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International business cycle synchronization since the 1870s: Evidence from a novel network approach

Nikolaos Antonakakis [a,b,c,d,*], Periklis Gogas [e], Theophilos Papadimitriou [e], Georgios Antonios Sarantitis [e]

[a] Vienna University of Economics and Business, Department of Economics, Institute for International Economics, Welthandelsplatz 1, 1020, Vienna, Austria

[b] University of Portsmouth, Economics and Finance Subject Group, Portsmouth Business School, Portland Street, Richmond Building, Portsmouth, PO1 3DE, United Kingdom

[c] Webster Vienna Private University, Department of Business and Management, Praterstrasse 23, 1020, Vienna, Austria

[d] Johannes Kepler University, Department of Economics, Altenbergerstrae 69, Linz, 4040, Austria

[e] Democritus University of Thrace, Department of Economics, Komotini, 69100, Greece

HIGHLIGHTS

- Examine business cycle synchronization in 27 developed and developing countries between 1875 and 2013.
- Employ a novel network approach, the Threshold-Minimum Dominating Set that uses tools from graph theory.
- Results reveal heterogeneous patterns of business cycle synchronization during various globalization periods since the 1870s.

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ABSTRACT

In this study, we examine the issue of business cycle synchronization from a historical perspective in 27 developed and developing countries. Based on a novel complex network approach, the Threshold-Minimum Dominating Set (T-MDS), our results reveal heterogeneous patterns of international business cycle synchronization during fundamental globalization periods since the 1870s. In particular, the proposed methodology reveals that worldwide business cycles de-coupled during the Gold Standard, though they were synchronized during the Great Depression. The Bretton Woods era was associated with a lower degree of synchronization as compared to that during the Great Depression, while worldwide business cycle synchronization increased to unprecedented levels during the latest period of floating exchange rates and the Great Recession.

* Corresponding author at: Webster Vienna Private University, Department of Business and Management, Praterstrasse 23, 1020, Vienna, Austria. Tel.: +43 1 313 36 4141; fax: +43 1 313 36 90 4141.

E-mail addresses: nikolaos.antonakakis@port.ac.uk, nikolaos.antonakakis@webster.ac.at, nikolaos.antonakakis@wu.ac.at (N. Antonakakis), pgkogkas@econ.duth.gr (P. Gogas), papadimi@econ.duth.gr (T. Papadimitriou), gsaranti@econ.duth.gr (G.A. Sarantitis).

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1. Introduction

The global economy has experienced several periods of globalization. First, the classical Gold Standard era with relatively free trade and capital mobility. Second, the two World Wars and the Great Depression with trade and capital controls. Third, the Bretton Woods era of fixed, albeit adjustable, exchange rates and limited capital mobility. Fourth, the floating exchange rates and Great Recession period with increased trade and capital integration. These developments have generated a lot of interest and debate about the changing patterns and degree of international business cycle co-movements.

The link between globalization and international business cycle synchronization is theoretically/empirically ambiguous. On one hand, rising financial and trade linkages could result in a higher degree of business cycle co-movement via the wealth effects of external shocks (see, for instance, Kose et al. [1], Artis et al. [2] and Kose et al. [3]). On the other hand, rising financial linkages could reduce cross-country business cycle correlations by stimulating specialization of production through the reallocation of capital in a manner consistent with countries' comparative advantage. Similar predictions exist for the link between trade integration and business cycle synchronization. For example, increased trade linkages generate both demand- and supply-side spillovers across countries that can lead to more highly correlated business cycles. Conversely, in the presence of sector-specific shocks, increased trade linkages may facilitate increased specialization of production across countries, which in turn will lead to less synchronized business cycles (see, e.g., Baxter and Kouparitsas [4]). Besides, other studies have found that business cycle synchronization between developed countries have decreased in the recent decades, largely on account of a remarkable cycle of de-synchronization in the late 1980s and 1990s (see, for example, Helbling and Bayoumi [5] and Doyle and Faust [6]).

The objective of our paper is to examine international business co-movements over fundamental periods of economic globalization. Our analysis is closely related to the empirical literature on business cycle synchronization (e.g. Otto et al. [7], Kose et al. [1], Imbs [8], Stock and Watson [9], Kose et al. [10], Crucini et al. [11] and Kose et al. [3]) and especially to Artis et al. [2] and Antonakakis [12]. In contrast to the existing literature, we propose the application of a novel complex network methodology, the T-MDS, in a sample of 27 developed and developing countries since 1875, which provides us with a bird's eye view on the link between economic globalization and international business cycle synchronization.

Complex Network analysis is a distinct field of applied mathematics that models complicated systems of interacting agents as networks, and then analyzes them with a variety of tools that range from simple descriptive metrics to very advanced and sophisticated clustering and optimization techniques. It was popularized mainly for the analysis of social networks [13,14], but also in applications such as metabolic-biological networks [15,16], air transportation networks [17], power grids [18] and many more. Eventually the use of complex networks was introduced in the analysis of complex economic systems such as financial networks [19–24] or macroeconomics [25–29]. Network analysis offers a multi-level analysis of the underlying system from the macroscopic level to the agent-specific one, and can thus provide an alternative or complementary context to the one of classic econometrics and statistics.

The T-MDS methodology that is used in the empirical section of this study is an improvement of the classic Minimum Dominating Set (MDS). The classic MDS has been mostly used in computer-based applications and in particular wireless networks' configuration [30,31] and data-mining [32,33]. The MDS identifies a sub-graph of the initial network that contains adequate information to describe the collective topology of the entire network using only a minimum fraction of nodes. For this kind of applications and analyses the classic MDS can be applied on the initial network "as is" without prior refinement, since all edges are crucial in the identification of the MDS. However, in an economics network where the edges describe the similarity of the incident nodes (e.g. a correlation-based network or the SCI similarity measure used here), not all edges contain reliable or useful information and thus, should not be included in the MDS identification process. For this reason, a threshold is selected prior to the MDS identification in order to eliminate all irrelevant edges. By doing this, all remaining edges are highly informative and reliable in terms of economic inference.

The contribution of our work to this literature can be summarized as follows. We demonstrate the utility of network analysis and especially the Threshold-Minimum Dominating Set in the analysis of business cycle synchronization in 27 developed and developing countries over the period 1875–2013 by paying particular attention to the dynamic evolution of business cycle synchronization under several fundamental globalization periods. To the best of our knowledge only three studies employ network analysis on the topic of business cycle synchronization patterns. These are, Gomez et al. [34], Caraiani [35] and Xi et al. [36]. However, the last two conduct only a static analysis that is based on the whole sample under consideration and they do not provide any evidence on the inter-temporal evolution of business cycles synchronization. Gomez et al. [34], employ the Minimum Spanning Tree technique (MST) within a dynamic context to study inter-temporal business cycle synchronization. The MST however, suffers an important shortcoming when applied on correlation-based economics networks: the no-loop restriction of the MST identification procedure may lead to sub-optimal solutions and possibly in wrong inference. Our work using the T-MDS overcomes the short-coming of the MST and also provides a dynamic historical analysis of business cycle synchronization that spans four major periods of globalization, namely, 1875–1912 (The Gold Standard), 1913–1944 (WWI, WWII and the Great Depression), 1945–1972 (Bretton Woods) and 1973–2013 (floating exchange rates).

This paper is organized as follows. The proposed methodology and the dataset are presented in Section 2. Results from the application of T-MDS on the selected dataset can be found on Section 3. The paper concludes in Section 4.