GLOBAL SUPPLY CHAIN DISRUPTIONS UNDER GEOECONOMIC FRAGMENTATION: A FIGARO-BASED MACROECONOMIC NETWORK ANALYSIS

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ANNOTATION

This article examines the macroeconomic implications of global supply chain disruptions in the context of growing geoeconomic fragmentation and confrontational globalization. The study explores how geopolitical tensions, technological fragmentation, sanctions, energy shocks, and post-pandemic restructuring processes transform the architecture of global production networks and intensify systemic economic vulnerabilities. Particular attention is devoted to the application of the FIGARO (Full International and Global Accounts for Research in Input-Output Analysis) international input–output framework for identifying structural interdependencies, strategic vulnerabilities, and the transmission channels of global shocks across countries and sectors.

The research combines approaches from global value chain theory, network economics, and input–output analysis. Using FIGARO data for 49 countries and 21 economic sectors during the period 2010–2023, the paper applies eigenvector centrality analysis to determine the most systemically important suppliers within the global economy. The findings reveal the dominant role of China's manufacturing sector and the increasing importance of U.S. financial, technological, and professional service sectors in global supply networks. The study also demonstrates how the COVID-19 pandemic, energy crises, and geopolitical conflicts accelerated the restructuring of global production systems and increased the significance of resilience-oriented economic policies.

The article argues that FIGARO-based network analysis provides an effective methodological framework for evaluating macroeconomic resilience, strategic dependencies, and the vulnerability of small open economies under conditions of global uncertainty. The results contribute to the understanding of structural transformations in the world economy and offer analytical tools for assessing supply chain resilience, reshoring processes, and geoeconomic risks.

Keywords: global supply chain disruptions; geoeconomic fragmentation; confrontational globalization; FIGARO; input–output analysis; network analysis; macroeconomic resilience.

JEL Classification: F15; F23; F44; C67.

გლობალური მიწოდების ჯაჭვების რღვევები გეოეკონომიკური ფრაგმენტაციის პირობებში: FIGARO-ზე დაფუძნებული მაკროეკონომიკური ქსელური ანალიზი

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ანოტაცია

სტატიაში განხილულია გლობალური მიწოდების ჯაჭვების რღვევებით გამოწვეული მაკროეკონომიკური შედეგები გეოეკონომიკური ფრაგმენტაციისა და კონფრონტაციული გლობალიზაციის გაძლიერების პირობებში. ყურადღება გამახვილებულია იმაზე, თუ როგორ ცვლის გეოპოლიტიკური დაძაბულობა, ტექნოლოგიური ფრაგმენტაცია, სანქციები, ენერგეტიკული შოკები და პანდემიის შემდგომი რესტრუქტურიზაციის პროცესები გლობალური საწარმოო ქსელების სტრუქტურას და როგორ ზრდის ეკონომიკური სისტემების მოწყვლადობას. განსაკუთრებული ადგილი ეთმობა საერთაშორისო დანახარჯები-გამოშვების ანალიზისთვის შექმნილი FIGARO-ს (Full International and Global Accounts for Research in Input-Output Analysis) ჩარჩოს გამოყენებას, რომლის მეშვეობითაც გამოვლენილია სტრუქტურული ურთიერთდამოკიდებულებები, სტრატეგიული მოწყვლადობები და გლობალური შოკების გავრცელების მექანიზმები ქვეყნებსა და ეკონომიკის სექტორებს შორის.

ნაშრომის მეთოდოლოგიურ საფუძველს წარმოადგენს გლობალური ღირებულების ჯაჭვების თეორია, ქსელური ეკონომიკის კონცეფციები და დანახარჯები-გამოშვების ანალიზის ინსტრუმენტები. 2010–2023 წლების FIGARO-ს მონაცემთა ბაზის საფუძველზე, რომელიც მოიცავს 49 ქვეყანასა და ეკონომიკის 21 სექტორს, გამოყენებულია საკუთარი ვექტორის ცენტრალურობის (Eigenvector Centrality) ანალიზი გლობალურ ეკონომიკაში სისტემურად უმნიშვნელოვანესი მომწოდებლების გამოსავლენად. მიღებული შედეგები ადასტურებს ჩინეთის დამამუშავებელი მრეწველობის წამყვან პოზიციას მსოფლიო მიწოდების ქსელებში და წარმოაჩენს ამერიკის შეერთებული შტატების ფინანსური, ტექნოლოგიური და პროფესიული მომსახურების სექტორების მზარდ მნიშვნელობას. კვლევის შედეგები ასევე ცხადყოფს, რომ COVID-19-ის პანდემიამ, ენერგეტიკულმა კრიზისებმა და გეოპოლიტიკურმა კონფლიქტებმა დააჩქარა გლობალური საწარმოო სისტემების ტრანსფორმაცია და მნიშვნელოვნად გაზარდა მდგრადობაზე ორიენტირებული ეკონომიკური პოლიტიკის როლი.

დასაბუთებულია, რომ FIGARO-ზე დაფუძნებული ქსელური ანალიზი ეფექტიანი მეთოდოლოგიური ინსტრუმენტია მაკროეკონომიკური მდგრადობის, სტრატეგიული დამოკიდებულებებისა და მცირე ღია ეკონომიკების მოწყვლადობის შესაფასებლად გლობალური გაურკვევლობის პირობებში. მიღებული შედეგები ხელს უწყობს მსოფლიო ეკონომიკაში მიმდინარე სტრუქტურული ცვლილებების სიღრმისეულ გააზრებას და ქმნის ანალიტიკურ საფუძველს მიწოდების ჯაჭვების მდგრადობის, წარმოების რელოკალიზაციის (reshoring) პროცესებისა და გეოეკონომიკური რისკების შეფასებისათვის.

საკვანძო სიტყვები: გლობალური მიწოდების ჯაჭვების რღვევები; გეოეკონომიკური ფრაგმენტაცია; კონფრონტაციული გლობალიზაცია; FIGARO; დანახარჯები-გამოშვების ანალიზი; ქსელური ანალიზი; მაკროეკონომიკური მდგრადობა.

JEL კლასიფიკაცია: F15; F23; F44; C67.

INTRODUCTION

In recent years, the global economy has undergone profound structural changes associated with the decline of hyperglobalization and the rise of confrontational globalization, where international economic relations are increasingly shaped by geopolitical competition, sanctions policies, technological fragmentation, and the growing securitization of trade and investment flows. In this environment, global supply chains (GSCs), once regarded as a foundation of international efficiency and specialization, have become a significant source of macroeconomic risk and instability.

Although a substantial body of literature has examined disruptions in global supply chains, most studies concentrate on isolated dimensions of the problem, including logistics failures, inflationary pressures, trade barriers, or sector-specific impacts. At the same time, the macrosystemic transformation of global production networks under conditions of geoeconomic fragmentation remains insufficiently explored.

In particular, limited attention has been devoted to the application of network-oriented approaches and international input–output systems for analyzing the restructuring of global production architectures, shifts in the hierarchy of country-sector linkages, and the transmission mechanisms of systemic shocks across the world economy.

This article contributes to the existing literature by combining the perspectives of global value chain theory, network economics, input–output analysis, and the concept of confrontational globalization. The methodological foundation of the study is the FIGARO framework, which enables the interpretation of the global economy as a complex multi-level system of interconnected production networks. The application of eigenvector centrality indicators and heatmap visualization techniques allows the identification of systemically important nodes, the evaluation of network influence concentration, and the analysis of structural transformations within global production networks under growing global uncertainty.

LITERATURE REVIEW

The growing instability of global supply chains has become one of the central issues in contemporary international economics and macroeconomic research. The COVID-19 pandemic, geopolitical conflicts, energy crises, technological decoupling, and accelerating geoeconomic fragmentation have clearly demonstrated the high vulnerability of global production systems to external shocks and structural disruptions. Consequently, the academic literature on supply chain resilience, global value chains (GVCs), and geoeconomic fragmentation has expanded significantly in recent years.

Most early studies concentrated on the short-term macroeconomic consequences of supply chain disruptions. Attinasi et al. (2021) showed that interruptions in global production and transportation networks generate substantial inflationary pressures and negatively affect industrial activity in both developed and emerging economies. Santacreu and LaBelle (2022) confirmed that supply chain bottlenecks were among the main drivers of the sharp rise in global inflation during the COVID-19 pandemic, primarily due to shortages of intermediate goods and logistical constraints.

More recent research has shifted toward deeper causal and long-term analysis. Bai, Fernández-Villaverde, Li, and Zanetti (2024) provide strong empirical and theoretical evidence that global supply chain shocks exert significant and persistent effects on output, employment, and inflation expectations. The authors stress that modern macroeconomic models must treat supply-side disruptions as structurally embedded phenomena rather than temporary exogenous events.

A prominent strand of literature examines the structural transformation of the world economy in the context of geopolitical rivalry and geoeconomic fragmentation. Papava (2022, 2024) and Bedianashvili (2023) argue that the global economy has moved from the era of hyperglobalization to **confrontational globalization**, characterized by strategic competition, widespread sanctions, securitization of trade and investment, and the weaponization of economic interdependence (Farrell & Newman, 2019). In this new reality, global supply chains are increasingly perceived not only as tools for efficiency and specialization but also as sources of strategic dependence and systemic vulnerability (Papava & Bedianashvili, 2024, 2025; Aiyar et al., 2023).

Along with academic research, issues of supply chain resilience and strategic dependencies are increasingly being addressed in documents from international organizations and economic policymakers. In particular, the European Commission's 2023 Annual Single Market Report: Single Market at 30 (European Commission, 2023) emphasizes that geopolitical tensions, energy crises, technological fragmentation, and the effects of the pandemic have significantly increased the vulnerability of global production systems. The document notes that ensuring the resilience of value chains, reducing critical external dependencies, and strengthening economic security are becoming key priorities for the European Union's economic policy. These findings confirm the growing importance of research aimed at identifying the structural vulnerabilities of global production networks and assessing the consequences of geoeconomic fragmentation for the global economy.

Network and input-output approaches have substantially enriched the understanding of these processes. Acemoglu, Akcigit, and Kerr (2016) demonstrated that the architecture of production networks plays a decisive role in the transmission and amplification of macroeconomic shocks. Studies focusing on GVC centrality indicate that countries and sectors occupying central "hub" positions tend to achieve higher

productivity and stronger firm performance (Criscuolo & Timmis, 2018; Alves et al., 2022). Graph-theoretical methods, particularly **eigenvector centrality** in international input-output frameworks, have proven highly effective for identifying systemically important suppliers and critical nodes (Sargent & Stachurski, n.d.).

The FIGARO database has emerged as a powerful tool for such multi-country and multi-sector analyses. Recent studies utilizing FIGARO and similar multi-regional input-output systems have significantly advanced the assessment of strategic dependencies, shock transmission mechanisms, and economic resilience under conditions of geoeconomic fragmentation (Panon et al., 2024; Conteduca et al., 2025; Georgieva, 2025). In particular, Panon et al. (2024) analyze how firms adjust sourcing strategies amid fragmentation, while Conteduca et al. (2025) evaluate potential future scenarios for global value chains.

Despite notable progress, several important gaps persist in the literature. First, relatively few studies address the **long-term structural transformations** of global production networks in the era of confrontational globalization. Second, the full integration of global value chain theory, network economics, and international input-output analysis within a unified framework remains underdeveloped. Third, many papers focus on short-term effects or individual sectors and do not sufficiently examine the changing hierarchy of country-sector centrality over the critical period of 2010–2023.

The present study seeks to address these gaps by integrating perspectives from global value chain theory, network economics, and FIGARO-based input-output analysis. Using eigenvector centrality analysis for the period 2010–2023, this paper identifies the most systemically important suppliers in the global economy and explores how geoeconomic fragmentation is reshaping the architecture of global production networks, strategic dependencies, and macroeconomic resilience.

THE POSSIBILITIES OF USING FIGARO IN RESEARCHING THE PROBLEMS OF DISRUPTIONS IN GLOBAL SUPPLY CHAINS

FIGARO is a modern international input–output system developed by the Joint Research Centre of the European Commission and creates significant opportunities for the study of global supply chains (Global Supply Chains/GVCs). The use of FIGARO is especially relevant in the context of confrontational globalization, geopolitical fragmentation and global economic uncertainty, when the risks of supply chain disruptions, logistical disruptions and structural economic shocks are increasing.

The main advantage of FIGARO is that it combines:

- multi-country input–output tables,
- sectoral economic linkages,
- foreign trade data,
- value added flows,
- and a detailed structure of global production interdependencies.

Therefore, FIGARO allows global supply chains to be analyzed not only from a trade perspective, but also from a systemic macroeconomic perspective. In studying disruptions in global supply chains, FIGARO is particularly important in the following areas:

1. **Analysis of inter-sectoral dependencies**

FIGARO makes it possible to identify the extent to which countries and economic sectors are dependent on each other. For example:

- semiconductors,
- energy,
- mechanical engineering,
- pharmaceuticals,
- or the agri-food sector.

In the case of supply disruptions, it is possible to assess which sectors experience the strongest macroeconomic impact.This is especially important in modern conditions, when even a small shock quickly spreads throughout the global economic network in the form of a "domino effect".

2. **Study of the transmission mechanism of global shocks**

FIGARO allows to assess:

- How geopolitical,
- energy,
- financial,
- or pandemic shocks

spread through global supply chains to different countries and sectors.

For example, it is possible to assess:

- How a decline in production in China affects European industry,
- Or how a shortage of energy resources affects the production networks of the European Union.

Such analysis is especially important in the context of confrontational globalization.

3. Value Added Analysis

One of the main advantages of FIGARO is the possibility of value-added trade analysis.

Traditional foreign trade statistics often fail to reflect:

- the real technological contribution,
- the role of intellectual capital,
- or the depth of production links between countries.

Using FIGARO, it is possible to assess:

- Which country creates real added value,
- Which country performs only the assembly function,
- And how this structure changes in the conditions of fragmentation of supply chains.

This is especially important when studying the competitiveness of small countries.

4. Identifying strategic dependencies

FIGARO is an effective tool for studying economic security.

Using it, it is possible to determine:

- Which critical resources a country depends on,
- In which sectors there is a high import dependence,
- And which economic directions create strategic vulnerability.

Of particular importance are:

- Energy security,
- Rare earth minerals,
- Semiconductors,
- Food security,
- Pharmaceuticals,
- And digital technologies.

5. Assessment of the effects of reshoring and nearshoring

In modern conditions, many countries are trying to:

- Return production (reshoring),
- or regionalization (nearshoring).

On the basis of FIGARO, it is possible to assess:

- How the sectoral structure will change,
- How this will affect employment,
- Productivity,
- Inflation,
- and economic growth.

This is especially relevant for the analysis of the economic policies of the European Union, China and the USA.

6. Vulnerability study of small countries

FIGARO is especially valuable for small and open economies. It can be used to assess:

- The intensity of the transmission of external shocks,
- The degree of dependence on trading partners,
- Export concentration,
- and the level of economic sustainability.

This is directly related to:

- Global sustainable competitiveness,
- and economic security issues.

7. Green economy and ESG transformation analysis

FIGARO is increasingly used for:

- carbon footprint analysis,
- green value chains,
- sustainable production systems,
- ESG-oriented structural analysis.

It is possible to assess:

- which sectors have the highest environmental burden,
- what are the international carbon flows,
- and what impact the green transformation will have on global supply chains.

This direction is particularly relevant in the context of the EU Green Deal.

8. Macroeconomic policy modeling

FIGARO data can be integrated into:

- CGE models,
- DSGE models,
- panel econometrics,
- SEM/PSEM systems

METHODOLOGY AND EMPIRICAL RESEARCH RESULTS

Various methods are used to analyze global supply chains (e.g., vector autoregressive analysis, CGE, and global DSGE models). For this paper, it is appropriate to identify key industries that play a significant role in global supply. Input-output tables can also be used for this purpose.

To identify important sectors of the global economy's supply chain, and therefore countries, it is possible to use input-output tables that cover not only specific sectors but also countries. These types of tables are often used for economic analysis, there are mainly four types of model: A, B, C, and D. (Miller & Blair, 2009). Using these types of tables, it is possible to calculate a matrix of relevant technical coefficients and then apply graph analysis. This approach was used by Nobel laureate Thomas Sargent and John Stachurski, and they described how this method should be used for the U.S. (Sargent & Stachurski, n.d.). This paper applies this approach to various industries of different countries around the world.

To obtain the technical coefficient matrix, equation 1 is used, where A is the technical coefficient matrix, Z is the intermediate consumption matrix, and X is the output vector. In the case of this paper, X is taken for simplicity as a vector of intermediate consumption sums for each sector of each country.

$$A_{i,j} = \frac{Z_{i,j}}{X_j} \quad (1)$$

Once the A matrix has been calculated, in order to identify the most important suppliers, it is necessary to use graph analysis, namely eigenvector centrality. For this hub-based eigenvector centrality is applied, as shown in equation 2, where C is approximated eigenvector, r is the spectral radius of matrix A, k represents the number of times the matrix is exponentiated, while I is an array of ones. After sorting the values of the resulting C vector in descending order, important sectors will be identified, where the highest centrality indicates the most important supplier. The software library quant_econ_books uses a value of 40 for k. For greater accuracy, since we are dealing with the world economy, this paper uses the number 100. Although a higher k provides greater numerical precision, the value adopted in this paper is computationally efficient, since increasing k beyond this point produces negligible changes for the first 50 producers.

$$C = r^{-k} * (A^k * I) \quad (2)$$

Table 1. Country classifier

Code	Country (iso-2)
01) BE	Belgium
02) BG	Bulgaria
03) CZ	Czechia
04) DK	Denmark
05) DE	Germany
06) EE	Estonia
07) IE	Ireland
08) GR	Greece
09) ES	Spain
10) FR	France
11) HR	Croatia
12) IT	Italy
13) CY	Cyprus
14) LV	Latvia
15) LT	Lithuania
16) LU	Luxembourg
17) HU	Hungary
18) MT	Malta
19) NL	Netherlands
20) AT	Austria
21) PL	Poland
22) PT	Portugal
23) RO	Romania
24) SI	Slovenia
25) SK	Slovakia
26) FI	Finland
27) SE	Sweden
28) NO	Norway
29) CH	Switzerland
30) GB	United Kingdom
31) ME	Montenegro
32) MK	North Macedonia
33) AL	Albania
34) RS	Serbia
35) TR	Türkiye
36) AR	Argentina
37) AU	Australia
38) BR	Brazil
39) CA	Canada
40) CN	China
41) ID	Indonesia
42) IN	India
43) JP	Japan
44) KR	Korea, Republic of
45) MX	Mexico
46) RU	Russian Federation
47) SA	Saudi Arabia
48) US	United States of America
49) ZA	South Africa
50) RoW	Rest of the World

Source: Eurostat

Table 2. NACE Rev.2 classifier

Code	Description - NACE Rev.2 A*21
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage; waste managment and remediation
F	Construction
G	Wholesale and retail trade; repair of motor vehicles and motor
H	Transporting and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other services activities
T	Activities of households as employers; undifferentiated goods
U	Activities of extraterritorial organisations and bodies

Source: Eurostat

The main assumption of this approach is that the matrix A is primitive.

DESCRIPTION OF DATA

This study is based on the Full International and FIGARO database developed by Eurostat and the Joint Research Centre of the European Commission. FIGARO is one of the most comprehensive international input–output systems available for the analysis of global production networks, intersectoral dependencies, and global value chains (Eurostat, 2021). The database integrates multi-country input–output tables, trade statistics, value-added flows, and sectoral economic structures into a unified analytical framework.

The dataset covers 49 countries and the aggregated "Rest of the World" economy. Economic activities are classified according to the NACE Rev. 2 classification system and include 21 sectors for each country (Eurostat, 2008). This structure enables simultaneous analysis at both the country and sectoral levels, which is essential for studying the dynamics of global supply chains and the transmission of macroeconomic shocks across interconnected production systems. The country and sector classifications are presented in Tables 1 and 2. Data was retrieved from here: Eurostat. (n.d.).

The observation period spans from 2010 to 2023 and includes several major global economic disruptions, including the post-2008 financial crisis recovery period, the COVID-19 pandemic, the Russia–Ukraine war, energy market instability, and increasing geoeconomic fragmentation. These developments significantly influenced the structure and resilience of global supply chains.

The study employs industry-by-industry input–output tables, commonly referred to in the literature as Model D, which are particularly suitable for network-based economic analysis. Sectors T and U were excluded due to their relatively limited role in international production networks, resulting in a 950 × 950 intermediate consumption matrixes for each year.

To identify the most influential suppliers within the global economy, the study applies eigenvector centrality analysis based on graph theory. This methodology makes it possible to determine strategically important sectors and countries within global supply chains and to assess the structural vulnerabilities of the world economy under conditions of confrontational globalization and growing uncertainty.

To simplify interpretation, the analysis combines country and sector identifiers using the format Country_Activity (e.g., CN_C for Chinese manufacturing or US_K for U.S. financial and insurance activities). The data used in this study were retrieved from the official FIGARO database published by Eurostat and the European Commission.

For the analysis, sectors T and U were excluded, resulting in a 950×950 intermediate consumption matrix for each year from 2010 to 2023. This period includes significant economic events such as negative interest rates following the 2008 financial crisis, the economic crisis resulting from the Covid-19 pandemic, and the Russia-Ukraine war. The corresponding technical coefficient matrices were computed for the obtained matrices and determined to be primitive based on the analysis.

RESULTS

An empirical analysis identified the most systemically important suppliers to the global economy for the period 2010–2023 using eigenvector centrality indicators calculated based on the international FIGARO input–output

Table 3. Top 50 suppliers revealed by eigenvector centrality for each year

#	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C	CN_C
2	RoW_B	RoW_B	RoW_B	US_C	RoW_B	RoW_B	RoW_B	RoW_B	RoW_B	RoW_B	US_K	US_K	RoW_B	US_K
3	US_C	US_C	RoW_C	RoW_B	US_C	US_C	US_C	US_C	US_C	US_K	US_M	RoW_C	RoW_C	US_M
4	RoW_C	RoW_C	US_C	RoW_C	RoW_C	US_K	US_K	RoW_C	RoW_C	US_C	RoW_C	US_M	US_K	US_C
5	JP_C	JP_C	US_K	US_K	US_K	RoW_C	RoW_C	US_K	US_K	US_M	US_C	US_C	US_M	RoW_B
6	US_K	US_M	US_M	US_M	US_M	US_M	US_M	US_M	US_M	RoW_C	CN_K	RoW_B	US_C	RoW_C
7	US_M	US_K	JP_C	JP_C	JP_C	CN_K	JP_C	JP_C	US_J	US_N	RoW_B	CN_K	US_N	US_N
8	DE_C	DE_C	DE_C	DE_C	DE_C	CN_G	US_J	US_J	US_N	US_J	US_J	US_J	CN_K	US_J
9	RoW_G	RoW_G	RoW_G	US_J	US_J	US_J	US_N	US_N	JP_C	CN_K	US_N	US_N	US_J	CN_K
10	US_J	US_J	US_J	US_N	US_N	US_N	CN_K	CN_K	CN_K	JP_C	CN_A	CN_G	CN_G	US_L
11	US_N	US_N	US_N	RoW_G	RoW_G	JP_C	DE_C	CN_G	CN_G	US_L	CN_G	CN_A	US_L	CN_G
12	JP_G	RU_C	RoW_K	US_G	US_G	CN_A	US_L	DE_C	RoW_G	CN_G	JP_C	US_L	CN_A	US_G
13	RoW_K	US_G	RU_C	RU_C	CN_K	DE_C	CN_G	US_L	US_L	CN_A	US_L	JP_C	US_G	CN_A
14	US_G	RoW_K	US_G	US_L	CN_G	US_L	RoW_G	RoW_G	DE_C	US_G	US_G	US_G	US_H	DE_C
15	US_L	KR_C	KR_C	RoW_K	US_L	RoW_G	CN_A	US_G	US_G	RoW_G	DE_C	DE_C	RU_C	US_H
16	SA_B	JP_G	US_L	KR_C	CN_A	US_G	US_G	CN_A	CN_A	DE_C	RoW_G	CN_D	RoW_G	RoW_G
17	KR_C	US_L	RoW_H	CN_G	RoW_K	US_H	US_H	US_H	US_H	US_H	US_H	US_H	CN_D	JP_C
18	US_H	US_H	US_H	CN_A	KR_C	KR_C	KR_C	KR_C	KR_C	RoW_K	CN_D	RoW_G	DE_C	CN_H
19	RU_C	RoW_H	CN_G	CN_K	SA_B	CN_H	RoW_K	RoW_K	RoW_K	CN_D	CN_H	CN_H	JP_C	CN_D
20	RoW_H	BR_C	CN_A	US_H	RU_C	RoW_K	CN_H	CN_D	CN_D	CN_H	RoW_K	CN_B	CN_H	RoW_K
21	IN_C	IT_C	JP_G	RoW_H	US_H	CN_B	CN_D	CN_H	CN_H	KR_C	CN_B	KR_C	CN_B	CN_B
22	BR_C	CN_A	CN_K	CN_D	CN_H	RoW_H	CN_B	CN_B	RU_C	RU_C	KR_C	RoW_K	RoW_K	KR_C
23	IT_C	DE_M	RoW_A	IT_C	CN_D	CN_M	RoW_H	RU_C	CN_B	CN_B	DE_M	RU_C	KR_C	RU_C
24	DE_M	CN_K	IT_C	CN_H	RoW_H	RU_C	DE_M	RoW_H	RoW_H	RoW_H	IN_C	DE_M	SA_B	IN_C
25	GB_K	IN_C	DE_M	DE_M	DE_M	CN_D	JP_G	DE_M	SA_B	DE_M	CN_M	CN_M	CN_M	CN_M
26	RoW_A	FR_C	BR_C	JP_G	IT_C	DE_M	RoW_A	RoW_A	DE_M	IN_C	RoW_A	IN_C	IN_C	RoW_H
27	CN_A	GB_K	IN_C	IN_C	CN_B	RoW_A	RU_C	JP_G	RoW_A	RoW_A	RoW_H	RoW_A	RoW_H	BR_C
28	GB_C	GB_C	GB_K	GB_K	RoW_A	IT_C	IT_C	IT_C	IN_C	CN_M	RU_C	RoW_H	RoW_A	DE_M
29	FR_C	RoW_A	GB_C	RoW_A	IN_C	GB_K	IN_C	IN_C	IT_C	IT_C	IT_C	IT_C	DE_M	RoW_A
30	CN_G	CN_G	CN_D	BR_C	GB_K	IN_C	GB_K	SA_B	JP_G	SA_B	JP_G	GB_K	BR_C	IT_C
31	GB_M	RU_D	FR_C	CN_B	GB_C	GB_M	CN_M	CN_M	CN_M	JP_G	DE_J	GB_M	US_B	GB_M
32	DE_K	RU_G	CN_H	GB_C	JP_G	GB_C	DE_H	GB_K	DE_H	GB_K	GB_K	DE_J	RU_H	GB_K
33	CN_K	CN_B	RoW_D	FR_C	FR_C	JP_G	GB_M	DE_H	GB_K	DE_H	DE_H	DE_H	IT_C	DE_H
34	DE_H	CN_H	RoW_M	RU_H	GB_M	DE_H	GB_C	BR_C	BR_C	GB_M	GB_M	JP_G	GB_M	GB_C
35	CN_H	RU_H	RU_H	GB_M	BR_C	FR_C	SA_B	GB_M	GB_M	RoW_M	GB_C	GB_C	GB_K	SA_B
36	DE_N	GB_M	CN_B	RU_D	DE_N	RoW_M	BR_C	DE_J	DE_J	DE_J	DE_K	RoW_D	RoW_D	US_B
37	RU_G	DE_K	RoW_J	DE_K	DE_J	BR_C	FR_C	RoW_M	GB_C	RoW_D	RoW_M	BR_C	DE_H	DE_J
38	RU_D	DE_H	GB_M	RU_G	DE_H	RoW_D	RoW_M	GB_C	FR_C	BR_C	DE_G	FR_M	GB_C	RoW_M
39	RoW_D	DE_N	RU_D	DE_H	DE_K	DE_J	DE_J	FR_C	RoW_M	RU_H	FR_M	CN_N	US_A	US_I
40	CN_B	RoW_D	RU_G	RoW_M	RoW_M	CN_N	RoW_D	RoW_D	RoW_D	GB_C	CN_N	DE_K	RoW_M	CN_N
41	FR_K	DE_J	DE_K	DE_J	RU_H	DE_K	DE_K	DE_K	RU_H	FR_C	ID_C	AU_B	CN_N	FR_M
42	RoW_M	RoW_M	DE_H	RoW_D	RoW_D	CN_J	FR_M	FR_M	RU_B	RU_B	BR_C	SA_B	RU_D	US_A
43	DE_J	CA_C	DE_J	DE_N	US_B	SA_B	ID_C	ID_C	RoW_J	FR_M	FR_C	FR_C	ID_C	JP_G
44	RoW_J	CN_D	DE_N	US_B	CN_M	RoW_J	RoW_J	RoW_J	FR_M	RoW_J	DE_N	RoW_M	DE_J	RoW_D
45	RU_H	ID_C	CA_C	CA_C	RU_G	FR_M	DE_N	RU_H	DE_K	DE_K	RoW_D	US_B	RU_G	ID_C
46	CA_C	FR_M	RU_B	RU_B	FR_K	RU_H	FR_K	DE_G	US_B	CN_N	CN_J	DE_G	JP_G	FR_C
47	ES_C	ES_C	RU_L	FR_M	FR_M	FR_K	DE_G	DE_N	DE_G	ID_C	RoW_J	ID_C	RU_L	US_D
48	ID_C	US_B	RoW_N	FR_K	RoW_J	CN_I	RU_H	US_I	DE_N	US_I	IN_A	CN_J	AU_B	DE_N
49	FR_M	FR_K	FR_M	RoW_J	RU_D	GB_N	GB_N	FR_K	CN_N	DE_G	FR_K	DE_N	US_D	DE_G
50	US_B	RU_L	ES_C	ES_C	DE_G	DE_N	US_I	ES_C	FR_N	DE_N	FR_N	RU_H	FR_C	RoW_J

Source: constructed by the authors based on Eurostat data

framework. The results presented in Table 3 reveal a high concentration of global production networks, in which a relatively small number of countries and industries occupy dominant positions in international supply chains (table 3).

These results demonstrate the persistent dominance of China's manufacturing sector (CN_C), which maintained its position as the most influential supplier throughout the study period. This result reflects not only China's role as a major global industrial hub but also the deep structural integration of Chinese industry into global production systems. The consistently high centrality of the Chinese manufacturing sector demonstrates that the global economy remains

significantly dependent on China's manufacturing potential, despite processes of reshoring, diversification, and geoeconomic fragmentation. Thus, the study's results confirm the continued high degree of systemic dependence of global production networks on the Chinese industrial complex. At the same time, the analysis reveals the growing strategic importance of US service industries, primarily financial and insurance activities (US_K), professional and scientific-technical services (US_M), and the information and communications sector (US_J). While the early stages of globalization were characterized by predominantly industrial-oriented interdependence, the post-pandemic period demonstrates an increasing role of knowledge-intensive and financial sectors in global production networks. This indicates a gradual transformation of the architecture of global supply chains—from a predominantly industrial model to a hybrid system combining industrial dependence with technological, financial, and digital centralization.

The strengthening of the position of the US financial and professional service sectors after 2020 deserves particular attention. This trend can be interpreted as the result of several interrelated processes. First, the COVID-19 pandemic has accelerated the digitalization of the global economy and increased the importance of financial infrastructure, technology platforms, and intangible assets in international production systems. Second, geoeconomic fragmentation and sanctions policies have strengthened the strategic role of financial networks and technological control mechanisms. Third, rising global uncertainty has encouraged companies and governments to rely more heavily on highly developed service industries capable of coordinating complex international production structures in high-risk environments.

The study's results also point to significant changes in the positions of traditional industrial economies. Germany's manufacturing sector (DE_C), which held a leading position in the early 2010s, gradually lost its relative influence after 2014. Similarly, Japan's manufacturing sector (JP_C) decreased its level of systemic centrality after 2020. Such changes may reflect several structural transformations in the global economy, including the gradual shift of industrial production toward Asia, rising energy costs in developed economies, heightened geopolitical tensions, and the gradual transition from traditional manufacturing dominance to technology- and service-oriented global value chains.

Another important result is the high importance of industries related to raw materials and energy extraction. The consistently high positions of the mining and quarrying sectors in the Rest of the World (RoW_B) group demonstrate that global supply chains continue to be significantly dependent on access to strategic resources and energy. This dependence has become particularly evident in the context of the post-pandemic energy crisis and geopolitical disruptions associated with the Russian-Ukrainian war. Thus, the results confirm that energy security and control over critical resources are increasingly becoming not only economic but also geoeconomic factors of macroeconomic stability.

The analysis also shows that following major global shocks, the structure of global production networks has become more concentrated. Contrary to expectations of large-scale decentralization, the COVID-19 pandemic and processes of geoeconomic fragmentation have rather strengthened the dominance of a limited number of strategically important countries and industries. This finding is fundamentally important, as it challenges the widespread assumption that reshoring and diversification can quickly reduce the concentration of global production. On the contrary, the empirical results indicate that contemporary fragmentation processes lead not to complete deglobalization, but to a selective restructuring of global supply chains. From a macroeconomic perspective, the concentration of global supply chains around a limited number of systemically important nodes increases the vulnerability of the global economy to external shocks. Disruptions in highly centralized sectors can quickly spread across countries through interconnected production and trade networks, generating inflationary pressures, shortages of intermediate goods, and financial instability. In this context, eigenvector centrality analysis allows us to identify key mechanisms for the transmission of global shocks and identify sectors in which disruptions can generate disproportionately strong systemic consequences.

These results are particularly significant for small, open economies, whose macroeconomic resilience depends significantly on external production networks and imports of intermediate goods. Countries with low levels of diversification and high external dependence are particularly vulnerable to disruptions arising in systemically important sectors of the global economy. Therefore, strengthening economic resilience requires not only diversification of trading partners but also the implementation of strategic industrial policies, technological modernization, and the development of adaptive supply chain strategies. Overall, the study's findings confirm that the contemporary global economy is characterized by both increasing geoeconomic fragmentation and the persistence of deep structural interdependence. Despite rising geopolitical tensions, sanctions regimes, and reshoring initiatives, the global economy remains tightly integrated through highly concentrated networks of production, financial, technological, and resource interconnections.

CONCLUSION

The research demonstrates that global supply chain disruptions have evolved from temporary logistical disturbances into structural macroeconomic challenges shaped by geoeconomic fragmentation, geopolitical rivalry, and confrontational globalization. The increasing securitization

of trade, technology, energy, and investment flows is fundamentally transforming the architecture of global production systems and intensifying the vulnerability of countries and sectors to external shocks.

The empirical analysis based on the FIGARO international input–output framework confirms that global production networks are highly concentrated around several systemically important suppliers. The results show the persistent centrality of China's manufacturing sector and the growing strategic importance of U.S. financial, technological, and professional service sectors in the functioning of the world economy. At the same time, the findings indicate that the post-pandemic period accelerated structural shifts in global value chains, strengthened reshoring and nearshoring tendencies, and increased the role of economic security considerations in macroeconomic policymaking.

The study further confirms that network-oriented input–output analysis and eigenvector centrality methods are effective instruments for identifying critical interdependencies, tracing shock transmission mechanisms, and evaluating structural resilience within the global economy. The FIGARO framework makes it possible to assess not only trade flows, but also value-added structures, strategic dependencies, and sectoral vulnerabilities under conditions of uncertainty.

Particular importance is attached to the implications for small open economies, whose resilience depends less on economic scale and more on diversification capacity, institutional adaptability, and integration into stable production networks. In this regard, strengthening economic resilience requires the development of flexible supply chain strategies, diversification of critical imports, support for technological upgrading, and the implementation of coordinated macroeconomic and industrial policies.

Overall, the paper highlights that the future evolution of global supply chains will increasingly depend on the balance between economic efficiency and strategic security. In an era of fragmented globalization, countries capable of adapting to structural transformation and reducing critical external dependencies will achieve higher levels of macroeconomic stability and long-term competitiveness.

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