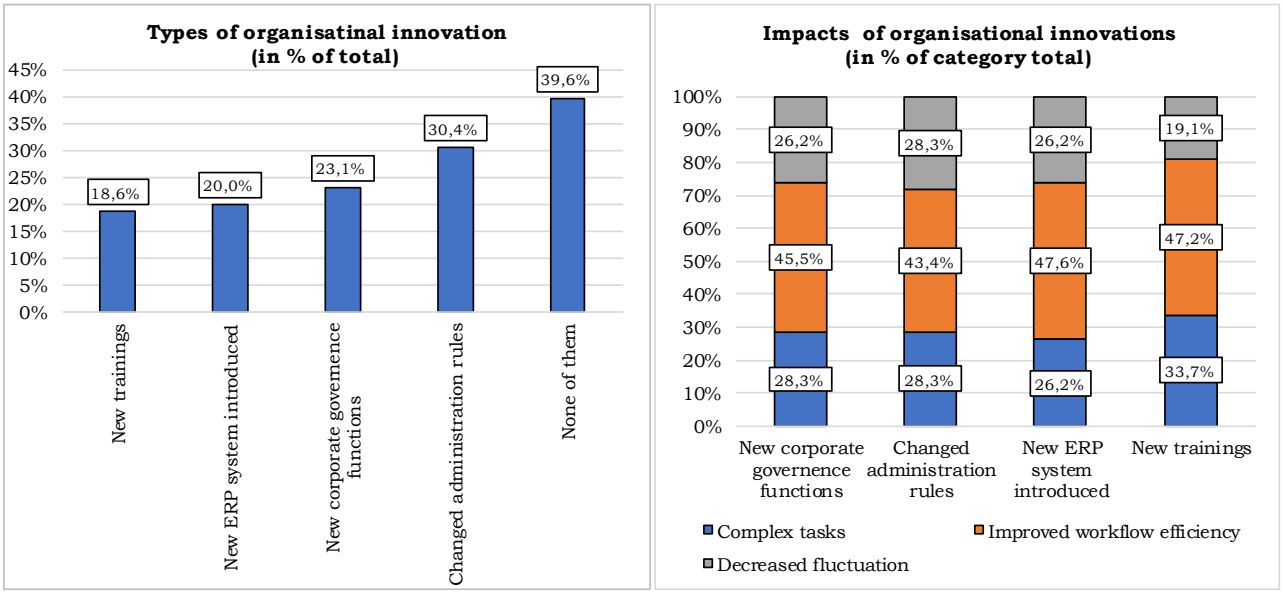
Digitalisation is prevalent in transportation and storage while the upgrade of the production process is not that common as it is mostly fixed and exogenous for them. That is, development of the assets (vehicles) used for production in the transportation industry is out of their scope of activity.

The main motivation behind process innovation was to decrease the prevalence of defected items and to reduce labour demand. Almost 1/3 of the process upgrades had no impact on any of the listed factors, which implicates that a significant part of the developments had no vital effect on the production factors or material costs. No doubt that these improvements were still useful, although the incentives were most likely to be different, and not strongly related to production. The motivations could be based on - *inter alia* - regulations, amortisation or competition. In case of the latter, adaption of recent trends is coerced by the market and the competitors and does not necessarily involve efficiency improvement[2]. This is supported by the question inquiring about the source of the innovation, in which 43 per cent of the process innovators answered that they were inspired by other (competitor) companies.

4.1.3. Organisational innovation

Almost one-third of the respondent companies introduced organisational innovation in the past years. The most common modernisation was a change in the administration system which was most likely due to regulatory changes. Besides that, corporate governance was extended by some new functions, but that was much less characteristic among the companies (only 23 percent of the sample was involved). It is interesting that only 19 per cent reported that the employees received acquired new skills through in-house trainings.

Figure 16



The main beneficiaries of organisational innovations are the middle size firms, since small enterprises are most probably too small for such changes. Large companies at the same

[2] For example, a hotel meeting with the recent trends, revises its food and beverage policy and in addition to the traditional cuisine it also serves vegan food. This does not induce any improvement in efficiency but requires process innovation.

time are too big, and any modifications in the organisation would take much more time to be implemented. It is the middle size (between 20 and 49 employees) stratum that is able to conduct smooth transitions. Trainings also took place chiefly at larger firms (above 20 employees), as around 30 per cent of them conducted such activities, while only 10 per cent of smaller enterprises had any coaching for the employees.

Owing to organisational innovations significant improvements were experienced in the workflow (at 67% of the respondents), but employee fluctuation also decreased in some cases, and 30% of the companies are now able to perform more complex tasks. There is no difference between the impacts of the innovation categories, all types have more or less the same results.

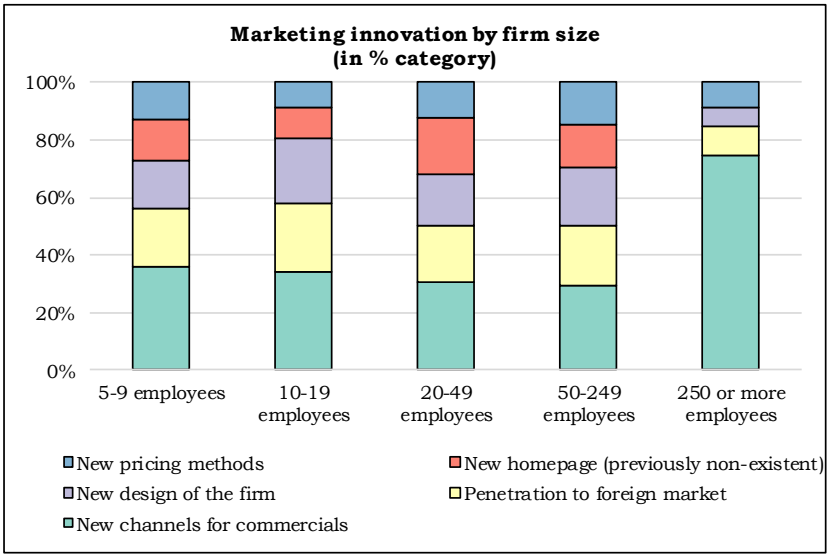
Organisational changes are barely negotiated with the employees. Decisions concerning structural modifications fall within the board's competence, as 65 per cent of the respondents reported. Small firms understandably are more open to board-employee discussions. Below 19 co-workers, firms include most colleagues in the decision-making process. Although it is barely discussed, most employees welcome the altering organisational structures, evaluating the reception at 3.53 on a 1-5 scale on average. Middle size companies reported the highest acceptance level (3.69), while large firms above 250 employees assessed it at 3.0.

4.1.4. Marketing innovation

Marketing innovation was rare among the respondents and it is strongly related to sales (27 per cent reported they introduced new commercial channels like social media). The reason why companies have been pursuing marketing innovations is to enlarge their market and to increase their revenue. Only 9 per cent stated that the firm changed its pricing strategy, which suggests that state-of-the-art marketing methods are not prevailed (such as AI-based customer management). Results suggest that most companies are engaged merely in sales promotion, that is revenue management mainly covers market expansion but not market efficiency improvement. Large companies (above 250 employees) are completely different from smaller ones as vast majority of them responded that new channels for commercials had been introduced, while other forms of marketing innovation are not common.

As a result of marketing innovations 24 per cent of the companies were able to enlarge their market and number of customers. The most successful innovation was the expansion on the foreign markets. Fifty-four per cent of those who penetrated any market outside of Hungary was able to increase their sales revenue. The outcome of other methods is rather ambiguous, because there are no distinct indications about favourable achievements (for example 40 per cent of those who began to use new commercial channels were only able to increase their revenue).

Figure 17



4.2. Regional aspects of innovation[3]

No doubt innovation has territorial features. Regional studies showed that companies that are resided in a close proximity to a large local innovative firm are more capable and receptive to new developments compared with those that are far from such large firms. Knowledge-based innovation centres emerge, led by the largest innovators, attracting smaller, but highly productive enterprises. Knowledge is cumulated in these centres, and owing to spill-over effects, the territorial coverage extends by time. The most emblematic example of such a region is the Silicone Valley in California, USA. Europe also has its own innovative regions: Switzerland, South-Germany, greater Helsinki, London, Gothenburg areas. In Central and Eastern Europe it is only the Prague region that could emerge, other territories are fading in terms of innovation[4].

Regions-based planning has been in the frontline of Hungarian innovation policy since the accession to the European Union in 2004. Since then beneficiaries have received around 700 billion forints, hence the impact was mediocre, owing to the inefficient utilisation of grants. However, some regions with significantly lower transfers achieved better results, which suggests that companies are capable of improving their innovation potential even if they need to use their own capital [Gajzágó and Gajzágó (2019)].

The survey conducted provides an insight into the regional aspects of innovation. It must be noted that the sample size (485) is very small for showing robust inferences, and the power of the estimations can be lower than the usual levels[5].

The regional distribution of product innovators is by far not uniform. Somogy county (NUTS3 code: HU232) has the highest share of product innovators, where 68 per cent of the respondents reported that they conducted such activities. Somogy is followed by Békés

[3] maps on the results of the survey about regional distribution of innovation see the Annex 2.
[4] See the Commission's Regional Innovation Scoreboard:
https://ec.europa.eu/growth/industry/policy/innovation/regional_en
[5] A powerful estimation would have required a sample size of around 3,000 (for one-sided tests of proportions).

(HU332) and Bács-Kiskun (HU331). The latter one accommodates the Mercedes-Benz plant which dominates the regional economy and has a significant spill-over effect in the neighbouring counties. As already discussed, most product innovations are adoptions from the market. Budapest (HU110) is lagging behind a bit based on its innovation potential, a bit more novel innovations would have been expected (only 10 per cent of the respondents developed brand new products).

Process innovations are strongly linked to product developments, because the introduction of new items in the portfolio often also needs an alteration of the production process. All types of process innovations (upgrade, restructure and digitalisation) are prevalent in all regions, although digitalisation seems to be a more common way of process innovation in the eastern part of the country, particularly in the less-developed regions like Nógrád (HU313) or Borsod (HU311).

It is the toughest task to conduct organisational changes in any company's life. Therefore, new corporate functions are far from being common compared with other options. Changes in administrative rules are prevalent almost in all counties, but most likely they are due to national regulations like the mandatory introduction of online cash registers. The low frequency of trainings for employees is rather disappointing, particularly in regions where one or more universities are operating.

Marketing innovation is undoubtedly dominated by new commercial channels like social media or internet advertisements. The launch or upgrade of websites are also popular and these two may go hand in hand as e-commerce emerged in the past years. Penetration to foreign markets is more common in Southern Hungary and that might be related to a growing car industry in the central part of country as well as the proximity to the border.

The attitude toward innovation is similar all over the country, although there are some irregularities. Vas (HU222), Tolna (HU233) and Komárom (HU212) are counties where reluctance to innovation is the highest. It seems that the acceptance of innovation is concordant with the existence of recognised universities in the region. That also underlies the relationship between the attitudes of the fields of education, innovation and management.

Labour shortage is the most significant hindering factor to innovation for companies, and it is becoming more severe from west to east, which has to do with migration within the country or outbound of it. Although sample size limits an inference, but one may observe some positive correlation between regional development and the lack of labour force, as employees are attracted by higher remunerations in the more developed counties. Hence, the assessment of labour force is statistically the same along all regions and a minor positive association is found between product innovation and the evaluation of the labour force. That implies that a lack of innovation is related not only to the quality but also to the volume of labour supply, which is disappointing again, because innovation ought to alleviate the lack of labour.

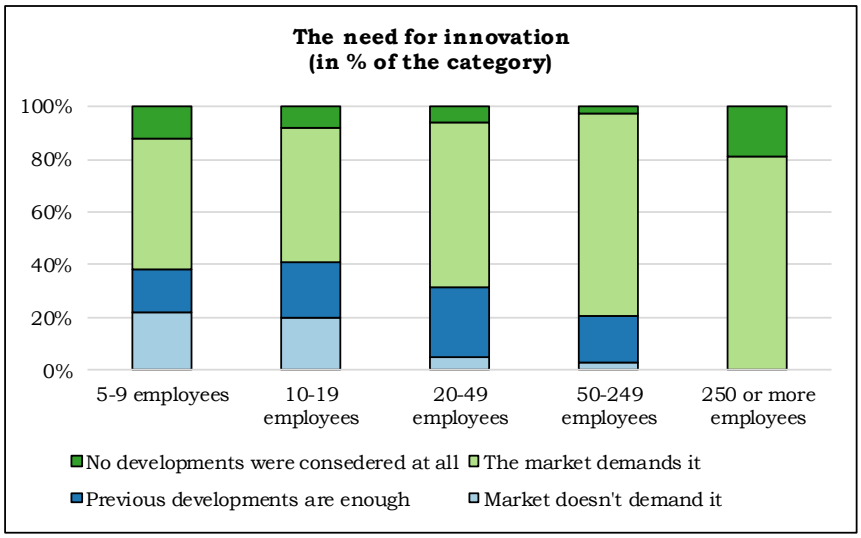
The institutional background is seen similarly by the firms in the country as averages do not differ statistically. Companies are unhappy with the administrative burdens, and do not find the state very supportive when it comes to innovation. The bureaucracy is burdensome, and the government does not provide enough financial support for the entrepreneurs, particularly for small sized firms.

4.3. Factor influencing innovation

Fully 87 per cent of the respondents have an annual business plan, and 77 per cent have a short-term strategy for development. When firms were asked to evaluate the necessity of innovation at their company 64 per cent agreed that it is a must and the market demands it. Only 7 per cent stated that the market is indifferent to any sort of innovation. Every sixth company had not considered the possibility yet and 15 per cent said that innovation is not needed owing to the previous developments being carried out at the company.

There is a significant difference among the firms according to their size. *Small entrepreneurs (less than 19 employees) tend to believe that the market is not interested in any innovation* (more than 20 per cent of them stated this), while other firms are convinced that to staying on the current market, innovation is definitely required.

Figure 18



Ownership structure is also a significant factor in this question. 14 per cent of the Hungarian companies responded that innovation is not needed, while those who are in foreign ownership it was only 5 per cent who reported this. It is interesting that 73 per cent of the foreign companies think that developments are demanded by the market and only 59 per cent of the Hungarian companies said the same.

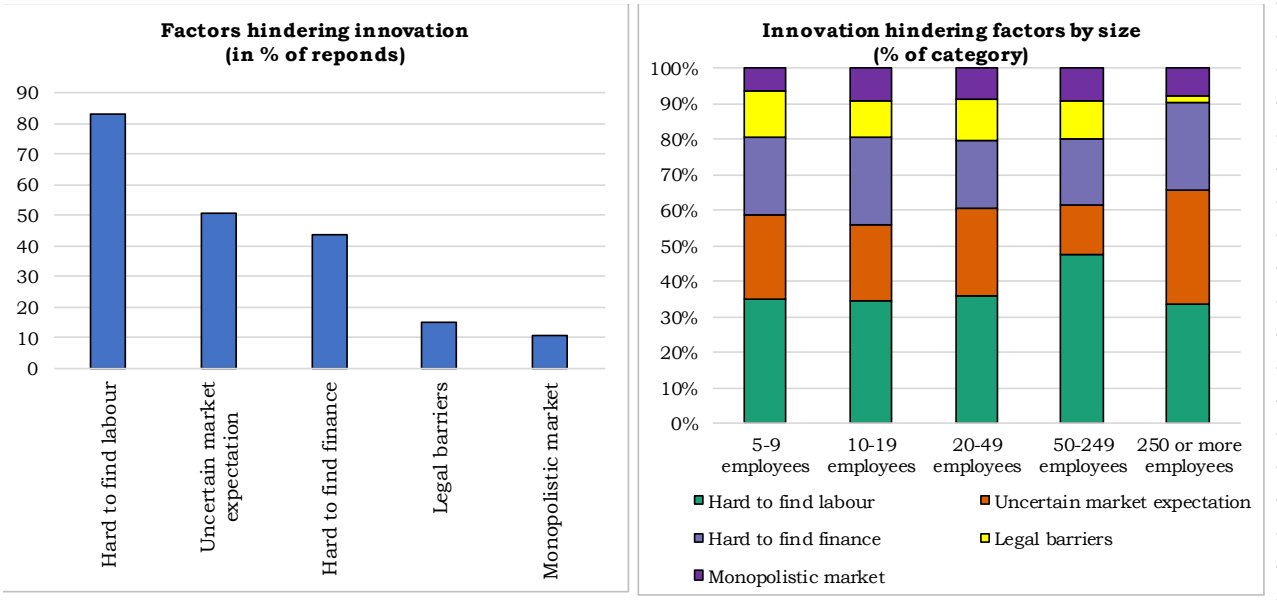
Companies were asked about the top three hurdles of innovation and almost all of them (precisely 83 per cent) reported in the first place that it is troublesome to find labour. The mention of other suggested hindering factors was much rarer. Some 51 per cent commented that market expectations are unpredictable, and therefore decisions over innovation must be taken under scrutiny. The third most mentioned problem was a lack of financial possibilities (44%).

It is chiefly the middle size companies that suffer from labour shortage. Fully 98 per cent of large companies and 91 per cent of medium-sized firms reported a severe lack of potential employees, while "only" 65 per cent of the small entrepreneurs said that this was a vital problem. The evaluation of financial resources is quite similar; large companies tend to agree that it is a significant blocking factor for innovation (70 per cent), while only half of the small and medium size companies were complaining regarding that factor. Market expectations are unfavourable, chiefly for the large respondents (for 94%), but much better

for the small ones. It should be noted that legal barriers are much more troublesome for smaller companies, mainly because most likely they have no legal departments or any administrative section that would manage such issues.

The following figure shows that the distributions of hindering factors are similar among the small companies. Labour force shortage and uncertain market outlooks are more severe among the large firms. This is likely rooted in productivity and market position differences between small and large companies.

Figure 19



Large companies tend to be market leaders that need to bear the risks of innovations. Small firms are rather market followers (except for innovative start-ups), most of them adopt innovations that are already tested on the market (that is, it is new to the company but not for the market). Foreign companies are more sensitive to market expectations, as they usually also depend on the world market besides the domestic one. Productivity and wage differences are significant differences as well, because large companies are traditionally more productive, and therefore the labour demands (both in quantity and quality) are also different. It is interesting that a lack of financial resources is more problematic for the large firms, although probably this has to do with diverse costs of investments linked to innovation. Bank loans and own capital are the most common ways to finance the investments. State financed financial support or EU2020 (Széchenyi Program) funds are not prevalent, only 13% of the respondents reported that they took advantage of one of these possibilities.

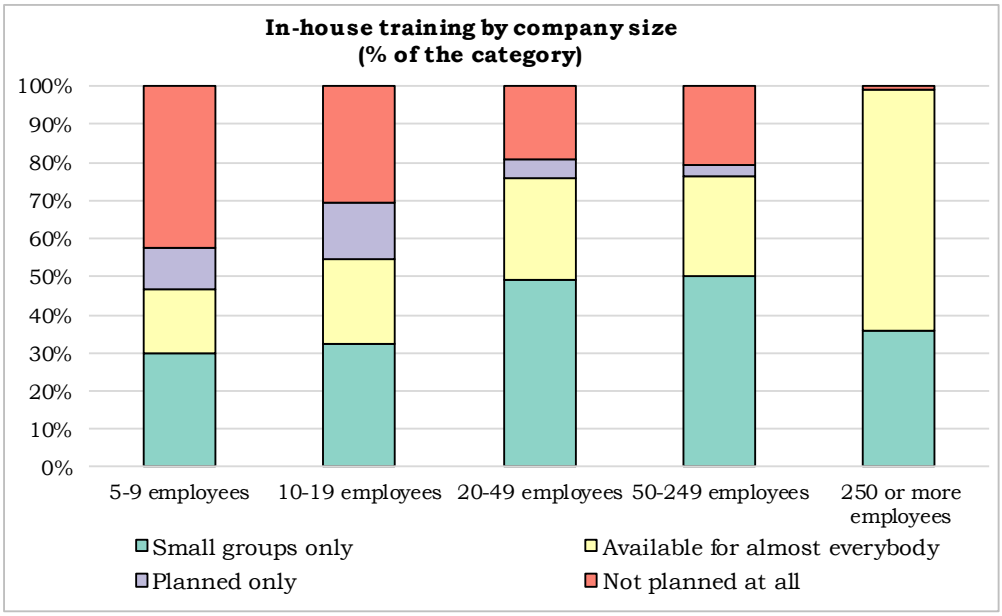
Respondents were only moderately satisfied with the qualifications of the workforce (the overall average was 3.48 on a 1-5 scale). Those who are participating in the dual vocational training system[6] gave 3.61 points. The assessment increases by company size, which can be explained by wage differences; large companies are skimming off workers with higher productivity rates from the labour market. Employees with higher education are graded better than skilled workers (3.8 on the same scale). There are significant differences along

[6] Only 10 per cent of the companies participate in the programme.

firm size, because medium size (50-249 employees) companies gave the best evaluation (4.13), while the smaller ones (10-49 employees) had a bit worse opinion (3.63). Foreign owned companies are more satisfied (4.02) than the Hungarian ones (3.72) which also has to do with wage differences and skim-offs. However, there is no difference between the industries. As a conclusion, one might observe that foreign owned large companies are able to attract employees of higher productivity, while Hungarian firms, particularly the smaller ones, do have a much tighter labour supply by which they hardly find the right labour force, therefore they downgrade their capabilities.

The frequency of in-house training is clearly increasing with the size of companies. Less than half of micro-enterprises offer some form of training to their employees, whereas in the case of large companies it is practically 100%. The nature of the training also depends on the size of the companies. More than 60 percent of large companies offer in-house training for all employees, while smaller companies typically offer it to a small group of employees.

Figure 20



A total of 21 per cent of the surveyed are not planning to organize any sort of in-house education in the near future. Within that, this rate is over 40 percent at micro firms and the proportion of firms ignoring the training of employees is rather high also in case of medium size firms (20-25%).

Most companies did not have any partners in the innovation process and those who did, typically chose a consultant company or research institute (12%). Firms are barely cooperating with any universities in Hungary (7.4%) or abroad (2.6%). The share of business partners in the cooperation is also very low (6.6% for the Hungarian companies and 1.9 percent for the foreign firms).

4.4. Assessment of institutional environment

Respondents were asked to evaluate the Hungarian institutional environment for innovation. Companies have a negative opinion on how supportive the government is

toward innovation, because the average score is 2.51 (scale between 1-5). Firms are mostly displeased with the bureaucratic burdens (mean score of 2.14), and only a little more satisfied with the regulatory environment (2.5) and intellectual property (IP) protection (2.65). There are differences in the evaluation of administrative burdens and IP protection along company size. Large companies consider the administrative burden heavier than average (1.71 compared to 2.14). In the case of IP protection, smaller companies assess the situation slightly better, as they graded IP protection better than the average (3.2 compared to 2.65). This might have to do with the R&D capability of small companies: while larger firms are more apt for such innovations that need IP protection, smaller ones are seldom able to develop such innovations due to a capacity limit. Enterprises employing not more than 20 co-workers would rather adopt innovations which require much less of an administrative process compared with those (usually larger companies) that wish to protect their IP.

A total of 81 per cent of the respondents indicated that the company is a member of a professional association where one can get an insight on recent innovations and developments. No information was provided about the activity of the respondents at these events. Associations, chambers of commerce regularly organise business meetings for small groups of members, but the efficiency of these is unproven.

Top barriers of innovation

One of the main aims of the survey was to identify the three most important barriers to innovation in Hungary. Although, the respondents had been asked directly about that, one can conduct a much deeper analysis if the internal structure of the answers is revealed. For that the method of multiple correspondence analysis was utilised, by which one is able to inspect the relationship between the variables that are coded as categorical. First, it will be shown what characteristics of innovation firms have.

Companies engaged in product innovation definitely have a preparation process prior to the introduction of the new goods or services. Mostly market research and comparative analyses are conducted, and in some cases, feasibility studies are also made. Despite the scrutiny before the product innovations, most of them are not new to the market, but only for the company. Those who have novel product innovations are very similar to those who introduced already existing items. At the same time, company size and sector are ambiguous factors, because product innovation seems to be independent from the number of employees and the industry in which the firm operates. **Innovative enterprises are rather neutral to the institutional environment, not satisfied, but also not discontented either, and they do not have serious problems with labour shortage or with other exogenous issues**.

Product innovators are often process innovators, too, although these developments emerged from the new products as modifications had to be set due to the altered product portfolio.

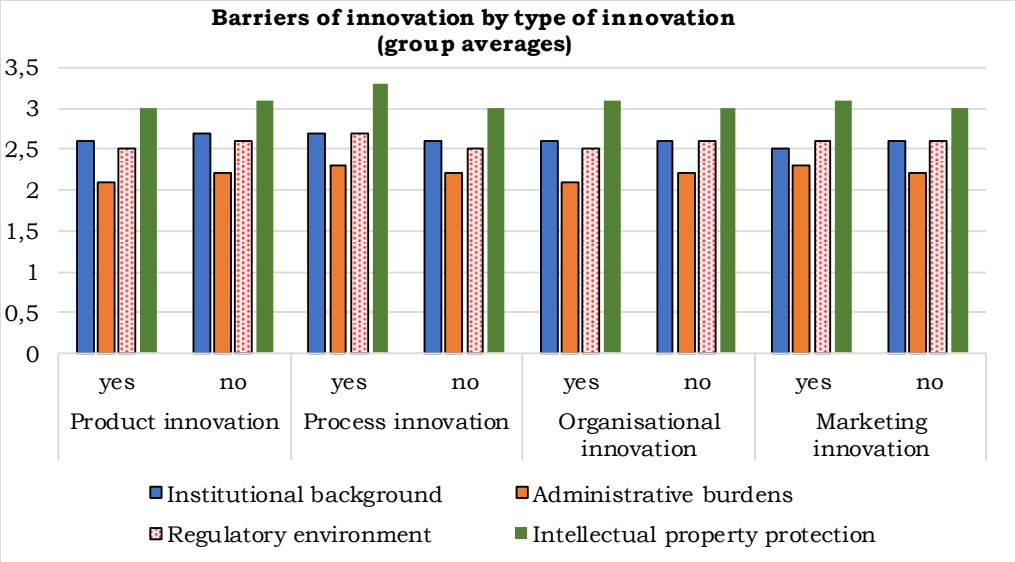
It is also the product innovators who change their organisational structure and introduce new corporate governance functions. Owing to these innovations, firms are ready to resolve complex tasks which they could not do before. It is remarkable that this was the main driver of process innovations, not cost reduction (or efficiency enhancement).

Those companies who did not conduct any product innovations believe that the market does not demand any developments from their company, thus they do not have a strategic development plan. They are rather small firms, although the picture is mixed, and one can find a few large companies among them. They have the belief that the market is dominated by some large companies, thus innovations do not count at all.

The unfavourable assessment of labour force (regardless of its level of education) is also something these companies have in common. Their objective is to reduce the pressure of labour shortage, therefore some of them modernised the production process (without product innovation), and sometimes also introduced new governance functions. Despite these measures they could still moderately decrease fluctuation and increase productivity. Companies are unhappy because of the bureaucratic burdens and the IP right protection, and they think that financing innovations is burdensome because of a lack of funding opportunities (they rely more on state subventions compared with EU funds).

The source of innovation reluctance is two-fold: there are some external factors like competition and labour shortage that certainly limit the willingness to innovate, although owing to internal peculiarities, innovation readiness would not necessarily be ensured even if the above-mentioned exogenous barriers were removed. These companies also struggle with in-house capabilities such as management knowledge and readiness, relevant skills and lack of funding possibilities. Based on the survey it is clear that most companies are aware of the necessity of innovation, and some developments are made regularly. The motivations behind these improvements are diverse. In addition to investments to cover depreciation, innovations are often conducted to mitigate a labour shortage or to keep up with state-of-the-art market trends. **Only a small portion of companies conduct innovation to overcome competitors or to change and develop permanently**.

In an economy it is not expected that most firms shall be high-level innovators, however the capability to innovate and to adopt the latest technologies and tailor them to the company is a fair demand on a competitive market. This requires management readiness, relevant skills, competition, favourable and stable market outlook and, last but not least, funding. It is not proven by the survey that companies' attitudes towards innovation would be different according to their location. If a business lacks any of the factors mentioned above, it will not be able to innovate effectively, regardless of the region in which it operates.



On the other side, there is no evidence of any association between type of innovation and the assessment of institutional environment, either. This suggests that firms are rational, and their views coincide on the exogenous factors. This implies a structural problem of innovation policy, because partial deficiencies (such as regulative barriers intellectual protection) would be seen by those firms that are impacted, but not by those who are not. However, the root of the problems does not necessarily innovation policy related, as other governmental policies, like education, anti-corruption and infrastructural development strategies also influence the common assessment of the institutional environment. As these factors are locked for every actor on the market, it is not unanticipated that all firms evaluate them similarly.

Based on the survey results, the top barriers of innovation in Hungary are the following (not in hierarchical order):

- Awareness of innovation necessity: most companies which are not innovative have the belief that innovation is not needed at all. This comes from management reluctance, lack of knowledge and from the lack of a long-term strategic approach. The importance and role of innovation in companies' lives ought to be promoted.
- Lack of relevant skills: although labour shortage is a severe factor in Hungary, which innovation should in theory alleviate, proper knowledge on this subject is often missing. This is rooted in the anomalies of the education and training system. A weak competitiveness is also a relevant factor, as it contributes to brain drain, while the economy struggles to attract modern expertise. A large part of the growth relies on cheap labour, and the economy is not knowledge-based, regional disparities are high, particularly in productivity.
- Lack of stable market outlook: any alteration in corporate life takes time to have the expected impact and always carries risks. Therefore, decision makers must have a clear vision of the firm's future, which includes particularly a stable external environment. Uncertainty reduces innovation willingness and investment appetite. It is chiefly the national government's authority to ensure a stable environment, although depending on the main market of the company, other exogenous factors should also be considered (such as raw material prices, purchasing power variation on the foreign markets etc.).

5. Main conclusions of the personal interviews

In the framework of the research we conducted personal interviews with 20 company managers and with 5 persons in leadership positions at professional organisations.

The company sample was linear in terms of firm size: 5-5 interviews in each firm size groups in different branches (manufacturing, public utility, construction industry, trade and other services) and in different regions. We asked company managers not only about their own innovation activities but also about their experiences on the willingness and capability to innovate among their business partners and other firms in their branch.

In addition to company managers, we contacted business organisations, chambers and social partners related to different sectors like commercial chambers, corporate umbrella organisations (Confederation of Hungarian Employers' and Industrialists', National Association of Entrepreneurs and Employers etc as well as the German-Hungarian Chamber of Industry and Commerce (DUIHK). The information gained from these interviews were important as these institutions have regular contacts to enterprises, so they have a comprehensive view on the innovation activity of firms in different sectors and can transmit the views of entrepreneurs about the infrastructural conditions of innovation (rules, laws, support, characteristics of a business approach to innovation, etc.). Furthermore, we consulted with the Hungarian Innovation Association (MISZ) and the Association of Hungarian Inventors (MAFE) as well as with an expert of venture capital.

In the interviews, we tried to identify the motivations and attitudes of Hungarian executives toward innovation, by giving them opportunities to express their personal experiences and opinions. In the interviews, we handled the topic more general and comprehensive. In addition to the closely related innovation issues, we addressed in the interviews the broader institutional and policy context of innovation, like the effect of education policy, fiscal (tax) policy, quality of the governance and R&D policy.

We planned to conduct interviews with managers of both innovative and non-innovative businesses, but in fact each of the companies surveyed has implemented a few or more innovations in recent years and has ongoing projects still. In such a small sample, this is not surprising at all.

In addition to the 20 in-depth interviews with executives, we randomly asked dozens of firm owners about their innovations and most of them reported some kind of innovation (e.g. such as the introduction of credit card payment on the marketplace, which is considered, in broader sense, as innovation).

All executives interviewed expressed the definite opinion that *every company that wants to keep its market share in longer run, must carry out smaller or larger innovation and use new technologies*. Anyone who does not do so will sooner or later fall out of competition.

Renewal of products, production, organization and sales has always been an important prerequisite for maintaining or improving competitiveness, but the current development of *digital world* poses a challenge that companies cannot meet without innovation. "*Not only the development of the digital technology but also the pressure to innovate is accelerating*".

5.1. The decisive role of Information technology innovations

Since some decades now, digitalization has been the major driver to innovate that forces the renewing of production and marketing processes across all sectors.

Corporate leaders interviewed in all sectors have unanimously identified **digitization as the main direction of innovation**. Nowadays, information technology pervades the business of companies (production, organization, sales, etc.) to such an extent that no company can ignore them. The emergence of digital technologies (such as artificial intelligence, robotization, software and applications) have brought about rapid and profound changes in the way innovation is created and diffused. This process of deep and rapid transformation is expected to accelerate.

The importance of the traditional, so-called technical innovations (development of new machines, new products) is steadily diminishing, while most innovation is now focused on IT. The application of digital technology in production and service activities (production management, route planning, resource optimization, robotization or even innovation management, etc.) is where the most significant innovations take place.

Even micro-sized companies cannot delink themselves from this process because these enterprises, just as larger firms, keenly need information technologies, e.g. website, billing program, new software, etc. It is not typically expected for a micro or small firm to develop a brand-new product, but it is essential to follow international (or at least domestic) trends, primarily embodied in information technology applications. The common opinion of executives is that those firms which do not have an informative website are actually no “firm”, they just imitate "entrepreneurship".

From this point of view, the biggest problem is that a significant part of Hungarian entrepreneurs come from the older generation (they launched their companies in the early 1990s), who have less affinity for and knowledge about IT solutions. So, for companies that have not involved the younger generation, whether in the form of changing generations within the family or recruiting younger managers from outside, there are major problems with adapting to digitalization. The importance of the use of digital technology is not even recognized by the majority of Hungarian SME executives - respondents believed.

However, a significant proportion of young people prefer to go abroad, which hinders, in many cases, the formation of firm-university cooperation. Young university students employed in dual training or even as trainees do not show enough commitment as they plan to pursue a career abroad, not at the company. Thus, **the brain drain of young workers with a much greater affinity for digital technologies has dramatic consequences for companies' ability to innovate.** It is perhaps no exaggeration to say that the brain drain of young people causes the greatest damage in this respect.

As we saw in Figure 11 (section 3.5), Hungary's position in digitalization is particularly poor in 2 items: in "Integration of Digital Technology" and "Digital Public Services". The former reflects the weak attitude of companies towards IT and/or the limited ability to find young and skilled workforce to make an IT overhaul, while the latter reflects deficiencies in public digital services.

5.2. Shortage of labour, wage increase as a driving force for innovation

In recent years, since the rapid wage increase started, the Hungarian economy entered a new paradigm. The labour shortage and the rising wages became a more significant driving force to innovate than before. New technological solutions and modernization of the production (goods or services) are the only way to overcome the labour shortage.

Companies that cannot reduce labour demand through process innovation and automation will lose out because they can only pay higher wages if effective labor intensity falls.

Regarding the availability of skilled workforce, corporate executives reported different experiences. It is a general finding that there is a serious shortage in high skilled labour in Hungary, which affects all companies. However, the extent how severely this affects a company depends to a large extent on the level of wages: obviously, higher-wage firms will find easier highly qualified workforce capable of participating in innovation, too.

This conclusion of the interviews coincides with the results of the survey. Larger companies mentioned labour shortage as a bottleneck much less than the average, either in terms of quantity or of quality.

A possible way to find skilled labour is close cooperation with training centres and universities. Large companies (both foreign and domestic) are almost invariably affiliated with the local university and vocational training centres and are involved in dual training. Even so, it is a frequent experience that the highly trained workforce eventually leaves the company and moves abroad. Many foreign-owned companies try to prevent this by directing their workforce to a subsidiary in another country. So, the workforce can be retained at least within the holding. It should be added that currently there is a lack of qualified labour force not only in Hungary but also in the country of the parent companies (mainly in Germany). Actually, the labour shortage in parts of Western Europe is a major factor behind the brain drain Hungary (and other countries in the region) face.

Conversely, micro and small businesses typically cannot take advantage of this opportunity, and it is even more difficult for them to obtain and retain qualified workforce. Nonetheless, many SMEs, especially medium-sized companies, whose owners/managers themselves are highly qualified, maintain active links with training centres and universities (some are even teaching there). These managers are in a better position to recruit and keep high-skilled labour force.

This is only a smaller proportion of SMEs, however. Many domestic SMEs have not yet recognized the importance of *knowledge* that is embodied in the skilled workforce is also the key to innovation. As one executive mentioned: "this is a vicious circle. CEOs who do not recognize the importance of innovation cannot afford to pay high qualified staff due to low productivity and efficiency. And if there is not enough skilled workforce, there will be no innovation as there is no capacity to invent and absorb innovation".

A significant proportion of Hungarian companies find themselves in this unfavorable situation. If current wage increase continues, this would clean up the market, as companies that cannot innovate will disappear.

5.3. Qualification of labour force and training

Interviews with corporate executives refined the picture from the survey a little bit, notably that "larger companies are more satisfied with the qualifications of their workforce than smaller companies because they are better able to pay for highly skilled labour". Large companies (both domestic and foreign) can also benefit from maintaining an active relationship with vocational training centers and local universities.

However, this is by no means limited to large companies. According to respondent company executives, many medium and even smaller companies can take advantage of this opportunity. Typically, not in a formalized way like the big ones but through personal professional relationships. A graduate manager has the opportunity to turn to his/her alma mater and try to create collaborative innovation. This is a rare occurrence, however, that depends mainly on the qualifications and skills of the company manager. And here we come again to the question of the qualifications of corporate executives: well-trained corporate executives are in a better position to acquire highly qualified employees, as well.

Another major point is that SMEs are at a significant disadvantage in obtaining highly qualified labor not only because of differences in salaries, but also due to the additional attractive opportunities (e.g. study trips at the parent company) offered by the multinational companies.

Virtually every corporate executive expressed their dissatisfaction with the quality of institutional education. In their opinion, skilled workers and university graduates typically do not have even the basic practical knowledge either. The exception is companies which themselves are actively involved in education. In other words, innovative businesses must train their workers themselves. In the case of large companies, this typically takes the form of in-house training, including trainings in the headquarter of the multinational company. Large companies (both domestic and foreign) operate their own training centers where systematic training is provided for the staff in order to spread firm-specific knowledge. For smaller businesses which intend to innovate, education is mainly done through external training.

Corporate executives were unanimous in their view that innovation and continuous training of the workforce go hand in hand. Companies that do not invest in training the workforce are also lagging behind in innovation. It is a watershed between companies that clearly outlines their future position in market competition.

Respondents believe that the early 2000s brought an end to the era in which non-innovative companies were able to vegetate in some way. Today the pace of digitalization has accelerated to such an extent that the existence of non-innovative companies has become dubious. And the key words in this respect are: knowledge and continuous trainings.

5.4. Financing and public support of innovation

It is worth to separate the financing needs of product innovation and the other three types of innovations. Organizational and marketing innovations typically do not require significant investment, so every company can afford it from its own resources. The question here is only *whether the CEO recognizes the need* for the purchase of new software, market surveys, monitoring of competitors, reorganization of client or customer relations, etc. This is also true to minor production process innovations.

These types of innovation are funded by all responding executives from the company's own resources.

Larger companies are obviously implementing more significant production process innovations at higher costs. However, the financial means of large companies makes it possible to finance them on their own. For example, creating a digitalized warehouse in which there is no humans, no heating, no lights, just computer aided robots, costs more hundred million forints but such a warehouse in only needed by large companies.

There are two types of product innovation: direct innovation and independent innovation. The former one is when the customer specifies exactly what product they need to develop. Such "targeted" innovation usually requires only the knowledge and experience of the supplier, without any particular capital investment and additional financing needs. However, for an independent product innovation project based on own-initiative businesses may require funding at a magnitude for which SMEs generally do not have the sufficient resources. Managers of companies of this size estimated the financing needs for an average incremental (t.i. not radical [see section 2.1.]) product innovation to HUF 150 to 300 million.

This is the magnitude where SMEs typically need external financing. Executives surmise that many ideas fail due to lack of funding, but the small sample size does not permit us to give a quantitative estimate about how many. In our sample, there were SMEs that received Széchenyi2020 support, and there were also some that did not receive the requested support. Another company manager never participates in any tender because he considers that the support (if any) entails so many restrictions and bureaucracy that it is not worth it.

Executives positively assessed the willingness and conditions of banks to lend.

Putting together these responses with the responses to questions regarding attitudes and managerial skills, discussed in section 5.1, we can come to the conclusion that, at present, the lack of funding is only rarely the sole cause of the failure of a product initiative. Rather, the lack of market knowledge and strategic approach causes the abortion of ideas, which makes the funding of those ideas impossible, too.

Venture capital is a special form of financing innovation. This type of financing is primarily aimed at co-financing start-ups, especially in the field of IT. In Hungary venture capital is plentiful (0.023% of GDP), much higher than in other countries of the region (0.002-0.01%) (EIB, 2018). This is because of strong public involvement. While public equity funds account for around 40% of total venture capital financing in the EU on average, this is over 90% in Hungary. While private funds are strongly focused on innovative IT solutions, public funds are open to other sectors and do not insist on innovation (eg. co-financing of a pet clinic).

5.5. The role of multinational companies (MNC) in the innovation

Not only the statistical data prove that multinational companies play an outstanding role in innovation and development in Hungary, but also the results of the interviews. Executives of both multinational companies and domestic firms had the view that foreign subsidiaries established in Hungary are an important driving force for the entire supplier network. Foreign companies do not hinder the innovation of domestic companies in any way, on the contrary: their business relationship with them requires continuous innovation, for several reasons.

On the one hand, the high-quality requirements of foreign companies pose a challenge for suppliers that can only be met through continuous innovation. Most multinational companies employing domestic suppliers provide regular training in various areas such as: the concept of innovation, innovation project management, innovation self-audit, etc.

On the other hand, foreign companies are outsourcing more and more development tasks to their suppliers. Nowadays, it is not necessarily true that MNCs keep core research tasks in the headquarter and outsource only lower level subtasks. Multinational companies' research activities are now organized around a global network and network centers, often involving the transfer of research from one subsidiary to another. And these research and innovation tasks are often outsourced to domestic suppliers.

The decision about the location of certain R&D activity mainly reflects local supply conditions, the technological skills of workforce, the cost of high tech labour, proximity to universities and research centers.

Undoubtedly, this situation sets a dependent development path for Hungarian innovation. However, this is a situation that, instead of being condemned, should rather be exploited by enabling domestic companies to participate in production chains. The goal should be for domestic companies to move up in these production chains where profitability is higher. The only way to achieve this is through innovation.

What has been described so far mainly concerns the manufacturing industry, particularly the foreign automotive industry and mechanical engineering companies, which (as seen in Section 2.2) make up the majority of R&D and innovation in Hungary. The research and innovation activity of these foreign firms are largely centralized. In other sectors, by contrast, some subsidiaries have introduced significant (digital) innovations on their own initiative, in cooperation with a local research center.

Entering and moving up the production chain requires considerable effort from the supplier, but this is basically a prerequisite for remaining competitive. Only an outstanding group of companies in Hungary can meet this requirement.

Not all companies accept this. Corporate executives think that when we talk about Hungary stuck in the middle-income track, we exaggerate the influence of multinationals – after all, they are only one (though significant) part of the economy. In principle, independent innovators would have the opportunity to create their own innovations, potentially putting the Hungarian economy on another development track.

Apart from the question of whether the executives overstate the pool of potential independent innovators, another question is to what degree the domestic conditions would support the aforementioned innovators. This leads us to the issue of the institutional environment of innovation.

5.6. Institutional environment of innovation

Corporate leaders considered the institutional environment to be mediocre or slightly worse. This result also coincides with the findings of the survey.

Among the negative features, they mentioned the frequent changes and inconsistencies in the *institutional framework* for research and development In Hungary.

Since the dissolution (virtually in 1994, legally in 2003) of the OMFB (National Committee for Technical Development: Országos Műszaki Fejlesztési Bizottság) which has been operating for decades, not only the name and organization of the institutions managing R&D, but also the concept has been changed often. Recent decades have been characterized by a constant struggle between the representatives of research (theoretical approach) and innovation (practical approach), and the frequent renaming and reorganization of the relevant institution it reflected (and reflects) the current state of this struggle.

The OMFB was replaced first by the NKFIH (National Office for Research, Development and Innovation) and from 2010 the National Office for Innovation (NIH). As of 1 January 2015, the latter was also abolished and the National Office for Research, Development and Innovation (NKFIH) was created. At the same time, the tasks of this office didn't remain unchanged, either: from 16 June 2018 the EU-funded research, technological development and innovation programs (GINOP, VEKOP) were transferred to the Ministry of Information and Technology (ITM). By this, the fragmentation of development tasks continued. Interested companies find it difficult to follow these frequent changes.

In January 2020, in parallel with the removal of the MTA research institute network, the operation of the NKFI Fund was taken over by the National Science Policy Council (NTT). In 2019, based on a new law by the Parliament, the far best Hungarian university, the Central European University (CEU) which was ranked in 2020 by the prestigious QS World University Rankings as the 30. best university in Politics and International Studies subject, was forced to leave Hungary. These changes in the research and development system did not directly affect the corporate sector but created uncertainty among the innovative firms.

In recent decades, there has been a variety of public institutions dedicated to supporting business innovation and innovative ideas. These are already directly affecting the innovations of firms. However, these public entities have also often changed. The established public institutions usually have disappeared after a few years and have been replaced by new ones. Currently the VALOR Hungariae (the successor of Carpathia kft, previously the Kárpát-Alpok Zrt. previously the Dialog Filmstudio Vállalat) is engaged in supporting corporate innovation (under the presidency of the renowned poet Géza Szöcs). The executives interviewed did not make use of such public advisory bodies but most of them have followed these changes and saw that these institutions have been far from being stable. The interviewed company executives decried the lack of a public institution that would contribute in a stable and transparent way to the care, financial and practical support of innovative ideas of Hungarian companies.

The opinion of a (successful) firm owner and executive: "*Much more money should be devoted to supporting enterprise innovation through a* ***transparent and normative*** *support system. Today, it is not known on what basis a company receives significant innovation support and another does not*".

Another sensitive issue regarding institutional framework is *education*. Executives evaluated the level of knowledge of new graduates from universities as only moderately satisfactory and have been definitely critical towards the qualification of VET students. This was already elaborated in section 5.3. In their view, the level of knowledge of VET students is constantly deteriorating, especially as regards their IT skills. Typically, they can hardly follow the constant changes in the VET system and do not know what the newly introduced system will result.

The third issue belonging to institutional condition has been the role of *EU funded* financial support. Although, a few of the firms led by executives interviewed requested and received EU-funded support, they also mentioned the negative effects of free money for innovations of company. "Why to make effort to innovate when you can easily benefit from free EU-support if you adjust your plans to the decision makers?" CEOs also mentioned anomalies surrounding the distribution of EU funding, including innovation grants.

5.7. Some other issues

- ***Cooperation***

Most executives emphasized the importance of cooperation with other firms or research centres in innovation. Most of them are cooperating in one way or another: either in the regional scene and/or in professional associations. However, some had negative experiences with universities because of the low motivation of university staff towards doing research. They think that the motivation of university professors to engage in research projects is weak.

Most of them were of the opinion that the willingness of firms to co-operate in Hungary is much lower than in more developed countries, which hinders the development of innovations. The lack of willingness to cooperate is attributed by company managers partly to cultural reasons, low level of trust and partly to state aid distribution policies that favor firms having close links to government over independent ones. The Hungarian business community is far from homogeneous in terms of whether it receives state or EU support (the latter is also distributed by the Hungarian authorities) based on its political affiliation. This divides the corporate community, making it difficult to collaborate.

Nevertheless, there are also positive examples for cooperation. An interviewee leading a medium-sized innovative company reported that because its order stock is rather volatile, it had tacitly agreed with a local multinational company with the same profile (which has constantly struggled with labor shortages) that the temporarily redundant workforce was taken over by that multinational company.

- ***Research and development***

The National Research Development and Innovation Strategy for the period 2013-2020 set the target of spending 1.8% of GDP on R&D. Based on the trends so far, this will depend primarily on whether corporate research spending continues to increase and whether university research activity will rise in the near future. Corporate executives expressed their dissatisfaction with the scientific activities of universities. This harmonizes with the

distribution of R&D in Hungary (see Figure 7 in section 3.4.) which is characterized by a low proportion of university research in total national research activity.

According to interviewed multinational executives, R&D activity in Hungary will increase. Multinational companies are still interested in bringing more research activities to Hungary (and the region) as, despite rising wages, this is still a cost-effective solution. And they will themselves train the skilled workforce at a higher intensity than before. However, improving the research cooperation between firms and universities remains a key issue of Hungarian R&D performance in the future.

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Annex 1:

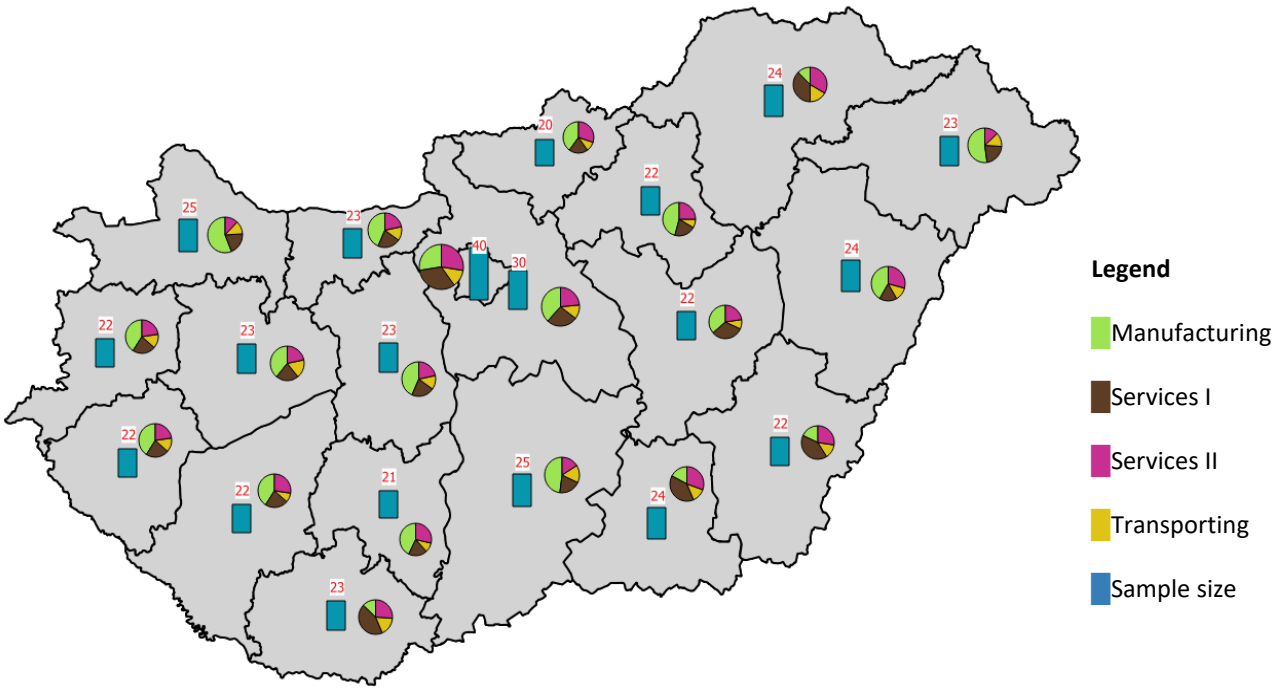
1.1. Sample frame, sample size and sampling of the questionnaire

To reveal the top three potential barriers of innovation among firms in Hungary a survey was conducted between 9 December 2019 and 24 January 2020. Altogether 485 questionnaires were collected, and all respondents provided a complete questionnaire. The sample frame of the survey was formed in a way to be "representative" in terms of NUTS3 level. Twenty strata were created (one for each NUTS3 region) containing at least 20 sample elements in each cell. True representativeness within the strata was ensured by simple random sampling.

It must be noted that the representativeness of the survey allows comparisons between and within NUTS3 regions. At the same time multi-level comparisons (that is, analysis of industrial differences between regions) are possible only at national level. In other words, industries and firms of different sizes can be analysed at national level only. Post-stratified adjustments (also known as weighting) might be needed for nationwide analysis. If it was performed it is clearly marked through the analysis.

The following figure presents the size and the industrial structure of the sample by NUT3 regions:

Size and industrial composition of the survey (n=485)



Source: Kopint-Tárki

Regional sample size varies by the relative differences between the regions. The optimal distribution of sample size was based on the strict constraint of total sample size (480). The strata were formed to manage the concentration of companies, since Budapest accommodates more than 30% of companies in the total population. In order to minimise the effect of variation in territorial densities, large differences were rescaled by natural

logarithm[7] and more weight was put on the moderately dense regions, while high density counties (such as Budapest) were given proportionally smaller weights. By this process such a distribution was achieved in which all NUTS3 regions are represented with a sample size appropriate for major statistical tests.

The industrial composition of the sample frame reflects the national structure. Categories have been formed according to the Community Innovation Survey and only innovative core activities are considered[8]. The next tables summarise the sample frame design by industry and sample size:

Table 1: Sample frame structure by industry and size (n=485)

Industry	Industry category (see map)	Number of employees				
		5-9	10-19	20-49	50-249	250+
B-C-D-E	Manufacturing	35	40	24	15	64
G46-M71-M72-M73	Services I.	38	32	29	7	10
H	Transporting	14	23	10	5	10
I-J-K-L	Services II.	48	42	16	7	16
	TOTAL	**135**	**137**	**79**	**34**	**100**

Source: Kopint-Tárki

Table 2: Sample structure by industry and size compared to the population

Industry	Share in sample (share in population)				
	5-9	10-19	20-49	50-249	250+
B-C-D-E	7% (13%)	8% (9%)	5% (7%)	3% (5%)	13% (1%)
G46-M71-M72-M73	8% (13%)	7% (7%)	6% (4%)	1% (2%)	2% (0.1%)
H	3% (6%)	5% (3%)	2% (2%)	1% (1%)	2% (0.2%)
I-J-K-L	15% (10%)	9% (8%)	3% (4%)	1% (1%)	3% (0.3%)
Total[9]	33% (42%)	29% (27%)	16% (17%)	6% (9%)	20% (1%)

Source: Kopint-Tárki

According to the second table large firms are overrepresented in the sample. One could argue that innovation champions mainly belong to the group of large companies, although there is recent evidence that firm size has little or no effect on innovation capacity [see Bouncken (2011), Saunila and Ukko (2014) or Leal-Rodríguez et al. (2015)]. On the other hand, numerous studies were published lately elaborating on the role of start-ups in innovation [see for example Ries (2011) or Carlson and Usher (2016)] as market leaders. Hence, post-weighting adjustment must be taken into consideration in order to manage imbalances in the sample.

[7] Utilising that logarithmic transformation is a monotone transformation.

[8] According to Commission Regulation 995/2012 (ANNEX II)

[9] Owing to rounding errors the sum does not necessarily add up to 100%

1.2. Sample adjustment

Re-weighting serves as a correction process to adjust over- or underrepresentation of strata to match the population distribution. The technique has two stages. In the first step selection weights are calculated, then post-stratification weights are estimated. The first serves as the unbiasing factor for population statistics, while the latter is to adjust final weights for the sample to conform to the population distribution. In other words, those elements of the population that have low probability of getting into the sample get higher weights (first stage), and those weights are deflated or inflated according to the representation of the given element in the sample. For example, in a random sampling process the conditional probability of sampling a large firm (more than 250 employees) from the manufacturing industry is 0.014, while it is 0.13 of sampling a small one (5-9 employees). In that particular case larger companies would get higher weight because in a representative sample only a few companies would represent the whole stratum. If larger firms are overrepresented (like in our sample) the initial weight is deflated. In case of the smaller entrepreneurships the lower weight will be inflated because they are underrepresented in the sample. The final, next table presents the final weighs by industry and size:

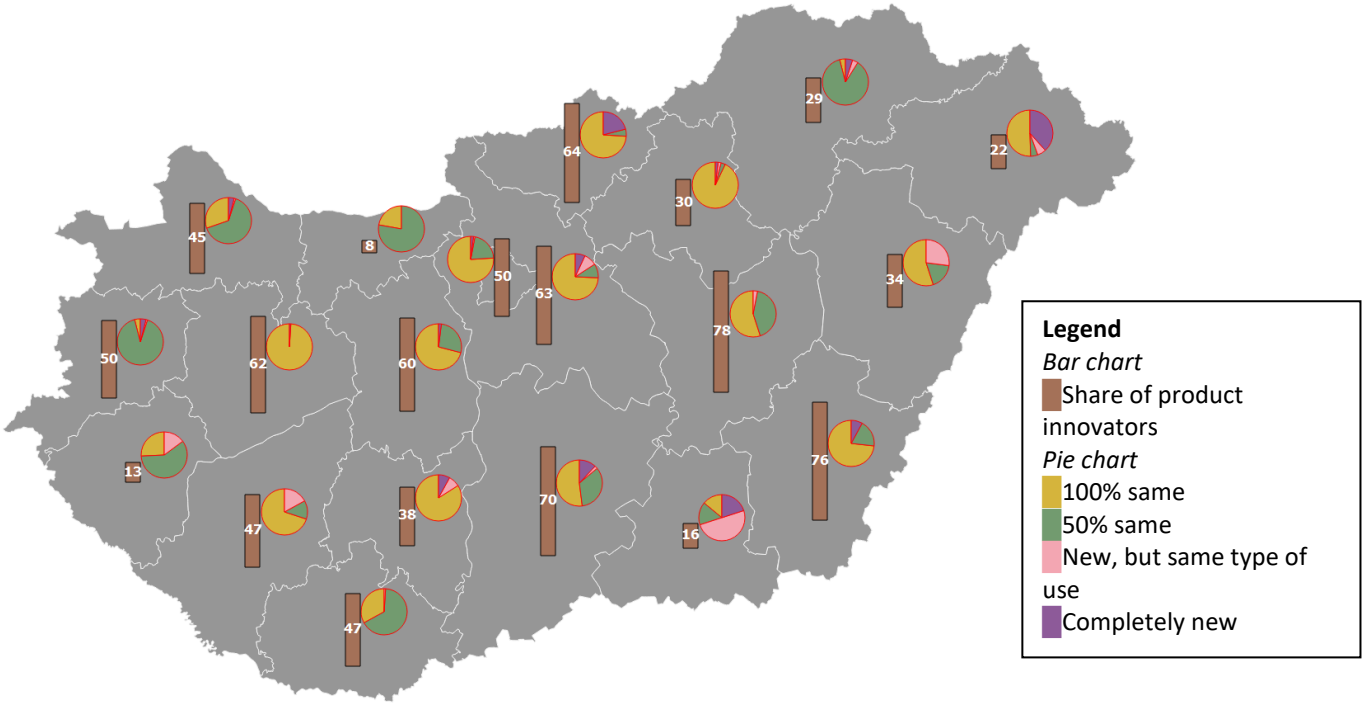
Table 3: Final weights for groups of sample elements

Industry	Size (person)	Count in the sample	Final weight
Manufacturing (B-C-D-E)	5-9	35	0.021346
	10-19	40	0.018678
	20-49	24	0.03113
	50-249	15	0.049808
	250+	64	0.011674
Services I. (G46-M71-M72-M73)	5-9	46	0.016242
	10-19	36	0.020753
	20-49	29	0.025763
	50-249	7	0.106732
	250+	10	0.074712
Services II. (I-J-K-L)	5-9	40	0.018678
	10-19	38	0.019661
	20-49	16	0.046695
	50-249	7	0.106732
	250+	16	0.046695
Transporting and storage (H)	5-9	14	0.053366
	10-19	23	0.032484
	20-49	10	0.074712
	50-249	5	0.149425
	250+	10	0.074712
Total		485	1

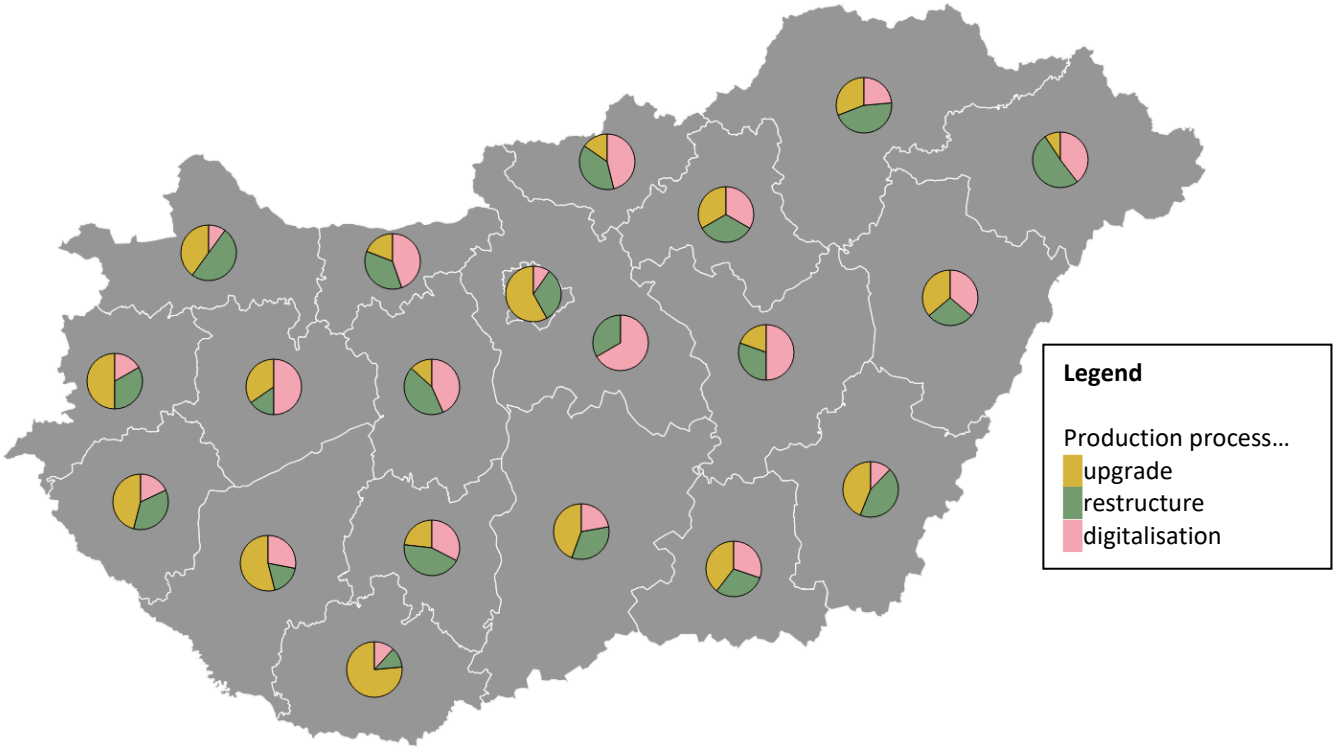
Source: Kopint-Tárki

Annex 2: Regional aspects of the survey results

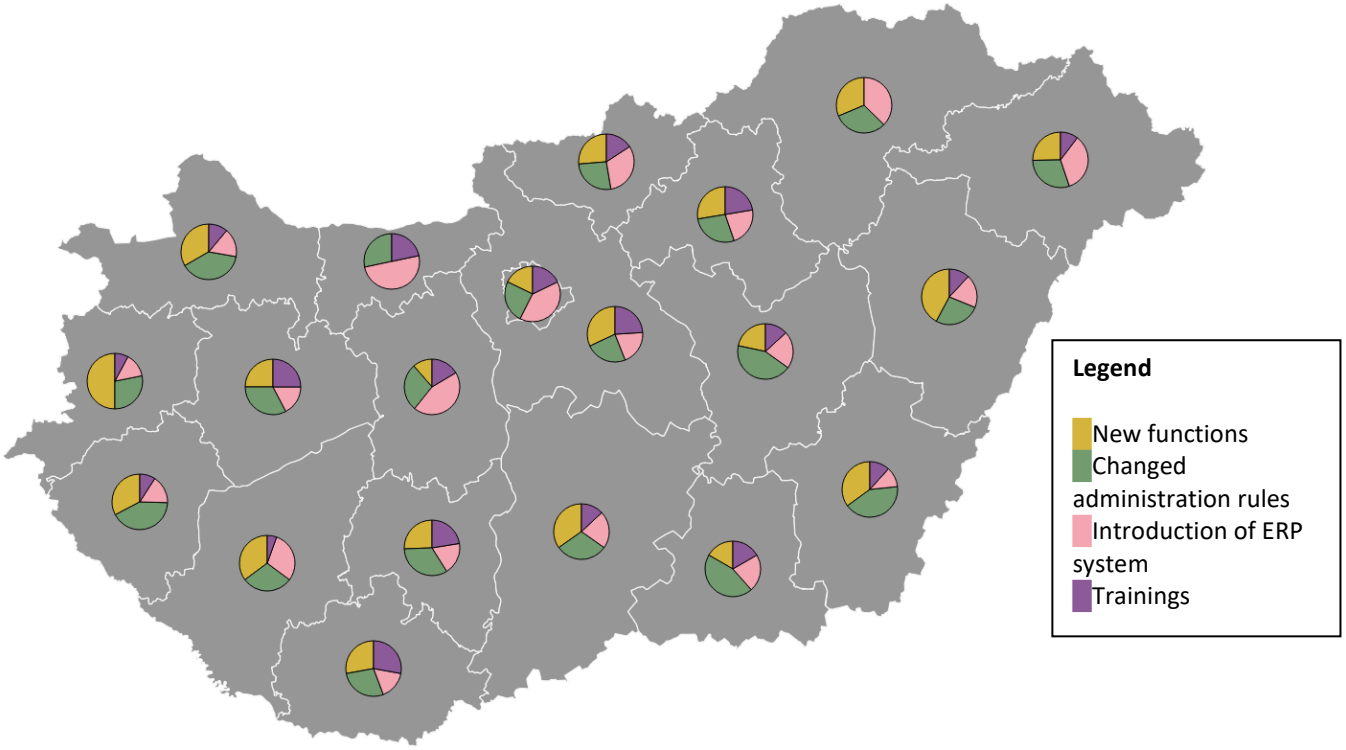
Product innovations by NUTS3 regions



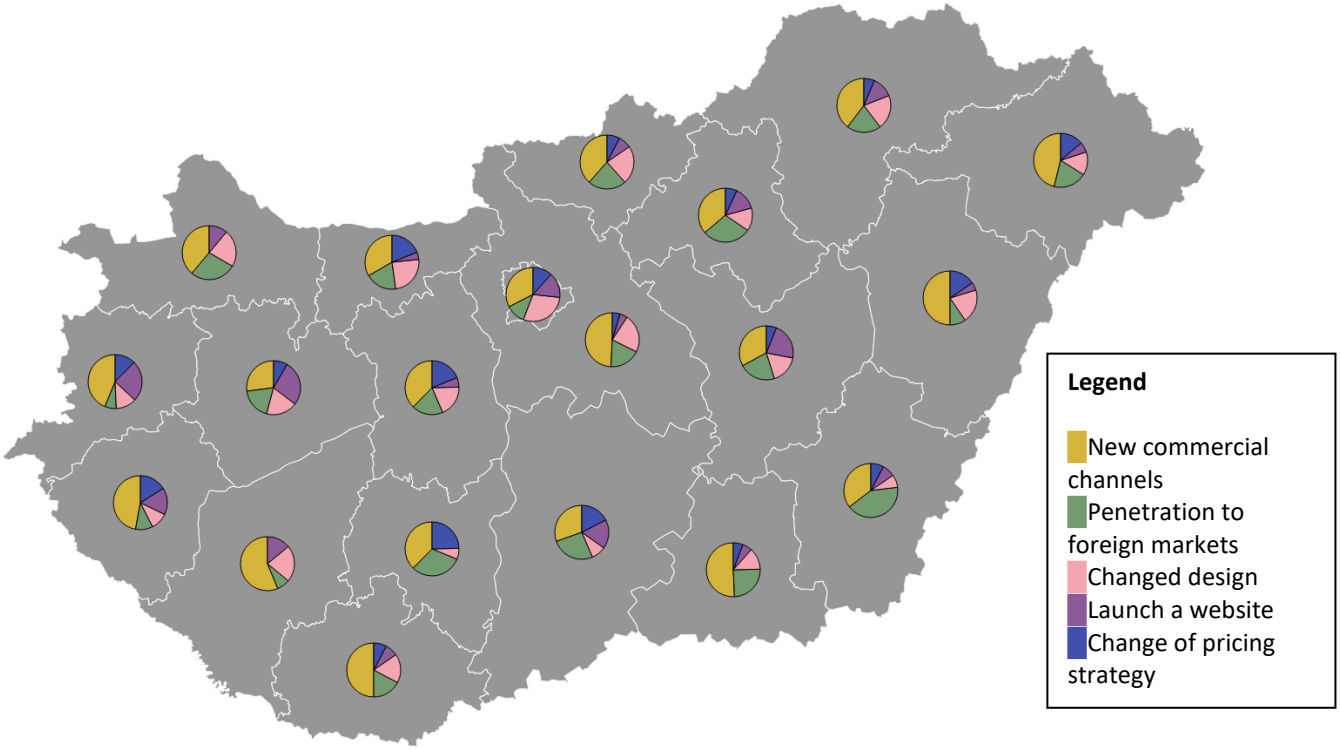
Process innovations by NUTS3 regions



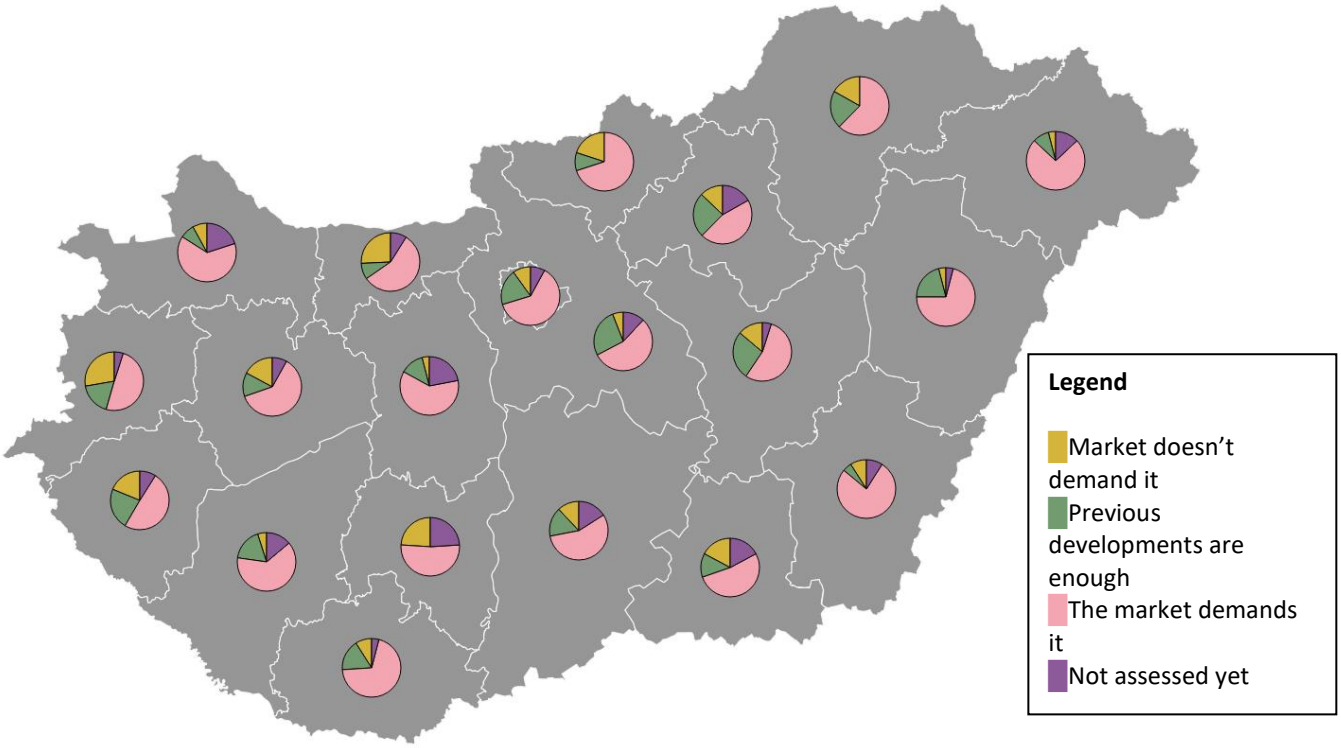
Organisational innovation by NUTS3 regions



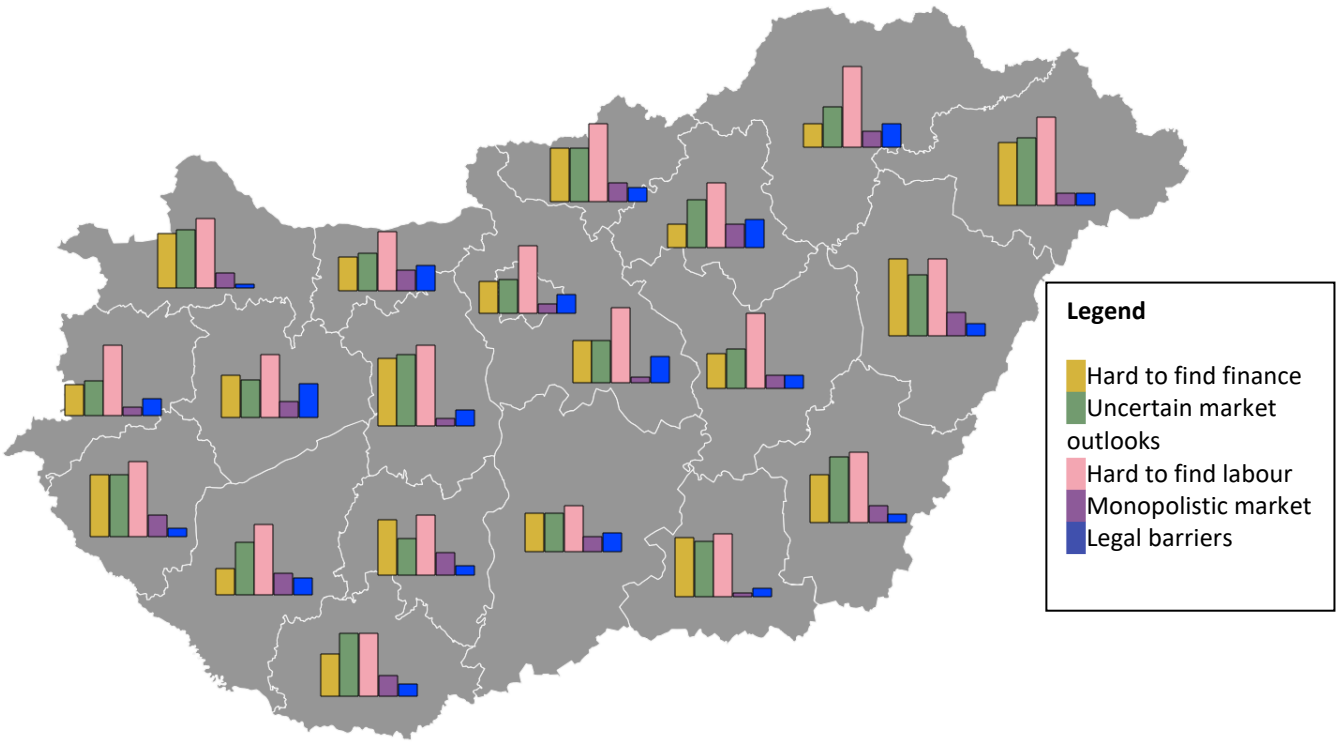
Marketing innovation by NUTS3 regions



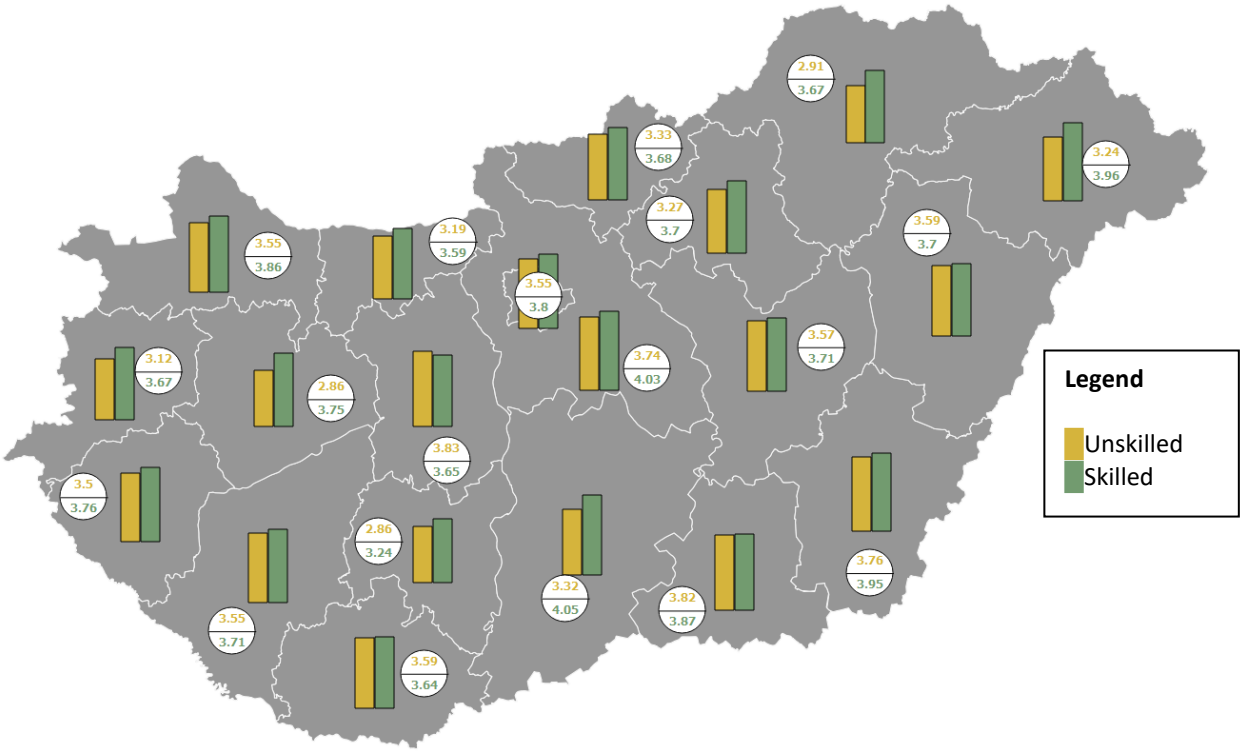
Need for innovation by NUTS3 regions



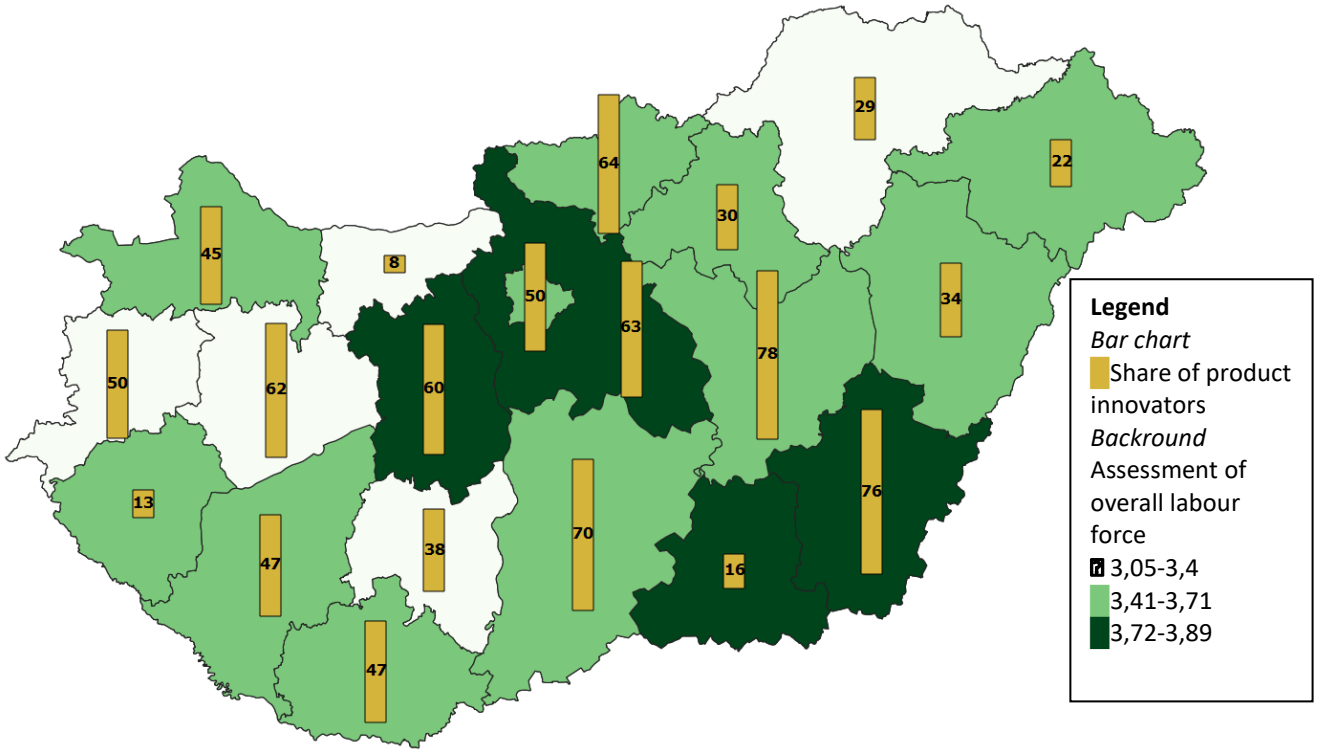
Factors hindering innovation by NUTS3 regions



Assessment of labour force by skill and NUTS3 regions



Assessment of labour force (background colour) and share of product innovators



Assessment of external environment