



UK Inter-Industry Economic Network: Insights from Payment Flows (2022–2024)

Prepared by: Mohd Nafees – Junior Data Analyst

MSc Data Science, University of London

Tools Used: Python (NetworkX, scikit-learn, pandas, matplotlib), Power BI, SQL

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ABSTRACT

This project looks at how money really moves through the UK economy. Using ONS UK Inter-Industry payment flow data from 2022–2024, I built a network view of industries to see who drives, connects, and stabilizes the system.

Through Python analysis, SQL and Power BI visuals, four main clusters emerged — the Financial Hub, Core Industries, Connector Sectors, and Peripheral Services. Finance holds the most influence, but it's the Core and Connectors that keep trade alive. The result is a clearer picture of how deeply linked and fragile the UK economy truly is.

1. Executive Summary

Exploring the UK's economy through its payment network turned out to be surprisingly eye-opening.

Between **2022 and 2024**, almost **£4 trillion** moved between industries — showing just how tightly connected everything is.

By treating each industry as a **node** and every payment as a **link**, I mapped out the real structure of the UK economy and discovered **four main clusters**:

- **The Financial Hub** (systemic control),
- **Core Industries** (the operational base),
- **Connector Sectors** (economic bridges), and
- **Peripheral & Community Services** (stabilizing sectors).

The **Financial Hub** sits at the top — driving more than **60% of the total flow** and acting like the *heart that pumps liquidity across the system*.

Though smaller in trade flow, it **dominates in systemic influence**, shaping how money and value circulate across all other industries.

What stands out most is that the **Core and Connector clusters together account for over 85% of all transaction volume**, keeping the economy alive day-to-day.

Meanwhile, the **Peripheral sectors** — like care, arts, and local services — play an underappreciated but vital stabilizing role, helping sustain regional balance and social resilience.

This study combines real **ONS data**, **Python network modelling**, and **Power BI visualization**, revealing how different parts of the UK economy work together — and how deeply dependent everything is on finance and trade connections.

2. Data and Methodology

I started this project with one question in mind: *how do UK industries interact through money movement?*

To answer it, I used **ONS's UK Inter-Industry Payment Flows** data (2017–2024) and the **UK SIC Structure dataset**, which detail how different sectors pay and receive funds.

First, I cleaned and merged the datasets, making sure each transaction had a clear payer, payee, and amount. Then I transformed the payment data into a **network model**, treating industries as nodes and transactions as weighted links.

Next came the metrics — I calculated:

- **Inflow and Outflow** (to measure how much each sector sends and receives),
- **Total Flow** (overall transaction volume),
- **Betweenness Centrality** (how strongly an industry connects others), and
- **Eigenvector Centrality** (how influential a sector is in the overall system).

I scaled all values between **1 and 100** for clarity and then ran **K-Means clustering** to group industries with similar payment behaviors. This step uncovered four meaningful clusters that together form the backbone of the UK's economic network.

Finally, I visualized the results in **Python (Matplotlib + Seaborn)** and built an interactive **Power BI dashboard** to explore payment flows, centrality scores, and systemic influence. Each visualization helped me connect the numbers to real-world insights — like how finance and logistics industries quietly dominate the network's stability.

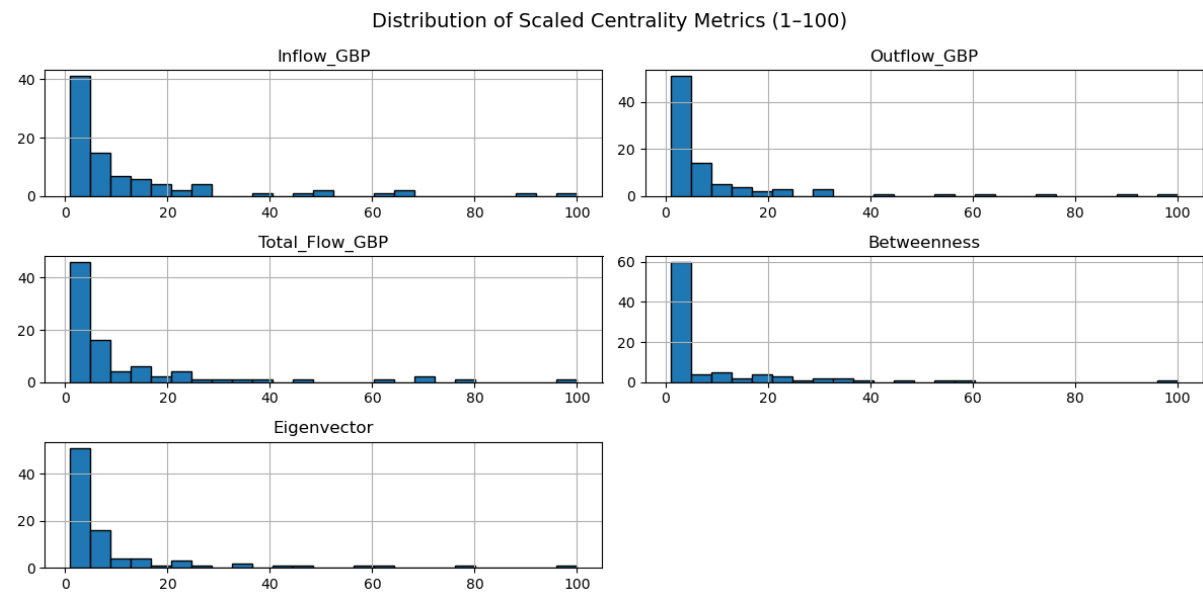


Image 1: Distribution of Scaled Centrality Metrics (1–100) Shows how most industries have low centrality while a few dominate the top range — typical of real-world network.

Next, using **K-Means clustering ($k=4$)** — validated by Elbow, Silhouette, and Davies–Bouldin indices — I identified four distinct economic roles.

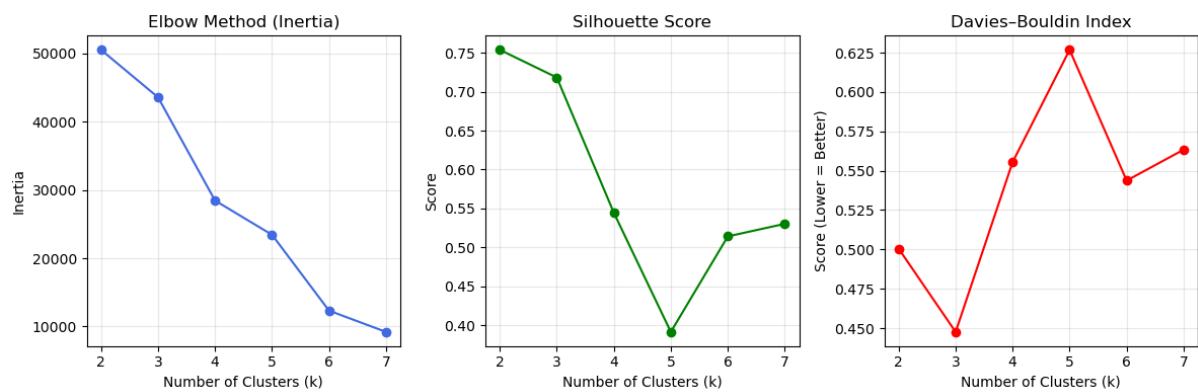


Image 2: Cluster Validation Plots (Elbow, Silhouette, Davies–Bouldin) Confirms that four clusters represent the most stable segmentation of the UK economic network

3. Key Findings

3.1 Cluster Composition and Roles

The analysis revealed four natural clusters in the UK economy:

Cluster Role	Description	Example Industries
0	Core Industries	Bulk of economic volume; operational foundation
1	Peripheral & Community Services	Low volume but socially stabilizing sectors
2	Connector Sectors	High-transaction “bridge” industries between Core and Finance
3	Financial Hub	Central control of liquidity & influence

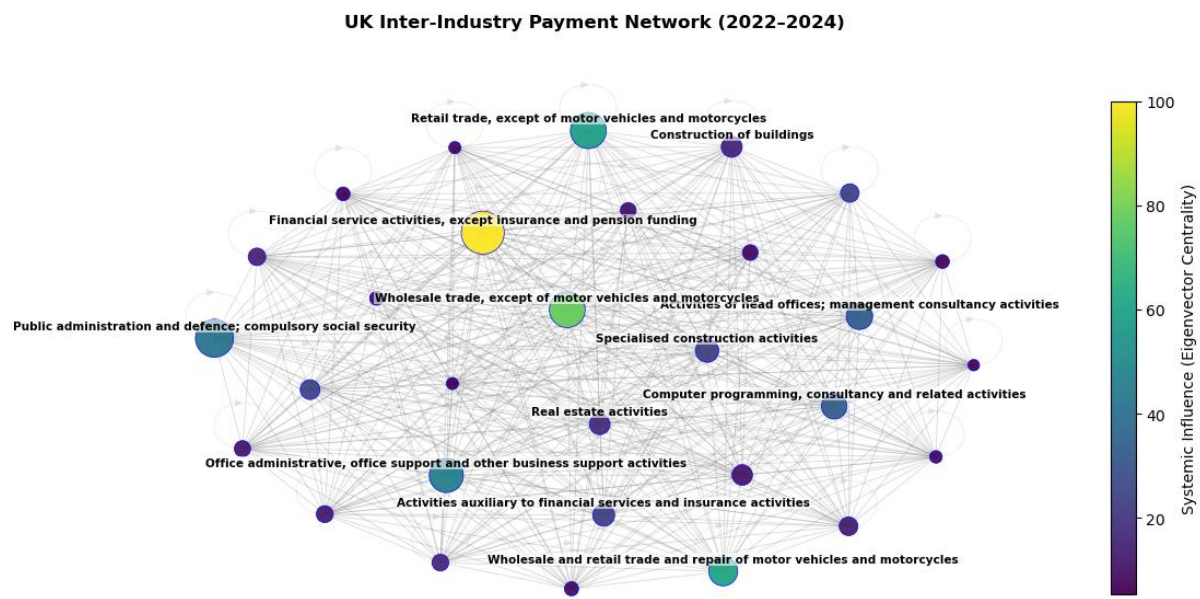


Image 3: UK Inter-Industry Payment Network (2022–2024)

The Financial Hub (yellow node) sits at the network’s centre, connected to every other major cluster.

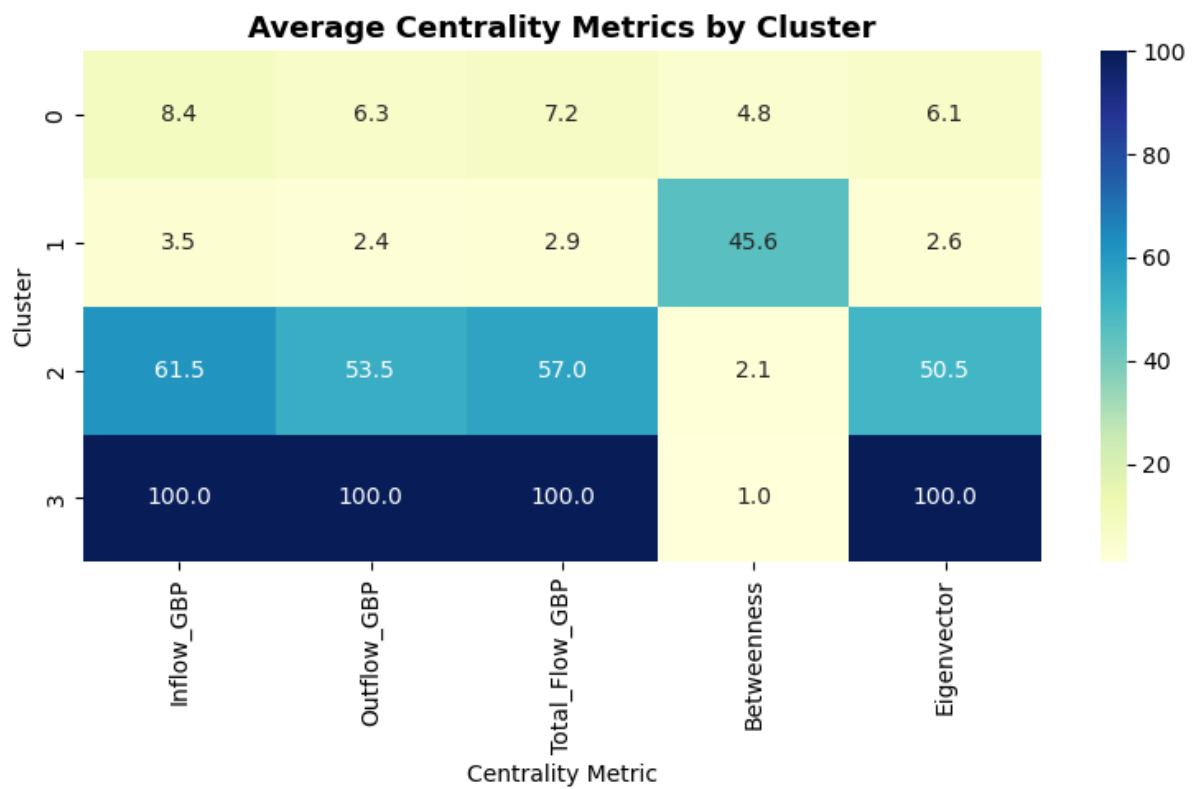


Image 4: Average Centrality Metrics by Cluster

Financial Hub (cluster 3) dominates across eigenvector influence; Connectors show balanced volume and connectivity.

3.2 Trends Over Time (2022–2024)

When I looked at payment flows over time, the story became clearer.
From 2022 to 2024, **total inter-industry payments rose steadily from £1.3T to £1.5T.**

The **Core and Connector clusters** drive the majority of that — over **£1.1T combined**.
These represent the daily economic engine: manufacturing, logistics, retail, and public administration.
The **Financial Hub** shows slower but stable growth, continuing to control liquidity across sectors.
Meanwhile, **Periphery sectors** (like care and creative work) stay small but steady, giving the economy social balance and resilience.

UK Inter-Industry Payment Flow by Cluster (2022–2024)

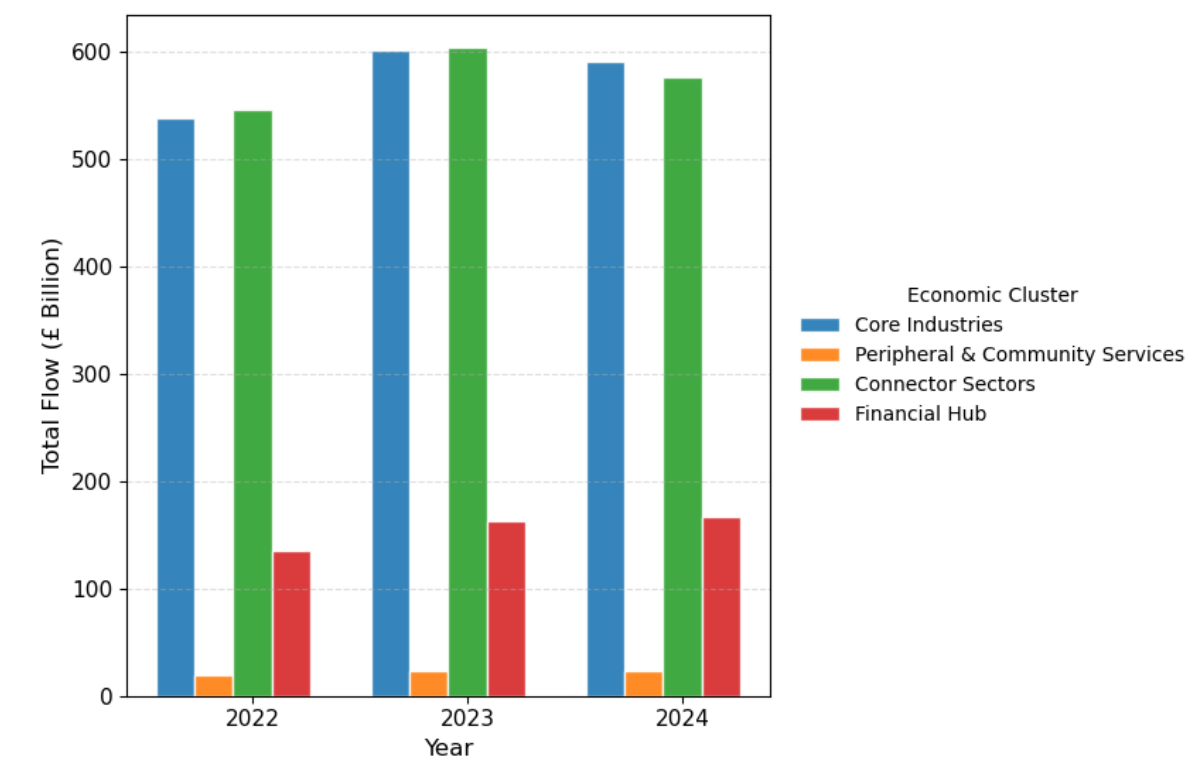


Image 5: UK Inter-Industry Payment Flow by Cluster (2022–2024)
Core and Connector sectors dominate transaction volumes, while the Financial Hub maintains steady systemic growth.

3.3 Influence and Vulnerabilities

Using centrality and correlation measures, I found that **inflow, outflow, and total flow metrics are tightly correlated (0.92–0.99)**, showing a well-connected but top-heavy structure.

The Financial Hub's eigenvector centrality is extremely high — meaning it's not just big but connected to other big players.

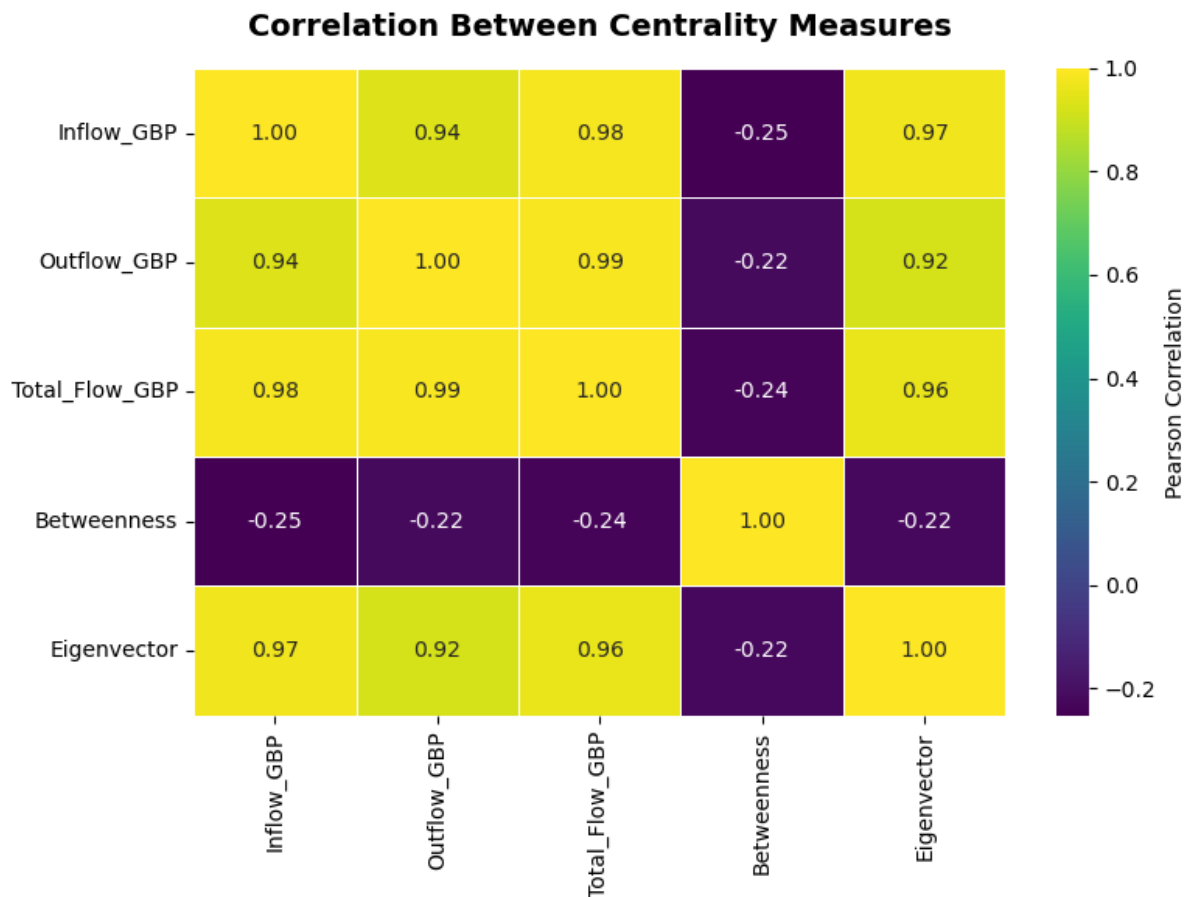


Image 6: Correlation Between Centrality Measures

Flow metrics are strongly correlated; betweenness (bridging power) stands apart, confirming unique industry roles.

The danger is that **too much influence sits within the Financial Hub**. A liquidity shock there could cascade through the entire network, hitting Core and Connector industries but the presence of strong Connectors and stable Core sectors adds resilience — they act as buffers.

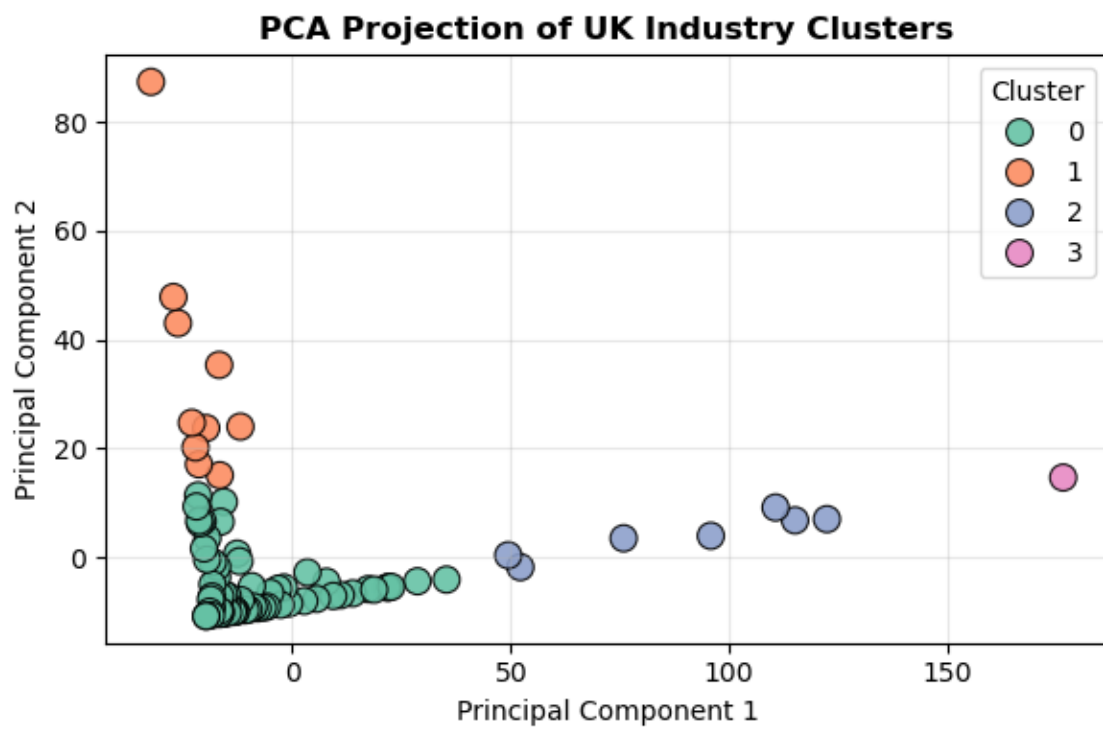


Image 7: PCA Projection of UK Industry Clusters

Shows how Financial Hub (cluster 3) stands apart, while Core and Connector sectors form the operational mass of the economy.

3.4 Cluster Profiles

Each cluster's profile reflects its distinct economic function.

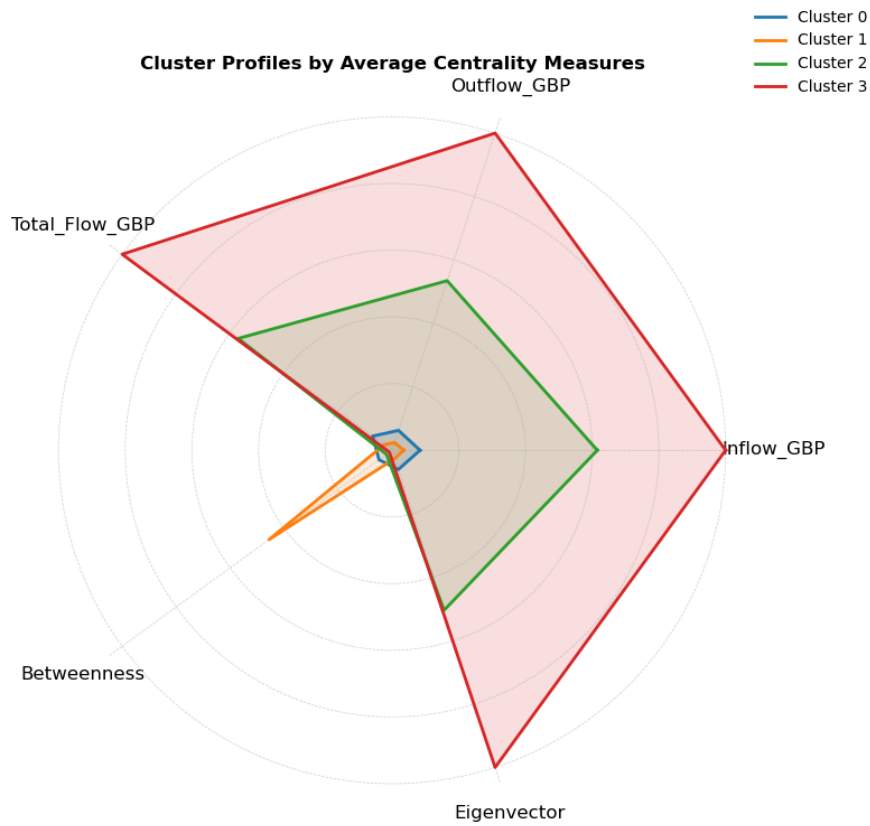


Image 8: Radar Chart – Cluster Profiles by Average Centrality Measures

Financial Hub(cluster3) dominates systemic influence; Connectors bridge; Core handles high volume; Periphery supports locally.

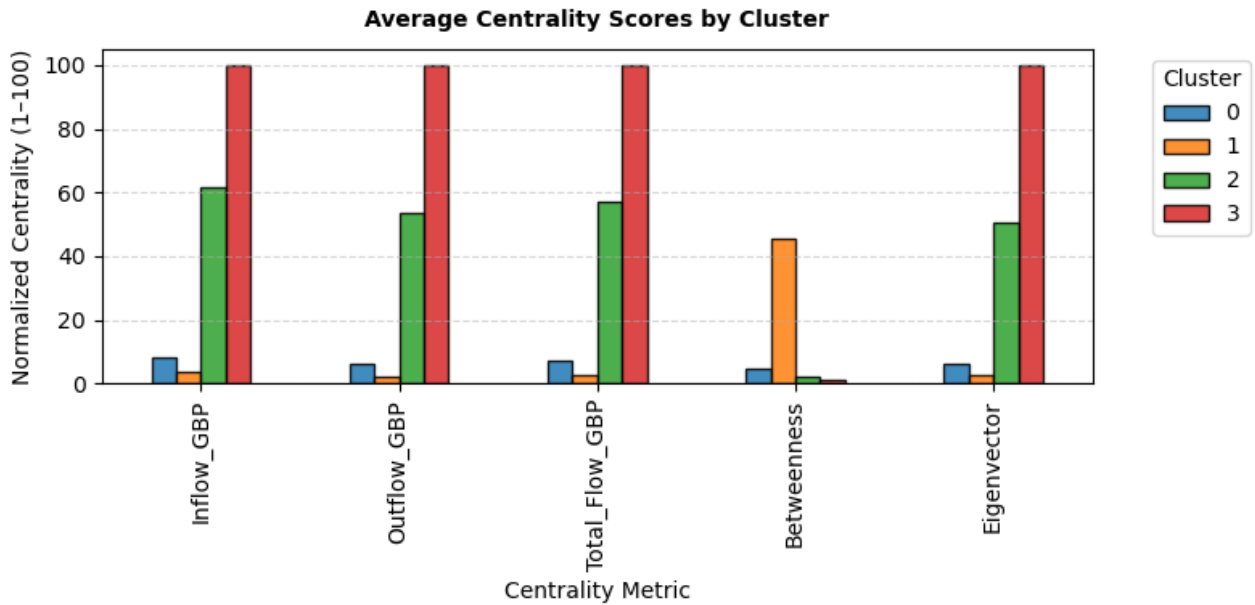


Image 9: Bar Chart – Average Centrality Scores by Cluster

This bar chart compares mean centrality values across clusters.

The Financial Hub (red bars) towers above all others on every measure, confirming its systemic control of the network.

Cluster 1 (orange) spikes on betweenness, highlighting its bridging function.

Cluster 2 (green) remains high and consistent across inflow, outflow, and eigenvector.

Meanwhile, Cluster 0 (blue) stays near the bottom, representing smaller scale but balanced activity.

The contrast between the tall red bars and the smaller ones visually captures how concentrated economic influence is within the UK's financial core.

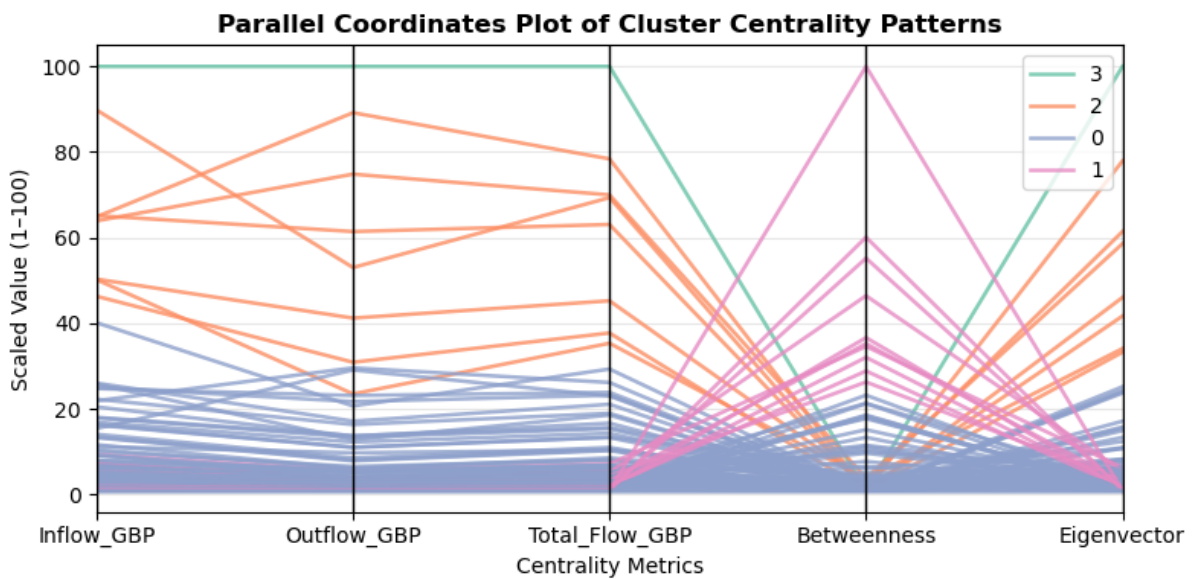


Image 10: Parallel Coordinates Plot of Cluster Patterns

Shows clear separation of cluster patterns across all metrics. Together, these patterns confirm a finance-anchored but structurally balanced economy.

4. Power BI Dashboard Summary

To complement the Python findings, I built an interactive **Power BI dashboard** with two pages:

Page 1 – Economic Flow Insights Dashboard

Total Payment Value: £3.98T

Total Transactions: 887M

Cluster Breakdown:

Core: 48.5%

Connector: 39.8%

Financial Hub: 9%

Periphery: 3–4%

Key Industries: Financial Services, Public Admin, Retail, Business Support

Top Insights:

“Core and Connector sectors handle over 85% of all transactions, while the Financial Hub manages the systemic liquidity.”

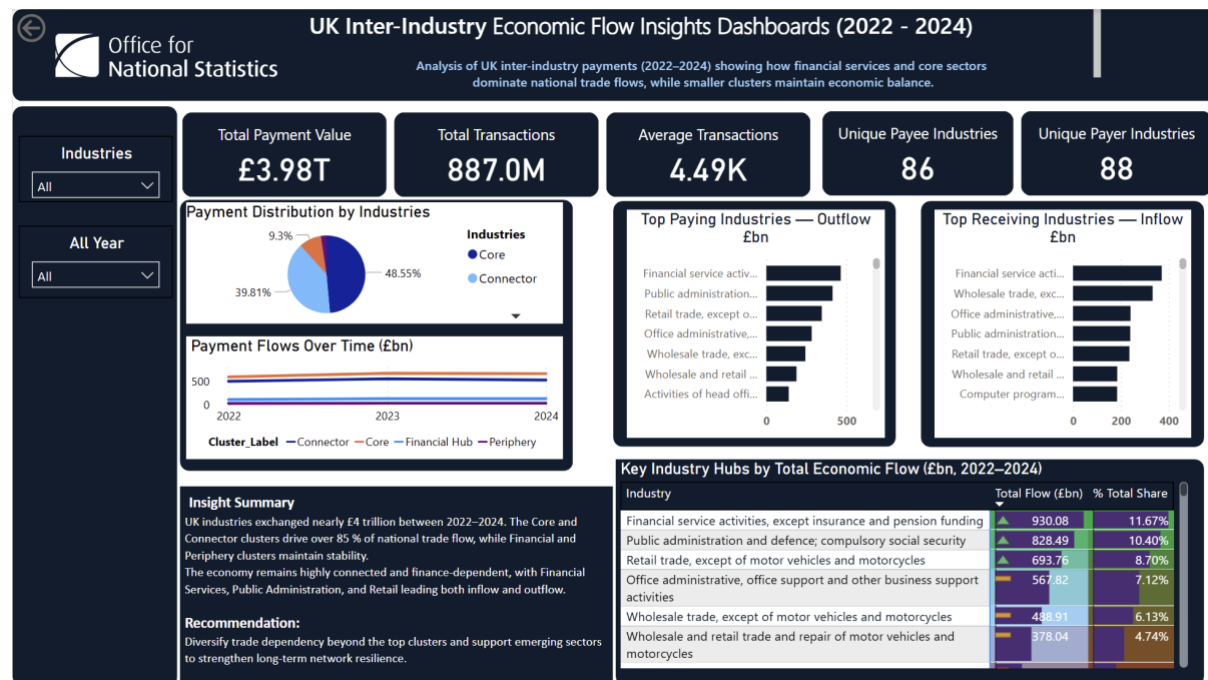


Image 11: Power BI Page 1 Screenshot – Economic Flow Insights Dashboard

Illustrates the trade balance and transaction distribution across Industries.

Page 2 – Network Influence Dashboard

Systemic Influence (Eigenvector): Finance ~63% of influence

Connector Bridge Power: 32%

Core Stability: 5%

Periphery Influence: <1%

Key Metrics Displayed:

Network Activity Index

Receiving Power

Spending Power

Systemic Influence Index

These visual KPIs match the centrality scores computed in Python, proving internal consistency.

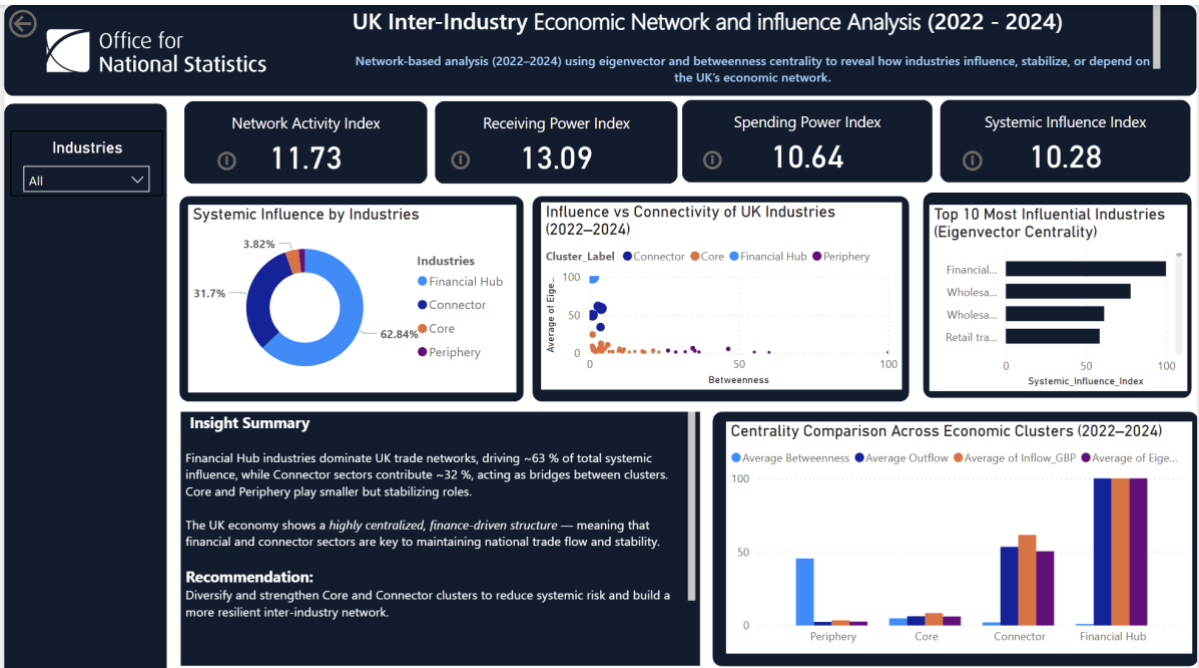


Image 12: Power BI Page 2 Screenshot – Network Influence Dashboard

Shows systemic influence, top industries, and cross-sector dependencies.

5. Strategic Insights & Recommendations

System Strengths:

Highly integrated Core + Connector sectors ensure transaction continuity.
Network shows stable growth and recovery after pandemic shocks.
Strong public administration and logistics links improve national resilience.

System Weaknesses:

Heavy financial dependency: 63% of influence concentrated in finance.
Peripheral sectors under-connected — limits local economic diversification.
Limited redundancy in Connector industries increases risk of bottlenecks.

Recommendations:

Diversify cross-cluster partnerships — especially between Core and Periphery sectors.
Support emerging regional industries through credit access and digital trade systems.
Embed network analytics into ONS monitoring to track systemic risk over time.
Promote resilience training in logistics and finance to reduce single-point dependency.

6. Conclusion

This project connects data science, economic analysis, and visual storytelling.
Using real-world ONS data, I turned complex industry payment flows into a network model that shows how the UK economy works under the hood.

It's clear that while the UK's economy is robust and well-connected, it's also **fragile at the top** — too much control sits in financial networks.
Still, the balance between Core, Connector, and Peripheral sectors provides hope for stability — if managed strategically.

In short: the UK economy is a living network — powerful, connected, and adaptive, but in need of balance.

7. References

Data Source:

[ONS UK Industry-to-Industry Payment Flows \(Jan 2017 – Nov 2024\)](#)
[ONS UK SIC Structure Summary \(1988–2025\)](#)

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