# Dynamics of international spillovers and interaction: Evidence from financial market stress and economic policy uncertainty

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## ARTICLE INFO

## ABSTRACT

This study examines the volatility (stress) spillovers in stock, securitized real estate, bond, and currency markets and the economic policy uncertainty spillovers across seven countries. We find that spillovers are important and account for, respectively, about 72% and 50% of the dynamics of financial market stress and economic policy uncertainty across the seven economies examined. Our results suggest a bulk of financial market stress and policy uncertainty are due to international spillovers. In the multi-country context, we find some evidence of policy uncertainty spillovers lead financial market stress spillovers. Thus, changes in international economic policy uncertainty spillovers may be a short-term predictor of changes in international financial market risk spillovers. Our analysis provides the first evidence regarding the link among the international spillovers in multi-country systematic risks. Policymakers who aim to make effective macroeconomic policies in this interconnected global environment should take these findings into account.

## 1. Introduction

During the global financial crisis (GFC), international financial market risk spillovers are important to the extent that the co-movements of asset/market volatilities and the risk of contagion increase significantly during this period of extreme turbulence, thereby exerting tremendous financial "stress" on the growth and recovery of overall economy (Apostolakis, 2016). In responding to this crisis, several financial stress indices are constructed by central banks and financial authorities to monitor and assess the current state of stress in the financial system, and combine them into "aggregate" stress indices. (Balakrishnan et al., 2009; Cardarelli et al., 2011; Cevik et al., 2013). However, there is insufficient attention given to develop a financial stress spillover index for individual financial sectors across a group of countries. Similar with the use of an aggregate financial stress index that constitutes to a better understanding of the overall financial stability of an economy (Apostolakis, 2016), a stress index developed for a constituent financial market (stock, securitized real estate, bond and currency markets, where each one is driven by its distinctive forces) across a group of economically close-linked countries helps assess and scrutinize the current level of financial stress in the respective financial sectors, after considering the "interconnectedness" of global financial markets (Diebold and Yilmaz, 2014).

With securitized real estate emerges as another essential asset class in investors' portfolios and plays an important role in the GFC, a real estate financial stress index will similarly be useful.[1] With recent financial and economic crises that shed light on the integration level and the volatility spillover patterns of global financial markets (Liow and Newell, 2016), volatility in financial markets of several countries may be tapping the same dimension of financial stress. An increase in volatility spillovers in the multi-country context may thus due to investors responding to financial stress. Thus, individual sectors' financial stress in the multi-country context can be proxied by volatility spillovers. Our approach recognizes that volatility is one popular and important indicator of financial stress and that high volatility is very likely to arise (but may not necessarily) in stressful periods. Moreover, the various volatility spillover measurements will contribute to a better understanding of the financial stress or systematic risk in an international environment. This is the focus of our first research issue.

Due to economic globalization, there is growing interest in studying the impact of uncertainty on economic activity (Baker et al., 2012), with a consensus that uncertainty has a negative effect on the level of growth and investment (Antonakakis et al., 2015). Moreover, financial markets dislike uncertainty because increased economic policy uncertainty (EPU) is associated with lower asset prices (Bansal and Yaron, 2004). Hence a decrease in stock prices can be significant when a

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[1] REIT is part of securitized real estate (public real estate). Although REITs may not be included in the financial stress indices, there are volatility spillover studies that consider REITS, such as: Payne and Mohammadi (2004); Stevenson (2002); Ambrose et al. 2007; Hoesli and Reka (2013); Lin (2013).

higher uncertainty about the government policy is observed in the economy (Pastor and Veronesi, 2011). Similarly, since EPU is highly correlated with the cost of finance, and negatively correlated with firms' capital expenditure and investment (Sum, 2013), investors and consumers are unwilling to invest and spend when they perceive higher degree of policy uncertainty in the economy. Using the Baker et al. (2012) index of policy uncertainty, our second contribution lies in adding evidence to the EPU spillover literature in the multi-country context, to examine whether the estimated EPU spillovers have changed over time and across individual economies, as well as who are the most influential player(s) in the EPU spillover relationship.

More recently, Chen et al. (2017) consider a dynamic asset pricing volatility model and assess the link between dynamic stock market volatility and economic fluctuations. Since stock market is part of financial market, it follows that financial market volatility spillover indices may be linked to EPU spillover indices, and may have lead-lag relationship in the multi-country context. Finding of a causality relationship between the two spillover indices will carry significant implications for international financial market stability and performance of the global economy. Moreover, evidence of short-term interaction between the two international systematic risks implies the existence of unobserved common shocks among the financial markets and macroeconomic environment in the respective economies. Accordingly, more opportunities of coordinated policy formulation to improve financial market stability and promote economic growth are desirable. However, we are not aware of any published study that investigates the interaction between the two spillover indices. Accordingly, our third research issue is to explore whether the two international spillovers are interdependent and share varying lead-lag relations in the multi-country context.

To address the three research issues, we examine seven international economies: China (CH), Japan (JP), France (FR), Germany (GE), the UK, Canada (CA) and the US; as well as their respective five major financial/asset markets: stock, securitized real estate, bond, currency and composite (all-asset). Excluding China, the other countries are the six top-ranked advanced economies with the current largest GDP and with the highest national wealth from the Group of 7 (G7) (CIA World Fact Country Rankings, 2016)[2]. Moreover, these economies have well-developed financial markets in their respective countries. CH is the World's second largest economy (by nominal GDP in year 2016: IMF, 2017). The role of CH is also recognized by Tsai (2017) that EPU in CH is the most influential with contagion risks spreading to other regional markets. Moreover, the growing influence of CH and the globalization of its financial markets are making fundamental changes to the nature of macroeconomic interdependence and economic spillovers between CH and the G7 countries (Kim et al., 2011). Given the prominent economic role played by CH, the impact of CH economy on the global business cycle is of great interest. Thus, our choice of CH's and six G7 countries are highly relevant in this research context.

We appeal to the concept of generalized spillovers/ connectedness approach developed by Diebold and Yilmaz (2009, 2012, 2014) to estimate international financial market volatility spillover indices (IFMVSIs) and international EPU spillover indices (IEPUSIs) across the seven countries, from February 1997 to August 2015, the longest study period dictated by the EPU data availability. One major advantage of our methodology is that this multivariate connectedness approach can reveal the direction of volatility transmission in addition to its strength (intensity), whilst at the same time the results are invariant to the variable ordering (Diebold and Yilmaz, 2012). Moreover, compared to traditional analyses based on bivariate correlation coefficients, the conditional spillover index methodology based on a combination of GARCH and VAR methodologies is more capable of

capturing the time-varying co-movement of financial market return and volatility fluctuations in more than two countries (Diebold and Yilmaz, 2012). After estimating the dynamic total and net directional spillover series, our second step is to implement time-varying causality tests from the bootstrap rolling window estimation to detect the co-movement and causality between the EPU spillovers and financial market stress spillovers in the multi-country context. This rolling window causality estimation method, as opposed to the fixed causality test, is adopted to account for structural changes caused by the financial and economic crises that can create shifts in the parameters, which may further cause the pattern and magnitude of the causal relationship between the two spillovers to change over time (Balcilar et al., 2010). A final point to take note is that although our approach in this study involves a comprehensive examination of the spillovers among assets and economies in multiple countries, we will also evaluate the increasingly important roles of the Chinese economy and its financial markets in influencing the international spillovers in EPU and financial market stress, in comparison to the world's largest economy (the US). This approach is justified in view of CH's rising economic potential, rapid growth of financial markets, massive urbanization and increasing recognition of private real estate ownership in the country (Liow and Newell, 2012). In this way, the contribution of this paper can be further enhanced.

This research thus add value to the existing literature along three directions. First, compared to the previous literature in this area is the inclusion of new asset class of securitized real estate. Studies of the dynamics and statistical properties of real estate has become an important part of financial analysis since real state became an additional tool for international diversification among stock, bonds and currencies, economic growth and the GFC. Second, the spillover approach and measures employed in this study pinpoint the role played by international spillovers in causing the cross-market financial stress and policy uncertainty transmission. This finding has important implications because financial market stress spillovers and EPU spillovers in the multi-country context are important aspects of economic globalization and financial integration in todays' international environment. Finally, exploring the dynamic interdependence between financial stress spillovers and policy uncertainty spillovers in the multi-country context is meaningful because of "interconnectedness" of modern economy and financial system (Diebold and Yilmaz, 2014). One good example is since the impact of EPU on real estate market fluctuations has attracted widespread attention by the public, especially after the subprime crisis, it may be natural to associate the real estate market volatility spillover with an increase in the EPU spillover for a group of countries. To our knowledge, this is the first study that empirically investigate the link between the two spillovers (systematic risks) in the multi-country context using a novel econometric procedure, i.e. rolling window bootstrap causality technique.

The remainder of this paper is organized as follows. Section 2 reports a review of related literature and specifies the gap in the literature. Section 3 describe the data and methodology. This is followed in Section 4 where the results of the two international spillovers and their dynamic interdependence are discussed. Finally, Section 5 concludes this paper.

## 2. Previous work and literature gap

First, our work is broadly related the financial stress literature. Since the global financial and economic crises, there has been growing interest in the development of various financial stress indices. These "aggregate" financial stress indices are constructed for one country (e.g. Illing and Liu, 2006) or for several countries (e.g. Balakrishnan et al, 2011; Cardarelli et al., 2011; Cevik et al., 2013). Balakrishnan et al. (2011) develop a financial stress index for developing countries and examine the transmission channels of financial stress between advanced and developing economies. They define an episode of financial

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[2] Another G7 country, G7, was excluded from this study, due to intermittent missing real estate data.