Assessing productive structures in Brazil with dynamic inputâ€“output networks

Topic: IO modeling: Conjoined Modeling Approaches
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Econophysics is the use of complex systems in economic studies (Carbonne et al., 2007; Jovanovic and Schinckus, 2017; Mantegna and Stanley, 1999; Pereira et al., 2017; Schinckus, 2013). It is an approach that has advanced both the identification of economic problems and attempts to solve them. According to Pereira et al. (2017), network theory is among the subareas that have contributed to econophysics. Schweitzer et al. (2009) defined the importance of network theory to the economy, since in networks, it is possible to study properties such as time and space, structure identification, and systemic feedback, providing a novel approach to assessing the productive structure of countries or regions.

The seminal study of network theory and production was conducted by Solow (1952), who analyzed aggregate fluctuations. Bak et al. (1993) later showed the importance of inputs and the supply chain in diffusing shocks between aggregate sectors. In the last two decades, interest in network theory and improvements in computation have enabled the development of several network analysis methods and the discovery of new network properties.

In the inputâ€“output (IO) field, a recent advance that has allowed hypotheses to be more flexible and has reinforced results is integration with other models, such as linear programming (Hristu-Varsakelis et al., 2012; San CristÃ³bal, 2012; Souza et al., 2016), econometric models (Kim et al., 2015; Kratena and Temursho, 2017) and complex networks (Carvalho and Gabaix, 2013; Cerina et al., 2015; Tsekeris, 2017). Specifically, Acemoglu et al. (2012) and Carvalho (2010) have used network theory to analyze the problem of aggregate fluctuations in macroeconomics. Cerina et al. (2015), using a world IO database, analyzed the inter-industry relations of several countries through calculations of PageRank centrality and community coreness. In addition, RÃ-o-Chanona et al. (2017) evaluated trade relations among 40 economies, and found a strong correlation between the three major economies (United States, China and Germany), indicating a high centrality between trade relations.

Recent research involving trade relations between several countries has used networks that emphasize the role of centrality (BlÃ¶chl et al., 2011; Xing et al., 2017) and country-specific assessments (He et al., 2017; Tsekeris, 2017; Xu et al., 2011). It is important to highlight that other studies have also analyzed production, but not necessarily using IO matrices (Atalay et al., 2011; Hidalgo and Hausmann, 2009; Ohnishi et al., 2010; Xiao et al., 2017).

Integrating IO models into network theory is even more interesting when applied to complex productive structures, as seen in Brazil. Moreover, results improved considerably if the database used covers a long period of time, because it can account for important factors, such as structural and governmental changes. However, this type of approach has rarely been applied to the Brazilian economy. This study intends to develop an analysis of dynamic IO networks to evaluate the evolution of the Brazilian productive structure, considering the varying sector relationships over time. As far of our knowledge, this type of approach has never been applied before. Thus, it is possible to measure the impacts of economic events such as financial crises or macroeconomic policies on the properties of the networks or the interconnection between economic sectors. For this, we use a network analysis of Brazilian IO matrices from the World Inputâ€“Output Database for the period 1995â€“2011.

The main contributions of this paper are: (i) a novel method for evaluating productive structures; (ii) an assessment of the macroeconomic policies introduced by different governments over time; and (iii) a contextualized analysis of strongly linked sectors. All of these topics could be generalized to any other country.