Innovation-Driven Enterprises in Hungary: Empirical Results at First Sight*

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This study examines the issue of the middle-income trap in the Hungarian economy and the possibilities for escaping it, given the end of the period of extensive growth and the need for a new growth model. Innovative companies, especially SMEs, have a key role to play in this transformation, as they can differentiate themselves in the market and achieve international success. Our research analyses business capabilities that contribute to gazelle-like growth and export market competitiveness. Adapting the experience gained from the MIT REAP programme to the Hungarian context, we examine the importance and characteristics of Hungarian innovation-driven enterprises. The study highlights the importance of developing financial, technological and human resources, and the need to create a favourable market and regulatory environment. To increase the number of HIDE enterprises and promote sustainable economic growth in Hungary, it is crucial to understand their operation and impact in more depth, which necessitates further research.

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1. The role of innovation-driven companies in the Hungarian economy

In this study, we contribute to the broader economic policy discourse that grapples with the challenges of the middle-income trap in the Hungarian economy and the urgent need to break free from it (*Havas et al. 2023; Győrffy 2022; Csath 2022; Kolozsi 2017; Bod 2015*). We also address the current issue of the period of extensive catching-up and growth for the Hungarian economy, primarily based on quantitative factors, which has reached its end. As our colleagues at the Magyar Nemzeti Bank (the Central Bank of Hungary, MNB) argued in the Growth Report 2023 (*MNB 2023*),

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the trends emerging at the end of the 2010s indicate that the old growth model in the previous structures is no longer sustainable. We align with the economic argument that seeks new growth model drivers in the economy to ensure Hungary's economic growth by enhancing productivity, value-added and competitiveness.

Innovation plays a crucial role in this intensive growth turnaround. Innovative companies can differentiate themselves in competition and, most notably in this respect, can enter international markets that allow them to grow and generate high revenues. Hungary has considerable reserves, especially in the related development of small and medium-sized enterprises (*Csath – Nagy 2023*), as this group has a particularly low level of accumulation of intellectual assets (so-called smart investment), which is also reflected in the low number of patents, trademarks and designs (*European Commission et al. 2023*).

The research questions, analyses and findings of this study, therefore, focus on expanding the empirical knowledge of the company capabilities that enable not only innovation, but also 'gazelle-like' growth or export market competitiveness. Enterprises with such capabilities are called Hungarian Innovation-Driven Enterprises (HIDEs). The characteristics of such firms and some initial findings are summarised in the MNB Growth Report 2023 (*MNB 2023*), the first result of a complex research programme conducted by a team of eleven experts at the Massachusetts Institute of Technology (MIT) Regional Entrepreneurship Acceleration Program (REAP), under the professional leadership of the MNB (*Gergely 2023*).

For more than 10 years, MIT has been intensively promoting the IDE (Innovation-Driven Enterprise) concept, including in the framework of REAP, which, according to its leading academics, is a major determinant of the economic growth potential of a region (*Guzman et al. 2023*; *Budden – Murray 2022; Budden et al. 2017*). In addition to being a market driver for innovation, IDEs also contribute significantly to employment growth through the spill-over effects of their activities. In essence, the MNB research adapted this concept to the domestic environment and examined the number of innovative and sustainable growth firms and whether the positive economic externalities on their environment can be justified.

In this study, we first briefly review the economic impact of innovation, then clarify the concept of HIDEs, i.e. Hungarian Innovation-Driven Enterprises, and show their importance for the national economy. We then review the innovation and entrepreneurship capabilities that characterise these companies, building in particular on the model used in the MIT Entrepreneurship Workshop. In the main part of the paper, we present the results of a survey of 182 Hungarian enterprises that we conducted to identify these capabilities, using a database of enterprises provided by the National Research, Development and Innovation Office (NRDIO),

which they consider to be innovative. This sample included 72 organisations that could be classified as HIDEs with the potential for rapid growth, and thus we were able to make an exploratory comparison with the 110 innovative but not HIDE firms. In this analysis, we show the differences between the two groups in terms of their perceptions of capabilities. We use these to arrive at the capabilities which need to be developed by an SME or fledgling start-up that is innovation-driven and wants to achieve rapid market growth and/or export sales.

2. Innovation and economic performance

The prominent role of innovation in raising productivity and improving economic performance is emphasised in the literature. *Schumpeter* (*1934*) drew attention to the concept of 'creative destruction' in his early work, describing the transformation of market structures through innovation, thereby promoting economic dynamism and growth. Other studies, e.g. *Poltarykhin et al.* (*2021*), *Khyareh and Rostami* (*2021*) and *OECD/Eurostat* (*2005*), also support the crucial role of innovation in promoting the competitiveness and economic progress of nations.

Pino et al. (*2016*) argue that innovation is essential to improve the international market performance of South American firms, while *Ghazinoory et al.* (*2020*) highlight the importance of harmonisation between innovative macro strategies and modern financial systems. *Nesterov et al.* (*2015*) focus on the cost effectiveness of innovation, while *Denkowska et al.* (*2020*) and *Siwek* (*2021*) examine the direct positive effects of innovation on economic growth and social welfare. *Terzić* (*2017*) analyses the innovation potential of developing economies, while *Zhu* (*2013*) discusses innovation management's theoretical and practical aspects. *Bashir and Akhtar (2016*) and *Kruja* (*2013*) analyse the effects of innovative entrepreneurship on economic dynamism and social development, while *Ziegler* (*2015*) emphasises the contribution of innovation to social justice.

In recent years, research in Central Europe has widely studied the importance and central role of innovation in the economy. These studies clearly confirm the importance of innovation in driving economic growth, business performance and socio-economic development. In studies ranging from exporting firms in South America to post-communist countries in Central Europe, researchers have used various methods and approaches to assess the impact of innovation activities and the strategies through which innovation contributes to improving international competitiveness.

Particular attention should be paid to Central Europe, where innovation is a critical factor for economic development and international competitiveness. *Dudukalov et al.* (*2016*) argue that global innovation networks are essential for knowledge transfer and technological development. *Dabic et al.* (*2014*) emphasise the need to improve the entrepreneurial environment in Central Europe, *Pełka* (*2018*) warns of differences in innovation performance across the European Union, *Olejnik and Żółtaszek* (*2020*) examine the impact of territorial innovation factors on economic performance, while *Ciocanel and Pavelescu* (*2015*) highlight the importance of boosting competitiveness through innovation.

Taken together, this research underlines the central role of innovation in economic and social development and the need to develop innovation strategies and policies at the regional and global level. Therefore, promoting and supporting innovation must be a key element of all economic policies for future sustainable development, improving international competitiveness and meeting global challenges.

2.1 Sources and drivers of innovation and other factors affecting innovation in Hungary

In 2023, Hungary spent 1.38 per cent of its gross domestic product (GDP) on research and development (R&D), below the previously set target of 1.8 per cent, indicating the need for further development in this area (*HCSO*[1] *2024*). This data suggests that while there is progress in the domestic R&D sector (the rate rose from 1.18 to 1.39 per cent between 2016 and 2022), the rate declined between 2021 and 2022, and the 2023 figure is not expected to show any significant change from 1.39 per cent, even at the forecast level. Hungary's gross R&D expenditure as a percentage of GDP remains below the EU average (2.24 per cent).

Hungary faces further challenges in innovation output. According to the *MNB* (*2022*), innovation is a key contributor to productivity growth, and R&D investment in the business sector directly impacts market competitiveness. However, the low innovation efficiency in international comparisons – 57 per cent compared to the EU average and 37 per cent compared to the EU TOP5 – suggests that while progress has been made in some areas, such as the number of top publications, significant improvements are needed in broader innovation outputs (*MNB 2023*). This reinforces the need for a three-pillar approach in Hungary, consisting of system, stakeholders and strategy (*MIT REAP 2023*), to refine the innovation ecosystem, stimulating knowledge-based economic growth and regional competitiveness.

[1] Hungarian Central Statistical Office

In the 2022 European Innovation Scoreboard (EIS) ranking, Hungary advanced one position to lead the group of emerging innovators, but its relative performance compared to the EU declined. However, it is important to highlight that the 2023 report shows that progress has been made: Hungary has moved into the category of moderate innovators, but is at the bottom of the list in this category (*European Commission 2022, 2023*).

3. Definition of Hungarian innovation-driven enterprises and presentation of their economic importance

An enterprise is generally considered innovative if it produces a new or improved product or process (or combination of products or processes) that differs significantly from its previous products or processes and is made available to potential users or is used by the enterprise (*OECD/Eurostat 2018*; *Galindo-Rueda – López-Bassols 2022*). In his often quoted lectures, Bill *Aulet* (*2013)*, Managing Director of the Martin Trust Center for MIT Entrepreneurship, defines innovation as the multiplication of *invention* and commercialisation *(innovation = invention x commercialisation*). The essential message on which the IDE concept is based is that an idea or a creative thought is not an innovation in itself, only if it leads to a business outcome or measurable success.

In its first edition, the Oslo Manual (*OECD/Eurostat 2018*) placed a strong emphasis on areas of innovation: product development, process organisation, marketing or the development of organisational structures. The first editions were then complemented by broadening the concept of innovation (e.g. to include government, non-profit or other public institutions), or by including social innovations that are much harder to measure than profit-driven expectations and long-term impacts that are harder to measure than direct quantifiable economic outcomes. To determine how innovative an enterprise is, we considered input and output variables, which can be found in *Horváth'*s (*2022*) summary in the first summary study of the research conducted for the NRDIO. As examples on the input side, Horváth cites corporate R&D expenditure, the number of R&D employees and the number of those with a scientific degree, and on the output side, the registered trademarks, patents and scientific publications, the technology export ratio and innovation-related turnover.

In addition to these characteristics, the MIT IDE model defines innovation-driven companies as those that receive early-stage investment early in their life cycle, essentially based on the idea, market plan and business model (*Budden et al. 2017*), and after successful market entry, they grow exponentially, which can mean significant returns for capital investors when the company is sold or goes public. This is particularly important in the case of technological developments, as large amounts of start-up capital are necessary primarily for companies where high-risk and high-value technical developments and investments are needed to bring the innovation to market.

In this research, we combined the two approaches to defining innovation-driven enterprises, defining Hungarian innovation-driven enterprises based on whether they have some innovation effort or innovation output that can be identified and linked to the company (R&D tax incentives, development grant, patent or trademark registration) and, on the other hand, if their turnover has grown exponentially, at least in one phase of their growth (by at least 20 per cent per year for three consecutive years).

The companies that met the above criteria were identified by processing data from around 400,000 businesses per year between 2009 and 2019, which involved linking several databases. In addition to the databases of the National Tax and Customs Administration (NAV), the database of the Hungarian Intellectual Property Office (with downloads of trademarks and patent registrations), the NRDIO's development funding database containing 1,700 firms per year and the market and venture capital funding databases containing around 100 firms were compared to identify Hungarian innovation-driven firms (*MNB 2023*).

The results identify 1,100 companies in Hungary that can be considered innovation-driven according to our definition. They account for 0.3 per cent of operating companies, so are barely visible in terms of volume – hence the apt name HIDE, which, along with the acronym Hungarian Innovation-Driven Enterprises, also refers to their hidden character. These companies are mature (9–12 years old) and predominantly Hungarian-owned. In terms of their activities, 43 per cent of them work in narrow industries requiring specialised skills, and they are more often found in knowledge-intensive activities such as scientific and technical research and development, computer programming, engineering, technical, business and IT consultancy, manufacturing and (wholesale) trade of specialised products, and creative sub-sectors (*MNB 2023*).

Their growth-generating effect is very promising for their numbers. The 1,100 HIDEs accounted for 13 per cent of total gross exports and 22.8 per cent of annual domestic GDP growth in the 10 years under review (*Szoboszlai et al. 2024*; *MNB 2023*). The economic potential of HIDEs is therefore significant, based on the first analyses. It certainly indicates that it is worthwhile to look deeper into their operation and examine their capabilities, which could be developed to increase their number and impact on the Hungarian economy.

4. The two defining capabilities of innovation-driven operations: innovation capabilities and entrepreneurship capabilities

To theoretically ground the research, we start from the MIT model that companies need two types of capabilities for IDE to be successful: Innovative Capabilities (I-CAP) on the one hand, and Business or Entrepreneurial Capabilities (E-CAP) on the other (*Budden – Murray 2019*).

The innovation capabilities of a business determine how successfully innovative solutions are created within the organisation (or, more broadly, within a region's ecosystem). These resources include creativity, research, technical development and the ability to introduce products, technologies and services that actually solve business or societal problems. Therefore, the I-CAP factors cover the whole chain from 'idea to exploitation', not only the R&D domain, but also the translation of results into economic benefits.

Entrepreneurship skills encompass the more general business development knowledge, attitudes, resources and conditions for starting a business. These skills support all types of entrepreneurial activity, including those needed to set up and run traditional SMEs, not just for IDE. These are relevant for our research because they are largely needed for market expansion, export market acquisition and exponential revenue growth.

Table 1
I-CAP and E-CAP elements and the MIT REAP team's initial assessment of the Hungarian situation

	I-CAP	Assessment	E-CAP	Assessment
Human Capital	Percentage of PhD graduates Percentage of STEM graduates Percentage of people employed in R&D Quality of STEM education	Partly a problem	People with a degree in tertiary education Entrepreneurial skills	Problem
Funding	Percentage of R&D expenditure Public R&D expenditure R&D expenditure of businesses	Partly a problem	Access to credit VC access Smart money	Problem
Infrastructure	ICT access Internet bandwidth Integration of ICT into business processes Availability of modern technologies	**OK**	Logistics Internet network Internet usage	**OK**
Demand and Market	Public investment in advanced technologies University-industry cooperation Market size, competition rules	Problem	Customer demand Domestic market size	Problem
Culture and Motivation	The quality of research institutes Quality of higher education STEM output	Problem	Entrepreneurial propensity Risk appetite Entrepreneurial diversity (e.g. proportion of women) Fear of failure Entrepreneurship status Business as a career Regulatory stability and security	Problem

Source: Budden – Murray (2019), Gergely (2023)

Table 1 presents the assessment template used by MIT-REAP participants to compile a comprehensive I-CAP and E-CAP map of the Hungarian innovation ecosystem and a subjective – expert perspective – assessment of the five characteristic capabilities each. The eleven participants represented five stakeholders in the Hungarian innovation ecosystem – four MNB staff, one government employee, two university employees, two company employees, one entrepreneur and one venture capitalist – who, prior to the assessment teamwork, provided a broad overview of Hungary's position in relation to the five I-CAP and E-CAP indicators based on secondary data. These resources are available in an organised format on the dedicated MIT open-

access portal.[2] Comparisons between countries and regions in terms of I-CAP skills can be made based on the European Innovation Scoreboard,[3] the Bloomberg Innovation Index,[4] the Global Innovation Index[5] and the Global Competitiveness Index[6] reports. Still, these are of course indicative, as they cover different time periods and use various statistical sources. Similarly, for E-CAP, data from the Global Entrepreneurship Monitor (GEM),[7] the Global Entrepreneurship Index (GEI),[8] and the Global Startup Ecosystem Report (GSER)[9] can be used to analyse and compare regional ecosystems.

The two types of capabilities determine the strengths and weaknesses of the organisation, i.e. its comparative advantages and disadvantages. For example, a company's I-CAP strength may be its good links with universities, strong research network or professional research capacity, while another company may have a comparative advantage because of a vibrant investor culture or simple management organisation, or perhaps because of its effectively exploited tax advantages.

The detailed background and empirical support for this resource-based approach among Hungarian SMEs is presented by *Szerb and Rideg* (*2003*), who also review a wealth of Hungarian research on the topic. The authors' summary highlights that technological development and increasing market competition make it essential for companies to recognise and effectively manage intellectual capital as a key resource. Companies in the domestic SME sector need to focus not on creating new knowledge and developing R&D capacities, but on absorbing innovation, collaborating and learning. The three main components of intellectual capital – human capital, structural capital, and social capital – contribute to increasing corporate innovation performance and competitiveness. And more important than physical resources are the skills of the people working in the company: the human capital.

Human capital, which encompasses workers' knowledge, creativity, health and skills, is essential for generating innovative ideas and driving technological improvements. The research of *Zhang et al.* (*2018*) highlights that intellectual capital directly improves product innovation performance and that the integration of supplier knowledge plays a mediating role in this process. The results show that the combination of intellectual capital and supplier knowledge integration contributes

[2] MIT Innovation Ecosystems: https://innovationecosystems.mit.edu/framework
[3] *European Commission et al.* (*2023*)
[4] Bloomberg Innovation Index 2021: https://ec.europa.eu/newsroom/rtd/items/713430/en
[5] Global Innovation Index 2023: https://www.wipo.int/global_innovation_index/en/2023/
[6] Global Competitiveness Index 2023: https://imd.cld.bz/IMD-World-Competitiveness-Booklet-2023
[7] GEM 2023/24: https://www.gemconsortium.org/reports/latest-global-report
[8] Global Entrepreneurship Index 2019: http://thegedi.org/global-entrepreneurship-and-development-index/
[9] Global Startup Ecosystem Report 2023: https://startupgenome.com/report/gser2023

significantly to the product innovation performance of companies, while *Madhar* (*2010*) stresses the critical importance of knowledge management for innovation and competitive advantage.

Structural capital, which includes corporate processes, organisational culture and knowledge management systems, enables the effective sharing and application of knowledge within the company. *Hsu'*s (*2011*) framework underlines the link between intellectual capital and organisational success, while *Subramaniam and Youndt* (*2005*) point out how intellectual capital influences different innovation capabilities.

Social capital, which refers to a company's external contacts and networks, is also important for gaining market insights and exploiting new business opportunities. According to *McDowell et al.* (*2018*), intellectual capital has a direct impact on companies' innovation ability.

Academic research consistently supports the role of intellectual capital in driving business success and innovation performance. Research by *Luthans et al.* (*2004*) and *Egbu* (*2004*) highlights the importance of psychological capital and knowledge management, while *Galeitzke et al.* (*2015*) and *McDowell et al.* (*2018*) emphasise the importance of strategic management of intellectual capital.

Overall, intellectual capital is a crucial element of business innovation and economic success. Companies must recognise the strategic importance of these resources and manage them in an integrated way to strengthen their competitive advantage and market position. The combined management of human, structural and social capital, as well as the use of knowledge-based HRM practices, can increase companies' innovative capacity, contributing to wider economic prosperity.

Continuous improvement and integrating a systems approach into innovation processes are key to improving business performance. *Terziovski* (*2002*) points out that a bottom-up continuous improvement strategy for Australian and New Zealand manufacturing companies significantly improves customer satisfaction and productivity. By contrast, the top-down strategy aims to increase technological competitiveness. Surprisingly, integrated strategies have been less effective, suggesting that companies have not yet achieved system integration and networking (*Terziovski 2002*).

Innovation 'leadership' is also a critical factor that directly improves business performance and increases strategic fit. According to *Carmeli et al.* (*2010*), innovation leadership enables firms to adapt to a changing environment, thereby achieving significant performance gains.

Knowledge management, particularly the management of human resources and the integration of information technology, is also essential to improve innovation performance. *Gloet and Terziovski* (*2004*) find that the simultaneous application of 'soft HRM practices' and 'hard IT practices' increases product and process innovation.

Extensive cooperation with external stakeholders, such as knowledge sharing and product innovation, also plays an important role in boosting innovation performance. *Markovic and Bagherzadeh* (*2018*) point out that this link is achieved through knowledge sharing and product innovation, which increases innovation performance.

5. Research questions and methodology

The data we used are the results of a primary survey that mapped the characteristics of Hungarian innovative and innovation-driven enterprises which are difficult to identify from existing statistical databases. The empirical study aimed to provide a comprehensive analysis of the characteristics and growth potential of the HIDE enterprises mentioned above. We set out to identify the characteristics that distinguish them from innovative firms in addition to their innovation performance. We focused on the five key assessment dimensions identified in the I-CAP and E-CAP competencies already described in the research.

The survey was conducted as part of the data collection by the National Research, Development and Innovation Office (NRDIO) from September to November 2022. The participating Hungarian companies were selected using a unique database compiled by the NRDIO. The sample consisted of 182 companies, of which 72 met the HIDE criteria, while 110 companies could not be classified as HIDE despite their innovation activity. This division provided an opportunity to conduct a comparative analysis between HIDE and innovative enterprises. The questionnaire did not ask about company size, activity and ownership, as we used a unique list of companies compiled by the NRDIO. In order to preserve anonymity and to increase the response rate, HIDE and innovative enterprises were identified based on additional information in the NRDIO database.

Our questionnaire included a total of 39 questions on a six-point Likert scale and 13 additional questions focusing on financing options (not included in our analysis).

The multi-item scale statements formulated during the literature research were checked by principal component analysis to examine whether the statements of the five selected main categories adequately describe the characteristics of the different

dimensions. Before presenting the research results, it is important to highlight that the factor analysis based on the statements in the questionnaire was designed to explore the structural relationships of the trends reported by the respondents.

5.1. Description of the variables tested

Our research framework was based on the 39 metric statements in our questionnaire, measured on a six-point Likert scale, and analysed according to five key dimensions: financial resources, infrastructure, human resources, market and demand, and culture and motivation. The non-metric variables in the questionnaire are not part of our analysis. In line with our aim, we wanted to use factor analysis to reduce the data's complexity and explore their structural relationships. This created a more manageable set of factors from the original wide range of variables, making data interpretation and further analysis easier. In our statistical analysis, we used the Kaiser-Meyer-Olkin (KMO) test, Bartlett's test of sphericity and Cronbach's alpha to confirm the suitability of the data for factor analysis and to ensure the reliability of the scales.

In the factor analysis, KMO and Bartlett's test were used to assess whether the correlation between variables was sufficient to perform the factor analysis. The results of the Bartlett test are shown in *Table 2*.

Table 2
Results of the KMO and Barlett test

Kaiser-Meyer-Olkin test		0.688
Bartlett's test	Approx. Chi-Square	2,627.956
	Degrees of freedom (df)	741
	Significance	0

The KMO test result was 0.688, which is above the accepted threshold of 0.6, indicating that the variables are suitable for factor analysis. The results of the Bartlett's test confirmed that the correlation between the variables is significant, i.e. the elements of the correlation matrix are not randomly different from zero.

Factor analysis was performed using principal component analysis to identify the factors that explain most of the variance between variables. To determine the number of factors, the Kaiser criterion was applied, according to which only factors with an eigenvalue greater than one were considered. The analysis using Varimax rotation identified 12 factors that together explained 67.73 per cent of the total variance, exceeding the generally accepted threshold of 60 per cent.

In determining the factors, we selected statements with a factor weight of 0.4 or more. The factors examined were grouped into the five main categories above, taking into account their characteristics and their impact on the innovation capacity of enterprises. The KMO test confirmed the appropriateness of our sample size (*Nkansah 2018*), while Cronbach's alpha (*Vaske et al. 2017*) and measures of composite reliability (CR), including average variance extracted (AVE), supported the internal consistency and convergent validity of our constructs (*Raykov – Grayson 2003; dos Santos – Cirillo 2021*). The AVE values measure the level of variance captured by the construct relative to the measurement error, and values above 0.7 are considered very good, while a level of 0.5 is acceptable. CR is a less biased estimate of reliability than Cronbach's alpha, and the acceptable CR value is 0.7 or higher. The AVE should be higher than 0.5, but a value of 0.4 is acceptable if the CR is higher than 0.6, so that the convergent validity of the construct is still acceptable (*Fornell – Larcker 1981*). These statistical methods reinforce the scale's applicability and increase our results' accuracy and relevance, allowing us to make robust interpretations of the complex relationships in our data.

Our scores for the factors Business Success and Market Position, Market Competition and Strategic Partnerships are outside the acceptable range. However, these factors have been retained by analytical choice to further refine the results between each main category and the two segments under analysis. It is likely that one of the main reasons behind the low Cronbach's alpha, CR and AVE values is the small sample size of the research sample. Thus, in order to test this, it would be useful to conduct further research and analysis on a larger sample.

Table 3 summarises each factor's classification into main categories, Cronbach's alpha, factor weights, CR and AVE values. This table clearly shows each factor's main categories and relevant statistical indicators, confirming their validity and reliability.

Table 3
Main categories examined and the factors assigned to them

	Factors	Claims*	Factor weight	CR & AVE values
Available resources and how they can be used	Financial support and access *Cronbach's alpha: 0.72*	My company has easy access to other (non-R&D) public funding.	*0.81*	*CR = 0.71*
		My company has easy access to public R&D funding.	*0.79*	*AVE = 0.48******
		My business can easily borrow money.	*0.40*	
	Risk capital network *Cronbach's alpha: –*	If my business needed it, I could easily contact business angels / venture capitalists.	*0.71*	*CR = 0.51**** *AVE = 0.51*
Business infrastructure situation	Technological development and human resources *Cronbach's alpha: 0.80*	In our company, the production/development process is sufficiently advanced.	*0.76*	*CR = 0.81*
		For our business, new technologies are readily available.	*0.74*	*AVE = 0.46******
		We are satisfied with the technological infrastructure needed to run our business.	*0.72*	
		Our employees are well trained.	*0.64*	
		Our employees have the entrepreneurial skills.	*0.50*	
The readiness, skills and education of human capital	Innovation excellence and intellectual capital *Cronbach's alpha: 0.73*	Continuous innovation in our products and services is the key to our market growth.	*0.74*	*CR = 0.77*
		We regularly spend on corporate research and development.	*0.73*	*AVE = 0.41******
		Our recognition is essentially due to our success in innovation.	*0.59*	
		We have a significant amount of intellectual property rights in various forms (patents, trademarks, copyrights).	*0.58*	
		Our employees are actively involved in the company's R&D activities.	*0.53*	
	Training quality and scientific competence *Cronbach's alpha: 0.57*	We have good experience of the quality and applicability of science education.	*0.84*	*CR = 0.78* *AVE = 0.55*
		We have good experience with the quality and applicability of business training.	*0.68*	
		We employ a high number of people with a degree in STEM (Science, Technology, Engineering, Mathematics).	*0.49*	
		We employ a high number of PhD graduates.	*0.40*	
Demand and market absorption	Market environment and government support *Cronbach's alpha: 0.50*	The Hungarian market demand is sufficient to sustain the long-term growth of the business.	*0.76*	*CR = 0.74*
		The majority of our company's turnover comes from import markets.	*0.67*	*AVE = 0.49******
		Our innovative products/services are also used by government/local governments.	*0.66*	
	Business success and market position *Cronbach's alpha: 0.33***	Our recognition is based solely on our business success.	*0.68*	*CR = 0.52****
		The market size is appropriate, my business has a well known and segmented customer base.	*0.50*	*AVE = 0.35*****

	Factors	Claims*	Factor weight	CR & AVE values
Cultural and motivational factors	Entrepreneurial motivation and commitment *Cronbach's alpha: 0.52*	I am happy with the freedom that entrepreneurship gives me.	*0.81*	*CR = 0.87*
		The main driving force for starting an entrepreneurial activity was the desire for independence.	*0.76*	*AVE = 0.45******
		At the beginning of my entrepreneurial activity, the motivation and knowledge for entrepreneurship came mainly from family, friends and acquaintances.	*0.71*	
		Financial reasons and incentives were the main driving forces for starting an entrepreneurial activity.	*0.70*	
		I am satisfied with the entrepreneurial skills of our company.	*0.67*	
		I chose the sector/industry of entrepreneurial activity based on previous professional activity/knowledge.	*0.64*	
		The main driving force for starting an entrepreneurial activity was the loss of a previous job or other life changes or career changes.	*0.54*	
		I have a high social esteem as an entrepreneur.	*0.48*	
	Entrepreneurial risk-taking attitude *Cronbach's alpha: 0.74*	I like working with women entrepreneurs because their attitudes towards entrepreneurial risk are positive.	*0.90*	*CR = 0.88* *AVE = 0.78*
		I like co-operating with male entrepreneurs because their attitudes towards entrepreneurial risk are positive.	*0.88*	
	Gender balance *Cronbach's alpha: –*	Our enterprise is gender balanced.	*0.81*	*CR = 0.65* *AVE = 0.65*
	Error and risk-taking *Cronbach's alpha: 0.78*	Within the enterprise, making mistakes is not accepted and is not seen as a learning opportunity.	*0.69*	*CR = 0.60****
		In my environment, I fear the failure of our ideas because it means a loss of reputation.	*0.62*	*AVE = 0.43******
	Market competition and strategic partnerships *Cronbach's alpha: 0.1***	Competition in the industry is strong.	*0.72*	*CR = 0.54****
		The risks of our business are scary.	*0.46*	*AVE = 0.30*****
		My enterprise works with Hungarian universities to promote strategic innovation and/or entrepreneurship.	*0.41*	

Note:
**measured on a 6-point Likert scale (1 = Strongly disagree, 6 = Strongly agree); after filtering out "I don't know" responses.*
*** Cronbach's alpha < 0.50 – rejected internal consistency*
**** CR < 0.70 – reliability below the acceptable range*
***** AVE < 0.50 – level of variance below the acceptable range compared to measurement error*
****** AVE < 0.50 but the CR value => 0.60 so the convergent validity of the construct is acceptable*

6. Findings

Based on the principal component analysis of the research, we examined how HIDE and innovative firms differ in five key categories: funding resources, infrastructure, human capital, market demand and absorptive capacity, as well as cultural and motivational factors. Factors in each category were determined by averages of statements rated on a six-point scale to provide a comprehensive assessment of the factors under study. A two-sample t-test was used to examine the differences between HIDE and innovative firms, and an ANOVA analysis of variance was performed between the means of each segment.

6.1. Available resources and how they can be used

The analysis of the main category of funding resources highlighted the crucial role of financial resources, including state aid, access to credit and venture capital, in financing enterprises' growth and innovation activities. For the comparison between HIDE and innovative firms, we took into account the averages of the statements on venture capital relationships and financial support and access. *Table 4* presents the results for the HIDE and innovative subsamples.

Table 4
Analysis of the main category 'Funding resources' and its dimensions

Main category	Factors	HIDE average (standard deviation)	Innovative average (standard deviation)	t-value	Degrees of freedom (df)	p-value
Available resources and how they can be used	Venture capital relationships	3.90 (1.42)	3.51 (1.49)	–1.62	153	0.10
	Financial support and access	3.36* (1.10)	3.50 (1.10)	0.83	178	0.41
	Total resources	*3.48 (1.05)*	*3.52 (1.04)*	*0.24*	*178*	*0.81*

*Note: * Significantly lower (95%) than the most important dimension of the sub-sample (based on ANOVA analysis)*

The results show that among the two factors in this category, the 'Venture capital relationships' factor group scored the highest (3.90) for HIDE companies. The difference between the factors of venture capital relationships as well as funding and access is significant (3.90 versus 3.36) (at the 95-per cent probability level). For HIDEs, venture capital relationships are the most important factor, while for innovative firms, there is no significant difference between the two groups of factors. It can be said that HIDEs have a higher average score (3.90) in the venture capital relationships factor compared to innovative enterprises (3.51).

In addition, we also compared the average 'total resources' of the two subsamples. Based on the analysis, no significant difference between the two groups was found.

This is likely to be influenced by the fact that our control group also had access to NRDIO sources, regardless of their purpose.

The analysis shows that HIDE enterprises rely more strongly on venture capital relationships, which profoundly impacts their ability to grow and innovate. The strategic use of funding and the wide availability of financial instruments are key to the success of businesses, especially in sustaining innovation activities. The results suggest that diversifying financing strategies and strengthening relationships with venture capitalists can help businesses grow and strengthen their market position.

6.2. Infrastructure situation of the company

The main category 'Infrastructure situation' includes technological development and human resources as critical factors affecting enterprises' productivity and innovation capacity. The availability of infrastructure, including modern technology and a skilled workforce, is a key determinant of a company's competitiveness and innovation potential. *Table 5* presents the results for the HIDE and innovative subsamples.

Table 5
Analysis of the main category 'Infrastructure'

Main category	Factors	HIDE average (standard deviation)	Innovative average (standard deviation)	t-value	Degrees of freedom (df)	p-value
Business infrastructure situation	Technological development and human resources	4.42 (0.71)	4.04 (0.88)	–3.20	173	0.002

The comparison results show that HIDE companies place significantly higher value on the technological and human resources available. This confirms that HIDEs perform better on average in integrating these resources, which contributes to the development of their production and development processes. The easier accessibility of new technologies and the possession of the tools to operate efficiently underline the advantage of HIDE enterprises over innovative organisations.

The outstanding performance of HIDEs in the main category 'Infrastructure' highlights the key role of technological development and human resources in increasing innovation capacity. Businesses should prioritise the modernisation of technological infrastructure and the continuous training of their workforce to facilitate innovative activities and improve their market competitiveness.

In addition, innovative businesses may need to rethink their technological and human resource development strategies, which can help increase operational efficiency and create new innovation opportunities. Investing in infrastructure

improvements can not only boost productivity and innovation but also lay the foundations for the long-term sustainability of businesses.

6.3. The readiness, skills and education of human capital

The main category 'Human capital' focuses on the quality of training programmes and the scientific and technological knowledge of the workforce, highlighting their importance for enterprises' competitiveness and innovation capacity. The level of skills and knowledge of the workforce directly affects firms' innovation potential and market adaptability. *Table 6* presents the results for the HIDE and innovative subsamples.

Table 6
Analysis of the main category 'Human capital' and its dimensions

Main category	Factors	HIDE average (standard deviation)	Innovative average (standard deviation)	t-value	Degrees of freedom (df)	p-value
Readiness, skills and education of human capital	Innovation excellence and intellectual capital	4.84 (0.79)	4.35 (0.90)	–3.74	180	0.00
	Training quality and scientific competence	3.57* (0.96)	3.17* (1.05)	–2.59	180	0.01
	Total innovation excellence and human resources	*4.30 (0.68)*	*3.87 (0.76)*	*–3.93*	*180*	*0.00*

*Note: * Significantly lower (95%) than the most important dimension of the sub-sample (based on ANOVA analysis)*

The results show that of the two factors in this category, innovation excellence and intellectual capital (4.84 and 4.35) scored higher for both HIDE enterprises and innovative companies. The difference between the average value of the two factors per group of companies is significant (at the 95-per cent probability level). This confirms that businesses rely heavily on their innovation and intellectual capital for their innovation activities.

The analysis also shows that, on average, HIDE enterprises associate a higher value with the main category and its sub-dimensions. These companies are more supportive of corporate R&D activities and rigorous in protecting their innovation results. Their employees actively participate in the enterprise's R&D activities and contribute to innovation through entrepreneurial skills. Furthermore, being more satisfied with the technological infrastructure needed to run a business suggests that they are prepared to support creative processes.

The study shows that human capital development is key for HIDEs, as it allows them to gain an advantage in the innovation race. This draws attention to the need for innovative businesses to train and develop their workforce to improve their innovation capabilities and competitiveness.

Businesses are encouraged to invest in their workforce's continuous training and development, with a particular focus on STEM areas and programmes to promote creative thinking. It is also important to share knowledge and actively involve employees in innovation activities, which can help to strengthen the company culture and generate new ideas.

6.4. Demand and market absorption

In our research, we examined the dimensions under the main categories of demand and market absorptive power, which focus on understanding market demand, leveraging government support, and strengthening business success and market position. These factors are key to achieving the long-term growth and stability objectives of businesses. *Table 7* presents the results for the HIDE and innovative subsamples.

Table 7
Analysis of the main category 'Demand and market absorptive power' and its dimensions

Main category	Factors	HIDE average (standard deviation)	Innovative average (standard deviation)	t-value	Degrees of freedom (df)	p-value
Demand and market absorptive power	Business success and market position	4.03 (0.93)	4.11 (0.96)	0.54	179	0.59
	Market environment and government support	2.91* (0.87)	2.85* (0.87)	–0.49	180	0.63
	Total demand and market	*3.46 (0.69)*	*3.47 (0.71)*	*0.03*	*180*	*0.98*

*Note: * Significantly lower (95%) than the most important dimension of the sub-sample (based on ANOVA analysis)*

The results show that of the two factors in this category, of business success and market position (4.03 and 4.11) scored higher for both HIDE and innovative companies. The average value of the dimensions 'market environment' and 'government support' (2.91 and 2.85) is significantly lower (at the 95 per cent probability level). This result shows that companies belonging to both subsamples see their business success in terms of demand and market as their primary source of recognition, and that they value their knowledge of the different market indicators and their understanding of their customers, and on this basis, their segmentability.

An analysis of the main category shows that business success is not only about increasing revenue, but also about the recognition of the business in the market.

The analysis suggests that it is strategically important for businesses to strengthen their market position and accurately segment their customer base. For the innovative companies included in the study, it is important to invest continuously in market research and analysis of customer behaviour and to make the most of government support programmes and export opportunities. Businesses need to adapt to market changes and proactively respond to demand trends to maintain and increase their market share and business success.

6.5. Culture and motivation

The main category 'Culture and motivation' focuses on the importance of entrepreneurial culture, motivation, gender balance, learning from mistakes and the role of strategic partnerships. These factors make a crucial contribution to enterprises' innovative capacity and market adaptability, which are essential to gaining and maintaining a competitive advantage. *Table 8* presents the results for the HIDE and innovative subsamples.

Table 8
Analysis of the main category 'Culture and motivation' and its dimensions

Main category	Factors	HIDE average (standard deviation)	Innovative average (standard deviation)	t-value	Degrees of freedom (df)	p-value
Cultural and motivational factors	Market competition and strategic partnerships	4.10 (0.86)	3.99 (0.89)	–0.79	180	0.43
	Entrepreneurial motivation and commitment	3.99 (0.86)	3.96 (0.75)	–0.24	173	0.81
	Gender balance	3.65* (1.53)	3.66* (1.53)	0.07	179	0.94
	Error and risk-taking	3.53* (0.79)	3.50 (0.76)	–0.238	177	0.81
	Entrepreneurial risk-taking attitude	2.72* (1.12)	2.49* (1.31)	–1.17	140	0.26
	Total cultural and motivational factors	*3.62 (0.58)*	*3.59 (0.56)*	*–0.40*	*180*	*0.69*

*Note: * Significantly lower (95%) than the most important dimension of the sub-sample (based on ANOVA analysis)*

The results show that the most important factors for both HIDE and innovative firms are market competition and strategic partnerships, with the highest average scores (4.10 and 3.99, respectively). Entrepreneurial motivation and commitment, the second factor on average, scored slightly lower than the first dimension (3.99 and 3.96), although not significantly so.

In examining the main category 'Culture and motivation' the least important factor was found to be entrepreneurial risk-taking attitude. This set of factors describes the importance of risk-taking and positive attitudes for both female and male entrepreneurs in entrepreneurial cooperation. This seems to be the least important for both sub-samples tested.

A comparison of the means of the two subsamples showed no significant difference. For the main category 'Culture and motivation' both HIDE and innovative companies score the same in each dimension.

The analysis shows that strategic partnerships and the ability to compete in the market are key for businesses. This underlines the importance of constantly monitoring market dynamics and building strategic alliances for business success. In addition, entrepreneurial motivation and commitment, as well as gender balance and learning from mistakes, are also important factors that support business innovation and adaptability.

Building strategic partnerships and thoroughly understanding competitive market factors can increase companies' market responsiveness and innovation capacity. Strengthening cultural and motivational factors is important for companies, as they directly contribute to business resilience and long-term success.

7. Summary

The research results highlight the differences between HIDE and innovative enterprises in terms of access to finance, the availability of infrastructure, and the quality and use of human capital. HIDEs benefit from significant advantages in terms of venture capital and financial support, which have a profound impact on their ability to innovate and succeed in the market. By contrast, innovative firms, while having similar infrastructure and human resources levels, are less likely to use these resources efficiently.

The benefits of infrastructure and human capital revealed by the factor analysis are paramount for HIDE enterprises, which better integrate and exploit these resources, thereby increasing the development of their production and development processes. The dimensions of culture and motivation are also important for firms'

innovative capacity and adaptability, although there are no significant differences between the two groups of companies.

Future research should look at internal communication strategies and information flows within individual companies, which could contribute to improving corporate resilience and crisis management capabilities. A deeper analysis of the links between innovation processes and corporate culture can help to understand how internal organisational factors influence innovation capabilities. In addition, the speed and efficiency of technological adaptation, including digitalisation processes and their impact on the competitiveness of companies, should be examined. The accelerating pace of technological development and the challenges of digital transformation can offer new perspectives on the adaptation strategies of HIDE and innovative businesses.

Finally, as research expands, the study of the relationship between corporate management styles and decision-making processes may also become a key issue. This can help to clarify how different management practices affect the ability of companies to innovate and adapt to the market. This analysis can help companies better understand and manage internal and external challenges in the innovation process.

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