European Journal of Operational Research 256 (2017) 945–961

Contents lists available at ScienceDirect

European Journal of Operational Research

journal homepage: www.elsevier.com/locate/ejor

Innovative Applications of O.R.

Information diffusion, cluster formation and entropy-based network dynamics in equity and commodity markets☆

Stelios Bekiros[a,b,1,*], Duc Khuong Nguyen[c,d], Leonidas Sandoval Junior[e], Gazi Salah Uddin[f]

[a] Department of Economics, European University Institute, Florence, Italy
[b] Department of Acc. & Finance, Athens University of Economics and Business, Athens, Greece
[c] IPAG Lab, IPAG Business School, Paris, France
[d] School of Public and Environmental Affairs, Indiana University, Bloomington, United States
[e] Insper Instituto de Ensino e Pesquisa, Sao Paulo, Brazil
[f] Department of Management and Engineering, Linköping University, Linköping, Sweden

ARTICLE INFO

Article history:
Received 17 June 2015
Accepted 24 June 2016
Available online 13 July 2016

Keywords:
Finance
Commodity markets
Transfer entropy
Complex network
Centrality

ABSTRACT

This paper investigates the dynamic causal linkages among U.S. equity and commodity futures markets via the utilization of complex network theory. We make use of rolling estimations of extended matrices and time-varying network topologies to reveal the temporal dimension of correlation and entropy relationships. A simulation analysis using randomized time series is also implemented to assess the impact of de-noising on the data dependence structure. We mainly show evidence of emphasized disparity of correlation and entropy-based centrality measurements for all markets between pre- and post-crisis periods. Our results enable the robust mapping of network influences and contagion effects while incorporating agent expectations.

1. Introduction

The commodity futures markets have recently received much attention from both academics and investor community, following their increasing financialization which is characterized by an increase in trading activity as well as the number and nature of traders since the early 2000s. The 2008 Commodity Futures Trading Commission (CFTC) (CFTC, 2008) staff report documented an net amount of $200 billion of commodity index investment as of June 2008, which is more than 10 times the level in 2003 and rose to about $250 billion in 2009 (Irwin & Sanders, 2011). Major investors of commodities traded in the US markets include institutional investors, index funds, sovereign wealth funds, and retail investors holding ETFs (exchange-traded funds), ETNs (exchange-traded notes), and similar instruments. Beside their traditional role in hedging price risks of underlying commodities, commodity futures have also been increasingly viewed as a new asset class providing high potential for equity risk diversification, especially during times of financial crises and downturns in stock markets. The rationale behind this trend is that commodity futures offer high returns with relatively low volatility and low correlation with stocks and bonds.[1] Gorton and Rouwenhorst (2006) produce some stylized facts on the commodity markets after the 2000s and find that futures contracts have the same average returns as equities along with a negative correlation between bonds and equities while comparatively demonstrating lower volatility. Moreover, the risk factors that drive the dynamics of commodity returns may differ from those that affect stock and bond returns (e.g., Domanski & Heath, 2007; Dwyer, Gardner, & Williams, 2011). Empirical studies such as Arouri, Jouini, and Nguyen (2011), Daskalaki and Skiadopoulos (2011), and Narayan, Narayan, and Sharma (2013) provide evidence of valuable diversification benefits from adding commodity assets into portfolios of traditional assets (bonds and stocks).

☆ We would like to thank the Editor Professor Emanuele Borgonovo and two anonymous referees for their valuable comments. The usual disclaimers apply.

* Corresponding author at: Department of Economics, European University Institute, Via della Piazzuola 43, I-50133 Florence, Italy. Fax: +39 554685902.
E-mail addresses: stelios.bekiros@eui.eu, bekiros@aueb.gr (S. Bekiros), duc.nguyen@ipag.fr (D.K. Nguyen), leonidassj@insper.edu.br (L. Sandoval Junior), gazi.salah.uddin@liu.se (G.S. Uddin).

[1] The first author has received funding from the EU Horizon 2020 research and innovation programme under the MS-C Grant No 656136.

[1] The modern portfolio theory suggests that investors can improve their risk-adjusted return performance by allocating resources to imperfectly correlated assets, which is the case of equities and commodities. The reduction of regional and international diversification benefits due to higher stock market linkages and contagion risk during crisis periods (Forbes and Rigobon, 2002; Chan-Lau et al., 2004; Haldane, 2009) has caused investors to increase their holdings in alternative asset classes including commodity futures.

http://dx.doi.org/10.1016/j.ejor.2016.06.052
0377-2217/