Innovation-driven Economic Growth – How Hungary Will Be Home to Innovative Entrepreneurs and Enterprises*

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Productivity is significantly higher in countries that consistently spend at least 3 per cent of GDP on R&D, irrespective of economic cycles. Increasing productivity is necessary to boost the competitiveness of the economy and accordingly, significant growth in domestic R&D expenditure is essential. The challenges of the Hungarian RDI ecosystem have been properly identified, and the policy actions of recent years have put in place a strategic, institutional and funding framework to achieve these goals. In the long term, the objective is to create an ecosystem that is self-sustaining on a market basis, but where the state assumes a key role in designing the regulatory environment and the funding and supporting instruments. By systematically implementing the strategy outlined in this article, Hungary may be able to boost its economic performance through innovative, Hungarian-owned firms capable of producing high value-added products.

Journal of Economic Literature (JEL) codes: O30, O38, O40

Keywords: RDI ecosystem, innovation by SMEs, economic competitiveness, value added, public incentives to promote innovation

1. Introduction

At the Olympics, Hungary's athletes have repeatedly shown that Hungarians are capable of achieving great results at the top international level despite the country's small size and limited opportunities: the number of recent summer Olympic gold medals won by Hungarian athletes is the 9th highest in the world in absolute terms. This same excellence can also be seen among Hungary's scientists and young talents: Hungary ranks 11th in the world in the number of Nobel Prize winners per capita, 5th in the absolute ranking of international mathematics student Olympiads and 9th

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

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in the ranking of physics student Olympiads. The success of Hungary's champions and researchers can also serve as an example for Hungarian entrepreneurs and enterprises. Indeed, as in sports and science, exceptional perseverance and preparation are also required in the world of business to achieve success.

Why shouldn't it become a reality that by 2035 many innovative Hungarian firms will have joined the ranks of the most influential, fastest growing technology companies in Europe or even the world? While the 'Olympic champions' of business do not return home with gold medals, their billions of euros in enterprise value, their ability to create high value added and their international presence make a significant contribution to the economic success of their country, in our case Hungary.

Innovation plays a key role in shaping a nation's competitiveness and economic development by facilitating the creation of high value-added products and services, increasing productivity and opening up opportunities for new markets, as first described in the growth model of *Solow* (*1956*). His model explains economic growth using three basic factors: labour, capital and technical progress. According to the model, long-term economic growth is primarily driven by the latter, as investment in technical development and innovation directly affects economic productivity and competitiveness. This enables a developed country to achieve sustainable economic growth even without significant changes in employment rates or the capital stock.

However, as early as 1987 Solow pointed out that the rise of the digital economy does not necessarily confirm the universality of this thesis (*Cséfalvay 2024*). The Solow paradox points out that even though digital progress takes place at a rapid pace, in many cases, its impact is not immediately reflected in productivity indicators. This is particularly evident in the decelerating economic growth and declining labour productivity observed in developed countries (*Cséfalvay 2024*). Identifying the causes of the productivity paradox at the global level and at the level of the national economy is of key significance for RDI[1] policy, as there is a need for interventions that can transform technological progress and innovation activities into real economic growth.

According to *Schumpeter* (*1942*), innovation is driven first and foremost by firms, as they are constantly seeking new, more efficient solutions; therefore, old structures can be replaced by more competitive models through 'creative destruction'. However, the entrepreneurial sector is not homogeneous: Innovation-Driven Entrepreneurship (IDE) needs to be distinguished from various other forms of entrepreneurship (*Botelho et al. 2021*).

In Hungary, innovation potential is determined by several factors (*NRDI Office 2021*), including the low innovation capacity of SMEs, the significant dominance of large,

[1] Research, development and innovation.

export-oriented companies, the inadequacy of university–industry cooperation, underdeveloped knowledge transfer between sectors and the lack of skilled labour (*Pongrácz – Nick 2017*).

Innovative enterprises have significant growth potential in Hungary as well: they grow faster (*Szoboszlai et al. 2024*) and show higher productivity (*Halpern, 2020; Halpern – Muraközy 2010*). Accordingly, government intervention should aim to create an environment for innovation-driven businesses that facilitates their growth and strengthens their position. RDI policy needs to be transformed to respond effectively to bottlenecks in the spread of innovation in Hungary, while also being able to address the challenges posed by the Solow paradox. According to the *Draghi Report* (*2023*), the role of innovation and the increasing importance of innovative companies may be a determinant of the formulation of economic policy strategies not only in Hungary, but also at the level of the European Union.

However, more than just radical technological progress is needed in order to increase competitiveness: developments that improve continuous operational efficiency are also required (*Gelei – Kenesei 2017; Katona 2021*). Therefore, it makes sense to elaborate a comprehensive portfolio of measures to promote the complex strengthening of the innovation ecosystem, increase its resilience, improve knowledge transfer and support Hungarian innovative companies with their efforts to enter the global market.

This essay outlines the challenges faced by the innovation ecosystem and the relevant policy responses.

Reflecting on the above, the vision of innovation policy is to increase the number and share of innovative companies in the economy and to strengthen and increase the number of export-capable champions among innovative companies, with some of them growing into globally outstanding technology companies which, based on Hungarian creativity and scientific achievements, are among the most successful ones in their respective industrial/technical fields. In the past decade, the government achieved numerous successes in the field of R&D and innovation: Hungary was the only country to advance one category to moderate innovator in the European Innovation Scoreboard in 2023; R&D expenditure has tripled in nominal terms since 2010; the headcount of R&D personnel has more than doubled (rising by 114 per cent, which was the third largest increase in the EU); and the number of PhD students has increased by almost 50 per cent in the past 10 years. The number of university patent applications in 2024 was 143, twice as many as in 2022 and nearly seven times as many as in 2018. The change in the university model, the renewal of the Hungarian Research Network, the strengthening of the National Research, Development and Innovation Fund and the new foundations of the funding structure have also contributed to these results. With this vision in mind

and based on the achievements of recent years, this essay highlights the importance of domestic innovation and the innovative business sector in enhancing economic competitiveness. To achieve this objective, we provide a comprehensive overview of the characteristics of corporate innovation in Hungary, and then present the strategic goals of innovation policy and the path to achieving those goals. We argue that research and innovation need a long-term strategy, with long-term, predictable and gradually increasing funding, as well as consistent, rigorous implementation. As US venture capitalist John Doerr put it: *'Ideas are easy. Execution is everything.'*

2. Background – why is it essential to strengthen innovative Hungarian companies today?

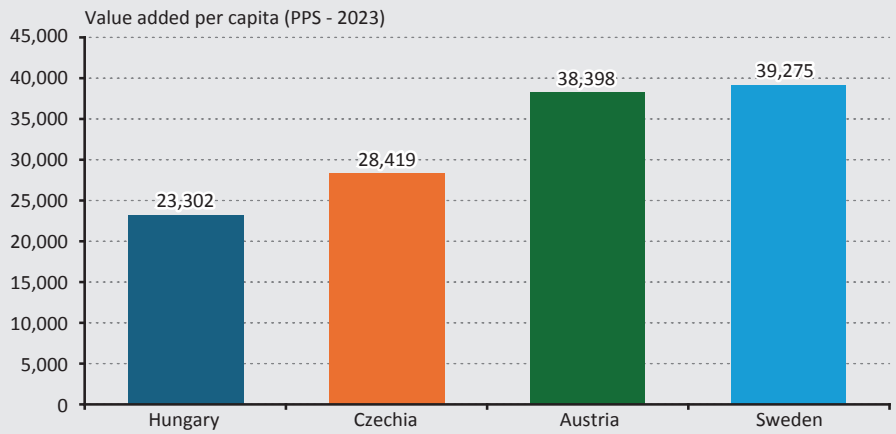
Based on an analysis by the global consulting firm *McKinsey* (*2020*), in the decade after 2010 economic growth was driven by an expansion in employment during the first five years, and by productivity growth during the second five years with continued growth observed, albeit at a slower pace, in employment.

In the period since 2010, nearly one million people have entered the Hungarian labour market, and according to the calculations of György et al. (*2024*)*, the Hungarian middle class has increased from 34.9 to 54.6 per cent.* Comparing Hungarian employment rates with those of Czechia, Austria and Sweden[2] – countries whose population size is similar to that of Hungary – we find that in most education categories Hungary has caught up with or even exceeded the employment rates of the benchmark countries.

Thus, while further accelerating employment growth continues to be an important economic policy objective, *over the medium to long term Hungary's economic growth may be based primarily on productivity growth*, in other words, growth in value added per employee (*McKinsey 2020*). International and domestic statistics on value added reveal that there is considerable scope for increasing value added per capita (*Figure 1*).

[2] For the purposes of this paper we used these three countries – which are similar in terms of population size to Hungary but with different levels of innovation – as benchmarks to set the target level for the development of innovation areas. Although these countries differ from Hungary in terms of their historical, economic and geopolitical situations, it is worth drawing inspiration from their examples.

Figure 1
Value added per capita (PPS, 2023)



Note: Added value at current prices calculated per one million inhabitants and divided by the GDP volume index per capita measured in purchasing power standard (PPS). Added value: https://ec.europa.eu/eurostat/databrowser/view/nama_10_a64/default/table?lang=en&category=na10.nama10.nama_10_ma; Population as of 1 January 2023: https://ec.europa.eu/eurostat/databrowser/view/tps00001/default/table; PPS adjustment: https://ec.europa.eu/eurostat/databrowser/view/tec00114__custom_11737615/default/table?lang=en

Source: Computations based on Eurostat data

Upon further analysis of the structure of Hungarian value added, we find that *foreign-owned companies play a significant role in the production of value added*. The same is true for all countries in the Central and Eastern European region. Over the past 15 years, economic policy has been able to significantly increase the domestic share of value added in Hungary (by about 10 percentage points), which is considered a major success. Nevertheless, it still stands at only 58 per cent, ranking Hungary 22nd among the EU Member States.

Partly as a result of this structure, an amount equal to 4 per cent of GDP – more than HUF 3,000 billion – exits Hungary each year on average in the form of capital income.

Research, development and innovation, including the use of new technologies, play a key role in boosting the value added generated by Hungarian-owned enterprises. The correlation can be also measured fairly well at the macro level: countries that spend more on R&D have significantly higher productivity. Companies relying on more advanced technologies and higher-level knowledge can be more competitive and produce more valuable products, not only domestically but also on international markets. This is particularly important for Hungary, as exports of high value-added products can stabilise and boost the economy's performance in the long term. This is also demonstrated by the 'smile curve,' which analyses the relationship between

value added and the individual activities of the production chain (see *Baldwin – Ito 2021*; *Boda 2020*). R&D and design are the highest value-added activities in the production chain.

Accordingly, *we can successfully increase value added per capita – i.e. productivity – in the Hungarian economy*, and thus ensure long-term economic growth, *if we increase the number of innovative companies and strengthen those that are already innovating.*

3. The role of innovative enterprises in the Hungarian economy

As innovation is the central theme of this essay, it is worth explaining what this term means. Innovation is defined in the Oslo Manual, an international standard for measuring innovation developed by the OECD and Eurostat. According to the Manual, an innovation is a new or improved product or process (or a combination thereof) that differs significantly from the company's previous products or processes and has been made available to potential users, in the case of a product, or brought into use by the company, in the case of a business process (*OECD/Eurostat 2018*). MIT provides a simple definition of what may at first seem a complex concept: *Innovation = Invention x Commercialisation* (*Aulet 2013*). This approach highlights that innovation is not merely the existence of an original idea or technological breakthrough, as its successful market introduction and utilisation are also fundamental prerequisites. If any of these are missing, we cannot talk about innovation.

To measure innovation performance, EU Member States conduct a survey every two years within the framework of the *Community Innovation Survey* (CIS), in which the self-reported innovation activity of the business sector in Member States is assessed using a comprehensive set of economic units with 100 or more employees, while a representative sample is used for units with 10–99 employees.[3] These results are aggregated by Eurostat and the latest survey data are available for the period 2020–2022.[4]

Taking the results of the CIS survey as a basis, the joint analysis of the Hungarian Central Statistical Office (HCSO) and the National Innovation Agency provides an accurate view of the role of innovative enterprises in the Hungarian economy (*Figure 2*).

[3] The target population of the survey is enterprises with 10 or more employees operating in sectors B – C – D – E – G46 – H – J – K – M71–73.

[4] *Community Innovation Survey 2022*. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Community_Innovation_Survey_2020_-_key_indicators&oldid=581743. (Last update: November 2024.) Downloaded: 21 January 2025.

Let us first examine the macro-level effects. Despite the fact that the share of innovative enterprises in Hungary is 30.2 per cent (in the period of 2020–2022), innovative enterprises account for:

- 64.7 per cent of the value added of enterprises (in other words, the GDP generated by this business sector);
- 68.7 per cent of the net sales revenue of export sales;
- 64.4 per cent of the net sales revenue; and
- 54 per cent of the number of employees.

Figure 2
Performance of innovative companies (2022)

Note: Data estimated using experimental methodology.

Source: HCSO

Breaking down these results by company, we find the following:

- *Innovative enterprises produce 58 per cent more value added per person on average, i.e. that much they are more productive than non-innovative enterprises.* Moreover, this is true for all size categories, i.e. not only for large – mainly foreign-owned – companies but also for – typically Hungarian-owned – small and medium-sized enterprises, where productivity is 25 per cent higher in the case of innovative firms.
- *Innovative enterprises have significantly higher employment* both in the case of SMEs and large *enterprises*.
- However, innovative companies are not only more productive and employ more people, but they also *pay significantly higher (31 per cent more) wages to their employees*. Moreover, *they export 90 per cent more* on average.

It is therefore reasonable to argue that strengthening the innovative business sector and increasing the number of innovative companies could make a significant contribution to the country's competitiveness – in terms of GDP, employment, wages and export capability – as innovation invariably has a positive impact on productivity (*Halpern 2020; Halpern – Muraközy 2010*)*.*

Now that we have explored the crucial role of innovative enterprises in Hungary's economic performance, we should examine how Hungary's business sector fares in terms of innovation activity.

4. Innovation activity in the Hungarian business sector

International innovation indices (such as the *Global Innovation Index* or the *European Innovation Scoreboard*) assess the innovation capabilities of countries in numerous dimensions (using around 80 and 32 indicators, respectively). While a detailed presentation of the indices falls beyond the scope of this paper, it should be noted that Hungary's innovation performance was ranked 36th in the world (*WIPO 2024:18*) and 21st in Europe in 2024 (*European Commission 2024a:3*) according to these indices.

The focus of our essay is on business innovation and its stimulation, and thus it is worth analysing the innovation willingness of the Hungarian business sector in more detail.

The individual segments of the Hungarian economy should be examined separately as an exporting medium-sized enterprise has completely different characteristics and needs a different type of support (as will be demonstrated later) than a micro-

enterprise or a startup. In the following, we analyse the main company segments as follows:

1) the MSME sector,[5] in particular Hungarian-owned (small-), medium-sized and large enterprises with or close to export potential,[6]

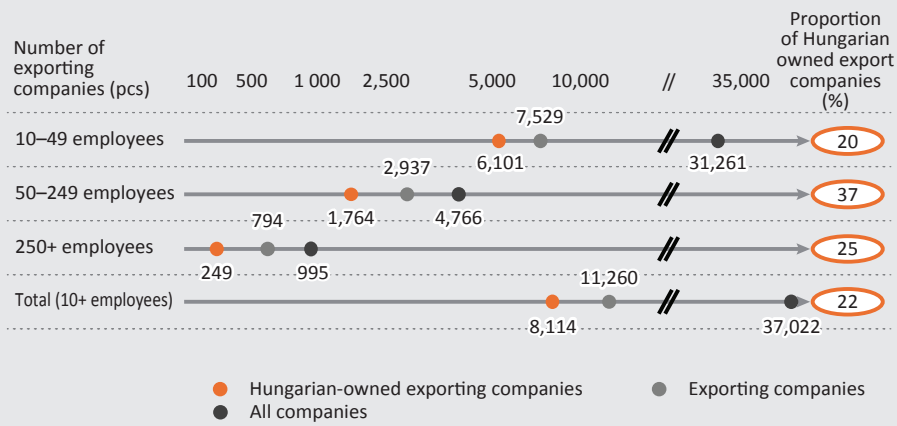
2) the innovative startup business sector.

4.1. Hungarian-owned companies with export potential and the MSME sector

How many companies are we talking about when we refer to the sector of Hungarian-owned small-, medium-sized and large companies with export potential?

Based on HCSO data for 2022, the total business sector[7] comprises around 37,000 companies with more than 10 employees (i.e. small, medium or large enterprises). Of these, just *over 11,000 (i.e. ~30 per cent) are engaged in exports, of which more than 8,000 enterprises are Hungarian-owned*. Of these, ~6,000 are small, ~1,800 are medium and ~250 are large enterprises (*Figure 3*).

Figure 3
Distribution of the number of exporting companies by size category and Hungarian ownership (2022)



Source: HCSO

[5] Micro-, small- and medium-sized enterprises.
[6] Based on their observations, *Halpern – Muraközy* (*2020*) suggested that innovation policy should treat Hungarian and foreign-owned firms differently.
[7] National economy sectors under review (TEÁOR'08): B-N, P-S, except S94.

An in-depth analysis of the data reveals that, while the share of Hungarian-owned companies is high among exporting small and medium-sized enterprises (80 and 60 per cent, respectively), *in terms of average sales revenue per company, foreign-owned companies have a significant advantage in these categories as well*: in the case of small enterprises, foreign-owned companies have a 6.1 times advantage and in the case of medium-sized enterprises they have a 4.8 times advantage on average in export sales revenue; consequently, the export sales revenue generating capability of Hungarian companies needs to be improved.

Looking at the data in an international comparison (*Table 1*), *at present Hungary has few exporting companies* proportional to its population: there are only 3,860 enterprises per million persons,[8] while the Austrian and Swedish corresponding examples indicate 4,700 – 5,200 enterprises, which means that considerably fewer companies enter the international markets from Hungary. There is also room for growth in terms of average export value, with Hungarian exporting firms earning around 30 per cent less from international sales as compared with companies of the benchmark countries. The lag is particularly noticeable in the case of SMEs (e.g. the average exports of medium-sized enterprises in Austria are nearly three times higher than in Hungary), but also the average export volume of Hungarian large companies is only about two-thirds of the same at Austrian and Swedish enterprises.

Table 1
Characteristics of exporting companies in 2022

	Average exports by enterprise category (EUR thousands)				Number of exporting companies per million persons
	Total	10–49 persons	50–249 persons	more than 250 persons	
HU	2,705	694	4,236	65,366	3,860
AT	4,052	1,493	11,343	100,275	5,192
SE	3,651	1,247	7,783	95,575	4,777

Note: Average exports: Export value/number of exporting companies (https://doi.org/10.2908/EXT_TEC01); calculated by population as at 1 January 2022 (https://ec.europa.eu/eurostat/web/interactive-publications/demography-2024#growing-population)

Source: Calculated based on Eurostat data

Not only the volume of sales, but also the value added of Hungarian exports lags behind the benchmark countries, especially compared to the performance of Austria and Sweden. In each country, the value added associated with the share of exports reflects the international competitiveness of the given economy and the innovation capacity linked to the quality of products. According to 2020 data, the value added

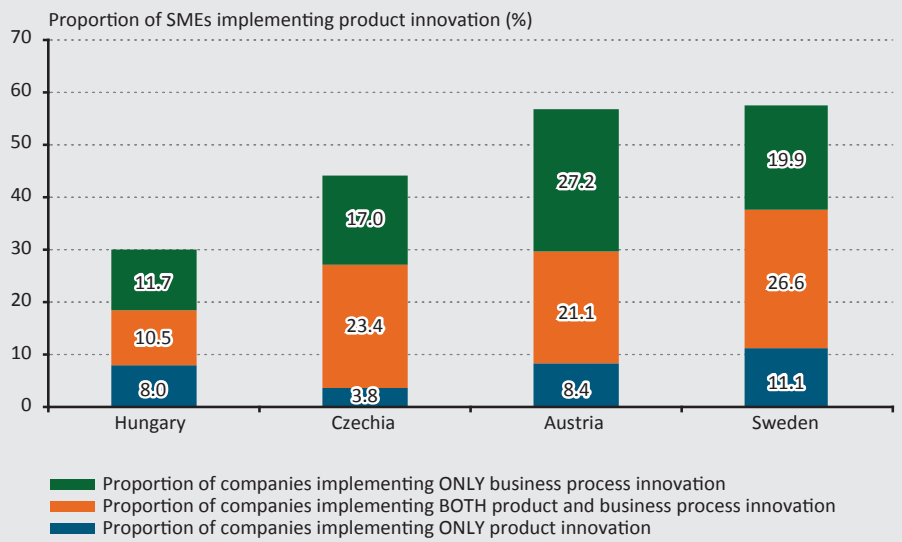
[8] It is important to note that all enterprises are included in these statistics, not the ones analysed earlier with more than 10 employees.

content of exports in Hungary is 55 per cent, while the corresponding figure is 62 per cent in Czechia, 70 per cent in Austria and 76 per cent in Sweden.[9]

Lower innovation activity is a key factor in the underperformance of Hungary's exporting business sector compared to the selected benchmark countries. Examining the Summary Innovation Index, *Halpern and Muraközy* (*2010*) found that Hungarian innovation activity, although similar to that of Slovakia and Poland between 2004 and 2008, was significantly lower than that of Czechia and the EU-27.

Nearly one-third of Hungarian enterprises (*30.2 per cent*) *are engaged in innovation activities*, far below the levels observed in Czechia (44.2 per cent) and Austria (56.7 per cent) (*Figure 4*). SMEs particularly lag behind in the area of business process innovation (discussed in more detail below): the Hungarian value is 21 per cent versus 39 per cent in Czechia and 50 per cent in Austria.

Figure 4
Proportion of active innovating enterprises in an international comparison (2022)



Source: Eurostat data (https://ec.europa.eu/eurostat/databrowser/view/inn_cis13_bas__custom_15555386/default/table?lang=en)

[9] Domestic value added in gross exports. https://data.oecd.org/trade/domestic-value-added-in-gross-exports.htm#indicator-chart. (Last update: 30 September 2020.) Downloaded: 21 January 2025.

Domestic companies are on par with the international benchmark countries in terms of product innovation: *Halpern and Muraközy* (*2010*) demonstrated for the period of 2004–2006 and *Katona* (*2021*) for the period of 2007–2017 that the innovation investments and developments of these companies are capable of becoming the engine of their own performance growth.

However, beyond product innovation alone, knowledge sharing, adaptation of modern technologies and process innovation are also of strategic importance for SMEs, which predominantly produce for the domestic market, as they play a key role in the productivity of companies and can reap additional benefits (*Gelei and Kenesei 2017; Katona 2021*).

Based on the country analysis of the European Commission's Report on the State of the Digital Decade 2024 (*European Commission 2024b, 2024c*):

- *52 per cent of* Hungarian *SMEs have basic digital skills* as opposed the EU average of 69 per cent;
- *only 7 per cent of SMEs use big data solutions* as opposed the EU average of 14 per cent;
- *only 21 per cent use cloud technologies* as opposed the EU average of 34 per cent; and
- *3 per cent of the enterprises use AI solutions* as opposed the EU average of 8 per cent.

These figures confirm that the SME sector's focus on adapting to the technological switch and therefore business process innovation is still limited.

Szoboszlai et al. (*2024*) demonstrated that the rapid growth observed among innovative firms was fuelled by improved technology, higher level of human resources, increased export intensity and access to venture capital. To increase competitiveness, it is therefore crucial to stimulate innovation and promote the international presence of domestic firms in order to enable Hungarian-owned enterprises to:

- increase the number of exporting companies;
- increase the sales revenues of exporting companies;
- achieve higher domestic value added in exports; and
- focus on the technological switch of micro and small enterprises through business process innovation.

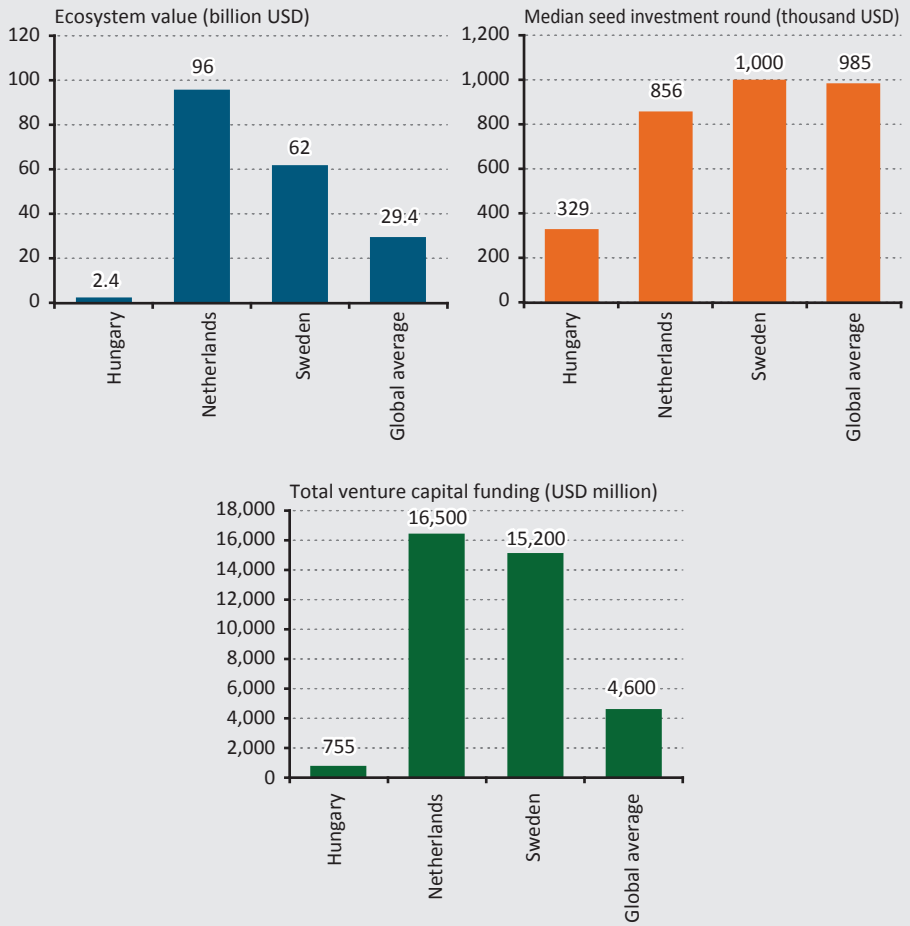
4.2. The innovative startup business sector

The Hungarian startup ecosystem is still significantly underdeveloped relative to the global average, as well as to the average of developed European countries of similar size. Based on data measured during the period 2021–2023, the *Startup Genome* (*2024*) report points out that:

- the *value of the ecosystem*, i.e. the consolidated value of the startups within the ecosystem, *is less than 10 per cent of the global average*, and compared to Sweden and the Netherlands the difference is 25 and 40 times, respectively;
- a threefold difference can be identified even for the median *seed investment rounds*;
- there *is also a significant gap in venture capital investment*: the Hungarian ecosystem lags behind the global average by a factor of six, and compared to the Swedish and Dutch ecosystems by a factor of 20 (*Figure 5*);
- the *number of business angels active in the ecosystem is low*: In Estonia it is around 165, in Austria around 250, while in Hungary barely a dozen angels are actively investing;
- *no new unicorns* (i.e. startups valued at more than USD 1 billion) were established in the period, compared to an average of 3 unicorns globally, 6 in the Netherlands and 7 in Sweden; and
- the *growth rate* (41 per cent) *of the ecosystem* has not reached the global average (48 per cent).

It follows from the above that, in the case of the startup ecosystem, policy needs to focus not only on increasing the number of startups, but also on their 'quality' improvement, including strengthening 'Deep Tech' startups that bring in-depth scientific results to the market, and on the available venture capital funding; in other words, comprehensive development is needed.

Figure 5
Selected indicators of the startup ecosystem in an international comparison (2023)



Source: Startup Genome (2024)

5. Financing innovation

It is difficult to measure innovation financing directly on its own; therefore, statistical offices apply international statistical standards, mainly R&D expenditure, as a proxy.

Based on the analysis of the structure of R&D funding in Hungary, the following conclusions can be drawn:

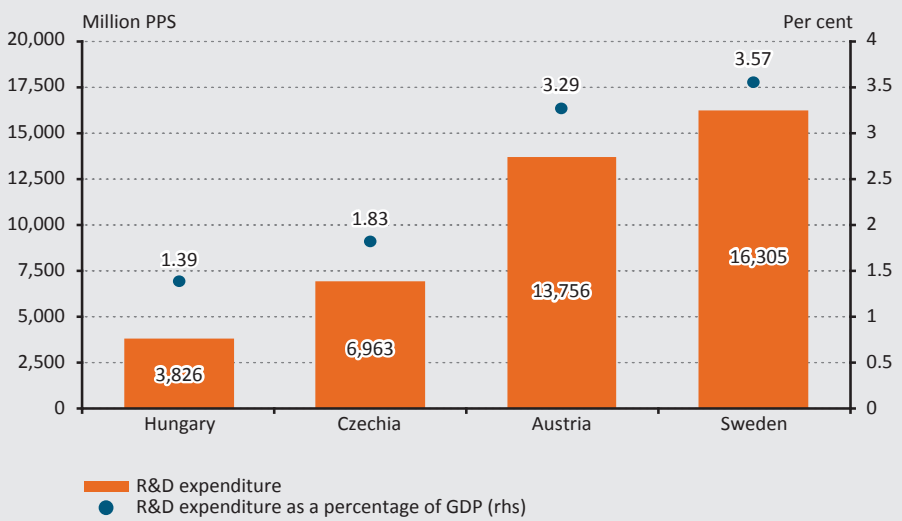
- The *ratio of Hungarian R&D expenditure to GDP* (1.39 per cent) remains below that of Czechia (1.83 per cent) and lags significantly behind Austria and Sweden (3.29 per cent and 3.57 per cent, respectively).

- The gap is even more significant in terms of *absolute expenditure* (in EUR millions), given the differences in GDP: *Hungary is more than 2 times behind Czechia and 5–7 times behind Austria and Sweden* (*Figure 6*). The costs incurred in research and innovation – such as research instruments, clinical trials (in life sciences) and labour costs – do not vary significantly between countries; consequently, the absolute figures are a better reflection of the differences in opportunities between the countries under review.

- The *share of public expenditure in total R&D is in line with international trends* (about one-third public and two-thirds market expenditure). It is important to note, however, that *foreign companies account for 62 per cent of corporate R&D expenditure*: in 2023, foreign R&D expenditure amounted to HUF 467.1 billion out of a total expenditure of HUF 757 billion.

- Although R&D expenditure *at universities* has increased significantly in recent years, *the proportion of resources devoted to applied research and experimental development is relatively low*: universities do not devote enough attention to the translation of research results into practical solutions, or to the valorisation and economic utilisation of applied research results.

Figure 6
Selected indicators of R&D expenditure in an international comparison (2023)



Note: provisional values.
Source: Eurostat (GERD by sector of performance. https://doi.org/10.2908/RD_E_GERDTOT)

Based on the above data, the following conclusions can be drawn:

- Hungary *needs to increase its R&D spending significantly,* both in absolute terms and as a share of GDP.
- *Today,* the *Hungarian-owned corporate sector spends little on research, development and innovation; there is a need to incentivise* both SMEs and large companies in this aspect.
- *Applied research expenditure at universities and research institutions needs to be increased further* in order to ensure that more research results are commercialised, e.g. through the establishment of spin-off companies.

6. The importance of state involvement in the market-driven development of innovation

6.1. Principles and intervention channels

In our view, *promoting innovation should be a market-driven process*. This means that the long-term goal is to create an ecosystem that is self-sustaining on a market basis; in other words, where a large number of adults are open to entrepreneurship, have market-viable, innovative ideas and can find the professional support and financial funding that is relevant to them at the time.

However, *international good practices* reveal that in all innovation ecosystems that are now considered advanced (such as Israel, Sweden, Singapore or South Korea), *the state played a significant role* in R&D and innovation expenditures, in setting up funding and supporting instruments and in formulating the regulatory environment. This primarily implies the following tasks:

1) education–training–knowledge provision,

2) organisational–structural,

3) regulatory and taxation, and

4) funding.

Channelling market perspectives into policy making is essential for successful innovation policy, which is why NIÜ has launched the *Startup Roundtable*, which brings together the key players in the startup and innovation ecosystem: startups, business angels and venture capital organisations, incubators and other stakeholders and opinion leaders in the ecosystem.

6.2. Target groups and strategic objectives of intervention by the state in the field of business innovation

In order to boost the innovation activity of the Hungarian corporate sector and the performance of the startup ecosystem above the European average, we have identified the following business segments to be developed and targets to be met by 2030:

1) On the one hand, it is necessary to focus on *developing and strengthening the export capacity of Hungarian-owned small, medium-sized and large enterprises operating in traditional, mature but innovation-driven industries* (e.g. food industry and production, health industry). Strengthening the innovation capacity of these companies will contribute to creating a stable, internationally competitive domestic industrial base and support them in adapting to global technology trends, thus improving the competitiveness and export capacity of the national economy. *Particular emphasis should be placed on 'champion' companies in this sector*, i.e. those which have demonstrated the fastest growth and innovation activity in recent years.

   Objective: The sector of exporting Hungarian-owned small, medium and large enterprises should be bolstered; the number and value added of exporting Hungarian-owned companies should be increased through new innovative products, technologies and services introduced to the market.

2) On the other hand, there is a need to focus *on innovative startups and technology startups, in particular, Deep Tech*[10] *companies* with high growth potential and innovative solutions. These firms are able to bring radical technological innovations that can compete not only on domestic market but also on international markets, contributing significantly to economic growth (*Botelho et al. 2021*).

   Objective: The performance of the Hungarian startup ecosystem should reach the global average, and 30–50 Deep Tech startups should be established every year.

3) Thirdly, there is also a need to focus on *micro and small enterprises addressing the issue of technical adaptation, i.e. implementing business process innovations*, e.g. by modernising their production technology, business model or logistics system.

   Objective: It should be achieved that one in two (50 per cent) Hungarian SMEs is engaged in innovation. In this context, the share of small businesses introducing

[10] Deep Tech companies, which are part of the startup ecosystem, are characterised by 5 key factors: (1) focus on new scientific and/or technical breakthroughs or on solving major societal challenges (academic background); (2) global scope; (3) high R&D intensity; (4) founders have high expertise in their field; and (5) significant funding needs.

innovation should rise from the current 26.6 per cent to 50 per cent, and the share of SMEs carrying out business process innovation should reach at least 40 per cent.

In the following, we present policy ideas and instruments aimed at the development of each business segment.

6.3. Bolstering the sector of Hungarian-owned small, medium-sized and large enterprises with export potential

As described above, the sector, which comprises around 8,000 companies, is characterised by low innovation activity (30.2 per cent) and relatively low value added and export revenue generation capacity. In terms of policy measures, special attention should be paid to the sector's outstanding 'champion' companies, the role of which is discussed in more detail below.

Ónodi and Répáczky (*2022*) found a significant correlation between managers' openness to innovation and successful corporate innovation. While this kind of openness of the leaders depends on personality traits, it can also be improved in a conscious, targeted manner through leadership training. In line with these findings, the most important reasons for the low innovation ambition and willingness of domestically-owned enterprises can be summarised below, based on our own experience:

- At many SMEs, management does not have a high level of English language skills and international market experience. This limits their ability to follow technical and managerial developments on the international stage and to compete at that level.
- The owners of firms in today's mature industries typically have a specialist background, and no or limited business skills, which limits their ability to organise their organisational processes and structure effectively beyond a certain point and size.
- Due to the distance between academia and industry, a large number of Hungarian-owned businesses do not have links with higher education institutions and research institutes, and are unable to effectively connect to the academic infrastructure, available services and collaboration opportunities. Today, only 11 per cent of innovative SMEs collaborate with universities and 3 per cent with research institutes.
- Innovation requires a great deal of managerial attention, as strategic management decisions and organisational culture have a significant impact on the effectiveness of innovation. However, this temporarily diverts resources from the main activity, while the results are perceivable only over the medium to long term. As a result,

innovation is often not a top priority for companies and encounters organisational resistance.

Based on the above analysis of the situation, in the case of these enterprises, policy should focus on the following tasks:

- education–training–knowledge:
  - disseminating and promoting innovation insights and highlighting the importance of innovation;
  - providing specialist assistance to businesses in terms of technology and market insights;
  - facilitating connections to universities and research institutes;
  - developing export capacity, strengthening international trade relations.

- regulation and taxation:
  - raising awareness among businesses about existing tax incentives.

- financing:
  - establishing connections with universities and research institutes for joint product and technology development.

The first step is to focus on *increasing the willingness and ambition to innovate* through various evangelisation[11] and education programmes. It is important for businesses to recognise that innovation is not an end in itself, but a strategic tool that gives them the opportunity to increase profits, boost revenues and operate more efficiently.[12] Intervention by the state may help these companies to become better equipped to identify and implement innovation opportunities. *This is the goal of the Hungarian Innovation Agency's (NIÜ) education and knowledge transfer programmes*: it is deemed a success that in 2024, nearly 1,000 companies participated in the NIÜ's business process innovation training, the majority of which had not previously been engaged in innovation.

In addition to the knowledge transfer programmes, *in 2024 the NIÜ launched its free innovation project development service*, whereby external experts (market and science/technology) are available to companies to assess not only their innovation development ideas but also the innovation readiness of the whole company, and to formulate proposals for their further development. This type of support can help companies to successfully identify areas where innovation can bring real value added, thereby laying the foundations for their long-term competitiveness.

[11] For the purposes of this paper the term 'evangelisation' refers to a set of active programmes and communication campaigns aimed at shaping attitudes.

[12] Analysing a sample of firms in the Central and Eastern European region, *Bistrova et al.* (*2017*) demonstrate that 1) the highest share of intangible assets is associated with the most profitable firms; and 2) regressions on return on equity, gross profitability and net profitability indicate that the increasing financial performance of the sample of firms is associated with the increase in the share of intangible assets.

Connecting with universities and research institutes takes place at two levels: education and training on the one hand, and research and innovation on the other. In education, cooperation can be implemented through internships, participation in dual training, cooperative doctoral training or the establishment of a corporate department. In research and innovation, cooperation can start by identifying topics for a corporate thesis or research paper, using university research services or joint development.

In order to encourage cooperation between the business sector and the sector of universities–research institutes, the *National Research, Development and Innovation Office (NRDI Office) has implemented the University-Business Ecosystem Platform (EVOP)* and its first module, Kooper. EVOP is intended to provide a single, transparent platform for companies, opening a window for them on the entire higher education and research sector.

Foreign market entry and embeddedness is facilitated by *the NIÜ's XPAND programme*, which involves a three-step process whereby NIÜ experts not only prepare companies to export and enter the relevant foreign market, but also support the best prepared companies to participate in the most important technology and innovation fairs in the selected target markets, with a number of relevant partner meetings organised on site. In 2024, the programme assisted more than 50 Hungarian SMEs with entering foreign markets.

The Hungarian *tax regime* provides *opportunities to* encourage research and innovation, but *only a small proportion of companies take advantage of them* (typically only 300–500 companies per year, while the number of companies involved in R&D has ranged between 1,700 and 2,100 in recent years).

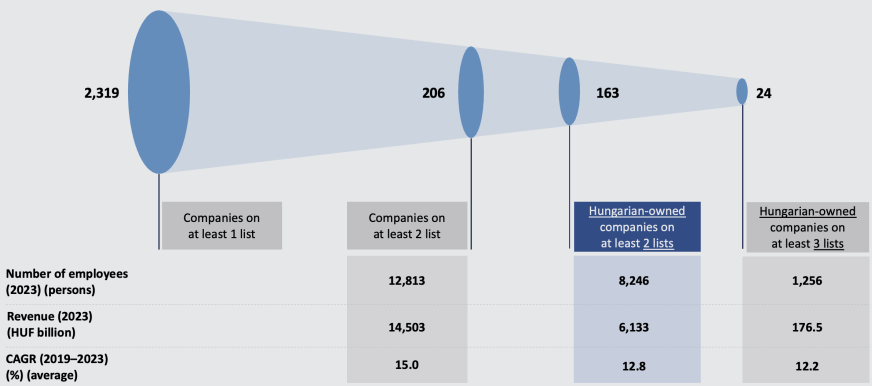
Product and technology development in cooperation with universities and research institutes is a key focus of policy and the NRDI Office, which is why the *SME Focus Area Innovation Programme* and the *Large Company Focus Area Innovation Programme*, announced for the first time in 2024, aim to encourage cooperation through non-refundable grants, typically with a 50–70-per cent funding intensity. In return for the grant, the funder expects three things: 1) a new product, technology or service should be created; 2) the company should protect the result of the development – primarily by means of a patent; 3) the developed product should generate sales revenue already in the short term, primarily on foreign markets. Co-financed projects enable companies to carry out major development projects with less risk, while stabilising their market position and maintaining their growth and profitability in the long term. For this purpose, in 2024 HUF 110 billion was allocated to SMEs and HUF 15 billion to large companies, and the funding schemes are also available in 2025.

As indicated above, particular attention should be paid to the targeted development of champions in the exporting Hungarian business sector. Based on the corporate analyses prepared by various Hungarian analyst firms (*Figure 7 and 8*), in recent years *163 Hungarian companies* have been identified with the greatest development potential*: they are the outstanding small and medium-sized exporting companies that may emerge as the national champions of the future.*

Figure 7
Hungarian-owned companies with the greatest potential

We compared 4 corporate ranking to determine which Hungarian owned companies have the biggest market potential

No.	Company list	Creator (source)	Number of companies	Criteria for selection
1	MNB IDE	Magyar Nemzeti Bank (based on Opten)	1,134	▪ Innovative (IP, R&D) + fast growing (20+%/year) (2016–2019)
2	Macronomic Winners of the decade	Macronomic Institute (based on Opten)	829	▪ Featured industry + rapid growth + export (2017–2021)
3	BSE 50	Budapest Stock Exchange (own data)	246	▪ Medium-sized companies with a stable market position (2018–2023)
4	Horizon winners	Horizon (CORDIS database)	278	▪ Companies receiving innovation funding in the Horizon 2020 program
+1	NRDI Office supported	NRDI Office (NRDI Fund grants)	-	▪ Companies receiving grant from the NRDI Office in the last 6 years
+2	EDIOP RDI supported	EDIOP Managing Authority (EUPR)	-	▪ Companies receiving grant from EDIOP RDI funds in the last 6 years

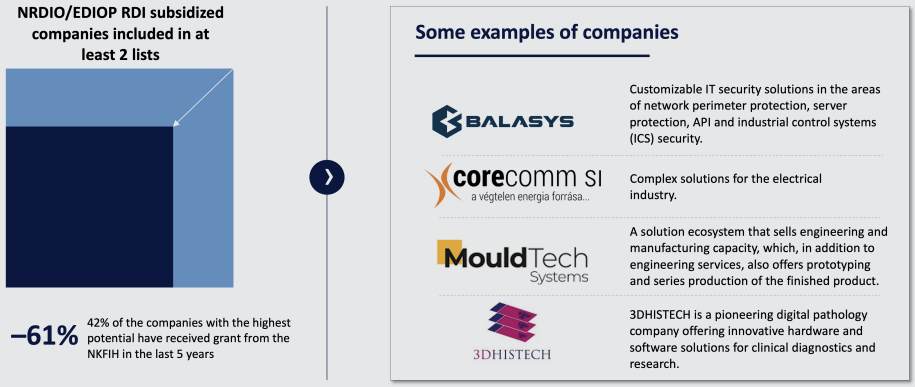


	Companies on at least 2 list	Hungarian-owned companies on at least 2 lists	Hungarian-owned companies on at least 3 lists
Number of employees (2023) (persons)	12,813	8,246	1,256
Revenue (2023) (HUF billion)	14,503	6,133	176.5
CAGR (2019–2023) (%) (average)	15.0	12.8	12.2

Source: KIM–NRDI Office–NIÜ

Of the 163 enterprises, *61 per cent have received R&D funding in* the last six years, indicating that the policy was successful in identifying enterprises with the greatest potential in the application process. The objective is to address these companies with proactive means to help them move forward and gain international prominence.

Figure 8
Funding rate and exemplary Hungarian-owned companies



Source: KIM–NRDI Office–NIÜ

6.4. Building up the startup and Deep Tech sector

In the case of the startup innovative enterprise sector, we believe that stronger state involvement is advisable compared to the previously described Hungarian-owned exporting companies. Indeed, as we have shown, Hungary has not yet developed and reinforced a startup and Deep Tech ecosystem by international standards. Thus, interventions by the state are intended to increase the number of startups and facilitate their rapid growth so that they become competitive (large) companies even in the international markets, in line with the approaches suggested by *Havas et al.* (*2023*), namely, ensuring a skilled workforce, appropriate entrepreneurial culture and knowledge sharing.

6.4.1. Education–training–knowledge provision

The *first phase of support is 'evangelisation' and education*: this ensures that the founders of innovative technology companies acquire the skills they need to grow fast and develop a healthy ambition.

Young people open to founding a startup face the following challenges:

- At present, most Hungarian founders lack ambition and thinking on an international scale. Risk aversion is high (which is not specific to Hungary: it is a challenge at the European level), exacerbated by several factors. Firstly, the acceptance level of failure is low: failure is often not seen as part of progress and learning, which discourages risk-taking.

- This is exaggerated further by the low level of savings, which results in a shorter 'personal runway.' Founders typically do not have sufficient financial reserves to sustain a risky business for years while also providing for their own livelihood. The same is true for the group known in the literature as *'friends, family and fools (FFF),'* whose members play an important funding role in the pre-seed stage of startups in developed ecosystems.

- The relatively young age of the Hungarian market economy, with a market environment that has existed for only 35 years, also contributes to the lack of entrepreneurial skills, which are typically not part of a multi-generational tradition. *Csákné Filep et al.* (*2020*) pointed out that Hungarian and international research ascribed an important role to the entrepreneurial skills acquired during the years of education in the success of startups.

The development of evangelisation and education is critical for stable, long-term results, but it is an activity that takes far too long to yield a market profit if any at all; therefore, the state has a key role to play at this stage. Consistency and continuity in these programmes are very important, as supporting a change in culture and the acquisition of basic skills requires continuous presence and communication.

With this in mind, the *Hungarian Startup University Programme* (HSUP), the flagship programme of the NIÜ, was launched almost 5 years ago and is constantly enhanced and relaunched year after year. The two-semester higher education programme has so far reached nearly 20,000 university students and has already resulted in numerous market-tested startups. The NIÜ's goal is to extend the programme to secondary school students in the coming years.

In addition to higher education students and secondary school students, the education of researchers is also of strategic importance, as they can become the founders, co-founders and technology leaders of internationally significant Deep Tech companies. This is why the NIÜ is launching the *Pathway to Business* programme this year, which in the first pilot year will give 20–25 doctoral and postdoctoral researchers from six higher education institutions the opportunity to work on bringing their research results to market in the framework of a one-year *sabbatical*, with subsistence and material costs covered.

6.4.2. Organisational–structural tasks

In addition to training programmes, it is the duty of the state to develop and bolster technology transfer processes in universities and research institutions. Experience shows that over the last 15–20 years, there have been many initiatives to build up these capabilities in universities, but none of them have been able to provide a long-term solution. It has been seen that, after the phase-out of a targeted funding

programme, the technology transfer offices reduce human resource capacities or do not focus on these activities as they should.

To address this issue, the *Technology Transfer Company (TTC)* project was launched at the end of 2023 to analyse the most successful university and research institute technology transfer models in the world, and to outline a model for Hungarian universities and research institutes that, based on experience, can most effectively and efficiently support the commercialisation of research results. In the first year, these companies were set up in the 100-per cent ownership of five higher education institutions, and this year's objective is to support the establishment of additional new TTCs. The TTCs are established by the institutions themselves, while state involvement is limited to the provision of continuous professional support from a dedicated directorate of the NIÜ.

6.4.3. Regulatory and taxation tasks

One of the key policy challenges is to create a regulatory environment for innovative startups that does not restrict, but rather supports them in successfully bringing their innovations to the (external) market. However, these regulatory challenges typically manifest themselves in everyday life. This is why NIÜ organised the Startup Roundtable in conjunction with participants of the startup and investor ecosystem to discuss and analyse these regulatory issues among others. Several achievements have been registered in this field in the last year and a half. Firstly, by creating the possibility of *Convertible Note*[13] financing in the summer of 2023, based on international (mainly US) examples, and subsequently, in the autumn of 2023, by addressing the tax challenges encountered in the application of the *Employee Stock Ownership Plan* (*ESOP*)[14] through regulation. In the autumn of 2024, another important step was *the introduction of a tax exemption for the in-kind transfer of intellectual property rights,* in conjunction with the stakeholders of the ecosystem. While these issues do not promote the startup ecosystem in and of themselves, they may act as a barrier to the development of the ecosystem, and their elimination is a common interest.

In addition to regulatory issues, it is a key objective that *tax measures* should also support – primarily – *the financing of early-stage startups*: based on international best practices, it would be reasonable to introduce in Hungary, as well, *a tax credit for business angels*, and focus should also be placed on *encouraging venture capital investments* in early-stage financing.

[13] A loan that can be converted to equity: an internationally widespread early-stage funding framework that enables startups to raise investment funds from incubators and individuals quickly and easily.

[14] A regulatory framework where key employees can share in the success of the company through stock options to maintain long-term motivation, whereby the tax on the increase in wealth from the shares is only payable after the liquidation event.

6.4.4. Funding tasks

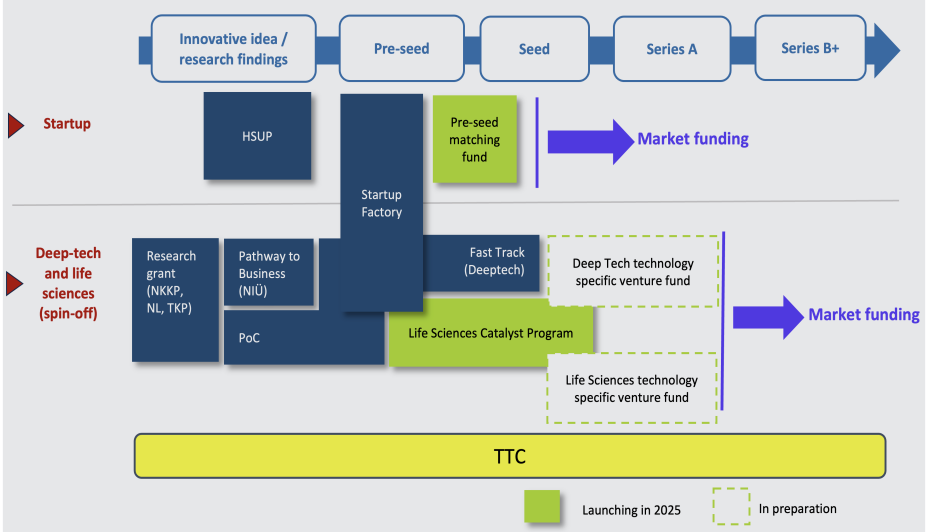
At present, the availability of early-stage funding in Hungary is limited, especially for pre-revenue enterprises. The reasons for this are the following:

- low savings and limited availability of FFF funding;
- scarcity of local angel investors;
- conservative institutional venture capital, which is also typical at the European level; and
- limited availability of tender schemes for early-stage firms.

State involvement in activating early financing is important, but it is not always ideal as direct financing. *Karsai* (*2022*) also stresses that public funds are unable to fully observe market considerations, and available funding is often allocated in a sub-optimal way, which is not sustainable in the long run.

Over the past two years, a funding structure for research and innovation has been established under the leadership of the NRDI Office (*Figure 9*), which supports the development of startups and Deep Tech companies from the birth of an innovative idea or research result through the various startup stages. *In all cases, it does so with the logic of market financing in mind, enforcing this as much as possible within the public framework.*

Figure 9
Research and innovation funding structure



Source: KIM–NRDI Office–NIÜ

The startup ecosystem

Beyond market initiatives, the development of the startup ecosystem will start with the HSUP programme, which is expected to generate a range of innovative ideas and startups. In order to strengthen Hungarian *incubators*, which play a key role in the early stage of startups even in developed ecosystems, the *Startup Factory programme* was launched for the fourth time in 2023, with the NRDI Office providing non-refundable grants to ten market incubators to incubate Hungarian startups.

To address pre-seed financing challenges, in consultation with market actors, the NRDIO is to launch a *pre-seed matching fund* (a venture capital fund), co-investing with market investors at 50 per cent, funded from the 2025 Programme Strategy. The fund does not make investment decisions on its own; its role is to invest in startups when there is a market lead, thus reducing the risk for the market investor (business angel, VC). In view of the problems of public funds, as mentioned by *Karsai* (*2022*), the fund will be managed by a market capital fund manager, selected through a public procurement process, so that the fund will be able to invest strictly on a market basis (not in the form of a state aid), which is significantly simpler and more manageable for startups than the funds provided under previous capital schemes funded by the state.

According to the professional view formulated on the basis of academic analyses (e.g. *Karsai 2022*), the Seed funding rounds should already be provided by market (domestic and international) investors for the startups, which means that the state's role in financing should end at this point, as a general rule.

The Deep Tech ecosystem

As a technical clarification, we wish to add that for the purposes of this essay, Deep Tech companies also include technology companies operating in the Life Sciences area (*pharma, biotech, medtech, healthtech*), because they share many of the characteristics of Deep Tech companies. However, the literature and some analyst firms typically separate these two areas, due to the different characteristics of their market entry, and we do the same in this chapter.

Deep Tech companies are typically based on a research insight resulting from a research project and take this scientific breakthrough to market in the form of products and technologies. In recent years – for the lack of space we will not go into detail – the NRDI Office has significantly reformed the system of excellence-based research funding under the supervision of the Research Council of Hungary, resulting in the establishment of the *National Research Excellence Programme* (*NKKP*) to replace the former Hungarian Scientific Research Fund (OTKA). *The budget for the NKKP has increased significantly* (from HUF 13 billion in 2023 to HUF 40

billion)*, and further increase is targeted.* Under the programme, around 250–300 high quality science research projects are launched every year, some of which can be subsequently nudged towards innovation. In addition to the research excellence programmes, numerous thematic research programmes (*National Laboratories, Thematic Excellence Programmes*) have been launched at the institutional level in recent years, which are also producing research results that can be consistently driven towards innovation.

The primary task of the TTCs is to identify these innovative research results in universities and research institutes and to finance their technological and market validation from their *Proof of Concept* funds, established in the framework of a programme launched in 2023.

One relatively new element in the funding system is the *Fast Track* Programme, which is intended to facilitate the market uptake of research results. The programme provides HUF 100–300 million in non-refundable pre-seed funding to existing Deep Tech companies. From 2025, life sciences will be separated from the Fast Track Programme and replaced by dedicated calls under the *Life Sciences Catalyst* Programme, tailored to the specificities of the field. It is important to note that *translational activities require significantly higher (public) investments* (especially in deep technology areas) than other (fundamental) research activities: in the field of medical biotechnology, for example, bringing a laboratory-validated medicinal product candidate to the end of Phase 1 of the clinical trials can take around HUF 1.5–2 billion. *Due to the high costs involved, many of the promising research projects do not have the opportunity to be utilised*.

The next step in the financing process needs to be provided by venture capital (VC) funds. As already mentioned, resources available in the domestic VC market are scarce; this is why the Ministry of Culture and Innovation intends to launch, with the planned use of EDIOP[15] Plus funds, *technology-specific venture capital funds*, which will make investments along the lines of market principles, under the guidance of market capital fund managers. This is where *Series A* investment rounds come into play, which are investments that venture capital funds are meant to provide, strictly on a market basis.

6.5. Strengthening the innovation activity of micro and small enterprises

As already discussed, the innovation activity of micro and small enterprises is low, due to two factors: 1) the lack of information available (why innovation is worthwhile); and 2) funding challenges that are even more acute in this particular sector.

[15] Economic Development and Innovation Operational Programme

Without repeating the contents of *Section 6.3*, let us only refer to the NIÜ's innovation training service, which concerns the tasks of education–training–knowledge provision.

In addition, for the first time in 2024 a dedicated *business process innovation call* (GINOP Plus 2.1.3-2024) was launched with a budget of HUF 75 billion for micro and small enterprises. Under this programme, the enterprises concerned can apply for a grant of HUF 20–50 million with a funding intensity of 70 per cent to switch technology and modernise their production, business model, logistics or marketing processes. The programme will reach more than 2,000 enterprises/entrepreneurs that have not previously been involved in innovation, which may in itself significantly increase the share of innovative SMEs. One important objective is to maintain these types of support programmes over the long-term in a predictable manner.

7. Summary

While the government has made numerous achievements in strengthening the R&D and innovation ecosystem over the past decade, there is still considerable room for further improvement, as we have seen in comparison with benchmark countries of a similar size. In the next decade, boosting productivity will be one of the key pillars of sustainable growth for the Hungarian economy, and R&D and innovation will play a major role in achieving this goal. Based on CIS data, our paper demonstrates that innovating companies outperform non-innovators in terms of productivity, size, value added and exports, and that it is essential further to increase the number of such companies to achieve the objectives of the national economy.

Based on international experience, in successful innovation ecosystems such as Israel, Sweden, Singapore and South Korea, the state has taken an active role in increasing R&D spending, developing financing instruments to stimulate innovation and improving the regulatory environment. In the long term, however, the objective is to create a market-driven system that stimulates innovation in a self-sustaining way.

The innovation policy objective for the coming years is to make significant progress along the lines of the above principle in three priority segments:

1. *Increasing the number and value added of exporting Hungarian companies* by bringing new innovative products, technologies and services to the market.
2. *Supporting innovative startups and tech firms,* especially Deep Tech companies with high growth potential and innovative solutions. The goal is to grow these enterprises both in terms of their number and market value.

3. Encouraging the technological development of domestic small and medium-sized enterprises and increasing the share of innovative SMEs to 50 per cent.

By focusing resources invested in innovation with these three objectives in mind, we can build a solid foundation not only for the competitiveness of the companies, but also for the long-term growth of the Hungarian economy.

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