

UNIVERSITY OF PÉCS
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Doctoral School of Earth Sciences

**The impact of disruptions in global
supply chains caused by COVID-19 on
Hungarian enterprises**

PhD thesis

Szabó, Zoltán Tamás

Supervisors

Dr. Alpek, Balázs Levente
Assistant professor

Dr. György, László
Assistant professor



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| NAME AND ADDRESS OF THE DOCTORAL SCHOOL: | University of Pécs, Doctoral School of Earth Sciences, H-7624 Pécs, Ifjúság útja 6. |
| LEADER OF THE DOCTORAL SCHOOL: | Dr. Geresdi, István DSc, professor Institute of Geography, Department of Geology and Meteorology |
| NAME OF THE DOCTORAL PROGRAM: | Geopolitics, geoeconomics, and political geography from a Central European perspective |
| MANAGER OF THE DOCTORAL PROGRAM: | Dr. Pap, Norbert DSc, professor Institute of Geography, Department of Political Geography, Development and Regional Studies |
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| SUPERVISORS: | Dr. Alpek, Balázs Levente assistant professor, Institute of Geography, Department of Human Geography and Urban Studies Dr. György, László assistant professor, Department of Comparative Economics |

1. INTRODUCTION

The geoeconomic disruptions arising from the COVID-19 pandemic have revitalized the professional discourse surrounding the organization and vulnerability of supply chains, as well as the issues of globalization and regionalization. The question has gained significant weight not only in academic analyses but also in the objectives and tools of EU and national economic policy. The transformation of supply chains and the rise of regionalization may offer opportunities for the Hungarian economy alongside the risks stemming from the changes.

The dissertation primarily examines the challenges faced by supply networks, the responses to these challenges, and the perspectives on supply security, resilience, and adaptability from the viewpoint of geoeconomic risks affecting Hungarian enterprises. The relevance of the question stems from the fact that the pandemic posed a significant challenge for the Hungarian economy, which has a developed and complex export portfolio yet is open and highly sensitive to input disruptions. However, the increasing emphasis on supply security following the crisis, along with the capability to adapt to new trends, can contribute to the development of the domestic economy and the realization of economic policy objectives aiming for convergence with the European core economies.

The COVID-19 pandemic and the escalation of the Russo-Ukrainian war have intensified certain deglobalization processes and their associated risks, which could determine the longer term opportunities for the Hungarian economy. Analyzing the effects of the COVID-19 pandemic is also beneficial as a framework because it allows for ex-post analyses that can be relevant in relation to the current crisis affecting certain supply chains in Europe – mainly energy carriers, food, and certain raw materials. The research on this topic is also timely and relevant, as significant dilemmas and differing professional opinions have emerged over the past one and a half decades regarding Hungary's convergence trajectory and the efficiency of the market economic model largely built on the foreign-owned manufacturing export sector, which is, to some extent, dependent in nature. Since the 2010s, the globally observable, but even more pronounced increase in state intervention in Hungary, the encouragement of domestic capital accumulation, and the success of specialization strategies towards higher value-added activities can significantly determine the success of the domestic economy's convergence to the core economies.

Uncovering the main reasons and explanatory variables behind the resilience, adaptability, and vulnerability of domestic enterprises to the disruptions caused by COVID-19 and positioning them within the framework of EU economic policy and global trends, can facilitate the identification of opportunities for the domestic economy. Additionally, it can promote the recognition and substantive exploitation of opportunities inherent in the change, alongside more efficient adaptation to the new situation and current challenges.

2. RESEARCH GOALS

The primary objective of this research is to determine how the COVID-19 pandemic affected the operation of domestic enterprises and to uncover the geoeconomic background and interrelations of these processes.

The study examines the disturbances arising from the pandemic and the interconnections of the global economic system, EU policy, and domestic economic policy through two main sets of criteria.

2.1. Objectives related to the exploration of geoeconomic and macroeconomic contexts

The overarching aim of this study is to examine various spatial, historical, institutional, structural, technological, competitiveness, and resilience aspects of the Hungarian economy, primarily from the perspectives of geoeconomics and economic policy. Following the establishment of a geopolitical, economic and institutional historical, operational organization, and foreign trade context, the research scrutinizes the influence manifested in these dimensions due to the disturbances arising from the COVID-19 pandemic, which has had a significant impact on both global economic trends, national and community industrial and economic policies, as well as the professional discourse related to supply networks and value chains.

- (1) Primarily through economic effects, especially those affecting supply chains, as well as the impact of disruptions surrounding the supply chains on the economy, society, economic policy, production organization, and the way we think about supply security.
- (2) In relation to this, in light of the national economic policy's convergence objectives, the study addresses – beyond the impact of the COVID-19 pandemic on the domestic economy and businesses:
 - a) On one hand, the opportunities emerging from processes initiated by the crisis. For instance, the domestic rise of digitalization or the potential shortening of supply chains, as well as along the lines of EU regionalization, reshoring, and sustainability objectives;
 - b) On the other hand, the dangers and challenges posed by the crisis and the intensifying geopolitical tensions since then for domestic enterprises and the national economy as a whole. Such as the aftermath of the COVID-19 pandemic or the risks presented by disruptions and supply issues stemming from the widening of the Russo-Ukrainian war.
- (3) An overview of the economic, geopolitical, and geoeconomic factors influencing the development of global supply networks.
- (4) An overview of the main arguments and relations emerging in the professional discourse related to the shortening of supply chains and sustainability objectives. Furthermore, a comparison of the main elements in this discourse with the answers obtained from the primary research questions directed in this manner

2.2. Analysis of micro-level data, uncovering resilience elements

The subject of this paper culminates in the analysis of the effects of the COVID-19 pandemic on supply chains and the domestic economy through the operation of domestic small, medium, and large enterprises. This is followed by positioning the results within the context of global geoeconomics, EU community, and national-level economic policies. The exploration of relevant relationships occurs along the following objectives:

- (1) Presentation of the historical and geographical context of the integration of the Hungarian economy into the European and world economies.
- (2) Analysis of the effects of the COVID-19 pandemic on the corporate sector:
 - a) Analyzing and uncovering the impact of the COVID-19 pandemic on Hungarian enterprises in terms of:
 - revenue,
 - business operations,
 - elements of their supply networks,
 - observable adaptation strategies.
 - b) Identifying the criteria by which the resilience and vulnerability of domestic enterprises appear in relation to disturbances caused by COVID-19.
 - c) Presentation of the dimensions and areas in which potential production difficulties emerged.
 - d) Specific questions related to supply chains.

Furthermore, the paper presents and explores issues affecting domestic enterprises that influence the geoeconomic context of the domestic economy, as well as its global exposure and prospects, such as:

- (1) the background and logic of the formation of global supply networks in the context of world-system theory;
- (2) the professional discourse on the transformation of supply networks, revitalized by the disturbances caused by COVID-19, and the evolution of production systems;
- (3) international trends emerging or intensifying as a result of the pandemic;
- (4) energy security as a current threat;
- (5) supply security in Hungary.

Main research hypotheses:

- (1) In comparison to the trends observed during the financial crisis starting in 2008, the economic disparities between counties, expressed as a ratio to the national GDP per capita compared to the national average, showed a decrease in 2020 during COVID-19.
- (2) Following COVID-19, the impact observed on the operations and labor force of companies in the sample moved in tandem, and they showed consistent direction, with a statistically significant correlation between them.
- (3) The severity of labor-force related issues emerging from the COVID-19 pandemic in the sample is associated with business demographic characteristics.

- a) Within the sample, the severity of labor-force related issues due to the COVID-19 pandemic significantly differed between the SME sector and large enterprises.
- b) In the sample, the severity of labor-force related issues due to the COVID-19 pandemic was more pronounced in large enterprises than in the SME sector.
- (4) In the sample, the extent of supply disturbances experienced as a result of problems arising from the COVID-19 pandemic correlates with certain business demographic features.
 - a) Within the sample, supply disturbances experienced due to problems from the COVID-19 pandemic affected businesses in the primary, secondary, and tertiary sectors to different extents.
 - b) In the sample, supply disturbances experienced as a result of the coronavirus pandemic significantly affected small, medium, and large enterprises in different manners.
 - c) In the sample, supply disturbances experienced due to disruptions from the COVID-19 pandemic affected various sections of the economy differently.
- (5) The supply disturbances experienced as a result of problems arising from the pandemic more severely affected the manufacturing industry among the sectors.
- (6) The Hungarian economy has significant input exposure, which constitutes vulnerability.

Thus, the research aims to uncover and provide a comprehensive interpretation of the impact of the COVID-19 global pandemic on the workforce, operations, and certain elements of the supply chains of Hungarian enterprises. It also aims to observe the adaptive strategies that were noticeable among them. In doing so, it explores the characteristics based on which the resilience and vulnerability of Hungarian businesses manifest in the face of disruptions caused by COVID-19. The research also delves into determining to what extent and with what efficacy the affected businesses were able to handle these specific challenges, including presenting the dominant modes of their responses. That is, the research not only takes into account the hardships experienced due to the crisis but also examines and analyzes the proactive steps and attempts of businesses to manage the situation.

3. RESEARCH METHODS

The dissertation employs a multifaceted methodology: both domestic and international (primarily European Union and national level) policy analysis, as well as a survey conducted using quantitative tools. Furthermore, in several respects, the work builds on the findings of the literature review that both underpins the research and provides an overview of the main dimensions of the topic. This methodology is suitable for the careful, multifaceted presentation of complex phenomena; the methods used reinforce and check each other, aiding in a comprehensive examination of the problem. Thus, the dissertation provides results that are relevant and capable of uncovering deeper interrelationships. In line with this model, the study draws on both primary and secondary sources.

Utóbbiak között a szakirodalom eredményei mellett kiemelt szereppel bírnak a gazdasági folyamatok értékelésének alapjául szolgáló alábbi adatbázisok:

- Hungarian Central Statistical Office's online databases (www.ksh.hu)
- Statistics of the National Bank of Hungary (MNB),
- Eurostat EU database,
- Data from the World Bank Group (WBG),
- Data collections of the International Monetary Fund (IMF),
- The Observatory of Economic Complexity (OEC) database.

The most important primary source is provided by a database consisting of responses to a corporate questionnaire survey comprising 35 topic areas, in total around 90 questions. The questions included simple multiple-choice, inquiries about some demographic or operational information of the company, dichotomous, Likert-scale, single and multiple-choice, as well as open-ended questions. The data collection was carried out by P-Line Ltd. between September 5 and October 5, 2022. The target group of the questionnaire survey was Hungarian companies categorized as small, medium, and large enterprises. To define the company size, we took into account the definition of the Hungarian State Treasury. The survey was conducted using a computer-assisted telephone interviewing (CATI) method, in which senior decision-makers of Hungarian corporate enterprises were questioned.

A total of 721 enterprises provided valid answers to the questionnaire, with the headquarters of the respondents covering 255 domestic localities. The questionnaire laid the foundation, and through statistical and logical methods, it facilitated the examination of the relevance of the main correlations. This helped in mapping out the relationships between various enterprise characteristics, features, and the operational and economic events and performance arising in connection with the COVID-19 pandemic.

The questionnaire survey focused on the following main groups of questions:

- (1) Characteristics of the respondent and the examined organization.
- (2) The impact of the COVID-19 pandemic on the enterprise.
- (3) The impact of the COVID-19 pandemic on the workforce and business operations.
- (4) Challenges related to supply and operational continuity arising from the COVID-19 pandemic.
- (5) The existence, severity, and ways of managing disruptions resulting from the COVID-19 pandemic.
- (6) Decisions and plans related to the enterprise's supply network, and its potential reconfiguration based on experiences from the COVID-19 pandemic.
- (7) Questions related to the enterprise's inventory management and its potential restructuring based on experiences from the COVID-19 pandemic.
- (8) The impact of the pandemic on revenue and corporate liquidity.
- (9) Criteria for selecting a location.
- (10) The questionnaire also provides insights into the enterprise's plans, certain strategic decisions, and future expectations.

Regarding the questionnaire survey, I first performed data cleaning, and subsequently determined the types of variables (which included nominal, ordinal, and ratio scale values). In certain cases – justified and substantiated by professional reasoning – I recoded and transformed the datasets to make operations and analyses more manageable. For instance, the business size category in the raw database was a nominal variable, but I added an extra dataset where the business size categories are replaced by discrete numbers. The larger business size category was represented by a larger number and vice versa. During the analysis, I conducted statistical examinations. Besides preparing and evaluating descriptive statistics, I primarily carried out frequency and cross-tabulation analyses, as well as tests for normality and variance analysis. The chi-squared test and the F-test were employed in relation to the tests.

A selection of charts and graphs with other visualisation tools were used to present the results.

The hypotheses were tested using the following methods:

- Formulation and testing of the null hypothesis;
- Chi-squared (χ^2) test, at a 0.05 significance level;
- F-test, at a 0.05 significance level;
- Cramer's V coefficient, at a 0.05 significance level;
- With the help of the Gamma coefficient, at a 0.05 significance level;
- Synthesizing and comparing the responses received from the questionnaire survey with results from other surveys and findings from the literature.

4. RESULTS

In the context of the examined issue, this paper arrived at the following main conclusions:

(1) What impact did the COVID-19 pandemic have on the business operations of domestic enterprises?

Both the findings of the domestic literature and the lessons from the sample survey indicate that the business operations of a large part of domestic companies were negatively affected by the pandemic. The companies in the survey typically faced challenges both in terms of workforce and supply security. As throughout Europe, in Hungary too, services requiring personal contact, especially in the tourism-hospitality sector, experienced the most severe problems.

(2) What adaptive strategies were observed among domestic enterprises in response to the COVID-19 pandemic?

Based on national statistics, there was a significant increase in the prevalence of home office and remote work compared to the ratio before COVID-19. Among the domestic companies in the sample, increasing inventory levels was common, and switching suppliers or involving other suppliers was a frequent strategy to manage supply disruptions. In response to the pandemic, about a third of respondents increased their average inventory levels, while less than a tenth decreased them. About a quarter of the respondents switched suppliers, with supply security being the most important selection criterion in their case.

- (3) Management of supply chain-related problems among domestic companies in the sample.

Among the companies in the sample that responded, the most common adaptation strategy was to wait and see, which was followed by 40.9% of the respondents. 11.9% modified their product, while many businesses tried to adapt on the supplier front. 26.8% of respondents involved another supplier to ensure input, 27% procured a substitute product from their previous supplier, and 28.8% procured a substitute product from another supplier. When switching suppliers, supply security was the most important consideration when selecting a new partner among the companies in the sample that responded. Almost half of the respondents indicated this. Speed was also a significant factor, which mattered for every fourth company that switched suppliers. Among the companies in the sample, geographical or spatial distance was not a significant factor when selecting new suppliers.

About one-third of the respondents in the sample have restructured, are currently restructuring, or plan to restructure their supply network, while two-thirds have no such plans. Therefore, the lessons of COVID-19 prompted a significant portion of the affected businesses in the sample to reconsider their supply strategy. However, the majority do not intend to adapt in this direction.

In relation to the examination of the hypotheses, this study reached the following conclusions:

- (1) In comparison to the trends observed during the financial crisis starting in 2008, the economic disparities between counties, expressed as a ratio to the national GDP per capita compared to the national average, showed a decrease in 2020 during COVID-19. The hypothesis was confirmed through data analysis.
- (2) Following COVID-19, the impact observed on the operations and labor force of companies in the sample moved in tandem, and they showed consistent direction, with a statistically significant correlation between them. The positive correlation between the two factors was confirmed by statistical test.
- (3) The severity of labor-force related issues emerging from the COVID-19 pandemic in the sample is associated with business demographic characteristics.
 - a) Within the sample, the severity of labor-force related issues due to the COVID-19 pandemic significantly differed between the SME sector and large enterprises. Based on the statistical analysis of the received responses, the severity of labor force-related problems significantly differs between the SME sector and large enterprises.
 - b) In the sample, the severity of labor-force related issues due to the COVID-19 pandemic was more pronounced in large enterprises than in the SME sector. Based on the statistical analysis of the received responses, the impact of the COVID-19 pandemic on the workforce showed significantly greater problems among large enterprises compared to the SME sector.
- (4) In the sample, the extent of supply disturbances experienced as a result of problems arising from the COVID-19 pandemic correlates with certain business demographic features.

- a) Within the sample, supply disturbances experienced due to problems from the COVID-19 pandemic affected businesses in the primary, secondary, and tertiary sectors to different extents.

Due to the disruptions arising from the coronavirus pandemic, the differences in the relative frequency of supply disturbances experienced by businesses in the primary, secondary, and tertiary sectors indicate a significant, weak relationship between the supply problem encountered by the business and its sectoral affiliation.

- b) In the sample, supply disturbances experienced as a result of the coronavirus pandemic significantly affected small, medium, and large enterprises in different manners.

The differences in the relative frequency of impact based on business size categories among the businesses in the sample do not significantly differ from the level of chance. Thus, this hypothesis was not accepted.

- c) In the sample, supply disturbances experienced due to disruptions from the COVID-19 pandemic affected various sections of the economy.

Based on the responses to the questionnaire, businesses belonging to different sections of the economy were affected by supply disruptions in significantly different proportions. Therefore, the sectional classification of a business has significant explanatory power in relation to the emergence of supply disruptions.

- (5) The supply disturbances experienced as a result of problems arising from the pandemic more severely affected the manufacturing industry among the sectors.

The empirical survey results support the hypothesis of the sensitivity of the manufacturing industry to supply disruptions.

- (6) The Hungarian economy has significant input exposure, which constitutes vulnerability.

The empirical survey results support the hypothesis of the input sensitivity of the Hungarian economy.

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