Testing for financial contagion: New evidence from the Greek crisis and yuan devaluation

Alexia Anastasopoulos

Department of Economics, Brock University, 1812 Sir Isaac Brock Way, St. Catharines, Ontario L2S 3A1, Canada

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ABSTRACT

This paper examines contagion effects from two recent crises. First, the effects of the Greek debt crisis on surrounding European nations, and second, the effects of the yuan devaluation on key trading partners such as the US and the BRICS countries. Kendall's tau correlation coefficient was used to measure the degree of cross-market linkages between equity returns before and during the crisis periods. To test for a significant increase in these coefficients that would indicate contagion, a test statistic developed by Li (2009) was used. Empirical results suggest both crises produced contagious effects. In addition, the results suggest that the contagion effects from the Greek debt crisis were not persistent while the effects from the yuan devaluation were. We further demonstrate that superior investment returns appear to be attainable when our contagion results are used for the management of trading risks.

1. Introduction

Financial contagion has received considerable attention throughout the literature to date. The term emerged out of the Asian crisis, triggered by the flotation of the Thai baht in 1997. Thereafter, the subject gained attention as more crises occurred that caused negative repercussions across nations. The presence of contagion as a threat to the stability of the global economy was highlighted during the sub-prime mortgage crisis of 2007. This crisis, along with many others have caused policy makers, investors and researchers to question why this phenomenon happens and what can be done to mitigate risk form contagious crises in the future. One might think that having witnessed several contagious crises in the 1990s and 2007, international governments and policy makers would have learned from these cases and implemented the reforms needed to protect nations from future external crises. But as will be seen in this paper, this is not the case. It seems that recent crises are still as contagious as crises in the past.

Previous studies have used correlation coefficients to detect contagion during four major crises in the past. These include the 1987 US stock market crash, 1994 peso devaluation, 1997 Asian currency crisis, and the 2007/2008 sub-prime crisis. In the first major paper on this subject, King and Wadhwani (1990) test for an increase in cross-market correlations between the U.S., U.K. and Japan using stock indexes and find that correlations increase significantly after the U.S. crash. Calvo and Reinhart (1995) use this approach to test for contagion after the 1994 Mexican peso crisis and find that the correlation in stock prices and bonds between Asian and Latin American emerging markets increased significantly, which is interpreted as contagion. Their results suggest that contagion can be more regional than global as regional patterns differed within Latin America and Asia. Baig and Goldfajn (1998) present a thorough analysis using a similar framework and test for contagion in stock indexes, currency prices, interest rates, and sovereign spreads in emerging markets during the 1997 East Asian crisis. They find that cross-market correlations increased during the crisis for many of the countries and attribute this to panic-driven herd behaviour. They further note that this type of contagion can be contained with credible policy actions. Forbes and Rigobon (2002) however, challenged these conclusions by pointing out the

problems with using correlation coefficients as the methodology. They demonstrate that tests done with correlation coefficients may be biased in the presence of heteroskedasticity, endogeneity, and omitted variables, suggesting that there is no way to tell if changes in cross-market correlations are due to these factors or actual changes in underlying correlation structure. In an attempt to overcome these problems, Li (2009) used a ranked correlation coefficient called Kendall's tau and created a test statistic to test for significant changes in this coefficient from the non-crisis period to the crisis period. Li (2009) further applied this test to the 1987 US stock market crash, the 1994 Mexican peso crisis, the Asian crisis of 1997 and the 2008 sub prime mortgage crisis and finds presence of contagion in all cases with the exception of the peso devaluation. The advantage of Li (2009) rank-based approach is that the contagion test results do not suffer from the biases identified in Forbes and Rigobon (2002) that much of the previous literature is subject to.

Several researchers have attempted to test for contagion stemming from the Greek crisis with mixed conclusions. Samitas and Tsakalos (2013) use an asymmetric dynamic conditional correlation model (A-DCC) as well as copula functions to test for dependence among European markets during the sub-prime crisis and the Greek debt crisis. They use data consisting of daily stock returns for major European markets and conclude that there were no significant contagion effects stemming from the Greek crisis. Inoue et al. (2013) find that contagious effects were propagated from Greece to several other EU member nations. They determined this using causality-in-mean and causality-in-variance models with 10-year government bond yields. Pragidis et al. (2015), using 10-year sovereign bond yields, estimate a corrected dynamic conditional correlation model (cDCC) in order to test for the spread of the effects from Greece to other major European countries. Their results do not suggest that any contagious effects were present during their chosen sample period.

It is important to further clarify the meaning of the term "contagion" that is adopted here. This term has been used generically and its definitions throughout the literature are diverse. Some economists specify contagion as a shock transmitted from a crisis country to another country or group of countries. This particular definition is very broad, and is termed "interdependence" by Forbes and Rigobon (2000). As an example, consider two countries whose financial markets are normally highly correlated. It would not be unusual for one market to fall in response to a decline in the other market as the two are interdependent. In other words, on any given day these markets are highly correlated regardless of whether one of those countries experienced a shock. On the other hand, two countries whose markets are usually not highly correlated may shift to a higher degree of correlation resulting from a shock to one of the markets. That is, the cross-market correlation between the two countries increased after one of those countries experienced a shock. This type of circumstance is known as "shift contagion" and describes contagion as any significant increase in cross-market linkages after a shock to an individual country. For the purpose of this paper, the latter definition will be used.

This paper tests for the presence of contagion during two recent crises. Namely, the Greek debt crisis of 2010–2011 and the Chinese yuan devaluation of 2015. These two crises were chosen for their recency in addition to the impact they have had internationally. Using daily returns of stock market indexes, Kendall's tau coefficients are estimated during stable and crisis periods. Then, using a test statistic developed by Li (2009), we determine if there was a significant increase in the rank-correlation coefficient during the crisis period. The results suggest strong, short term contagion effects from both crises. For the Greek crisis, contagion spread to several other European countries including Portugal, Spain, Italy, Germany and the Netherlands. For the yuan devaluation, contagion tested positive for the surrounding Asian nations and surprisingly, spread to the BRICS countries as well. When testing for persistence of these effects, the results suggest that contagion from the Greek crisis was short lived but the effects from the yuan devaluation are still prevalent.

In the past, most studies have relied on a more restrictive method of linear correlation. However, the method of ranked correlation has yet to be used, which detects possible non-linear relationships between variables. This paper contributes to the literature on contagion by being the first to apply this newly developed methodology to two of the more recent crises. The results from this study will add to the ongoing debate of whether Greek contagion exists. As for the yuan devaluation, no attempts have been made to test for contagion thus far, but the topic is of international importance and the results can be a step towards understanding the mechanisms of the ongoing crisis. Furthermore, the results of this paper have important policy implications for example, providing the IMF with information on how to reduce a country's exposure to external shocks. Testing for increases in cross-market linkages reveals if the crisis was transmitted through crisis-contingent channels or more permanent channels that exist in stable times as well as periods of turmoil. If the effects are transmitted through crisis-contingent channels, then short run isolation strategies such as capital controls can be effective in minimizing crisis effects. Otherwise, any attempt to isolate the effects would just delay the country's adjustment to the shock and may not do much to minimize its exposure.

The results of this paper are not to be taken as a universal truth. Although this study has uncovered empirical regularities that exist within our specific data set that spans a chosen group of countries, we do not attempt to portray their meaning as anything deeper than probabilistic evidence of contagion. According to Downward (2016) a time series analysis alone cannot fully explain the complex social phenomena underlying the events in study. As such, we complement our econometric analysis qualitatively, providing the reader with a brief historical background to which they can place the results of this study.

1.1. A short history of financial crises

As was briefly discussed in the previous section, the Greek crisis and yuan devaluation are not the only crises which have had far reaching effects. Reinhart and Rogoff (2009) collect a comprehensive dataset that documents numerous episodes throughout history in which multiple countries were experiencing a crisis at a given time. The first documented global crisis began in 1825 and involved Europe and Latin America. During this time, Greece and Portugal defaulted as well as most of the independent nations in Latin America. Then there was the banking panic of 1907 which started in the United States and spread to countries including Japan,