

Strategic coupling in the European (global?) periphery: Debrecen as an emerging location of the automotive industry

Erika Nagy^a, Gábor Kozma^b, Ernő Molnár^{c,*} 

^a Institute for Regional Studies, ELTE Centre for Economic and Regional Studies, Békéscsaba, Hungary

^b Department of Social Geography and Regional Development, University of Debrecen, Debrecen, Hungary

^c Department of Social Geography and Regional Development, University of Debrecen, Debrecen, Hungary

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ABSTRACT

This paper is focused on strategic coupling processes of automotive production networks and in the European (semi-)periphery through the lens of the cultural political economy. Adopting the case study approach and a combined methodology (interviewing, analysis of national and local development documents, press materials and statistical data) we reveal how Hungary's second largest city, Debrecen, is emerging as a new location of the automotive industry in the intersection of the European and the Asian value chains. By analysing the processes of strategic coupling, we grasp how firm (productive capital), national and local state agency are related in developing a new imaginary and how it is made hegemonic for local and national economic development. The paper unpacks how emergence of the new automotive location can be explained by the long-term location advantages of Eastern Europe and the electromobility-based industrial policy of the Hungarian government on the one hand, and the exhaustion of (human) resources in the traditional locations combined with a state policy highly prioritizing the case study city on the other. We also discuss how reindustrialisation emerged as a source of subjectivity by developing counter-narratives of this imaginary, and why unfolding social movements failed to articulate an alternative hegemonic vision.

1. Introduction

The deep structural crisis of post-socialist economies and the rise of CEE as a European and a global industrial (semi-)periphery have been a rich source for empirical insights in changing relations of capital, state, labour and civil society in the time of rolled-out Neoliberalism (Pickles & Smith, 2015; Raco, 2005). These papers aimed at understanding and theorising the interplay of macro-scale process and local agency resulting diverse paths, and unpacking and scrutinizing hegemonic development narratives (Blažek & Steen, 2022; Bohle, 2009; Görmar & Kinossian, 2022; Lux, 2017; Nagy et al., 2024; Pavlínek, 2022). Evolving industrial paths have also been discussed in relation to the subsequent crises. Meltdowns impacted the global division of labour and highlighted the structural aspects of the vulnerability of the (semi-)periphery and the roots of political discontent which fuelled centralisation and the rise of authoritarian regimes (Bohle et al., 2022; Schmalz et al., 2021; Szalavetz, 2017). Although, the unfolding polycrisis inspired academic debates on reconceptualising peripherality, crisis and industrialisation relationally (Domański et al., 2024; Éber, 2019; Šćepanović & Bohle,

2018), we are still in need for insights in local processes to grasp the dynamics and diversity of the European periphery.

This paper aims to contribute to theorising industrial path change in this structural context in two ways. (i) On the one hand, we give an account of local and non-local agents' strategies and relations driving a radical path change (break) in the context of an unfolding authoritarian and financially dependent regime (Karas, 2022; Scheiring, 2021). Here, regional paths are defined externally such as by the compromises of highly selective, top-down state policies and the specific fractions of productive capital. We aim to grasp how this development regime was adopted and 'domesticated' locally in Hungary in the post-GFC era. (ii) For the insight, we rely on the cultural political economic (CPE) approach and the strategic-relational conceptualization of state agency to grasp power relations in the processes of strategic coupling and how those are embedded in national and global accumulation strategies articulated as economic development imaginaries. The latter 'have a performative and constitutive force' (Jessop, 2009), encompassing social relations and actions, naturalizing selected practices and instruments which define the structural position and actions of various

* Correspondence to: Department of Social Geography and Regional Development, University of Debrecen, Egyetem tér 1, Debrecen H-4032, Hungary.

E-mail address: molnar.erno@science.unideb.hu (E. Molnár).

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agents in the path change discursively and materially. This approach allows us to get a deep insight into the changing position and relations of agents of peripheral industrialization, and to interpret those beyond the context of the case study.

The automotive industry is a relevant choice for studying strategic coupling processes in Eastern Europe. While automotive production networks have strong internationalization tendencies and are organised in regional context due to production organization and economic policy considerations (Dicken, 2011; Sturgeon et al., 2008) the CEE region is a winner of their spatial restructuring before, during and after the 2008–2013 global crisis. This situation can be explained by the lower labour costs, (exhausted) labour surplus, geographic proximity to the key markets and the development of transport infrastructure supporting this, EU membership or preferential trade arrangements as well as by ‘FDI-friendly’ state policies including investment incentives and flexible labour practices. As the integrated periphery of the European automotive industry, CEE is characterized by predominating foreign ownership and control, export-oriented production, selective upgrading processes with a weak presence of higher value-added and strategic functions, and a lower-rank position within the supplier networks. This situation is described by the concepts of “dependent”, “truncated” and “dual” development (Domanski et al., 2024; Jürgens & Krzywdzinski, 2011; Molnár et al., 2020; Pavlínek, 2022; Pavlínek et al., 2009; Pavlínek & Ženka, 2016; Rugraff, 2010; Rusnák et al., 2024; Szalavetz & Sass, 2023). The dependence of the region on the automotive sector with structural deficits can be contrasted to the ambitions of the national governments to promote new coupling processes. Electric transition with its adaptation pressures in the region exposed to the restructuring of automotive networks, and the rise of new, powerful Asian actors entering the European market (Szanyi, 2020) in an era of deepening global tensions make these ambitions particularly relevant.

Our analysis is unfolded along three questions. (1) How were local, national and global productive capital interests articulated and related within this development imaginary discursively and through changing institutional arrangements and practices (public infrastructure developments, regulative changes)? (2) How are national and local state agency related in shaping the imaginary focused on peripheral industrialization (Arrighi, 1990), i.e. what techniques of governance (Sum, 2009) are deployed to make peripheral, automotive sector-focused industrialization the dominant vision for path change, community building and subjectivity-making in a city which could mobilize vast local resources to take alternative paths? (3) Moreover, how are subjectivities being forged in this process? What counter-narratives of local citizenship have been developed and how were those excluded or used in the making of the new path?

After the introduction the paper is structured as follows: the next section describes theoretical grounding while section three is about the methodology of the research. Empirical results are summarized in section four followed by discussion in part five, and conclusion at the end.

2. Theoretical grounding

This paper aims to give a deep insight in the processes of peripheral industrialization at a local scale in the time of fundamental technology changes and shifts in geopolitical power, which are heralding a new accumulation regime (Jessop, 2015). This focus connects our argumentation to the current debates on path development, which are gravitating toward a more fine-grained understanding of how different institutional contexts and multiple local and non-local agency interact and launch diverse, interrelated and often, competing trajectories (Hassink et al., 2019; Isaksen et al., 2018), as well as to relating those to broader accumulation processes (Coe & Yeung, 2015; MacKinnon et al., 2019). Our paper contributes to this growing body of academic work by unpacking how radical change, i.e. a new development path (Grillitsch et al., 2018) is created in the structural context of the European periphery. This structural position manifest not only in depending on

extra-regional flows of capital and knowledge, exploitation of low costs and immobility of local labour, and in vulnerability to crises (Arrighi, 1990; Éber et al., 2017; Gál & Lux, 2022), but also in changing state agency which aimed to reposition CEE economies/regions globally and within Europe through corporate tax policies, labour regulations, changing distributive practices and major public investment projects (Czifusz et al., 2019; Pavlínek, 2024; Vliegthart & Overbeek, 2009). Such practices indicated and also fuelled the fundamental shift in state-capital-labour relations and in state’s role in social reproduction, along with the re-spatialization of state power and introducing spatially and sectorally more selective policies after the GFC. Changing policies, institutional arrangements and practices manifested as different forms of authoritarian mechanisms throughout CEE, which were also perpetuated by new forms of state control in the Covid years (Bohle et al., 2022; Sata & Zerkowska-Balas, 2025). Hungary has been identified an extreme case in this process, i.e. as the system of unfolding authoritarian capitalism, in which state interventions impact not only the realms of capitalist accumulation, labour rights, social reproduction, but its power is extended over communities and citizens violating local autonomies (Ban et al., 2024; Bohle et al., 2022).

We argue for that this unfolding centralized-authoritarian system took control over the institutional environment and increasingly dominated the agency of path change at sub-national scales, while remaining strongly dependent on external resources (hence, inherently peripheral) which is reflected in hegemonic development narratives and governance techniques. Therefore, we rely on the political economic approach to grasp how local path change is related to broader accumulation processes (MacKinnon et al., 2019; Rutherford et al., 2018), and to the changing position of peripheral economies at macro-scale. We consider peripherality as an ontological context in which local agency is subjected to external power relations (primarily, extended state control and reshuffling GPNs), decisions and transactions often lack transparency, and development narratives are forged to justify increasingly uneven social relations driving economic restructuring and the exploitation of local resources. Researching path change in a peripheral-authoritarian context made us to scrutinize state agency which manifests in a centralized institutional environment and also as a system-level agency (Blažek & Květon, 2022; Uyarra & Flanagan, 2022) governing local economic transitions directly. Although, institutional environment (external to local context) and local agency are usually separated in the literature (MacKinnon et al., 2019) we argue for that boundaries could be blurred particularly, in the periphery where resources are scarce, and state interventions are substantial and widespread, and the government bends the rules deliberately to implement major development schemes. Such projects aim to mobilize local resources for path change and go beyond the realm of the economic, and impact social relations, communities, individual identities profoundly; new paths are forged and interpreted as the future of people and places.

To understand radical path change in the industrial periphery and highly centralized political systems, we propose a combined conceptual framework which rests on strategic coupling as an analytical tool, and anchor our analysis in strategic-relational and cultural political economic approach which helps us to unpack how local path change is being shaped by changing state power geometries and related ideology.

The relevance of the strategic coupling concept lies in proposing a framework for the deep and fine-grained analysis of how firm strategies (production cost optimization in GPNs by mobilizing networked assets and strategic coupling, financialization, changes in national institutional-regulative contexts, the fluidity of market imperative) and local contexts interact. Through its agency focus, it highlights power relations, how those change and are played out in the economy (in inter-firm and labour relations) and beyond that (in social reproduction, local politics, etc.) and identifies the multiplicity of causal mechanisms which drive constant change in the organisation of production (Coe & Yeung, 2015; 2019; MacKinnon et al., 2019). The insights in the processes in the industrial peripheries enriched the concept by stretching the analyses

beyond the firm focus to explain the changing economic geographies of the post-GFC era. Studies digging deep in regional and local processes revealed the multiplicity of agents and their relations to understand how CEE industrial peripheries are (re)produced and why those take different paths (Blažek & Steen, 2022; Domański et al., 2024; Pavlínek, 2018), moreover, highlighted the centrality of state agency in strategic coupling (Dawley et al., 2019; Gerócs & Pinkasz, 2019; Morgan, 2013).

To grasp the complexity of state agency (as a regulator, developer, owner, and consumer) in such processes, we embrace the strategic-relational approach (Horner, 2017; Jessop, 2009) and define the state as a dynamic geometry of power relations which works through hegemonic projects manifesting various (global, national, local) accumulation strategies (Dawley et al., 2019; Rutherford et al., 2018). For us, this approach entails (i) looking into the scalar organization (division) of state power and how it is impacting the position and strategy of various agents (firms, institutions, communities, individuals) and their bargaining for local resources (see also Jacobs & Lagendijk, 2014; Smith, 2015), (ii) understanding more how hierarchical and horizontal (networked) organizations interact in embedding new projects locally in the periphery, and (iii) scrutinizing the selectivity of the current investment regime and the socio-spatial outcomes locally. In this way, we can look into the dynamics of power in a political system where new path development in a region is dominated by the strategies and bargaining of external agents. To grasp these dynamics, we discuss how the post-GFC economic development imaginary of the Hungarian government has become an all-encompassing framework for social agents' strategies and daily practices (Jessop, 2009; Sum & Jessop, 2013) since the early 2010s. This imaginary grew increasingly selective, as it rested on state-guided major development schemes providing thousands of jobs, mobilizing enormous (public and private, local and external) resources, and relating new regional development paths tightly to macro-scale policies. In sum, in post-GFC Hungary, the imaginaries which had been shaped by local and external agents' strategies and negotiations earlier were challenged and overwritten by the new narrative of development. The latter clearly prioritized global embedding and being in the front line of technology change through the automotive industry, along with a substantial extension of central governmental agency (Gerócs & Pinkasz, 2019; Szanyi, 2020).

This paper aims to unpack how the agents of local path change adapted to and navigated in this evolving imaginary. We contribute to the strategic coupling literature by revealing how the imaginary of industrialization in the (European-global) periphery is acknowledged and 'domesticated' through the interactions of various agents (firms, state institutions, communities, citizens) in local spaces which spread out (further) to networks and hierarchies, entailing changes in social relations and subjectivities locally and beyond. Thus, we get a deeper insight in how power relations (state/productive capital; local/external) are played out and negotiated in exploiting local/regional resources, and understand more its multiple social consequences.

3. Methodology

3.1. Research design

In order to answer our questions, we elaborate on a case study, which focuses on an emerging automotive location of the integrated periphery. Our country, Hungary – similarly to Czechia and Slovakia – has a strong automotive specialization, and accordingly, is dependent on GPN dynamics in the sector. The study focuses on the post-crisis era for three reasons. Firstly, there is a technological change (electric transition) in the global automotive industry which reconfigures the power situations within the sector and – completed by industry 4.0 and geopolitical-geoeconomic ruptures – has an influence on its spatial structure (Freyssenet, 2012; Pavlínek, 2023). Secondly, there is a strategic response to this challenge from the side of the largely interested (dependent) Hungarian central state that targets to strengthen its

position within the emerging production networks of electromobility and to become a key node of the interconnecting European (German) and Asian value chains (Brennan et al., 2024; Czirfusz, 2022; Györfy, 2023). Thirdly, this is the era when industrial policies had more pronounced foci throughout Central and Eastern Europe, and central governmental agency grew more prominent in local development hence, power asymmetry between the central state and the local actors in economic development became more explicit particularly, in Hungary.

The research design rests on multiple sources (see Table 1) and a combined methodology.

- (i) To grasp how new post-GFC development imaginaries have been formulated, we analysed national and local development documents produced in the post-GFC era. We focused on how problems and goals related to economic development were identified, what objects of interventions were constructed, and how agency was articulated in the texts. We also looked at the broader context of texts i.e. the spatial reorganization of state power and the reorientation of national policies as a response to the changing geopolitical context and GPN rearrangements to highlight how new narratives and structuration processes were entangled (Sum, 2009). For that, we relied on secondary and primary sources (relevant acts; an interview with a senior state official, I8). The analysis was complemented by reviewing 'grey' sources (media news, NGOs' brochures) and municipal documents to highlight how hegemonic narratives were made accepted unconditionally, entailing an uneven reconfiguration of structural constraints which enable/limit various social agents' goals, strategies and projects (Fairclough, 2003).
- (ii) Corporate agency and state-capital relations were revealed by interviewing agents of the local economy holding a key position and having a deep insight in the current restructuring of the automotive sector in Debrecen, our case study. We had two interviews with a former executive of the local economic development agency (EDC Debrecen: I1) and the communication advisor and translator of the mayor, who also is the leader of Deutsches Kulturforum Debrecen and the organizer of the Automotive Cluster in Debrecen (I2). Both of them had (or even have) a strategic position within the local institutional context. Moreover, we had interviews with large manufacturing TNCs (I3, I4) and medium-sized domestic enterprises (I5, I6) and a locally rooted large logistics company with nationwide scope of activities (I7). Three for the interviewed firms are members of the Automotive Cluster. Beyond the local partners, we interviewed

Table 1
Information sources of the research; source: authors' compilation.

Information	Sources
Narratives and strategies of central government	Strategic documents, law, press materials, I8
Narratives and strategies of local government	Strategic documents, press materials, I1, I2
Company data	Database of ceginformacio.hu
Employment data of sectors and subsectors	Database of Hungarian Central Statistical Office
Migration data of Debrecen and HB county	Database of Hungarian Central Statistical Office
Data of secondary vocational education	Database of Hungarian Central Statistical Office
Data of university education	Information System of Higher Education
New path creation (infrastructural developments, negotiations)	Press materials, I1
New path creation (economic, social and cultural consequences)	Press materials, I2, I3, I4, I5, I6, I7
Local protest, environmental and social conflicts	Press materials, I1, I2

with a senior state official who is an expert on international economic relations (I8). We analysed interview transcripts as texts focusing on the articulation of firm strategies in relation to sectoral processes and state policies (hegemonic narratives) and institutional practices, while reflecting on the positionality of the speaker. The content was analysed in relation to sectoral statistics and publicly available company data.

- (iii) The making of subjectivities within the new imaginary has been revealed through contrasting hegemonic development narratives and powerful local agents' interpretations against unfolding local movements' articulations of local problems and alternative visions. For that, we collected and reviewed local events and media news on protests and other forms of resistance.

The introduction of the empirical results and the discussion rest on triangulation, analysing various sources (texts, data) reflexively, relating those to one another, to events and structural changes in Debrecen and beyond, at national and global scale. The authors were also aware of and constantly reflected on their own positionality throughout this process. Two of them are local residents embedded in multiple local networks and information flows in Debrecen, which entailed a deeper insight in economic restructuring processes and also frequent crossings of the insider/outsider boundary, while ethical problems (protecting sources; not publishing insider information) had to be considered.

3.2. Debrecen as case study location

This study relies on a case study approach to get an insight how local path change and strategic coupling are interrelated and conditioned by strategies and interactions of local and non-local agents. Our city, Debrecen, has been integrated into the automotive production networks recently, and its development path is largely shaped by the strategic coupling processes between the restructuring automotive GPNs and the "regional side" determined by the changing power balance between the

central state and the local actors.

Debrecen is the *second largest city* of Hungary with a relatively stable population (200,000), located in one of the 20 less developed NUTS-2 regions of the European Union with lower income level and higher unemployment rate compared to the national average. The city is one of the five regional centres (Debrecen, Szeged, Miskolc, Pécs, Győr) in the Hungarian urban hierarchy with a quite *complex institutional environment*. As a "knowledge centre" (Lengyel & Vas, 2024), it is one of the three most diversified higher education centres outside Budapest with 30 thousand students (including nearly 7 thousand foreign students from 140 countries), completed by significant R&D capacities in natural and life sciences and also in agriculture. Although, traditionally, technology has not been the strongest field in higher education, a substantial adaptation processes has been unfolding in the past decade.

Despite its service sector orientation, the city has significant and diversified but less automotive-focused *manufacturing traditions*: beyond Budapest, Debrecen took the third place after Győr and Székesfehérvár by the number of employees in the secondary sector in the early 2010s. However, the city is located outside the globally embedded regional enclaves of the automotive industry concentrating in the northwestern part of the country (Fig. 1).

Beyond embodying a current (post-GFC) CEE model of peripheral industrialisation (Ban et al., 2024; Nagy et al., 2021) the economic path change in Debrecen exhibits the structural conditions of local agency in the non-metropolitan regions of the eastern (semi)periphery of Europe. It gives us an insight how fiscal processes impose limitations on municipal actions (e.g. dependence on the allocation of tax revenues, scarcity of own revenues, post-GFC restrictions on indebtedness) perpetuated by dependent financialization (Bohle et al, 2022; Sokol, 2017). Moreover, it gives an insight how the scalar rearrangement of state power in Hungary after 2010 entailed a decaying municipal agency unprecedented in CEE, i.e. the loss of control over local resources and the decisions (e.g. on land use) impacting on everyday life and well-being (Nagy et al., 2021; Pálné & Kovács, 2019). Such processes entailed a massive loss of resources (revenues and institutions) and

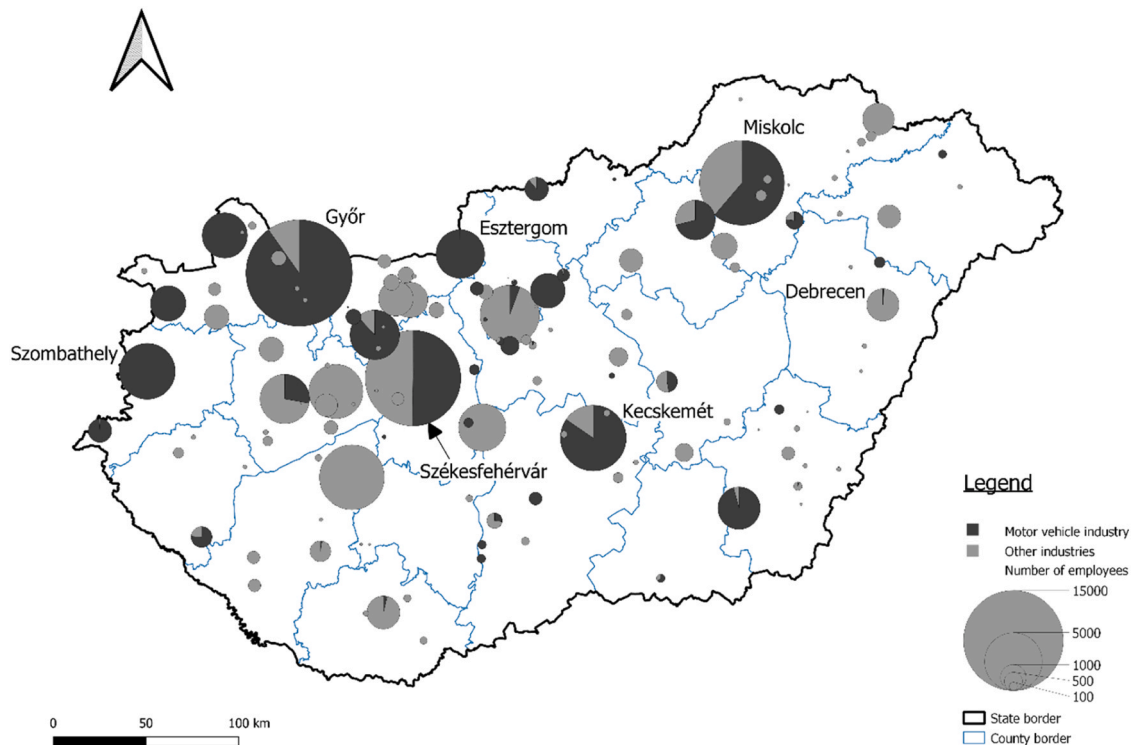


Fig. 1. Spatial distribution of manufacturing employees in Hungarian automotive industry (members of sectoral associations and clusters, 2019); source: authors' compilation based on several databases.

regulative power over local processes also in Debrecen.

4. Empirical results

4.1. Industrialization as a state-forged imaginary

To unpack how state agency has changed in local path development, we looked into how a new development imaginary has been forged and made hegemonic at a national scale, which inscribed changing power relations and entailed new selectivities in terms of sectors, agency and outcomes (Jessop, 2009; Sum & Jessop, 2013). The relevance of the concept lays in its evolutionary and agency focus, which allows us to look into the changing selectivity of goals, agency and legitimization in national development policies, and how those were ‘naturalized’ by internalizing the new goals, related institutional structures and practices by local organizations and individuals, in Debrecen. We looked into how industrialization and industrial regions were contextualized and what agents and relations were connected to development priorities.

The shift to a new development imaginary was conditioned by the perception of the vulnerability of CEE as a global periphery which entailed policy shifts throughout the region after 2010 (Czirfusz et al., 2019; Lux, 2017; Szanyi, 2020). For the populist-rightist government of Hungary entering power in 2010, the GFC was a wake-up call: the impact of FDI on balance of payments was thinning, the profit was transferred back to home countries, unemployment was growing while national output was heavily dependent on FDI (80% in 2007) (Szanyi, 2022). Although, a variation of development narratives emerged at the time of the crisis, the shift toward re-prioritizing international economic relations (‘turning to the East’) and sectoral policies along with redistributing power among agents was discernible in national development documents and also in institutional rearrangements and practices in the 2010s.

The crisis-born imaginary of national development policy (National Development and Regional Development Plan, NDRDP for 2014–2030) placed employment, economic growth and stability in the focus. Due to the Plan’s macroeconomic approach, the central state agency was implicitly put in the fore by proposing infrastructure network development, green energy projects, labour market adjustments through education and health care improvements as a way out of crisis. The document proposed interventions along a sectoral logic and in a top-down manner, indicating a shift to new selectivities, i.e. supporting specific industries, prioritizing government and firm agency in development policies, and disconnecting regional and economic development. The latter manifested in the articulation of macro-scale and subnational scale strategies in two separate documents which lacked systematic connectedness, moreover, in undermining local agency in regional development systematically (2011CXCVIII. Törvény), by taking governmental-sectoral control over resources (operative programs), and abolishing the multiscalar institutional system representing the needs of all regions and localities. The first revision of the NDRDP (2014) deserves an analysis for introducing two powerful narratives. (i) One is the introduction ‘patriotic’ economic policy principles, embracing the further specification of the fields (sectors, social relations and spaces) of state interventions, such as reindustrialization through embedding of SMEs in GPNs in selected ‘strategic’ sectors (i.e. automotive, electronics, IT, logistics), the support of domestic firms to exploit local resources and improve their export performance, moreover, the upgrading of labour supply to fuel economic growth along with mitigating social problems in a workfarist manner. Social inequalities and exclusion were introduced as problems specific to regions and localities which allowed the central government to identify those as non-systemic/marginal issues. (ii) The document also unpacked the geopolitical and economic reorientation of international relations towards the East and to the global South. The turn meant to place economic relations ahead of political interests, and reduce the economic (hence, the political) dependency of Hungary on (European) core economies perceived as spaces of deindustrialization

and declining power. The ‘turn towards East’ reprioritized the relations with South Korea and China (Szanyi, 2020), and knitting political and economic relations closely in daily practices of diplomacy. This shift was matched skilfully with national policies such as addressing economic slowdown and deficits in R&D potential in South Korea (I8), and also with state-orchestrated expansion of Chinese firms, i.e. including CEE economies in the ‘One Road One Belt’ strategy for which, Hungarian government took the lead in the region (Szunomár, 2020; Völgyi & Peragovics, 2020). The new imaginary of being part of a global(ized) industrial periphery has been prevailing up until today, and manifested in governmental papers with specific focus to guide development practices toward supporting digitalization, technology change, green energy, networking and upgrading in GPNs (Industry 4.0.), using terms of green transition and social cohesion for legitimizing the dominant development narrative (Partnership Agreement, 2021–2027).

The concept of space in the unfolding new imaginary remained highly abstract: development papers focused on knowledge and capital flows through networks, connecting firms, and the institutions of innovation and of the central government. In this logic, crisis was (is) related to localities and regions where such agencies were weak and constantly losing ground. This narrative materialized in institutional rearrangements and practices primarily, in gaining power over local resources by undermining municipal power systematically through shrinking local regulative power, financial scope and questioning political legitimacy (Nagy et al., 2021; Pálné Kovács et al., 2016). Central state control and place-making praxis manifested clearly in the exceptionality schemes which rested on individual bargaining between the (central) government and the productive capital, entailing massive public investments in major industrial development projects supervised directly by governmental bodies (Ban et al., 2024; Geröcs & Pinkasz, 2019). In this context, implicitly, the introduction of new development paths in local economies was considered instrumental for the prevailing imaginary on the one hand, and a practical outcome with ‘side-products’ (enhanced mobility, environmental conflicts, etc.) which has to managed locally, on the other.

Debrecen has been settled as a primary target of the new strategy from the late 2010s. The 2018 NDRDP identified the city as one of the three economic-technological development hubs outside the Budapest agglomeration. The cornerstones of the local strategy were laid through a bilateral negotiations between the central government and the municipal leaders as part of the ‘Modern Towns’ Program (2015–2022). It included the development of the local industrial park and the airport, an innovation centre, an intermodal transportation hub and an international school. In line with the prevailing hierarchical-centralised territorial governance concept, it was taken completely from its broader, regional context. Moreover, a new political content has been added to the industrial centre narrative after the 2019 municipal elections. As Budapest’s political loyalty toward the regime has been questioned, Debrecen was labelled as the ‘second capital city’ henceforth in the government’s communication (Dehir, 2024; Demokrata, 2024). Therefore, entering a new economic development path had a clear political connotation, exhibiting industrialization as non-metropolitan/anti-Budapest imaginary. Up until the 2020 s, local development strategies embraced multiple tiers of economic development, including the mobilization of industrial capacities and connecting those to local innovation/R&D capacities (upgrading, branching), and also SSC, tourism and other services (Euro-Régió Ház, 2007; Euro-Régió Ház – INNOVA, 2014). Current development priorities are targeting local institutions and technical infrastructure differently, and relate those clearly to the narrative of industrialization, such as new education programs (training technicians and engineers for the automotive and battery industry), the expansion of local industrial parks, and related transportation networks. Those projects are supported by the central state directly, as an owner (Debrecen Airport, ‘Inpark’ industrial park) and a developer/public funder. Local decisions are tied explicitly to the government’s goals which is reflected also by the recent shifts in

international relations, represented not only by municipal policies but also by local institutional practices (Cívishír, 2024; DE, 2024; DN, 2025). Meanwhile, the complex environmental, social and political consequences remained unaddressed, considered merely externalities, and left to local agents to manage. It entailed unintended and unexpected processes such as environmental crisis, urban/hinterland conflicts, resistance, and the making of new subjectivities questioning the current peripheral accumulation regime.

4.2. Stages of new industrial path development

Debrecen's industrialization based on strategic coupling between the automotive production networks and the local economy is still in its initial phase. Looking at the post-GFC dynamics of the manufacturing sector in Hajdú-Bihar county (determined by the data of Debrecen), we can distinguish between two periods. The first one has stable employment with low and rather decreasing location quotient of the sector: in 2018, Hajdú-Bihar was the least manufacturing-oriented county outside Budapest. The second stage starts after 2022: growing manufacturing employment and related location quotient data combine with the emergence of the earlier marginal manufacture of motor vehicles, trailers and semi-trailers (NACE 29). In 2025, both manufacturing and motor vehicle production reached the location quotient 1.00 expressing that the sectors are represented in the local employment as much as in the whole country. Although manufacture of electrical equipment (NACE 27) has grown as well, and Hajdú-Bihar accounted for 15% of the national employment in the narrower manufacture of batteries and accumulators (NACE 2720), the importance of this subsector is (still) under the national average (Figs. 2–3).

The first stage can be regarded as a 'preparation phase' of strategic coupling characterized by the mobilization of local resources and shaping local assets according to the needs of the (potentially) investing GPN firms. Although some "early bird" companies (e.g. ThyssenKrupp) opened their plants, the effects remained limited until 2022. Shaping local assets is still relevant, but the second 'take-off phase' after 2022 can be described by the growing employment effects of industrialization

(2025 is largely determined by the opening of the BMW car plant).

The location decision of BMW seems to be a turning point in industrial path change for several reasons. (i) It was the first large-scale investment that contributed directly and indirectly to the new industrial path development. After BMW, further automotive companies settled in the city that are related directly to the carmaker or exploit the milieu of an emerging automotive location around the company (Table 2). The underway change of BMW strategy toward electromobility can be connected with the arrival of Asian battery producers. Follow sourcing (Humphrey & Memedovic, 2003) can be observed in order to achieve the intra-market content requirements (60%) of the EU: battery is known to have a 40% share of value in the electric car, while cathode with separator film or anode makes more than 60% of the value of battery. Accordingly, EVE entered as the battery producer of BMW, while CATL has relations to several European carmakers including ones settled in the broader region of "Central European Manufacturing Core" (Stehrer & Stöllinger, 2015; Telex, 2025). Semcorp is supposed to deliver separator films to EVE and CATL. Ecopro produces cathode for Samsung and SK having plants in Hungary (I1). The composition of investors and their relations show that the reindustrialization strategy of the Hungarian government targeting a key position in electromobility (Czifusz, 2022; Györffy, 2023), and becoming a node interconnecting German and Asian value chains (Brennan et al., 2024) meet the strategies of the investors whereby BMW is the prime agent. The new capacities are visible even on a global scale: CATL is communicated as the largest investment of Hungarian history, contributing to the emergence of the country as one of the global leaders in battery production (Dehir 2022a). Beyond the mining, almost the whole electromobility value chain is expected to settle in and around Debrecen. According to one of our interviewees, considering the broader region (including Nyíregyháza in a 50 km distance), a similar concentration and diversity of battery producers in such a small area can be observed only in Southeast China (I1). However, new plants are mostly in the building or starting phase. In some cases, the delay is significant, the planned capacities (if at all) will be achieved later than originally expected. In addition, Table 2 includes also declining companies.

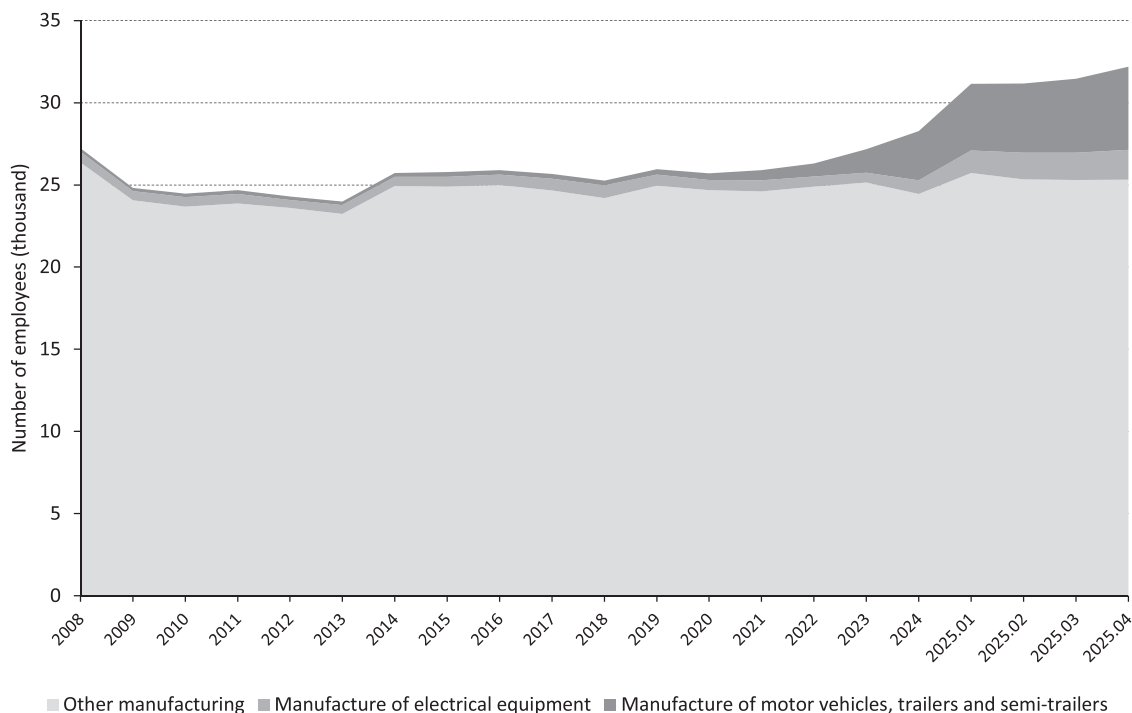


Fig. 2. Number of employees in the manufacturing sector and in the two examined subsectors in Hajdú-Bihar county (2014–2025); source: authors' compilation based on HCSO data.

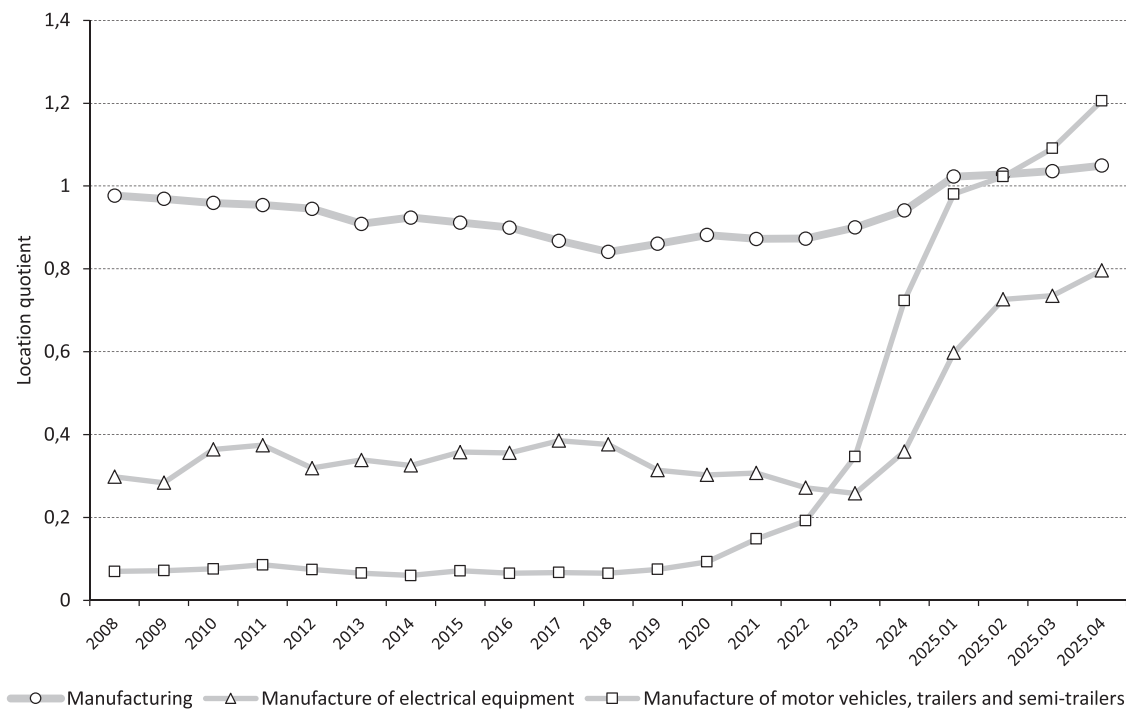


Fig. 3. Location quotient of manufacturing and the two examined subsectors in Hajdú-Bihar county, compared to the national average (2014–2025); source: authors' compilation based on HCSO data.

Table 2

Larger manufacturing firms in Debrecen, integrated in motor vehicle production networks. Source: authors' compilation based on press materials, company databases and interviews.

Company	Profile	Year of foundation*	Headquarter	Employment 05.01.2026 (planned)
BMW Manufacturing Hungary Ltd.	2910 Manufacture of motor vehicles	2018	Germany	4070** (10,000)
Contemporary Amperex Technology Hungary Ltd.	2720 Manufacture of batteries and accumulators	2022	China	644 (9000)
EcoPro BM Hungary Inc.	2720 Manufacture of batteries and accumulators	2021	South Korea	181 (631)
Eurings Inc.	2550 Forging, pressing, stamping and roll-forming of metal; powder metallurgy	2000	Italy	28
Eve Power Hungary Ltd.	2720 Manufacture of batteries and accumulators	2022	China	126 (440)
HAJDU Autótechnika Ipari Inc. (Téglás)	2932 Manufacture of other parts and accessories for motor vehicles	2005	Hungary	156
Halms Hungary Ltd.	2453 Casting of light metals	2021	China	83 (300)
Inter Traction Electrics Ltd.	2910 Manufacture of motor vehicles	2016	Hungary	12 (320)
METRI Automotive Ltd.	2433 Cold forming or folding	2001	Netherlands	Under liquidation
MITOR Ltd.	2562 Machining	2007	Italy	68
Schaeffler Debrecen Ltd.	2815 Manufacture of bearings, gears, gearing and driving elements	1999	Germany	1132
Schaeffler Motion Technologies Debrecen Ltd. (Continental/Vitesco)	2931 Manufacture of electrical and electronic equipment for motor vehicles	2018	Germany	1135 (450 + 450)
Schedl Hungária Ltd.	4520 Maintenance and repair of motor vehicles	2023	Germany	37 (60)
Semcorp Hungary Ltd.	2221 Manufacture of plastic plates, sheets, tubes and profiles	2020	China	468 (440)
Thyssenkrupp Springs & Stabilizers Ltd.	2593 Manufacture of wire products, chain and springs	2017	Germany	307 (250)
ZF Chassis Modules Hungary Ltd.	2932 Manufacture of other parts and accessories for motor vehicles	2023	Germany	12 (200)

Note: The grey coloured companies represent the “pre-GFC” engineering traditions of the city and its region. ***Year of foundation” means the official establishment of the company or the start of its operations in Debrecen. ** Data published by [HR Portal \(2026\)](#).

BMW is also the main initiator of the local Debrecen Automotive Cluster established in 2025 which mirrors their experience in organizing the Automotive Cluster Ostdeutschland. Accordingly, the executive manager of the BMW plant is called by the mayor as “the engine of the local economy in Debrecen” (I2). The organization aims to embrace local economic actors including SMEs within and beyond the automotive industry and make the representation of their interests efficiently (e. g. capacity growth of state-financed vocational training, improved transport conditions including the local airport). These steps are in line with the earlier, rather positive expectations of the interviewed economic actors about the emerging “critical mass”, which sustains local economic dynamics, and contributes to a more efficient interest representation of local industry (I3, I4, I5, I6, I7).

(ii) Due to the needs of the BMW and its suppliers larger-scale infrastructural developments including industrial estates and transport connections have been required which led to the more direct intervention of the central state in local economic development. While the municipality spent a considerable sum of 5–6 billion HUF for electricity and gas supply of the industrial areas in the planning period of 2014–2020, covering the costs partly from EU funds (I1), the central government spent hundreds of billions (HUF) on laying the technical foundations of the new path. The municipality took out a loan of 44 billion HUF with permission and guarantee from the central state in 2018 to finance land purchase and infrastructural developments related to BMW manufacturing site. The local government received further 125 billion HUF support for the construction of roads and communal infrastructure (HVG, 2018). In 2022, two government decisions (1025/2022, 1041/2022) were accepted about infrastructural developments in the South Economic Zone predominated by battery producer companies approaching 100 billion HUF. The Northwest Economic Zone (620 ha)

and the South Economic Zone (710 ha), established in this way, make up the majority of the 1860 ha industrial area (Fig. 4) emerging Debrecen among the top 30 European cities (Dehir, 2022b).

The needs of BMW played a central role in building new connections to the existing motorway and higher capacity roads to the city as well as a new railway terminal for freight transport in the Northwest Economic Zone. Track capacities between the new freight terminal and the main station were extended and the electrification of this secondary connection until the next town was carried out. New local bus lines between the city and the industrial parks were launched and the development of the local airport was put on the agenda. However, despite these developments financed mostly by the central government, the pressure on existing transport infrastructure is growing. Logistic facilities of about 100,000 m² are under construction and further 400,000–500,000 m² is likely to be claimed (I1). Although, Debrecen received 500 billion HUF of public money for industrial development up to now, likely, further 250 billion HUF is needed to deal with the growing traffic and keep the city liveable (HAON, 2024). Transport plays a key role in these spending whereby the plans about the renewal of railway infrastructure and the new system of train stops exploiting the potential in joint organization of urban and suburban traffic seem to be promising.

(iii) The BMW investment also had an influence on the conflict-laden issue of labour supply. While the negotiations with Continental/Vitesco about employment conditions were extremely long (1.5 year), after the location decision of the BMW “nobody asked for the human labour supply: industrial area and infrastructure remained the only critical point” (I1). However, regarding BMW as guarantee for skilled labour supply seems to be unfounded. The plant’s growing labour catchment area stretches over 100 kilometres and it has employees from 50 countries. Because of the need for a more rapid production growth (due to the

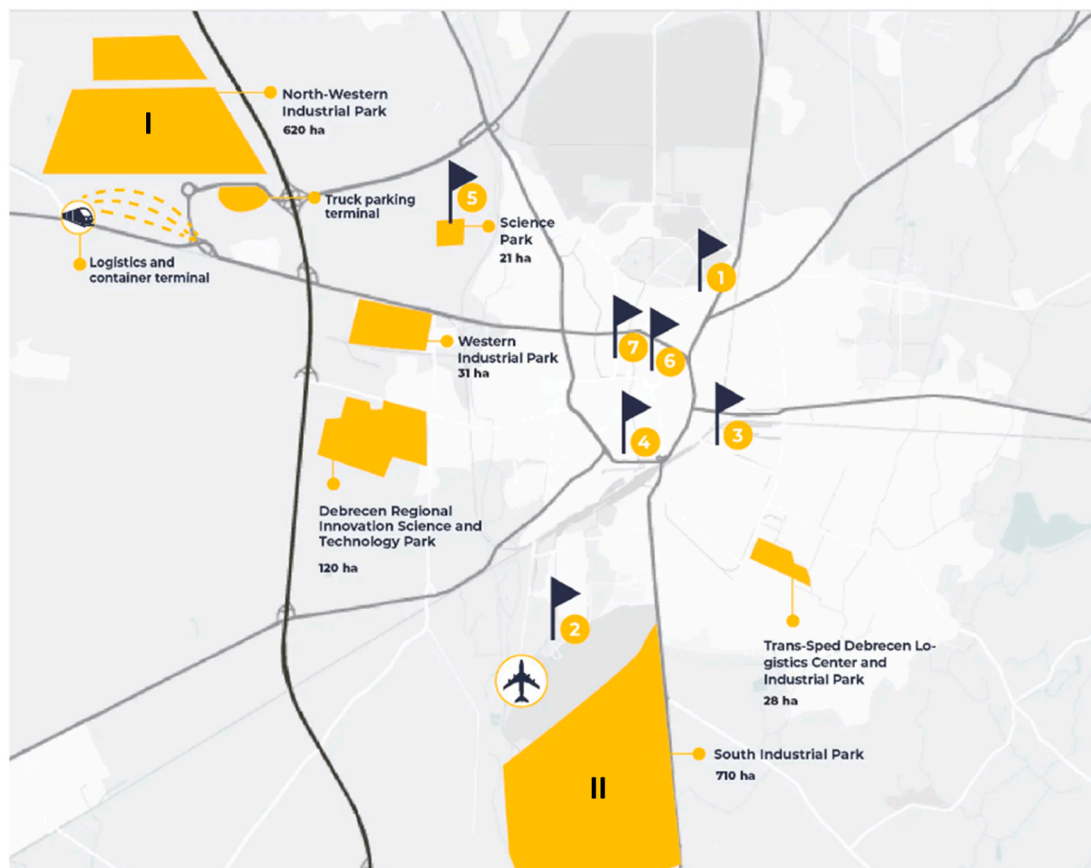


Fig. 4. Location and size of the Northwest Economic Zone and the South Economic Zone; Source: EDC/DIF Debrecen, 2026 Note: I. Northwest Economic Zone; II. South Economic Zone.

larger-than-expected demand on the model planned to be produced here), BMW temporarily directed employees from its other plants to Debrecen to accelerate capacity extension. The longer-term recruitment strategies of BMW (and also other local firms) cover mobilizing the labour force expected to be laid off by other Hungarian automotive plants due to the recent crisis, hiring from the neighbouring regions of Romania, employing foreign students of the university, and luring back Hungarians who work abroad now. Accordingly, the number of foreign employees including both expats from other locations of the investing companies and guest workers partially coming from third countries (e.g. Philippines), recently estimated to be about 5000 in Debrecen (I2). This is not a big mass compared to the number of locally employed (125,844 according to the census 2022) and it is less than the number of foreign students (6856 in the academic year of 2023/2024). However, there is a dynamic growth due to new manufacturing facilities, which is reflected by the rate of international migration (Fig. 5). On the other hand, domestic migration balance is continuously negative and – in the case of Debrecen – declining. This is due to the strong suburbanization trends enhanced by the extremely growing real estate prices making the city the most expensive market outside Budapest (Fig. 6). The negative balance of domestic migration in Hajdú-Bihar county shows that the traditional pattern of the internal migration (from the periphery to the core, from East to West) has not been changed until 2024 which exhibits limits on/potential conflicts stemming from the new path.

BMW is one of the key partners for vocational training where the effects of reindustrialization are visible now: after the demographically determined decline of students in technical schools, upper secondary vocational schools and vocational training schools until the end of 2010s, there is a 10% growth (from 10.000 to more than 11.000) between 2020 and 2023 (KSH). The University of Debrecen provides BSc and MSc majors in mechanical engineering, mechatronics, vehicle engineering, as well as material, electrical and chemical engineering, and chemistry in both Hungarian and English. In the academic year of 2023/2024, there were more than 2400 students (about 800 foreigners) registered on these majors. Although, the adaptation of higher education started well before the expansion of the automotive industry, the new fields (vehicle engineering BSc and MSc, battery chemistry specialization in chemistry BSc) are clearly related to the new investments. “BMW

effect” can be observed in the establishment of the International School of Debrecen (2019) and the Deutsche Grundschule Debrecen (2022) as well (I2).

The entry and strategic coupling of international automotive (-related) firms was initiated and supported by the combined agency of central government and municipality, which explicitly targeted new path creation against the “traditional” local sectors (food, health industry, SSC sector etc.) had been evaluated as not dynamic enough from the point of view of FDI (I1). It was institutionalized as the cooperation of HIPA (Hungarian Investment Promotion Agency) and EDC Debrecen (a local development organization) throughout the discussed period. The HIPA was established as a legal successor of the Hungarian Investment and Trade Agency in 2014, and it is controlled by the minister of foreign affairs and trade. The EDC Debrecen was established in 2015 to deploy more proactive and flexible economic development policy in the city and its region. About 80% of all investors were directed by the HIPA to Debrecen and managed by the EDC locally. As its former employee summarized the role of the organization: “We took everyone, always and everywhere during the local negotiations: in the case of the BMW, we signed 120 confidentiality clauses only within the city, so many people helped the project. It was a real city-level collaboration.” While keeping touch with the representatives of the municipality, the providers of public services, the university and the vocational training institutions and directly taking part in the infrastructural developments, EDC Debrecen involved the local members of parliament and the mayors of the neighbouring settlements in joint discussion about the future economic perspectives (I1). Recent (re)industrialization is interpreted by Debrecen’s mayor as the “third industrialization wave” locally – after the era of Austria-Hungary and the state socialist period – whereby the city will be a European centre of electromobility, the “most promising sector of the 21st century” (Debrecen.hu, 2024). Although, the current creation of a new path entails a technological advancement, the non-transparency of the processes and the limits on local agents’ scope, i.e. being the ones who adapt and facilitate, recalls the top-down logic of the second (state-socialist) era, while the scale and resource requirements of change reflects and seems to reproduce the structural conditions of the industrial periphery.

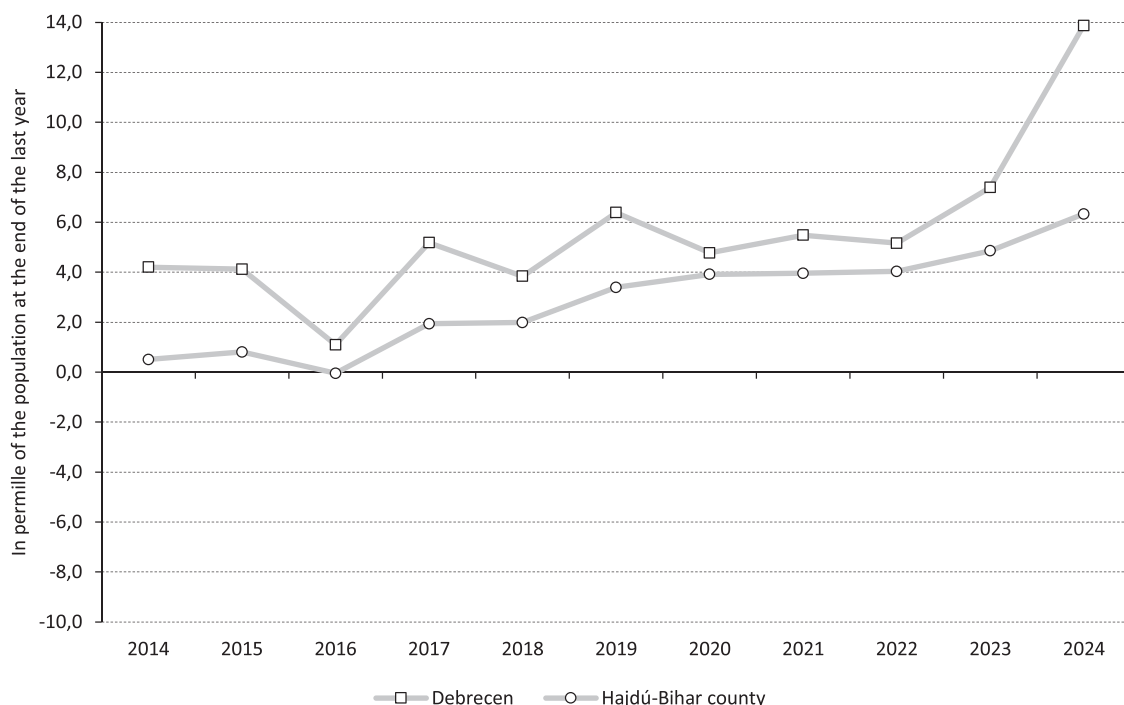


Fig. 5. International balance of migration in Debrecen and Hajdú-Bihar county; source: authors’ compilation based on HCSO data.

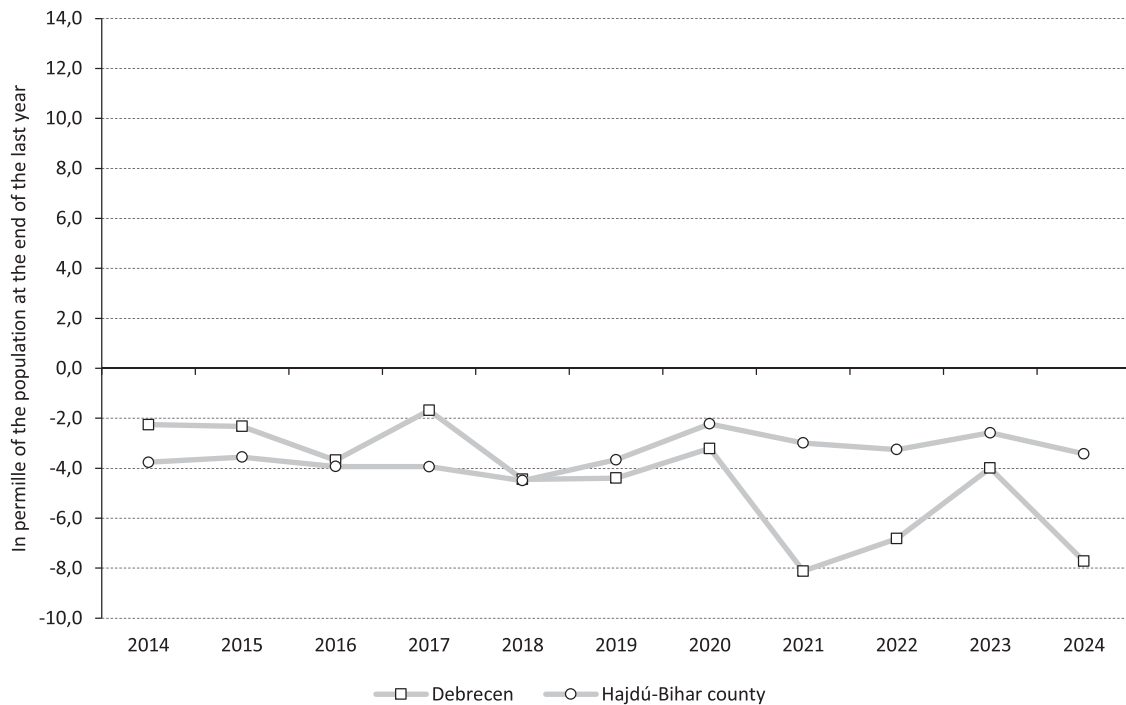


Fig. 6. Domestic balance of migration in Debrecen and Hajdú-Bihar county; source: authors' compilation based on HCSO data.

4.3. The production of new subjectivities?

The expected negative environmental and social consequences of the large-scale industrial developments heated local protest. Plant building of BMW on the best agricultural land released from protective regulations raised the aversions of local people first (MFOR, 2018). The protests entered a new level after the entry of battery producers whereby the most consistent resistance can be observed from the side of the local and locally embedded national NGOs. The fears are connected to the resource (electricity and water) needs and the potential environmental damage of battery production underlined by the widely-discussed conflicts of the first battery plant in Hungary (Samsung, Göd) which was mismanaged and in many senses, hushed up by the public authorities (Éltető, 2023). The entry of the second battery producer and the first registered water pollution of a battery components plant in Debrecen deepened these concerns. Scandalous public hearings, demonstrations, initiatives of local and national referendums, a conference with experts, negotiation and legal attack of environmental and emergency management permissions of the largest planned factory emerged as protest forms. In Debrecen, the narrative of becoming a “colony” of battery production was set against “world power” of battery production (Debreceiner, 2023; 2024).

The attitude of national government toward local protest(s) is confrontative: public referendum initiatives have been blocked, regulation of public hearings have been changed, protesters have been labelled as “enemies of the nation” limiting the spaces of discourses. In the case of the municipality having strong cooperation with the national government and striving for good connections with the economic actors but representing the local people as well, both elements of confrontation and “Umarmungspolitik” can be observed. While arguing with workplaces and local business tax revenues, the mayor's office organized a counter-campaign under the title “13 lies – 13 truths” about battery manufacturing. The credibility of the university was also exploited by involving their experts in the new environmental control system to be developed (I2). Despite the protests, the construction of new plants is going on, moreover, the municipal elections in 2024 has cemented the lead party's (Fidesz) and the mayor's position who received more votes than 5 years before. Apparently, the current imaginary which identifies

Debrecen as global hub of e-car production and also as ‘the second capital of Hungary’ incorporated the local polity, by throwing the long term social and environmental consequences to future generations, and ‘exporting’ negative externalities to the neighbouring communities. Mikepércs (in the vicinity of Debrecen and the CATL plant) emerged as a centre of environmental movement. Meanwhile, the central government's anti-migration rhetoric has been translated to fears by locals and is thought to result in the loss of credibility of the ruling party at municipal elections (2024) in the neighbouring small towns of Hajdúböszörmény and Hajdúnánás where the number of guest workers is rising rapidly and in a clearly visible way (Debreceiner, 2024).

5. Discussion

The new imaginary focused on re-defining the position of Hungary in the European and global industrial periphery was developed in the 2010s, as an economic space where the investors of the ‘East’ and the ‘West’ meet and interact. The vision has been developed and put in practice in a top-down manner, placing central governmental and corporate agency in the focus. The selectivity of the unfolding, centralised institutional-regulative system manifested in multiple ways, yet here we highlight the key agents of the system, their connectedness and practices, and how those manifest the social relations of peripheral industrialization in local spaces.

- (i) In capital-labour relations, the interests of productive capital were prioritized by the state through subsequent steps of curtailing employees' rights (Czirfusz et al., 2019) and state-orchestrated inward migration of workers from third countries. Such steps were legitimized by economic growth and employment as pillars of the prevailing imaginary. Nevertheless, conflicts are also emerging. MNEs and local firms, the automotive cluster and ‘outsiders’ to that are competing on a shrinking regional labour market, which exhibits how powerful non-local agents and sectoral interests grow dominant and channel resources in new activities while closing up opportunities for traditional industries and small firms including potential agents of path diversification/future suppliers. The growing positional

power of labour (Smith et al., 2014) is likely to result in higher salaries and better working conditions and also demonstrates that path change relying on low-cost resources is losing steam in the region. Finally, there is a tension emerging between the city and its hinterland due to spreading negative externalities of economic growth, which manifested in the realm of social reproduction (rising housing prices, jammed transportation lines) and left entirely to the surrounding municipalities to deal with.

- (ii) The selectivity of the current imaginary manifest in the highly uneven distribution of public resources and power which aim to support new path development through mega-projects. Those include not only infrastructure schemes, but pouring money in supporting employment and education programs. This entailed an extreme concentration of resources in selected localities, but tensions stemming from this selectivity were left unaddressed in lack of consistent regional and social policies. Although, the major centres of industrialization like Debrecen benefit from the current system, they also face multiple risks and loss of control over local processes. Our case study suggests that municipalities have to bear the enormous costs of changes in organizing everyday life (transportation, land use change, institutional capacities) and the requests of investors not addressed by the central government, which could push local governments into debt. The political risks are not less either. The current imaginary rests on bargaining between corporate and state agents which raised problems for (non-)transparency in local affairs undermining local democracy and possibly, the trust in local leadership in case of failure. Currently, such deficits are disguised by labelling the recent leadership 'pragmatic' and 'efficient' and legitimized by the expected boom in the local economy, yet such institutional practices are feared to erode community spirit and activism.
- (iii) The negative externalities of industrialization are largely environmental which are born by the residents of the urban hinterland disproportionately. This is a source of conflicts which emerged between and within municipalities entailing landslides in local politics and placed local leaders in a position in which they had to take side i.e. choosing between party loyalty or representing their community. Such conflicts also inspired the development of new subjectivities through locally embedded activism questioning the foundations of the current imaginary. Such movements are not isolated, they are organised at national scale, sharing knowledge and relational capital (Bródy et al., 2024), and along with municipal support, they challenge the current political system.
- (iv) In daily practices, the actual imaginary is made work by the strategic alliance of the central government, productive capital and municipal leaders, and also by the emerging coalition of corporate agents. The newly established Debrecen Automotive Cluster with the agile leadership of the BMW's executive manager integrates several transnational actors (e.g. BMW, CATL, EVE Power, Schaeffler) of the emerging industry. It has the aim to involve also local economic actors within and beyond the automotive industry and to shape the local assets (e.g. vocational training, public transport, local airport) according to the interest of its members. Hence, the new path has been institutionalized locally as an organization alternative to existing ones which represent local economic actors outside the cluster (chamber of industry and commerce, clusters of the food and the pharmaceutical industries, alliance of the local SSC sector etc.). The tensions stemming from competing for the same, limited local resources is still lurking and unspoken.
- (v) Another dimension of operationalizing the current imaginary is connecting corporate agency of the new path to local horizontal networks. It includes new initiatives to make foreign companies and their employees accepted, such as Deutsches Kulturforum Debrecen which promotes the arrival of the "German enterprise

culture" (I2) at Debrecen and builds trust between the new entrants and the local community. The activity of the organization now goes beyond the German-Hungarian relations. They established the OTT-HOME International Meeting Point ("otthon" means "home" in Hungarian), which is open to Chinese, Korean, Mexican etc. people offering a place for contacting, and organising intercultural trainings (I2) to make Debrecen more open and diverse by producing new subjectivities, yet leaving the fears and conflicts of everyday life unresolved at a regional scale. This initiative also highlights that making Debrecen a hub for the global industrial periphery is still very much driven by powerful agents of the European core (BMW).

6. Conclusions

Strategic coupling between automotive production networks and regional assets rests on the complementarities and shared interests of TNCs seeking cost-efficient production locations within the EU and the joint commitment of the Hungarian government and the municipality of Debrecen to be integrated in global production networks of electromobility. Nevertheless, the coupling processes, which are just giving rise to a new European hub of automotive industry were launched by the alliance of the international productive capital and the ruling political elite. This relationship manifested in an economic development imaginary which materialized in national policy documents, yet being constantly renegotiated as new problems and needs arise from the ongoing swift and thorough economic and social transformation. Today, Debrecen works as a laboratory for new path development, where powerful corporate agents are just taking the lead role over from government bodies in path development through formal organisations and informal networks. Nevertheless, local traditional industries and small businesses are under pressure due to the ongoing path change which poses risks for embedding of the new cluster as well as for diversification at firm level and in the local economy. This unfolding path change and firm relations should be studied further to reveal, how (whether) unrelated variety (Grillitsch et al., 2018) works in a context where resources are scarce and distributed unevenly.

Our case study delivered lessons on the ambiguous effects of path change on local firms and industries, such as crowding out on the labour market, uneven distribution of public funds and access to relational capital. Nevertheless, it also suggests to look beyond firm relations (Becker et al., 2020; Breul et al., 2021), and consider environment, communities, households, and workers as subjects and also as agents of economic transformations. In Debrecen, local citizens were (are being) distanced systematically from the decision-making steps which are changing their everyday life. The legitimation deficit of the path change and the related discontent is stemming from (i) the selection of key narratives i.e. superlatives stressing to scale and thoroughness of change particularly, the size of local battery industry against locally embedded-appreciated traditional industries; (ii) the inherent inconsistency of related political ideology i.e. migration policies vs. traditional community values and the retention of counter-narratives which related communities and environmental concerns; (iii) the structural constraints blocking information flow and lacking explanation of what was to happen locally moreover, obstruction of public discourse on ongoing investments. The latter is reflected in limiting the focus of local movements to environmental issues and the little concern with the long-term economic and social risks (Éltető, 2023; Györffy, 2023).

The emerging resistance forced all powerful local agents to take action. The municipal leaders have mobilised credible actors (the university, recognised international experts, businessmen) to change the local discourse and make changes accepted, along with discrediting environmental movements even though, it is likely to undermine the credibility of the institution of community self-governance. This strategy reflects not only the power relations in the highly centralised institutional system of the Hungarian state but also refers to the

interdependency between local and national politics. Although, the power asymmetry is unquestionable, the enormous public costs of the electromobility projects under the current fiscal conditions (which have been constantly on limbo for three years) have to be justified and yield tax revenues.

Finally, the strategic coupling between electromobility production networks and local economy bargained by the national and local economic development agencies under the strong commitment of the national government and the municipality seems to face challenges from outside now. The European economic policy context by shaping the regulation frame of electric transition and determining the conditions of trade and investments with the USA and China as the leading markets and powers of electromobility could entail a gloomy future for the sector. Recent trends i.e. the re-evaluating earlier electric transition policy bringing the European carmakers into a more disadvantageous position compared to their US and Chinese competitors or the changing conditions of international trade radically influenced by the steps of the new American government point toward less economic gains than earlier expected which could question the powerful imaginary of e-car production in Debrecen and beyond.

CRedit authorship contribution statement

Ernő Molnár: Writing – review & editing, Writing – original draft, Visualization, Resources, Methodology, Investigation, Formal analysis. **Gábor Kozma:** Resources, Methodology, Investigation, Formal analysis. **Erika Nagy:** Writing – review & editing, Writing – original draft, Resources, Methodology, Investigation, Formal analysis, Conceptualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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