DYNAMIC RELATIONSHIPS BETWEEN ECONOMIC GLOBALISATION AND CROSS-PUBLIC PROPERTY MARKET CORRELATIONS

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ABSTRACT

In this paper, the dynamics and current status of economic globalization and cross-public property market correlations, as well as their linkages, among the three Greater China (GC) economies (mainland China, Hong Kong and Taiwan) and across the GC region with their regional and international partners (Japan, Singapore, Australia, the US and the UK) are assessed. Results indicate that there is adequate evidence of economic globalization represented by three international parity variables (real interest differential, uncovered interest differential and relative purchasing power differential) that are likely to hold as a long-run equilibrium condition. The increased cross-public property market correlations and cross-stock market correlations imply that international capital markets have become increasingly linked over the study period.

Over the last two decades, there were moderate degrees of co-movements between economic globalization and cross-public property market correlations across the three parity measures. Specifically, the dynamic correlation analysis finds wide differences for different frequencies of cyclical development over the economic cycle. Economic globalization and cross-public property market correlations are moderately linked in the long-run; but in a different manner according to the frequencies and economy-pairs considered, particularly for the short-run frequencies. Moreover, the underlying dynamic relationships between economic globalization and cross-market correlations are different for securitized property and stock markets.

Key words: economic globalization, cross-public property market correlation, international parity, conditional correlations, dynamic correlation in frequency domain

INTRODUCTION

This paper is devoted to an empirical investigation of the dynamic relationships between economic globalization and cross public property market correlation (herein the term "public property markets" is used interchangeably with "real estate securities markets" or "securitized property markets") within and across the Greater China (GC) region using three international parity conditions: the hypothesis of real interest parity (RIP), uncovered interest parity (UIP) and relative purchasing power parity (RPPP) from 1996 to 2012. Correlation is a popular measure of cross-market relationship. Taking this approach implies that economic globalization is considered in terms of real and financial integration, as defined in the international economic literature. The three international parity conditions (RIP, UIP and RPPP) provide a unified framework explaining the relationship among exchange rates, inflation and interest rates in a simple and imperfect world. According to Cheung et al (2006), the RIP condition depends on whether capital flows equalize real interest rates across economies, UIP involves financial arbitrage between money and foreign exchange markets and RPPP entails arbitrage in goods and

services. Mathematically, the RIP condition is derived by requiring that UIP, RPPP and the *ex-ante* Fisher equation in both the domestic and foreign currency to hold. In this way, the RIP condition encompasses elements of both real and financial integration and is a stringent parity condition that implies both UIP and RPPP hold.

Over the last two decades, the world stock markets are becoming more integrated in that major stock markets share increased co-movements. Further, increasing globalization of financial and economic activities has affected many national property markets. Economic literature has pointed out in addition to positively impacting trade activities and investment flow, globalization can influence real and financial markets through the pricing of and investment in local real estate markets as well as in international capital markets (Bardhan et al 2008). Although it might be a foregone conclusion that economic globalization is important and on an upward trend for many economies and, as a result of this globalization and internationalization of real estate investments, securitized property markets would have become increasingly integrated. However, what is formally less understood is the nature, extent and variation of the relationship between economic globalization and cross-public property market correlation over time, due possibly to the lack of a formal body of knowledge linking the two relationships. Moreover, any observed increased pace of cross-public property market correlation could be due to local events and factors (social, political and economic, for example) that caused country-specific stock price reactions, as in emerging/developing markets. Such co-movements might also be persistent and non-predictable. Consequently, the interactions between economic globalization and market correlation is difficult, if not impossible, to understand and forecast in this context.

Our research is motivated by empirical evidence from the finance literature stating that cross-market correlation is increasing all over the world. Further, the main contribution of this paper to the extant literature stems from the importance of understanding the dynamic evolution of the relationship between economic globalization and cross-public property market correlation at different time horizons of the economic cycle, primarily because information linkage can be interpreted differently across the spectra. This effort complements the traditional correlation analysis that a single measure (or time-varying) of correlation summarizes the relation between the variables which is expected to hold at all points in the frequency distribution. From the practical standpoint, in trying to link global economy to cross-stock market correlation and also to cross-public property market correlation, our dynamic correlation analysis finds wide differences for different frequencies of cyclical development over the economic cycle. Moreover, the dynamic interdependence between economic globalization and cross-market correlation is different for securitized property and stock markets. This analysis reinforces our contribution since the securitized property sector has now been recognized as an "essential" asset class in mixed-asset portfolios. As such it should behave differently from stocks (Liow and Newell, 2012) at different time horizons of the economic cycle, as our results have indicated.

Our study is differentiated from the literature such as Bracker et al (1999) and Tavares (2009) who link economic globalization to stock market correlations in three main aspects. First, Bracker et al (1999) specify a set of macroeconomic variables that could possibly influence the degree of co-movement for each pair of stock markets (US and other eight developed stock markets) using a pooled time-series regression model. Their significant factors include bilateral trade dependence, real interest rate differentials, market size differential and a time dummy. In

our study, economic globalization is instead represented by RIP, UIP and RPPPP, which are three pillars of international economics. We explore to what extent these three globalization variables co-move with, as well as the nature and magnitude of interactions with, cross-public property market correlation over the full study period and at different time horizons of economic cycle using MGARCH and frequency domains dynamic correlation approaches. Our frequency domain study approach is particularly relevant because the interdependencies of the economic development in China and in developed economies (see Data, below) are largely different. Consequently, the co-movement between economic globalization and cross-public property market correlation could be different at different stages of economic development within and across the GC region. This current focus, wider scope and innovative methodology of our study are thus different from Bracker et al (1999) and others, although the theme of studies is similar.

Second, because real estate stocks are a hybrid of stock and real estate and given that the investment characteristics of stock and real estate are different in many aspects, one would expect real estate stocks to behave differently from stocks at different time horizons of the economic cycle (Giliberto, 1990, Lizieri and Satchell, 1997, Liow and Newell, 2012). For example, public properties are more dependent on the performance of the underlying real estate assets in the long run; whereas they behave more like stocks in the short-term. Accordingly, we would expect the co-movements between economic globalization and cross-public property correlation to be different from those studies that have examined stock market co-movements such as Bracker et al (1999). Real estate securities allow investors to own commercial properties without the requirement for large amounts of capital. Given the immobile nature of physical properties, the emergence of real estate securities makes it flexible and easy for investors to invest in global property markets. This knowledge of relationship between international real estate securities markets and parity conditions is critical for investors to understand investment opportunities in a global context. Both RIP and UIP are highly related with risk of real estate securities investment, as real estate securities are sensitive to economic factors such as interest rates and global market recessions. Investing in foreign real estate securities markets involves additional risk of currency fluctuations, which is considered as RPPP in this paper. If any form of arbitrage is found to exhibit high co-movement with the property stock market correlations, it indicates that the degree of international market integration can be boosted by economic globalization. The finding of this paper will shed fresh light on the global diversification opportunities and investment risk in the real estate securities sector for global investors.

Third, although it might appear that this paper has similar contributions to those of Liow and Newell (2012) because both studies cover the public property market correlation among the GC economies and between the GC region and the US, the current study has wider international scope (GC/US/US/Australia/Japan/Singapore), richer theme and focus (economic globalization, cross-public property market correlation and their interactions) and employs two different state-of-art econometric methodologies (MGARCH and frequency domain). Together they expand the body of evidence linking economic globalization, stock markets and public property markets in an international environment. To our knowledge, no previous study has embarked on such work. Thus, the contributions of this paper should be seen in this light.

SCOPE AND RESEARCH QUESTIONS

Our analysis focuses on the Greater China (GC) region since globalization and emergence of China in the world economy were two major events in the international economic literature over the last two decades. Since then China has become one of the fastest growing economies in the world with an informal economic region that embraces Mainland China, Hong Kong and Taiwan which is rapidly emerging as a new epicentre (GC) for industry, commerce and finance. The accession of China to the World Trade Organization in November 2001 further marks a distinctive break in China's economic relations with the rest of the world. With continuing strong economic growth, massive urbanization and the growth of private real estate ownership in China, the scope for Hong Kong REITs to provide more pure-play property investment opportunities in China, as well as Taiwan's growing economic ties with China, the GC region is expected to grow into an important player in the global capital markets, with their direct real estate and public property markets attracting the interest of domestic and international investors (Johansson and Ljungwall, 2009).

These GC economies, as well as with its major Asia-Pacific and international partners (Singapore, Japan, Australia, the UK and the US) thus provide an interesting setting to assess the interdependencies between economic globalization and cross-public property market correlation, and whether this relationship is time-varying. In the broader context, our research motivation is reflected over three related developments in this region:

(a) Asia-Pacific is the most dynamic region and its regional integration, as well as its global integration (i.e. vis-à-vis rest of world) deserve critical attention from international investors and policy makers;
(b) the emerging discussion on convertibility of Renminbi (Chinese Yuan) and an Asian zone implies a need for more research on contagion, market linkages, capital mobility and business cycle synchronization between and among countries of the region; and
(c) the increasing "tradability" of the ultimate non-tradable asset, real estate, through its complex linkages with the financial world via the development of a global real estate capital market through the rapid development of REITS in many Asian countries.

The core objective of this article is to systematically examine the evolution and nature of dynamic relationships between economic globalization and cross-public property market correlation within and across the GC region from 1996 to 2012. Given the unique political and economic settings in the GC region (Cheng and Glascock 2005), we explore this globalization issue through answering three related questions:

(a) to what extent are the three GC economies, as well as between the GC economies and their regional and international partners, already integrated as defined by the RIP, UIP and RPPP conditions?;
(b) to what extent are the public property markets of the three GC economies correlated, as well as between the GC economies and their regional /international partners?; and

(c) whether there is a significant relationship between cross-public property market correlation and economic globalization and what is the nature and extent of this relationship at different time horizons of economic cycle?

Although it is not the intention of this paper to focus on the parity topic which is in the realm of international economics and addressed by various authors including IMF, a brief assessment of the current economic globalization within and across the GC areas is fundamental to subsequent parts of the analysis.

Empirical studies on the three parity relations framework include Goodwin and Grennes (1994), Chinn and Frankel (1995), Moosa and Bhatti (1996), Wu and Chen (1998), Fountas and Wu (1999), Holmes and Maghrebi (2004), Cheung, Chinn and Fujii (2003, 2006), Holmes and Wang (2008) and Cuestas and Harrison (2010).

Finally, as stock market indexes includes real estate stock, our analysis is also extended to the corresponding stock markets for detecting the corresponding differences between public property markets and stock markets in this globalized economy, thereby linking the global economy to stock markets as well as to public property markets.

The first research question has well been addressed by prior studies in international economic literature. For example, Cheung et al (2003) show that economic globalization is on an upward trend among the three GC economies given that the three GC markets have strong historic, political, geographical and economic ties. Consequently, we shall only provide a brief update of the current status of globalization within and across the GC region.

For the second research question, our literature review finds there are considerable studies investigating the correlation structure between the GC and international stock markets (Cheng and Glascock, 2005, Cappiello et al 2006, Qiao et al 2008 and Johansson and Ljungwall 2009), as well as among the GC economies and across international public property markets (Liow et al 2009, Liow 2012, Liow and Newell 2012). The latest study is by Liow and Newell (2012) who have investigated simultaneously the effects of volatility spillover and time-varying conditional correlations on the cross-market relationships among the three GC public property markets, as well as their international linkages with the US real estate securities market. Using a MGARCH model, they find that the conditional correlations between the GC public property markets have outweighed their conditional correlations with the US market and supported closer integration between the GC markets due to geographical proximity and closer economic links. Similar to (a), a brief current update of the sample public property markets within and across the GC region is deemed sufficient for the purpose of current study.

Our significant contribution is derived from the third research question where we investigate the nature and extent to which cross-public property market correlations are linked to economic globalization as defined by the three international parity conditions. Finding a strong positive co-movement between cross-public property market correlation and economic globalization after controlling for stock market effect implies that real estate capital mobility can be enhanced through facilitating financial and commodity arbitrage in this part of the world. Consequently, the differentials between these economies' rate of return on real estate investment are reduced,

thereby enhancing the development of a real estate capital market in the longer term. In contrast, failure to detect a significant positive relationship between securitized property market correlation and economic globalization might imply that the co-movements of the public property markets are not or less responsive to economic globalization; possibly because there are idiosyncratic country-specific and firm-specific risk factors at work in the respective real estate securities and stock markets. Additionally, the comparison of results between stock market and real estate securities market would reinforce our statement that real estate securities behave differently from general stocks when interacting with economic globalization. Thus, we cannot simply borrow conclusions from the general finance literature and a separate study on real estate securities is warranted.

We will appeal to two contemporary econometric approaches to address this question. First, our MGARCH methodology explicitly parameterizes the conditional correlations between the three parity differential series and two market correlation time series after explicitly accounting for their volatility spillover effect in the five-variable-GARCH model. Second, the frequency domain methodology examines the relative importance of particular frequencies for the behavior at work. In this regard, the dynamic correlation (Croux et al 2001) is decomposed by frequency and frequency band to study the cyclical interdependence between economic globalization and cross-market correlation at three time horizons: from long-run relations, business cycle links to short-run co-movements. Although frequency domain approach has been adopted in macroeconomics, especially in the business cycle and finance literature after Granger (1986), its use in the real estate literature is limited. Results from this study can thus provide a better grasp of the functioning of the GC economies and public property/stock markets, as well as allowing investors and policy makers to understand better the driving economic forces that influence the co-movements of the GC real estate securities markets in the long-run and short-term.

DATA

We cover three GC economies; namely, Mainland China (CH), Hong Kong (HK) and Taiwan (TW) and their five regional and international partners; namely, the US, the UK, Australia (AU), Japan (JP) and Singapore (SG). As highlighted by Cheng and Glascock (2005), the three GC markets play increasing important roles in the world financial markets and have unique historic and economic ties that are hard to find in other markets. Internationally, the US, the UK, JP and AU are the GC's major trading partners and foreign investors. These markets also belong to the well-developed countries and are historically close linked to each other, as well as having well-developed financial markets and open capital accounts in the respective economies. SG, due further to its geographical proximity and cultural similarity, has had close economic ties with the three GC economies. Therefore, the choice of these eight economies is ideal to understand in context the evolution and patterns of the relationships between economic globalization and cross-public property market correlation in an international environment that involves the three GC economies.

We next gather monthly observations on one-month interbank interest rates, exchange rates and inflation rates (represented by consumer price indices) of the eight economies. The interbank interest rate is regarded as the most flexibly determined interest rate available. The sample period is from February 1996 to December 2012, the longest time series data that is available for each economy since China's one-month interbank rate was only available only from February 1996.

(A unified national interbank market was only established in January 1996, prior to that the interbank market in mainland China was substantially controlled (Cheung et al 2003)). For the 18 economy-pairs (including three GC pairs (CH/HK, CN/TW and HK/TW), three GC and US pairs (CH/US, HK/US and TW/US); three GC and UK pairs, three GC and AU pairs, three GC and JP pairs and three GC and SG pairs), the *ex post* RI differentials, *ex post* UI differentials and *x post* RPP differentials are computed as the differential of RIP, UIP and RPPP between the two markets. The calculations of differential of RI, UI and RPPP are not included for brevity, with further details found in Cheung et al (2003). An assessment of the mean, stationary and trend characteristics will allow us to make useful preliminary inferences regarding the respective parity characteristics and provide current evidence in favour of or against the presence of economic globalization.

Return data are derived from the daily common stock and real estate stock indices, extracted from the Broad Market Index (for common stocks) and Global Property (for real estate stocks) sections of the Standard and Poor (S&P) database. (This global property database, the latest international public real estate database in the market, is designed to reflect components of the broad universe of investable international real estate stocks reflecting their risk and return characteristics.) Daily stock returns are computed as the natural logarithm of the total return indices relative in successive days, over February 1996 to December 2012. Finally, monthly cross-market correlations are estimated based on the respective daily return-pairs over the corresponding months.

METHODOLOGY

As mentioned above, we employ two econometric methodologies to address the third research question. They are briefly described below:

MGARCH-VAR-VECH Model

Using this econometric approach, we hope to estimate the implied time-varying correlations between cross-public property market correlation and economic globalization of the market-pairs examined. Based on the construction of the three parity variables, we would expect a negative conditional correlation between the two sets of indicators because higher correlations should be related to declining RI/UI/RPP differentials. Consequently, this negative outcome will imply cross-public property market correlation and economic globalization is positively linked and is consistent with the requirements of economic theory. Moreover, the conditional results also suggest the implied co-movements between economic globalization and cross-market correlations are dynamic and evolving over time.

MGARCH methodology has now been widely used to investigate volatility and correlation transmission and spillover effects because they are able to explicitly parameterize the conditional cross-moments and identify the sources and magnitudes of the spillover effects. One common specification, Diagonal VECH model, is employed to restrict the ARCH and GARCH coefficients to be diagonal. The VECH-MGARCH methodology was developed by Bollerslev, Engle and Woodbridge (1988) to capture the conditional heteroskedascity in the system of residual variance among financial assets. An alternative approach is a BEKK-MGARCH model which has been studied by Liow and Newell (2012). They are specified as rank one matrix. This specification reduces the number of parameters estimated and guarantees the conditional

covariance matrix to be positive semi-definite. In addition, the Diagonal VECH specification identifies the own-volatility and cross-volatility spillover effects.

In the present context, we develop a Diagonal VECH-MGARCH model to examine the joint processes between economic globalization and cross-market correlation in a five-variable (3 parity differential and 2 correlation variables) VAR framework. Then the implied time-varying conditional correlations between the parity differentials and cross-market correlations are estimated. Moreover, for each parity differential series, the respective time trend is derived by estimating regression:

$$Corr_{property} = f(Corr_{poperty}(-1), Corr_{stock}, trend) \qquad \text{Equation 1}$$

for the 18 economy-pair and 8 pooled groups (all, GC, GC-International, GC-US, GC-UK, GC-AU, GC-JP and GC-SG). Since international correlations of securitized property markets and broader stock markets co-move (Liow et al 2009), the inclusion of the cross-stock correlation factor ($Corr_{stock}$) in regression (1) serves to control for any cross-stock market effect on the cross-public property market correlations so that any residual relationship between the detected market correlation and economic globalization can reasonably be attributed to the public property markets *per se*.

In addition to changes in the stock market correlation, the estimated time trend controls for the effect that the correlation of property stock market changes with respect to time. If time trend is statistically significant, the estimation will add credence to the literature that although public property market is part of wider stock market, they can behave differently from stocks. Finally, the VECH-MGARCH model was introduced by Bollerslev, Engle and Woodbridge (1988) with the following specification:

$$VECH(H_t) = W + A.VECH(\mu_{t-1}\mu'_{t-1}) + B.VECH(H_{t-1}), \mu_t / \Omega_{t-1} \sim N(0, H_t) \qquad \text{Equation 2}$$

where:

μ_t is a nx1 disturbance vector;
W is a nx1 parameter vector;
A is the coefficient matrix for the ARCH term;
B is the coefficient matrix for the GARCH term; and
VECH (.) for the operator that stacks the upper triangular portion of a symmetrical matrix

Frequency domain's dynamic correlation approach

The objective here is to estimate the dynamic correlation between economic globalization and cross-public property market correlation at different frequency intervals and frequency bands. Following Croux et al (2001), if $S_x(\lambda)$ and $S_y(\lambda)$ are the spectral density estimates of two time series, X and Y , and $C_{xy}(\lambda)$ is the co-spectrum, which are defined for all frequencies $-\pi \le \lambda \le \pi$, then the dynamic correlation is:

$$\rho_{xy}(\lambda) = \frac{C_{xy}(\lambda)}{\sqrt{S_x(\lambda)S_y(\lambda)}} \qquad \text{Equation 3}$$

Pair	Mean (%)			PP Unit-root test			Time-trend (%)		
	RIP	UIP	RPPP	RIP	UIP	RPPP	RIP	UIP	RPPP
CH-HK	0.437	2.088***	1.651***	-12.09***	-10.26***	-13.88***	0.3	-0.006	0.38
CH-TW	0.43	-0.468	-0.897	-20.62***	-11.07***	-12.38***	-0.44	-0.094	-0.48
HK-TW	-0.007	-0.448	-0.441	-14.17***	-11.23***	-12.13***	0.079	0.13	0.17
CH-US	0.611*	1.831***	1.220***	-12.34***	-10.58***	-13.62***	0.099	0.023	-0.037
HK-US	0.174	-0.257*	-0.431	-14.19***	-11.80***	-14.13***	0.21	0.007	0.22
TW-US	-0.181	-0.788	-0.97	-17.43***	-11.38***	-12.51***	-0.23	0.2	-0.41
CH-UK	0.271	-2.777	-3.048	-7.50***	-14.86***	-14.36***	0.1	0.046	0.23
HK-UK	-0.166	-4.786**	-4.711**	-12.20***	-14.85***	"-14.69***	0.37	0.009	0.33
TW-UK	-0.159	-4.274	-4.116	-19.32***	-14.48***	-14.74***	-0.43	-0.3	-0.92
CH-AU	-0.614**	-6.109**	-5.496*	-4.29***	-13.39***	-13.35***	0.005	0.23	0.39
HK-AU	-1.05	-8.241***	-7.180**	-12.16***	-13.01***	-13.41***	0.3	-0.013	0.51
TW-AU	-1.043	-7.458***	-6.415**	-16.99***	-14.03***	-14.81***	-0.39	0.19	-0.26
CH-JP	0.928***	1.593	0.666	-10.47***	-13.90***	-14.01***	-0.15	-0.18	-0.011
HK-JP	0.491	-0.572	-1.062	-12.69***	-13.95***	-13.63***	0.39	-0.33	-0.032
TW-JP	0.498	0.143	-0.354	-20.71***	-14.81***	-16.10***	-0.53	-0.28	-0.48
CH-SG	1.505***	0.902	-0.603	-16.24***	-14.00***	-15.17***	0.058	0.14	0.39
HK-SG	1.069	-1.363	-2.431	-14.10***	-14.42***	-15.07***	0.32	0.48	0.84
TW-SG	1.076	-0.998	-2.073	-17.17***	-15.72***	-17.54***	-0.33	0.028	-0.28

N*ote:*

*(a) The differentials for real interest parity (RIP), uncovered interest parity (UIP) and purchasing power parity (PPP) series between the three Greater China (GC) economies, i.e. Mainland China (CH), Hong Kong (HK) and Taiwan (TW), as well as between each of the GC economies and US, UK, Australia (AU), Japan (JP) and Singapore (SG) have been adjusted for the effects of the July 1997 Asian financial crisis (AFC) and July 2007 Global financial crisis (GFC). They are annualized and measured in percentage terms. ***, ** and * indicate that the sample average differential is statistically significant at the 1, 5 and 10% levels respectively.*

*(b) The null hypothesis of the Phillips-Perron (PP) unit root test (with intercept and a trend term) is that the series has a unit root. **** indicates the null hypothesis is rejected at the 1% level.*

*(c) The Hodrick-Prescott technique is first applied to estimate the long-term component of each parity differentials series. For each series, the final level (as of 2012M12) is compared with its initial level (1996M02) and its average time trend over the full period is estimated (i.e. average annual time trend = [total change (%) /203 months]*12*

RIP, UIP and RPPP Differentials: 1996M02 to 2012M12
Source: Authors
Table 1

The dynamic correlation coefficient is defined to be between -1 and +1. In addition, the average value of dynamic correlation over all frequencies is approximately equal to the static correlation. It can be interpreted as a decomposition of the aggregate correlation into co-movements at particular frequencies. We perform co-spectral analyses to obtain the three component estimates

($S_x(\lambda)$, $S_y(\lambda)$ and $C_{xy}(\lambda)$) in (3) for the 18 economy-pairs' RI differential, UI differential, RPP differential, cross-public property correlation and cross-stock correlation at each frequency.

Spectral/co-spectral analysis is a means of revealing variance and covariance, but in the frequency domain. On the basis of NBER studies by Christiano and Fitzgerald (1999), we adopt a standard decomposition of frequency band. With monthly observations, long-run co-movements correspond to the low frequency band [0, π/48] (which corresponds to cycles with a period longer than 8 years); whilst business cycle co-movements belong to the frequency band [π/48, π/9] (which corresponds to cycles with a period between 1.5 and 8 years). The short-run movements are defined by frequencies over π/9. We smooth the empirical covariance function by a Barlett window equal to $\sqrt{t}$, where *t* is the number of observations. We also consider Barlett window with a size of $\sqrt{t/2}$ and Haming window with a size of $\sqrt{t}$. The pattern of the results does not change with the method of estimation.

RESULTS

Current state of economic globalization

Table 1 presents the three parity differentials' average annualized percentages for the full sample period, along with unit-root test statistics and the time-trend test. First, the null hypothesis that the RI, UI and RPP differentials are equal to zero cannot be rejected in 14, 11 and 12 economy-pairs, respectively. The PP unit root test statistics indicate that the null hypothesis of a unit root is rejected in all (absolute) differential series at one percent level of statistical significance, although there are 4 cases (RI), 7 cases (UI) and 6 cases (RPP) of significant differential averages (from zero) that may imply the existence of persistent opportunities for arbitrage activities. We test for the presence of zero mean reversion characteristics in the three differential series using the Philips and Perron (1988) non-parametric test statistic (PP), calculated with a constant and trend terms. The PP test statistics are used in preference to standard Augmented Dickey-Fuller (ADF) tests because they tend to have to have more power in finite samples (Bodman 1995). The main argument underlying this PP stationary test is that if the deviations from ex post parity are transitory and stationary, then even though the condition does not hold in the short run, deviations from parity are stationary. In contrast, if the deviations from parity are not stationary, there is permanent disequilibrium resulting from shocks and consequently there is no guarantee to restore the parity condition in the long run.

Overall, it appears there is economic globalization among the three GC economies in the long run and, to a lesser extent, financial and goods integration between CH and TW, as well as between HK and TW in the long run. Similar evidence of economic globalization as defined by capital, financial and goods integration are detected for the three GC economies with their regional and international partners in different degrees despite the presence of short-run disequilibrium in some parity differential series. Finally, although the time trend results are less conclusive, the individual economy-pair specific time trends have a negative sign in 7 (RI differential), 7 (UI differential) and 9 (RPP differential) cases, implying the differentials are narrowing in about 43% of the economy-pairs during the sample period.

Based on the results, we are inclined to conclude that there is some evidence of an upward trend in economic globalization within the GC region, Moreover, the GC economies are connected

with the international markets even though it has been recognized that the interdependencies between economic development in CH and in developed economies are largely different. Our brief results are in agreement with the findings reported by Cheung et al (2003).

Cross- public property market/stock market correlations

Table 2 reports the individual mean monthly time series of cross-public property and cross-stock correlations over the same period, along with the PP unit root test statistics. For brevity, the cross-market time series monthly correlation profiles for the 18 economy-pairs are not graphed.

The range of average cross-public property correlations is between 0.179 (CH-UK) and 0.409 (HK-SG). All cross-public property correlations are lower than the corresponding cross-stock correlations, ranging between 0.200 (CH-UK) and 0.485 (CH-HK). These results are in agreement with Liow et al (2009) who find (significantly) lower cross-real estate securities market correlations than the corresponding cross-stock market correlations in developed countries.

	Mean		**Phillips-Perron (PP) unit root test statistic**	
	Public property markets	**Stock markets**	**Public property markets**	**Stock markets**
CH-HK	0.320	0.485	-7.78***	-4.86***
CH-TW	0.249	0.321	-11.46***	-9.13***
HK-TW	0.279	0.386	-11.02***	-7.89***
CH-US	0.209	0.252	-14.05***	-11.48***
CH-UK	0.179	0.200	-13.09***	-11.78***
CH-AU	0.237	0.325	-11.38***	--8.71***
CH-JP	0.216	0.283	-13.92***	-10.99***
CH-SG	0.289	0.371	-10.22***	-8.99***
HK-US	0.254	0.290	-10.40***	-10.07***
HK-UK	0.200	0.214	-14.22***	-12.29***
HK-AU	0.283	0.374	-9.38***	-8.08***
HK-JP	0.257	0.340	-12.42***	-11.01***
HK-SG	0.409	0.464	-9.06***	-7.22***
TW-US	0.206	0.237	-13.62***	-10.93***
TW-UK	0.180	0.207	-15.52***	-12.68***
TW-AU	0.218	0.312	-11.29***	-9.90***
TW-JP	0.236	0.306	-11.68***	-9.27***
TW-SG	0.268	0.367	-10.74***	-8.90***

Notes**: The null hypothesis of the Phillips-Perron (PP) unit root test (with intercept and a trend term) is that the series has a unit root. * indicates the null hypothesis is rejected at the 1% level.*

Cross-Market Correlations: 1996M02 to 2012M12
Source: Authors
Table 2

Pair	RIP		UIP		RPPP	
	Average correlation	Time trend	Average correlation	Time trend	Average correlation	Time trend
CH-HK	-0.0407	-0.0000279	-0.073	0.000244***	-0.0136	-0.0000381*
CH-TW	0.0458	-0.0000622**	0.0288	-0.0000321***	0.0832	-0.0000198*
HK-TW	0.0489	-0.000137**	-0.0057	0.0000736***	0.0287	0.0000352**
CH-US	-0.0769	-0.000144***	-0.0666	0.000006	-0.0333	**-0.000393*** **
HK-US	-0.0219	0.0000234	-0.0692	0.000018	-0.03	-0.0000224*
TW-US	0.0704	0.0000169	0.1809	-0.0000229	0.2401	-0.0000191**
CH-UK	0.0731	-0.000923***	-0.0563	0.000005	-0.0534	0.0000056
HK-UK	-0.0342	-0.0000610**	-0.0515	0.0000439	-0.0491	0.0000347
TW-UK	0.0025	-0.0000234	-0.0029	0.0000002	-0.0015	0.0000031
CH-AU	-0.0136	0.0000378**	-0.0689	-0.0000422	-0.0751	-0.0000236*
HK-AU	0.0017	-0.00025	-0.0018	0.0000932	-0.0101	0.000134
TW-AU	-0.0408	-0.0000462	-0.0155	0.0000136	-0.0485	0.0000017
CH-JP	-0.0011	-0.0000148	0.0734	-0.0000332***	0.0931	-0.0000298**
HK-JP	-0.0318	**-0.00116*** **	-0.0054	-0.0000131	-0.0365	-0.0000005
TW-JP	0.0343	-0.0000247	0.1376	-0.0000223	0.105	0.000312
CH-SG	-0.0781	0.000311***	0.0442	0.0000843***	0.0293	0.0000330***
HK-SG	-0.1628	0.0000378***	0.0443	**-0.000196*** **	-0.0617	-0.0000422*
TW-SG	-0.0355	0.0000247**	-0.1796	0.0000143	-0.148	0.000164
Pooled sample						
All	-0.0154	-0.00015	-0.0045	0.0000206	0.00013	0.000059
GC	0.018	-0.0000861***	-0.0166	0.0000404	0.0328	-0.0000281*
GC-INT	-0.020986	-0.00013	-0.0025	0.0000179	-0.00532	0.000102
GC-US	-0.0095	-0.0000288	0.015	0.0000021	0.0589	-0.000123
GC-UK	0.0138	-0.0000025	-0.0369	0.0000153**	-0.0347	0.000185***
GC-AU	-0.0176	-0.000109**	-0.0287	0.000155	-0.0446	0.0000188
GC-JP	0.00047	-0.000234*	0.0685	-0.000188*	0.0539	-0.0000348
GC-SG	-0.0921	0.0000350**	-0.0304	-0.0000300***	-0.0601	-0.0000474

(a) The time-varying conditional correlation estimates are derived from multivariate VAR-VECH-GARCH (1, 1) model, covering RIP, UIP, RPPP, cross-property market correlation and cross-stock market correlations. Of particular interest is the correlations between economic globalization (as defined by the three parity differentials) and cross-property market correlations. The corresponding results for stock markets are not reported for brevity reason.

(b) For each parity condition, the respective time trend is derived by: $Corr_{property} = f(Corr_{poperty}(-1), Corr_{stock}, trend)$ *+error term (with robust standard error); ***, **, * - indicates two-tailed significance at the 1*, 5% and 10% levels respectively*

(c) All 18 country-pairs are organized into eight groups (GC, GC-US, GC-UK, GC-AU. GC-JP, GC-SG, GC-International and ALL).The pooled estimation is then performed via pooled regression with fixed effect (pooled OLS)

Average Conditional Correlations Between Parity Conditions (RIP, UIP and RPPP) and Public Property Correlations: 1996M02 – 2012M12
Source: Authors
Table 3

Over the study period, the estimated cross-correlations among the three GC public property markets are 0.320 (CH-HK), 0.249 (CH-TW) and 0.279 (HK-TW). This GC average (0.283) is higher than the GC-International average (0.243). The GC-international average correlation is estimated by taking the simple averages of CH, HK and TW with US, UK, AU, JP and SG (bivariate basis) as reported in Table 2.

Similarly, the corresponding correlations for stock markets are 0.397 (GC) and 0.303 (GC-International). Together with the conditional correlation results reported by Liow and Newell (2012), we are inclined to conclude that there is closer integration among the GC capital markets than across the GC markets due to geographical proximity and closer economic links. These correlation coefficients are however on the lower side and indicate opportunities can be exploited by international investors investing in stocks and real estate stocks within the GC region.

Finally, results from the PP unit root test consistently reject the null of non-stationary in every case of stock and public property markets. Therefore the cross-public property and cross-stock market correlations of the countries do not persistently diverge from one another in the long run.

Conditional correlations between economic globalization and public property market integration

Table 3 summarizes the results of the implied conditional correlations between the three parity differentials and two cross-market correlation series from the MGARCH model. The MGARCH estimation generates two main types of the results: (a) own-volatility and cross volatility spillover coefficients; (b) implied conditional correlation coefficients. The volatility spillover results are not reported as they are not the main focus of the study. Moreover, the time-varying conditional correlation graphs are not shown for brevity.

The numbers indicate that with 11 (RI differential), 12 (UI differential) and 11 (RPP differential) economy-pairs of negative conditional correlations, there is adequate evidence to support a positive relationship between economic globalization and cross-public property market correlation. Nevertheless, all negative correlation coefficients are on the low side, with the absolute highest of only 0.163 (RI), 0.180 (UI) and 0.148 (RPP) in the 18 economy-pairs. Across the 18 economy-pairs, the correlation coefficients are consistently negative (in all three parity conditions) in CH-HK, CH-US, HK-US, HK-UK, CH-AU, TW-AU, HK-JP and TW-SG. In contrast, the other 10 economy-pairs behave in different manners depending on the parity variables defined. Moreover, the GC group has a small negative correlation coefficient of -0.017 for the UI differential, but small positive coefficient for both RI and RPP differentials. In contrast, higher cross-public property market correlations are positively linked to economic globalization in the GC-AU and GC-SG groups in all three parity differentials.

For each parity variable, Table 3 also reports the estimated simple time trend of the relationship from estimating regression equation 1. Across the 18 economy-pairs, this time trend is significantly negative for 10 (RI differential), 6 (UI differential) and 10 (RPP differential) economic-pairs. The highest estimated annual time trends are, respectively, -0.116% (RI), -0.020% (UI) and -0.039% (RPP), implying that the implied co-movements of economic globalization and cross-public property market correlation can advance at the pace of between 0.24% and 1.39% per year across the three parity measures after accounting for the cross-stock

correlation effects. It is further noted as public property market correlations do not completely synchronize with stock market correlations, the estimated significant time trends in many cases should be orthogonal to the underlying stock markets' correlation effect, as our results have implied.

Overall, we are inclined to conclude that the link between economic globalization and cross-public property market correlation is adequately positive within the international parity framework. Over the last two decades, there are co-movements of economic globalization and cross-public property market correlation across the three parity measures after controlling for the cross-stock market correlation. However, the relatively small magnitude of this co-movement prevents us reaching a conclusive answer on the significance of their dynamic relationships over time.

Cyclical relation between economic globalization and cross-public property market correlation

Figure 1 graphs the dynamic correlation profile between the three parity differentials and cross-public property market correlations, between zero and π frequencies. Dynamic correlation at zero frequency is related to stochastic co-integration. Low frequencies at the left-hand side of the graphs correspond to long term (persistent) fluctuations, while high frequencies at the right-hand side of the graphs correspond to short-term (transitory) fluctuations. The vertical lines mark the conventional limits of the business cycles frequencies (between 1-1/2 year cycles at π/9 and 8-year cycles at π/48).

The graphs indicate that dynamic correlations are generally in the low to moderate range and are in many cases negative in the long-run and at business cycle frequencies. At the short-run frequencies the direction of dynamic correlation is less clear and experiences volatile fluctuations for several economy pairs.

Over the frequency band (0, pi) is the static dynamic correlation coefficient (Table 4), where the corresponding absolute value appears to be small (between -0.172 and 0.117). Additional analyses reveal that these aggregate results hide strong differences according to the frequency and frequency bands considered. First, we can see a relatively homogenous picture for the long-run cycle frequencies with 9 (RI differential), 15 (UI differential) and 13 (RPP differential) economy-pairs (37/54 = 68.5%) that have negative dynamic correlations. Moreover a total of these 24 negative dynamic correlation coefficients are greater than -0.30 (24/37 = 64.9%), implying greater economic globalization (lower parity differential) could be accompanied by higher cross-public property market correlations in the long-run. We follow rules of thumb whereby dynamic correlations between 0 and 0.3 are considered low, between 0.3 and 0.7 (moderate) and above 0.7 (strong).

This negative relationship appears weaker at the business-cycle frequencies where there are 11 (RI differential), 14 (UI differential) and 13 (RPP differential) economy-pairs that report a dynamic correlation of between -0.075 and -0.448, and with only 10 negative values that are greater than -0.30 (10/38 =26.3%) . Finally, although there are 8 (RI differential), 10 (UI differential) and 9 (RPP differential) economy-pairs of negative dynamic correlation at the short-run frequencies, none of the average values is above -0.30. Results for the six market-groups (GC, GC-AU, GC-JP, GC-SG, GC-UK and GC-US) are in agreement with the individual

economy-pairs, implying moderate pro-cyclical co-movements between economic globalization and cross-public property market correlations at the frequencies of more than 1.5 years.

Based on the results, we are inclined to conclude that the frequency domain's dynamic correlations between economic globalization and public property market integration are not constant over frequencies, but varying. Across the 18 economy-pairs, there is adequate evidence to suggest that cross-public property market integration is linked to economic globalization in the long-run frequencies and, to lesser extent, at the business-cycle frequencies. However, the magnitudes of dynamic correlations at the short-run frequencies are either small (/moderate) negative or marginally positive.

From the perspective of portfolio diversification, the estimation of dynamic correlation at different frequencies offers fresh information for investors at both long-term and short-term investment horizons. For long-term investors, they are more interested in the relationship between economic globalization and property stock market correlations at long run cycle frequency or business cycle frequency. On the contrary, short-term investors focus on the short-term fluctuations which result from the higher frequency band. The result of moderate/weak co-movement between arbitrage differentials and property stock market correlations indicates potential benefits of diversification in these markets. Overall, this paper provides fresh insights in the real estate literature on frequency domain analysis of market co-movement, which was not formally studied before. Consequently, investors of different horizons can resort to the results of this paper at varying frequency levels for insights of property stock investment.

Turning to the regional differences, Table 4 reveals the average dynamic correlations for the GC group are small negative at the long-run and business-cycle frequencies. Among the three economy-pairs, the numbers indicate moderate negative average dynamic correlations for CH with TW (RIP: -0.525, UIP: -0.461 and RPPP: -0,471) and for HK with TW (UIP: -0.568 and RPPP: -0.359) for the long-term economic development. In contrast, only HK has a moderate dynamic correlation coefficient of -0.355 with TW at the business-cycle frequencies. Finally, negative dynamic correlations dominate CH and HK at the short-run frequencies possibly because the short-run dependences of economic developments might be more important in the case of CH over the last two decades.

Across the GC region and their economic partners, moderate negative dynamic correlations are detected in GC-JP (RIP: -0.337; UIP: -0.502 and RPPP: -0.471) and to a lesser degree in GC-SG (UIP: -0.566 and RPPP:-0.494) at the long-run frequencies. This indicates where, in the Asian region, more intensive economic and financial relationships with the GC economies is developing, with greater economic globalization between GC and JP as well as between the GC and SG appearing to interact positively with their higher cross-public property market correlations in the long run, with CH, TW and HK contributing to this long-term trend in different degrees. In contrast, the corresponding long-run dynamic correlations are either marginally positive or small negative for AU, UK and US, respectively with the GC region.

Among the three GC economies, it appears that CH has the lowest level of co-movements between economic globalization and cross-public property market correlations with their international partners. One possible explanation is because CH has different macroeconomic

conditions and unique market institutions from the Western developed economies. Finally, we can see large differences in the short-run. Near to the frequency π, while some dynamic correlations are moderately negative; several other economy-pairs show low negative or even marginally positive dynamic correlations between economic globalization and cross-public property market integration. It thus becomes less meaningful (if not impossible) to generalize about the patterns of the dynamic correlation movement across all 18 economy-pairs

Figure 2 compares graphically the average dynamic correlations for the public property and stock market groups at the four frequency bands. For each parity differential, we have 24 comparisons which are based on 4 frequency types (overall, long-run, business cycle and short-run) x 6 groups (GC, GC-AU, GC-JP, GC-SG, GC-UK and GC-US). Detailed dynamic correlation results for stock market-pairs are not reported because they are not our main focus and are thus omitted for brevity.

Of the 24 stock market pairs, negative average dynamic correlations exist in 21 (RIP), 23 (UIP) and 20 (RPPP) pairs; the corresponding numbers are lower for public property markets: 14 (RIP), 19 (UIP) and 16 (RPPP). Additional Wilcoxon signed rank test (non-parametric) in Table 5 reveals the frequency variations of the average dynamic correlation are significantly different for the public property and stock markets for 8 (RIP), 12 (UIP) and 10 (RPPP) economy-pairs at least at the 10% level at the overall frequency band. With two exceptions, the correlation fluctuations are significantly different between public property and stock markets in at least 9 economy-pairs (50%) at the business-cycle and short-run frequencies for the three parity variables. Results for long-run frequency band are not available as there are not enough observations for the Wilcoxon test (individual economy-pair).

On regional basis, the time-series fluctuations in the average dynamic correlations are significantly different between the stock and public property markets for the GC-JP, GC-SG, GC-US and GC groups. This seems to be especially strong for the GC-JP group where the dynamic correlation estimates are consistently different for the stock market and public property market pairs for all parity variables and frequency bands. Moreover, it appears that the long-run component has outperformed the business-cycle and short-run components, with 5 (RIP), 4 (UIP) and 5 (RPPP) cases of significant differences for the stock and public property market group. This finding reinforces investors' perception that stock and public property markets are significantly different, especially in the long run.

The results from the above analysis are important for risk management in the real estate securities market internationally. The empirical evidence of both time- and frequency-varying offers adequate information for investors of different types. For investors in the Asian region, it would be more profitable to diversify their wealth between Greater China market and overseas markets out of Asia in the long run given the same broad level of economic globalization. The comparison analysis between stock market and property stock market also indicates that diversification benefits should be different in the two asset markets. From the perspective of policy makers, the results can be utilized to predict the trend of public property market co-movement and economic integration given the knowledge of one another. Moreover, it would be critical to understand contagion effect during the crisis as well as economy and trade interaction at regional and global level.

Frequency	[0, π]			[0, π/48]			(π/48, π/9)			(π/9, π]		
Pair	RIP	UIP	RPPP	RIP	UIP	RPPP	RIP	UIP	RPPP	RIP	UIP	RPPP
Panel A	**Individual Market- Pair**											
CHHK	0.43	2.66[1]	-3.38[1]	-	-	-	-	-1.60	-2.67[1]	1.82[3]	3.74[1]	-2.36[2]
CHTW	-	-	-1.12	-	-	-	-	2.67[1]	2.67[1]	-	-	-1.79[3]
HKTW	-1.25	-0.39	-0.25	-	-	-	0.06	1.13	2.67[1]	-0.96	-0.38	-0.66
CHJP	2.07[2]	-	-4.39[1]	-	-	-	-0.41	-	-1.95[3]	2.79[1]	-	-3.60[1]
HKJP	-0.13	-	-4.73[1]	-	-	-	-1.01	-0.41	-0.06	0.59	-	-4.63[1]
TWJP	2.70[1]	-	-0.95	-	-	-	-	-	-1.60	3.74[1]	-1.60	-0.21
CHSG	-0.73	2.99[1]	4.50[1]	-	-	-	1.84[3]	-	-2.67[1]	-1.03	3.83[1]	5.37[1]
HKSG	-	-	-3.58[1]	-	-	-	-	-	-2.67[1]	-	-	-3.02[1]
TWJP	-1.12	-	-3.58[1]	-	-	-	-0.77	1.01	0.89	-0.63	-	-3.61[1]
CHUS	-	2.13[2]	-1.18	-	-	-	-	-	-2.67[1]	-	2.77[1]	0.18
HKUS	2.65[1]	3.12[1]	2.56[2]	-	-	-	0.77	2.07[2]	1.01	2.87[1]	3.14[1]	2.59[2]
TWUS	-1.36	-	-4.04[1]	-	-	-	-	-1.60	-2.67[1]	-0.44	-	-3.31[1]
CHUK	0.40	0.40	0.20	-	-	-	2.67[1]	2.67[1]	2.67[1]	-0.20	-0.91	-1.16
HKUK	-0.14	1.89[3]	2.31[2]	-	-	-	2.67[1]	2.67[1]	2.31[2]	-1.55	0.77	1.54
TWUK	-1.44	0.81	1.13	-	-	-	-	1.48	0.41	-0.99	0.63	1.23
CHAU	-	-	-2.99[1]	-	-	-	-1.36	0.30	0.18	-	-	-2.88[1]
HKAU	-0.34	-0.40	-0.09	-	-	-	-	-0.06	0.41	0.53	-0.15	0.01
TWAU	-	-	-1.27	-	-	-	-	-0.06	0.30	-0.49	-	-1.01
Significant	8	12	10	-	-	-	10	6	9	6	11	9
Panel B	**Group Market-Pair**											
GC	-	-0.07	-2.46[2]	-2.67[1]	-2.43[2]	-2.55[2]	-	1.83[3]	1.80[3]	2.72[1]	2.09[2]	-1.45
GCJP	2.77[1]	-	-5.69[1]	-2.67[1]	-2.67[1]	-2.67[1]	-	-	-2.31[2]	3.48[1]	-	-4.52[1]
GCSG	-	-	-0.78	-2.67[1]	-1.95[3]	-2.67[1]	-	-	-1.85[3]	-0.30	3.50[1]	4.67[1]
GCUS	-	1.44	-1.96[2]	-2.67[1]	-2.67[1]	-2.67[1]	-2.50	-0.14	-2.50[2]	-	3.30[1]	0.02
GCUK	-0.79	1.72[3]	1.91[3]	1.01	1.01	0.06	2.07[1]	4.16[1]	3.68[1]	0.54	0.07	-0.34
GCAU	-	-	-2.77[1]	-2.67[1]	-2.67[1]	-2.67[1]	-3.87	0.07	0.12	-0.22	-0.88	-0.96
Significant	5	3	4	5	4	5	5	2	3	3	4	2

***Notes**: the reported numbers are z-statistics from Wilcoxon signed rank test. [1], [2] and [3] indicate that null hypothesis of no difference between dynamic correlations (parity-stock) and dynamic correlations (parity-property) is rejected at the 1%, 5% or 10% two-tailed significance level, respectively. The last row reports the total number of cases where the null hypothesis is rejected at the four frequency bands. The interval of [0,π], [0,π/48], (π/48,π/9] and (π/9,π] corresponds to the overall movement, long run movements (greater than 8 years), business cycle frequency movement (1.5 to 8 years) and short run frequency movements (less than 1.5 years), respectively. The long-run component estimates for the individual economy pairs are not available due to insufficient number of data available for estimation (Panel A- third part)*

Wilcoxon Signed Ranks Test (Non-Parametric): Between Dynamic Correlations (Parity-Stock Correlations) and Dynamic Correlations (Parity-Property Correlations)
Source: Authors
Table 5

Overall, we are inclined to conclude that even for the stock market index including real estate securities the cyclical co-movements between economic globalization and cross-market correlations are significantly different for some stock and public property markets over the

economic cycle. Accordingly, additional future research studies on international public property markets are warranted in order to uncover fresh insights regarding the evolution and nature of interdependencies between economic globalization and cross-public property market correlations in an international environment.

CONCLUSIONS

In the context of increasing globalization and financial market integration, the main contribution of this paper is to examine the dynamic relationships between economic globalization and cross-public property correlations among the three GC economies and across the GC region with their regional and international partners during the period from February 1996 to December 2012. Although it might be a foregone conclusion that economic globalization is important and on an upward trend for many economies and, consequent to this, globalization and internationalization of real estate investments, it is expected public property markets would have become increasingly correlated. However, less is formally understood about the nature and extent of relationships between economic globalization and cross-public property market correlations. Our study is particularly meaningful as China has become an important factor of growth of the global economy over the last two decades. Consequently, the economic developments in China and in developed economies are largely different. In particular, the short-term dependencies of economic development might be more important in the case of China.

We integrate the literature from international economics and real estate by first documenting that there is adequate evidence of current economic globalization, in particular, real and financial integration within the three GC economies and across the GC area regionally and globally. The GC public property markets have become increasingly correlated among themselves and with their economic partners. Over the last two decades, there are some co-movements between economic globalization and cross-public property market correlations across the three parity measures after controlling for cross-stock market correlations in the long run. The cyclical co-movements between economic globalization and cross-market correlations are, however, significantly different for several stock and public property markets over different time horizons.

Finally, the application of the frequency domain's dynamic correlation methodology reveals economic globalization and cross-public property market correlations are moderately linked (especially) in the long-run; but in a different manner according to the frequencies and economy-pairs considered, particularly for the short-run frequencies. Among the GC economies, negative dynamic correlation dominates China and Hong Kong at the short-run frequencies because the short-run dependencies of economic developments might be more important in the case of China over the last two decades. The three GC economies appear to co-move more intensively with cross-public property market correlation in the long-run across the Asia-Pacific region, in our case, with Japan and Singapore. Subject to the usual empirical caveats, further studies are definitely required in order to confirm whether the GC results reported in this paper could be generalizable to other developed and emerging economies.

Overall, our study provides key implications for investors at different investment horizons to recognize diversification benefits across GC markets and other regions in the long-run and at short-term investment horizons. The findings of this study also remind them to consider economic integration levels and their changes when investing in different property stock markets.

For macroeconomists and governors, the extent to which economic globalization and property stock markets are linked is important for them to monitor the level of market development and to develop strategies to refine their financial market institutions, especially in the emerging economies of China and Taiwan.

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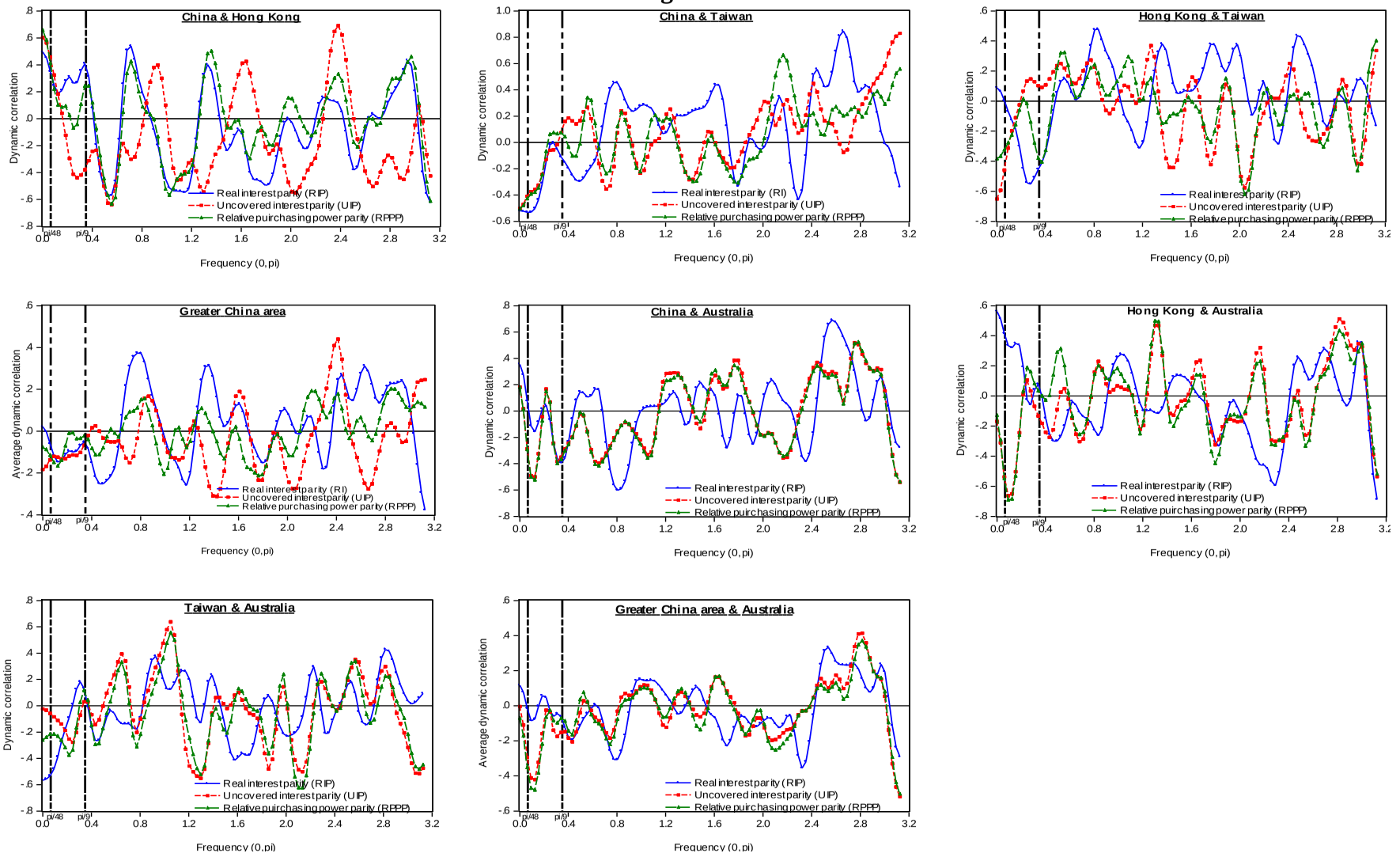
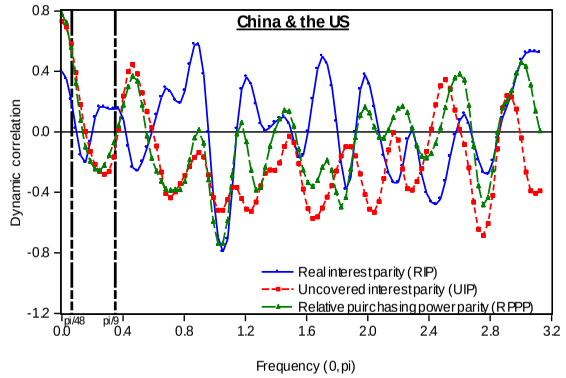
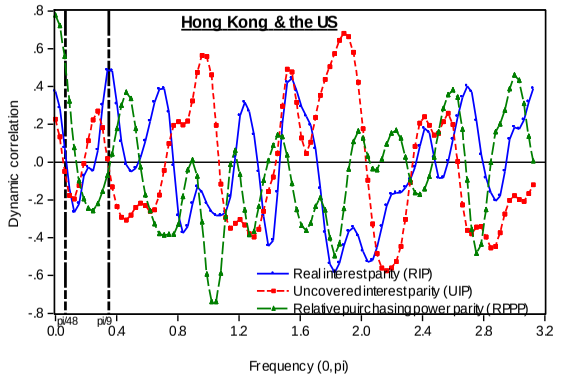
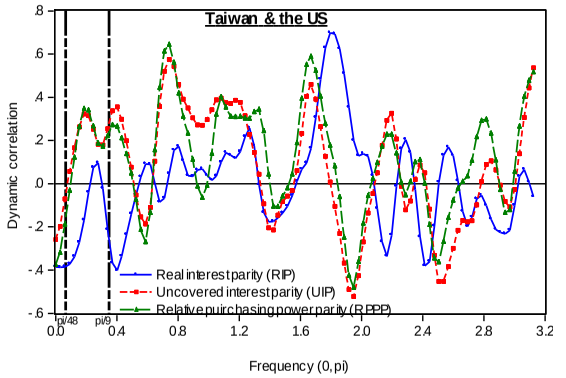
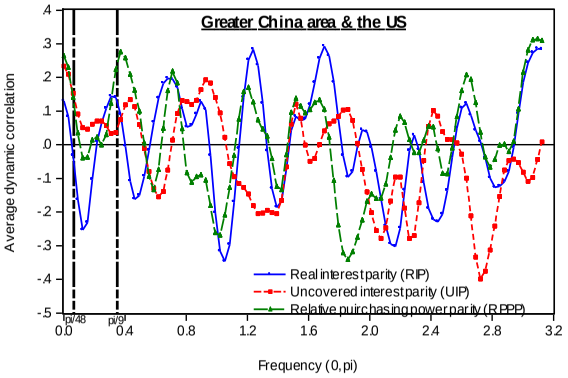
Cyclical Co-Movement Between International Parity Conditions (RIP, UIP and RPPP) and Cross-Public Property Market Correlations: 1996M02 to 2012M12
Source: Authors
Figure 1

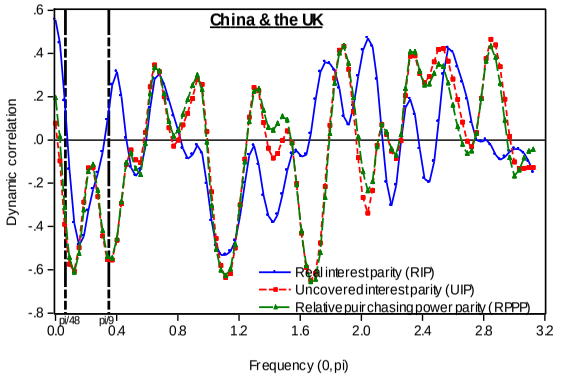


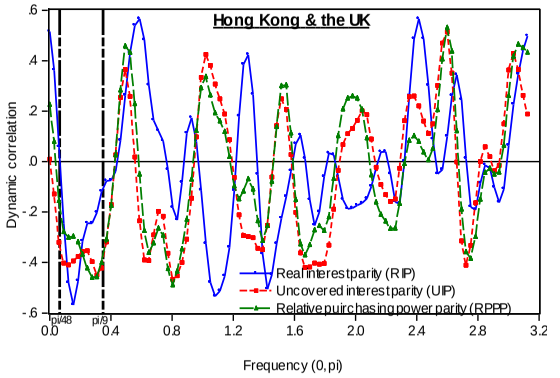

China & the US
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
pi/48
pi/9
Frequency (0, pi)

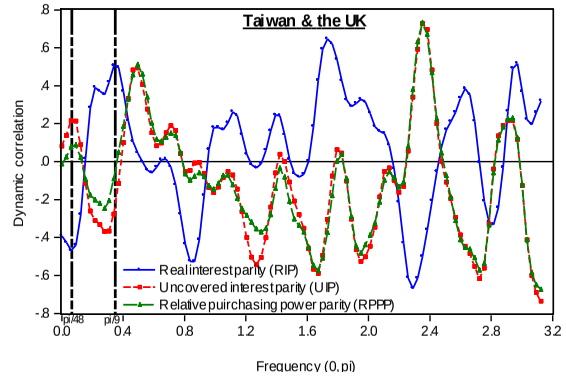

Hong Kong & the US
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
pi/48
pi/9
Frequency (0, pi)

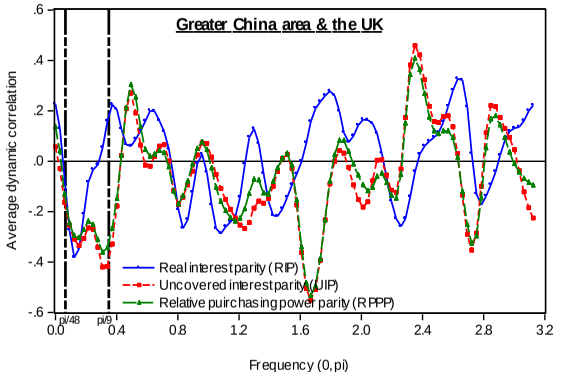

Taiwan & the US
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
pi/48
pi/9
Frequency (0, pi)

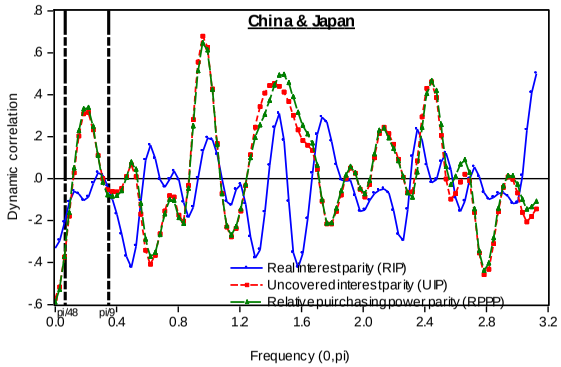

Greater China area & the US
Average dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
pi/48
pi/9
Frequency (0, pi)

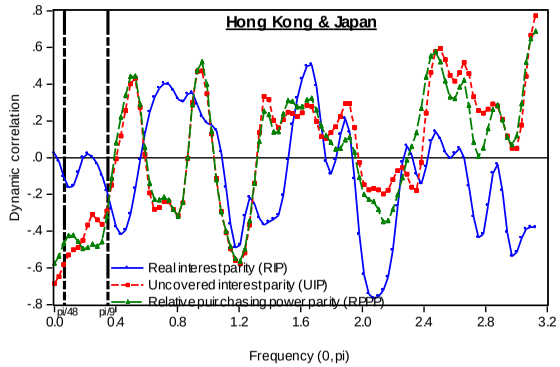

China & the UK
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
pi/48
pi/9
Frequency (0, pi)

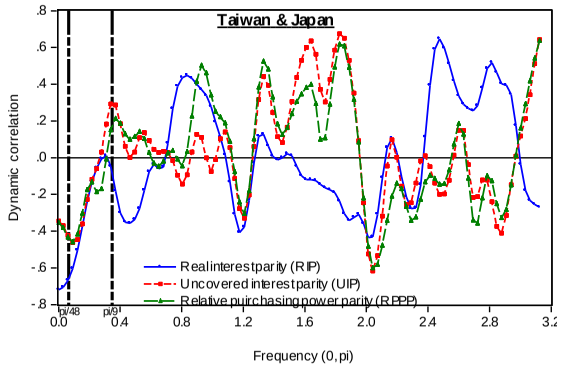

Hong Kong & the UK
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
pi/48
pi/9
Frequency (0, pi)

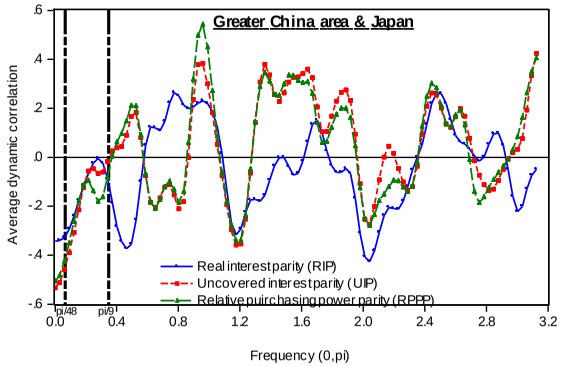

Taiwan & the UK
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
pi/48
pi/9
Frequency (0, pi)

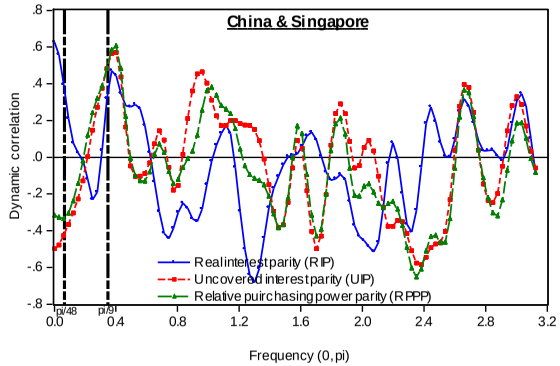

Greater China area & the UK
Average dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
pi/48
pi/9
Frequency (0, pi)

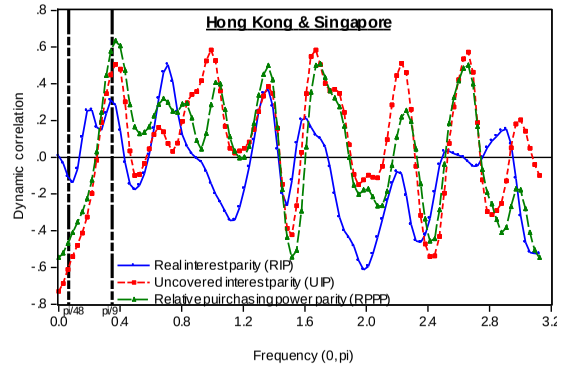

China & Japan
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
Frequency (0,pi)

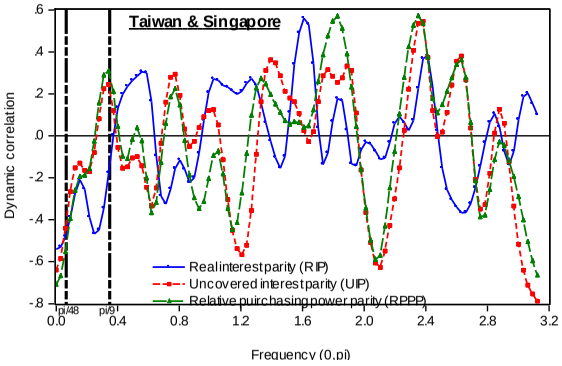

Hong Kong & Japan
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
Frequency (0,pi)

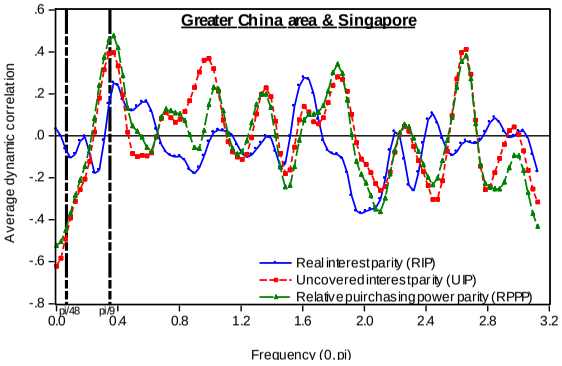

Taiwan & Japan
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
Frequency (0,pi)


Greater China area & Japan
Average dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
Frequency (0,pi)


China & Singapore
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
Frequency (0,pi)


Hong Kong & Singapore
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
Frequency (0,pi)


Taiwan & Singapore
Dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
Frequency (0,pi)


Greater China area & Singapore
Average dynamic correlation
Real interest parity (RIP)
Uncovered interest parity (UIP)
Relative purchasing power parity (RPPP)
Frequency (0,pi)

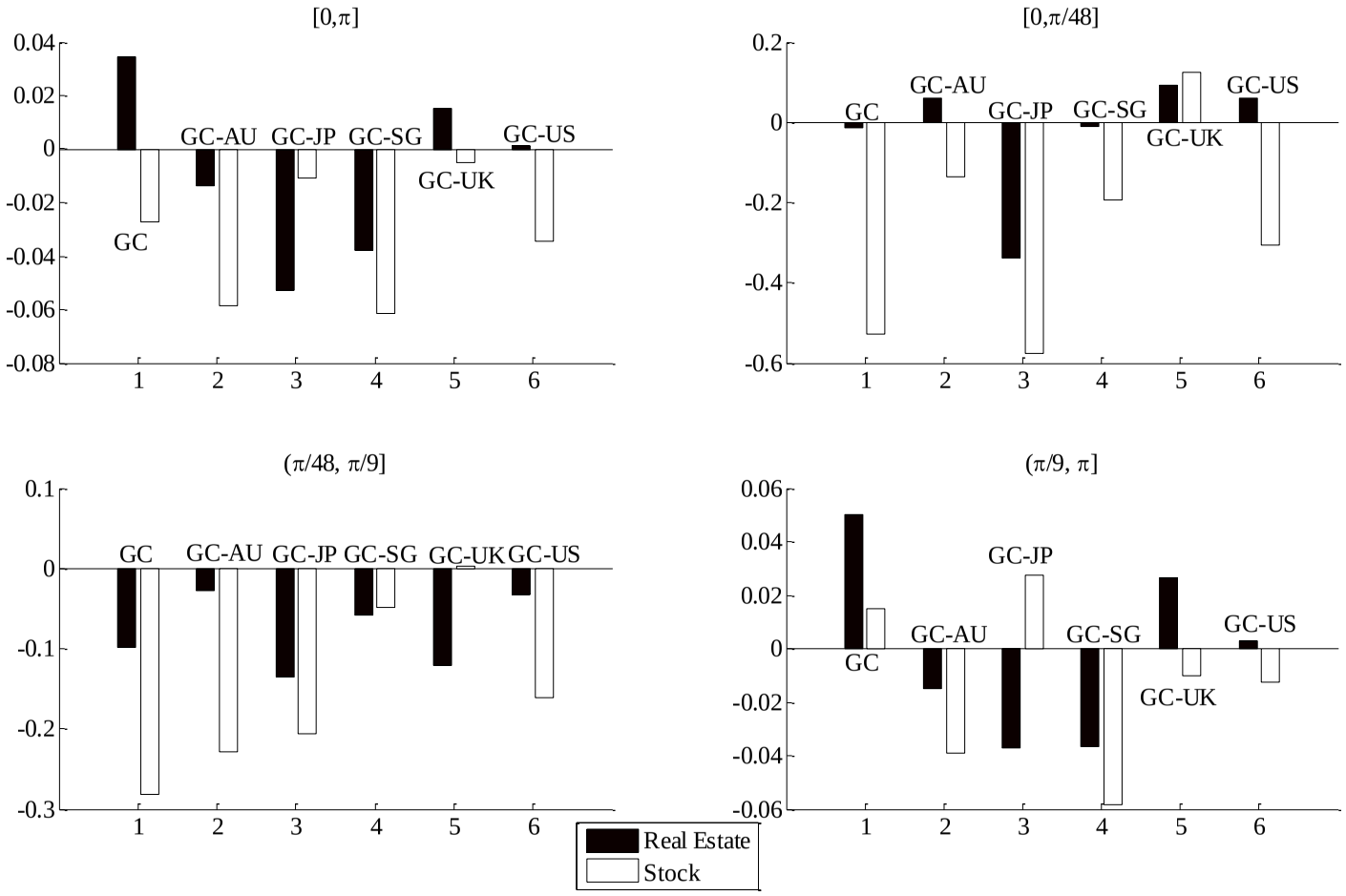
	RIP				UIP				RPPP			
	$[0,\pi]$	$[0,\frac{\pi}{48}]$	$(\frac{\pi}{48},\frac{\pi}{9}]$	$(\frac{\pi}{9},\pi]$	$[0,\pi]$	$[0,\frac{\pi}{48}]$	$(\frac{\pi}{48},\frac{\pi}{9}]$	$(\frac{\pi}{9},\pi]$	$[0,\pi]$	$[0,\frac{\pi}{48}]$	$(\frac{\pi}{48},\frac{\pi}{9}]$	$(\frac{\pi}{9},\pi]$
CH-HK	-0.053	0.431	0.281	-0.102	-0.144	0.541	-0.170	-0.164	-0.002	0.551	0.085	-0.029
CH-TW	0.107	-0.525	-0.234	0.162	0.074	-0.461	-0.165	0.116	0.057	-0.471	-0.128	0.093
HK-TW	0.050	0.052	-0.355	0.090	-0.050	-0.568	-0.008	-0.037	-0.052	-0.359	-0.168	-0.031
GC	0.035	-0.014	-0.098	0.050	-0.040	-0.163	-0.117	-0.029	0.001	-0.093	-0.075	0.011
CH-AU	0.013	0.234	-0.152	0.022	-0.005	-0.029	-0.234	0.019	-0.015	-0.033	-0.251	0.010
HK-AU	-0.027	0.496	0.174	-0.065	-0.033	-0.340	-0.235	-0.002	-0.023	-0.322	-0.185	0.003
TW-AU	-0.027	-0.552	-0.107	-0.002	-0.033	-0.038	-0.145	-0.022	-0.066	-0.239	-0.195	-0.048
GC-AU	-0.014	0.059	-0.027	-0.015	-0.023	-0.136	-0.213	-0.002	-0.035	-0.198	-0.225	-0.012
CH-JP	-0.043	-0.278	-0.050	-0.034	0.022	-0.487	0.108	0.030	0.032	-0.497	0.117	0.041
HK-JP	-0.096	-0.034	-0.077	-0.100	0.036	-0.639	-0.404	0.102	0.023	-0.527	-0.448	0.088
TW-JP	-0.019	-0.698	-0.217	0.023	0.030	-0.380	-0.130	0.060	0.024	-0.390	-0.189	0.059
GC-JP	-0.053	-0.337	-0.136	-0.037	0.029	-0.502	-0.174	0.064	0.026	-0.471	-0.199	0.063
CH-SG	-0.040	0.526	0.012	-0.064	-0.028	-0.468	0.028	-0.019	-0.063	-0.326	0.094	-0.070
HK-SG	-0.069	-0.044	0.141	-0.091	0.072	-0.676	-0.110	0.115	0.040	-0.513	-0.013	0.064
TW-SG	-0.005	-0.517	-0.328	0.045	-0.054	-0.554	-0.046	-0.038	-0.031	-0.642	-0.052	-0.009
GC-SG	-0.038	-0.012	-0.059	-0.037	-0.003	-0.566	-0.088	0.020	-0.018	-0.494	-0.037	-0.005
CH-UK	-0.008	0.395	-0.237	0.001	-0.034	-0.137	-0.386	0.004	-0.032	-0.034	-0.384	0.003
HK-UK	-0.011	0.311	-0.321	0.009	-0.060	-0.146	-0.395	-0.024	-0.044	0.050	-0.366	-0.014
TW-UK	0.065	-0.428	0.179	0.070	-0.113	0.146	-0.192	-0.114	-0.105	0.029	-0.125	-0.108
GC-UK	0.015	0.093	-0.121	0.027	-0.069	-0.046	-0.309	-0.045	-0.060	0.015	-0.276	-0.040
CH-US	0.030	0.322	0.035	0.020	-0.172	0.669	-0.082	-0.209	-0.054	0.686	-0.094	-0.075
HK-US	-0.021	0.244	0.008	-0.033	-0.017	0.103	0.033	-0.026	-0.011	0.243	0.008	-0.022
TW-US	-0.005	-0.386	-0.139	0.021	0.080	-0.175	0.221	0.074	0.117	-0.294	0.210	0.121
GC-US	0.001	0.060	-0.032	0.003	-0.036	0.199	0.067	-0.053	0.017	0.212	0.051	0.008

Note: *The interval of [0,π], [0,π/48], (π/48,π/9] and (π/9,π] corresponds to the overall movement, long run movements (greater than 8 years), business cycle frequency movement (1.5 to 8 years) and short run frequency movements (less than 1.5 years), respectively.*

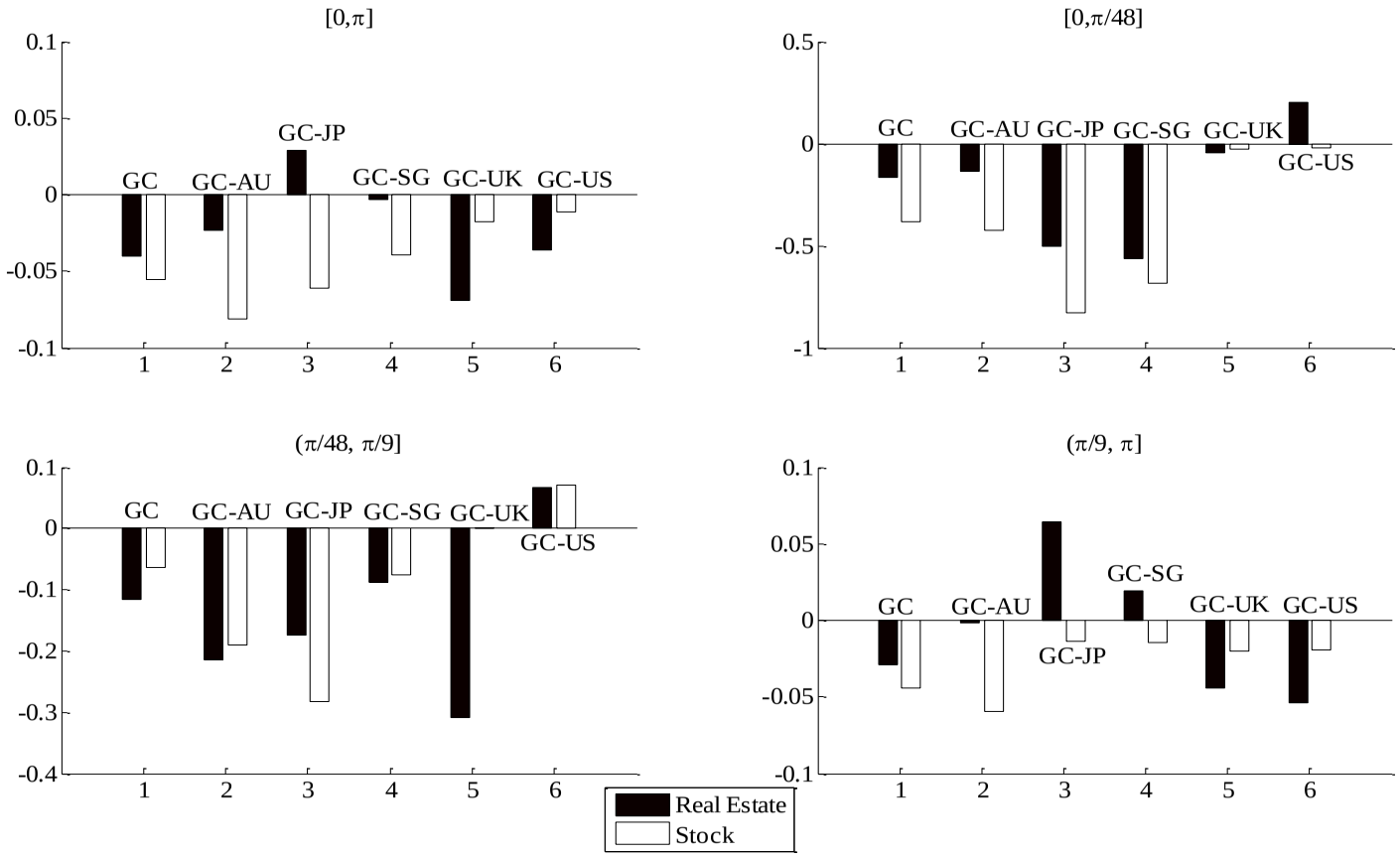
Dynamic Correlations (Frequency Domain) Between International Parity Conditions (RIP, UIP and RPPP) and Cross-Public Property Market Correlations at Selected Frequency Bands: 1996M02 to 2012M12
Source: Authors
Table 4

Dynamic Correlations (Frequency Domain) Between International Parity Differentials and Cross-Market Correlations: Public Property Markets Versus Stock Markets
Source: Authors
Figure 2

RIP



UIP



***Note**: These graphs present the directions and magnitudes of the average dynamic correlations between three international parity conditions (RIP, UIP and RPPP) and cross-market correlations (public real estate and stock markets) according to four frequency bands. The interval of [0,π], [0,π/48], (π/48,π/9] and (π/9,π] corresponds to the overall movement, long run movements (greater than 8 years), business cycle frequency movement (1.5 to 8 years) and short run frequency movements (less than 1.5 years) respectively.*