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The Economical, Social, Political and Environmental Impacts of the CATL Battery Factory Regarding the City of Debrecen and its Region

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Abstract: In recent years, the Hungarian economy has increasingly concentrated on the automotive industry, particularly on battery production. This study examines the implications of CATL battery plant investment in Debrecen, focusing on residents' attitudes, city administration plans, and expert projections. The central question is whether factory construction will exacerbate existing economic, environmental, and socio-political issues in the region. These findings indicate that lithium-ion battery production poses significant environmental risks in the absence of stringent regulations. The semi-arid climate of Debrecen presents a challenge to the city's ability to manage its water resources effectively, particularly in light of the assurances provided by local authorities regarding the availability of water. The findings of researches conducted in the city indicate a lack of confidence in the efficacy of local environmental monitoring efforts and a significant level of opposition (over 60%) among residents who prefer factory relocation; from an economic perspective, the factory could potentially boost tax revenues (Skrydstrup et al., 2020). However, the low return on investment and substantial environmental damage anticipated, especially **during** the initial phase with lenient regulations, raises concerns about the long-term sustainability of the project. From a social perspective, the project offers limited benefits, with plans to employ lower-paid foreign workers because of a domestic labor shortage. Overall, investment is expected to impose significant political and social burdens on Debrecen, with potentially severe environmental consequences and insufficient economic returns to offset the damage (Debrecen City Governance, 2023).

Keywords: Battery Industry, Environmental Impact, Foreign Direct Investment (FDI), Hungarian CATL, Regional Development

JEL Codes: R11, O18, Q56, L52.

1. Introduction

One of the most pivotal roles in the ongoing struggle for environmental sustainability is to advocate for the increased utilization of electric transportation (International Energy Agency, 2022a). Over the past decade, the number of electric vehicles has increased exponentially; while there were almost no such vehicles in 2010, by 2021 their number had increased to 16.5 million globally (International Energy Agency, 2022a). The imperative to decarbonize is expected to reinforce this trend, which will significantly increase the demand for batteries for electric cars (Hungarian Government, 2022; Hawkins, 2024; Polyák, 2024). The significance of the region is reflected in the fact that, in the global context of 2021, Hungary had become the third largest producer of batteries, with a production capacity of 28 gigawatt hours, after China and the United States (Yu-Sumangil, 2021; Samsung SDI, 2019). This capacity is set to be augmented by the Chinese Contemporary Amperex Technology Co., Limited (CATL) in 2025, with an investment of 7.34 billion euros in Debrecen to create 100 gigawatt-hours of capacity (Szabó et al., 2022).

This study examines the question of whether battery production in the Hungarian economy, with significant government support, will serve Hungary's long-term economic catch-up. Four specific areas require further investigation. The initial area of focus is the economic aspect. Secondly, it is necessary to consider the social influence on local communities and the lives of the people of Debrecen. Thirdly, it is inevitable to examine the potential impact of the factory on the local environment, including the soil, water, air, and other natural resources. Finally, it is crucial to comprehend the political conflicts surrounding the construction of the battery factory, as well as the perspectives and prevailing sentiments of non-governmental organizations and political parties.

The research is guided by the following question: How does the establishment of the CATL battery factory in Debrecen affect the region's economic development and environmental sustainability, what are the related social implications, how does it contribute to political polarization and public mistrust, and what are the perceived long-term consequences for local stakeholders?

2. Literature Review

To ensure clarity and consistency throughout this manuscript, the following key concepts are defined at the outset of this literature review:

2.1. Political Legitimacy

Political legitimacy is defined as a virtue of political institutions and the decisions made within them, encompassing laws, policies, and candidates for political office. It can be understood descriptively, referring to people's beliefs about political authority, or normatively, concerning the justification of political power or authority and the associated obligations (Peter, 2017). A **legitimacy deficit** would therefore imply a shortfall in this virtue, indicating a lack of justification or acceptance of political power or authority.

2.2. Legitimacy Deficit

A **legitimacy deficit** refers to a situation where a political entity, such as a state, lacks sufficient justification or acceptance of its authority and actions by its constituents. This can manifest in various forms, including failures in **input legitimacy** (lack of mechanisms for authorization considered legitimate by the people), **output legitimacy** (failure to provide effective governance or deliver public goods), and **identity-based legitimacy** (challenges arising from the role of identity in shaping alternative visions and grievances against the state) (Lindberg, 2021).

2.3. Social License to Operate (SLO)

Social License to Operate (SLO) refers to the ongoing acceptance of a company or industry's standard business practices and operating procedures by its stakeholders and the general public. It is an informal contract that signifies a community's approval and broad acceptance of an operation. More specifically, SLO can be understood as a community's ongoing acceptance of operations in cases where that community holds a **moral authority** over those operations, meaning their acceptance is a necessary condition for the operations' overall moral legitimacy (Thomson & Boutilier, 2011).

2.4. Public Trust

Public trust refers to the confidence and belief that citizens have in their government institutions and officials to act in the best interests of the public. This concept is crucial as it underpins the legitimacy of governmental authority, influences public opinion, and affects the overall stability of democratic systems. High levels of public trust generally lead to greater civic engagement and compliance with laws and regulations (OECD, 2017).

2.5. CORIS Framework (Challenge-Oriented Regional Innovation Systems)

The **Challenge-Oriented Regional Innovation Systems (CORIS)** framework is an approach that re-evaluates the traditional Regional Innovation System (RIS) concept. While conventional RIS focuses on technological and business innovation for competitiveness and economic growth, CORIS addresses persistent environmental and social challenges (e.g., climate change, aging, inequalities). This framework embraces a more critical view of innovation, emphasizes the directionality of change, incorporates new innovation actors across different territorial scales, and prioritizes the application and upscaling of innovation within and beyond the region (Tödtling et al., 2022).

This literature review establishes the theoretical and empirical context for analyzing the CATL battery factory investment in Debrecen. It critically examines key academic debates and relevant studies across several domains: regional innovation systems, particularly the challenge-oriented approach; mission-oriented innovation policies; the environmental impacts of lithium-ion battery production; and the regulatory, policy, and local development contexts in Hungary.

2.5.1. Regional Innovation Systems and the Challenge-Oriented Approach

While traditional regional innovation systems (RIS) focus on technological growth, CORIS emphasizes mission-driven innovation to address complex societal challenges. This framework is particularly relevant to the **Political Dimension** sub-question, which examines how power dynamics and governance structures influence public trust and polarization in the context of large-scale foreign investments.

CORIS addresses these limitations by emphasizing mission-driven innovation aimed at specific regional challenges (Isaksen et al., 2022; Tödtling et al., 2021). It promotes collaboration among diverse stakeholders—including government, businesses, research institutions, and civil society—to foster an innovation ecosystem that generates and implements new solutions (Tödtling et al., 2021; Trippel et al., 2022). Unlike the often-decentralized governance of traditional RIS, CORIS advocates for more centralized coordination to tackle complex, multi-sectoral problems (Tödtling et al., 2021).

However, a critical analysis of CORIS reveals potential limitations, particularly in the context of post-socialist countries like Hungary. The framework may present an idealized view of institutional influence and harmony between government and regional decision-makers, often overlooking significant power imbalances between local governments and multinational investors (Purdy, 2016). Furthermore, its technological optimism might not adequately address fundamental environmental challenges inherent in industries like battery manufacturing, especially when communication on environmental protection mismatches actual production impacts. These limitations necessitate adapting the framework to account for the substantial power differences prevalent in such contexts. While Trippel et al. (2021) examine automotive regions in transition, their analysis often overlooks the distinct environmental and skill-related demands of a shift to battery manufacturing. This subsection, therefore, sets the stage for a critical application of the CORIS framework, adapted to the specific political and institutional realities of the Debrecen case.

2.5.2. Challenge-Oriented Innovation Policies

Building on the CORIS framework, this section examines **mission-oriented innovation policies**, as conceptualized by Mazzucato (2018). This theoretical lens is essential for addressing the **Economic Viability** sub-question, as it provides a framework for assessing whether state-provided resources and public subsidies for the CATL factory align with broader societal goals, such as sustainable economic growth and decarbonization.

However, applying Mazzucato's theory to Hungary's investment-driven growth model reveals contradictions. The theory assumes significant state autonomy and bargaining power, which may not hold true in Hungary, where competition for foreign investment can lead to deregulation and weaker environmental controls. Moreover, Mazzucato's 'entrepreneurial state' framework may not fully account for the relational networks in former socialist countries, where investment decisions might serve individual interests over strategic development. Voszka's (2019) research provides valuable context on national industrial policies in a global environment, highlighting challenges governments face in balancing political autonomy with attracting foreign investment, a dynamic clearly evident in the CATL case. This critical perspective is crucial for evaluating the true economic costs and benefits of the CATL investment, moving beyond simplistic job creation metrics.

2.5.3. Environmental Impacts of Lithium-Ion Battery Manufacturing

The following review of the literature on raw material extraction, manufacturing processes, and waste management provides the scientific basis for assessing the quantifiable environmental risks posed by the CATL factory in Debrecen.

The environmental implications of lithium-ion battery production are central to this study. Li et al. (2018) provides a comprehensive overview of battery developments, including environmental impacts from raw material extraction and manufacturing. These processes are associated with significant environmental impacts, including habitat destruction, water pollution, and resource depletion, often raising ethical concerns regarding sourcing (Li et al., 2018; Philippot et al., 2019). Improper disposal can lead to the leakage of hazardous chemicals, soil and groundwater contamination, and the loss of valuable materials (Toshiba 2024; Manthiram, 2017).

However, critical analysis highlights methodological limitations in some literature, such as Li et al.'s primary focus on technical aspects with limited analysis of social impacts or comprehensive life cycle assessments, particularly concerning water use and toxic waste management. Philippot et al. (2019) specifically examine the water footprint of battery production, a crucial aspect for water-scarce regions like Debrecen. Yet, their methodology, while robust for direct process water accounting, may overlook broader hydrological impacts (e.g., watershed integrity, groundwater resources) critical in diverse geographical settings. This raises the fundamental question of whether large-scale battery production can be truly sustainable in arid areas. Yang et al. (2023) offer a more holistic view on sustainable battery production through digital economic developments, while Wu's (2024) research on the acceptance of Chinese battery manufacturers in Hungary provides important context on local power relations and social acceptance.

2.5.4. Regulatory and Policy Context

Understanding the interplay between EU regulations, national strategies, and local governance is crucial for evaluating the effectiveness of the existing frameworks in mitigating risks and ensuring sustainable outcomes.

European Commission regulations provide the supranational framework for environmental and sustainability compliance, though their implementation can present nuances, sometimes diverting attention from direct manufacturing impacts or supporting problematic developments (European Commission, 2023).

At the national level, the Hungarian Investment Promotion Agency (HIPA) website and the Hungarian Government's (2022) "National Battery Industry Strategy 2030" outline the policy framework. HIPA's reports, while providing data on investment scale, often rely on optimistic economic forecasts and uncritically assume sustainable development, necessitating critical evaluation. The National Battery Strategy itself, while outlining policy, has analytical shortcomings, including reliance on general assumptions for environmental impact assessments and a focus on manufacturing that risks dependent development rather than innovation. This suggests a more political than comprehensive development plan, requiring rethinking for balanced regional development.

2.5.5. Regional and Local Development Context

By examining existing research on local economic development, labor issues, and regional disparities in Hungary, this section provides the necessary background for understanding the community's perceptions and the potential social impacts of the CATL factory.

Bajmócy (2011) provides a theoretical framework for local economic development, though its applicability can be limited by overestimating local government bargaining power against large international firms and lacking specific tools for environmental impact assessment. Bodnár's articles (2021, 2022, 2023) offer empirically valuable case studies on environmental violations and labor issues, despite methodological scrutiny due to their journalistic format. Gyórfy (2021) examines regional economic disparities, highlighting how weak institutional quality can hinder development benefits, though its macro-level analysis may overlook crucial regional and local differences. Nagy et al. (2019) explore reindustrialization in Central and Eastern Europe, with implications for foreign worker employment, but their framework may oversimplify regional nuances and predate significant global disruptions.

2.6. Conclusion of the Literature Review

This comprehensive review of the literature has established the theoretical and empirical context for analyzing the CATL battery factory investment in Debrecen. While each domain offers valuable insights, several critical gaps and areas for further investigation have emerged, which this study aims to address.

Firstly, existing frameworks such as the Challenge-Oriented Regional Innovation System (CORIS) and mission-oriented innovation policies, while powerful, often present an idealized view that may not fully account for the complex power dynamics and institutional realities prevalent in post-socialist economies like Hungary. The literature reveals a need for more nuanced applications of these theories, particularly in understanding how they interact with foreign direct investment (FDI) pressures and local governance structures. This study contributes by critically adapting these frameworks to analyze the specific case of the CATL investment, thereby enriching the understanding of their applicability in contexts marked by significant power asymmetries.

Secondly, despite extensive research on the environmental impacts of lithium-ion battery production, there remains a critical need for context-specific assessments, especially concerning water-scarce regions and the broader hydrological impacts beyond direct process water accounting. The current literature emphasizes technological solutions but less frequently addresses the systemic environmental challenges inherent in large-scale manufacturing in vulnerable ecosystems. The research addresses this gap by scrutinizing the environmental sustainability of the CATL factory within Debrecen's semi-arid climate, focusing on water

consumption, hazardous waste management, and soil contamination, and evaluating the adequacy of local regulatory frameworks.

Thirdly, the literature highlights a limited understanding of how regional innovation systems can effectively transform economic development with broader environmental and social goals, particularly in the context of rapid industrial transformation in Central and Eastern European regions. There is a scarcity of research that comprehensively integrates economic, environmental, social, and political dimensions to provide a holistic view of such mega-projects. This study bridges this gap by offering a multidimensional analysis, examining the interplay between industrial development, environmental health, social stability, and political trust. By doing so, it provides a robust case study for advancing theoretical and empirical knowledge on sustainable regional development in similar contexts.

In synthesizing these insights, this literature review underscores the necessity of a holistic and critically informed approach to evaluating large-scale industrial investments. The identified gaps directly inform the sub-questions guiding this research, ensuring that the study contributes meaningfully to academic discourse and provides practical insights for policymakers and local stakeholders grappling with the complex trade-offs of economic development and sustainability.

3. Research question/objectives

The global transition to electric mobility has positioned Hungary as a key hub for battery manufacturing, highlighted by the €7.34 billion investment from Contemporary Amperex Technology Co., Limited (CATL) to build a massive battery factory in Debrecen. While promoted as a landmark project for economic growth, the investment has ignited significant public controversy and political debate. This research provides a multidimensional analysis of the project's anticipated impacts, moving beyond simple economic metrics to explore the complex interplay between industrial development, environmental health, and social stability.

The central research question guiding this study is: How does the establishment of the CATL battery factory in Debrecen affect the region's economic development and environmental sustainability, what are the related social implications, how does it contribute to political polarization and public mistrust, and what are the perceived long-term consequences for local stakeholders?

To address the multifaceted nature of the central research question, this study will be guided by the following four sub-questions, each aligned with a key analytical dimension:

1. **The Economic Viability Question:** To what extent does the CATL factory investment contribute to sustainable regional development, and how do the economic benefits (e.g., job creation, tax revenue) weigh against the costs (e.g., public subsidies, reliance on foreign labor, risk of dependency)?
2. **The Environmental Sustainability Question:** What are the quantifiable environmental risks posed by the factory—particularly concerning water consumption, hazardous waste management, and soil contamination—and are the existing regulatory and monitoring frameworks sufficient to mitigate these risks effectively?
3. **The Social Acceptance Question:** How does the local community in Debrecen perceive the social impacts of the factory, including the effects of a large expatriate workforce on social cohesion, public services, and quality of life, and what factors shape their 'social license to operate'?
4. **The Governance and Political Trust Question:** In what ways has the decision-making process surrounding the CATL investment influenced political polarization and public trust, and how do the power dynamics between the national government, local authorities, and the multinational corporation align with the principles of a Challenge-Oriented Regional Innovation System?

(CORIS)? The research delves into the political conflict and governance failures surrounding the investment. It seeks to understand the roots of widespread public mistrust, the exclusion of local communities from the decision-making process, and the power imbalances between the national government, the multinational corporation, and local authorities.

This study employs a mixed-methods approach within a Challenge-Oriented Regional Innovation System (CORIS) framework. By focusing on these interconnected economic, environmental, social, and political dimensions, the research aims to provide a holistic understanding of the CATL investment, offering crucial insights for ensuring that future industrial projects align with principles of sustainable and equitable development.

4. Methodology

The study employs a mixed-methods research design to provide a comprehensive analysis of the economic, environmental, social, and political impacts of the CATL battery factory investment in Debrecen. The methodology is structured around the Challenge-Oriented Regional Innovation System (CORIS) framework, which guides data collection and analysis by focusing on how the region responds to the multifaceted challenges posed by the investment.

The research is built on two pillars: primary and secondary data collection. Secondary research involved a systematic review of academic literature, government reports, policy documents, and media sources to establish a foundational context (Boncz, 2015; Stewart & Kamins, 1993). However, due to the politically sensitive nature of the topic and the early stage of the investment, much of the necessary data was unavailable or biased, necessitating a strong focus on primary data collection (Boncz, 2015).

The primary research consists of three distinct methods:

1. **Qualitative In-depth Interviews:** Eight semi-structured interviews were conducted with key stakeholders, including senior city government officials, opposition representatives, and members of non-governmental organizations (NGOs). Snowball sampling technique was used to access these hard-to-reach individuals (Patton, 2015; Bryman, 2016; Noy, 2008). The interviews were designed to capture nuanced perspectives on the investment's preparation, perceived impacts, and the surrounding political controversies. Data was manually transcribed, anonymized, and thematically coded using the CORIS framework to identify key regional challenges, actor roles, and collaborative networks.
2. **Qualitative Survey with an Observational Phase:** A survey of 150 individuals was conducted at Debrecen's main railway station using a quota sampling method to ensure demographic diversity across age and gender (Babbie, 2020). This method combined two elements: participants were asked for their immediate word association with the "Debrecen battery factory," while an observer simultaneously documented their non-verbal emotional reactions (facial expressions and body language). This innovative approach captured both conscious attitudes and subconscious, pre-reflective responses, providing deeper insight into public sentiment (Davidson et al., 2016).
3. **Quantitative Attitude Survey:** A quick, single-question online survey was distributed via social media to gauge public opinion. The question, "How do you feel about the battery factory investment near Debrecen?", garnered 112 responses, which were analysed to provide a broad quantitative measure of positive, negative, and neutral sentiments toward the project.

By integrating these qualitative and quantitative findings, the methodology facilitates a robust, multi-dimensional analysis. The in-depth interviews provide expert context and detail, the observational survey

captures raw public perception and emotion, and the attitude survey offers a snapshot of overall public opinion. This triangulation of data ensures a more valid and holistic understanding of the complex impacts of the CATL investment on the Debrecen region (Creswell, 2017).

5. Results

The results of this multifaceted investigation into the CATL battery factory investment in Debrecen reveal a deeply polarized landscape, where official narratives of economic progress clash with significant public apprehension and documented risks. Analysed through the Challenge-Oriented Regional Innovation System (CORIS) framework, the findings indicate a regional system under strain, struggling to balance externally imposed industrial ambitions with local environmental, social, and political realities.

5.1. Stakeholder Perspectives and Governance Failures

The in-depth interviews exposed a fundamental schism between government officials and local stakeholders. City administration representatives framed the investment as a strategic necessity for economic development, attributing public opposition to politically motivated misinformation spread by opposition parties. They emphasized the robustness of official environmental monitoring systems, asserting that all operations would comply with legal standards.

In stark contrast, opposition representatives and non-governmental organizations (NGOs) painted a picture of a top-down, non-transparent process that has actively marginalized the local community. They cited the repeated rejection of local referendums and the government's use of a "priority investment" designation as proof that democratic principles and the public's right to consultation under the Aarhus Convention were bypassed. These stakeholders expressed profound mistrust in the official environmental impact assessments, which they described as superficial and tailored to facilitate, rather than scrutinize, the investment. This governance failure has created a significant legitimacy deficit, undermining social acceptance crucial for sustainable development.

5.2. Public Perception and Emotional Response

The quantitative and qualitative surveys confirmed that this legitimacy deficit is widespread among the public. The online attitude survey revealed that a clear majority of respondents (65%) hold a negative view of the investment, with only 20% expressing positive sentiment.

The observational survey provided deeper insight into these attitudes. While "economic development" and "job creation" were mentioned as positive associations, they were largely accompanied by negative terms like "pollution," "environmental degradation," "wastewater," and "insecurity." A striking finding was the disconnect between verbal responses and emotional reactions. A significant majority of participants (67%) displayed neutral or unreadable facial expressions, even when voicing an opinion. However, when emotions were visible, negative expressions were far more common and strongly correlated with negative verbal associations. This suggests that while many may be undecided or disengaged, those who are engaged are predominantly concerned.

Generational differences were also notable. Younger generations (Z and Y) were more likely to mention both technological innovation and environmental pollution, reflecting a dual awareness of promise and peril. Older generations (X and Baby Boomers) focused more on economic risks and social instability (Twenge and Campbell, 2009). This divergence highlights that the community is not a monolith; different demographics perceive the challenges and opportunities of the investment in distinct ways.

5.3. Economic Impacts: A High-Risk Venture

The study's analysis of the economic dimension reveals that the CATL factory represents a high-risk, state-driven venture rather than a market-led development. While the projected GDP contribution is substantial, the reliance on massive state subsidies (with payback periods estimated between 7.5 and 17 years) raises serious questions about its long-term viability, especially given the rapid pace of technological change in the battery sector (Járdi, 2023; Szabó, 2022a).

Furthermore, the promise of local job creation appears tenuous. The reliance on imported labor from countries like the Philippines, often at lower effective wages and under precarious leasing arrangements, means the primary economic benefits may not flow to the local community (Spirk, 2023). Instead of fostering endogenous innovation and building local skills, this model risks creating a dependent "low-value manufacturing" enclave, locking Debrecen into a vulnerable position within the global supply chain without significant knowledge transfer or local economic integration (Tödtling et al., 2021).

5.4. Environmental Harm: A Significant Challenge

The environmental findings present the most concerning findings. The factory's immense water demand poses a direct threat to Debrecen's semi-arid climate and already strained water resources. Independent analysis suggests water consumption could be significantly higher than officially disclosed figures and promises to use treated greywater remain vague and unenforceable (Hancz, 2024; Philippot et al., 2019).

The risk of chemical contamination from heavy metals and other toxic substances is a primary concern, amplified by a regulatory environment that interviewees described as deliberately weakened to attract foreign investment (Bodnár, 2023; Hungarian Government Office, 2023b). The lack of a robust, independent environmental monitoring system and the authorities' perceived leniency towards existing polluters have eroded public confidence that safety standards will be enforced (Czirfusz, 2022; Degen & Schütte, 2022). The potential for Hungary to become a destination for toxic electronic waste under future EU recycling mandates further compounds these fears.

6. Discussion

While the project is framed as a catalyst for economic modernization, it simultaneously exposes deep-seated tensions between national industrial policy, regional sustainability, and democratic governance. This discussion interprets the results through the lens of the Challenge-Oriented Regional Innovation System (CORIS) framework, highlighting the systemic failures and potential pathways forward.

6.1. The CORIS Framework in a Post-Socialist Context: A Mismatch of Theory and Reality

The CORIS framework, with its emphasis on mission-driven collaboration and multi-stakeholder engagement, provides a useful ideal for assessing the Debrecen case. However, the reality on the ground reveals a significant mismatch. Instead of a collaborative ecosystem, the findings point to a top-down, state-led model where the national government and a multinational corporation dictate terms, largely excluding local government, civil society, and the public from meaningful participation. This aligns with critiques of the CORIS framework that question its applicability in contexts with high power asymmetries and weak institutional capacity (Purdy, 2016).

The Debrecen case suggests that in post-socialist countries like Hungary, where centralized power and a reliance on foreign direct investment are dominant features of the political economy, the CORIS model may be more aspirational than descriptive. The "challenge" being addressed appears to be less about regional

sustainability and more about fulfilling a national industrial strategy, even at the expense of local well-being. This raises a critical question for both theory and practice: How can the principles of challenge-oriented innovation be adapted to function effectively in environments where democratic institutions are under pressure and state-corporate power is concentrated?

6.2. The Illusion of Economic Modernization: Dependency and the Low-Value Trap

The economic analysis reveals that the CATL investment, while significant in scale, may not deliver the promised benefits of sustainable regional development. The reliance on substantial public subsidies, coupled with the importation of a low-wage foreign workforce, suggests a model of dependent development rather than genuine economic upgrading. This approach risks locking Debrecen into a “low-value manufacturing” trap, where the region provides cheap labor and resources without capturing the higher-value aspects of the innovation chain, such as research and development or strategic management (Tödtling et al., 2021).

This finding challenges the prevailing narrative of FDI-led growth in Hungary, suggesting that not all investment is equally beneficial. Without strong institutional frameworks to ensure knowledge transfer, local sourcing, and fair labor practices, such mega-projects can exacerbate existing inequalities and create a dual economy, with a high-tech, foreign-owned enclave disconnected from the local economic fabric. This underscores the need for a more discerning and strategic approach to industrial policy, one that prioritizes long-term regional resilience over short-term GDP growth.

6.3. Environmental Risks and the Erosion of Public Trust

The environmental findings are perhaps the most stark, highlighting the tangible risks of locating a water-intensive and potentially polluting industry in a semi-arid region. The lack of transparent and credible environmental impact assessments, coupled with a history of regulatory leniency, has created a deep-seated public mistrust that cannot be dismissed as mere misinformation. This erosion of trust is a critical failure of governance, as it undermines the social license to operate and fuels political polarization.

The Debrecen case serves as a powerful reminder that environmental sustainability is not a technical problem to be solved by engineering solutions alone; it is fundamentally a political and social issue. Without robust, independent, and transparent environmental governance, even the most technologically advanced projects will face legitimate public opposition. This highlights the urgent need for a paradigm shift in how environmental risks are assessed and communicated, moving from a compliance-based approach to one that prioritizes public participation, precaution, and long-term ecological stewardship.

6.4. The Social Dimension: A Community Divided

The social impacts of the CATL investment are complex and multifaceted. While some residents see the potential for economic opportunity, a significant portion of the community is deeply concerned about the erosion of their quality of life, the strain on public services, and the potential for social friction arising from a large influx of foreign workers. These concerns are not simply a matter of xenophobia; they reflect a legitimate anxiety about the capacity of the local community to absorb such a rapid and large-scale transformation.

The generational divide in perceptions is particularly revealing. Younger generations’ simultaneous awareness of technological promise and environmental peril suggests a more nuanced and perhaps more realistic understanding of the trade-offs involved. Older generations’ focus on economic and social stability reflects a deep-seated concern for the preservation of their community’s character and way of life. These

divergent perspectives underscore the need for a more inclusive and participatory approach to development, one that acknowledges and addresses the diverse concerns of all community members.

7. Conclusion

The study has provided a multidimensional analysis of the CATL battery factory investment in Debrecen, revealing a complex and often contradictory landscape of economic ambition, environmental risk, and social tension. The findings challenge the simplistic narrative of foreign direct investment as a panacea for regional development, highlighting the critical importance of robust governance, environmental stewardship, and public trust in ensuring sustainable and equitable outcomes.

The central conclusion of this research is that the CATL investment, in its current form, represents a significant gamble for the Debrecen region. While the potential economic benefits are substantial, they are accompanied by equally significant risks, including environmental degradation, social disruption, and the erosion of democratic accountability. The study's analysis through the Challenge-Oriented Regional Innovation System (CORIS) framework reveals a system that is failing to effectively balance these competing interests, with a top-down, state-led approach that has marginalized local stakeholders and fueled public mistrust.

The implications of these findings are far-reaching. For policymakers, the study underscores the need for a more strategic and discerning approach to industrial policy, one that prioritizes long-term regional resilience over short-term economic gains. It highlights the urgent need for stronger environmental regulations, more transparent and participatory decision-making processes, and a greater emphasis on building local innovation capacity. For local communities, this research provides a framework for understanding and articulating the complex trade-offs involved in large-scale industrial projects, empowering them to advocate for their interests and hold decision-makers accountable.

This study also contributes to the academic literature on regional innovation systems, mission-oriented innovation policies, and the political economy of post-socialist development. It demonstrates the need for a more critical and context-sensitive application of these theoretical frameworks, particularly in environments characterized by high power asymmetries and weak institutional capacity. By providing a rich, empirically grounded case study, this research offers valuable insights for scholars seeking to understand the complex interplay of economic, environmental, social, and political forces shaping regional development in the 21st century.

Looking ahead, further research is needed to monitor the long-term impacts of the CATL investment as it moves from construction to operation. Longitudinal studies will be crucial for tracking the actual economic benefits, environmental consequences, and social changes over time. Comparative research with other battery factory investments in Europe and beyond would also provide valuable context and help to identify best practices for ensuring that the transition to a green economy is both just and sustainable.

In conclusion, the case of the CATL battery factory in Debrecen serves as a powerful cautionary tale. It reminds us that the path to a sustainable future is not simply a matter of technological innovation; it is a complex and often contentious process that requires careful navigation of competing interests, a deep commitment to democratic principles, and a steadfast focus on the well-being of both people and the planet.

Conflict of Interest Statement

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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