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Google matrix of the world network of economic activities

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Abstract. Using the new data from the OECD-WTO world network of economic activities we construct the Google matrix G of this directed network and perform its detailed analysis. The network contains 58 countries and 37 activity sectors for years 1995 and 2008. The construction of G, based on Markov chain transitions, treats all countries on equal democratic grounds while the contribution of activity sectors is proportional to their exchange monetary volume. The Google matrix analysis allows to obtain reliable ranking of countries and activity sectors and to determine the sensitivity of CheiRank-PageRank commercial balance of countries in respect to price variations and labor cost in various countries. We demonstrate that the developed approach takes into account multiplicity of network links with economy interactions between countries and activity sectors thus being more efficient compared to the usual export-import analysis. The spectrum and eigenstates of G are also analyzed being related to specific activity communities of countries.

PACS. 89.75.Fb Structures and organization in complex systems – 89.65.Gh Econophysics – 89.75.Hc Networks and genealogical trees – 89.20.Hh World Wide Web, Internet

1 Supplementary Material (additional figures)

Correlator matrix of sectors of Eq.((10) in shown in Fig.S1

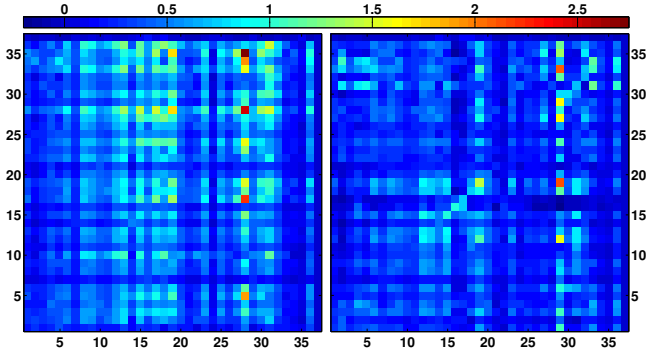

Fig. 1. Fig.S1 Sector PageRank-CheiRank correlation matrix $\kappa_{s,s'}$ Eq.(10) for years 1995 (left) and 2008 (right) with correlator values shown by color. The code indexes s and s' of all $N_s = 37$ sectors are shown on y and x axes by their corresponding numbers (see Table 2).

From the global matrix T of size N we obtain the reduced matrix $R_{ss'}(c)$ of size N_s describing the transformation for activity sectors for a country c. We have $R_{ss'}(c') = \sum_c T_{s,s',c,c'}$ where c' is a target country we are interested in. The matrices $R_{ss'}(c')$ are shown in Fig.S2 giving the transformation of sector s' to all other sectors s for c' of China, USA, Germany. The reduced transformation matrix for the whole world is obtained by averaging over countries with $R_{ss'} = \sum_{c'} R_{ss'}(c')/N_{c'}$ (see Fig.S2). The results of Fig.S2 show a few characteristic features: the reduced transfer matrix has a strong diagonal element (this is because each product is strong projection on itself), there are characteristic horizontal lines corresponding to important sectors (e.g. $s = 2, 7, 11, 25$). The matrix structure differs between countries but there are global structures which are similar for all three countries and the whole world.

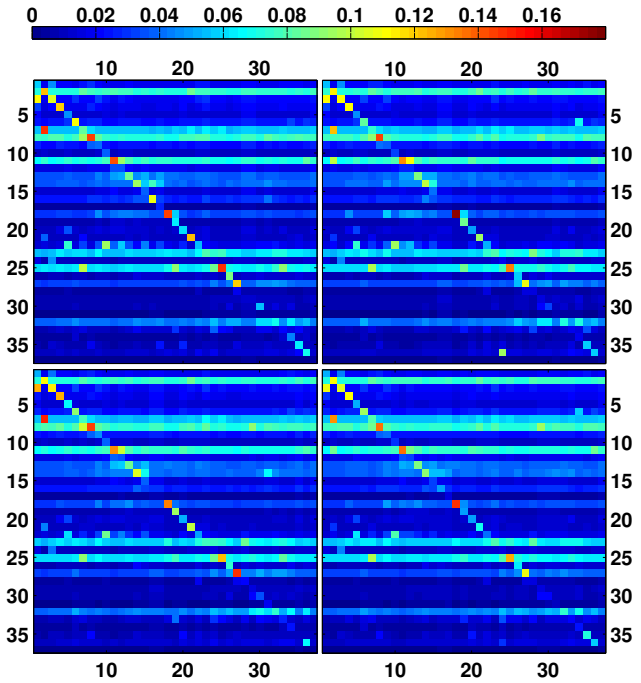

Fig. 2. Fig.S2 Images of reduced transfer matrix $R_{s,s'}$ of sectors to sectors for countries: China (top left panel), USA (top right panel), Germany (bottom left panel). The average transfer matrix $R_{s,s'}$ of the whole World is shown in bottom right panel for year 2008. Here x-axis represents the initial sector s' and y-axis represents the final sectors s into which s' is transformed. The sector numbering is given in Table 2. Colors are proportional to matrix elements and $\eta = 0.7$.