Network and vulnerability analysis of internatioanal spice trade

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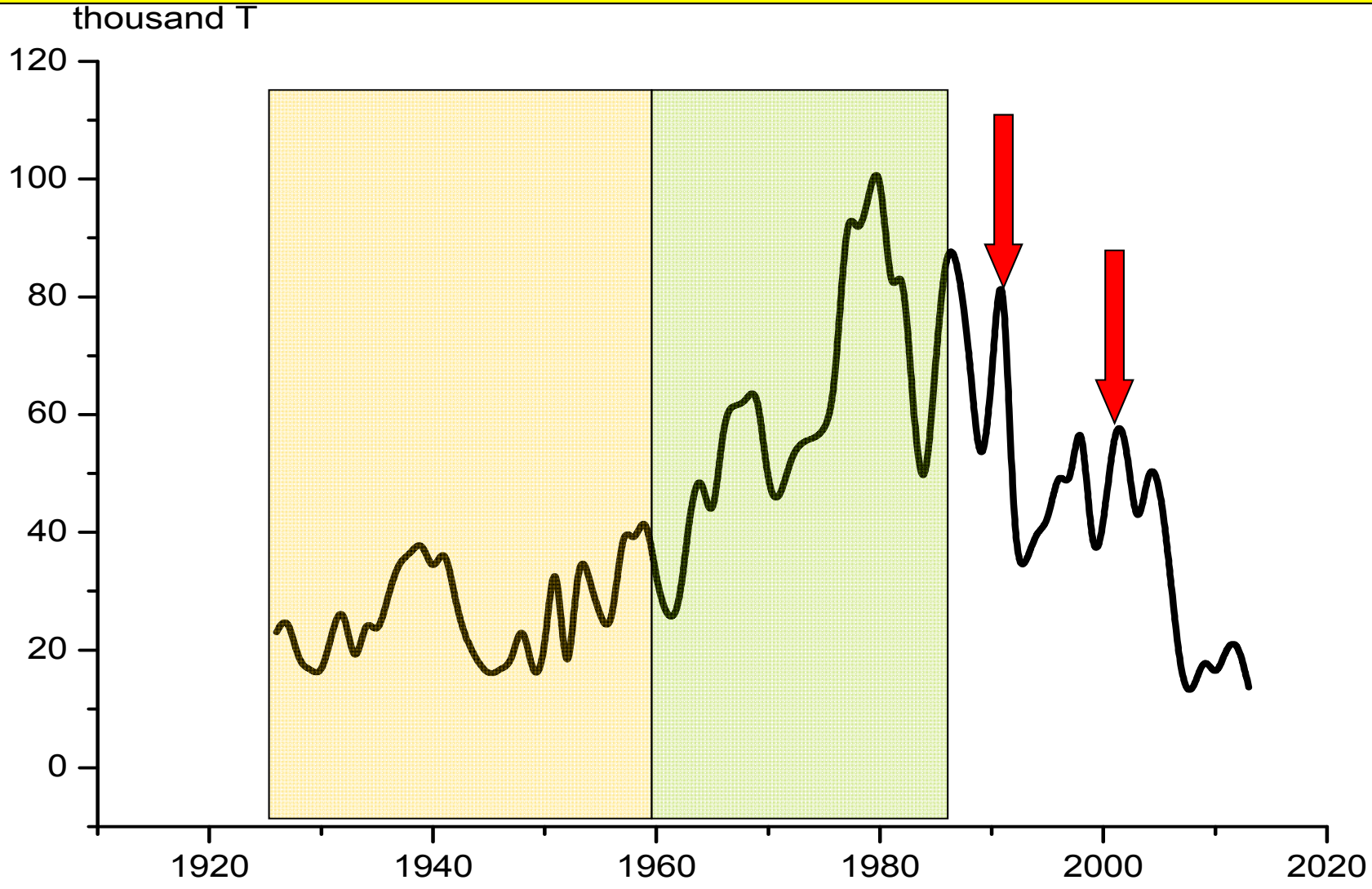
Paprika: an emblematic product of Hungary

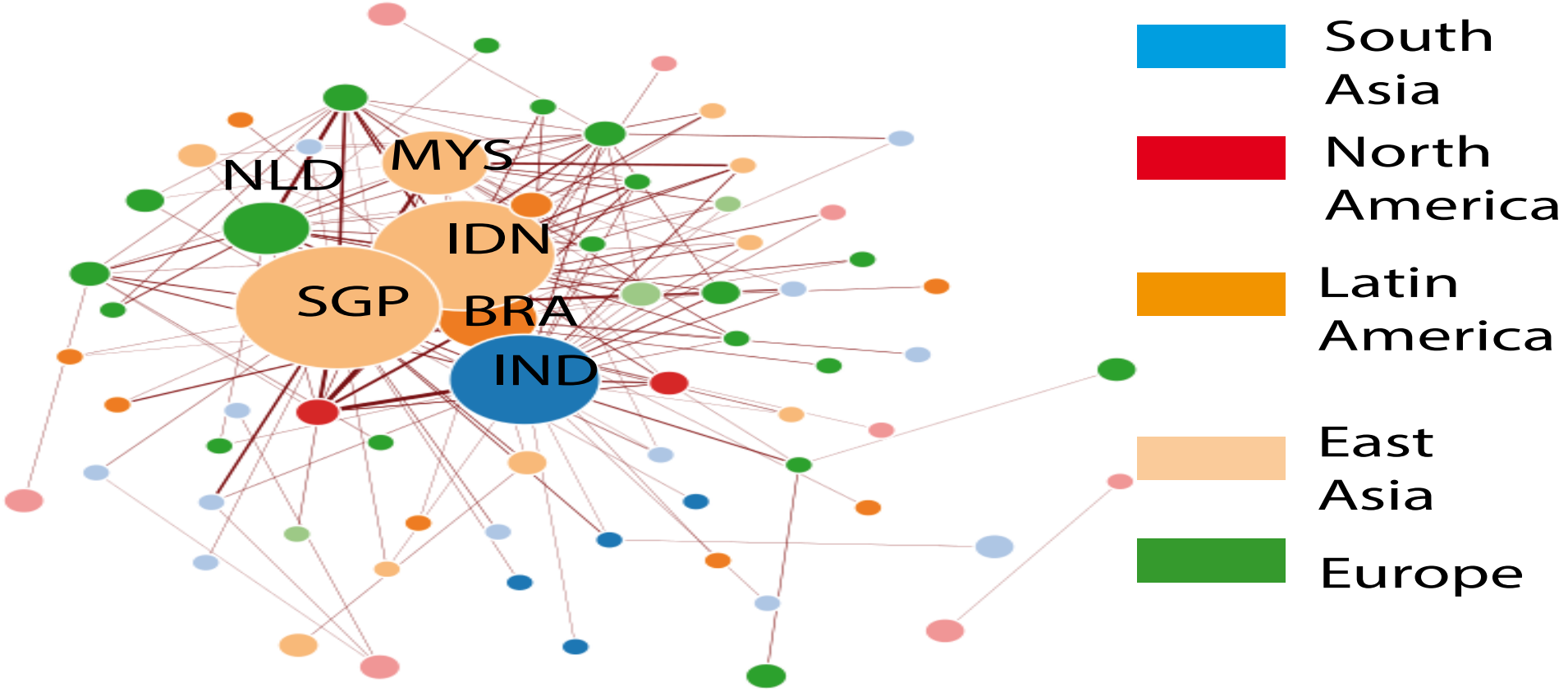
PRIDE OF
SZEGED
HUNGARIAN
HOT PAPRIKA
KEEP IN A COOL DRY PLACE

Paprika and political marketing: the paternalistic „war MP”

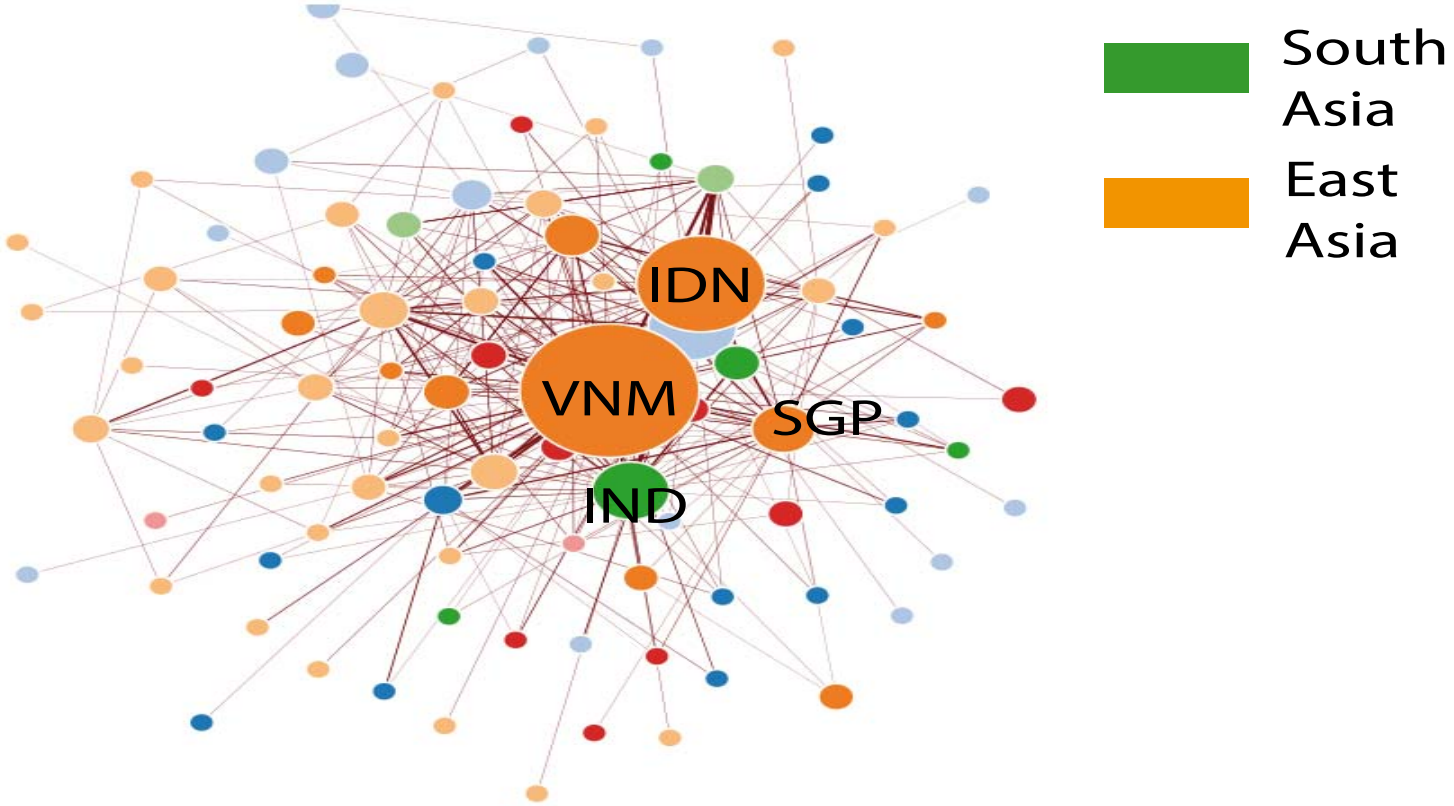
Paprika production in Hungary



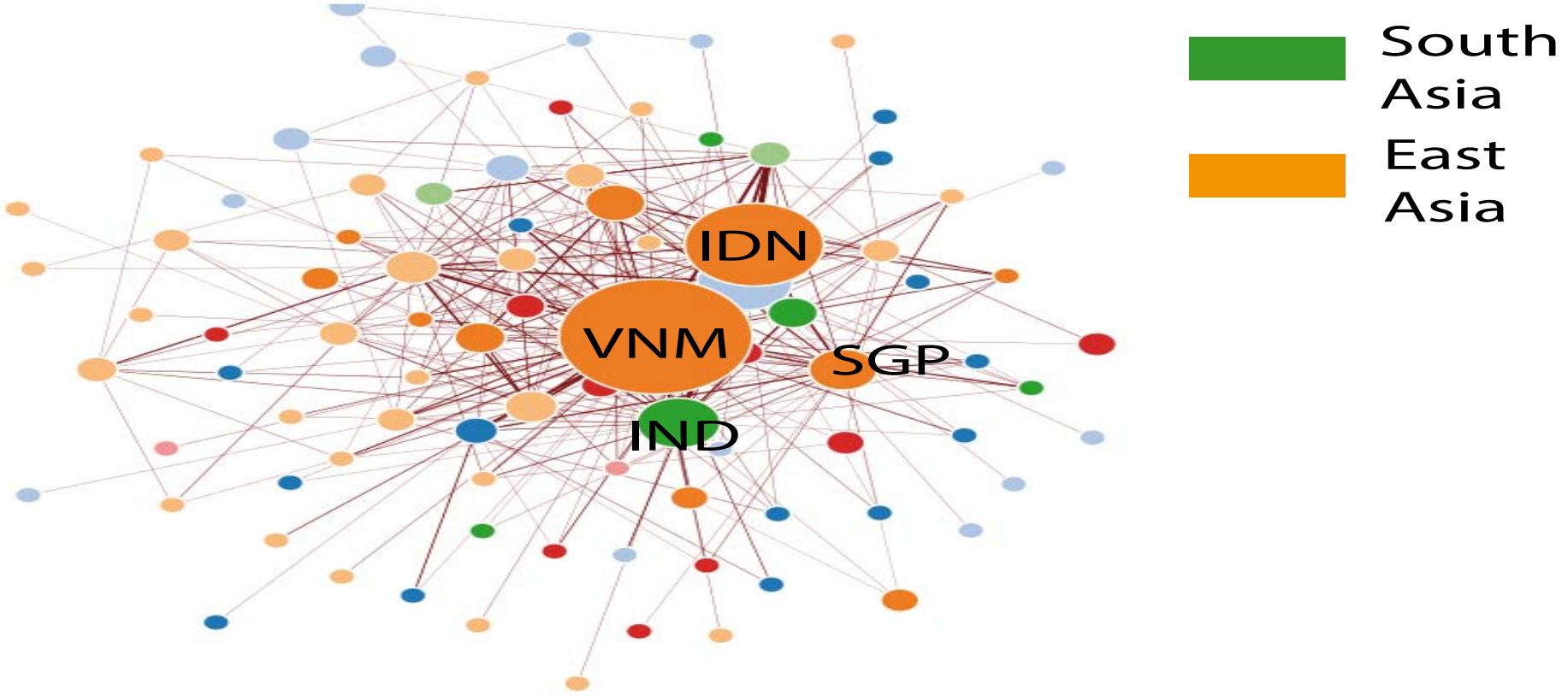
Global trade network of dried papper, 1998



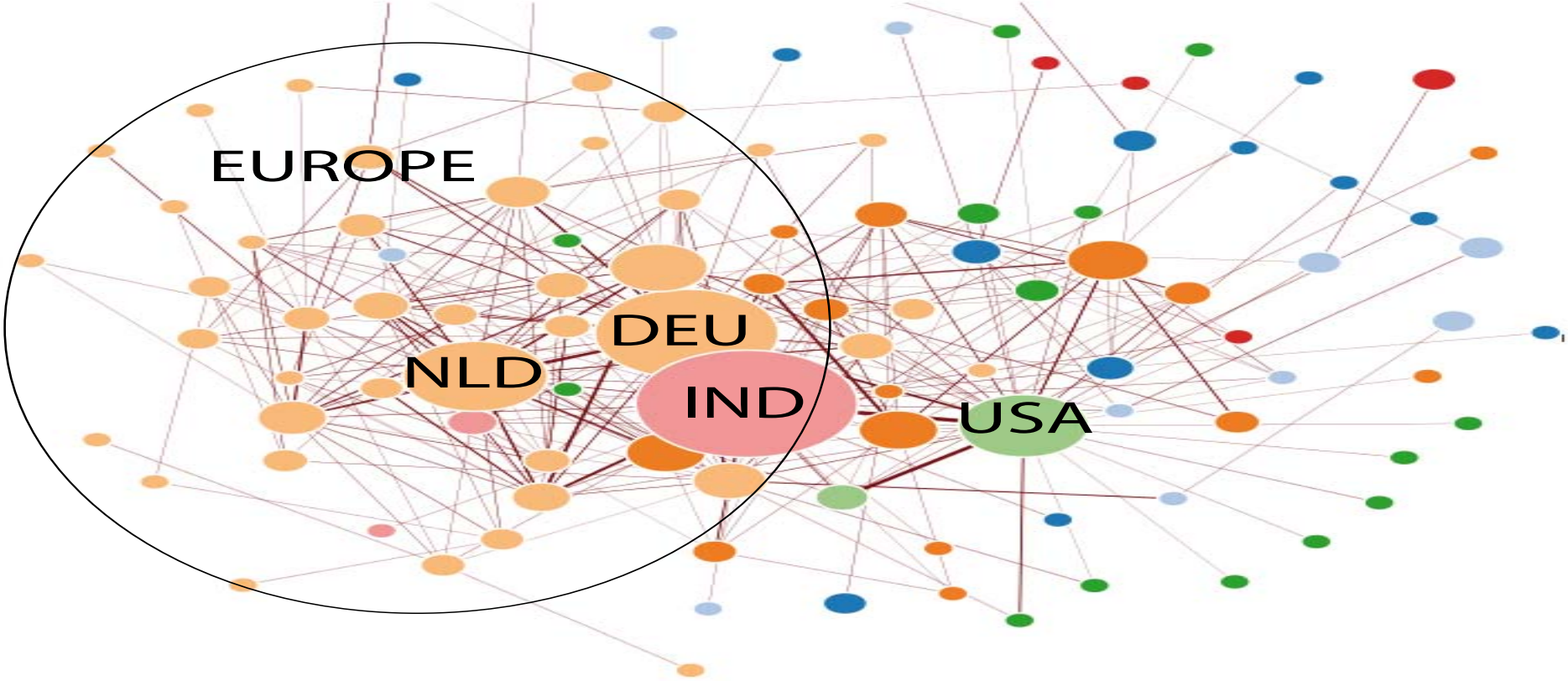
Dried pepper trade 2003



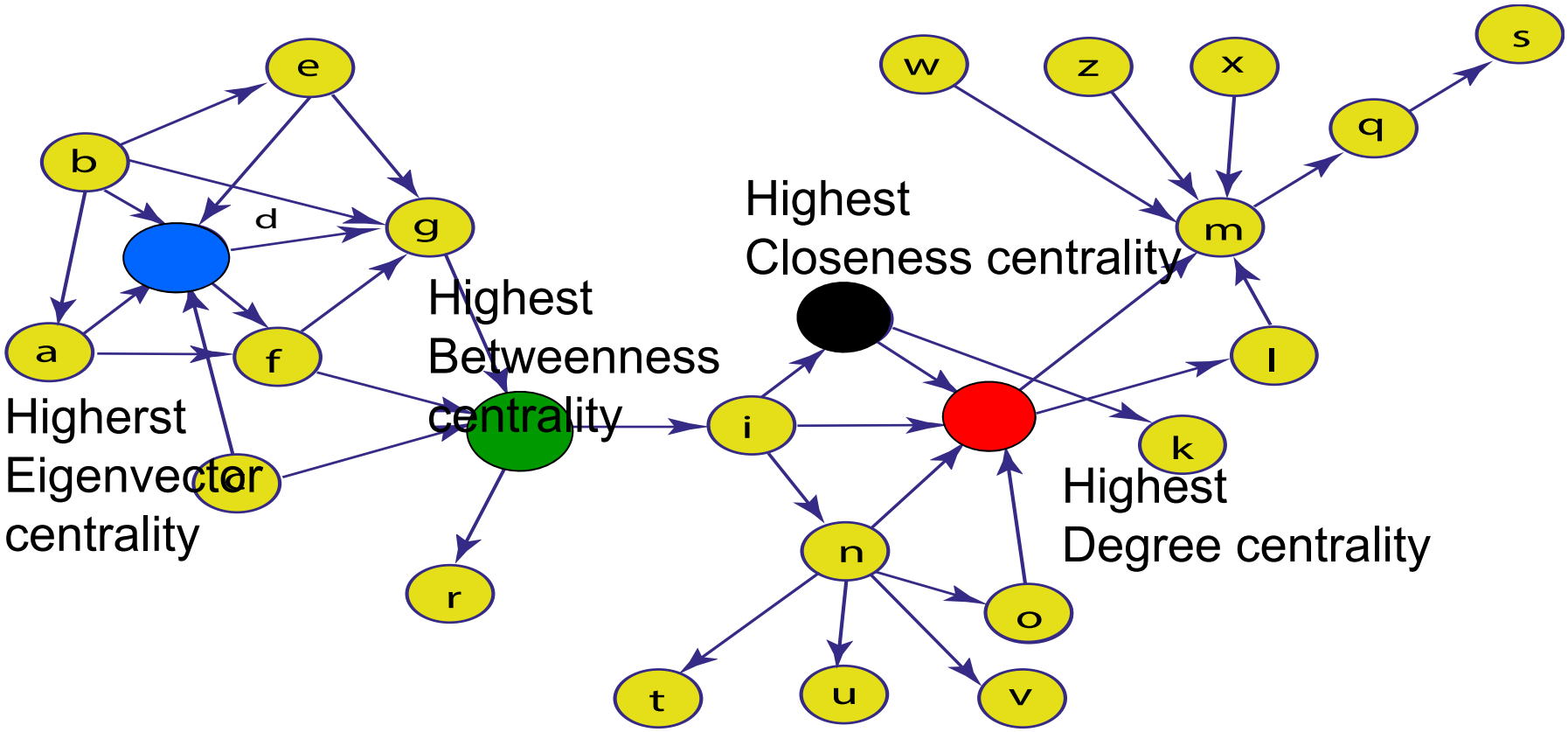
Dried pepper trade, 2014



Crushed pepper trade, 2014

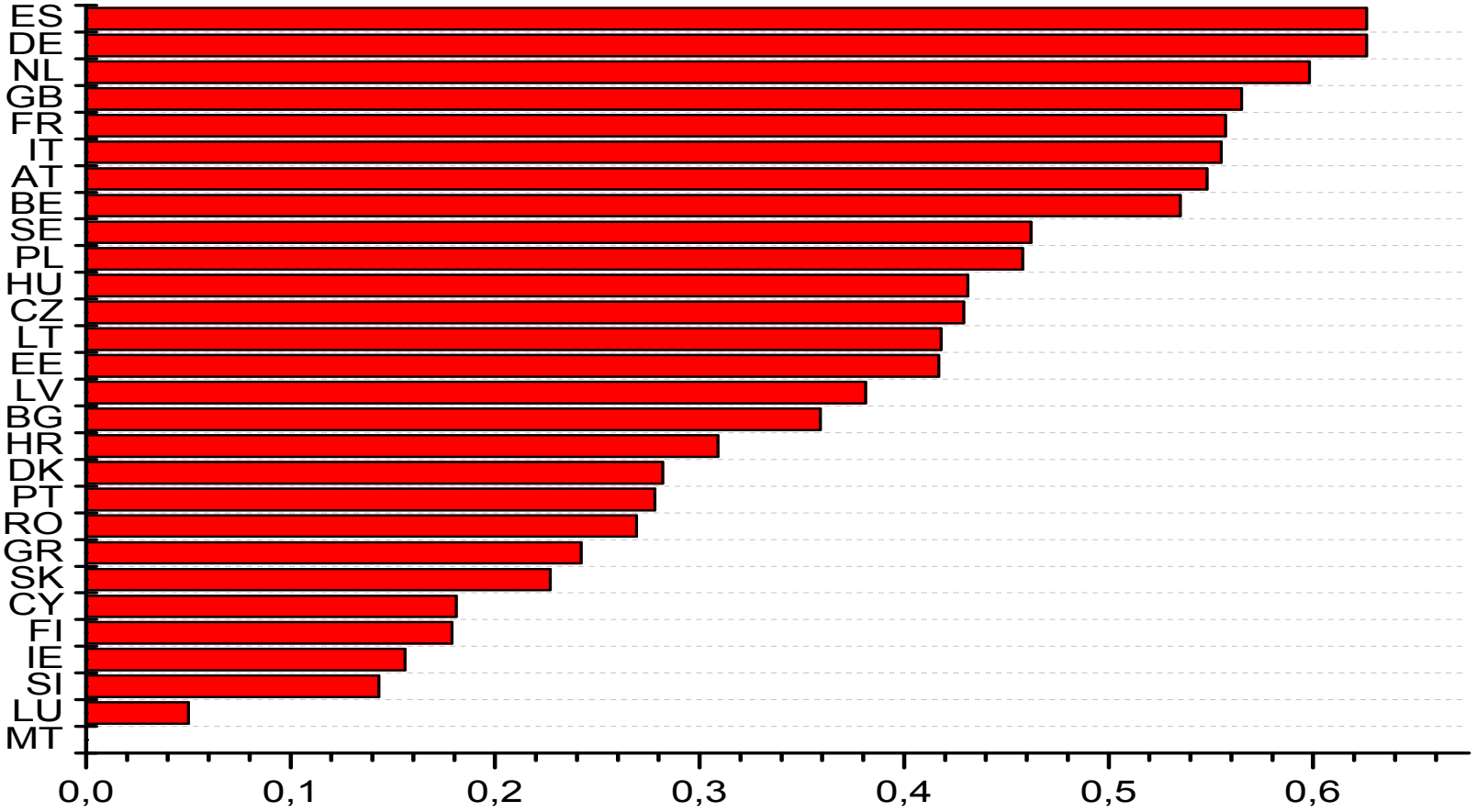


Who is in the center?

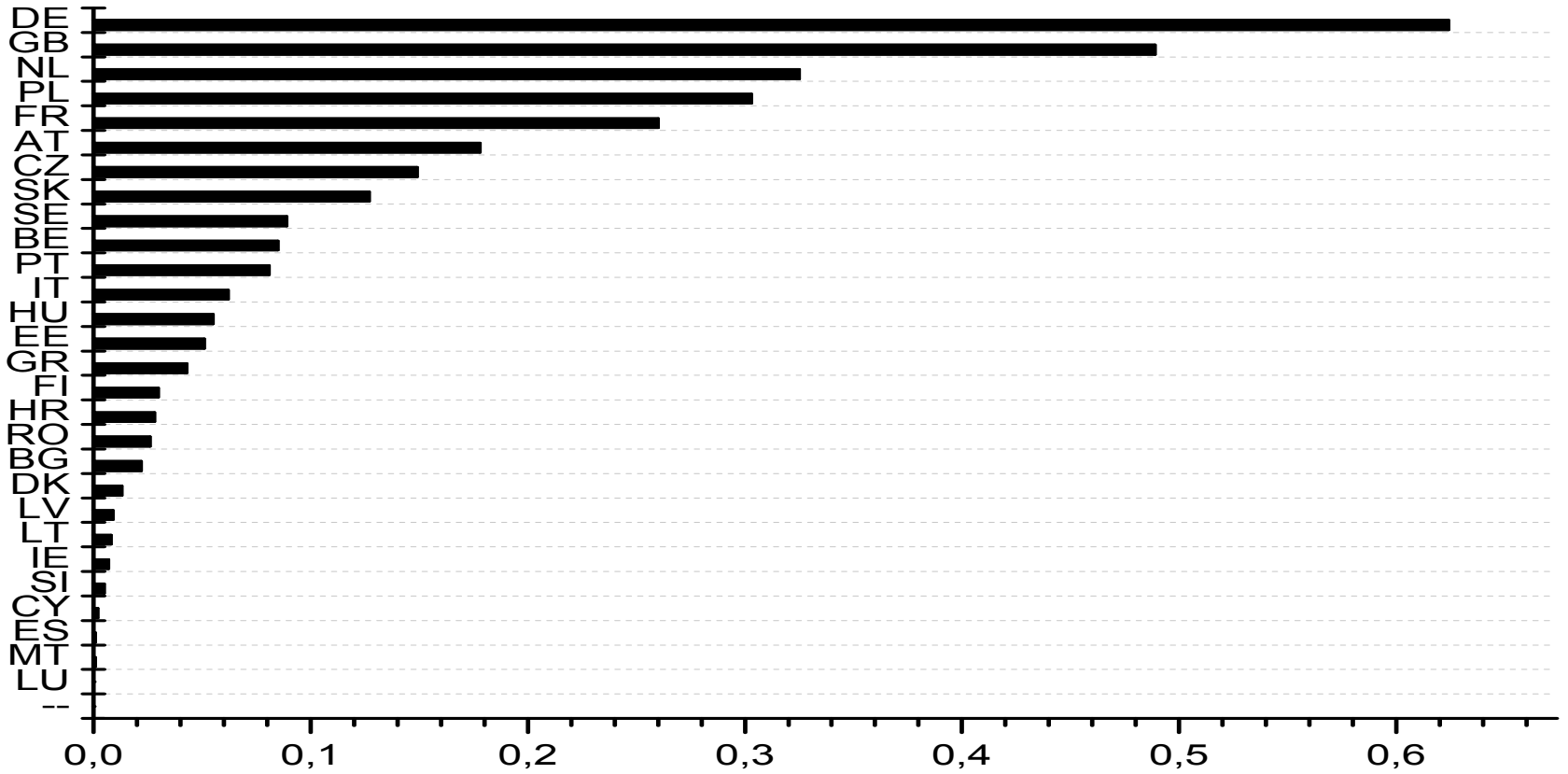


Discovering Sets of Key Players in Social Networks – Daniel Ortiz-Arroyo – Springer 2010

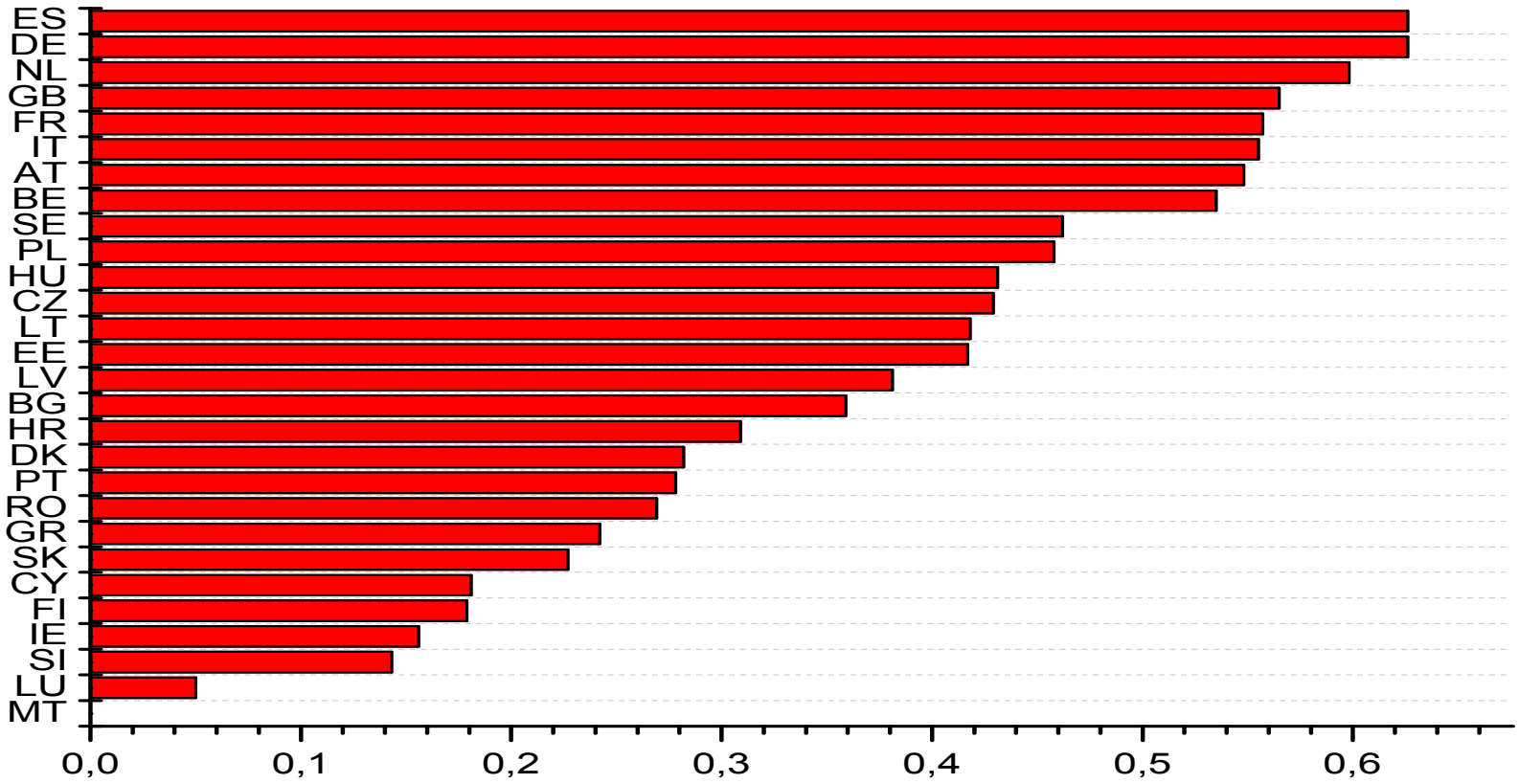
Brockerage role of actors in European paprika powder trade network



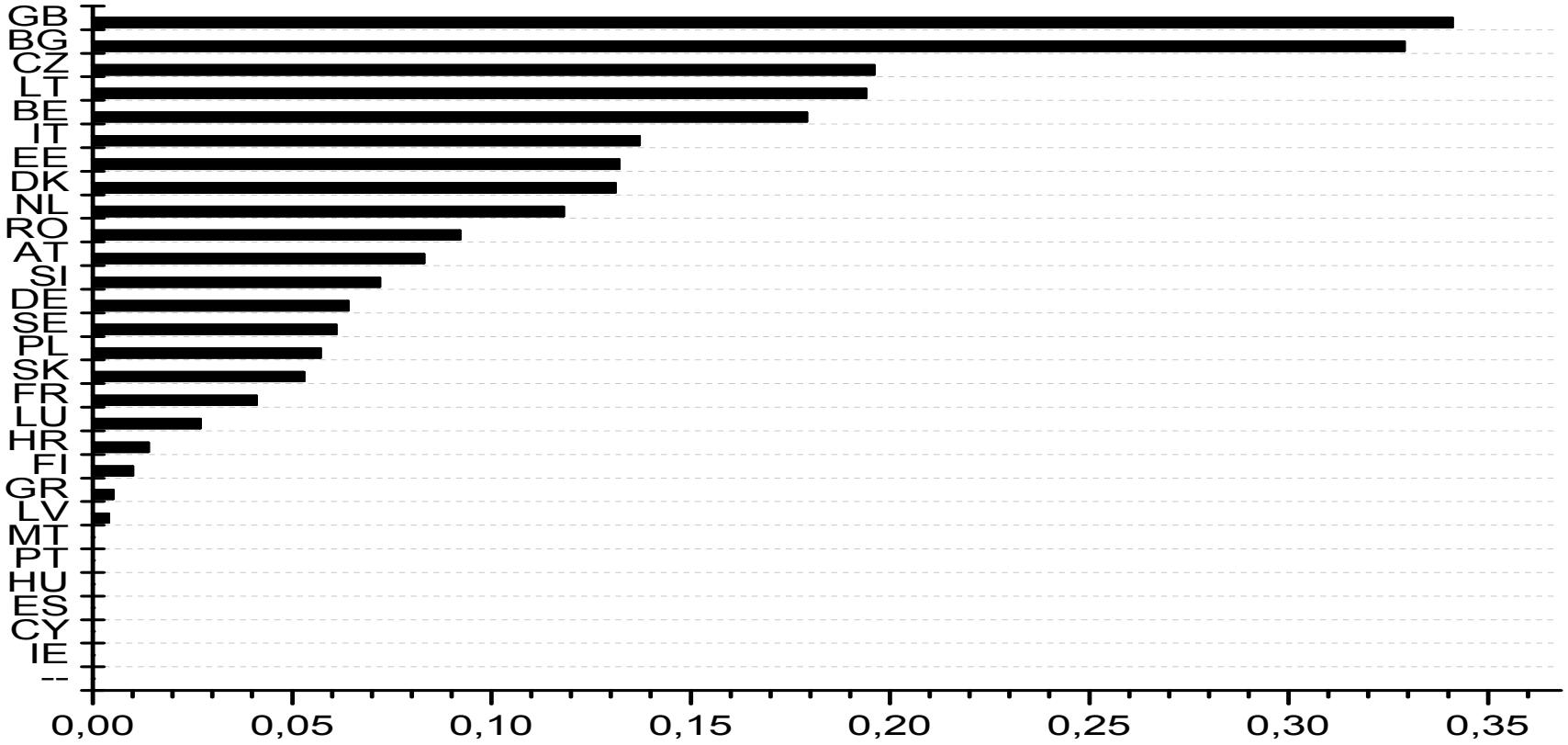
Authority centrality



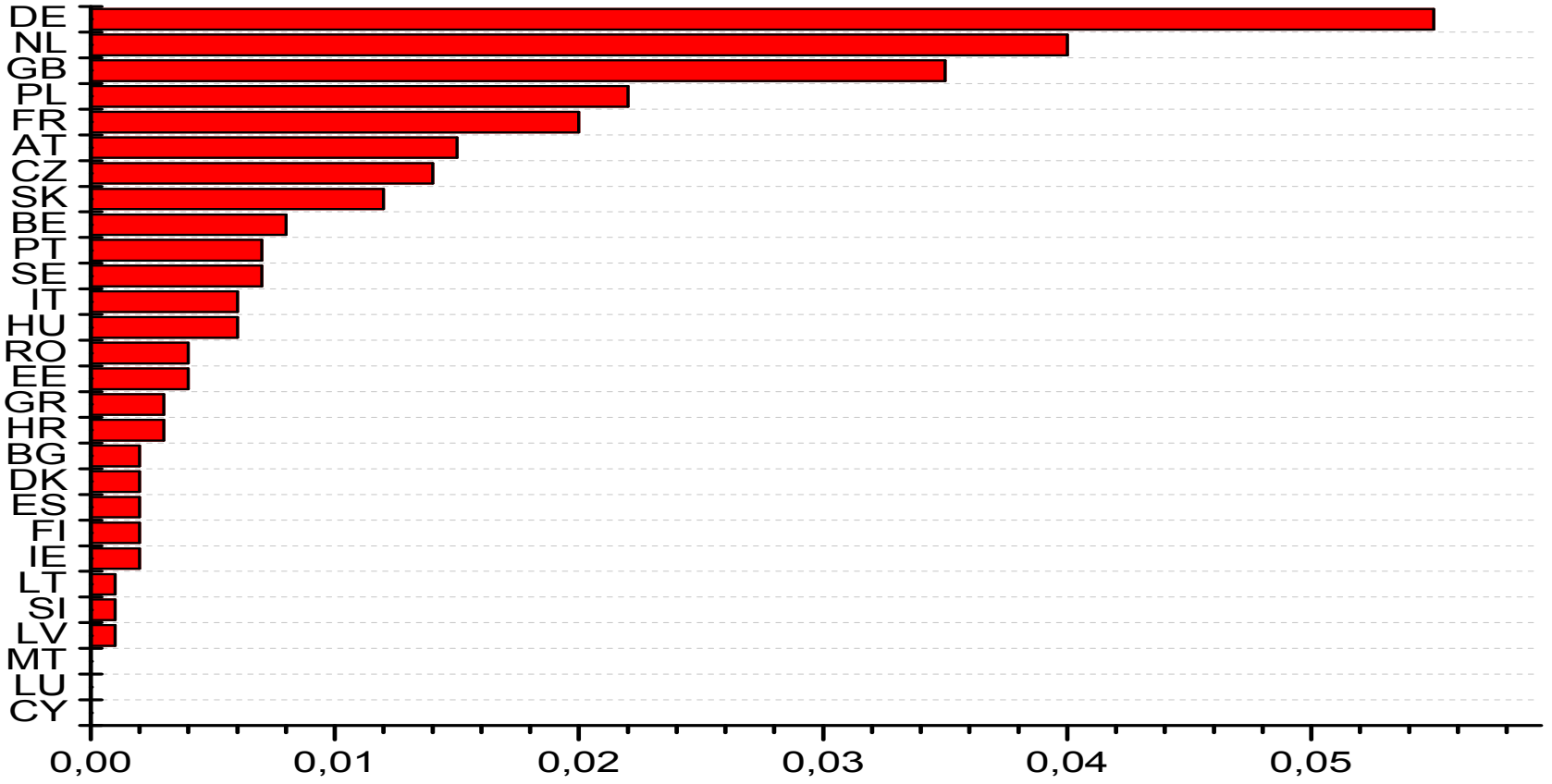
Eigenvector-centrality



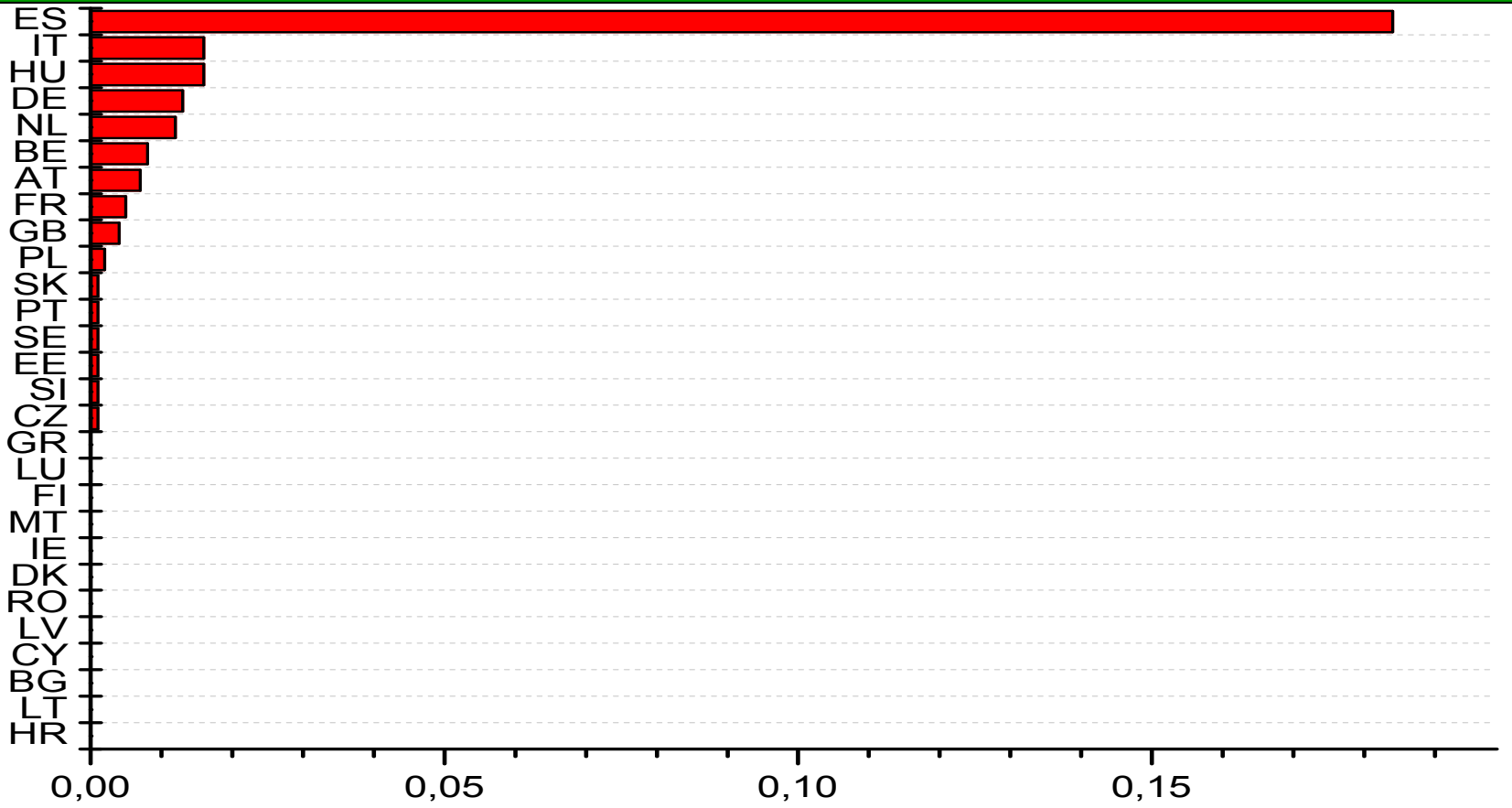
Betweenness centrality

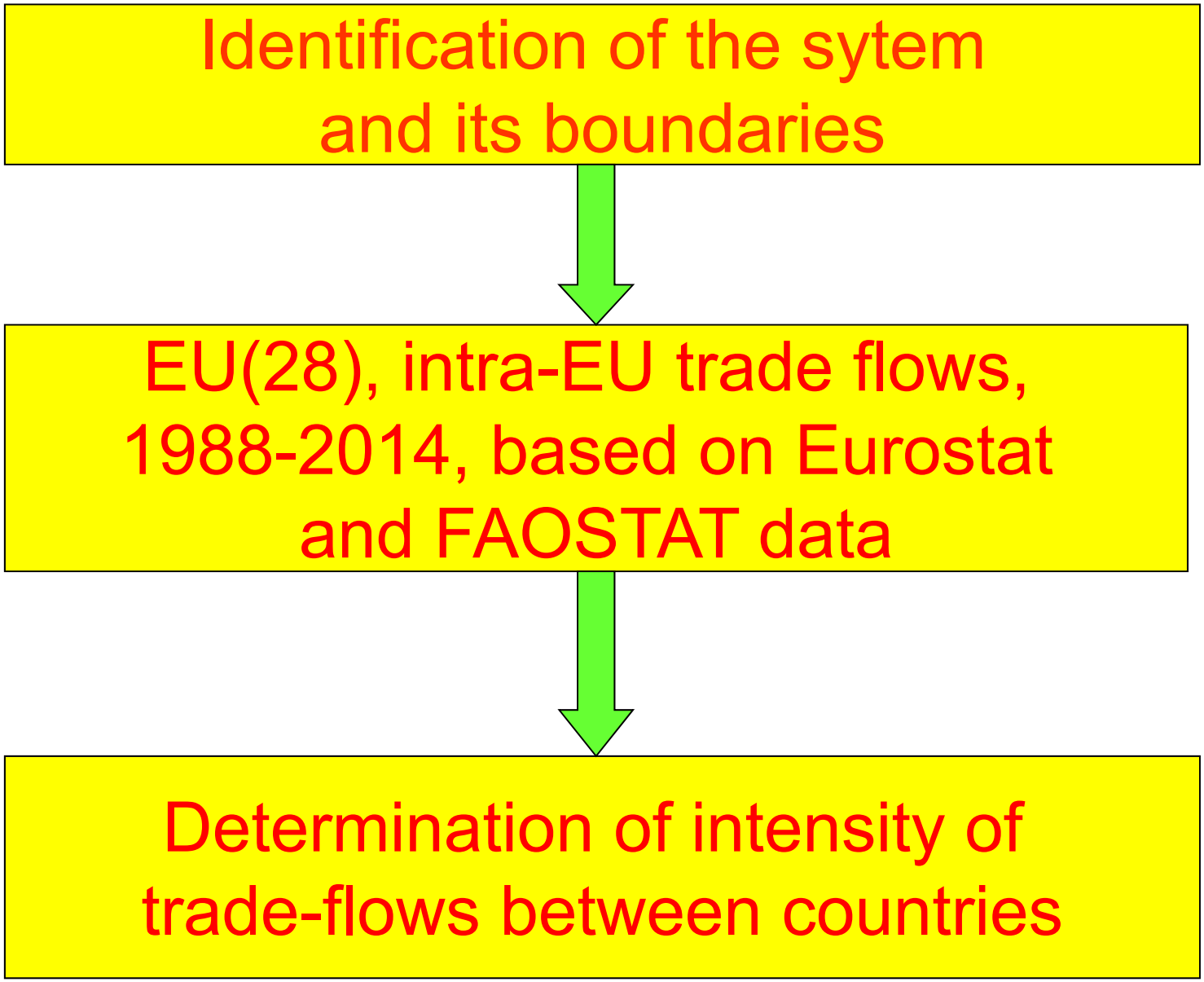


In-degree centrality



Out-degree centrality



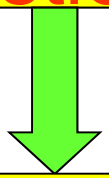

Identification of the sytem
and its boundaries
EU(28), intra-EU trade flows,
1988-2014, based on Eurostat
and FAOSTAT data
Determination of intensity of
trade-flows between countries

Based on stochastic characteristics of trade flows, simulation of potentical consequences of emergence of contaminated products

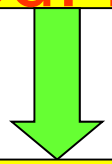
Boundary conditions:
-just the intra-EU trade;
-10% domestic consumption between the steps;
-homogenous product;
-discrete steps

Simulation by

Simulation parameters
Input: 28×28 trade matrix,
Edges are stochastic variables;
Nodes: domestic consumption

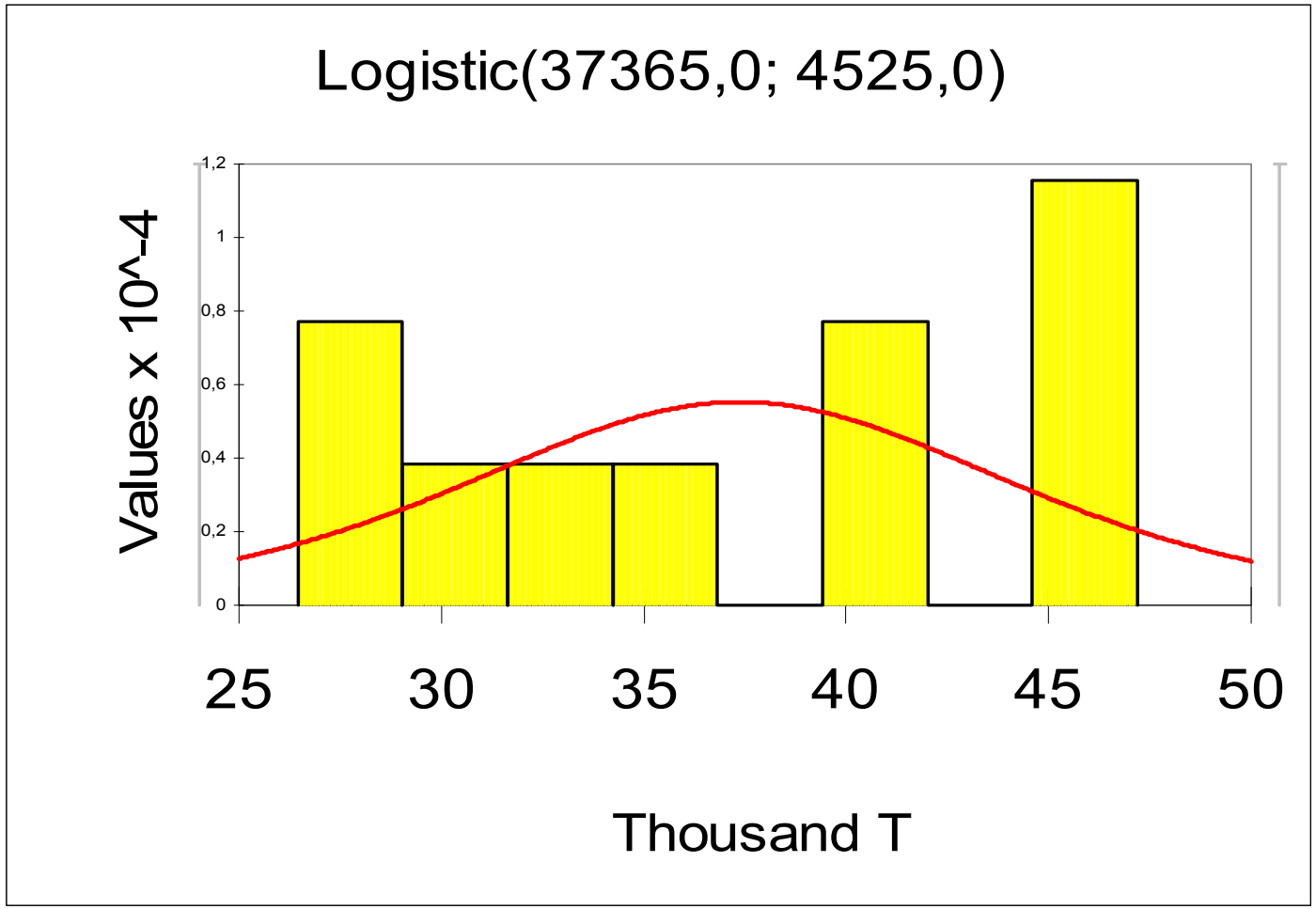


Simulated contaminations
2×1000×28 series of simulations
Method: Euler



Analysis of results by

Fitting a function to data: an example of Spanish-German parpika trade

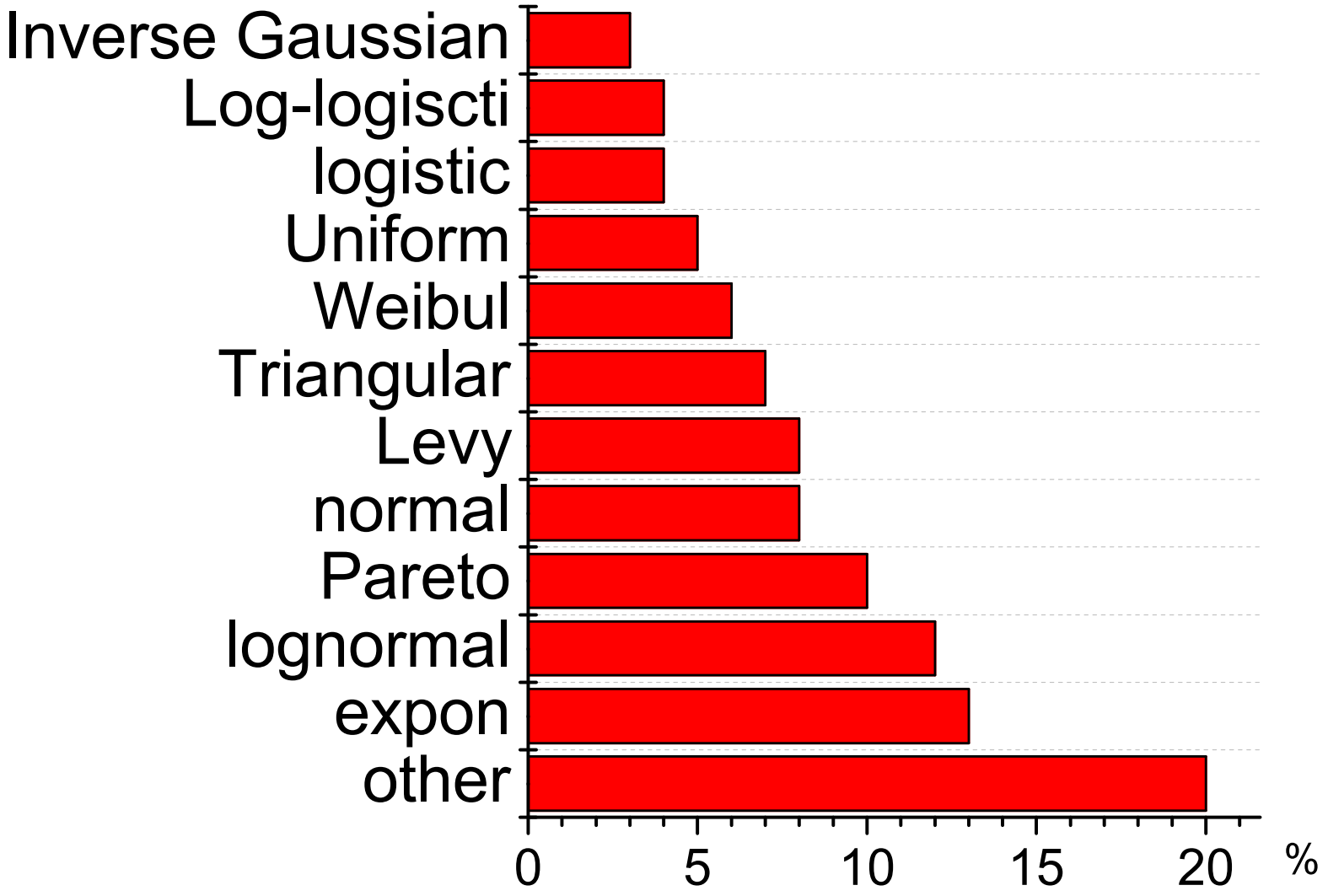


Analysis of 2004-2014 years

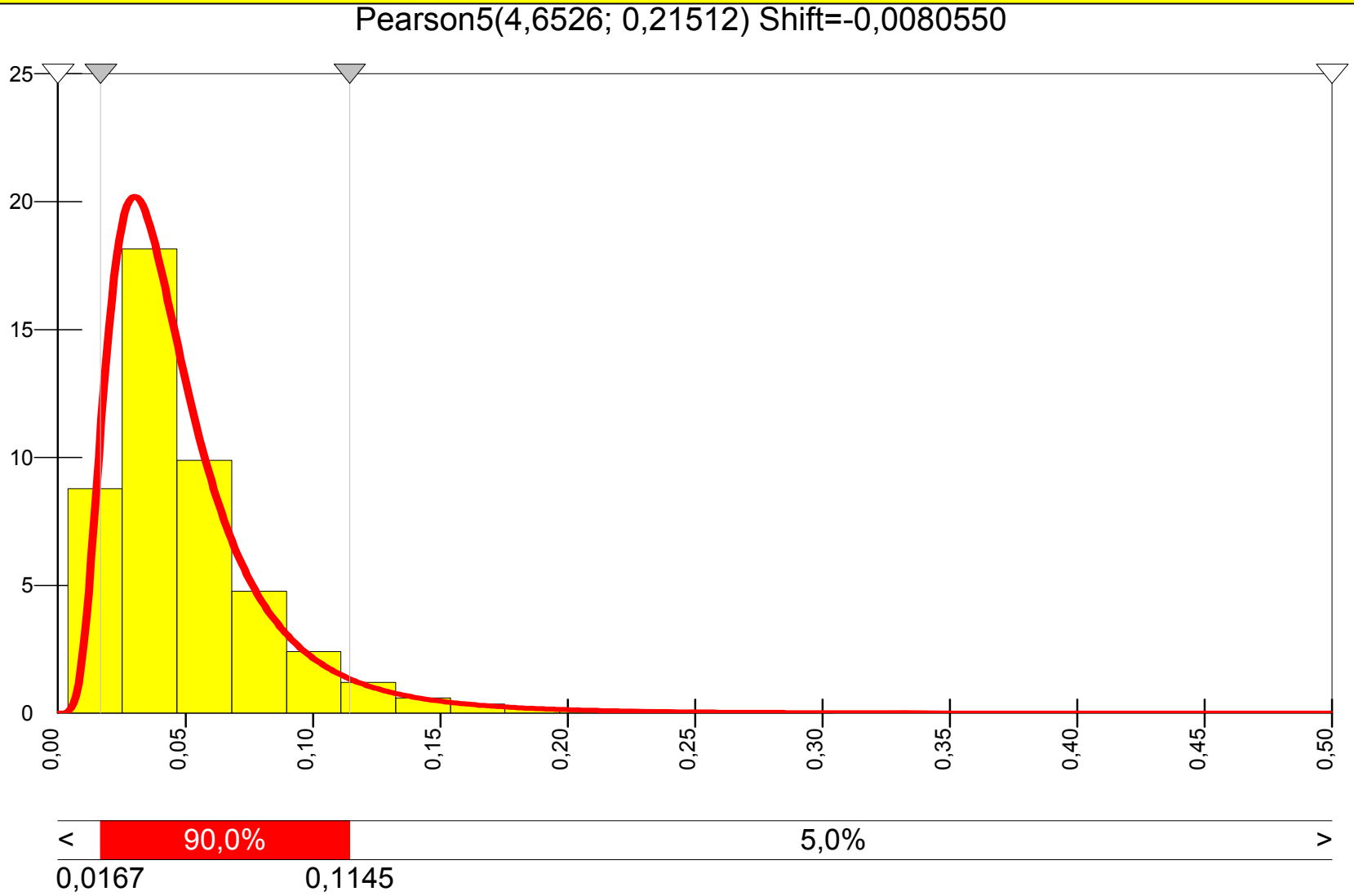
- Active trade in last five years;
- More than 30 fitted fucntions;
- Test statistics:
  - Chi-square test;
  - Kolmogorov-Smirnov test;
  - Anderson-Darling test.

  Last word: expert estimations

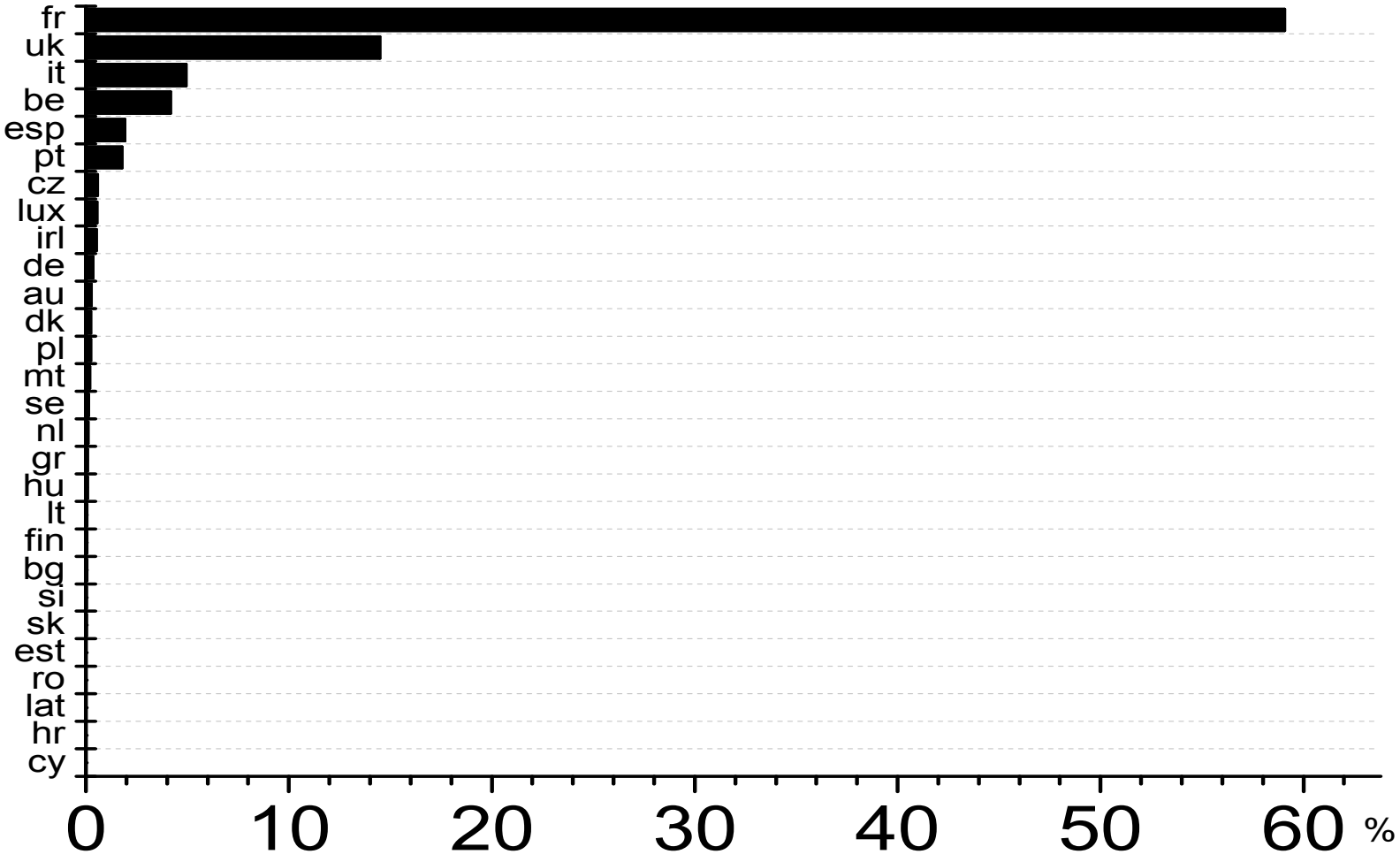
Relative frequency of fitted distribution types



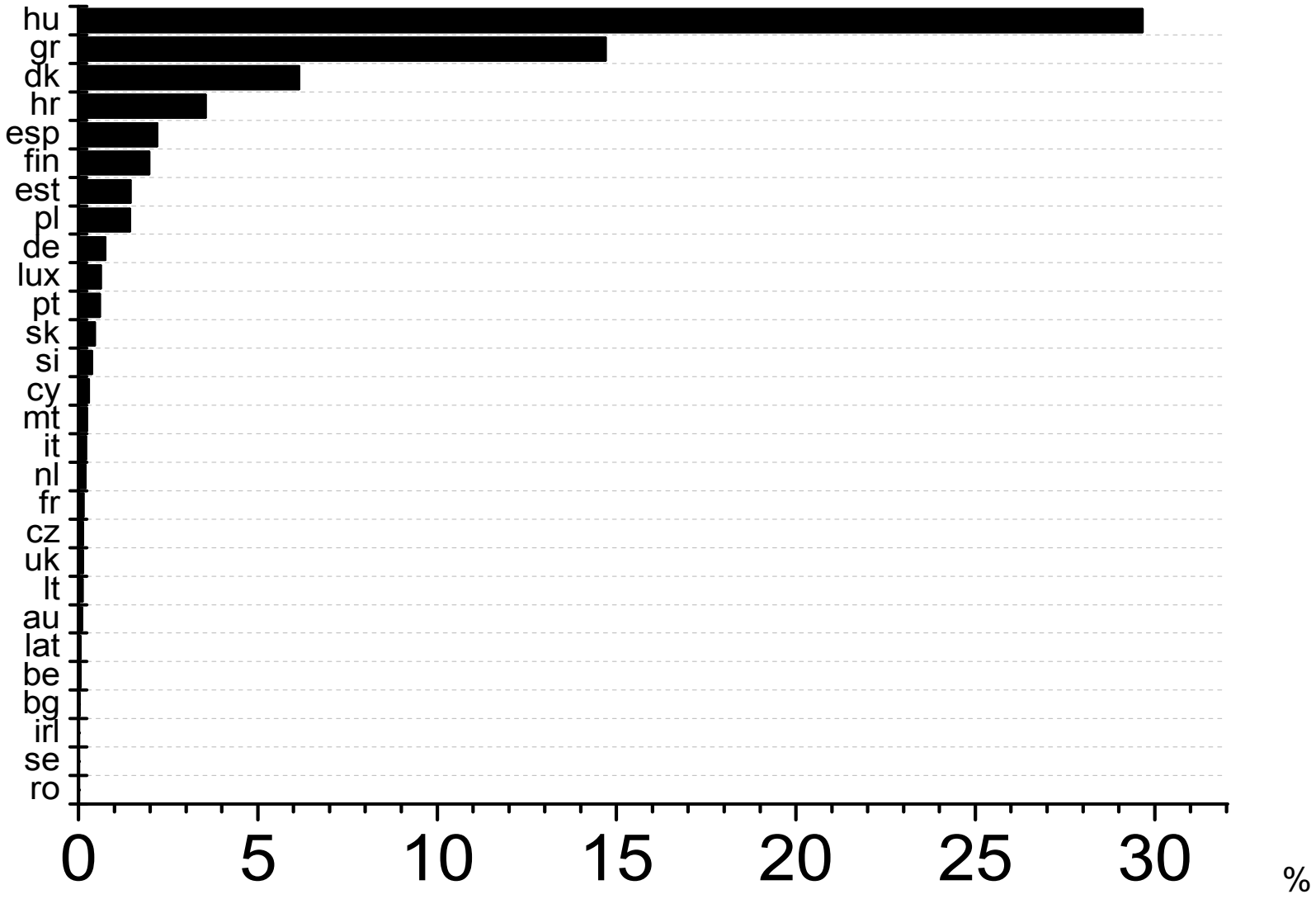
Example: density function of simulation results of Contaminated paprika in Bulgaria at 0+3 Source UK



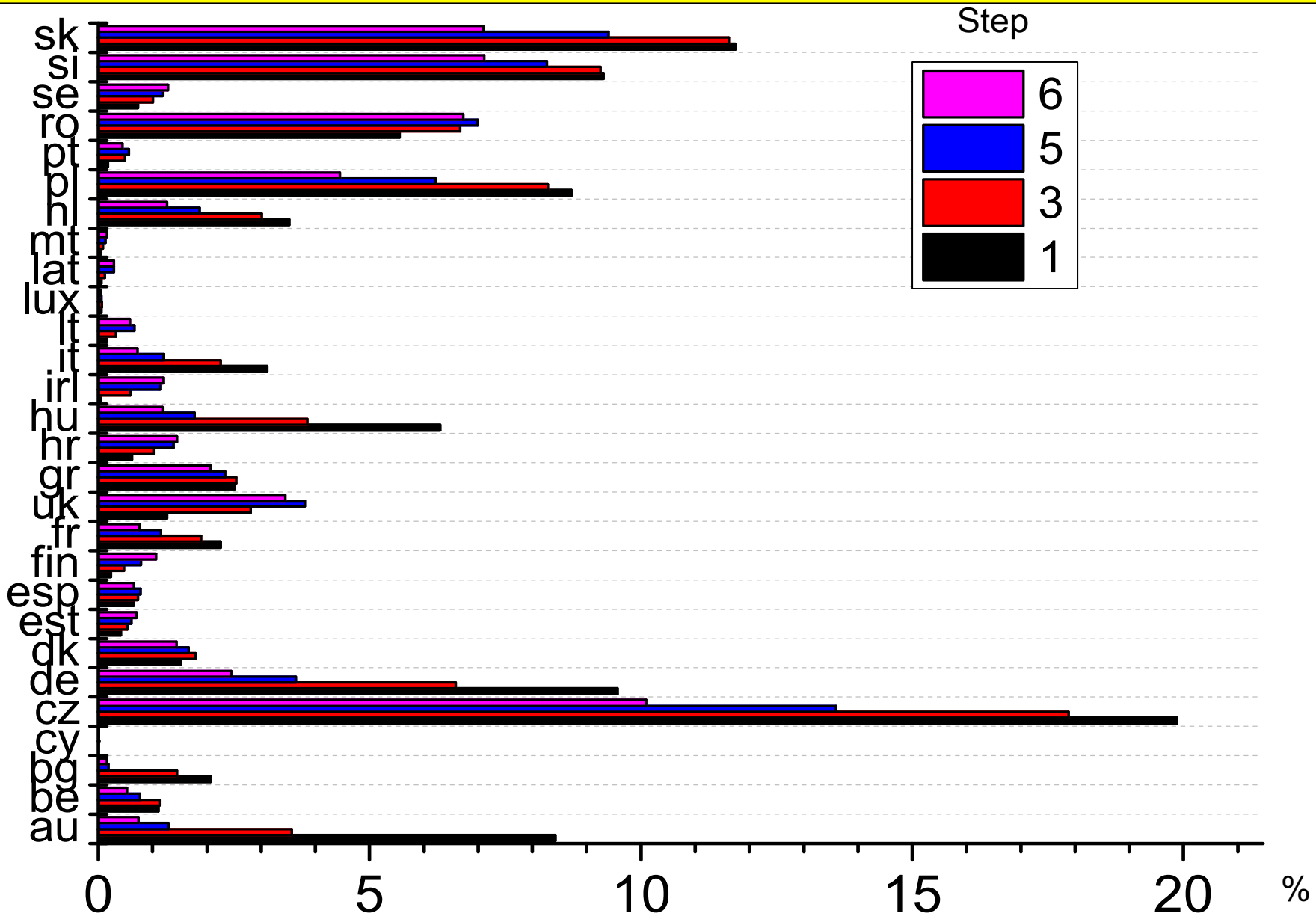
Proliferation profile of contaminated pepper at 0+2 time step Source of contamination: Fr



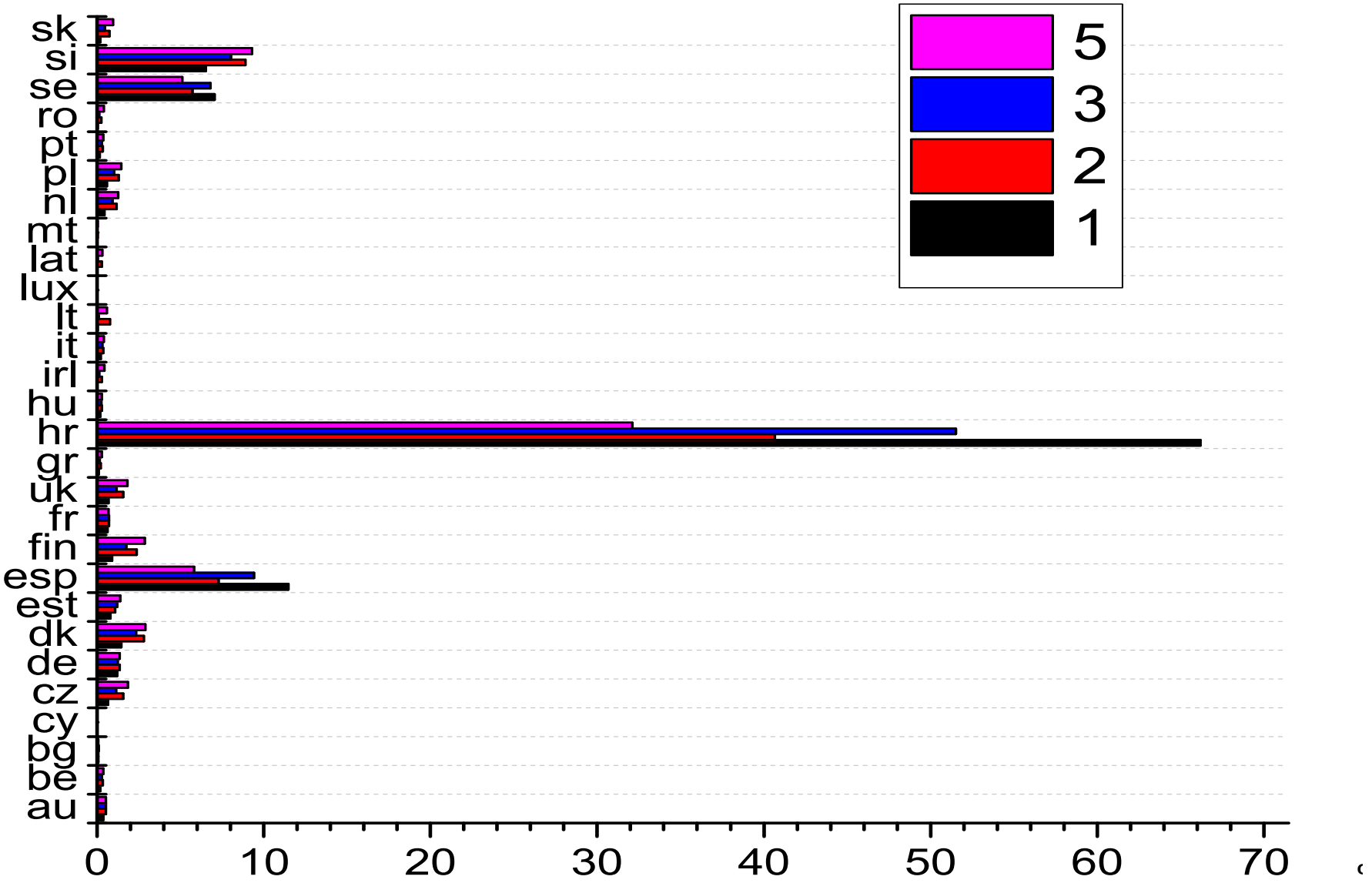
Proliferation profile of contaminated pepper at 0+5 time step



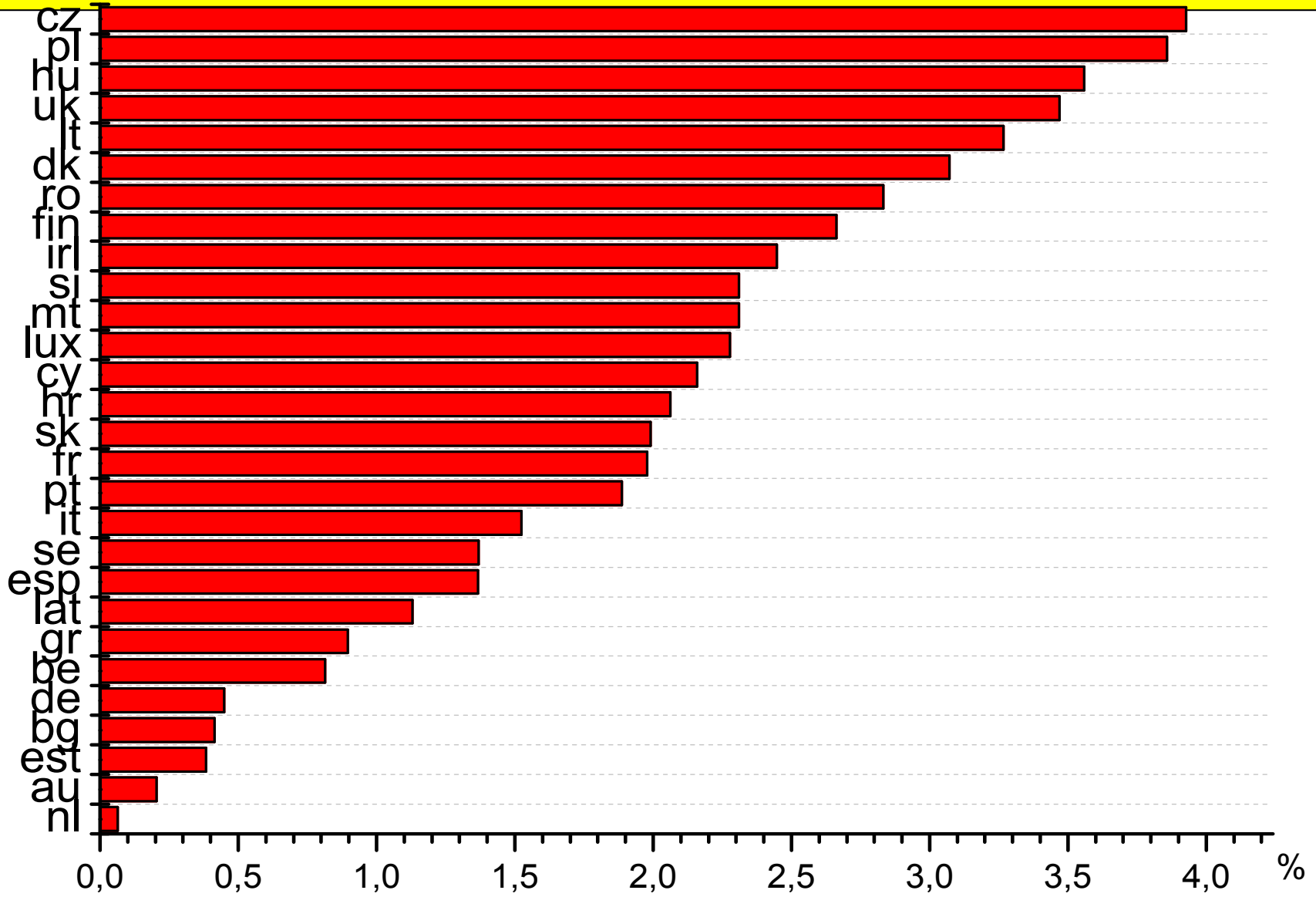
Proliferation profile of contaminated red pepper
Supposed source: FR



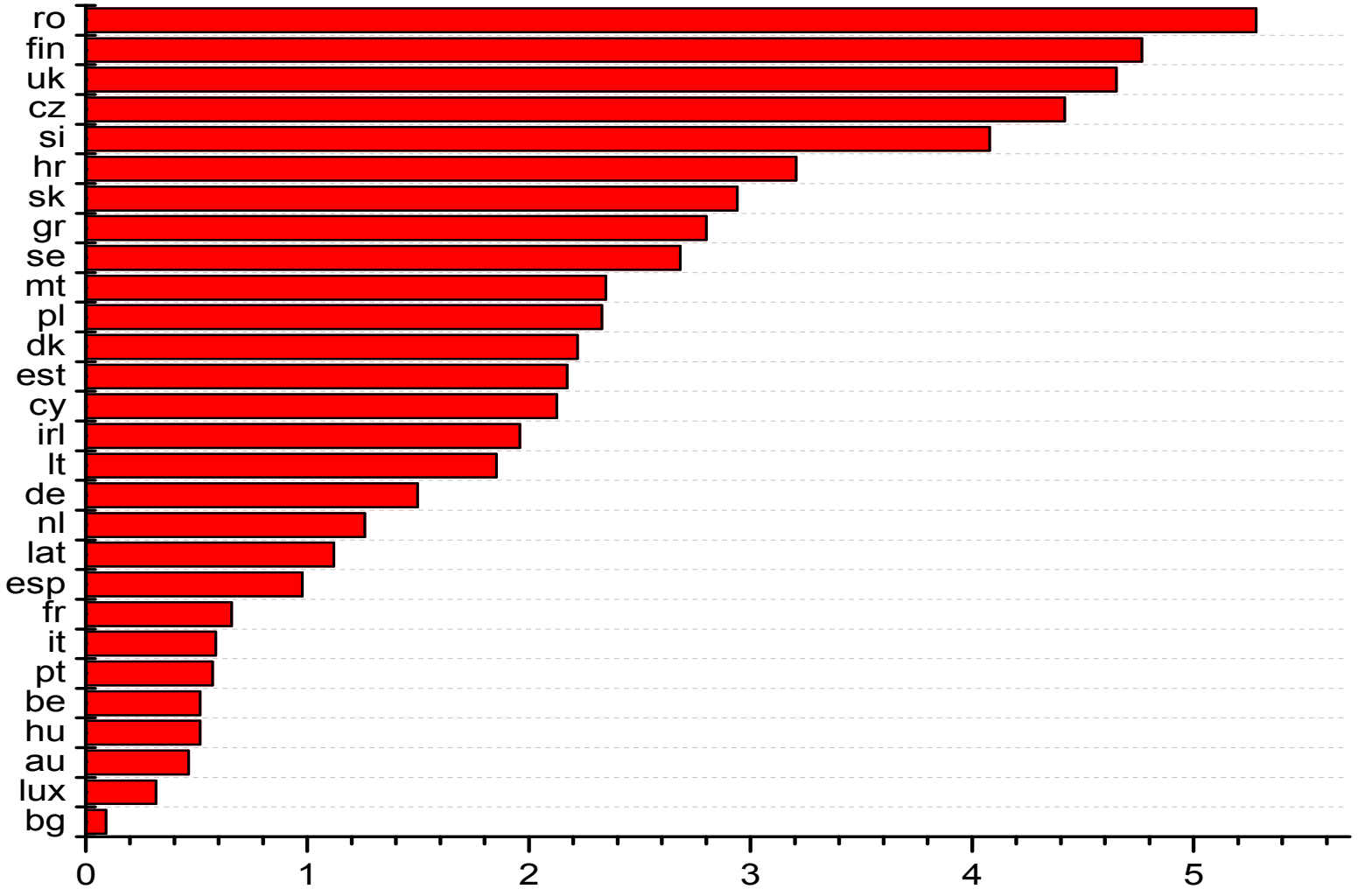
Proliferation profile of contaminated red pepper Supposed source: HR



Average burden of contaminated pepper after 0+6 step (all potential sources)



Average burden of contaminated Chilli pepper after 0+6 step (all potential sources)



System of factors, influencing burden of Proliferated Chilli papper after 0+6 step

$Y=0.42\ X_1+0.18\ X_2-0.29\ X_3$

$R=0.72$

Where

Y	burden of accumulation of Chilli papper
X_1	domestic consumption
X_2	inbound centrality
X_3	outbond centrality

System of factors, influencing burden of proliferated pepper after 0+6 step

$Y=0.55\ X_1+0.09X_2$

$R=0.77$

Where

Y burden of accumulation of pepper

X_1 domestic consumption

X_2 normalised Bonacich centrality

Lessons

- The spice network is a vulnerable network;
- An ideal target for politics-driven terrorism and economic sabotage;
- The control should be focussed on hubs;
- In case of emergency: the network-based simulation is able to optimalise the quarantine strategy