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Interactions Between Global Value Chains and Foreign Direct Investment:

A Network Approach

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Figure 1: Stylized weighted directed network

Note: The figure shows a stylized weighted directed network with nodes indicated by letters A–H and numbers indicating the weight of a directed link. Source: Own elaboration.

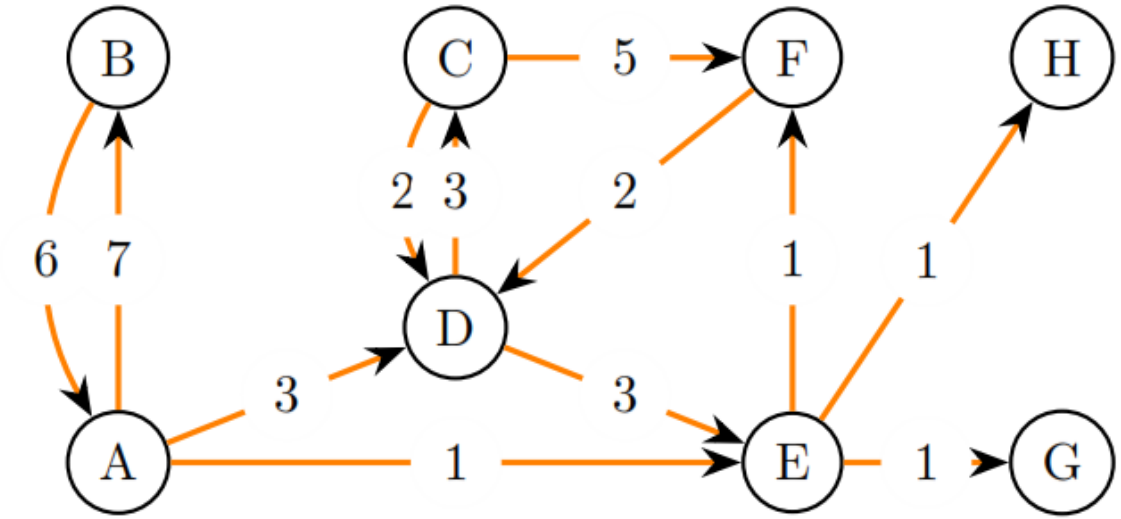


Table 3: Selected centrality measures for the stylized network

Node	PageRank	Degree	In-degree	Out-degree	Weighted degree	Weighted in-degree	Weighted out-degree
A	0.12	0.57	0.14	0.43	17	6	11
B	0.10	0.29	0.14	0.14	13	7	6
C	0.13	0.43	0.14	0.29	10	3	7
D	0.22	0.71	0.43	0.29	13	7	6
E	0.14	0.71	0.29	0.43	7	4	3
F	0.15	0.43	0.29	0.14	8	6	2
G	0.07	0.14	0.14	0.00	1	1	0
H	0.07	0.14	0.14	0.00	1	1	0

- Nodes denoted by **letters A-H** connected by weighted directed linkages (the weights are indicated by numbers).
- Nodes **differ significantly** in terms of their **relative connectivity** to other nodes and their overall importance to the system.
- Nodes H and G have a total degree (or degree centrality) of 1, while nodes D and E have the degree of 5.
- To illustrate **the difference** between a **conventional approach** and a **network perspective**, it is useful to compare nodes **B** and **D**.
- Node **D** is much **moe important** to the network as it **bridges 4** other **nodes**, as opposed to node B, which is only linked to node A.
- Certain network-based measures of connectivity can take into account such **second-order connectivity effects** due to the adjacent nodes (“neighbors"), along with **the weight** and **the direction** of the nodes' own linkages, to arrive at a **proper measure** of a node's centrality in the network.

- In this paper, among other measures, we therefore use **PageRank centrality**, originally developed in **Brin and Page (1998)** and **Page et al. (1999).**
- PageRank allows to summarize the centrality of a node in the network taking into account the **weight** and the **direction** of **linkages**, as **opposed** to **simple eigenvector centrality** measure.
- In brief, PageRank centrality is an **eigenvector-based algorithm** that measures the fraction of **time spent visiting** a **given node** in a random walk summarized over all linkages in the network.
- PageRank can be viewed as the **probability** that a **shock originating** in a **randomly chosen node** anywhere in the network and **traveling through it** from one node to another via the linkages will arrive at a given node (averaged over all possible shock source nodes in the network).

- Originally, **PageRank** was used to quantify the **relative importance** of **web pages** in the Internet (hyperlinked network)
- Also PageRank has **gained popularity** in **other disciplines** given its desired properties that allow to account for more **complex network relationships**.
- Table 3, PageRank indeed identifies node **D** as the most **"central" node** in the stylized network, unlike simpler measures.
- Thus, by construction PageRank centrality varies in the **0-1 range** with greater values reflecting **higher probability** of being visited by a shock, i.e. greater multilateral connectivity.

Figure 2: The structure of an inter-country input-output database

Note: The figure shows a stylized inter-country input-ouput database for J countries and S sectors. Source: own elaboration.

			Use of inputs and value added by countries and sectors									Final use (households, government, GFCF)			Total use
			Country 1			...			Country J			Country 1	...	Country J	
			Sector 1	...	Sector S	...			Sector 1	...	Sector S				
Intermediate inputs supplied by countries and sectors	Country 1	Sector 1													
		...													
		Sector S													
	...	...													
	Country J	Sector 1													
		...													
		Sector S													
Total value added															
Gross output															

Figure 3: GVC network, 2015

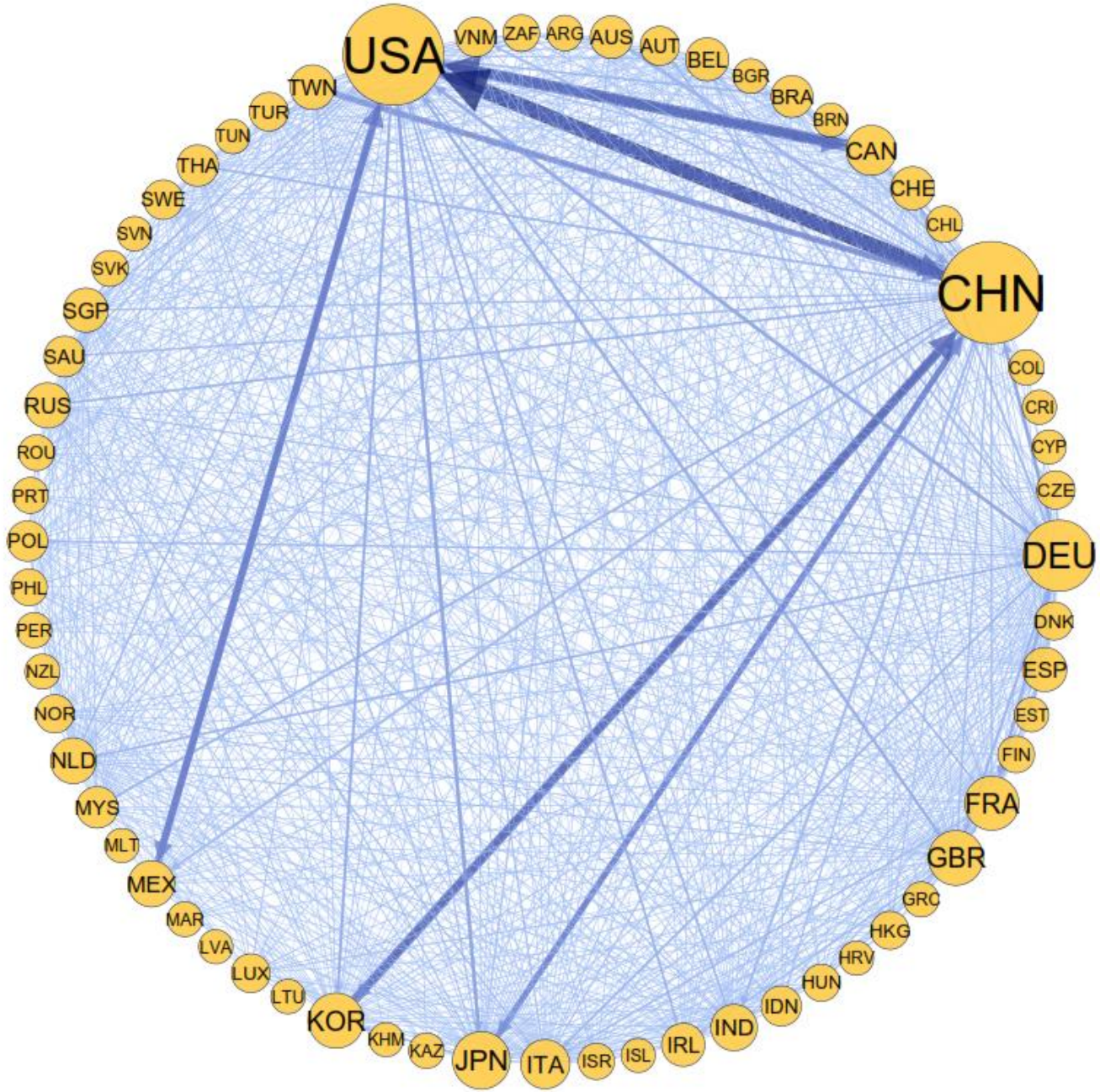


Figure 4: GVC network–core, 2015

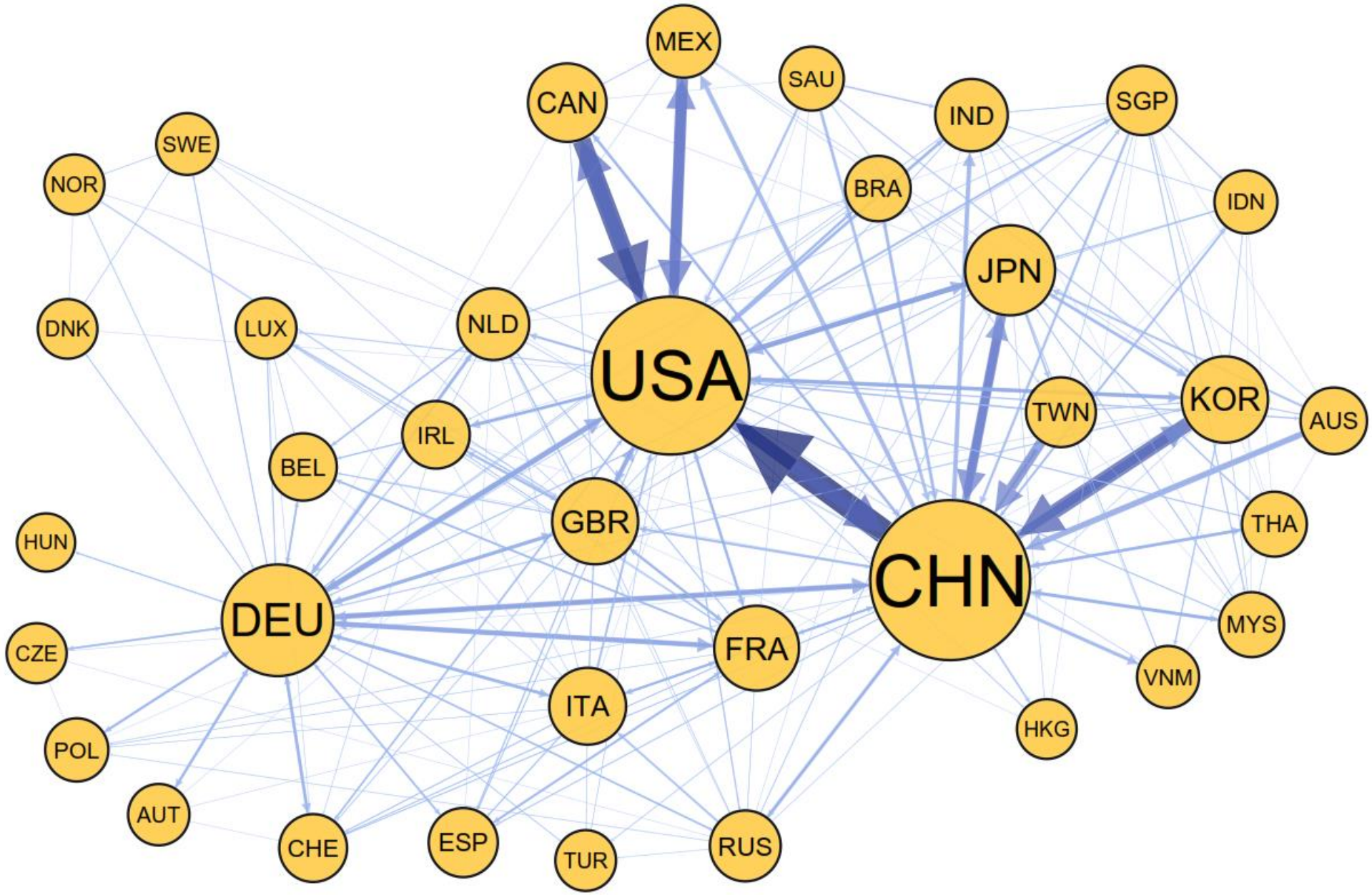


Figure 5: FDI network, 2015

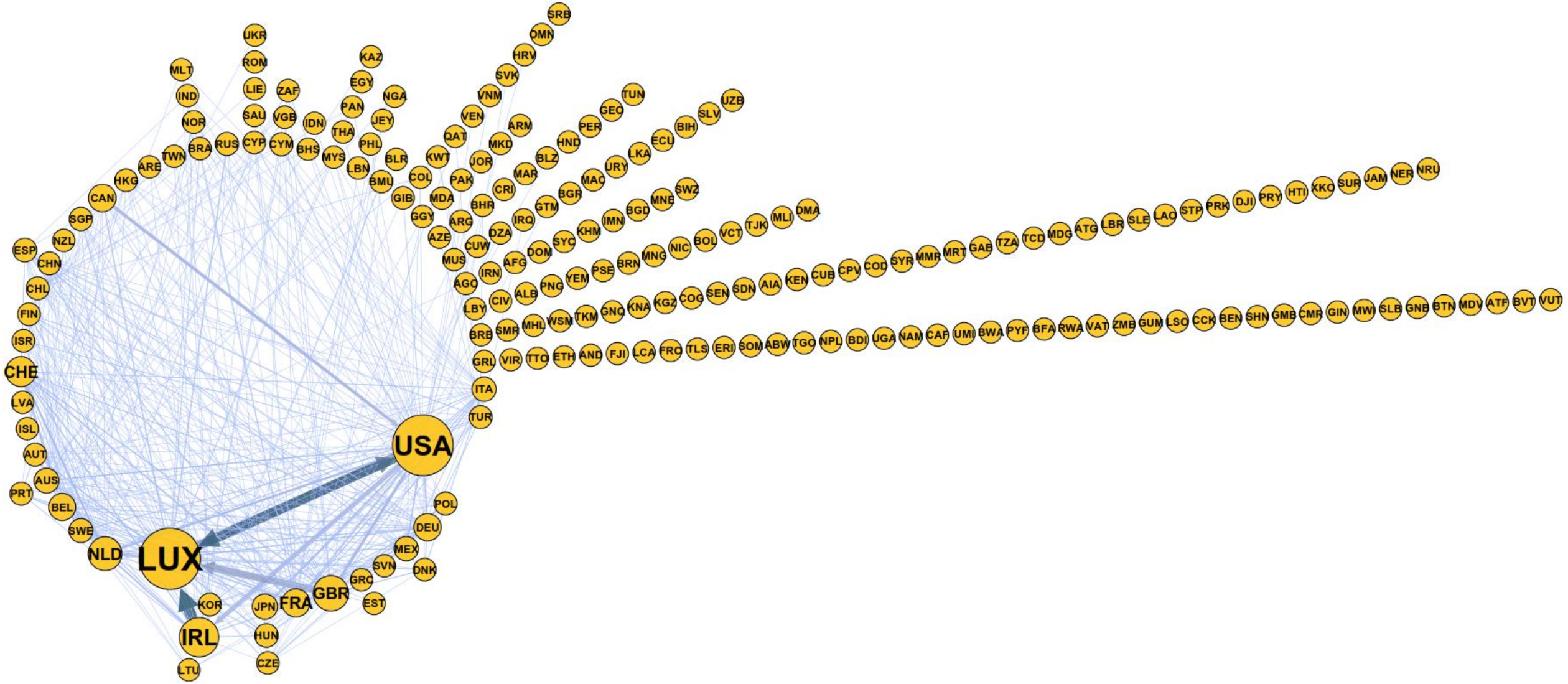


Figure 6: FDI network–core, 2015

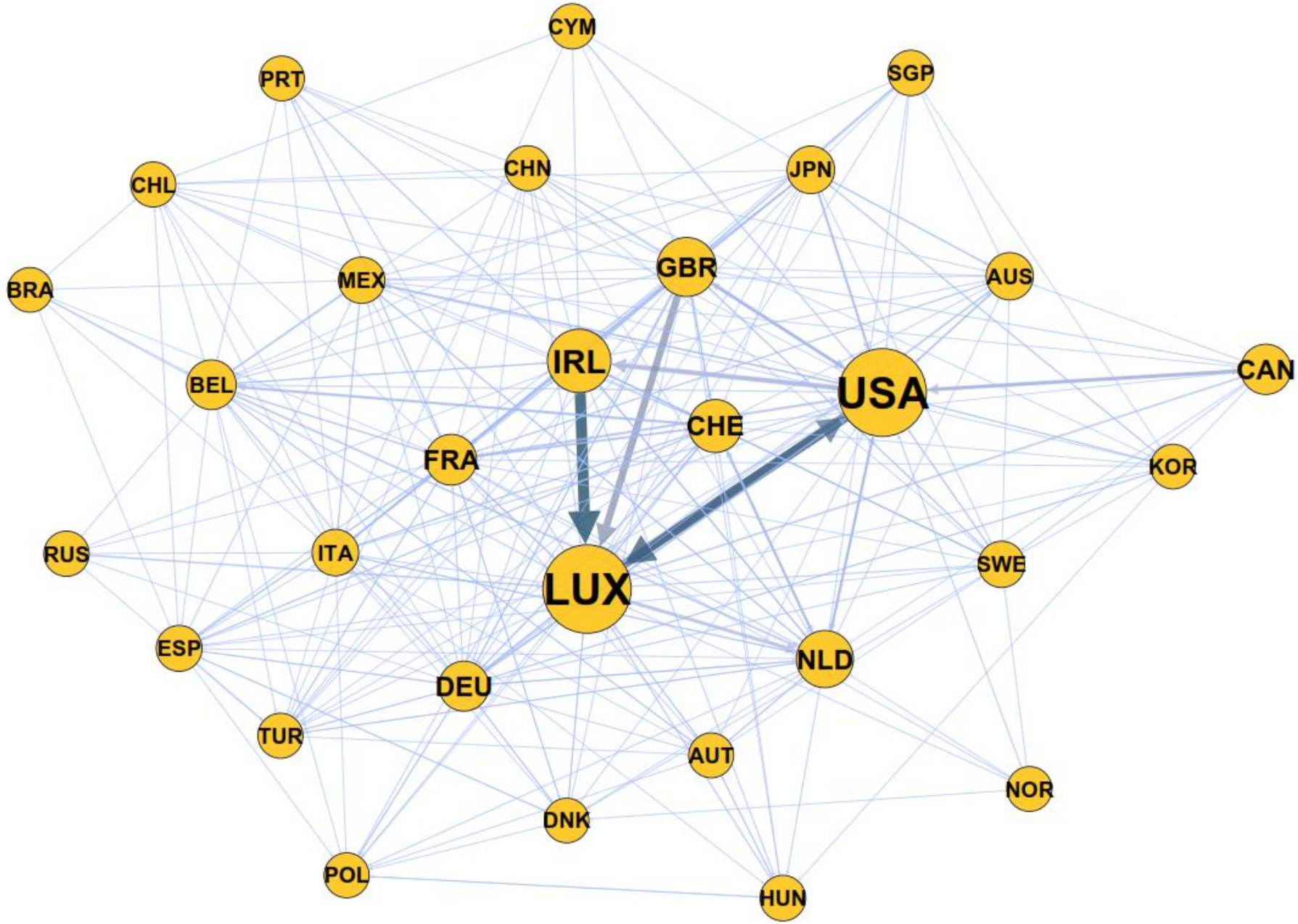
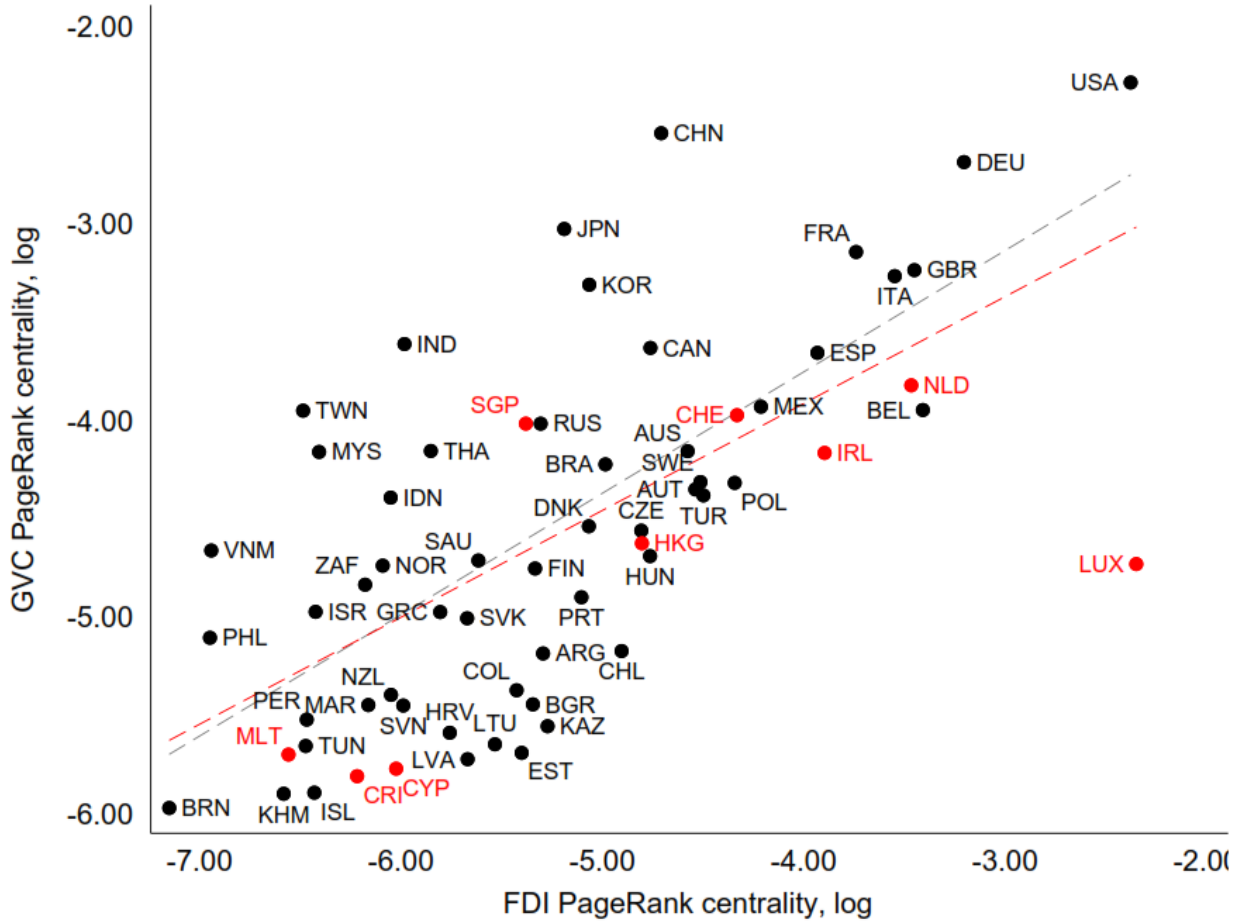


Figure 7: Scatterplot of GVC vs FDI PageRank centrality



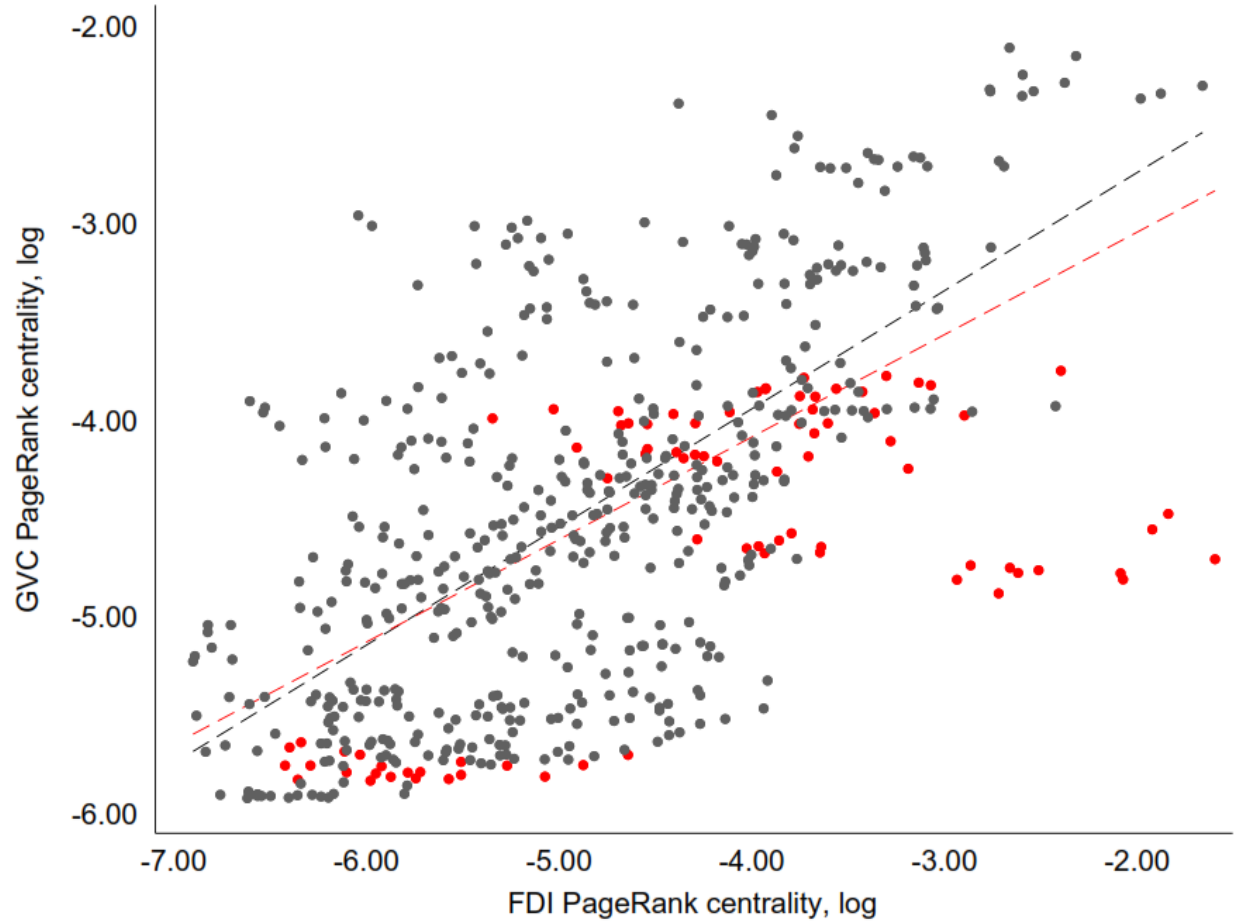


Figure 8: Evolution of selected countries in the GVC–FDI centrality space