

# Global trade competition patterns in categorised meat products: A weighted network analysis

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## Electronic supplementary material (ESM)

Supplementary Text S1

Supplementary Text S2

Supplementary Text S3

Supplementary Text S4

Supplementary Text S5

## DEFINITIONS AND FORMULAS OF WEIGHTED NETWORK INDICATORS

### S1. Strength centrality

In a weighted network, strength centrality measures the total weight of connections associated with a node and is defined as:

$$S(i) = \sum_{j=1}^N w_{ij} \quad (1)$$

where:  $N$  – the total number of nodes in the network;  $w_{ij}$  – the weight of the edge between node  $i$  and node  $j$ .

### S2. Cumulative strength distribution

The cumulative strength distribution characterises the distribution of node strength in the network and is defined as:

$$P \geq (S) = P(\text{Strength} \geq S) \quad (2)$$

which measures the proportion of nodes whose strength is greater than or equal to a given value  $S$ .

### S3. Strength-degree correlation

The strength-degree correlation describes the relationship between node degree and node strength and is expressed as:

$$S(k) = \frac{1}{N_k} \sum_{i \in V_k} S(i) \quad (3)$$

where:  $V_k$  – the set of nodes with degree  $k$ ,  $N_k$  – the number of nodes with a degree of  $k$ .

### S4. Weighted clustering coefficient

The topological clustering coefficient of node  $i$  in an unweighted network is defined as:

$$C_i = \frac{2t_i}{k_i(k_i - 1)} \quad (4)$$

where:  $t_i$  – the number of triangles involving node  $i$ ;  $k_i$  – the degree of node  $i$ .

The weighted clustering coefficient is defined as:

$$C_i^w = \frac{1}{s_i(k_i - 1)} \sum_{j,h} \frac{(w_{ij} + w_{ih})}{2} a_{ij} a_{ih} a_{jh} \quad (5)$$

where:  $w_{ij}$  and  $w_{ih}$  – the weights of the edges between node  $i$  and nodes  $j$  and  $h$ , respectively;  $a_{ij}$ ,  $a_{ih}$  and  $a_{jh}$  – elements of the adjacency matrix, where equal 1 if an edge exists between nodes, otherwise 0.

### S5. Weighted average nearest neighbour degree

In an unweighted network, the average nearest neighbour degree of node  $i$  is defined as:

$$k_{nn}(i) = \frac{1}{k_i} \sum_{j \in \tilde{A}_i} k_j \quad (6)$$

where:  $\tilde{A}_i$  – the set of all neighbours of node  $i$ .

In a weighted network, the weighted average nearest neighbour degree is defined as:

$$k_{nn}^w(i) = \frac{1}{s_i} \sum_{j \in \tilde{A}_i} w_{ij} k_j \quad (7)$$