

Article

# EU Stock Markets vs. Germany, UK and US: Analysis of Dynamic Comovements Using Time-Varying DCCA Correlation Coefficients

Oussama Tilfani <sup>1</sup>, Paulo Ferreira <sup>2,3,4,\*</sup>, Andreia Dionisio <sup>4</sup> and My Youssef El Boukfaoui <sup>1</sup>

<sup>1</sup> Faculty of Sciences and Techniques, Cadi Ayyad University, Marrakech 40000, Morocco; tilfani.oussama@gmail.com (O.T.); m.elboukfaoui@uca.ma (M.Y.E.B.)

<sup>2</sup> VALORIZA—Research Center for Endogenous Resource Valorization, 7300 Portalegre, Portugal

<sup>3</sup> Instituto Politécnico de Portalegre, 7300 Portalegre, Portugal

<sup>4</sup> Center for Advanced Studies in Management and Economics of the Universidade de Évora (CEFAGE), IIFA, Universidade de Évora, Largo dos Colegiais 2, 7000 Évora, Portugal; andrea@uevora.pt

\* Correspondence: pferreira@ippportalegre.pt

Received: 30 March 2020; Accepted: 4 May 2020; Published: 7 May 2020

**Abstract:** For this paper, we dynamically analysed the comovements between three major stock markets—Germany, the UK, and the US—and the countries of the European Union, divided into two groups: Eurozone and non-Eurozone. Correlation coefficients based on a detrended cross-correlation analysis (DCCA) were used, and the respective temporal variation was evaluated. Given the objective of performing a dynamic analysis, sliding windows were used in an attempt to represent short and long-term analyses. Critical moments in financial markets worldwide were also taken into account, namely the subprime debt crisis, the sovereign debt crisis, and Brexit. The results suggest that Germany and other Eurozone countries generally share high levels of comovements, although the Brexit decision reduced those connections. The subprime crisis also increases comovements among markets.

**Keywords:** comovements; correlation coefficient; DCCA; European Union; stock market integration

---

## 1. Introduction and Literature Review

Comovements among stock markets is a continuing and important topic in the financial literature, related with the phenomenon of stock market integration. Besides academic interest, it is worth mentioning the various impacts of stock market integration on welfare, consumption, and economic growth (see, for example, Obstfeld 1994; Kearney and Lucey 2004; Bekaert et al. 2005). This integration is also relevant given its effects on the increasing risk of shock transmission, since more integrated markets could amplify the effects of financial crises (see, for example, Bekaert et al. 2014).

With the occurrence of financial crises, the analysis of stock market comovements becomes more important, because these events can have a relevant impact on financial variables and cause increased financial contagion (Beine et al. 2010). Forbes and Rigobon (2002) found that contagion occurs when a given shock leads to an increased shift in assets' comovements. Moreover, interest in studying times of turmoil is also related to the fact that complex systems, such as financial markets, reveal their characteristics better at those times than in normal conditions (Sornette 2003). In this work, we do not explore the contagion effect identified by Forbes and Rigobon (2002), since we do not consider a given event separating before and after that event, but we make a differential analysis to study how stock market comovements have evolved over time.