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Budapest's Prominent Role in Hungarian R&D Activity: Evidence From Higher Education and Basic Research Funding

ABSTRACT

In Hungary, research and development (R&D) activities are highly concentrated in the capital due to sector-specific requirements. This phenomenon enhances Budapest's competitiveness at the European level and supports sectoral objectives, while simultaneously widening the gap between the capital and the rest of the country. This study examines the development and characteristics of R&D concentration, with a particular focus on higher education and government-sector research, assesses its advantages and disadvantages, and analyses its representation in Hungarian policy documents. Using international rankings and Eurostat R&D statistics, the research confirms Budapest's favourable position in the European context. The historical development of this concentration has already been described in the relevant literature. An analysis of Hungarian regional R&D data from 2005 to 2024 demonstrates the capital's growing advantage within the country. This concentration is also reflected in the allocation of Hungarian basic research grants, formerly OTKA and later NKKP. Although major university cities outside the capital do not provide a sufficient counterbalance, their participation in OTKA projects occasionally exceeds Budapest's share. Our examination of development policy documents revealed a divergence in approaches: sectoral documents largely ignore the issue, whereas national territorial development policy seeks to reduce concentration. In contrast, the capital's development strategies do not include such objectives, as a strong R&D presence is consistent with Budapest's interests.

Keywords: Budapest, geographical concentration, NKKP, OTKA, R&D

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INTRODUCTION

Among settlements, capital cities often occupy a special position, as certain functions may be found exclusively there, or are concentrated there to a much greater extent than elsewhere in the country (Pacione, 2009). A classic example is research and development (R&D), as the sector has specific requirements that can be met most effectively in large cities, including capital cities (OECD, 2006; Siedschlag et al., 2013), and R&D investments are particularly attracted to such regions (Du et al., 2022). This may result in a high degree of concentration, and while the creation and development of large research clusters may generate benefits for research actors, they may also have negative consequences (Mudambi & Swift, 2010). Furthermore, a high level of concentration may contribute to territorial disparities within a country, becoming a broader societal issue and a policy challenge affecting not only R&D but also territorial development. Consequently, the phenomenon can be viewed both as an advantage and as a problem (efficiency versus solidarity (Chiocchetti, 2018)). In the latter case, direct and indirect objectives may be formulated within national, regional, and local development policies, accompanied by instruments designed to address the issue of concentration.

Budapest, the capital of Hungary, represents a prominent example of social and economic concentration. This is rooted in the city's central role over more than a thousand years and in the fact that, as it expanded and developed, it gradually surpassed the cities in both its immediate and wider surroundings. The last major step in this process occurred following the establishment of the new borders under the Treaty of Trianon (1920), which ended World War I and resulted in Budapest losing its regional counterweights (major metropolitan centres) within the country (Beluszky, 2004). Since then, the social and economic predominance of the capital has continued to evolve with varying intensity and emphasis, while also becoming a source of concern for national policymakers and parts of society. This is equally true for contemporary R&D activity, which remains one of the most geographically concentrated phenomena in Budapest (Dőry, 1996).

The main aim of this study is to explore the extent to which the concentration of R&D activity in the capital should be regarded as both a challenge and an opportunity. To this end, we analyse, on the one hand, how Budapest became the country's dominant R&D hub and how the degree of concentration increased over time and, on the other hand, how Budapest performs in the field of research, development, and innovation (RDI) within the European context. In addition, we examine the national policy positions that have emerged in relation to the concentration of R&D activity in Budapest and analyse how sectoral and territorial development plans respond to this situation.

Research and development (R&D) is a highly heterogeneous activity encompassing a wide range of institutional settings, objectives, and outputs. According to the internationally accepted statistical framework applied by Eurostat, R&D is conventionally divided into four main sectors: business enterprise (BES), government (GOV), higher education (HES), and private non-profit (PNP) (Eurostat, 2026). Across these sectors, R&D activities are further classified into basic research, applied research, and experimental development, all aimed at generating new knowledge and facilitating its practical application (Frascati Manual, 2015). Given this diversity, the present study focuses primarily on



the segment of the domestic RDI system associated with higher education institutions and research institutes, as these constitute the most characteristic bases of scientific and territorial concentration. Although corporate R&D activity accounts for a substantial share of national RDI capacity, the purpose of this analysis is not to examine this sector in detail but rather to explore the spatial and policy dimensions of scientific and institutional concentration.

LITERATURE REVIEW

The Role of Capital Cities Among Global Cities and in the R&D Sector

The capital city is the decision-making centre of a country and can influence not only the nation itself but also the lives and future prospects of other countries. Capital cities are characterised by a permanent central position and require a specific environment for the effective performance of governmental and administrative functions (Gottmann, 1983). This prominent political status, together with the fact that in most countries the capital is also the largest city by population, attracts numerous other high-level functions as well as a wide range of social and economic actors operating at domestic, international, and global scales. As a result, capital cities not only provide basic and intermediate-level services for their own populations and surrounding agglomerations but also deliver the highest-level services for the entire country while simultaneously performing international functions. They are further characterised by the presence of functions that are often unique within the national territory, such as stock exchanges, the headquarters of national organisations (e.g., chambers and trade unions), and specialised social services, including certain healthcare services and unique higher education programmes. In addition, they typically host a high concentration of other functions, such as corporate headquarters and, of particular relevance to this study, higher education institutions and research institutes (Hall, 2006).

Research, development, and innovation (RDI) is a sector in which both public and private actors are present through institutions, employees, and funding mechanisms. The private sector is represented primarily through corporate research departments (although these often cooperate with universities), where territorial and urban efficiency considerations play a major role in site selection. The public sector is represented partly by research institutes and partly by higher education research capacities, where territorial allocation may be influenced not only by efficiency considerations but also by solidarity-related objectives. Overall, the location of R&D facilities is strongly influenced by the labour market for researchers. Consequently, the availability of a highly skilled workforce and opportunities for personal interaction have long been key factors in location decisions, resulting in a concentration of R&D activity in metropolitan regions (Du et al., 2018; Malecki, 1987). Enyedi's theory of urban growth stages (2011) suggests that advanced economic and innovation functions tend to concentrate in metropolitan regions during the globalisation phase, thereby reinforcing the dominant role of large cities in knowledge production and R&D activities. Csomós (2022) identifies several characteristics

of capital cities that contribute to the territorial concentration of R&D, including city population size (UN, 2018), the level and structure of local economic development (Lang & Török, 2017), the presence of universities and research institutes, local R&D traditions, researchers' professional networks, and a country's ability to assert its interests in science policy. Regarding the concentration of R&D activities in capital cities, the Barca Report emphasises that these activities require a place-based development policy approach, as knowledge bases and organisations engaged in R&D are intrinsically embedded in their local environments (Barca, 2009). Furthermore, capital regions tend to receive greater levels of public R&D support because they generally possess stronger development potential than other regions (Fitjar, 2025). It has also been demonstrated that larger research clusters may experience stronger growth, have greater opportunities to secure R&D funding, and benefit from denser knowledge networks among researchers (Cooke et al., 2007). Sassen argues that global cities—including many capital cities such as London, Tokyo, Paris, Amsterdam, and Beijing—are among the most important centres of innovation production (Sassen, 2001). However, Fritsch and Wyrwich (2020) observe that territorial differences in patented inventions do not always exhibit strong concentration in capital cities, even in major metropolitan areas. In other words, although agglomeration economies may provide advantages for innovation activities, these benefits are not always substantial, and theories emphasising the role of large cities may overstate their importance for innovation. Moreover, the establishment and attraction of higher education and research institutions in rural areas have become important tools of territorial development and have been widely used by local, regional, and national decision-makers since the 1990s to stimulate regional economic growth (Hassink, 2013).

In general, a certain degree of territorial concentration of social and economic functions can generate numerous benefits, including cost savings, expanded consumer and labour markets, and the development of specialised services. However, beyond a certain threshold, concentration may also produce negative effects, such as declining quality of life resulting from urban congestion or disproportionate local benefits that reinforce territorial inequalities (Komlósi & Páger, 2015). The same applies to R&D concentration, which can be viewed both as an asset and as a problem, depending on the degree of concentration and the balance between social justice and efficiency. This dichotomy has also been recognised by the European Union, and the concept of Smart Specialisation was introduced within regional development policy as a means of promoting a more balanced territorial distribution of R&D activities (Smart Specialisation Strategies, 2010). Nevertheless, some scholars have highlighted the challenges associated with this concept, particularly in regions that lack sufficient institutional, technological, and social resources. This suggests that the concept alone is insufficient and that additional policy instruments are necessary to achieve balanced territorial development (Barzotto et al., 2020). Addressing the issue may occur at various levels of development policy—national, regional, and local—and may involve both general and sector-specific interventions. Direct and indirect objectives can be formulated, and a range of policy instruments may be employed to influence the degree of concentration.

Such interventions were already implemented during the twentieth century to reduce the concentration of population in capital cities. For example, improvements in living conditions were

pursued through the construction of new suburban settlements located at a distance from the capital but still within comfortable commuting range by rail. Restrictions on economic activities were also introduced in some capitals (e.g., limitations on industrial development, office expansion, and land use), while new infrastructure was developed and incentives were offered to encourage the expansion of activities into areas surrounding the city. These measures may have slowed growth within the capital while simultaneously stimulating development and rapid growth in neighbouring areas. Policies aimed at limiting metropolitan expansion became common in both large metropolitan capitals (such as London, Paris, and Moscow) and medium-sized capitals (such as Helsinki, Stockholm, Madrid, and the Randstad region) (Hamilton, 1998). Restrictions specifically targeting R&D activities in large cities were uncommon in Europe; however, regional policies often supported the establishment of technology centres and higher education institutions in rural regions outside major urban areas to stimulate economic growth (e.g., Sweden (Hallgeir et al., 2002) and France (Horváth, 1998)).

All of these phenomena and processes can also be observed in the case of Hungary's capital city. Budapest became the centre of Hungary and the Carpathian Basin through a long process of historical development. The area of present-day Budapest has been inhabited since ancient times, and following the Hungarian conquest of the Carpathian Basin (895), it gradually emerged as a central area. During the Middle Ages, three neighbouring settlements—Buda, Óbuda, and Pest—developed on the banks of the Danube, with Buda serving as the seat of Hungarian rulers. Political power and central status gradually strengthened the economic role of the area, and by the nineteenth century rapid industrialisation, the unification of the three cities in 1873, and the development of a capital-centred transport network had transformed Budapest into the dominant centre of both Hungary and the wider Carpathian Basin (Beluszky, 2024). At that time, the capital had approximately 300,000 inhabitants (1873), representing less than 3% of the country's population. The foundations of modern scientific research also emerged in Budapest during the first half of the nineteenth century following the establishment by law of the first Hungarian scientific society (1825), the predecessor of the later Hungarian Academy of Sciences. Initially supported by the Hungarian nobility and later by the state, the institution made significant contributions to scientific development.

Hungary's first university was founded not in present-day Budapest but in Pécs (the seat of Baranya County) in 1367. Shortly thereafter, in 1395, a university was established in Óbuda, which is now part of Budapest. It is also worth mentioning the foundation of the University of Bratislava in 1467, which at the time was located within the borders of the Kingdom of Hungary. However, none of these medieval universities survived in the long term, and their activities ceased after only a few decades (Mikonya, 2014). The next major milestone in Hungarian higher education was the establishment of the University of Nagyszombat in 1635, which is the legal predecessor of several contemporary universities operating in Budapest. The university was relocated to Buda in 1777 following a royal decision, placing the territory of the present-day capital in an advantageous position in terms of higher education and scientific development (Ladányi, 1969).

During the eighteenth and nineteenth centuries, numerous smaller institutions that would today be considered higher education establishments—such as colleges, residential colleges, law academies, and

engineering academies—also operated in Hungary. From the second half of the nineteenth century to the beginning of the twentieth century, the Hungarian higher education system underwent substantial development. The principal beneficiary of this process was Budapest, where approximately 60% of all higher education students pursued their studies. At the beginning of the twentieth century, higher education and science policy sought to reduce institutional concentration in the capital. Consequently, new universities were established in Debrecen and Bratislava, bringing the total number of universities in the country to four (Budapest, Cluj-Napoca, Debrecen, and Bratislava) (Ladányi, 1999).

A major increase in the concentration of population, economic activity, and institutional functions resulted from a political event in 1920. The Treaty of Trianon, which concluded World War I, reduced Hungary's territory and population by almost two-thirds and left Budapest with very few counterbalancing urban centres within the new national borders. Four of the country's six largest cities became part of neighbouring states (Beluszky, 2004). At that time, Budapest's population was approximately 900,000, representing around 11.5% of the population within the new territory. The loss of major cities such as Cluj-Napoca and Bratislava also increased the concentration of research capacity within the new borders, a situation that contemporary higher education and science policies attempted to mitigate (Ladányi, 1999). As part of these efforts, universities were developed in Debrecen, Szeged (with professors from the relocated University of Cluj-Napoca), and Pécs (with professors from the relocated University of Bratislava). Alongside the expansion of higher education, the establishment of modern research institutes played a significant role, although most of these were located in the capital (Romsics, 2007). Consequently, attempts to reduce concentration in Budapest did not achieve their intended results.

Another major increase in social and economic concentration resulted from an administrative reform. On 1 January 1950, twenty-three surrounding settlements, including seven towns and sixteen large villages, were incorporated into Budapest by law, creating a city with more than one million inhabitants (Sipos, 2018). Plans for Greater Budapest had existed for half a century but had not been implemented due to political and economic considerations (Szekeres, 1996; Kovács & Dövényi, 2024). Since the annexed areas possessed little meaningful R&D capacity, the resulting increase in concentration primarily affected industrial activity and population. By 1960, Budapest's population had reached 1.8 million, accounting for approximately 18% of the national population. Between 1950 and 1960, the enlarged capital also began to develop a new agglomeration zone, which has continued to expand ever since. Policymakers attempted to reduce industrial concentration through administrative measures (Egedy et al., 2017). The first major effort to reduce concentration occurred in 1971, when the government adopted the National Urban Network Development Concept, which designated five counterpole cities for Budapest: Miskolc, Debrecen, Szeged, Pécs, and Győr (Kovács & Dövényi, 2024). However, the programme failed to meet expectations and did not substantially reduce the capital's dominance (Rechnitzer & Smahó, 2016). Although population growth in Budapest slowed during these decades, it did not cease until 1980, when the city reached approximately 2 million inhabitants, representing 18.7% of the national population. Thereafter, the population stagnated

or declined. According to the 2022 census, Budapest had approximately 1.68 million inhabitants, accounting for 17.5% of Hungary's population.

The number of higher education institutions gradually increased from the 1950s until the late 1960s and, after a temporary decline, remained relatively stable at around sixty institutions until the political transition of 1989. Hungary currently has 63 higher education institutions, representing a threefold increase compared with the period before 1949. At the same time, student numbers increased substantially, from 32,500 in 1950 to 100,000 in 1980 (Kiss, 2014). During the 1950s and 1960s, efforts were made to reduce the capital-centred nature of higher education and scientific research. However, these measures achieved only limited success because, despite the expansion of the Hungarian Academy of Sciences' national research network and the establishment of several higher education institutions outside the capital (e.g., in Miskolc, Veszprém, and Szolnok), Budapest retained its dominant scientific position (Drabancz & Fónay, 2005).

Following the political transition of the 1990s, Hungarian science policy promoted the extensive expansion of higher education institutions and supported the establishment of new institutions in connection with the broader expansion of higher education (Barakonyi, 2004). This process resulted in a fragmented institutional landscape with a large number of actors. Around the turn of the millennium, the state sought to integrate this system through a series of institutional mergers (Fónay, 2016). Nevertheless, the restructured higher education system remained strongly centred on Budapest, particularly in terms of student numbers and research performance (Teperics & Dorogi, 2014). A government policy paper published in 2015 explicitly stated that the Budapest-centred nature of Hungarian higher education should not be viewed as a problem but rather as an asset (Graduation change in higher education, 2015). As a result, the concentration of RDI activities in Budapest has become an increasingly important issue in both sectoral and territorial policy debates.

The concentration of RDI activities in Budapest has been examined by Hungarian scholars since the 1990s. Research has demonstrated that Hungary's regional economic structure exhibits substantial disparities, which are also reflected in the distribution of RDI activities (Birkner et al., 2022). Most domestic studies conclude that scientific dominance has continued to increase in Budapest, its agglomeration, and the surrounding region of Pest County (Dőry, 1996; Lengyel & Leydesdorff, 2008; Keczer, 2009; Horváth, 2009; Lengyel & Varga, 2018). According to some authors, this phenomenon may already be limiting Hungary's broader economic development (Keczer, 2009; Horváth, 2009). Nevertheless, these studies also agree that major university cities outside the capital possess meaningful R&D capacities that improve their positions relative to Budapest, although these capacities remain insufficient to compete effectively with the capital (Csomós, 2022; Lengyel & Leydesdorff, 2008; Keczer, 2009; Horváth, 2009; Lengyel & Varga, 2018). Consequently, Budapest continues to dominate Hungary's RDI spatial structure. While this pattern is not unique within Central and Eastern Europe, its intensity is particularly pronounced in Hungary. Similar tendencies can be observed in other Central and Eastern European capitals, including Vienna, Warsaw, Prague, Bucharest, Ljubljana, Zagreb, and Sofia, which likewise serve as the principal centres of academic

life within their respective countries (Csomós, 2022). A study examining the capitals of the Visegrád Group (Poland, Czechia, Slovakia, and Hungary) similarly found that a substantial share of RDI expenditure is concentrated in the capitals, despite the fact that RDI is often not treated as a priority area in national strategic documents (Szabó, 2023b).

Based on both international and domestic literature, it can be concluded that the concentration of R&D activities in capital cities is a widespread phenomenon, although its extent varies considerably between countries. In Hungary, historical and economic factors have produced an especially strong concentration in Budapest, which can only be partially mitigated through domestic development policy instruments.

METHODS

In addition to the literature review, the study involved the analysis of statistical data. To position Budapest within the European context, we analysed Eurostat regional R&D data for the most recent reference year available (2021). To assess the R&D significance of the Hungarian capital, we examined regional research and development data published by the Hungarian Central Statistical Office (HCSO), including the number of research institutions and research personnel, for the period 2005–2024. We compared absolute values, analysed their proportions within the national context, and examined changes over the study period.

Regarding research organisations, the HCSO data collection system—following the recommendations of international organisations—covers all entities engaged in research and experimental development. In this study, these entities are collectively referred to as institutions. Concerning employment, the HCSO provides the combined number of staff and non-staff personnel, regardless of the amount of time devoted specifically to research and development activities.

To analyse the territorial characteristics of research activity, we used data from Hungary's principal basic research funding scheme, the OTKA (Hungarian Scientific Research Fund) database (EPR), covering the period 2005–2023. The database contains information on research proposals dating back to 2005. Although HCSO data are available from 2000 onwards, the analysis begins in 2005. From 2024, OTKA has continued to operate in a transformed framework under a new name, the National Research Excellence Programme (NKKP), established within the framework of the John von Neumann Programme.

To identify possible changes associated with the introduction of the new system, we compared the county-level distribution of supported projects in the final year of OTKA (2023) with those funded through the NKKP in 2024.

In addition, we examined how the territorial characteristics of research activity changed between 2005 and 2023 by calculating the number of proposals per researcher. Applications were assigned to counties according to the location of the submitting institution. Consequently, in the case of

multi-partner OTKA projects involving researchers from several counties, only the host institution of the proposal was considered.

Furthermore, we conducted a documentary analysis of Hungarian governmental development policy documents related to the R&D sector that have been in force during the past decade. The aim was to explore how Hungarian territorial policy addresses the issue of the concentration of R&D activities in Budapest.

RESULTS

Budapest R&D Concentration: Competition in Europe, but a Growing Gap Within the Country

Budapest's advantageous position in European urban competition is reflected in several international rankings and statistical indicators. In the Innovation Cities Program's 2021 ranking of the world's 500 most innovative cities, Budapest ranked 97th, the highest position among cities in the Central and Eastern European (CEE) region (Innovation Cities, 2021). In 2019, the European Commission published the second edition of the Cultural and Creative Cities Monitor, in which Budapest ranked seventh within its category. Among the capitals of the surrounding countries, only Vienna achieved a higher position. Budapest also ranked first in one sub-category, namely the creation of new jobs in the creative sector (Cultural and Creative Cities Monitor, 2019). However, according to the Nature Index ranking of 200 cities based on scientific publications, Budapest was ranked only 194th, with only Warsaw (110th) and Vienna (54th) achieving higher positions within the broader macro-region (Nature, 2023).

Eurostat data allow for the comparison of relevant R&D indicators across NUTS 2 regions within the European Union, particularly through the use of relative measures. At this territorial level, Budapest constitutes an independent NUTS 2 region, whereas several European capitals are represented together with their surrounding agglomerations or wider metropolitan regions. In 2021, the most recent reference year available, 68 of the 223 NUTS 2 regions in the EU (approximately 30%) recorded a share of R&D personnel (measured in full-time equivalents) equal to or above the EU average. In proportional terms, Budapest ranked fourth with a share of 4.12%, behind Prague and the two Belgian regions surrounding Brussels. This result is particularly notable given that many NUTS 2 regions include not only the capital city itself but also its surrounding metropolitan area. Even when Budapest and the surrounding Pest County are considered together, the resulting share of 2.56% still places the region 24th in the ranking. When only researchers are considered (measured in full-time equivalents), the Budapest region recorded the highest proportion in Europe in 2021, accounting for 3.07% of all researchers.

According to Eurostat analysts, the high concentration of research activity in capital regions can be attributed to several factors, including the concentration of research institutions, universities, and

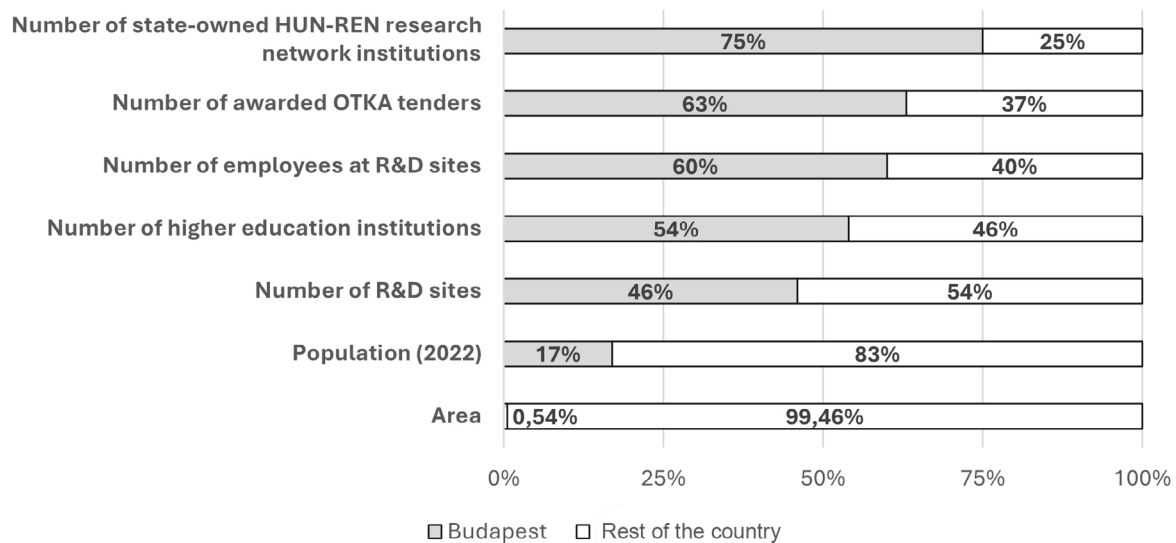
scientific organisations; advanced research infrastructure and equipment; substantial research and innovation funding; opportunities for collaboration and networking; and a broad range of employment opportunities for researchers (Eurostat, 2021). These factors closely correspond to those identified by Csomós (2022). Based on Eurostat data, Budapest is not only Hungary's dominant research centre but also one of the leading research hubs in Central Europe, enabling it to compete successfully with other major cities in the macro-region.

Budapest's R&D position continues to strengthen, which represents an advantage given that the European Union lags behind several other major economic centres in terms of R&D performance. This challenge was recognised in the Budapest Declaration adopted in autumn 2024, which set the objective of increasing R&D expenditure to 3% of GDP by 2030 (Budapest Declaration, 2024).

According to county-level data published by the Hungarian Central Statistical Office for 2024, the proportion of activities associated with serving the population of the capital is often close to Budapest's share of the national population. However, owing to the capital's dominant role within Hungary, several social and economic functions are represented to a significantly greater extent in Budapest. These include secondary education, cultural services, specialised healthcare, economic output, the number of business partnerships, foreign-owned enterprises, and tourism-related overnight stays. Particularly high levels of concentration can also be observed in R&D (number of institutions and researchers) and higher education (number of institutions, students, and staff). In the latter case, Budapest accounts for more than 50% of the national total. This situation can be interpreted from two perspectives: on the one hand, such concentration strengthens Budapest's competitiveness in European urban competition; on the other hand, it clearly reflects the substantial gap between the capital and the rest of the country.

The analysis of domestic data further highlights the disparity between the R&D capacity of Budapest and that of the rest of Hungary. Based on HCSO data for the period 2005–2024, 46.2% (1,367) of the country's research and development sites were located in Budapest in 2024 (Figure 1), compared with 42.4% in 2005. Following Budapest, the counties with the highest shares were Csongrád-Csanád (8.0%), Hajdú-Bihar (7.7%), and Pest (6.8%). In terms of personnel employed at research and development sites, Budapest accounted for 45,107 employees, representing 60.4% of the national total. This proportion exceeds Budapest's share of research sites, indicating that research institutions in the capital are, on average, larger than those elsewhere in the country (Figure 1). In 2005, the corresponding figure was only 51.4%, demonstrating a strengthening of Budapest's position during the study period. After Budapest, the largest shares of R&D personnel were found in Csongrád-Csanád (6.1%), Hajdú-Bihar (5.1%), and Pest (4.6%) counties. HCSO data further indicate that Csongrád-Csanád and Hajdú-Bihar counties maintained their relative positions throughout the study period. In other words, despite the gradually increasing dominance of the capital, no substantial restructuring occurred within the rural R&D landscape.

Figure 1. The Predominance of Budapest in R&D Indicators in the 2020s



Source: HCSO, EPR

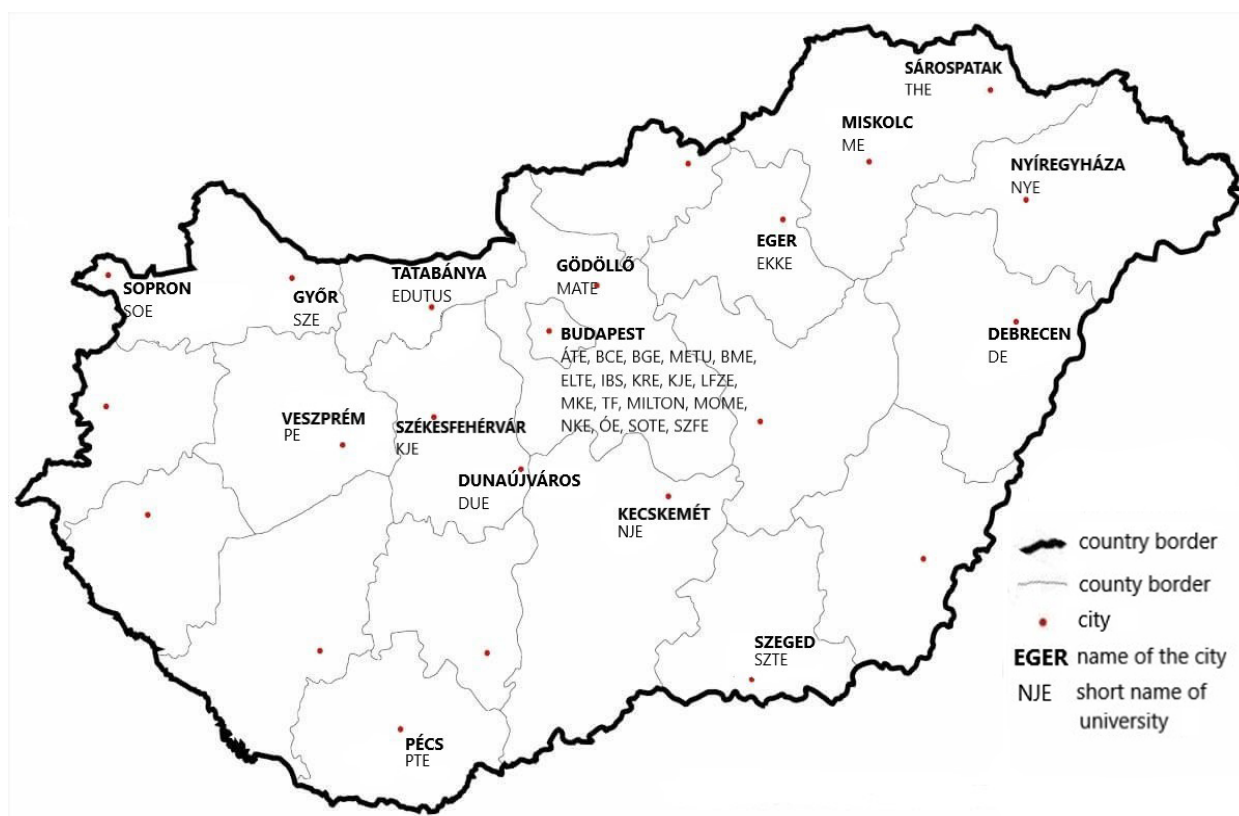
Higher education institutions are also highly concentrated in Budapest. Slightly more than half of Hungary's 63 higher education institutions (54%) are located in the capital, including 11 colleges and 23 universities (Figures 1 and 2). In addition, 75% of the institutes belonging to the Hungarian state research network (HUN-REN, formerly the research network of the Hungarian Academy of Sciences) are located in Budapest (12 out of 16 units) (Figure 1). The outstanding scientific role of Budapest within Hungary is clearly illustrated by Figures 1 and 2.

This explains why Budapest stands out among Hungarian regions and cities. Debrecen and Szeged—the county seats of Hajdú-Bihar and Csongrád-Csanád counties and the second and third most populous cities in Hungary after Budapest—host two major universities and therefore occupy particularly prominent positions compared to other counties. Pest County, which surrounds Budapest and contains the capital's agglomeration area, is also home to a major university located in Gödöllő.

The available data make it possible not only to determine the extent of territorial disparities in research capacity but also to assess the degree to which these disparities are reflected in actual research activity. This can be examined through OTKA, one of Hungary's principal funding schemes for basic research. OTKA supports basic research projects irrespective of scientific field; consequently, the topics of funded projects are highly diverse. The programme includes several funding schemes and therefore provides opportunities for researchers at different stages of their academic careers.

During the study period (2005–2023), a total of 25,278 basic research proposals were submitted to OTKA, of which 7,673 received funding. This represents only 30.3% of all submitted proposals, indicating intense competition for basic research funding in Hungary. The highest number of funded projects (4,835) originated from Budapest, accounting for 63% of all projects supported during the period (Figure 1).

Figure 2. The Most Important University Cities and Universities in Hungary



Source: Authors

Among the funded institutions in Budapest, higher education institutions accounted for the largest share (46.6%), followed by research institutes (44.2%), and then other institutions hosting research activities, such as museums, hospitals, and archives. A small number of companies also received funding, although their share was not significant, provided that they met the eligibility criteria specified in the OTKA calls. This sectoral structure is also characteristic of other counties, where universities and research institutes constitute the principal beneficiaries of OTKA funding.

In terms of the number of funded projects, Budapest was followed by Csongrád-Csanád County (945 projects; 12.3%) and Hajdú-Bihar County (763 projects; 9.9%). These were followed, after a considerable decline, by Baranya County (371 projects; 4.8%). In these counties, funded projects are concentrated primarily in the county seats due to the location of major higher education institutions. In addition to Debrecen and Szeged—the two major university cities highlighted above—Pécs (the fifth most populous city in Hungary) also hosts a major university and therefore represents a significant centre of research activity (Turcsán, 2024).

When comparing funded projects under the 2023 OTKA programme and the 2024 NKKP scheme, it should be noted that the NKKP offered substantially more funding opportunities for researchers, comprising nine different sub-programmes compared with only four under the 2023 OTKA system. Nevertheless, no meaningful territorial differences can be observed between the two funding frameworks. Under the new system, the majority of funded projects were still submitted from Budapest,

followed—after a considerable gap—by Csongrád-Csanád, Hajdú-Bihar, and Baranya counties (Table 1). The table does not include counties in which zero or only one project received funding.

Table 1. The County Distribution of 2024 NKKP Winning Projects

County name	Number of winning projects (pcs)	Proportion of winning projects (%)
Budapest	308	54.5
Csongrád-Csanád	78	13.8
Hajdú-Bihar	57	10.1
Baranya	38	6.7
Veszprém	21	3.7
Pest	12	2.1
Bács-Kiskun	11	1.9
Győr-Moson-Sopron	10	1.8
Heves	8	1.4
Szabolcs-Szatmár-Bereg	5	1.0
Fejér	2	1.0
Borsod-Abaúj-Zemplén	2	1.0
Vas	2	1.0

Source: Authors

During the analysis of OTKA application activity, we divided the number of applications submitted in 2005 and 2023 by the number of researchers in the respective years (based on HCSO data). The results showed that although the number of researchers increased substantially during the study period (by approximately 50% compared to the base year), application activity declined slightly (by approximately 33% compared to the base year). This decrease affected almost all counties; only Baranya, Szabolcs-Szatmár-Bereg, Heves, and Fejér counties recorded an increase.

It is important to note that although the largest number of researchers are employed in Budapest, their application activity lags behind that observed in Csongrád-Csanád, Hajdú-Bihar, and Baranya counties. This finding is supported by the study of Fritsch and Wyrwich (2020), according to which research activity per capita may be higher in smaller cities if they possess a strong higher education base.

In addition to the prominent role of Budapest, substantial R&D activity is also present in the cities of Debrecen, Szeged, and Pécs, which contributes to their appearance in international rankings. These county seats host major university centres; however, their scale remains considerably smaller than that of Budapest. Their populations are significantly lower than that of the capital: Budapest has approximately 1.7 million inhabitants, while Debrecen has around 200,000, Szeged 159,000, and Pécs 139,000.

Double Vision in Hungarian Development Policy Documents Regarding the Concentration of R&D in Budapest

The concentration of social and economic functions is a current issue in Hungarian territorial development policy. This is clearly reflected in the National Development and Territorial Development Concept (Országos Fejlesztési és Területfejlesztési Konceptió; hereinafter OFTK), which remained in force in 2025. The document states that the role of Budapest within the Hungarian settlement network is outstanding and identifies as a fundamental problem the fact that the capital's dominance cannot be effectively counterbalanced by regional centres. To achieve a polycentric spatial structure, the OFTK argues that it is necessary to reduce Budapest's centrality within the country, distribute development investments more evenly, and strengthen spatial structures and regional relationships that enhance regional competitiveness. At the same time, the OFTK also emphasises the importance of preserving and strengthening Budapest's macro-regional leadership role.

Over recent decades, Hungarian governments—with varying levels of commitment—have sought to address the capital-centred concentration of society and the economy through policies aimed at limiting concentration in Budapest and strengthening selected Hungarian cities as counterpoles (OFTK, 1998; OFTK, 2014). In the 2020s, particular attention has been devoted to Debrecen, Hungary's second most populous city, for both regional development and political reasons. Proposed initiatives have included, for example, the relocation of national cultural institutions from Budapest to Debrecen. However, the objectives of the Budapest Municipality are not decisive in this regard. According to its strategic plans (Home in Budapest, 2022), the municipality focuses primarily on the city's internal development and on achieving the standards of a modern European capital.

Based on the analysis of national development policy documents, it can be concluded that the issue of capital-city concentration is either not addressed directly or is approached through the strengthening of rural regions and urban counterpoles. At the same time, these documents consistently seek to preserve Budapest's international competitiveness while promoting the development of rural areas (Szabó, 2023a).

The territorial dimension of R&D policy reflects the same contradiction. The Hungarian government also acknowledges Budapest's scientific dominance. The OFTK explicitly states that “an effort must be made to resolve the one-centeredness and the territorial diversification of the domestic RDI sector” (OFTK, 2014, p. 216). As a means of mitigating concentration, the document identifies the development of university-centred innovation ecosystems, arguing that rural universities can function as knowledge hubs that stimulate economic actors within their surrounding regions (Zmiyak et al., 2019; Tóth, 2024).

Another important policy document, Hungary's Research, Development and Innovation Strategy (2021–2030), published in 2021, states that existing territorial disproportionalities cannot realistically be eliminated. Nevertheless, it identifies the stimulation of innovation development outside the Central Hungary region as an important objective and emphasises that innovation capability is crucial

for all economic actors (Hungary's RDI Strategy, 2021). Beyond this statement, however, territorial disparities are not discussed in detail, and the document primarily reflects a sectoral perspective.

The National Smart Specialisation Strategy (2021–2027), also adopted in 2021, emphasises that its conceptual framework is based primarily on national and non-territorial considerations. Nevertheless, within the RDI domain, Hungarian counties are classified into three categories (knowledge areas, industrial production zones, and moderate knowledge- and technology-intensive areas), and specific development measures are defined for each category. Budapest and its principal domestic competitors—Szeged, Debrecen, and Pécs—were all classified as Knowledge Areas (National Smart Specialisation Strategy, 2021).

The most recent strategic document is the John von Neumann Program, adopted in 2023. This programme does not address territorial disparities directly but instead focuses on improving Hungary's innovation performance, aiming to place the country among the ten most innovative EU member states by 2030 (from its current 21st position) and among the world's top 25 countries (from its current 34th position) (John von Neumann Program, 2023).

In light of these documents, it would be beneficial to improve the coordination of development strategies and to establish clearer priorities so that national R&D development objectives can be pursued more effectively. It can also be argued that the objectives of government R&D investments are not closely linked to efforts aimed at reducing territorial disparities and may therefore contribute to increasing rather than reducing such disparities (Forth & Jones, 2020).

We also examined Budapest's strategic planning documents to determine whether they address the concentration of R&D activities or the development of R&D functions. Currently, two relevant documents are in force: the Capital Settlement Plan and Home in Budapest – Integrated Settlement Development Strategy 2021–2027. The Capital Settlement Plan highlights the city's R&D potential and defines two key objectives: first, expanding the range of open-access data provided by the Budapest Municipality; and second, increasing R&D expenditure to more than 3% of GDP by 2034. The Integrated Settlement Development Strategy merely states that the municipality supports the implementation of innovative ideas and initiatives aimed at improving residents' quality of life and cooperates with economic, research and development, and tourism stakeholders. However, the strategy does not specify concrete measures in this regard (Metropolitan Settlement Plan, 2026; Home in Budapest, 2022).

CONCLUSIONS

The concentration of social and economic functions represents an important topic within territorial research. In addition to measuring the degree of concentration and analysing its changes over time, research increasingly examines political and policy objectives aimed at mitigating concentration, reflecting both societal perceptions of the phenomenon and evolving scientific perspectives. This is also true of the RDI sector, which is particularly attracted to large cities and capital regions due to a

range of economic, institutional, and social factors. Budapest, the capital of Hungary, provides a clear example of this process.

This study examined the historical, statistical, and policy dimensions of R&D concentration in Budapest. Through the analysis of Eurostat data and various Hungarian statistical sources (HCSO and OTKA), we demonstrated that Budapest exhibits an exceptionally high and growing level of R&D concentration both in the Hungarian and European context. Hungarian cities hosting major universities remain significantly behind the capital in this respect. This disparity is only partially offset by the fact that their research activity, measured through participation in OTKA basic research proposals, is relatively stronger than that of Budapest.

The concentration of R&D activity in the Hungarian capital has a dual character. On the one hand, Budapest occupies a favourable position in European urban competition, contributes to the achievement of national development objectives, and supports the fulfilment of the European Union's R&D commitments set out in the Budapest Declaration. On the other hand, rural regions remain substantially behind the capital. In our view, and in line with findings reported in the literature, one potential consequence of strong capital-centred R&D concentration is that rural cities and their research institutions may face comparatively less favourable access to certain resources, including domestic and international funding opportunities, research infrastructure, and highly skilled human capital. At the same time, it is important to emphasise that the allocation of research capacities and funding is shaped by complex, multi-level mechanisms; therefore, these patterns are neither uniform nor deterministic. Nevertheless, such tendencies may contribute to the persistence or widening of disparities between the capital and rural regions.

Our analysis of national territorial development documents also revealed a dual policy approach. On the one hand, these documents advocate reducing concentration and strengthening regional centres; on the other hand, they simultaneously seek to preserve and enhance Budapest's macro-regional leadership role. Furthermore, the territorial dimension appears to play only a limited role in recent sectoral policy documents. These findings suggest the need for a more integrated, well-prioritised, and long-term RDI development strategy that explicitly addresses regional disparities in Hungary.

To reduce the concentration of R&D activities in the capital, it would be useful to identify counties where the number of research institutions and research personnel could be expanded and to explore ways of making rural locations more attractive for researchers. In addition, it may be worthwhile to develop targeted support programmes for R&D institutions located in counties with significant development potential. Such measures could provide an alternative to development policies that primarily focus on competitiveness and that may unintentionally reinforce the spatial concentration of R&D activities through investments in pole cities, science and technology parks, universities, and research infrastructure.

The reduction of R&D concentration does not appear as a meaningful objective in Budapest's own strategic documents. This is understandable, as maintaining a strong presence in the R&D sector serves the city's interests by attracting investment, highly skilled labour, and innovation-related

activities, thereby strengthening its position in European urban competition. Consequently, the classic dilemma of development policy—competitiveness versus solidarity—emerges once again.

The achievement of the European Union's commitment expressed in the Budapest Declaration (allocating 3% of GDP to R&D by 2030) may, in the short term, be more efficiently supported through the geographical concentration of research resources. The Eurostat data analysed in this study indicate that capital regions tend to have higher shares of R&D personnel and more concentrated research inputs than other regions, which may facilitate the achievement of this objective. In Hungary, where Budapest is the only city with metropolitan functions of clear European significance, further concentration of R&D activities may therefore occur. A possible policy solution would be to refrain from attempting to reduce the scientific dominance of Budapest directly while simultaneously strengthening rural knowledge centres. An alternative strategy would be to pursue a deliberate reduction in concentration while still seeking to enhance Hungary's role within the international research landscape.

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Author contributions

Conceptualization: Zs. T., P. Sz.; Methodology: Zs. T., P. Sz.; Data curation: Zs. T.; Formal analysis: Zs. T.; Investigation: Zs. T., P. Sz.; Visualization: Zs. T.; Writing – original draft: Zs. T., P. Sz.; Writing – review & editing: Zs. T.. All authors have read and approved the final version of the manuscript.

Data availability

The data supporting the findings of this study are available in Eurostat, KSH at https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=Research_and_development_statistics_at_regional_level; https://www.ksh.hu/stadat_files/tte/hu/tte0023.html. The data cannot be made publicly available due to privacy restrictions. Access: not possible.

Ethical approval

Not applicable: this study did not involve human participants, animal experiments, or sensitive personal data requiring ethical approval.

Informed consent

Informed consent to participate was obtained from all participants, and specific consent for the publication of identifiable information was obtained from the relevant individuals.

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