

EXAMINING REGIONAL ROLE OF INDUSTRIAL PRODUCTION IN TRANSFORMATION OF HUNGARIAN ECONOMIC STRUCTURE

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Abstract. Following the economic crisis of 2008, most developed countries, including the European Union member states, have experienced an economic paradigm shift. The rethinking of economic production has led to a shift towards knowledge-intensive, innovative and high-tech industries. As a result, today's technological innovations are having a markedly more mature and powerful impact on changes in social relations, the labour market and its strategic development. As it has been observed in the technological innovations of recent decades, the industrial sector (manufacturing, energy, IT, automotive) has played a prominent role. At the macroeconomic level, almost all of the strategically comprehensive innovations have been closely linked to the development of this sector. All these visible macroeconomic links have led us to focus our attention on the strengthening of industrial production and its regional disparities, and to explore the regional differentiation in development resulting from FDI. We have chosen the period 2008-2020 as the interval for our analysis, in which we have examined the correlation between the value of industrial production per capita and its changes, as well as the spatial distribution of the value of industrial production. In our study, we sought to answer the question of how spatial inequalities in production change as the value of industrial production increases, and, in a complex model, how the level and unequal spatial distribution of foreign direct investment affect the development of a given economic space in Hungary.

Keywords: regional economy; industrial production; foreign direct investment; Hoover index.

Introduction

The trends in economic development in post-socialist countries are highly dependent on the level of foreign capital investment, its spatial location and its impact on innovation [1]. The exploration of the interrelationships between these macroeconomic factors is one of the most important areas of analysis in economics today. Nothing is more proof of this than the fact that a number of international studies [2-5] have examined in detail the spatial economic effects of economic growth and the interrelationships between aspects of uneven territorial development. In the 21st century, the industrial innovation capacity of countries and of businesses within them has become a source of economic competitive advantage, an important element of market survival and a key basis for dynamic development. All of this suggests that innovation capability will be the basis of economic competitiveness in the coming decades, and therefore innovation strategy-making and the study of the interrelationships between innovation and development are of primary importance. The issue of innovation and its regional and sectoral analysis is also present in the economic sciences, but until now there have been fewer digitised data sets available for comprehensive analyses, although the analysis of these factors is becoming increasingly important in the study of economic resilience. International studies show that the key to the future viability of economic sectors is to effectively develop their innovative potential and increase their innovation activity.

Since the emergence of industrial innovativeness, it has been observed that different forms of technological change and innovation have been the source of productivity growth and material welfare gains [6]. However, economic innovation is a very complex process, as evidenced by the large number of publications on the subject [7; 8]. These studies emphasise the interactive and collective nature of innovation systems, the wide range of actors involved in the process of industrial innovation and their complementary roles, and the importance of information, knowledge and learning. The international study of innovation from a system perspective is usually completed in the emergence of national innovation systems [9; 10], where the analysis of the economic and social situation of the country in question and the analysis of its interrelationships also play a prominent role.

With the development of the spatiality of the economy, the concept of innovation systems has been extended to include regional [11], technological [12] and industrial [13] innovation systems. The results of research on these industrial innovation systems show that the innovation activity and performance of firms depend primarily on the nature of industries, especially the specificities of the knowledge and knowledge base specific to industries, but the primary determinant of the theoretical framework of

industrial innovation systems is the localisation of innovation systems, the geographical location of industries [14; 15]. All these research results suggest that the innovation activity and performance of industries depend primarily on industry-specific spatial characteristics and secondarily on regional social framework conditions, which explain the different innovation patterns and performance in similar industries. Nowadays, there is a distinctive focus on identifying the factors influencing knowledge creation, diffusion and application in knowledge-intensive economic activities, while energy-intensive economic activities are slowly taking a back seat. Knowledge-intensive activities have very different characteristics compared to traditional industries, but cannot be considered in isolation from other types of innovation systems. The international literature highlights the complementary interaction between industry, national, regional and technological innovation systems [16-18], which contribute to higher innovation performance for the firms concerned [19].

Our research in previous years has demonstrated that the results of the regional framework condition analyses influence the overall developmental concept of regional industrial innovation systems, justifying the need to embed innovation in the social context and the interactive relationship between innovation and learning at the regional level. All these results have led us to continue our research to investigate, from a new perspective, how the economic development of industrial innovation and entrepreneurship has influenced the growth of the regional economy in the period under analysis, and what the links are between localisation and the economic relations between industrial innovation.

Materials and methods

In this chapter, we describe the indicators and calculation methods used for our analysis. The indicators analysed are collected at NUTS-3 territorial unit level. The basic indicators used are taken from the Hungarian Central Statistical Office - Information Database. The values expressed in thousands of HUF have been converted into EUR for ease of comprehension. The average annual exchange rate registered by the Hungarian National Bank has been used for the HUF/EUR exchange rate for each year (2008-2021) under review [20-22]:

- Resident population at the end of the year (data calculated further from finalised data of the population census), capita (2008-2021);
- Gross output value of industrial activities, without value added tax, including price subsidies (NACE Rev. 2.: B, C, D), EUR (2009-2021);
- FDI of foreign direct investment enterprises, EUR (2008-2020).

The general period of the study is 2008-2020, while the period of industrial production per capita is 2009-2021. Indexes measuring the spatial variation of indicators have also been carried out at NUTS-3 territorial level. For our analysis we used the Hoover index (h), a complex indicator based on distribution ratios:

$$h = \frac{1}{2} \sum_{i=1}^n |x_i - f_i|, \quad (1)$$

where x_i – share (%) of the unit area i in the values of one of the variables;
 f_i – share of the area unit i (%) in the values of the other variable.

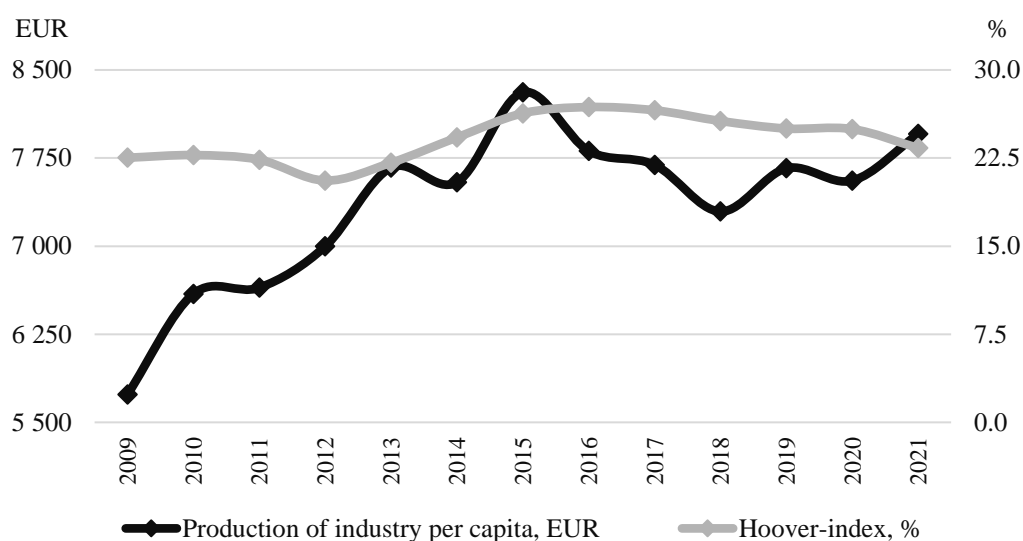
The most important feature of the index is that it measures the percentage difference between the spatial distributions of the two quantitative criteria, besides being asymmetric in nature, so that the two distributions compared can play an interchangeable role [23]. In our study, we applied the Hoover index method to the spatial distributions of industrial production and population and of FDI and population. In addition, time series plots and map visualisation were used.

Results and discussion

As discussed in the introduction of our study, economic growth in the EU's CEE countries depends to a large extent on the economic strength of industry and the level of FDI. In terms of the emergence of innovations, it can be observed that technological innovations have played a prominent role in the period under study, with the industrial sector representing a prominent share of the determinants of growth. At the same time, economic growth within a given country (in this case, Hungary) has occurred at different rates across territorial units, and our analysis has shown that the uneven spatial distribution

of economic activity has led to the persistence and widening of territorial disparities. In relation to our results, we find (Figure 1) that the change in industrial production per capita (left axis), the rate of industrial production and the unequal spatial distribution of the population (right axis) show a close relationship.

Based on our research, we found the industrial production per capita in Hungary increased by 139% from 2009 to 2021. Our results show that the industrial production volume increased continuously above the EU average between 2013 and 2021 (excluding 2020) [24], which resulted in an increase in employment rates and an improvement in various welfare factors. However, if we also look at the territorial level, the picture is much more differentiated, with significant differences at NUTS 3 level. Among the NUTS-3 territorial unit levels in Hungary, Bács-Kiskun, Heves and Veszprém have experienced the highest growth between 2009 and 2021, but even with these outstanding results, the per capita industrial production thresholds of the top quartile NUTS-3 territorial units will not be reached in 2020. This is also confirmed by the results obtained after the Hoover index calculations, which show a downward trend until 2013, an upward trend between 2014 and 2016 and a downward trend from 2017 onwards, based on the inequality values of the NUTS 3 territorial units.



Note: Data in 2021 is preliminary at the time of manuscript finalisation

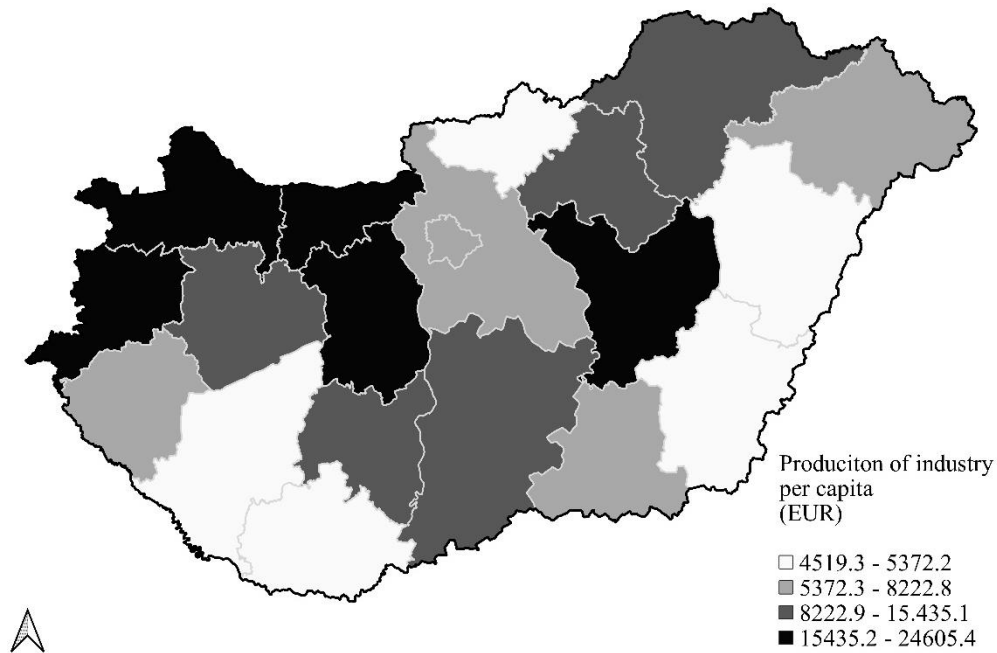
Fig. 1. Changes in the volume and in the territorial concentration of the production of industry in Hungary, 2009-2021

Our results show that, as a result of the unequal distribution of industrial production and population, 24.97% of industrial production in relation to the population would have to be reallocated between the counties in 2020 in order to bring the spatial distribution of industrial production into line with the distribution of the resident population. If the 2020 Hoover index value is compared with the 2009 value, a slight increase of 2.44 percentage points is observed, indicating that the spatial distribution of industrial production inequality has increased over the period under study (Figure 1).

Continuing our investigation, we analysed the changes in the distribution of industrial production per capita. Closely related to the time series analysis, Figure 2 shows the industrial production per capita at NUTS-3 territorial unit level, based on 2020 data.

The map of industrial production per capita in Hungarian counties shows a very striking pattern of spatial differences. It can be seen that the largest share of industrial production per capita in 2020 will be concentrated in the western part of the country, and mainly in the north-west. In this context, it is important to note that in the years preceding the economic crisis of 2008, value creation from industrial production and industrial working capital were strongest in three regions (Central Hungary, Central Transdanubia and Western Transdanubia) [25, 26], and that the effect of this is still strongly correlated with the results of the 2020 data. All this shows that the spatial distribution of industrial production is clear: industrial activity is high in the majority of NUTS 3 regions, where proximity to Western European markets is a key geographical and locational advantage. From our results, we have found that

the share of FDI in industry (especially in manufacturing) has shown a steadily increasing trend in the years following the 2008 economic crisis, so that NUTS-3 regions that have attracted significant industrial capital have become highly valued from an economic point of view (Figure 2).



Note: In 2020 1 EUR = 351.2 HUF (based on the average of the exchange rate)

Fig. 2. Map of the production of industry per capita in Hungary – NUTS-3 territorial level, 2020 (EUR)

Despite the fact that the most important drivers of economic growth (e.g. labour productivity, R + D + I) are mainly concentrated in the capital (Budapest), Hungary’s economic recovery depends mainly on the economic development of those NUTS-3 regions that have become centres of foreign-interest industrial production in the last decades (Fejér, Győr-Moson-Sopron, Komárom-Esztergom, Vas). The concentration of industrial production in this direction and the related economic development have led to a significant increase in the role of these territorial units.

As a continuation of our analysis, we have analysed the situation of foreign direct investment (FDI) between 2008 and 2020. First, we examined the change in FDI per capita (left axis) and the unequal spatial distribution of FDI between size and population (right axis).

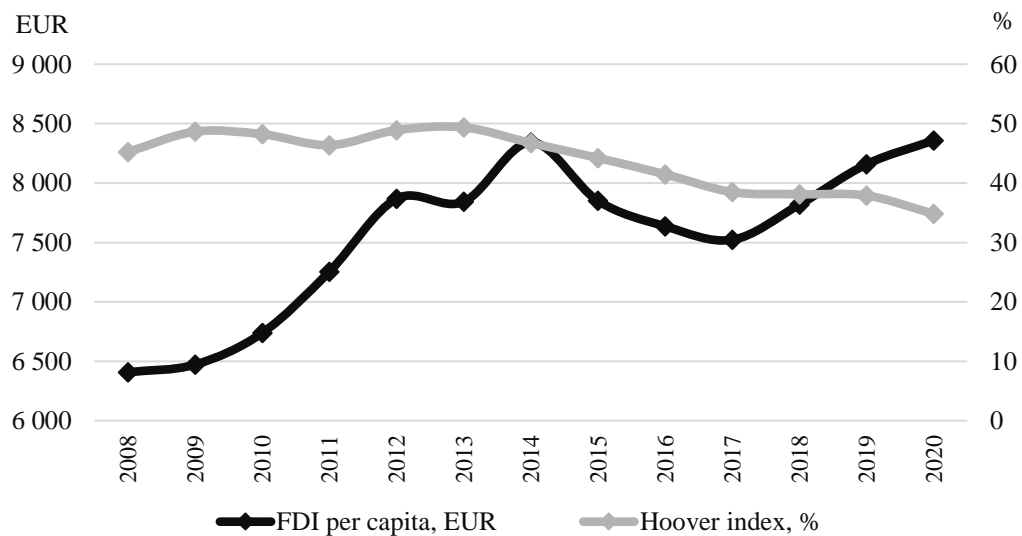
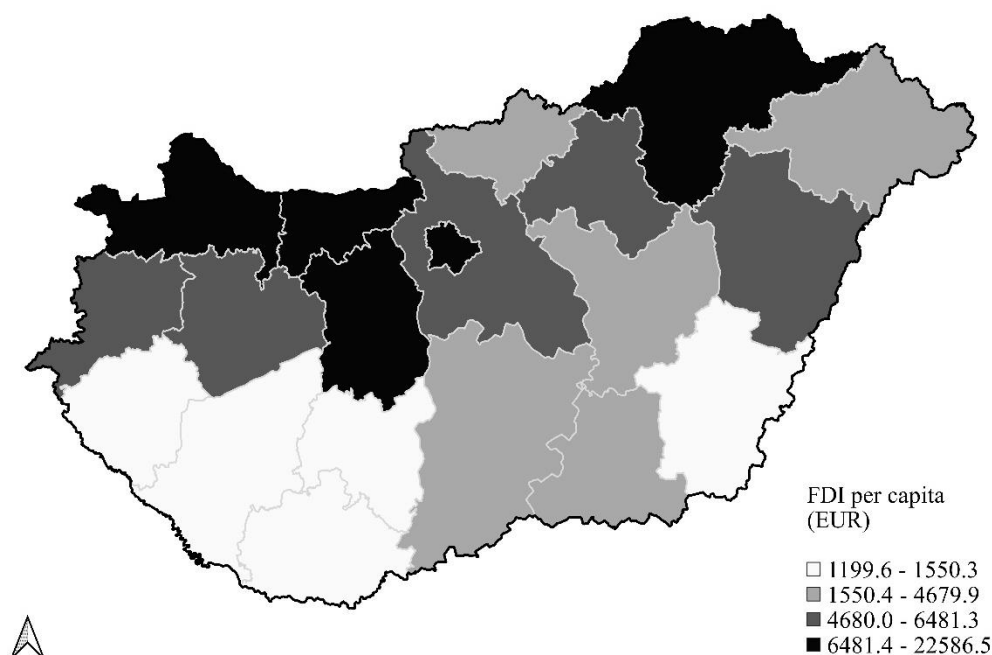


Fig. 3. Changes in the volume and in the territorial concentration of FDI in Hungary, 2008-2020

Our results show a 130% increase in FDI per capita between 2008 and 2020. This increase can be explained by the fact that the changes in economic policy during the period under review have significantly helped international companies to invest FDI, thus further increasing the concentration of the economy. An analysis of the HCSO shows that manufacturing FDI accounts for 44.41% of the country's total FDI stock, which also supports our results that there is a strong correlation between the development of industrial production and the growth of FDI. Our values obtained in the inequality calculations (h) show markedly higher values, but with opposite dynamics, as the Hoover index of FDI shows 10.41 percentage points decrease between 2008 and 2020. A noteworthy result of our analysis is that, relative to the population, the unequal spatial distribution of FDI is 9.85 percentage points higher (i.e. more unequal) than the spatial distribution of industrial production (Figure 3).

Our results clearly show that the spatial correlations (Figure 2, Figure 4) show a significant overlap. Hungary's industrial centres and the presence of foreign working capital per capita are also highest in the NUTS-3 regions of Fejér, Győr-Moson-Sopron, Komárom-Esztergom and Budapest (capital). At the same time, it is clear that FDI is also lower in the economically/socially more disadvantaged counties of Eastern Hungary and South Transdanubia. In addition to this, the centre (Budapest) has the highest concentration of FDI, which shows the concentration of the headquarters of large service companies. In our view, it is also necessary to analyse GDP rankings when analysing economic development by region. Based on the GDP data of 2020, only two of Hungary's NUTS-3 regions (Budapest (capital) and Győr-Moson-Sopron) have GDP that is 75% of the EU average, and two counties (Fejér and Komárom-Esztergom) have GDP producing 65% of the EU average. At the same time, it can be noted that not only the spatial distribution of GDP per capita is similar to the distribution of foreign capital per capita, but also, among others, investment, export sales, average earnings and employment rates [27]. Counties with a high share of FDI also perform better in these areas. Overall, looking at the determinants of economic growth, it can be observed that in Hungary it is not the capital city, which concentrates the economy primarily on advanced business services, R + D + I and skilled labour, but the counties that concentrate industrial and manufacturing FDI that stimulate the country's GDP growth (Figure 4).



Note: In 2020 1 EUR = 351.2 HUF (based on the average of the exchange rate)

Fig. 4. Map of FDI per capita in Hungary – NUTS-3 territorial level, 2020 (EUR)

Conclusions

1. Based on our analysis, we find a significant relationship between industrial production and FDI, and the impact of this relationship on regional development is marked in the years after 2008.

2. As a result of our analysis, we have found that in Hungary, among all sectors of the economy, foreign working capital in manufacturing (44.41%) has generated an outstanding development trajectory.
3. On this basis, we conclude that the economic development of Hungary depends on the economic performance of those counties that have become centres of foreign-interest industrial production, even if the most important factors of economic growth (e.g. labour productivity, R + D + I) are mostly concentrated in Budapest.
4. Hungary's economic growth in the period 2008-2020 was generated by the counties specialized in industrial production (Fejér, Győr-Moson-Sopron, Komárom-Esztergom), where, apart from FDI-driven investments, the other factors contributing to economic growth are very limited. In addition, the development of these counties, which benefit from significant amounts of capital and domestic innovation factors, is proceeding at a very slow pace. In our opinion, by exploiting the potential of knowledge-based economic development (e.g. R + D + I, higher educational development), the economy and society of rural areas in the country could also develop in the future. In this context, we intend to explore this topic in a more complex way in the future.

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Author contributions

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