Preferential Attachment and Edge Rewiring in Container Shipping

Michael Kitromilidis[1]

[1] Centre for Complexity Science, Department of Physics, Imperial College London, UK

In this work we approach commercial container shipping from a complex networks perspective. This is an application of network theory which remains underinvestigated when compared to other transportation and logistics systems (e.g. rail, underground or airlines), yet it presents very interesting properties such as hub-and-spoke behaviour, fat-tailed degree distributions and high correlations between node centrality and significance in the shipping network.

While previous studies focus mainly on the analysis of network measures, we propose investigating evolutionary processes to understand the network's internal workings. More specifically, we suggest modelling the global container shipping network and regional sub-networks from the viewpoint of preferential attachment and edge rewiring; we link established models in the literature to observed phenomena, such as the Bianconi-Barabási model to the growth of latecomer ports, and rewiring processes to containership rerouting, a common practice among operators. We support these observations by looking specifically at the containership network in the Mediterranean region and the port of Malta in particular.

With regards to the Bianconi-Barabási model, we propose modelling a port-node's fitness in terms of its location: how centrally it is positioned in the region where it belongs and how much it deviates from the trading lines passing through that region. We further suggest that the impact of each of these factors differs in the macro- (global) and meso- (regional) scales, with centrality being more important in the regional scale and service deviation being more important in the global scale.

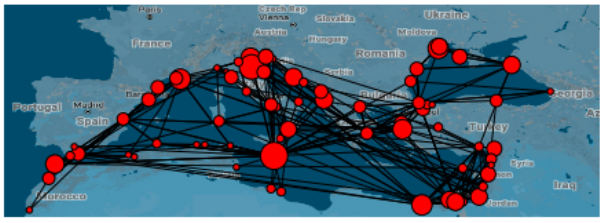

Figure 1: Regional containership network in the Mediterranean (node size represents the degree).

[1] G. Bianconi and A-L. Barabási, EPL (Europhys. Lett.) **54**, 436 (2001).

[2] Y. Hu and D. Zhu, Physica A **388**, 2061 (2009).

[3] P. Kaluza, et al. J. R. Soc. Interface **7**, 1093 (2010).