

It's nice to e-meet you

European
Parlement

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EU-27 Trade Network Analysis

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Objective & Problem Statement

- Examine the flow of trade goods within the union to identify patterns and trends in intra-EU trade dynamics
- Understand the economic interactions driving the EU's single market and address challenges such as vulnerabilities, dependencies, and inefficiencies within the trade network
- Provide actionable insights for policy-making and enhance economic strategies for a more resilient EU economy
- Covers all 27 member states, excluding the United Kingdom post-Brexit

Methodology

Data Collection:

- We relied on the European Commission's Access2Markets portal, which provides extensive trade data, including the value and volume of imports and exports across all EU-27 member states
- We focused on 2022 data

Network Analysis Tools & Technics:

- Python: NetworkX, Matplotlib
- Countries: Nodes
- Trade flows: Directed edges
- Given that all members engage in mutual trade, initial network was fully connected. We filter the network to remove edges representing trade flows below 1 billion euros



Finding & Analysis

A multi-scale analysis

Our ambition is to analyze the network on different scale to be as complete as possible

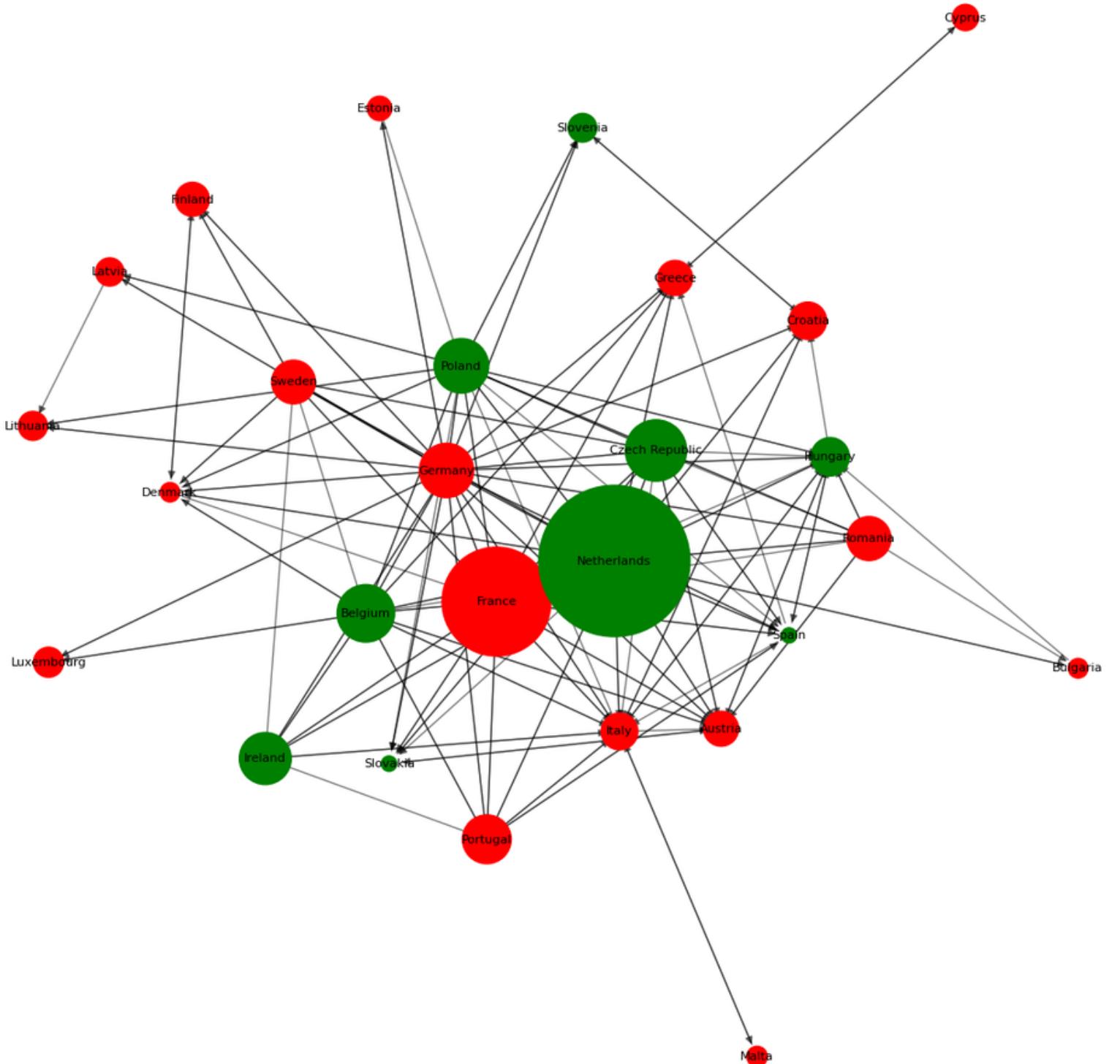
I. Network structure
Global descriptors

II. Regional analysis
Community detection

III. Individual members
Local descriptors

I. Network Structure

Global descriptors



- **Number of nodes :** 27 nodes, one for each member
- **Number of edge :** 191 edges (trade balance > 1 billion euros)
- **Average degree :** 7.1 (each country trade with 7 other country on average)
- **Average distance :** 1.8 (most country being connected through 2 intermediaries)
- **Density :** 0.27 (27% of possible links are actively utilized, not fully saturated network)
- **Clustering coefficient :** 0.67 (strong tendency among members to form clusters)
- **Kirchhoff index :** 7 (Resilient and connected network, trade can be derouted to alternative path)
- **Random Walk index :** 0.14 (high degree of connectivity and accessibility within the trade network)



II. Regional Analysis

Community detection

01. Infomap Algorithm

Theoretical strengths but practical challenges

- Detect communities by minimizing the expected random walk distance on a network or in other words grouping together nodes that share more frequent interactions
- Either one big community or several communities of one member even with finetuning the parameter
- Maybe because of the high interconnectivity of the network or because the network is too much balanced (uniform trade policies across members)

02. Louvain Method

Not ideal in theory but has nice results in practice

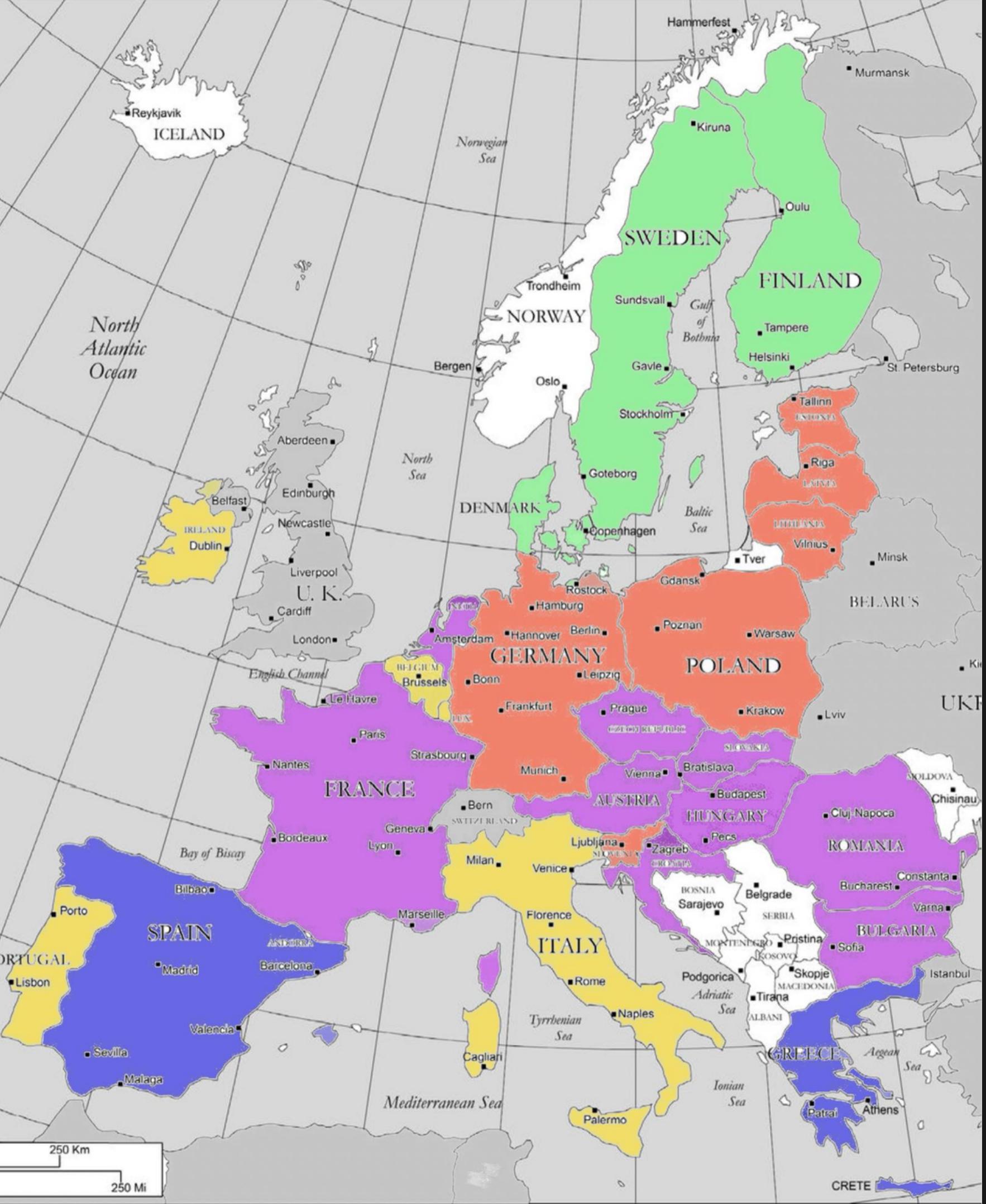
- Heuristic based algorithm that seeks to maximize modularity (maximize the density of links within communities compared to link between communities)
- Unlike Infomap algorithm, Louvain method produced economically coherent communities
- Focus on the strength of the connections, making it better suited for trade flows network



II. Regional Analysis

Community detection

- **Purple Community** : France, Austria, Bulgaria, Croatia, the Czech Republic, Hungary, the Netherlands, Romania, and Slovakia. Mix of Western and Eastern EU countries, suggesting a balanced trade dynamic that bridges the east-west divide within the Union with cheap east labor.
- **Yellow Community** : Belgium, Ireland, Italy, Luxembourg, Malta, and Portugal. Service-oriented economy. Reflect specialized trade agreements such as pharmaceutical or worldwide imported product.
- **Red Community** : Estonia, Germany, Latvia, Lithuania, Poland, and Slovenia. Germany likely play a significant role in the economic health of the region, potentially driven by Germany's european importation to export globally after.



II. Regional Analysis

Community detection

- **Blue Community :** Cyprus, Greece, and Spain. May be shaped by similarities in economic structure, such as reliance on sectors like tourism and agriculture, or by geographical proximity and shared trade policies within the Mediterranean region.
- **Green Community :** The Scandinavian countries – Denmark, Finland, and Sweden – Reflects a common socio-economic model, as well as historical trade ties and shared cultural and geographical characteristics.

III. Individual members

Local descriptors

Focus on 3 interesting
members



France
Largest Negative Balance

Spain
Smallest Absolute Balance

Netherlands
Largest Positive Balance

France

Facing a significant trade deficit of 129 billion euros, marked by its extensive trade linkages and significant role in the network's connectivity

Degree : 14

Active trade participation

Eccentricity : 2

Furthest distance from any node. Central player within european union

Betweenness Centrality : 0.9

Critical intermediary acting as a central place for exchange

Closeness Centrality : 0.7

Short average distance, proximity with other members

Strength : 22 billion euros

Relatively strong despite huge negative balance

Clustering Coefficient : 0.6

Robust regional role in its community



Spain

Moderate level of connectivity and near equilibrium balance of 700 million euros indicate potential area of development.

Degree : 8

Moderate trade participation

Eccentricity : 2

Furthest distance from any node. Engage in trade with minimal intermediary steps

Betweenness Centrality : 0.1

Act more as a terminal market in the network

Clustering Coefficient : 0.8

Spain trade partners are highly connected among themselves



Closeness Centrality : 0.5

While not central, have a moderate position in term of average shortest path

Strength : 8 billion euros

Relatively low but coherent with regard of its balance

Netherlands

Pivotal node with the largest positive balance of 251 billion euros, revealing a strategic role as a leading trade hub.

Degree : 18

Deeply involved in the network

Eccentricity : 2

Furthest distance from any node. Central node with efficient trade flows.

Betweenness Centrality : 0.95

Confirm role as an indispensable broker for trade across the EU

Closeness Centrality : 0.7
Really close to all members

Strength : 42 billion euros
Highlight Netherlands economic vitality

Clustering Coefficient : 0.4
May indicate a tendency to serve as a primary partner to diverse communities





Discussion & Recommendations

Global Implications

- Highly integrated network, dense connections, compact structure which facilitate efficient trade flows
- Room for further integration, high clustering coefficient while showing strong relation, could suggest the existence of trades cliques
- Efficiency and resilience shown by different indices provide a strong foundation for EU to navigate internal economic challenges



Discussion & Recommendations

Regional Implications

- **Economic Cohesion :** Highlights opportunities for regional policies (e.g., tourism and agriculture for the Mediterranean, innovation and sustainability for Scandinavia).
- **Diversification Strategies :** Regions heavily reliant on trade with a dominant partner (e.g., Germany's trade with Baltic states) could be supported in diversifying their trade relations to reduce dependency.
- **Enhancing connectivity :** Need to improve connectivity between communities to ensure more uniform benefits from the single market



Discussion & Recommendations

Local Implications

- Addressing trade balance disparities, like the Netherlands' surplus and France's deficit, is crucial for fostering a more equitable trade environment within the EU.
- Local policies should support sectors where countries have or can develop competitive advantages, improving their trade balance.
- Providing specialized support to countries with lower centrality in the trade network to diversify trade portfolios and strengthen their positions, aiding local development and reducing disparities.



Future Research

- **Dynamic Analysis:** Incorporating time dynamics is essential to capture the evolving nature of trade relationships.
- **Sector-Specific Insights:** Investigating critical sectors could reveal specific trade flows, dependencies, and vulnerabilities.
- **Impact of Non-EU Trade Relationships:** Understanding trade with major non-EU partners is crucial for a holistic view of the EU's trade dynamics.
- **Engagement with Recent EU Trade Policies:** Aligning analysis with EU policies like the European Green Deal enhances its relevance and applicability.

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Thank you !