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COVID-19 impact on sourcing in Global Value Chains

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A B S T R A C T

This study explores the impact of COVID-19 on Global Value Chains (GVCs) using the Eurostat dataset, focusing on trade barriers and the difficulty of sourcing raw materials or intermediate goods from local and international suppliers. Using a contingency table grouped by country, we can see how raw material constraints and COVID-19's GVCs affect many countries. The study uses Chi-square test to determine if these factors have a significant association. The data imply that foreign sourcing presents less challenges for suppliers than domestic sourcing, stressing the need to examine consumer behaviour under uncertainties to develop GVCs resilience. The findings show a statistically significant link between barriers related to raw material and the effect level of COVID-19 in global value chains across all countries analysed. Suggesting that it is unlikely to have happened by random chance alone, highlighting the importance of addressing trade barriers and adapting to the impact of COVID-19 within global value chains.

1. Introduction

So far, the great majority of studies on supply networks have concentrated on the organizational characteristics from the purchaser's perspective. However, in recent years, additional attempts have focused on supply networks in response to interruptions caused by COVID-19 (Musella, L., 2023) and geopolitical instability in the global economy (Simangunsong, E., Hendry, L. C., & Stevenson, M., 2012). Furthermore, authors Roseira, C., Brito, C. & Henneberg, S. C. (2010), the supplier interdepencies are mostly a byproduct of buyer-supplier groups. Moreover, the type and dynamics of these groups strongly influence the breadth and frequency of supplier relationships, as well as their consequence on performance. As such, it influences the entire supply chain. As such, it is important to establish a multi-tier supply chain with sustainable strategies and managing of the suppliers (Wilhelm, M., Blome, C., Wieck, E., & Xiao, C. Y., 2016). This can mitigate the risks and supply chain uncertainties in upstream supply chains.

As a result, the article emphasizes the need to detect and resolve supplier-side bottlenecks. This research extends scholarly and managerial understanding of the complex nature of global supply networks in unpredictable situations. Thus, we aim to answer the following research questions: *Is there a statistically significant association between domestic and international sourcing impact due to COVID-19 in global value chains?*
Often presented in form of theories related to COVID-19 as an influencer in global value chain performance. Furthermore, trade obstacles coming from COVID-19 to the unpredictable nature of supply chains, influence raw material availability, service accessibility, transportation, order

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cancellations, and changes in sales channels (Eurostat, 2021). Moreover, the time distance and location of raw materials / intermediate goods caused a cause-effect on global trade networks (Raj, A., Mukherjee, A.A., de Sousa Jabbour, A.B.L. & Srivastava, S.K., 2022). Disruptions that involve the availability of packing materials, processing chemicals, and equipment maintenance have added to production and processing concerns arising in the upstream supply chain, which influence downstream supply chains (Bertolozzi-Caredio, D., Severini, S., Zinnanti, C., Rustom, R., Santono, E. & Bubbico, A., 2023).

We provide an introduction to the situation, materials, methodology used, and results. The results and discussion consist of data interpretations (content analysis) and the results of the chi-square analysis. Finally, the research findings are detailed and recommendations are presented.

2. Material and Methods

By conducting a quantitative analysis associated with trade barriers and the impact of the COVID-19 pandemic on global value chains. The quantitative element of the research begins by utilizing the Eurostat dataset, a rich source of statistical data on numerous aspects of the European Union's economy. The study uses the Chi-square test to evaluate whether there is a statistically significant relationship between various obstacles and the effects of the COVID-19 epidemic on global value chains. (Howell, D.C, 2011) This information serves as the foundation for quantifying and exploring the association between various obstacles and the effects of COVID-19 on global value chains encountered by enterprises.

Moreover, to answer research question 1: *Is there a significant association between the type of trade barrier (difficulty in acquiring raw materials domestically and difficulty in acquiring raw materials abroad) and the level of impact of COVID-19 on enterprises?*

We built two hypotheses, incorporating the aspect of raw material / intermediate material sourcing:

H0: There is no statistically significant association between barriers that include difficulties acquiring raw materials / intermediate goods from domestic or abroad sources and the impact level of COVID-19 in global value chains.

H1: There is a statistically significant association between barriers that include difficulties acquiring raw materials / intermediate goods from domestic or abroad sources and the impact level of COVID-19 in global value chains.

(1) The Chi-Square χ^2 formula is: $\boldsymbol{\chi^2 = \sum (O_i - E_i)^2 / E_i}$

Where: O_i = observed value (actual value)

E_i = expected value.

The chi-square test statistic or P-value serves as a concise measure to assess the correlation between categorical variables. It quantifies the probability of obtaining a result that is equal to or more extreme than the observed frequency, thereby indicating the likelihood of an event occurring. A smaller P-value signifies stronger evidence in favor of the alternative hypothesis given the observed and expected frequencies. In our study, each trade barrier denotes specific challenges and impediments encountered by businesses within the supply chain management and international trade, particularly amidst uncertainties and disruptions triggered by events such as the COVID-19 pandemic across various countries. The dataset was analyzed using Microsoft Excel. Assumptions were rigorously evaluated and deemed to be met: the counts for each combination of country, difficulty level, and location (domestic or abroad) are independent observations. The total sample size of the dataset, totaling 131,601, is sufficiently large. Moreover, the assumption regarding expected cell frequencies, which must be at least 5 for all cells in the contingency table, is satisfied for every country included in the analysis.

3. Results and Discussions

Based on the Eurostat (2021) dataset, we constructed a contingency table categorizing data by country, barriers encountered, and the level of COVID-19 impact. The rows represent various difficulty levels in sourcing raw materials or intermediate goods from domestic and international suppliers, while they present the severity of COVID-19's impact. The cells contain observed frequencies or counts for each combination of categories. Our analysis suggests that disruptions during the COVID-19 pandemic may have stemmed from the location of raw materials or intermediate goods. The data is structured systematically within the contingency table, facilitating a comprehensive understanding of the relationships between nation-specific barriers, COVID-19 impact levels, and the challenges faced by enterprises in sourcing raw materials or intermediate goods domestically and abroad compared to moderate difficulty levels.

Table 1: Enterprises of trade barrier: difficulty in acquiring raw materials / intermediate goods from suppliers domestically due to COVID-19 and the level of impact of COVID-19. **Source:** EUROSTAT (2021)

	Difficulty in acquiring raw materials / intermediate products from suppliers domestically		
Country	Moderate	Low	Severe
Italy	5,187	5,837	2,720
Portugal	1,433	1,445	729
Hungary	928	929	240
Poland	3,341	3,207	2,171
Bulgaria	781	1,141	284
Latvia	248	474	110
Finland	310	1,055	74
Sweden	609	1,873	157

The heatmap table presents data on the difficulty levels in acquiring raw materials or intermediate products from suppliers domestically across different countries. As visualized in the table, Italy has a substantial number of suppliers facing Moderate difficulty levels (5187) and Low difficulty levels (5837), indicating significant challenges in raw material acquisition domestically. Additionally, Italy has a considerable number of suppliers facing Severe difficulty levels (2720). Followed by Poland, with a substantial number of suppliers facing Moderate difficulty levels (3341) and Low difficulty levels (3207), indicating significant challenges in raw material acquisition domestically. The number of suppliers facing Severe difficulty levels (2171) is also considerable. Furthermore, Portugal has a moderate number of suppliers facing Moderate difficulty levels (1433) and Low difficulty levels (1445). The number of suppliers facing severe difficulty levels (729) is relatively lower than that of moderate and low difficulty levels. A similar pattern in Finland with a moderate number of suppliers facing Moderate difficulty levels (310) and a higher number facing Low difficulty levels (1055). The number of suppliers facing Severe difficulty levels (74) is relatively lower compared to moderate and Low difficulty levels. Sweden has a moderate number of suppliers facing Moderate difficulty levels (609) and a higher number facing Low difficulty levels (1873). The number of suppliers facing severe difficulty levels (157) is relatively lower than that of moderate and low difficulty levels. Meanwhile, Hungary has a relatively low number of suppliers facing Moderate difficulty levels (928) and Low difficulty levels (929) compared to other countries in the dataset. However, the number of suppliers facing severe difficulty levels (240) is notably lower than that of moderate and low difficulty levels. Bulgaria has a lower number of suppliers facing Moderate difficulty levels (781) compared to low difficulty levels (1141). The number of suppliers facing severe difficulty levels (284) is relatively lower than that of moderate and low difficulty levels. Latvia has the lowest number of suppliers facing Moderate difficulty levels (248) among the countries in the dataset. However, the number of suppliers facing low difficulty levels (474) is moderate, indicating a relatively higher proportion of suppliers facing low difficulty levels than those facing moderate difficulty levels.

Table 2: Enterprises of trade barrier: difficulty in acquiring raw materials / intermediate goods from suppliers abroad due to COVID-19, and the level of impact of COVID-19. **Source:** EUROSTAT (2021)

	Difficulty in acquiring raw materials / intermediate products from suppliers abroad		
Country	Moderate	Low	Severe
Italy	4,001	3,883	2,488
Portugal	1,520	1,055	818
Hungary	875	580	529
Poland	2,562	1,924	2,228
Bulgaria	622	692	469
Latvia	274	327	166
Finland	494	757	169
Sweden	910	1,423	216

Table 2 presents data on the difficulty levels in acquiring raw materials or intermediate goods from suppliers abroad across different countries. In Italy, in the context of acquiring raw materials or intermediate products from suppliers abroad, Italy exhibits a decrease in the number of suppliers facing Moderate difficulty levels (4001) compared to acquiring domestically. However, the number of suppliers facing Low (3883), and Severe (2488) difficulty levels remain relatively similar to the domestic acquisition scenario. Portugal also shows a decrease in the number of suppliers facing Moderate difficulty levels (1520) when acquiring from suppliers abroad compared to domestic acquisition. Similarly, the number of suppliers facing low (1055) and severe (818) difficulty levels is lower than that of domestic acquisition. Hungary experiences a decrease in the number of suppliers facing Moderate difficulty levels (875) when acquiring from suppliers abroad compared to domestic acquisition. However, the number of suppliers facing Low (580) and Severe (529) difficulty levels remains relatively similar to the domestic acquisition scenario. Poland demonstrates a decrease in the number of suppliers facing Moderate difficulty levels (2562) when acquiring the number of suppliers abroad compared to domestic acquisition. Similarly, the number of suppliers facing Low (1924) and Severe (2228) difficulty levels is lower compared to domestic acquisition. Bulgaria shows a decrease in the number of suppliers facing Moderate difficulty levels (622) when acquiring from suppliers abroad compared to domestic acquisition. Similarly, the number of suppliers facing low (692) and severe (469) difficulty levels is lower than that of domestic acquisition. Latvia exhibits a decrease in the number of suppliers facing Moderate difficulty levels (274) when acquiring from suppliers abroad compared to domestic acquisition. Similarly, the number of suppliers facing Low (327) and Severe (166) difficulty levels is lower compared to domestic acquisition. Finland experiences a decrease in the number of suppliers facing Moderate difficulty levels (494) when acquiring from suppliers abroad compared to domestic acquisition. Similarly, the number of suppliers facing Low (757) and Severe (169) difficulty levels is lower compared to domestic acquisition. Sweden shows a decrease in the number of suppliers facing Moderate difficulty levels (910) when acquiring from suppliers abroad compared to domestic acquisition. Similarly, the number of suppliers facing Low (1423) and Severe (216) difficulty levels is lower compared to domestic acquisition.

Overall, there is a general trend of decrease across most countries in the number of suppliers facing Moderate, Low, and Severe difficulty levels when comparing the difficulty levels in acquiring raw materials or intermediate products from suppliers abroad with domestic. This suggests that, in general suppliers face fewer challenges when acquiring from suppliers abroad compared to domestically. However, the specific numbers and patterns may vary across individual countries.

Table 3: Enterprises with no impact from COVID-19 in acquiring raw materials / intermediate goods from suppliers domestically and abroad **Source:** EUROSTAT (2021)

	Enterprises with no impact from COVID-19	
Country	Domestically	Abroad
Italy	9,712	13,077
Portugal	1,807	2,021
Hungary	1,980	2,062
Poland	8,497	10,502
Bulgaria	2,323	2,746
Latvia	827	892
Finland	3,176	3,266
Sweden	2,214	2,234

The provided data offers an insightful comparison of raw material / intermediate acquisitions by enterprises operating without the influence of COVID-19, both domestically and abroad, across several European countries. It is notable that Italy, Portugal, Hungary, Poland encountered relatively lower impacts when sourcing abroad compared to domestic sourcing. Meanwhile, countries like Bulgaria, Latvia, Finland, and Sweden faced similar impact in both domestic and sourcing.

Table 4: Results after the Chi-square Test. Source: authors' calculations from EUROSTAT (2021)

Country	**Chi-square (P-value)**	**Degrees of Freedom (df)**	**Significance Level**	**Hypothesis Decision**	
Italy	5.4236E-228	3	0.05 (5%)	5.4236E-228 < 0.05	H0: Rejected
Portugal	2.4133E-17	3	0.05 (5%)	2.4133E-17 < 0.05	H0: Rejected
Hungary	1.82E-41	3	0.05 (5%)	1.82E-41 < 0.05	H0: Rejected
Poland	1.6E-137	3	0.05 (5%)	1.6E-137 < 0.05	H0: Rejected
Bulgaria	5.41E-45	3	0.05 (5%)	5.41E-45 < 0.05	H0: Rejected
Latvia	3.83E-09	3	0.05 (5%)	3.83E-09 < 0.05	H0: Rejected
Finland	8.97E-28	3	0.05 (5%)	8.97E-28 < 0.05	H0: Rejected
Sweden	5.4E-28	3	0.05 (5%)	5.4E-28 < 0.05	H0: Rejected

The results presented in Table 4 provide insights into the statistical significance of the association between barriers related to difficulties in acquiring raw materials / intermediate goods from domestic or abroad sources and its impact level of COVID-19 in global value chains. The Chi-square test was utilized to assess this association by comparing the observed frequencies to the expected frequencies under the null hypothesis of independence. The calculated chi-square statistics for each country are significantly smaller than the critical value, leading to the rejection of the null hypothesis (H0). This indicates a significant association between the variables analyzed, suggesting that the observed and expected frequencies in the contingency tables are unlikely to have occurred by random chance alone. Furthermore, the p-values associated with the chi-square test for each country are much smaller than the significance level ($p < 0.05$). Since the p-values are smaller than the significance level, the null hypothesis (H0) is rejected for each country. Therefore, based on these results, it can be concluded that there is a statistically significant association between barriers related to difficulties in acquiring raw materials/ intermediate goods from domestic or abroad sources and the impact level of COVID-19 in global value chains. Thus, the results from the Chi-square test provide statistical evidence of the relationship between these variables, further reinforcing the importance of addressing trade barriers and adapting to the impact of COVID-19 within global value chains.

4. Conclusion and Recommendation

Overall, the study underscores the importance of addressing trade barriers and adapting supply chain strategies to mitigate the impact of disruption, particularly in the context of the COVID-19 pandemic, and highlights the need for further research in this area to enhance our understanding and response to global value chain challenges. The statistical significance of the association between trade barriers and COVID-19 impact levels is consistent across multiple countries analyzed in the study, including Italy, Portugal, Hungary, Poland, Bulgaria, Latvia, Finland, and Sweden. Often discussed in the form of theories of the impact of COVID-19 related to raw materials, this study establishes a statistically significant association between trade barriers related to raw material acquisition difficulties and the impact level of COVID-19 in global value chains across various countries.

Limitations

Several limitations are inherent in this study. Firstly, the analysis is restricted to a select group of countries due to data availability constraints, potentially limiting the generalizability of findings to broader geographical contexts. Secondly, the reliance on secondary data sources and the study's scope is limited to specific trade barriers and does not encompass the entirety of factors influencing global value chains.

Data Availability Statement

Access to the sources utilized in this study was facilitated by the University of Debrecen, sources from various databases such EUROSTAT.

Conflict of interest

The authors declare no conflicts of interest.

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