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International trade and financial integration: a weighted network analysis

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Abstract

The authors analyse patterns of international trade and financial integration using complex network analysis. The combination of both binary and weighted approaches delivers more precise and thorough insights into the topological structure and properties of international trade and financial networks (ITN and IFN). It is found that the ITN is more densely connected than the IFN, while both types of network display a core–periphery structure. This hierarchical organization is more pronounced in financial markets, suggesting that the bulk of trade in financial assets occurs through a handful of countries acting as hubs. High-income countries are better linked and form groups of tightly interconnected nodes. This kind of structure can explain why the recent financial crisis has spread rapidly among advanced countries while reaching emerging markets only in a second phase.

Keywords:

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Notes

⊥Examples of classical studies in the field include Rapoport and Horvath (1961), Milgram (1967), Granovetter (1974), and Padgett and Ansell (1993).

†We refer the reader to Fagiolo et al. (2009) for more formal definitions of network concepts.

†Among the weighted clustering coefficients reviewed in Saramaki et al. (2007), the one used here is the only one that takes into account the weights of all three edges in any triangle (while disregarding weights not participating in any triangle), and that is invariant to permutations of edge weights (which allows one not to discriminate single nodes but rather to consider cliques or triads as one single entity).

‡Then, while we expect the IFN to be on average less clustered for the reasons seen above, it is likely that the WCC attains its maximum values in correspondence of financial hubs.

§It is worth noting that the very notion of international financial integration is still debated. For instance Bekaert and Harvey (2003) suggest that integration occurs only when ‘assets of identical risk command the same expected return irrespective of their domicile’ (p. 4). This implies that an expected return model is required to pursue a direct measure of financial integration.

¶At the time when this paper was written, only data for 2001–2004 were available. The list of countries used in the analysis is reported in Appendix A; note that a few important players such as China did not participate to the survey.

⊥A perfect match was impossible to achieve, since the CPIS includes a number of small financial centres for which no trade data are available.

†This includes also instances where a positive figure is censored, i.e. we know that cross-holding of that particular asset is positive but we ignore its magnitude.

‡The full set of results on symmetry is available upon request.

§In the rest of the paper we will only discuss the network of total financial assets. Results for specific asset types do not change much from a structural point of view. A brief discussion is nevertheless presented in section 5.6 below.

¶One alternative possibility to deal with very dense graphs is to define thresholds for the interactions among links (see Kali and Reyes 2007), which allows one to eliminate 'weak' ties. We will see in what follows that a threshold approach does not allow us to recover the results of weighted analysis.

⊥The support of the distributions is standardized to offset the impact of different sample sizes.

†Size-rank plots display the fraction of nodes with a degree (strength) higher than a given value; in other words they plot ND (NS) against their complementary cumulative distribution in log–log scale, thus magnifying the upper-tail behaviour of the distribution.

‡A further consequence is that the correlation between ND and NS in the trade network is only significant at 11%.

†To compare our results with existing studies of the ITN, we have also set a minimum threshold value for each (trade) link weight (along the lines of Kali and Reyes 2007), which implies dropping around 20% of all (trade) links. The resulting binary statistics imply a strongly disassortative network: the correlation between ND and ANND ranges between −0.96 and −0.93, suggesting the existence of many low-weight links connecting peripheral nodes among themselves, so that imposing a threshold artificially inflates the relevance of hub-spokes connections. This however is not a correct representation of the ITN according to the weighted approach discussed above. Similar conclusions hold for a smaller threshold that eliminates only 10% of links.

†In the binary case, the random network amounts to a graph with same density but re-shuffled links. In the weighted case, we keep the binary structure constant and we re-shuffle link weights. The comparison between the observed correlations and those computed for the random networks is similar for both the binary and the weighted networks. In the latter case, however, differences are significant only at a level of 7–15%.

‡In the international trade literature, a large body of evidence have investigated the role of distance in the context of so-called gravity models (see for instance Brun et al. 2005). Recently, this methodology has been applied to financial data as well: Portes and Rey (2005) suggest that distance proxies some information costs. Furthermore, Hau (2001) postulates that informational asymmetries in financial markets may depend on investor location.

†This point is confirmed by a comparison of the binary results with a 'threshold analysis'. As before, we have set a minimum value for each link weight, so as to retain only 80% of all trade links and then computed binary indicators (as proposed in Kali and Reyes 2007). In the case of the correlation between node degree and clustering, results from this 'threshold-based' analysis not only confirm the negative sign, but the coefficient is much more negative, ranging between − 0.88 and − 0.86, thus conveying a picture substantially different from the one obtained through the weighted approach.

‡The same results are obtained once we substitute this relative criterion with an absolute one and attribute core status to those countries displaying values of centrality above the mean plus one standard deviation.

†The full set of results on different asset classes is available from the authors upon request.

Additional information

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