Macro-economic indicators as the basis of evolving weighted bi-partite networks

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Macro-economic indicators (MEI) can be taken as elements of a vector describing the economy of a country. Considering several countries leads to construct bipartite networks: nodes being either countries or MEI. Thus one aims at a so called factor graph, i.e, a bipartite graph made of (i) variable nodes (countries) $i, j, ...$, one for each variable, and (ii) function nodes (MEI) $a, b, ...$ [1]. A link joins a variable node i and a function node a if and only if $i \in a$, that is the variable s_i appears in H_a, *the* term of a Hamiltonian associated to a. It is shown how the decomposition of a Hamiltonian through a finite number of components, the variable nodes, serves in defining evolving clusters. As an illustration the network built from data representing correlations between 4 macro-economic features, i.e. the so called *vector components* spanning the phase space, of (the chronologically first) 15 EU countries, being the function nodes, is discussed [2–5]. For the purpose of illustration of the technique, the 4 variable nodes spanning the phase space are chosen to be: the Gross Domestic Product (GDP), the Final Consumption Expenditure (FCE), the Gross Capital Formation (GCF) and the Net Exports (NEX). The statistical distance filtering technique is used to define clusters over some time span and for given time windows. We show that statistical physics principles, like the maximum entropy criterion illuminates the existence of macro-economic clusters. It is observed here that the *maximum* entropy corresponds to a cluster which does *not* explicitly include the GDP but only the other (3) axes, i.e. consumption, investment and trade components. On the other hand, the *minimal* entropy clustering scheme is obtained from a coupling necessarily including GDP and FCE. Moreover we introduce the *average overlap index* for weighted networks, generalizing a few previous considerations on assortativity, and allowing for ranking nodes (countries) with some hierarchy after projection on each MEI axis. The results confirm intuitive economic theory and practice expectations [6, 7] at least as regards geographical connexions. The technique can be applied to many other cases in laboratory physics or in the management of socio-economic networks.

PACS numbers:

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