

Determinants of Time Varying Co-movements among International Stock Markets

This version: May 27th 2014

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Abstract: We investigate contagion and whether or not the transmission mechanisms are crisis-contingent. We define contagion as a significant increase in time varying co-movements in stock markets using the Engle (2002) methodology taking possible heteroscedasticity into account. We report results for a total of 190 country pairs from developed and emerging markets during four crisis episodes including the most recent subprime (2008) and Eurozone (2010) crisis as well as the Asian (1997) and Russian (1998) crisis. We find that the conditional correlations are higher during crisis periods and lower during tranquil periods indicating contagion. The highest correlations are observed in developed country pairs and lowest correlations among emerging country pairs in both crisis and tranquil periods. Bilateral trade size and shared religion are the two non-crisis contingent determinants of co-movement, which are stable during both tranquil and crises periods among all developed and emerging country pairs. We report three transmission mechanisms that are crisis contingent. GDP growth rate differential is a crisis contingent transmission mechanism for developed market pairs and especially during the Asian and Russian crisis. Term spread and market size differentials are significant crisis contingent transmission mechanism for emerging market pairs only with market size differential being important during the subprime and Eurozone crisis especially. Culture and inflation differentials between country pairs are important as transmission mechanisms mainly during tranquil periods but not during crisis periods. We contribute to the crisis literature by showing that in addition to changing correlations transmission mechanisms also change during the crisis periods. Policy implications are important as we show different transmission mechanisms are at work under different crisis conditions across country pairs and policy institutions can choose intervention vehicles accordingly.

Abstract (100 words): We investigate contagion and whether or not transmission mechanisms are crisis contingent. We report results for a total of 190 country pairs during four episodes including the subprime (2008), Eurozone (2010) Asian (1997) and Russian (1998) crisis. Conditional correlations are higher during crisis periods and lower during tranquil periods indicating contagion. We contribute to literature. by differentiating between crisis contingent and non-contingent variables. Bilateral trade size and shared religion are the non-crisis contingent determinants of stock market co-movement. GDP growth rate, term spread and stock market size differential are crisis contingent propagation mechanisms with different impact across different country pairs.

Key Words: Stock market Co-movement, Developed and Emerging markets, Crisis, Contagion

JEL Classification: G01, G11, G12, G15, Z12

1. Introduction:

Dependence structures of international equity markets have recently appealed increasing attention among theorists, empirical researchers, and practitioners following the recent global crisis. The crisis of 2008 has been called the worst crisis since the Great Depression of the 1930s. Erupting in the US and taking a worldwide proportion shortly after the collapse of Lehman Brothers in September 2008 it affected developed as well as the emerging countries. Repercussions were many including the Eurozone crisis; occupy London movement and the several public reactions in Greece, Italy, Turkey and Egypt This has upturned tremendous interest in the underlying fundamentals of how stock markets are correlated with one and other for better understanding of the causes of the sudden and simultaneous deterioration of wealth in many countries around the world. Important questions were raised about the determinants of co-movements among the different country pairs and the stability and commonality of those determinants during crises and non-crisis periods.

We investigate two separate but closely related issues. We have observed during the recent crisis that the dramatic movements in one market, the US can have powerful impact on others around the world. The first issue we investigate is does this mean that we have evidence for contagion? Before answering this question, contagion must be defined. We define contagion as in Forbes and Rigobon (2002) in terms of increased correlations. If two markets are highly correlated during tranquil periods and continue to be highly correlated during the crisis this does not indicate contagion. It merely indicates strong linkages between the two stock markets that exist in different states of the economy. If cross-market correlations significantly increase after a shock we refer to this as contagion. We provide evidence for

contagion in worldwide markets developed or emerging. The major advantage of this definition of contagion is that it enables us to distinguish how crisis are transmitted across the markets.

This brings us to the second issue of propagation of the shocks during the crisis periods. How the shocks are propagated is more important for policy makers than shocks are transmitted or not. If the two countries are closely linked through economic fundamentals then a crisis would have a strong impact on the other but this would not constitute contagion as defined here. However if there is a contagion, intervention from IMF and provision of liquidity and bail outs can be meaningful. Nevertheless, if there is contagion, then it becomes important to understand how the determinants of correlations change during the crisis. Is the transmission mechanisms crisis contingent or non-contingent? Exogenous shocks do not change how the shocks are transmitted across markets and therefore are non-crisis contingent. We show that common religion and high level of bilateral trade are non-crisis contingent. However, endogenous shocks fundamentally change and how shocks are propagated across countries and therefore are crisis contingent. For example we show that the difference in GDP growth rates of country pairs is crisis contingent. . We observe that during a crisis correlations increase among developed country pairs when their growth rates are similar whereas we observe this for developed-emerging market pairs during tranquil periods. Country pairs having similar stock market size, and term spreads becomes a significant transmission mechanism during the crisis for emerging market pairs only while they are non-crisis contingent as transmission mechanisms for other country pairs. Similar culture and similar inflation rates among country pairs are important as transmission mechanisms during tranquil periods but not during crisis periods.

The time varying nature of stock market co-movement is widely documented (see for example, Hamao et al., 1990; Bakaert and Harvey, 1995; Longin and Slonik, 1995; Longin and Slonik, 2001; Caporale et al., 2005; and Bakaert et al., 2009).¹ The common message from these studies is that the international stock market co-movements change over time due to globalization and liberalization. Recent studies demonstrate that the emerging markets are more segmented compared to the developed markets (e.g., Bakaert et al., 2011, Carrier et al., 2007, Christoffersson et al., 2012) due to their fundamental characteristics such as size, institutional structure and geographical location (Forbes and Rigbon, 2002; Carrier et al., 2007, Christoffersson et al., 2012). This literature motivates us to focus on the developing emerging and mixed country pairs when investigating contagion as well as the determinants of stock market co-movements with changing economic regimes including global shocks, and tranquil periods which have not been studied before. Christoffersson et al., (2012) provides evidence that on average, for a developed market, dependence with other developed market is higher than the average dependence with emerging markets. Does it also mean that correlations remain high at their

¹ The studies are done mostly in mature markets except Bakaert and Harvey, 1995 and Caporale et al., 2005

tranquil period levels during the crisis in developed country pairs? Do correlations remain low and at their tranquil period levels in emerging market pairs? How about mixed pairs of developed and emerging markets? Walti (2011), explains stock market co-movements by using various variables that indicate economic and financial integration. What are the determinants of time-varying correlations? Are they crisis contingent or non-crisis contingent? Are the determinants of correlations during tranquil periods significant during crisis periods also or do they change? Do the determinants vary among the country groups? We investigate the commonality and stability of determinants of stock markets co-movements between stable and tranquil periods among different country pairs. To date, the empirical research on this area is segmented and much is still unknown about supporting or refuting the crisis and non-crisis contingent hypothesis among different country pairs. The stability test of the determinants of stock market co-dependence may help to identify those countries which are at risk of contagion and the general policy interventions which can reduce those risks.

We specifically investigate the following hypotheses. First, we investigate whether the stock market co-movements among the country pairs are higher during crisis period. If there is contagion they will be higher. Second, we investigate whether the determinants of time varying correlations differ between tranquil and crisis periods. If the determinants of correlations do not change during crisis and tranquil periods they are non-crisis contingent otherwise they are crisis contingent. We extend the impact of all two hypotheses among three forms of country pairs. We analyze country pairs that are (1) both developed markets and (2) both emerging markets and (3) mixed pairs where one country is developed and the other is an emerging market. Our paper contributes to the existing literatures in three ways. **Firstly**, our study contributes to the existing contagion studies, by comparing the time varying conditional correlation's of stock markets during tranquil and crisis periods considering various combinations of country pairs and 4 major global shocks. **Secondly**, our study investigates the commonality and stability of both economic and cultural determinants of stock market co-movements among different country pairs that are both developed, that are both emerging markets and pairs with one developed and one emerging country. To the best of our knowledge, this is the first paper that investigates not only developed or emerging but also mixed county pairs during crises and tranquil periods that have substantial differences in economic, financial, and cultural attributes, which might have influence on the time-varying co-movements. **Finally**, we compare the commonality and stability of the determinants of stock market co-movements during tranquil and crisis periods in various country pairs whereby the existing research is silent.

The major finding of our study is that there is contagion; the conditional correlations in stock markets are high in magnitude during crisis periods compared to tranquil periods but the levels of correlations differ among three different country pairs. Correlations are highest during crisis among developed country pairs and lowest among emerging country pairs. We show that a number of economic and financial factors such as market size difference, inflation difference, GDP growth rate

difference, total trade size and cultural factors such as perceived similarity of religion, and cultural differences are the main determinants of bilateral stock market co-movements. Country pairs with similar religion and high level of bilateral trade have higher stock market correlations. This relation is non-crisis contingent. As described in detail in Forbes and Chinn (2004) direct trade among countries is important in transmission of shocks. We show that direct trade among nations is the most stable economic determinant of time varying correlations in stock markets worldwide during both tranquil and crisis periods Religion on the cultural side is a fundamental measure of social norms and practices and it is also a non-crisis contingent determinant of time varying correlations. The sign, significance level and explanatory power of the other determinants of time varying correlations change between tranquil and crisis period and among different country pairs.

The remainder of the paper is organized as follows: section 2 presents the hypotheses development and related literature section 3 presents the data and methodology used in this paper, section 4 discusses the main empirical results and section 5 concludes the paper.

2. Related literature and hypotheses development

Stock market co-movement is an issue of interest in financial literature. Market co-movement, interdependence, and contagion are widely discussed terminologies around this research. Co-movement does not necessarily indicate contagion. Forbes and Rigobon (2002) define contagion as a significant increase in cross-market linkages usually measured correlations. The term interdependence, on the contrary, refers to high degree of co-movement during periods of stability as well as crisis and thus according to Forbes and Rigobon (2002, pp. 2224) "...it is only contagion if cross-market co-movement increases significantly after the shock". Similarly, Bekaert et al. (2005) define contagion as excess correlation, which is the correlation over and above what is expected. . Contagion represents the transmission of shocks attributable to the crisis and can be evaluated against interdependence in determining the particular impact of shocks of one market to another during crisis. We use this definition for measuring contagion. When the correlation between country pairs increases significantly we define this as contagion, otherwise even if the correlation coefficients are high we interpret this as interdependence.

Empirical work reports mixed results. King and Wadhvani (1990) study the correlations between developed markets, US, UK and Japan and show that they increased significantly following the crash in the US in 1997. Lee and Kim (1993) extending this analysis to a dozen countries including emerging markets confirm increased correlations and thus contagion during the 1987 US stock market crash. Calvo and Reinhart (1996) investigate the 1994 Mexican crisis and show correlations increased in a group of emerging markets. Caparole et al. (2005) study the Asian crisis and report significant increase in co-movement among a group of South East Asian Countries and conclude contagion. Corsetti et

al. (2005) study the Asian crisis and co-movements in 17 countries including 7 developed and 10 emerging countries and report that for five countries they report contagion and for others they report interdependence. Chiang et al (2012) also report contagion during the two phases of the Asian crisis using a longer sample period. Forbes and Rigobon (2002) study the 1994 Mexico and the 1997 Asian crisis in 24 countries again both developed and emerging markets. They report there is not contagion but interdependence in both episodes among the countries they study.

The main reason for the discrepancy in the results of previous literature is the use of different methodologies especially in dealing with heteroscedasticity issues. Whether or not there is contagion is important for policy makers. A negative shock from one country to another can reduce financial flows even if the fundamentals of the shock receiving country are strong if correlations increase or if transmission mechanisms change. Then intervention from international agents such as the IMF can be justified. For example, during the Asian and the Russian crisis although many emerging markets did not have close economic ties with these countries they imported the shocks as investors perceived riskiness of these markets similar and withdrew their investments from them. IMF bailouts can then be helpful. Short term loans can help the shock receiving country to be bailed out from a financial crisis. However, if the two countries are interdependent and their economies are closely linked through fundamentals the crisis will have a real impact on the shock receiving country. This sort of transmission will be due to interdependence and not constitute contagion. For example the UK has close ties with the US in terms of economic fundamentals, especially trade and the impact of the US subprime crisis on the UK has been immediate and strong. Therefore we approach the choice of methods in measuring pairwise correlations with care.

There is a heteroscedasticity problem when measuring correlations. This is caused by increasing volatilities during the crisis period. When contagion is defined as a significant increase in cross market co-movements the measurement of correlation must involve a dynamic element and the time-varying nature of the correlations especially during the crisis periods must be sorted out. Also the choice of the window length is important in carrying out these tests (Billio and Pellizzon, 2003). Different authors use different methodologies and time frames in their analysis (Forbes and Rigobon 2002; 2003; Froot et al., 2001; Corsetti et al., 2005; Chiang et.al, 2007). We use a dynamic approach that estimate pairwise

correlations using a dynamic approach and at the same time correcting for heteroscedasticity; Dynamic Conditional Correlation (DCC) following Engle (2002). However, an important issue in contagion studies referred before is the estimation methodology used in cross market correlation coefficients. The tests used for contagion using correlations of country pairs can be biased due to heteroscedasticity (Forbes and Rigobon, 2003; Caporale et.al. 2005). The correlation between stock markets is conditional on the market volatilities. Volatilities usually increase during the crisis periods and correlation coefficients tend to increase and be biased upwards. If we do not adjust for this bias in the correlation coefficient we find evidence for contagion although in fact it may not exist. We use time varying heteroscedasticity consistent estimators of Engle (2002) whereby the coefficients are estimated using a dynamic approach. We use a cross-country, multivariate GARCH model DCC model to overcome the limitations found in the existing literature, which is appropriate for measuring time-varying conditional correlations. This methodology enables us to address the heteroskedasticity problem raised by Forbes and Rigobon (2002) without arbitrarily dividing the sample into two sub-periods and using constant conditional correlation with too many parameters (Logan and Slonik, 1995). Moreover, we use the mean GJR GARCH model to whiten the residuals in the DCC model. We then use the Fisher Z-transformation of conditional correlation adjusted the potential problem of non-normality with this analysis is that the source of contagion has to be identified beforehand (Corsetti et al., 2005). However, Forbes and Rigobon, (2002, P. 224) “defines contagion as a significant increase in cross-market linkages after a shock to one country (or group of countries). This refers that if two markets are highly correlated during stable period and continue to be highly correlated after a shock, this may not constitute contagion, while it is only contagion if cross market co-movement increases significantly after the shock.” It is interesting to investigate the contagion during the major global shocks and including the recent crises.

H₁: Whether the Time varying stock markets co-movements are high during crises?

The theory of stock market co-movement mechanisms in the international finance literature mainly concentrates on the two main approaches; one, fundamental through interlinked economic, trade and financial activity called theories of non-contingent crisis (Masson, 1998; Forbes and Rigobon, 2000; Kaminsky and Reinhart, 2000); two, behavioral or extra economic referred as theories of contingent crisis (Masson, 1998; Forbes

and Rigobon, 2000; Kaminsky and Reinhart, 2000). Theories of non-contingent to crises assume that transmission mechanisms following a shock are not significantly different from those prior to the shock or the crisis. Accordingly, excessive co-movements between markets are by nature a continuation of the pre-crisis links (Masson, 1998; Forbes and Rigobon, 2000; Kaminsky and Reinhart, 2000). This approach is often qualified as “fundamental contagion”. It is recognized through repercussions or spillovers resulting from the interdependences via Economic [Ammer and Mei, (1996)], Trade [Eichengreen et al, (1996) and Glick and Rose (1998)], or Financial links [Alen and Gale (2000)]. This crisis contingent view is also complementary to the “wake-up-call” argument presented in Goldstein (1998). The wakeup call hypothesis also tested by Bakaert (2011), who assumes that markets with similar characteristics should highly co-move and investors margin call during the crisis causes portfolio re-balancing, fight to quality and herding. Such behaviour is also consistent with the forms of a ‘rational inattention’ (Tutino, 2011, and Wiederholt, 2010). According to rational inattention theory, given the existence of costs in acquiring and processing information, rational agents could optimally choose to ignore some information. The crisis contingent hypothesis narrated by Caporale et al. (2005) assumes that during crisis due to change of investor’s behavior channel of transmission may be also various.

The prevailing literature identifies diverse economic, financial and cultural variables as determinant of stock market co-movements. However, we include three categories of transmission mechanism in our study such as economic, financial and cultural. Firstly, economic category, we consider three variables such as GDP growth rate, Inflation and trade size. As we know that the degree of inter-connectivity between two countries matters. Two economies with a similar economic structure are significantly more correlated because economies grow through evolving stages of diversification. We expect a negative significant relationship among GDP growth rate and inflation differential is with the stock market co-movement [see for example, Pretorious (2002), Johnson and Soenen (2002, 2003)]. However, we expect a positive relationship between bilateral trade size and correlation of co-movement [see for example, Forbes and Chinn (2004); Tavares, J., (2009)]. Classical Ricardian and modern theory [Baxter, 1992] explains that trade permits exploitations of gains from greater specialization and increased trade results in increased sector specialization. If, for example, country A exports significant part of its production of cars to country B, a shock to country B (that causes

decrease in demand for cars) will negatively affect the revenues of automobile industry in country A and thus the prices of automobile related stocks in country A will decline. Significant trade linkages between countries can analogously influence whole national stock indices or industries. Forbes & Chinn (2004) studied five largest and forty emerging markets and found that direct trade flows are the most important determinants of financial market co-movements. Frankel and Rose (1998) find strong evidence that closer trade linkages lead to an increase in the correlation of business cycles. However, in a recent study Baele et al., (2010) found that macro-economic fundamentals contribute little in explaining stock and bond return correlation but other factors such as liquidity proxy play a more important role indicates some changes of the determinants during crisis. Secondly, we consider two variables as financial linkages transmission mechanism such as term spread and market size. We expect a negative significant relationship between term spread differences and market sizes with the stock market co-movement [see for example, Christofersson, 2012]. Potential explanations for the relative size of a national equity market may also have a bearing on that country's equity returns, due to greater information costs, transaction costs, and less liquidity associated with trading equity in smaller national markets (Brackers et al., 1999). Finally, We expect a negative relationship between cultural differences and stock market co-movement as it indicates less information asymmetry [Kogut and Singh, (1988), Lucey and Zhang, (2010)]. However, we expect a positive relationship between religion similarity and stock market co-movement. This might be because of their similar risk averseness criteria (La Porta et al., (1999); Osoba, (2003); Lucey and Zhang, (2010)] and theoretically connected with the gravity model.

According to crisis-contingent models it is assumed that investors behave differently after a crisis, implying a change in the transmission mechanism during a crisis, and therefore an increase in cross-market linkages after a shock hits the economy. This group of theories suggests a number of different channels through which shocks are transmitted internationally. One possibility is that changes in investors' sentiment shift the economy from a good to a bad equilibrium (see Masson, 1999). An alternative one is given by endogenous liquidity shocks. For instance, a margin call that is generated by a bad return on a particular asset might force investors to sell other assets - a case of "herding" [Kaminsky and Schmukler, 1999]. We expect that the transmission mechanism differ if the crisis contingent hypothesis hold and it would be same if the non-crisis contingent hypothesis works out. We include several economic, financial and cultural variables to check whether those determine the

stock market co-movement first. However, we further investigate whether those transmission mechanisms varies during crisis. According to Forbes and Rigobon (2002) the transmission of a crisis from one country to another cannot be interpreted as contagion if the operation of the channel does not change across regimes. Accordingly, contagion is identified as a structural break in the crisis transmission mechanism, i.e. a correlation breakdown. Based on this assumption, we expect that contagion does not only change correlation co-movement but also the transmission mechanisms of those co-movement. The existing studies on transmission mechanism of market co-movement and contagion considers various factors and remaining inconclusive over time. Finally, interesting research questions arise how the determinants between stable and tranquil period vary. The transmission mechanisms may be same during both crises and tranquil periods if shocks are propagated through stable real linkages between countries. The approach to reforming the international financial architecture needs to include aspects of each crisis contingent and non-crisis contingent mechanisms to make it clear whether reforms address the causes of co-movement specifically. By considering this, we are also motivated to test whether the determinants change during stable and tranquil periods including major global shocks namely the 1997 Asian crisis, 1998 Russian crisis, Global financial crisis (GFC) 2008, and 2011 Euro-zone crisis (EZC).

H2: Whether the determinants change during crisis?

3. DATA AND METHODOLOGY

We use MSCI daily US dollar denominated indices for 20 (ten developed vs. ten emerging) for the period 1995-2011. The indices are extracted from the Thomson Financial DataStream. The developed countries include Australia, Canada, French, Germany, Hong Kong, Italy, Japan, Sweden, UK, and USA. We also include 10 most liquid markets in emerging sample. The countries are Argentina, Brazil, Chile, China, India, Indonesia, Korea, Malaysia, Russia and South Africa. The country-wise pairs are arranged as developed-developed, emerging-emerging, and developed-emerging. Further, we include four major global crises namely the 1997 Asian crisis, 1998 Russian crisis, Global financial crisis (GFC) 2008, and 2011 Euro-zone crisis (EZC). We define crises periods 1997-1998, 2008-2011, and Tranquil periods as 1995-1996, 1999-2007 respectively. We have collected the economic and bilateral trade data from IMF, Direction of trade statistics and World Bank development indicators. We use Hosftede's cultural index is considered as the cultural variable in our study (Kogut and Singh, 1988).

We use the DCC-GARCH estimation method introduced by Engle (2002) to calculate the time varying conditional correlation among the country pairs. This model assumes time variant in correlations, and allows us to reduce the complexity of parameters and simplify interpretation of the coefficients. We start with the following return series for each country indices.

$$r_{i,t} | \mathfrak{F}_{t-1} \approx N(0, D_t R_t D_t) \quad (1)$$

$$D_t = \text{diag}\{\sqrt{h_{i,t}}\} \quad (2)$$

$$Q_t = (1 - a - b)\bar{R} + a\varepsilon_{t-1}\varepsilon'_{t-1} + bQ_{t-1} \quad \dots\dots\dots(3)$$

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \quad (4)$$

Where $D_t = \text{diag}\{\sqrt{h_{i,t}}\}$ is an $n \times n$ diagonal matrix with the square roots of the conditional variances in the diagonal, and $h_{i,t}$ is obtained by a GARCH(1,1); $\varepsilon_{it} = r_{it}/\sqrt{h_{it}}$ is the standardized residual¹ and r_{it} is the return of series i at time t ; $\bar{R} = E[\varepsilon_t \varepsilon'_t]$; $Q_t^* = [q_{iit}^*] = [\sqrt{q_{iit}}]$. We obtain the a and b by maximizing the log-likelihood of the DCC process given by the following equation:

$$L = -\frac{1}{2} \sum_{t=1}^T (n \log(2\pi) + 2 \log|D_t| + \log|R_t| + \varepsilon'_t R_t^{-1} \varepsilon_t + r'_t D_t^{-1} D_t^{-1} r'_t - \varepsilon'_t \varepsilon_t)$$

An imposed restriction on the model is that $a + b < 1$. We obtain the pattern of dynamic correlations by simply using equation 5, where the dynamic correlation between series i and j at time t is simply equal to R_{ijt} .

$$\rho_{ijt} = \frac{E_{t-1}(u_{it} u_{jt})}{\sqrt{E_{t-1}(u_{it}^2) E_{t-1}(u_{jt}^2)}} = \frac{q_{ijt}}{\sqrt{q_{iit} q_{jtt}}} \quad (5)$$

Where, we define $\rho_{i,j,t}$ as the conditional correlation between country i and j at time t . DCC-GARCH model uses a GJR GARCH specifications of variances and hence, the conditional variances (together with the conditional means) can be estimated using N univariate models². Our method is free from heteroscedascity bias, which has been widely observed in the contagion literature, especially Forbes and Rigobon (2002). We estimate the bivariate time varying dynamic conditional correlation (DCC) for each country pair in our sample by employing Eq. (5).

We at first present the daily DCC conditional correlation of each country against its 19 country pairs. We observe a clear time varying correlation patterns in each country markets with its pairs. We show that the correlation between each market pairs with developed and emerging pairs differ mostly with the sample of developed market pairs compare to emerging market pairs further guide us to see the pattern of co-movement during crises with different country groups. However, we find a clear time varying co-movement of stock markets in each pair, even though the trend is not same for each group of countries. We also plot the DCC annual conditional correlation for different country-pairs in figures (2) below. Figures 2(a) represents developed-developed, figure 2(b) represents emerging-emerging and figure 2(c) represents developed-emerging pairs. We observe significant shifts in correlations during Asian and Russian crisis (1997-1998), Global Financial Crisis (2008-2009) and Euro-zone crisis (2010-2011). This demonstrates a time varying correlation co-movement and differs among the three country pairs (developed-developed, emerging-emerging, and developed-emerging). The range of country pairs correlation is much higher with the developed market pairs compare to emerging market pairs and the mixed pair group is in between position. Nevertheless, we find consistency that the pairwise correlations are higher during crises periods than the tranquil periods. The pattern of time varying correlations that in developed and emerging country pairs are consistent with the findings of Christoffersson et al. (2012) who reports that the correlations for developed markets are higher than those observed for the emerging markets using coupla correlation.

[Insert Figures 1, 2 about to be here]

Table 1 panel A, Panel B and panel C represents the descriptive statistics for the average annual pair-wise correlations using dynamic conditional correlation (DCC). The sample includes 190 country pairs of which 45 are developed-developed, 45 are from emerging-emerging, and 100 are mixed country-pairs (developed-emerging). The conditional correlation (mean) for the full sample is 0.32 (all years), but the conditional correlation is significantly higher during crises periods (0.39) than the tranquil periods (0.28). Similarly, the conditional correlation (mean) for the developed-developed pairs is 0.42, which is different from crises periods (0.47) and tranquil periods (0.39). The same is true for the emerging-emerging pairs (0.34 vs. 0.23) and developed-emerging pairs (0.37 vs. 0.25) respectively for crises and

² We select an AR (1), APARCH (1, 1) with a normal distribution for the error term.

tranquil periods. However, the median conditional correlation for full sample for three periods (e.g. the full period, crises and tranquil periods) is 0.28, 0.36 and 0.24 respectively. The trend is same for each country groups (e.g. developed-developed, emerging-emerging, and developed-emerging). The median conditional correlation is 0.39 for full sample period, smaller than crises periods (0.46) larger than tranquil periods (0.35). Similarly, the median conditional correlation for emerging-emerging pairs is 0.23, which is smaller than crises periods (0.34) and larger than tranquil periods (0.20). Moreover, the developed-emerging pairs have a higher median conditional correlation (0.26) than the emerging-emerging pairs (0.23). In brief, we observe a higher average and median conditional correlation during crisis periods compare to tranquil periods suggest that correlation co-movement significantly vary between crises and tranquil periods irrespective of the country pairs (developed-developed, emerging-emerging, developed-emerging. This is in line with the thought that developed countries are highly co-integrated than the emerging countries. Christofersson et al., (2012) reported similar findings by applying coupla correlation.

[Insert Table 1 about to be here]

We further preliminary try to test our first hypothesis (**H1**) that time varying correlations between stock markets are higher during the crisis and also investigate whether the correlation differs between country groups. We test whether the extent of conditional correlation is higher during crises periods than the tranquil periods. The primary focus is on the degree of co-movement between the crises and tranquil periods rather than contagion³. We perform both parametric and nonparametric test, e.g. two samples T-test and Mann-Whitney Wilcoxon (MWW) U test for mean and median differences between crises and tranquil periods.

The two sample t-test for unpaired data is defined as $H_0: \mu_1 = \mu_2$, $H_a : \mu_1 \neq \mu_2$ and the related test statistic is given as:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{s_1^2 / n_1 + s_2^2 / n_2}} \dots\dots\dots(6)$$

where, n_1 and n_2 are the sample sizes, \bar{X}_1 and \bar{X}_2 are the sample means of correlation coefficient between crisis and tranquil periods, and s_1^2 and s_2^2 are the sample variances.

³ Conceptually the causes of the above contagion can be distinguished between two broad classes as argued by Forbes and Rigobon (2001) in explaining how crises are transmitted across markets, i.e. the crisis-contingent hypothesis and the non-crisis-contingent hypothesis.

The test statistic for the Mann Whitney Test U is defined below:

$$U_1 = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1$$

and

$$U_2 = n_1 n_2 + \frac{n_2(n_2 + 1)}{2} - R_2$$

where n_1, n_2 are the two crisis and tranquil samples, R_1 and R_2 be the sum of the the ranks of 1st and 2nd samples respectively. Since U is approximately normally distributed; so,

$$Z = \frac{U - E(U)}{\sqrt{\text{Var}(U)}} \text{-----}(7)$$

$$E(U) = \frac{n_1 n_2}{2}$$

$$\text{Var}(U) = \frac{n_1 n_2 (n_1 + n_2 + 1)}{12}$$

Further, Table 1 panel D and E presents the mean difference (T-test) and median difference (MWW) between the crises and tranquil periods for the full sample, developed-developed, emerging-emerging, and developed-emerging pairs. Panel A represents t-test between the mean conditional correlations for the country pairs. The mean conditional correlation for the full-sample, developed-developed, emerging-emerging, developed-emerging pairs during crises (tranquil) periods are 0.39

(0.28), 0.47 (0.39), 0.34 (0.23), and 0.37 (0.25). The t-statistics are significantly (positive) for all pairs indicating significant increase in conditional correlation during crises periods compared to the tranquil periods. These results reject H_{01} . Panel B represents MWW-test between the median conditional correlations for the country pairs. The median conditional correlation for the full-sample, developed-developed, emerging-emerging, developed-emerging pairs during crises (tranquil) periods are 0.36 (0.24), 0.46 (0.35), 0.34 (0.20), and 0.35 (0.23). The MWW-statistics are significant (positive) for all pairs also indicating significant increase in conditional correlation during crises periods compared to the tranquil periods. These results also reject H_{01} .

We test H_{02} that the determinants of time varying correlations are stable during crises and tranquil periods and across country pairs using the regression model described below (Eq. 8). We first investigate whether the determinants of stock market co-movements are economic, financial or cultural using panel data specification allowing for time fixed effects in order to control for common international shocks (Wälti, 2011). We estimate the base line regression as:

$$Concorr_{ij,t} = a_0 + \sum_{a=1}^A b_a Economic_t^a + \sum_{c=1}^C g_c Financial_t^c + \sum_{c=1}^C d_c Cultural_t^c + e_t \dots \dots \dots (8)$$

Where, $Concorr_{ij,t}$ is annual average conditional correlation between country i and j at time t, start with alpha zero and explain every coefficient For example it should read Beta is the coefficient estimate for Economic variables at time t. $Financial_t$ are the financial variables, $Cultural_t$ are the cultural variables. ε_t is the error term, and α , β , γ , and δ are the vectors of coefficient estimates. We have considered three economic variables such as GDP growth differences, Inflation differences and bilateral trade. Here, GDP growth rate differences denote the absolute difference between the annual growth rate of real GDP between country i and j. We define inflation differential as the absolute Inflation differential between market i and j. The bilateral trade size is measured as average of export and import from i to j country deflated by the total market size of i countries. We also considered two financial variables such as market size and term spread. Term spread differences between country pairs are measured as the difference of long-term (10 years) government yield and 3 months Treasury bill rate. We define the market size as relative ratio of each country's (i and j) market capitalization in terms of world market capitalization. Finally, we considered two cultural variables such as cultural differences and religion. We define cultural differences between two pair countries as the absolute differences between bilateral cultur-

al difference indices. We measure religion similarity between two countries using dummy variable, which is 1 if the two countries have similar religion and 0 for vice versa.

We present the descriptive statistics of all explanatory variables (economic, financial and cultural) in Table 2. We find that the average absolute market size difference ratio differs between crises (1.27) and tranquil periods (1.57) whereas the mean is 1.47. The T-statistics for differences of mean find that the average market size differential is higher in the mix pair group compare to developed and emerging pairs. However, the average bilateral trade size is higher (3.28%) in the tranquil periods compare to crises periods (2.92%). Further, as expected we find that the average interest rate and inflation rate differential is much higher in emerging markets pairs compare to developed markets pairs.

In addition, in the overall sample, we find that the absolute difference of GDP growth rate differential is higher (0.95%) during crises periods than the tranquil periods (0.76%). We also observe that the average GDP growth rate differential is lower in developed countries pairs compare to emerging countries. The highest difference is found in the mix group sample pairs as expected. Similarly, we find that the average term spread differential as a proxy for market stress for illiquidity is also higher during crises periods (0.24%) than the tranquil periods (0.12%). The significant T-statistics also reports that the difference of term spread is higher in the emerging pair sample compare to mix pairs sample and develop pair's sample. Nonetheless, we observe an average religion commonality, which is higher in the developed market pairs compare to mix and emerging pairs. Similarly, we report that bilateral average cultural difference is higher in the mix pairs compare to develop and emerging pairs.

[Insert Tables 2 about to be here]

4. Results and Discussion:

4. Results and Discussion:

In this section, we present the results of the main hypothesis H_1 and H_2 of the study.

4.1. Do time-varying co-movements change during crisis and tranquil periods?

Table 3 presents whether the conditional correlation change in each market pairs separately using the reference of Chiang et al., (2007) in defining the Asian crisis and tranquil period but we add recent global crisis including EZC. Here it important to note that we did not focus on the source country of crisis, rather we focus whether there is any contagion in different crises with 20 developed and emerging market pairs. We report that on an average 50% of our sample market pairs experience contagion with its pairs during Asian crises whereas none but Japan was free from contagion effect during the recent global crisis. We report that conditional correlation increases significantly during crises. So, we reject our null hypothesis of no contagion and accept contagion during crisis. Our findings confirm the findings of Chiang et al., (2007) and refute the findings of Forbes and Rigobon (2002) in general. However, the choice of one month sample in Forbes and Rigobon (2002) study may not be sufficient to see the impact of crisis.

4.2 Determinants of stock market co-movements:

We have classified fundamental determinants of stock market co-movements as economic (difference in GDP growth rates, difference in inflation rates, the size of bilateral trade), financial (difference in term spreads, difference in the size of the stock markets size), and cultural (difference in Hofstede's culture index and difference in religion). We start with economic variables. The coefficient estimate for the GDP growth rate differential is negative indicating that the lower the GDP growth rate difference between the two countries, the higher will be the co-movement between these market pairs. The coefficient estimate for the GDP growth rate differential is significant for the full sample, developed to develop and mixed country pairs (developed-emerging), but insignificant for emerging-emerging pairs. These results are consistent with Pretorious (2002) who reports that similar economic structures synchronize business cycle and market co-movement through diversification stages.

The coefficient estimate for the inflation rate differential between the country pairs is negative in the full sample. Higher the inflation rate differential between the two countries, the lower will be the co-movement between their stock markets. Coefficient estimates for inflation differential between the country pairs is also significant and negative for the developed-to-developed country pairs while being negative but insignificant for emerging country pairs. The coefficient estimate for the inflation differential is positively significant in the developed to emerging market pairs. This sign switch is interesting. In developed emerging market pairs it is usually the emerging market that has a higher inflation rate. We observe that the time varying correlation between the developed and emerging market pairs become

higher when the inflation rate difference between them is larger. The theoretical argument that the coefficient estimate would be negative holds for developed country pairs alone but not for mixed country pairs.

The coefficient estimate for bilateral trade is positive and significant in all country pairs indicating that in country pairs where bilateral trade is higher time varying co-movements of the stock markets will also be higher. Other authors also report that the bilateral trade size should be positively related to the stock market co-movement [Forbes and Chinn, 2004, Lucey and Zhang, 2010] because when two countries have a strong bilateral trade relationship, their economies and stock markets are expected to be highly interdependent [Walti, 2011]. We provide further evidence that this relation holds for all country pairs, whether they both are developed countries, or both are emerging markets, or they are mixed country pairs with one developed and the other being an emerging market. The financial variables we use as the determinants of time-varying co-movements are the differences in term spreads and the size of the stock markets. The coefficient estimate for the term spread differential between the country pairs is insignificant for all country pairs. The term spread differential is a proxy for the yield curve differential between the country pairs. On the one hand it is a risk factor as defined in arbitrage pricing theory by Roll, Ross and Chen, (1986) that indicates higher riskiness in the environment. Investors would prefer short term bonds and demand a higher return for long term bonds when uncertainty about the future is higher and they are reluctant to invest long term. **On the other hand, term structure theories (Fama, 1990)** predict especially during a crisis to compensate for high uncertainty higher premiums will be demanded for long term bonds by long-term investors. Thus, we would expect a negative relationship between term spreads and stock market co-movements. We will return to this argument later in the next section when we discuss the determinants of time-varying stock market co-movements during crisis.

The coefficient estimate for the stock market size differential is negative and significant for all country pairs. This indicates that when the size of the stock markets of the two countries in a country pair are similar the time-varying correlations between those markets will be higher. To the extent that equities of a given country are widely held internationally, a fall in that country's stock market will trigger a negative wealth effect for asset holders in the world, thereby affecting consumer demand and in turn, and output co-movements. On the other hand, international diversification of portfolios allows smoothing consumption patterns without having to diversify production, thereby leading to the possibility of greater specialization. The former effect would increase business cycle synchronization, whereas the latter effect would tend to reduce co-movements. Empirical evidence on the role of financial fundamental of business cycle synchronization is somewhat mixed. Bordo and Helbling (2004) conclude that financial fundamental does not affect business cycle synchronization but Imbs (2004, 2006) and Kose et al. (2003) show that financial fundamental integration impacts positively on business cycle co-movements. We find that the financial market development indicator (market size

differential) is significant consistently (negative) in the full sample, developed-developed, emerging-emerging and the mix pair (developed-emerging). That means stock markets with similar size provide higher co-movement between pairs.

Finally we consider the cultural fundamentals of the stock market co-movements that include cultural differences and religious differences. The coefficient estimate for the culture variable is negative and significant for developed and mixed country pairs. The smaller the cultural difference between the country pairs the higher is the time-varying stock market correlations. We use the index developed by Hofstede (1994) who defines culture as the collective programming of mind that affect people's attitude, behavior and decisions. The variables used to construct the index are based on Kogut and Singh (1988) and Hofstede's cultural dimensions include different perspective of environment that people live and work with. Hofstede describe these dimensions in many ways like individualism (Harshliefer and Thakor, 1992), masculinity (Gleason et al, 2000), power distance (De Jong and Semenov, 2002), uncertainty avoidance (Riddle, 1992). Aggarwal et al. (2012) and Lucey and Zhang, (2010), use cultural variables in explaining the cross border portfolio flows and argue that cultural distance acts as a proxy for transaction costs, information asymmetries and lower levels of familiarity as well as the existence of agency problems that tends to shy away foreign investors.

The coefficient estimates for the religion variable is positive and significant for all country groups. We define primary religion as the one with the largest most people believing in one country. Our religion dummy takes the value of one when the two countries have a shared religion. Our results indicate that when the country pairs have a shared religion the time varying correlations are higher. Lucey and Zhang, (2010) argue that having same religion represents perceived similarity of culture and risk tolerance behavior. We also assume that the similar religion among country pairs should be a proxy for similarity in belief systems, which effect investor attitudes, behaviors, and finally decisions.

4.2. Do the determinants of stock market co-movements change during crises?

Table 4 reports the results for the determinants of conditional correlations to analyze whether they vary during tranquil and crisis periods for the full sample. Column 1 presents results for tranquil periods and column 2 presents results for crisis periods. We start with economic variables. The coefficient estimate for the GDP growth rate differential is negative both during tranquil and crisis periods indicating that the lower the GDP growth rate difference between the two countries, the higher will be the co-movement between these market pairs. The coefficient estimate for the inflation rate differential between the country pairs is significant and

negative only during tranquil periods but not during the crisis periods. This indicates that inflation differential is no longer a transmission mechanism during the crisis periods. The coefficient estimate for bilateral trade is positive and significant both during tranquil and crisis periods indicating that the higher the bilateral trade between the two countries the higher will be the time-varying stock market correlations. Next we consider the financial variables. The coefficient estimate for the term spread differential between the country pairs is negative and significant during the tranquil periods only. It is not a crisis transmission mechanism during the crisis periods. The coefficient estimate for the stock market size differential is negative and significant both during the tranquil and crisis periods indicating that when the size of the stock markets of the two countries in a country pair are similar the time-varying correlations between those markets will be higher. Finally we consider the cultural distance and religion variables. The coefficient estimate for the cultural distance variable is negative and significant during the tranquil periods indicating that if the cultural distance between the country pairs is low time-varying correlations will be high during the tranquil periods. The relation becomes insignificant during the crisis periods indicating that it is no longer a transmission mechanism during the crisis. The coefficient estimate for the religion variable is positive and significant both during the tranquil and crisis periods indicating that country pairs with similar religion will have higher correlation coefficients. Overall our results indicate that GDP growth rate differential, bilateral trade, the stock market size differential and religion are all crisis non-contingent. They determine how shocks are transmitted from one market to the other both during tranquil periods and crisis and indicate that greater integration through these mechanisms increase correlations. Inflation differential, term spread differential and cultural distance transmit information from one country to the other during tranquil periods but not during crisis periods. Therefore none of those variables can be classified as crisis contingent mechanisms of shock transmission. Next we shall investigate if there are crisis contingent transmission mechanisms for different country pairs.

[Insert Table 4 about to be here]

Table 5 reports the results for the determinants of time varying correlations for developed country pairs during tranquil and crisis periods. Column 1 presents results for tranquil periods and column 2 presents results for crisis periods. First we consider economic variables. The coefficient estimate for the GDP growth rate differential is not significant during the tranquil periods but becomes negative and significant during the crisis period. GDP growth rate differential does not act as a shock transmission mechanism among developed market pairs during tranquil periods. The negative and significant coefficient estimate during the crisis period indicates that it is a crisis contingent variable. The lower the GDP growth rate difference between the two developed countries, the higher will be the co-movement between these market pairs during the crisis. The coefficient estimate for the inflation rate differential between the developed country pairs is significant and nega-

tive both during tranquil and crisis periods. This indicates that the lower the inflation differential between developed country pairs, the higher the time varying stock market correlations. The coefficient estimate for bilateral trade is positive and significant both during tranquil and crisis periods indicating that the higher the bilateral trade between the two countries the higher will be the time-varying stock market correlations. We continue with financial variables. The coefficient estimate for the term spread differential between the country pairs is not significant for developed country pairs during either the tranquil or crisis periods. The coefficient estimate for the stock market size differential on the other hand, is negative and significant both during the tranquil and crisis periods indicating that when the size of the stock markets of the two countries in a country pair is similar the time-varying correlations between those markets will be higher. When we consider the cultural distance and religion variables we observe that the coefficient estimate for the cultural distance variable is negative and significant during the tranquil periods demonstrating that lower the cultural distance between the developed countries pairs higher will be the time-varying correlations during the tranquil periods. The relation becomes insignificant during the crisis periods indicating that it is no longer a transmission mechanism during the crisis. The coefficient estimate for the religion variable is positive and significant both during the tranquil and crisis periods showing that country pairs with similar religion will have higher correlation coefficients. Overall our results indicate that inflation differential, bilateral trade, the stock market size differential and religion are all crisis non-contingent. They determine how shocks are transmitted from one market to the other both during tranquil periods and crisis periods and indicate that greater integration through these mechanisms increases stock market correlations. Term spread differential is not a variable that transmits shocks among country pairs either during tranquil or crisis periods. Cultural distance transmits information from one developed country to another during tranquil periods but not during crisis periods. Therefore none of those variables can be classified as crisis contingent mechanisms of shock transmission. For developed country pairs the only variable that can be classified as crisis-contingent is the GDP growth rate difference among two developing countries. GDP growth rate differential does not act as a shock transmission mechanism among developed market pairs during tranquil periods but it does transmit shocks during crisis periods. This explains for example the transmission of the subprime crisis to the UK and Europe through the economic growth route. During the crisis the countries that received the shock first were the ones with similarly large economies with low growth rates. Further results about this period are given in the next section.

[Insert Table 5 about to be here]

Table 6 reports the results for the determinants of time varying correlations for emerging country pairs during tranquil and crisis periods. We first report results for economic variables. The coefficient estimate for the GDP growth rate differential is not significant during the either the tranquil period or the crisis period. GDP

growth rate differential does not act as a shock transmission mechanism among emerging market pairs. The coefficient estimate for the inflation rate differential between the emerging market pairs is significant and negative during tranquil periods but becomes insignificant during crisis periods. This indicates that the inflation differential transmits information during the tranquil periods only. The coefficient estimate for bilateral trade is significant and positive both during tranquil and crisis periods. The higher the bilateral trade between the two emerging markets the higher will be the time-varying stock market correlations. Next we report results for financial variables. The coefficient estimate for the term spread differential between the country pairs is not significant for emerging market pairs during tranquil periods but it becomes positive and significant during the crisis periods. Term-spread differential is a crisis-contingent determinant of time varying stock market correlations. The other crisis-contingent determinant of stock market correlations in emerging markets is the size of the stock markets. The coefficient estimate for the stock market size differential is insignificant during tranquil periods but becomes negative and significant during the crisis period. When the size of the stock markets of the two emerging market countries are similar the time-varying correlations between those markets increase during the crisis periods. Finally we report results for the cultural distance and religion variables. We observe as in developed country pairs that the coefficient estimate for the cultural distance variable is not significant during the tranquil or crisis periods indicating that cultural similarity not a shock transmission mechanism for emerging markets. The coefficient estimate for the religion variable is positive and significant both during the tranquil and crisis periods showing that country pairs with similar religion will have higher correlation coefficients. Overall our results indicate that bilateral trade and religion are both non-crisis-contingent variables. They determine how shocks are transmitted from one market to the other both during tranquil periods and crisis periods and indicate that greater integration through these mechanisms increases stock market correlations. Cultural distance and GDP growth rate differential are not significant either during tranquil or crisis periods indicating that they do not transmit information among emerging market pairs. Inflation differential transmits shocks during tranquil periods but not during crisis. For emerging country pairs there are two crisis-contingent transmission mechanisms: the term spread differential and the stock market size differential. They do not act as a shock transmission mechanism among emerging market pairs during tranquil periods but they do transmit shocks during crisis periods. This explains for example the transmission of the Asian and Russian crisis among the emerging markets. During these crises the emerging market countries might have received the shocks from their emerging market counterparts that had similar riskiness as revealed by term spreads and market capitalizations of stock markets. Further results about this period are given in the next section.

[Insert Table 6 about to be here]

Table 7 reports the results for the determinants of conditional correlations for mixed country pairs of one developed and one emerging market during tranquil and crisis periods. We start with economic variables. The coefficient estimate for the GDP growth rate differential is negative during tranquil periods only and it becomes insignificant during crisis periods. The coefficient estimate for the inflation rate differential between the developed and emerging market country pairs is significant and positive during both tranquil and crisis periods. This indicates that when the discrepancy between the inflation rates of a developed country (usually with lower inflation) and an emerging market country (usually with higher inflation) increases the correlation between their stock markets also increases. The coefficient estimate for bilateral trade is positive and significant both during tranquil and crisis periods indicating that the higher the bilateral trade between a developed and an emerging market country pair the higher will be the time-varying stock market correlations. Next we consider the financial variables. The coefficient estimate for the term spread differential between the developed and emerging market country pairs is insignificant during both tranquil and crisis. The coefficient estimate for the stock market size differential is negative and significant both during the tranquil and crisis periods indicating that when the size of the stock markets of a developed country and an emerging market pair are similar the time-varying correlations between those markets will be higher. Finally we consider the cultural distance and religion variables. The coefficient estimate for the cultural distance variable is negative and significant during the tranquil periods indicating that if the cultural distance between developed and emerging market country pairs is low time-varying correlations will be high during the tranquil periods. The relation becomes insignificant during the crisis periods indicating that it is no longer a transmission mechanism during the crisis. The coefficient estimate for the religion variable is positive and significant both during the tranquil and crisis periods indicating that country pairs with similar religion will have higher correlation coefficients. Overall our results indicate that inflation differential, bilateral trade, the stock market size differential and religion are all crisis non-contingent variables. They determine how shocks are transmitted from one developed (emerging) market to the other emerging (developed) market both during tranquil periods and crisis and indicate that greater integration through these mechanisms increase correlations. GDP differential and cultural distance transmits information from a developed (emerging market) country to an emerging market (developed) country during tranquil periods but not during crisis periods. Therefore none of those variables can be classified as crisis contingent mechanisms of shock transmission. Term spread differentials do not transmit information among mixed country pairs. Further results about the origin of the crisis will be discussed in the next section.

[Insert Table 7 about to be here]

4.3. Robustness Tests

We conducted two types of robustness checking of our analysis. Firstly, we see whether different crisis matter in terms of the determinants of time varying stock market correlations. Secondly, we test whether our results are robust considering the adjustment of endogeneity problem.

4.3.1 Does the source of the crisis matter in terms of the determinants of time varying stock market correlations?

Table 8 panel A reports the results for the determinants of conditional correlations during the Asian and Russian Crisis during 1997 and 1998. Both crisis are triggered by a crisis in an emerging market, and spread around the world. The results reported for all country pairs during the Asian and Russian crisis periods are similar to those reported in table 4. We will now look into the transmission mechanisms among different country pairs. We start our analysis of the determinants of time varying correlations during the Asian and Russian crisis with the economic variables. The coefficient estimate for the GDP growth rate differential is negative and significant for developed country pairs alone. Inflation differential does not have a significant coefficient estimate in any one of our estimations with different country pairs. It is not a transmission mechanism for Asian and Russian crisis. The coefficient estimate for bilateral trade is positive and significant for developed country pairs and mixed country pairs (developed and emerging market) but not for emerging market pairs. Next we consider the financial variables. The coefficient estimate for the term spread differential between the country pairs is insignificant in all estimations indicating that this variable does not constitute a shock transmission mechanism during Asian and Russian crisis. Similarly the coefficient estimate for the stock market size differential is insignificant indicating that it does not constitute a shock transmission mechanism. Finally we consider the cultural distance and religion variables. The coefficient estimate for the cultural distance variable is not significant in estimations for different country groups but the coefficient estimate for the religion variable is positive and significant for both emerging market pairs and mixed pairs with one developed and one emerging market country indicating that for these country pairs those with similar religion will have higher correlation coefficients. Overall our results indicate that the transmission mechanisms were different for different country pairs during the Asian and Russian crisis. For developed country pairs GDP growth rate differential is observed as a crisis contingent variable and shocks were propagated through it during the Asian and Russian crisis among developed market pairs. For emerging market pairs neither market size differential nor term spread differential are observed as crisis-contingent variables during this crisis episode.

[Insert Table 8 about to be here]

Table 8 panel B reports the results for the determinants of conditional correlations during the Subprime and Eurozone crisis during 2008-2011. Both crisis started in developed markets US and Europe. We will investigate the transmission mechanisms among different country pairs during the most recent crisis that started in the US and the Eurozone. We start with the economic variables. The coefficient estimate for the GDP growth rate differential is not significant for developed country pairs but it is significant for emerging market pairs and mixed pairs with one developed and one emerging market country. Inflation differential has a negative and significant coefficient for developed country pairs indicating that as the inflation rates are closer to each other correlations are higher among developed country stock market. However the coefficient estimate for inflation differential is positive for mixed country pairs showing that as the difference between the inflation rates of a developed country (usually with lower inflation) and an emerging market (usually with higher inflation rate) increases the time varying correlations between their stock exchanges increase. The coefficient estimate for bilateral trade size is positive and significant for all country pairs. We continue with financial variables. The coefficient estimate for the term spread differential between the country pairs is insignificant in all estimations indicating that this variable does not constitute a shock transmission mechanism during the subprime and Eurozone crisis. On the contrary, the coefficient estimate for the stock market size differential is significant in all estimations indicating that it constitutes a shock transmission mechanism during the Subprime and Eurozone crisis among all country pairs. Finally we consider the cultural distance and religion variables. The coefficient estimate for the cultural distance variable is not significant in estimations for different country groups except for developed country pairs, but the coefficient estimate for the religion variable is positive and significant for all country pairs indicating that for all country pairs those with similar religion will have higher correlation coefficients. Overall our results indicate that the transmission mechanisms were different for different country pairs during the Subprime and Eurozone crisis. Groth rate differential which we have observed as a crisis contingent propagation mechanism for developed country pairs for the previous crisis is no longer a statistically significant variable during the Subprime and Eurozone crisis. For emerging market pairs stock market size differential is the only crisis-contingent variable during the Subprime and Eurozone crisis. If the two emerging markets have stock markets of similar size time varying correlations are higher among them during the most recent sub-prime and Eurozone crisis.

4.3.2. We use the two-step system GMM approach adopted by Arellano and Bover (1995) and Blundell and Bond (1998) for endogeneity tests in testing Eq. 8. This approach allows us to treat all the explanatory variables as endogenous and orthogonally uses their past values as their respective instruments. It also creates a

matching equation of the first differences of all variables and estimates the model via GMM using the lagged values of the right-hand side variables. First differencing eliminates unobserved heterogeneity and omitted variable bias. System GMM estimates were obtained using Roodman's (2009) 'xtabond2' module in Stata.

The diagnostics tests in Table 6 show that the model is well fitted with statistically insignificant test statistics for both second-order autocorrelation in second differences (AR(2)) and the Hansen J-statistics of over-identifying restrictions. The residuals in the first difference should be serially correlated (AR(1)) by way of construction but the residuals in the second difference should not be serially correlated (AR(2)). Accordingly, the model fit and diagnostics section in Table 6 shows the desirable statistically significant AR(1) and statistically insignificant AR(2). Likewise, the Hansen J-statistics of over-identifying restrictions tests the null instrument validity, and the statistically insignificant Hansen J-statistics indicates that the instruments are valid in the two-step system GMM estimation. Overall, consistent with expectations, the 'two-step system GMM' estimates, after controlling for unobserved heterogeneity, simultaneity and dynamic endogeneity, are consistent with pooled regression results.

[Insert Table 6 about to be here]

Overall, the results from Tables 4-6 report that the market size negatively (significant), bilateral trade positively (significant), term spread negatively (insignificant) related to the stock market co-movement. We also find that the time varying conditional correlation varies between tranquil and crisis periods and the determinants of stock market co-movements are not stable between crisis and tranquil periods as well as across different country pairs. Religion commonality and average trade size is positively significant in the entire sample and stable across three market pairs. In brief, the study evidence only religion and trade size as stable and common variables among all the variables chosen during crisis and tranquil periods and among all market pairs. However, other factors such as size, inflation difference, GDP growth rate difference, cultural difference and term spread are also significant but not stable around crisis and tranquil periods as well as among different market pairs.

5. Conclusion:

This paper investigates the determinants of time varying co-movements among international stock markets. From the DCC analysis, we find that the conditional correlation is high during crises periods.. From the regression analysis, we report that the determinants of co-movement are not only fundamental during crises, which supports crisis contingent hypothesis even though the sign, significance level and explanatory power of the determinants change between crises and tranquil periods among different country pairs. Particularly, the stability and commonality of co-movement of stock markets mostly vary over time during crises periods and across country pairs. However, bilateral trade size and shared religion are the two determinants of co-movement that are stable during both crisis and tranquil periods and among all country pairs. The other variables such as market size difference, economic variables, cultural difference is also significant, but not stable across tranquil and crises periods among different country groups. The findings help in evaluating the role and effectiveness of international financial architecture as well as policy makers of financial institutions in managing financial crises. Evidence of stable cross market linkages, and therefore of shocks mainly propagated through innovations to the fundamentals in one country, would suggest to the policymakers of the country affected by a negative shock to take measures to improve the fundamentals to ensure financial stability and portfolio investors or speculators to search for portfolio diversification and arbitrage opportunity. On the other hand, evidence of unstable cross-market linkages, and therefore of shocks propagated even though the fundamentals are sound, would suggest the appropriateness of IMF interventions and bail-outs and adequate liquidity to survive against the contagion. The implication of these hypotheses test are that the portfolio managers and investors need to know about the different mechanisms by which co-movement spread differ among the country pairs to take appropriate investment decisions. Policymakers also need to know about the mechanisms of transmission of stock market co-movement, their changes for appropriate policy decisions, otherwise if they do not take these differences into account they may do worse than better.

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Table 1: Pairwise conditional correlations during Crisis and Tranquil Periods

Panel A: Full period												
Variable	N	mean	Sd	min	max	skew-ness	kurto-sis	P1	P25	median	P75	P99
Full sample	3230	0.32	0.19	-0.07	0.97	0.95	3.58	0.04	0.18	0.28	0.41	0.87
Developed-Developed	765	0.42	0.22	0.02	0.97	0.54	2.40	0.39	0.26	0.38	0.58	0.93
Emerging-Emerging	765	0.27	0.14	-0.03	0.73	0.83	3.08	0.05	0.16	0.23	0.36	0.64
Developed-Emerging	1700	0.29	0.16	-0.07	0.88	0.77	3.26	0.03	0.17	0.26	0.37	0.74
Panel B: Crises periods												
Full Sample	1140	0.39	0.21	-0.04	0.97	0.47	2.62	0.04	0.22	0.36	0.53	0.90
Developed-Developed	270	0.47	0.25	.020	0.97	0.23	2.0	0.37	0.29	0.46	0.66	0.95
Emerging-Emerging	270	0.34	0.16	-0.03	0.72	0.23	2.24	0.05	0.23	0.34	0.45	0.71
Developed-Emerging	600	0.37	0.19	-0.04	0.88	0.29	2.29	0.03	0.21	0.35	0.52	0.75
Panel C: Tranquil periods												
Full Sample	2090	0.28	0.16	-0.07	0.93	1.23	4.83	0.04	0.16	0.24	0.36	0.83
Developed-Developed	495	0.39	0.21	0.03	0.93	0.68	2.74	0.04	0.25	0.35	0.51	0.89
Emerging-Emerging	495	0.23	0.11	-0.03	0.60	1.01	3.83	0.05	0.15	0.20	0.28	0.58

Developed- Emerging	1100	0.25	0.13	-0.07	0.80	0.77	3.78	0.17	0.16	0.23	0.33	0.63
Panel D: Mean Comparison												
Full sample			Developed-Developed pairs			Emerging-Emerging pairs			Developed-Emerging pairs			
Mean (C)	Mean (T)	T-test	Mean (C)	Mean (T)	T-test	Mean (C)	Mean (T)	T-test	Mean (C)	Mean (T)	T-test	
0.39	0.28	15.3***	0.47	0.39	5.0***	0.34	0.23	11.6***	0.37	0.25	15.0***	
Panel E: Median Comparison												
Median (C)	Median (T)	MWW test	Median (C)	Median (T)	MWW test	Median (C)	Median (T)	MWW test	Median (C)	Median (T)	MWW test	
0.36	0.24	14.9***	0.46	0.35	4.1***	0.34	0.20	9.8***	0.35	0.23	13.3***	

Notes: Full period consists of periods from 1995-2011, Crises periods 1997, 1998, 2008-2011, and Tranquil periods 1995-1996, 1999-2007 respectively. Pairwise average annual conditional correlations are calculated using bivariate DCC GARCH modeling as described in equation (5). We report the results of two-sample T test and Wilcoxon rank-sum (Mann-Whitney) [MHW] test to investigate whether conditional correlations are higher during crisis periods. T-tests are conducted to test if the means (or is it variances) of conditional correlations are different between crisis and tranquil period across the following: Full sample pairs (1) Developed market pairs (2) and Emerging market pairs (3) and Developed to emerging market pairs (4). Similarly, MHW tests are conducted to test if the median variances between crisis and tranquil period are equal period across the following: Full sample pairs (1) Developed market pairs (2), Emerging market pairs (3) and Developed to emerging market pairs (4). The null hypothesis for T test and Wilcoxon rank-sum (Mann-Whitney) is as follows: H_0 : Mean difference between crisis and tranquil sample is zero. C is crises periods and T is tranquil periods. H_0 : median variances between crisis and tranquil are equal; *** significant at 1% level; ** significant at 5% level, *significant at 10% level

Table 2 : Descriptive Statistics of the other explanatory variable for the whole period, Crisis periods (1997-1998, 2008-2009) and tranquil periods (1995-1996, 1999-2007)

PANEL A: ALL PERIOD															
Variable	N	Mean	Sd	Min	Max	Skewness	Kurtosis	P1	P25	Median	P75	P99	T-test 1&2	T-test 2&3	T-test 3&1
Market size	3192	1.4742	1.2993	-2.7061	6.4816	0.6100	3.7625	-1.4842	0.5546	1.2734	2.2455	5.2898	4.0138***	-14.1076***	10.2370***
Bilateral Trade	3128	0.0292	0.0474	0.0000	0.5028	5.0727	41.2543	0.0000	0.0053	0.0148	0.0337	0.1987	8.3739***	-3.2596***	-8.6074***
Interest rate	2875	1.2492	1.4405	-6.2802	4.6385	-0.4069	4.2388	-2.6593	0.4947	1.3082	1.9933	4.1875	-16.0985***	6.5332***	12.2810***
Inflation rate	3229	1.0217	1.3432	-5.0065	5.2862	-0.3533	4.1630	-2.5257	0.2390	1.1314	1.8901	4.4226	-15.0153***	-3.1930***	21.8780***
GDP growth	3048	0.8217	1.1592	-4.6052	3.0412	-1.2073	5.0876	-2.8134	0.2311	1.0595	1.6630	2.6369	-16.0985***	6.5332***	12.2810***
Term Spread	3132	0.1678	1.2841	-8.0661	3.8357	-1.1750	6.5974	-3.9159	-0.4308	0.3717	0.9801	2.7824	-11.4042***	5.2839***	8.1161***
Religion	3230	0.2105	0.4077	0.0000	1.0000	1.4209	3.0160	0.0000	0.0000	0.0000	0.0000	1.0000	7.5891***	-4.5408***	-4.2911***
Culture	2907	1.5823	1.0573	0.0000	4.3451	0.5746	2.5585	0.0082	0.7785	1.4210	2.2470	4.2349	0.2814	-13.8332***	15.0394***
PANEL B: CRISIS SAMPLE (1997-1998, 2008-2009)															
Market size	1102	1.2760	1.4545	-2.7061	6.4816	0.3305	3.4034	-1.9536	0.3600	1.1091	2.1766	5.0560	1.49	-5.48***	-3.97***
Bilateral Trade	1076	0.0223	0.0426	0.0000	0.4977	5.4146	47.1844	0.0000	0.0000	0.0084	0.0243	0.1917	-9.07***	3.13***	7.91***
Interest rate	1010	1.2693	1.4116	-6.2802	4.6385	-0.4730	4.8748	-2.5257	0.5265	1.3040	2.0028	4.2715	3.55***	-0.96	-3.98***
Inflation rate	1140	1.0340	1.2939	-5.0065	4.0814	-0.8172	4.4841	-2.6593	0.3075	1.2712	1.9054	4.0175	-13.41***	-1.40	17.98***
GDP growth	961	0.9512	1.1236	-4.6052	3.0412	-1.1546	4.9153	-2.6593	0.3853	1.1442	1.7405	2.8112	-6.68***	-1.91*	10.06***
Term Spread	1120	0.2468	1.0928	-5.9795	2.2093	-1.1684	5.2966	-3.0426	0.3241	0.4464	1.0046	1.9566	-6.36***	2.79***	4.92***
Religion	1140	0.2105	0.4079	0.0000	1.0000	1.4201	3.0167	0.0000	0.0000	0.0000	0.0000	1.0000	4.50***	-2.69***	-2.55**
Culture	1026	1.5823	1.0576	0.0000	4.3451	0.5746	2.5585	0.0082	0.7785	1.4210	2.2470	4.2349	0.16	-8.21***	8.97***
PANEL C: TRANQUIL SAMPLE (1995-1996, 1999-2007)															
Market size	2090	1.5787	1.1968	0.0000	6.4006	1.0064	3.7564	0.0291	0.6401	1.3391	2.2766	5.3395	4.13***	-14.27***	10.33***
Bilateral Trade	2052	0.0328	0.0494	0.0006	0.5028	4.9710	39.2743	0.0011	0.0078	0.0170	0.0376	0.2494	7.76***	-3.30***	-7.77***
Interest rate	1865	1.2383	1.4561	-4.6052	4.4461	-0.3728	3.9315	-2.8134	0.4511	1.3137	1.9906	4.1755	-13.30***	5.79***	9.45***
Inflation rate	2089	1.0150	1.3695	-4.6052	5.2862	-0.1378	4.0173	-2.5257	0.2151	1.0818	1.8687	4.4676	-17.39***	3.48***	16.45***

GDP growth	2087	0.7621	1.1707	-4.6052	2.9952	-1.2309	5.1368	-3.2189	0.1484	1.0006	1.6174	2.5642	-13.56***	-2.61***	19.62***
Term Spread	2012	0.1239	1.3774	-8.0661	3.8357	-1.1222	6.5104	-4.2115	-	0.3366	0.9555	2.8642	-9.47***	4.48***	6.51***
Religion	2090	0.2105	0.4078	0.0000	1.0000	1.4201	3.0167	0.0000	0.0000	0.0000	0.0000	1.0000	6.10***	-3.65***	-3.45***
Culture	1881	1.5823	1.0574	0.0000	4.3451	0.5746	2.5585	0.0082	0.7785	1.4210	2.2470	4.2349	0.23	-11.12***	12.09***

Note: *** Refers significant at 1% level; ** refers significant at 5% level, *refers significant at 10% level. T-test_1&2 refers the T statistics between the variances of mean between developed country pairs (1) and emerging Country pairs (2); T-test_2&3 refers the T statistics between the variances of mean between emerging country pairs (2) and Cross Country pairs (3) T-test_3&1 refers the T statistics between the variances of mean between cross country pairs (3) and developed country pairs (1).

Figure 1: Average country wise market conditional correlation of each market to (1) all market pairs, (2) developed market pairs, (3) emerging market pairs: The countries are Australia, Canada, French, Germany, Hong Kong, Italy, Japan, Sweden, UK, USA, Argentina, Brazil, Chile, China, India, Indonesia, Korea, Malaysia, Russia and South Africa serially.

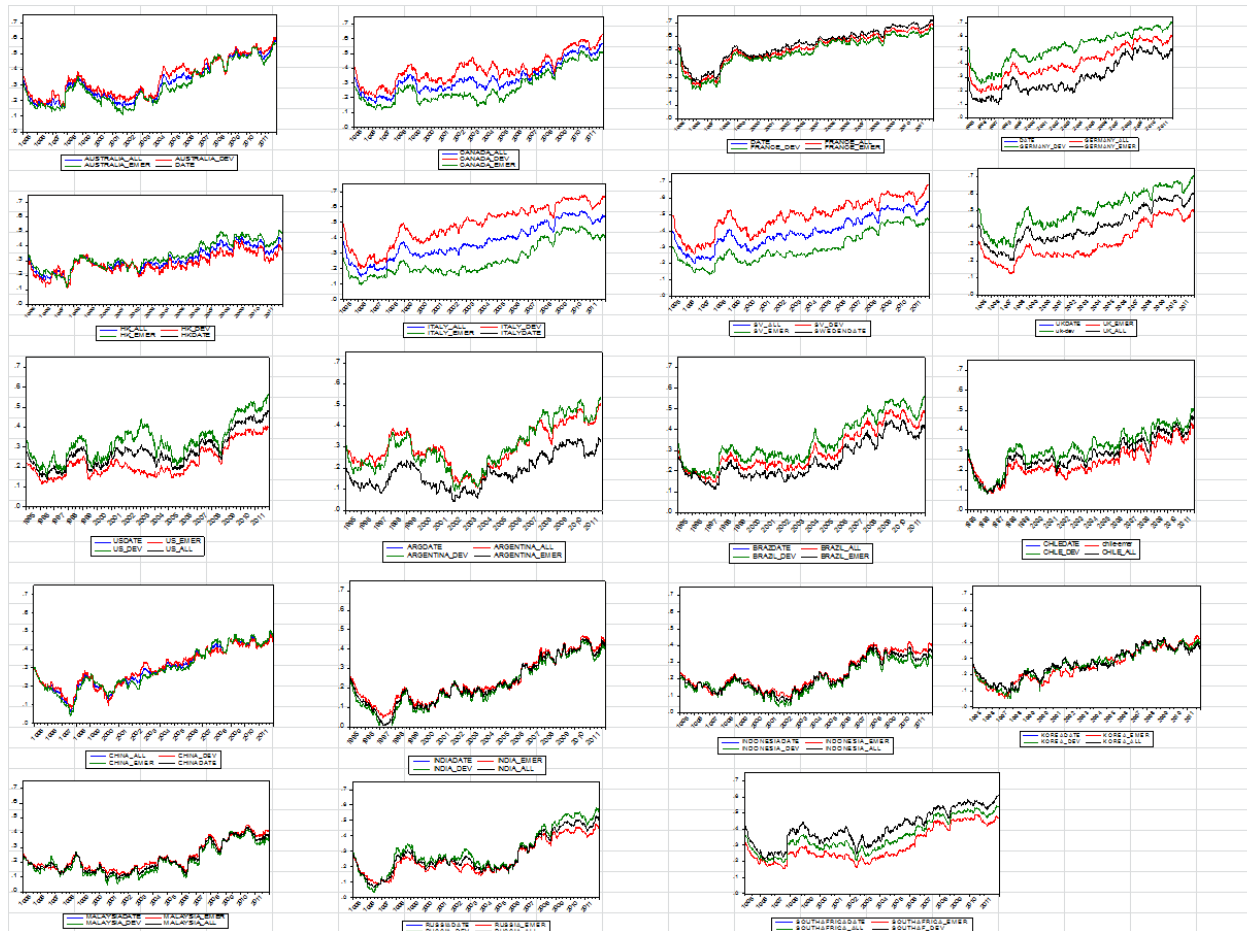


Figure 2: Average market pairs conditional correlation over time:

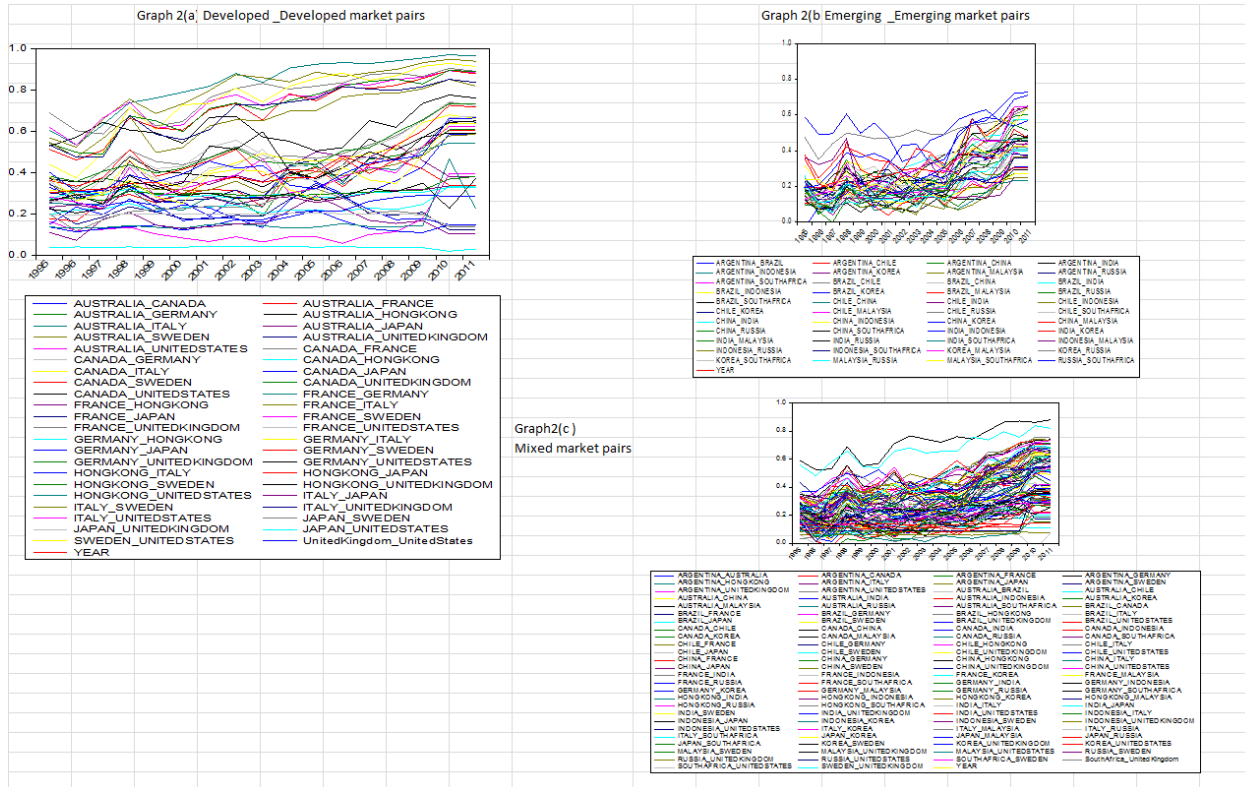


Table 3: Are Conditional Correlations Higher During the Crisis?

country	pre-asian (corr)	Asian (corr)	pre-asian-Fisher (adjusted corr)	asian-Fisher(adjusted)	T-test	Contagion	pre-global (corr)	glob-al(cor r)	pre-global-Fisher(adjusted corr)	global-Fisher(adjusted)	T-test	Contagion
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				ed corr)						corr)			
Australia	0,16	0,29	0,16	0,30	-1,60*	C		0,31	0,49	0,32	0,53	-4,89***	C
Canada	0,20	0,31	0,20	0,32	-1,36*	C		0,32	0,48	0,33	0,52	-4,48***	C
French	0,29	0,43	0,30	0,46	-1,80**	C		0,57	0,63	0,64	0,75	-2,49***	C
Germany	0,22	0,34	0,23	0,35	-1,39*	C		0,44	0,57	0,47	0,65	-4,03***	C
HongKong	0,19	0,29	0,19	0,30	-1,30*	C		0,32	0,41	0,33	0,44	-2,48***	C
Italy	0,20	0,28	0,21	0,29	-0,97	N		0,40	0,53	0,42	0,58	-3,73***	C
Japan	0,11	0,21	0,11	0,22	-1,18	N		0,28	0,22	0,29	0,22	1,67**	N
Sweden	0,23	0,35	0,24	0,37	-1,45*	C		0,41	0,52	0,44	0,58	-3,31***	C
Uk	0,23	0,33	0,23	0,34	-1,21	N		0,43	0,55	0,45	0,62	-3,97***	C
Us	0,18	0,26	0,18	0,27	-0,98	N		0,25	0,39	0,25	0,41	-3,62***	C
Argentina	0,25	0,36	0,26	0,38	-1,39	C		0,25	0,42	0,26	0,45	-4,497***	C
Brazil	0,16	0,26	0,16	0,26	-1,15	N		0,30	0,44	0,31	0,48	-3,84***	C
Chile	0,12	0,25	0,12	0,26	-1,54*	C		0,29	0,38	0,30	0,40	-2,45***	C
China	0,11	0,21	0,11	0,21	-1,11	N		0,33	0,44	0,34	0,47	-2,86***	C
India	0,02	0,13	0,02	0,13	-1,26	N		0,24	0,39	0,24	0,41	-4,02***	C
Indonesia	0,13	0,18	0,13	0,18	-0,59	N		0,23	0,35	0,23	0,36	-3,06***	C
Korea	0,12	0,14	0,12	0,14	-0,19	N		0,30	0,38	0,31	0,40	-2,12**	C
Malaysia	0,16	0,19	0,16	0,20	-0,37	N		0,21	0,37	0,21	0,38	-4,11***	C
Russia	0,12	0,27	0,12	0,27	-1,74**	C		0,24	0,46	0,24	0,49	-5,89***	C
Southafrica	0,21	0,32	0,22	0,33	-1,32*	C		0,36	0,50	0,37	0,55	-4,12***	C

Note: This Table represents how time varying co-movements in stock markets change over time with a sample of 20 markets. -2.32, -1.64, and -1.28 represents 1% (***), 5% (**), and 10% (*) respectively. Each country represents the averages of conditional correlation with 19 other country pairs. Where, Fisher Z transformations of correlation coefficients before and after the crisis. The test statistic is approximately normally distributed and is fairly robust to the non-normality of correlation coefficients. Corsetti et al. (2005) have employed this test. Here C represents contagion and N represents no contagion.

Table 4: Determinants of Stock Market Co-movements (among 3 country groups) during tranquil and crises

Variables	Full Sample		Tranquil		Crisis	
	Estimates	t	Estimates	t	Estimates	t
GDP growth	-0.0564***	-8.01	-0.0520***	-6.66	-0.0371**	-2.16
Inflation	-0.0411***	-6.52	-0.0469***	-6.65	-0.0207	-1.36
Bilateral trade	3.2050***	19.54	3.1409***	17.36	2.4049***	5.80
Term spread	-0.0081	-1.32	-0,0173***	-2,61	-0.0198	-1.21
Market Size	-0.0627***	-9.59	-0,0652***	-8,35	-0.0969***	-7.07
Culture	-0.0467***	-6.18	-0,0477***	-5,46	-0.0296*	-1.69
Religion	0.2326***	11.97	0,2022***	9,05	0.3335***	7.34
Intercept	0.6397***	17.18	0,7234***	35,78	0.9285***	22.18
R-Squared	0.3925		0,3228		0.1909	

F-Statistics	72.4***	121.99***	26.76***
N	2601	1799	802

Notes: This table presents the results whether the determinants Changes during crisis. Dependent variable is pairwise conditional correlation;*** significant at 1% level; ** significant at 5% level, *significant at 10% level. Year dummies included in the regression equation not reported here. Market size represent average market capitalization differences between two markets compare to world market capitalization; Bilateral trade presents the average size of export and import between two countries, inflation represents the absolute differences between the inflation rate between two countries; GDP represents the absolute GDP growth rate differences between the two countries; Term Spread represents absolute differences between long term government bond yield and 3 months treasury bill or interbank rate between two countries.

Table 5: Determinants of Stock Market Co-movements (within developed country groups) during tranquil and crises

Variables	Full Sample		Tranquil		Crisis	
	Estimates	t	Estimates	t	Estimates	t
Panel B: Developed market pairs						
GDP growth	-0,0443*	-2,32	-0,0288	-1,40	-0,92**	-2,08
Inflation	-0,1170***	-5,59	-0,1472***	-6,47	-0,132***	-2,72
Bilateral trade	3,1689***	10,04	2,9846***	8,63	2,638***	3,46
Term	-0,0254	-1,43	-0,0333*	-1,84	0,054	1,26

spread						
Market Size	-0,1820***	-7,97	-0,1962***	-7,37	-0,184***	-3,82
Culture	-0,1105***	-5,59	-0,0861***	-2,76	-0,11*	-1,84
Religion	0,2215***	4,56	0,1552***	2,79	0,384***	3,53
Intercept	0,9181***	9,61	1,082	20,15	1,266***	11,70
R-Squared	0,3425		0,3041		0,2117	
F-Statistics	15,17***		30,15***		7,48***	
N	694		491		203	

Notes: This table presents the results whether the determinants Changes during crisis. Dependent variable is pairwise conditional correlation;*** significant at 1% level; ** significant at 5% level, *significant at 10% level. Year dummies included in the regression equation not reported here. Market size represent average market capitalization differences between two markets compare to world market capitalization; Bilateral trade presents the average size of export and import between two countries, inflation represents the absolute differences between the inflation rate between two countries; GDP represents the absolute GDP growth rate differences between the two countries; Term Spread represents absolute differences between long term government bond yield and 3 months treasury bill or interbank rate between two countries.

Table 6: Determinants of Stock Market Co-movements (within Emerging country pairs) during tranquil and crises

Variables	Full Sample		Tranquil		Crisis	
	Estimates	t	Estimates	t	Estimates	t
Panel B: Emerging market pairs						
GDP growth	0,0065	0,71	-0,00095	-0,90	0,0449*	1,78
Inflation	-0,0135*	-1,65	-0,0242***	-2,69	-0,0005	-0,02
Bilateral trade	4,2412***	10,31	4,5649***	9,16	2,2705***	2,14
Term spread	0,00012	0,14	-0,0092	-1,04	-0,0697***	-2,78
Market Size	-0,0528	-4,98	0,0168	1,18	-0,0822***	-3,47
Culture	-0,0153	-1,40	0,0037	0,28	-0,029	-0,94
Religion	0,2196***	7,30	0,1862***	5,00	0,412***	5,25
Intercept	0,3821***	7,34	0,3533***	11,67	0,706***	10,52
R-Squared	0,6311		0,4190		0,2848	

F-Statistics	35,70***	34,30***	8,82***
N	504	341	163

Notes: This table presents the results whether the determinants changes during crisis. Dependent variable is pairwise conditional correlation;*** significant at 1% level; ** significant at 5% level, *significant at 10% level. Year dummies included in the regression equation not reported here. Market size represent average market capitalization differences between two markets compare to world market capitalization; Bilateral trade presents the average size of export and import between two countries, inflation represents the absolute differences between the inflation rate between two countries; GDP represents the absolute GDP growth rate differences between the two countries; Term Spread represents absolute differences between long term government bond yield and 3 months treasury bill or interbank rate between two countries.

Table 7: Determinants of Stock Market Co-movements (within Mixed country pairs) during tranquil and crises

Variables	Full Sample		Tranquil		Crisis	
	Estimates	t	Estimates	t	t	Estimates
Panel C: Mixed market pairs						
GDP growth	-0,0478***	-6,11	-0,0442***	-5,40	-0,019	-0,93
Inflation	0,0282***	4,59	0,0244***	3,79	0,058***	3,29

Bilateral trade	2,9605***	14,55	3,0396***	14,36	1,506***	2,47
Term spread	0,0089	1,51	-0,0042	-0,72	-0,0005	-0,28
Market Size	-0,0500	-4,98	-0,0575***	-8,79	-0,087***	-6,15
Culture	-0,0190***	-2,86	-0,0196***	-2,68	0,002	0,12
Religion	0.2066***	10,84	0,1854***	8,98	0,27***	5,13
Intercept	0,4294***	11,19	0,5452***	24,69	0,727***	12,9
R-Squared	0,4501		0,2996		0,1561	
F-Statistics	49,07***		58,60****		11.31***	
N	1403		967		436	

Notes: This table presents the results whether the whether the determinants Changes during crisis. Dependent variable is pairwise conditional correlation;*** significant at 1% level; ** significant at 5% level, *significant at 10% level. Year dummies included in the regression equation not reported here. Market size represent average market capitalization differences between two markets compare to world market capitalization; Bilateral trade presents the average size of export and import between two countries, inflation represents the absolute differences between the inflation rate between two countries; GDP represents the absolute GDP growth rate differences between the two countries; Term Spread represents absolute differences between long term government bond yield and 3 months treasury bill or interbank rate between two countries.

Robustness

Table 8:

Panel A: Determinants of Stock Market Co-movements during Asian Crisis:

Variables	Full sample		Developed market pairs		Emerging market pairs		Developed to Emerging market pairs	
	Estimates	t	Estimates	t	Estimates	t	Estimates	t
GDP growth	-0,3957***	-2,50	-0,0819	-2,13	0,0386	1,62	0,0178	-1,04
Inflation	-0.0088	-0,66	0,0336	0,76	0,0099	0,46	-0,0068	-0,52
Bilateral trade	2,4556***	6,81	2,4299***	3,94	0,7831	0,53	1,8274***	3,50
Term Spread	-0,4091***	-2,52	0.0100	0,29	0,0181	0,59	-0,01792	-0,86
Market Size	-0,0628***	-4,17	-0,1686***	-3,68	0,03214	0,61	-0,2750	-1,72
Culture	-0,1765	-0,95	-0,0520	-0,93	-0,0234	-0,80	-0,0089	-0,48
Religion	0,2067***	4,56	0,1500	1,52	0,5584***	6,86	0,1543***	3,07
Intercept	0,6172***	15,42	0,9798***	9,83	0,2458***	2,86	0,4813	9,72
R-squared	0,2960		0,2309		0,5388		0,1171	
F-stat	18.86***		4.82***		9,51***		4.39***	
N	322		90		52		180	
Panel B: Determinants of Stock Market Co-movements during Global crisis periods:								
	Estimates	t	Estimates	t	Estimates	t	Estimates	t
GDP growth	-0,0578***	-2,33	-0,0738	-1,06	0,0720***	2,61	-0,947***	-2,93
Inflation	-0,0500***	-2,17	-0,2122***	-2,97	0,0213	0,72	0,1269***	3,94
Bilateral trade	3,0966***	4,85	3,8867***	3,04	2,8539***	2,75	3,2357***	3,48
Term Spread	-0,0134	-0,60	-0,0713	-0,93	-0,0287	-1,10	0,0049	0,21
Market Size	-0,0745***	-4,09	-,1711***	-2,51	-0,1196***	-5,27	-0,0617***	-3,38
Culture	-0,0581***	-2,51	-,2055***	-2,32	-0,2362	-0,67	-0,0031	-0,13
Religion	0,3803***	6,18	0,4818***	2,99	0,2837***	3,47	0,3518***	5,02
Intercept	1.1369***	19,00	1,5071***	9,49	0,8058***	10,92	0,8005***	8,73
R-squared	0,2077		0,2457		0,3282		0,1788	
F-stat	18,94***		6,21***		8,68***		8,93***	

N	480	113	111	256
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Notes: This table presents the results whether the determinants change during Asian crisis and global crises period. Dependent variable is pairwise conditional correlation; *** significant at 1% level; ** significant at 5% level, *significant at 10% level. Year dummies included in the regression equation not reported here. Market size represent average market capitalization differences between two markets compare to world market capitalization; Bilateral trade presents the average size of export and import between two countries, inflation represents the absolute differences of inflation rate between two countries; GDP represents the absolute GDP growth rate differences between the two countries; Term Spread represents absolute differences between long term government bond yield and 3 months treasury bill or interbank rate between two countries.

Table 9: Determinants of Stock Market Co-movements-GMM Estimates (full sample)

Variablers	Full-sample	
	Estimates	T-value
Conditional Correlation _{t-1}	0.8823***	33.23
Religion	0.0468**	2.99
Culture	-0.0122**	-2.30
Market Size	-0.0190**	-2.43
Inflation	-0.0009**	-2.09
Gdp growth	-0.0040	-1.48
Intercept	0.1871***	6.74

F-stat	410.31***
N	2529
Time Fixed Effect	Yes
Firm Fixed Effect	Yes
AR(1)-p-value	0.000
AR(2)- p-value	0.115
Hansen J-stat (p-value)	0.986

Notes: Bilateral trade term spread is considered as the instruments in the GMM system.