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## Financial crises and dynamic linkages among international currencies



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### ABSTRACT

This paper investigates the interdependence of US dollar exchange rates expressed in other major currencies. Focusing on different phases of the Global financial crisis (GFC) and the Eurozone Sovereign Debt Crisis (ESDC), we adopt a dynamic conditional correlation model into a multivariate Fractionally Integrated Asymmetric Power ARCH (FIAPARCH) framework, during the period 2004–2011. The findings indicate a decrease of exchange rates correlations during the turmoil periods, suggesting the different vulnerability of the currencies. The most stable periods of the two crises for all currencies are the early phases of the GFC, while the first phase of ESDC exhibit the most cases of decreasing correlations. Finally, the Japanese yen and Swiss franc show evidence of safe heaven currencies across several phases of the two crises. The results provide crucial implications for portfolio diversification strategies and highlight the need for some form of policy coordination among central banks.

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## 1. Introduction

The global severe deterioration in various asset markets as well as in macroeconomic fundamentals occurred during the last half decade, characterized it as one of the most unanticipated and tumultuous periods in the recent economic history. Two major crises events took place over this turmoil period: the Global financial crisis (GFC, hereafter) of 2007–2009 and the Eurozone Sovereign Debt Crisis

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(ESDC, hereafter) that started at the fall of 2009 and triggered by the Greek debt problem. During crises, the issues of risk management and asset allocation are very important to practitioners and academics. While the effects of these two crises on stock, bond and other asset markets have been described and analyzed (e.g., [Arghyrou and Kontonikas, 2012](#); [Baur, 2012](#); [Chan et al., 2011](#); [Guo et al., 2011](#); [Kenourgios and Padhi, 2012](#); [Dimitriou et al., 2013](#)), studies that examine the behavior of exchange rates during those turmoil periods are still rare.

There is prior literature investigating the volatility spillover linkages among exchange rates since the seminal paper of [Engle et al. \(1990\)](#), who support that the uncertainty in exchange rates arises not only from local shocks, but also transmitted across markets. Most of the early literature analyzes the volatility spillovers among currencies employing conventional methodologies, such as cointegration, causality, generalized autoregressive conditional heteroskedasticity (GARCH) specifications and cross-correlation function. For example, [Nikkinen et al. \(2006\)](#) examine the expected future volatilities among major European currencies during the period 2001–2003 and find that implied volatility of EUR affects those of GBP and CHF. [Inagaki \(2007\)](#) examines volatility spillover effects among EUR and GBP during the period 1999–2004 and finds that EUR unidirectional causes-in-variance the GBP.

However, this literature suffers from certain limitations. First, cointegration methodology does not accommodate the possibility of non-normality and asymmetry in the variance of returns ([Baele, 2005](#)). Second, there is a heteroskedasticity problem when measuring correlations caused by volatility increases during a crisis ([Forbes and Rigobon, 2002](#)). Third, most of the GARCH family models assume that correlation coefficients are constant over the sample period, while their multivariate variants suffer from the curse of dimensionality. Fourth, empirical analysis must examine the second moments of correlations and covariances in order to provide evidence of dynamic changes in linkages among markets across stable and crisis periods ([Pesaran and Pick, 2007](#)).

To avoid the limitations of this literature, recent research on exchange rates linkages focuses on their dynamic conditional correlations in a time-varying GARCH framework. The dynamic conditional correlation (DCC) GARCH model developed by [Engle \(2002\)](#) provides a robust analysis of time-varying linkages by allowing conditional asymmetries in both volatilities and correlations, while investigates the second order moments dynamics of financial time-series and overcomes the heteroskedasticity problem.<sup>1</sup> For example, [Perez-Rodriguez \(2006\)](#) provides evidence on the fluctuation of correlations among EUR, GBP and CHF over the period 1999–2004, using the DCC-GARCH model of [Engle \(2002\)](#). [Kitamura \(2010\)](#) analyzes intraday volatility spillovers among EUR, CHF and GBP via a Varying-Correlation (VC) multivariate GARCH model and finds evidence of spillover effects from EUR to the other two currencies during the period 2008–2009. [Antonakakis \(2012\)](#) uses a DCC-GARCH model and finds bidirectional cross-market volatility spillovers among major European exchange rates markets, focusing on the period before and after the introduction of euro.<sup>2</sup>

This work focuses on the impact of the GFC and ESDC on major international currencies. Specifically, we empirically investigate the time-varying linkages of five daily US dollar exchange rates, namely euro (EUR), Japanese yen (JPY), British pound (GBP), Swiss franc (CHF) and Australian dollar (AUD) from 1st January 2004 to 31st December 2011. While an increasing number of studies use the standard GARCH-DCC model of [Engle \(2002\)](#), we differentiate our analysis by employing a DCC model into a multivariate fractionally integrated APARCH framework (FIAPARCH-DCC model). In this set up, we estimate the time-varying dynamic conditional correlations among the currencies and then examine the dynamic patterns of correlation changes across four phases of the GFC and two phases of ESDC. The advantage of the FIAPARCH model of [Tse \(1998\)](#) used in this paper is its flexibility, since it includes a large number

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<sup>1</sup> Other advanced techniques, which avoid the restrictions of the conventional approaches, are regime switching models (e.g., [Boyer et al., 2006](#)), copulas with and without regime-switching and nonparametric approaches (e.g., [Rodríguez, 2007](#); [Kenourgios et al., 2011](#)).

<sup>2</sup> In the area of copulas, [Patton \(2006\)](#) pioneers the study of time-varying copulas for modeling asymmetric exchange rate dependence. He examines the dependence between the Deutsche mark (DM) and the JPY, in the sense that a different degree of correlation is exhibited during joint appreciations against the USD versus during joint depreciations. He finds evidence that the DM–USD and JPY–USD exchange rates are more correlated when they are depreciating against the USD than when they are appreciating. [Boero et al. \(2011\)](#) use copula models and identify changes in the dependence structure of EUR–GBP and EUR–JPY pairs since the launch of euro.

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