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THE ECONOMIC STRUCTURAL IMPACTS OF THE INDUSTRIALIZATION WAVE IN DEBRECEN

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Abstract: *Over the past decade, an intensive industrialization process has unfolded in Debrecen, driven primarily by foreign direct investment (FDI). Large-scale industrial investments—particularly projects in the automotive and battery industries—are fundamentally transforming the city's economic structure. The aim of the research is to examine how new industrial investments are altering Debrecen's manufacturing structure, as well as to what extent the emerging industrial structure differs from the previous economic structure. The empirical basis of the study is the manufacturing production database of the Central Statistical Office, as well as land-use data from companies operating in or relocating to Debrecen's two main industrial zones (the Southern Economic Zone and the Northwestern Economic Zone). During the research, I applied several empirical methods: the Herfindahl–Hirschman concentration index, shift–share analysis, and finally, the Location Quotient assessment. The results show that the new wave of industrialization is leading to significant industrial concentration. More than ninety percent of the manufacturing area in the industrial zones examined is linked to two industries—vehicle manufacturing and electrical equipment manufacturing. The significant increase in concentration indices indicates that Debrecen's economy is shifting toward a specialized industrial model. This process holds significant potential for economic growth, but it also increases the risk of economic vulnerability.*

Keywords: *Industrialization, Economic restructuring, FDI, Industrial cluster, Debrecen*
(JEL code: R11, R12, O18, L60, L62)

INTRODUCTION

Regional economic structural change is a fundamental phenomenon of economic development. As a result of globalization and international capital flows, the economic structure of cities may undergo significant transformation. This is particularly true for the Central and Eastern European region, where, following the transition, foreign direct investment played a key role in the transformation of the industrial structure.

In recent years, Debrecen has become one of Hungary's fastest-growing industrial centers. Large-scale industrial investments in the city—such as the BMW automobile plant and battery industry projects—have triggered significant economic and spatial changes.

The fundamental research questions of the study are as follows:

1. What industrial structure characterized Debrecen's economy prior to the new wave of industrialization?
2. In what direction are the new industrial investments transforming this structure?
3. What economic impacts and risks might the emerging industrial concentration entail?

LITERATURE REVIEW

The issue of economic structural change has been extensively examined in the literature on regional economics and economic geography. According to Henderson's (1994) classic model, settlements of different sizes fulfill distinct economic functions in the spatial division of labor. Medium-sized cities often become centers of manufacturing production, particularly when they successfully integrate into global production networks.

In post-socialist countries, foreign direct investment played a significant role in the transformation of the industrial structure (Harloe, 1996). Investments by multinational corporations often introduce new industries to a given region, which can lead to rapid economic growth and technological development (Vida et al., 2025).

According to Porter's (1998) cluster theory, industrial concentration can promote productivity growth and innovation, as stronger knowledge flows develop among spatially concentrated firms. At the same time, excessive industrial specialization can also increase economic vulnerability, especially when the dominant industry is exposed to global economic fluctuations (Parkinson et al., 2016; Szobonya, 2025).

The study of regional economic restructuring has gained new momentum in recent years, particularly due to the transformation of global value chains, technological changes, and geopolitical tensions. The literature since 2020 increasingly emphasizes that foreign direct investment (FDI) is not merely a source of economic growth but one of the most important catalysts for the transformation of the regional industrial structure.

The latest empirical research has clearly demonstrated that FDI contributes to economic growth through multiple channels, particularly through technology transfer, job creation, and infrastructure development. (Chornyi & Nelya, 2026). However, these effects do not manifest evenly across regions but are often highly concentrated, which can lead to regional disparities and inequalities (Molnár & Radics, 2024).

The 2026 OECD analyses highlight that FDI plays a key role in boosting regional productivity and strengthening innovation, particularly in regions capable of integrating foreign investment into the local entrepreneurial and innovation ecosystem (OECD, 2026). However, such integration is not automatic: it depends heavily on the quality of local human capital, infrastructure, and the institutional environment.

Recently published regional studies have also highlighted a reciprocal relationship between FDI and industrial structure: on the one hand, a more advanced industrial structure attracts foreign investment, and on the other hand, FDI itself contributes to the modernization and transformation of the industrial structure. (Wen et al., 2024). This interaction is particularly pronounced in metropolitan areas and during the formation of industrial clusters.

In the 2025 research also emphasizes that the regional concentration of FDI has a dual effect. On the one hand, it promotes economic growth and structural transformation; on the other hand, however, it can increase territorial inequalities and economic dependence. (Khdir & Cieślik, 2025). This is particularly relevant in the Central and Eastern European region, where foreign investment is often concentrated in a few key industrial hubs.

The theory of global value chains (Global Value Chains – GVC) also provide a key framework for understanding industrial restructuring. According to recent research, FDI enables regions to integrate into global production networks, facilitating technological catch-up and industrial upgrading (Li & Adam, 2026). At the same time, the success of such integration depends heavily on local innovation capacities and the institutional framework.

Post-2020 literature on industrial policy and economic geography places increasing emphasis on the role of industrial clusters. Industrial clusters represent not merely geographical concentrations, but economic systems in which companies, suppliers, research institutes, and educational institutions are closely interconnected. The formation of such clusters can significantly boost the competitiveness of the regional economy, yet it also carries the risk of excessive specialization (Gereffi, 2020; Porter, 1998).

The latest global trends indicate that FDI is increasingly directed toward strategic industries—such as the battery industry, semiconductor manufacturing, and digital infrastructure—which is significantly reshaping the international economic landscape (McKinsey Global Institute, 2025). This trend is particularly important in the case of Debrecen, where the rise of the electromobility industries aligns well with these global processes.

Overall, the literature from after 2020 clearly supports the view that industrialization driven by foreign direct investment simultaneously presents an opportunity for economic convergence and a risk through increased economic dependence. This duality is particularly important in the case of medium-sized cities like Debrecen, where the rapid transformation of the industrial structure can determine the trajectory of economic development in the long term.

MATERIALS AND METHODS

The research is based on two data sources:

Initial industrial structure

Based on KSH data (KSH, 2025b) the manufacturing sector in Debrecen and Hajdú-Bihar is relatively diversified, with several sectors holding significant weight:

- vehicle manufacturing
- pharmaceutical industry
- food industry
- machinery industry

This structure is the result of the stratification of multiple industrialization eras.

Data sources:

- KSH manufacturing production data (KSH, 2025a)
- Production values of companies with over 49 employees

Estimation of the new industrial structure

Land use data for Debrecen industrial zones (Southern Economic Zone and the Northwestern Economic Zone.)

- Zoning plan + land registry data + field survey
- Classification of companies according to Statistical Classification of Economic Activities in the European Community (TEÁOR)

Methodological approach

- Comparative structural analysis
- Use of proxy indicators (land use → future industrial weight)
- Analysis of sectoral concentration

This approach is consistent with the indirect estimation methods used in regional economic analyses (Nagy & Lengyel, 2016).

The first data source is the manufacturing statistics of the KSH, which contains the production value of companies operating in Hajdú-Bihar County by sector group.

The second data source is the land use database for Debrecen's industrial zones, which contains the land area occupied by companies in the Southern Economic Zone and the Northwestern Economic Zone (DMJV, 2025).

In the empirical analysis, it was applied the following methods:

- Herfindahl–Hirschman concentration index
- Shift–Share analysis
- Location Quotient

RESULTS AND DISCUSSION

Industrial concentration – based on the calculation of the Herfindahl–Hirschman index

The Herfindahl–Hirschman index is an indicator used to measure industrial concentration, consisting of the sum of the squares of the shares of individual industries.

$$HHI = \sum s_i^2$$

where:

si is the share of the given industry in total industrial production.

I used the following basic data in the calculation:

- total industrial production: 636,000 million HUF
- vehicle manufacturing: 137,029 million HUF
- pharmaceutical industry: 113,634 million HUF
- food industry: 94,623 million HUF.

Based on the calculation, for the initial industrial structure, HHI ≈ 0.15, which indicates a relatively low concentration, meaning this structure is diversified.

However, taking new industrial investments into account, the index value increased significantly to HHI ≈ 0.43, indicating a significant increase in concentration. Vehicle manufacturing ≈ 50%, electrical equipment (battery industry) ≈ 42%, all others ≈ 8%. In other words, the HHI is as follows:

$$HHI = 0.5^2 + 0.42^2 + 0.08^2$$

$$= 0.25 + 0.1764 + 0.0064 = 0.4328$$

This means that: Debrecen's industrial structure is highly concentrated overall, as it is dominated by two industries. In other words: the Herfindahl–Hirschman Index value of 0.43 does not reflect the concentration of individual industries, but rather the concentration of the entire manufacturing sector, indicating that the vast majority of economic output is concentrated in two dominant sectors! From an economic perspective, this indicates a strong positive correlation with increased efficiency and specialization. However, it also significantly increases the region's economic exposure. For example, if the automotive industry declines, the entire region will be affected by the negative consequences.

Shift Analysis

The shift–share analysis (often referred to simply as shift analysis) is a classic method in regional economics. It serves to break down the sources of a region's economic growth. In other words, it shows to what extent the growth of an industry or region is a consequence of national trends, industry-specific characteristics, or local competitive advantages. The basic principle of shift–share analysis is that changes in an industry's output value consist of three factors:

1. National growth effect (National share), 2. Industry structure effect (Industry mix), 3. Regional competitive effect (Regional shift). The sum of these three components yields the total change.

$$\Delta E_i = E_i^0(g) + E_i^0(g_i - g) + E_i^0(g_{ri} - g_i)$$

where:

1. The national growth effect indicates how much growth would have occurred in the region even if it had only followed national economic growth. If this component is large, then the region's growth is partly the result of the national economic cycle.

2. The sectoral structural effect indicates whether the given sector is growing faster or slower than the national average. If positive: the region is in a "strong sector." If negative: the region's sector is underperforming nationally.

3. The regional competitiveness effect indicates whether the region performs better or worse than the national average within the same industry. If positive: the region is more competitive. If negative: the region is at a competitive disadvantage.

The shift-share analysis is illustrated through the following example: The baseline datesets: KSH (2025a), (2025b) and (2025c) – value of industrial production by location (Hajdú-Bihar County, manufacturing sectors, based on 2025 data) is 137,029 million forints.

1. The initial value of Debrecen's automotive industry is therefore 137,029 million HUF

2. National industrial growth: 0.05

3. National growth of the automotive industry: 0.10

4. Growth of Debrecen's automotive industry: 0.20

1. The national impact is therefore

NS = 137,029 × 0.05 = 6,851

2. The industry impact:

IM = 137,029 (0.10 − 0.05) = 6,851

3. The regional impact:

RS = 137,029 (0.20 − 0.10) = 13,703

The total growth is: 6,851 + 6,851 + 13,703 = 27,405

The results show that Debrecen's industrial growth stems from a combination of three factors: The general industrial growth of the Hungarian economy increases production on its own. Debrecen relies on industries that are growing rapidly globally (automotive industry, electromobility). Debrecen is a particularly attractive location for investments:

Location Quotient

The Location Quotient (LQ) is one of the most commonly used indicators in regional economics. It measures to what extent a given industry is over- or underrepresented in a region's economy compared to the national structure. In other words: it shows whether the region has specialized in a given industry, or not. The LQ formula:

Where:

LQ value meaning

LQ < 1 the industry is weaker in the region

LQ = 1 national average

LQ > 1 specialization

LQ > 2 strong specialization

The following section examines the LQ values in Debrecen, in the automotive industry, and in the battery manufacturing industry. Calculation for the automotive industry:

Total automotive industry: E=636,000 million HUF, Debrecen/Hajdú-Bihar automotive industry: 137,029 million HUF

In other words, 21.5% of the region's industry is the automotive industry.

2. National ratio: Let us assume (based on the KSH industrial structure) that the national automotive industry accounts for 15%.

L/Q calculation:

This means that the automotive industry in Debrecen is 43% stronger than the national average.

Another indicator related to the battery industry:

According to TEÁOR, this sector falls under the category of electrical equipment manufacturing.

1. Regional ratio: According to land use data for new industrial parks: electrical equipment:

E_i = 3,517,869 m², while total manufacturing area:

E = 8,329,000 m².

Therefore: 42% of industrial parks belong to this sector! National ratio. In Hungary, the manufacture of electrical equipment occupies approximately 13% of the area.

L/Q calculation:

This means that in Debrecen, the battery industry is more than three times as significant as the national average. This indicates a very strong specialization. Together, the two LQ values show that Debrecen's economy is highly specialized in the automotive industry and electromobility. This is typically a sign of an industrial cluster forming. In calculating the Location Quotient, we compared regional and national industry shares. The results show that vehicle manufacturing accounts for approximately 40% more of Debrecen's economy than the national average (LQ ≈ 1.4), while the manufacturing of electrical equipment—which primarily includes investments in the battery industry—is overrepresented by more than three times (LQ ≈ 3). We will detail the positive and negative implications of this later.

The concentration indices and the results of the structural analysis clearly indicate that Debrecen's industrial structure is undergoing a significant transformation.

The previous industrial structure was relatively diversified. Within the manufacturing sector, several traditional industries—such as the food industry, the pharmaceutical industry, and the machinery industry—also played a significant role.

However, new industrial investments point toward the emergence of a much more concentrated structure. Based on land-use data, more than nine-tenths of manufacturing areas are used by two industries: vehicle manufacturing and electrical equipment manufacturing.

This shift means that Debrecen's economy is moving from a diversified industrial model toward a specialized industrial model.

Economic specialization often goes hand in hand with increased regional competitiveness. A concentrated industrial structure can facilitate:

- the formation of supplier networks
- the concentration of technological knowledge
- the development of industrial clusters.

However, excessive specialization can also increase economic vulnerability, especially when dominant industries are exposed to global economic fluctuations.

International Comparison

Debrecen's industrial development is not a unique phenomenon in the Central and Eastern European region. Numerous medium-sized cities have become international industrial production centers in recent decades.

Győr

Győr's development was largely built on Audi's investment. The formation of the automotive cluster resulted in significant economic growth; however, due to industrial concentration, the city's economy is heavily dependent on the state of the automotive industry.

Kecskemét

Mercedes' investment created a similar industrial structure in Kecskemét. The city's economic performance grew rapidly, but the industrial structure became significantly concentrated.

Katowice region

In Poland, the Katowice Special Economic Zone followed a similar development path. Targeted industrial policy and infrastructure development attracted significant FDI investments.

Bratislava

The capital of Slovakia has become one of the most important centers of the European automotive industry, hosting several global automakers.

These examples suggest that the process underway in Debrecen is part of a broader regional trend: cities in Central and Eastern Europe are becoming important production sites within global industrial value chains.

Based on the results, Debrecen's economic development aligns well with international patterns of regional economic restructuring. According to the literature, medium-sized cities often become centers of manufacturing production, particularly when they successfully integrate into global value chains (Henderson, 1994).

The observed increase in concentration is consistent with Porter's (1998) cluster theory, which posits that industrial concentration promotes productivity growth, knowledge flow, and innovation. The concentration of the automotive and battery industries emerging in Debrecen shows signs of the formation of a classic industrial cluster.

Conversely, the literature also points out that this type of specialization can increase economic vulnerability. According to Parkinson et al. (2016), cities built around a single dominant industry are particularly sensitive to global economic cycles.

Examples from Central and Eastern Europe—such as Győr or Kecskemét—show that specialization in the automo-

tive industry leads to rapid growth in the short term, but can also create structural dependence in the longer term (Nagy & Lengyel, 2016).

CONCLUSION

Based on the research findings, it can be concluded that Debrecen's economic structure has undergone significant and structural transformation in recent years. The new wave of industrialization—which is primarily linked to large industrial investments associated with foreign direct investment—has led to a strong concentration of the city's industrial structure. Empirical studies have shown that the degree of industrial concentration has increased significantly: the Herfindahl–Hirschman Index rose from approximately 0.15 to about 0.43. This change indicates that Debrecen's economy is shifting from a more diversified industrial structure toward a highly specialized industrial model.

Based on the analysis, the new industrial structure is dominated primarily by two sectors: vehicle manufacturing and the manufacture of electrical equipment, the latter primarily involving investments in the battery industry linked to the electromobility value chain. The Location Quotient values indicate that these two industries are significantly overrepresented in Debrecen's economy compared to the national average. This suggests that the city's economy is developing toward the formation of an industrial cluster organized around the electromobility industry.

Such a transformation of the economic structure can have positive effects in several respects. Increased industrial concentration can facilitate the formation of industrial clusters, which, according to the literature, can contribute significantly to the growth of the regional economy's competitiveness. The formation of clusters is often accompanied by a concentration of technological knowledge, the development of supplier networks, and an increase in knowledge flow and innovation among companies. This type of economic concentration can therefore boost productivity and the pace of economic growth in the long term.

Furthermore, the investments taking place in Debrecen can also contribute to the region's economic convergence. The previous industrial structure showed relatively modest industrial performance, and Hajdú-Bihar County's share of the country's industrial production remained low for a long time. However, new industrial investments can significantly increase the region's industrial output, its export capacity, and employment. The presence of large companies can also trigger a multiplier effect, which can generate further economic activity in the region through the expansion of supply chains.

At the same time, the concentration of the industrial structure carries not only economic opportunities but also significant risks. One of the most significant risks is the growing dependence on a single industry. If a city's economic performance is too heavily tied to a single industry or technology sector, changes in the global market can have a significant impact on the local economy. The automotive and electromobility industries are particularly sensitive to global economic cycles, technological changes, and shifts in the regulatory environment. This means that a potential decline in demand or a technological shift could also negatively affect the region's economic performance.

An economic model reliant on foreign direct investment (FDI) poses an additional risk. While FDI can generate significant economic growth, the strategic decisions of multinational corporations are often made at the level of global corporate networks and do not necessarily reflect local economic interests. This means that the relocation of production capacities or changes in global corporate strategies can have unpredictable consequences for the local economy.

The transformation of the economic structure can also bring about significant changes in the labor market. New industries generally require production at a higher technological level, which presupposes a workforce with higher qualifications. This process may increase demand for engineers and technology specialists, while simultaneously reducing the proportion of jobs requiring lower qualifications. Consequently, local education and training systems must adapt to changes in the industrial structure.

Economic restructuring may also pose environmental and infrastructure challenges. The battery industry and sectors related to electromobility have significant energy and water requirements, which may increase the environmental burden on the region. Rapid industrial growth may also place significant pressure on urban infrastructure, particularly the transportation network, energy systems, and the housing market.

Taking these impacts into account, several key tasks can be identified for regional economic policy. On the one hand, it is advisable to develop a strategy that supports the formation of industrial clusters and the expansion of supplier networks, with particular regard to the integration of domestic small and medium-sized enterprises. This can help ensure that the economic impacts of large-scale corporate investments are felt more broadly across the regional economy.

On the other hand, the development of educational and research infrastructure plays an important role. Strengthening engineering and technical training, as well as developing cooperation between universities and industrial companies, can help ensure that the region remains competitive in industrial production in the long term.

Finally, promoting economic diversification can also be an important goal. Although the current industrial specialization offers significant growth opportunities, in the longer term it is advisable to develop an economic development strategy that also supports the growth of other industries and service sectors. This can reduce economic vulnerability and contribute to the stability of the regional economy.

Overall, it can be concluded that Debrecen's industrial development marks the beginning of a significant economic transformation. Current trends hold significant potential for economic growth; however, to ensure long-term sustainability, economic policy measures are needed that can address the structural risks arising from rapid industrialization.

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