Similarly, the conditional correlations on bond market returns (as shown in Table 4) are positive during both crisis and non-crisis periods. The time-varying conditional correlation between Canadian and the U.S. bond returns (0.804 in Table 4) is higher than the stock markets (0.691 in Table 3). Whereas AU and JP exhibit the opposite patterns in their bond (0.129 and 0.093 in Table 4) and stock returns (0.144 and 0.133 in Table 3). This finding could be attributed to the more developed and therefore more integrated bond markets of US and CA, as compared to AU and JP. Similar to the stock markets, each country pair shows a higher mean correlation in the bond market returns during the market turbulence relative to the non-crisis periods. Therefore, the descriptive statistics suggest the existence of contagion among bond markets in APEC countries during the crisis periods.

Table 4
Descriptive Statistics on Dynamic Conditional Correlations of US Bond Market Returns versus Selected Bond Market Returns

	AU	*CA*	*JP*	*NZ*	*SG*
Panel A: Non-crisis periods					
Mean	0.102	0.793	0.080	0.091	0.353
Std. Dev.	0.045	0.035	0.059	0.047	0.083
Skewness	0.341	-0.503	0.252	-0.053	0.164
Kurtosis	-0.138	0.702	-0.783	0.017	-0.614
Panel B: Crisis periods					
Mean	0.129	0.804	0.093	0.105	0.398
Std. Dev.	0.062	0.045	0.061	0.051	0.082
Skewness	-0.217	-2.198	0.819	0.009	-0.208
Kurtosis	0.581	8.820	1.522	-0.410	-0.494

Note: Numbers reported in the table are dynamic conditional correlations (DCC). DCC is calculated by first using Eq. (1) to demean the return series. Then, the conditional variance of the residuals can be decomposed into three components as denoted in Eq. (3). The time-varying conditional correlation is then retrieved from the time-varying correlation matrix. The sample countries are Australia (AU), Canada (CA), Japan (JP), Singapore (SG), New Zealand (NZ) and the U.S. (US).

Finally, Table 5 presents the changes in conditional correlation between US bond market return and other countries' stock market returns. Contrary to the single asset class analysis, correlations between the US bond market return and other countries' stock market returns are lower during the crisis periods relative to the non-crisis periods, highlighting a decrease in correlations during the crisis periods and that the correlations ended up in the negative level. These findings support the existence of the flight-to-quality phenomenon. In the next section, we extend these preliminary analyses by employing an AR model to test for structural breaks in the time varying conditional correlations due to the financial crises.

4.2. Determinants of Contagion and Flight-to-Quality

4.2.1. Contagion in Stock and Bond Markets

4.2.1.1. Contagion in Stock Markets

Table 6 presents the tests of changes in dynamic correlations when MX stock market return is used as the source country. During the Mexican crisis, there is a significant decrease in correlation

Table 5
Descriptive Statistics on Dynamic Conditional Correlations of US Bond Market Returns versus Selected Stock Market Returns

	AU	*CA*	*CL*	*HK*	*ID*	*JP*	*KR*	*MY*	*MX*	*PE*	*PH*	*TW*	*TH*	*US*
Panel A: Non-crisis periods														
Mean	-0.026	0.000	-0.049	-0.044	-0.029	-0.042	-0.032	-0.039	-0.045	-0.060	-0.009	-0.047	-0.035	0.031
Std. Dev.	0.046	0.107	0.070	0.039	0.046	0.039	0.036	0.030	0.089	0.051	0.039	0.030	0.043	0.143
Skewness	0.029	0.519	-0.077	-0.476	0.660	-0.391	-0.200	-0.026	0.417	-0.219	-0.814	0.007	-1.211	0.468
Kurtosis	-0.966	-0.528	-0.841	0.144	0.390	-0.808	-0.644	-0.237	-0.596	-0.079	-0.187	0.079	1.531	-0.905
Panel B: Crisis periods														
Mean	-0.058	-0.161	-0.147	-0.091	-0.054	-0.077	-0.086	-0.059	-0.188	-0.136	-0.044	-0.089	-0.075	-0.186
Std. Dev.	0.042	0.125	0.089	0.049	0.038	0.039	0.036	0.044	0.107	0.073	0.038	0.036	0.033	0.159
Skewness	-0.197	1.016	0.537	-0.062	0.118	0.061	0.283	-0.049	0.774	0.167	0.344	-0.273	-0.150	1.024
Kurtosis	-0.418	1.128	-0.401	-0.947	-0.739	0.254	0.003	-0.547	0.317	-0.568	0.085	-0.414	-0.649	0.818

Note: Numbers reported in the table are dynamic conditional correlations (DCC). DCC is calculated by first using Eq. (1) to demean the return series. Then, the conditional variance of the residuals can be decomposed into three components as denoted in Eq. (3). The time-varying conditional correlation is then retrieved from the time-varying correlation matrix. The sample countries are Australia (AU), Canada (CA), Chile (CL), Hong Kong (HK), Indonesia (ID), Japan (JP), Korea (KR), Malaysia (MY), Mexico (MX), Peru (PE), Philippine (PH), Taiwan (TW), Thailand (TH) and the U.S. (US).

Table 6
Tests of Changes in Dynamic Correlations between MX Stock Market Returns versus Selected Stock Market Returns during Different Crisis Periods

	AU	*CA*	*CL*	*HK*	*ID*	*JP*	*KR*	*MY*	*PE*	*PH*	*TW*	*TH*	*US*
Constant	0.187***	0.110	0.216***	0.078***	0.096***	0.068***	0.116***	0.069***	0.210***	0.089***	0.035**	0.054**	0.026
ρ_{t-1}	0.985***	0.998***	0.994***	0.995***	0.991***	0.992***	0.992***	0.993***	0.992***	0.988***	0.994***	0.995***	0.999***
Mexico	-0.080	-0.113**	0.046	-0.044	-0.075	0.037	-0.089	0.012	0.133	0.016	0.047	-0.057	-0.108
Asia 1	0.080	0.185	0.136	0.028	0.004	-0.003	0.000	-0.050	0.186	0.022	-0.043	-0.036	0.180**
Asia 2	0.085**	-0.015	0.019	0.077**	0.058**	0.038	0.008	0.066**	0.100***	0.172***	0.000	0.081***	-0.021
Russia	0.055	0.015	0.045	-0.052	-0.115	0.030	-0.091	-0.049	0.019	-0.047	0.021	-0.078	0.027
LTCM	-0.113	0.087	0.083	-0.019	-0.060	-0.113	0.006	0.010	0.069	-0.025	-0.099	-0.132	0.086
Brazil	0.061	-0.124	0.097	-0.112	-0.049	0.015	-0.064	-0.063	0.170**	-0.022	0.058	0.001	0.018
Dot-Com	0.073	0.076	0.094***	0.040	-0.089	-0.011	0.036	-0.104	0.062	0.034	0.094	0.057	0.043
Argentina	0.026	0.013	0.000	0.015	0.002	0.025	0.023	0.006	0.033	-0.022	0.045**	0.017	0.005
GFC 1	-0.001	0.033	0.126***	0.020	0.071***	0.001	0.025	0.028	0.137***	-0.011	0.032	0.047**	0.024
GFC 2	0.076***	0.044	0.084***	0.049**	0.103***	0.009	0.028	0.082***	0.191***	-0.022	0.045**	0.039	-0.002

Notes: This table reports the regression output of Eq.(8). ρ_{ij} is the time-varying correlation between the stock returns of Mexico and the stock returns of selected economies. ρ_{t-1} is the time-varying correlation lag one period. *Mexico* is the dummy variable for the Mexican crisis (1/1/95-31/3/95), *Asia 1* is the dummy variable for the first phase of Asian crisis (2/7/97-17/11/97), *Asia 2* is the dummy variable for the second phase of Asian crisis (18/11/97-31/12/98), *Russia* is the dummy variable for the Russian crisis (17/08/98-31/12/98), *LTCM* is the dummy variable for the LTCM crisis (23/9/98-15/10/98), *Brazil* is the dummy variable for the Brazilian crisis (7/1/99-25/2/99), *Dot-Com* is the dummy variable for Dot-Com crisis (28/2/00-7/6/00), *Argentina* is the dummy variable for Argentinean crisis (11/10/01-3/3/05), *GFC 1* is the dummy variable for the first phase of GFC (26/7/07-9/3/09), and *GFC 2* is the dummy variable for the second phase of GFC (10/3/09-30/7/10). The sample countries are Australia (AU), Canada (CA), Chile (CL), Hong Kong (HK), Indonesia (ID), Japan (JP), Korea (KR), Malaysia (MY), Mexico (MX), Peru (PE), Philippine (PH), Taiwan (TW), Thailand (TH) and the U.S. (US). *** and ** indicate statistical significance at 1% and 5% levels, respectively.

between MX and CA, which is inconsistent with expectation. However, significant contagion effects (positive change in correlation) are found during the Asian, Dot-Com and GFC crises when Mexico is employed as the source country.

As presented in Table 7 and Table 8, using either TH or HK stock market returns as the source country, the evidence of an increase in correlation are prominant during the second phase of the Asian crisis. There is a significant increase in correlation between TH stock market returns and the stock market returns of various Asian (namely, HK, MY, PH, TW) and emerging economies (namely, MX and CL). When HK is used as the source country, significant increases in correlation between HK stock market returns with the various Asian (namely, MY, PH, TW, TH) and emerging economies (namely, MX, TL) are also found. Interestingly, we also observed significant increase in correlations between TH, HK (as source countries) and developed economies such as US.

Consistent with Chiang *et al.* (2007), this study argues that investors seem to focus on the local country factors during the early phase of the Asian crisis. After realising the full impact of the crisis on the global economy, they withdrew funds from all Asian economies fearing that the crisis may transmit to other Asian countries. This created an overall crash in the Asian stock markets, producing a wide spread contagion effect in the region. In addition, correlations increase significantly during the GFC, illustrating the existence of contagion effects between the stock market returns of APEC countries with HK and TH as the source country, respectively.

Table 9 reports the findings when US stock market return is used as the source country. We find that contagion effect exists in most of the APEC countries, but not during every crisis period. The evidence reveals that the correlations of most APEC countries increase significantly during the GFC period, highlighting the presence of contagion effect and the significant role of US as the source country of the crisis.

Overall, the significant increases in correlations between stock markets especially during the Asian crisis and the GFC highlighted the presence of contagion effects. This finding is consistent with the existing literature (Caramazza *et al.*, 2004; Cheung *et al.*, 2010; Dungey *et al.*, 2010). Besides, the results also suggest that diversification benefits in international equity markets are reduced when they are needed most during the market turmoils. It should also be noted that the magnitude of a crisis is closely associated with the level of contagion effects. Crises such as the 1997 Asian crisis and GFC are the ones that produce significant increases in correlations in most country pairs. GFC, which results in the largest recession since the Great Depression, created a widespread fear among international investors, causing massive withdrawals of funds in international equity markets. Therefore, every single stock market in the sample suffered a contagion effect during the GFC.

4.2.1.2. Contagion in Bond Markets

Table 10 reports the change in correlations of U.S. bond returns versus Australia, Canada, Japan, New Zealand and Singapore bond market returns during the crisis periods. In contrast to the stock markets findings, majority of the country pairs do not exhibit a significant increase in correlation during market turbulence, except for CA and US during the earlier stage of the Asian crisis and the Argentinean crisis. We argue that since the Canadian and the U.S. bond

Table 7
Tests of Changes in Dynamic Correlations between TH Stock Market Returns versus Selected Stock Market Returns during Different Crisis Periods

	AU	*CA*	*CL*	*HK*	*ID*	*JP*	*KR*	*MY*	*MX*	*PE*	*PH*	*TW*	*US*
Constant	0.112***	0.081***	0.096***	0.137***	0.087**	0.089**	0.077**	0.174***	0.054**	0.078***	0.066**	0.067**	0.055***
ρ_{t-1}	0.995***	0.993***	0.993***	0.995***	0.997***	0.996***	0.997***	0.994***	0.995***	0.993***	0.997***	0.996***	0.992***
Mexico	0.025	0.025	-0.086	0.117**	0.078**	0.062	-0.098**	0.186***	-0.057	-0.009	0.111***	0.086**	0.013
Asia 1	0.072	-0.019	-0.005	-0.065	0.093	0.034	0.048	-0.029	-0.036	0.024	0.024	0.021	0.008
Asia 2	0.060	0.046	0.106***	0.115***	0.047	0.054	0.048	0.082***	0.081***	0.010	0.106***	0.079**	0.072**
Russia	0.035	-0.012	-0.101	-0.063	-0.015	-0.022	-0.031	-0.085	-0.078	0.036	-0.068	-0.097	-0.049
LTCM	-0.021	-0.056	-0.128	0.086	0.218	-0.021	0.006	-0.093	-0.132	0.065	0.111	0.109	-0.131
Brazil	0.030	-0.045	-0.114	0.094	-0.058	0.009	0.112	0.002	0.001	-0.014	0.047	-0.056	-0.001
Dot-Com	0.060	-0.007	0.023	0.107	-0.059	0.133	0.035	0.008	0.057	0.016	0.069	0.067	-0.019
Argentina	0.010	-0.004	0.004	0.017	0.010	0.035**	0.027	0.000	0.017	-0.026	0.005	0.037	0.014
GFC 1	0.086***	0.063***	0.042	0.099***	0.072**	0.098***	0.084***	0.079***	0.047**	0.121***	0.071***	0.095***	0.070***
GFC 2	0.043	0.057	0.072***	0.068***	0.039	0.046	0.028	0.048	0.039	0.045	-0.005	0.052	0.073**

Notes: This table reports the regression output of Eq.(8). ρ_{ij} is the time-varying correlation between the stock returns of Thailand and the stock returns of selected economies. ρ_{t-1} is the time-varying correlation lag one period. *Mexico* is the dummy variable for the Mexican crisis (1/1/95-31/3/95), *Asia 1* is the dummy variable for the first phase of Asian crisis (2/7/97-17/11/97), *Asia 2* is the dummy variable for the second phase of Asian crisis (18/11/97-31/12/98), *Russia* is the dummy variable for the Russian crisis (17/08/98-31/12/98), *LTCM* is the dummy variable for the LTCM crisis (23/9/98-15/10/98), *Brazil* is the dummy variable for the Brazilian crisis (7/1/99-25/2/99), *Dot-Com* is the dummy variable for Dot-Com crisis (28/2/00-7/6/00), *Argentina* is the dummy variable for Argentinean crisis (11/10/01-3/3/05), *GFC 1* is the dummy variable for the first phase of GFC (26/7/07-9/3/09), and *GFC 2* is the dummy variable for the second phase of GFC (10/3/09-30/7/10). The sample countries are Australia (AU), Canada (CA), Chile (CL), Hong Kong (HK), Indonesia (ID), Japan (JP), Korea (KR), Malaysia (MY), Mexico (MX), Peru (PE), Philippine (PH), Taiwan (TW), Thailand (TH) and the U.S. (US). *** and ** indicate statistical significance at 1% and 5% levels, respectively.

Table 8
Tests of Changes in Dynamic Correlations between HK Stock Market Returns versus Selected Stock Market Returns during Different Crisis Periods

	AU	*CA*	*CL*	*ID*	*JP*	*KR*	*MY*	*MX*	*PE*	*PH*	*TW*	*TH*	*US*
Constant	0.499***	0.273***	0.094***	0.199**	0.290	0.055	0.175***	0.078***	0.093***	0.231***	0.140	0.137***	0.169***
ρ_{t-1}	0.988***	0.983***	0.993***	0.994***	0.993***	0.998***	0.994***	0.995***	0.99***	0.991***	0.995***	0.995***	0.988***
Mexico	0.029	0.039	-0.080	0.067	-0.006	-0.147***	0.148***	-0.044	0.005	0.051	0.059	0.117**	0.031
Asia 1	-0.074	-0.003	-0.008	0.056	-0.031	0.022	0.028	0.028	-0.011	0.133**	-0.023	-0.065	-0.026
Asia 2	0.040	0.127***	0.104***	0.031	0.002	-0.009	0.078***	0.077**	0.089***	0.123***	0.093**	0.115***	0.067**
Russia	0.056	-0.043	-0.082	-0.048	-0.037	0.036	-0.143***	-0.052	-0.004	-0.058	-0.096	-0.063	-0.001
LTCM	-0.112	0.029	0.016	0.156	-0.009	0.186	0.057	-0.019	0.086	0.150**	-0.059	0.086	-0.022
Brazil	0.072	-0.100	-0.118	0.111	-0.071	0.066	-0.028	-0.112	0.082	0.118	-0.051	0.094	-0.020
Dot-Com	0.073	-0.022	0.035	0.014	0.091	0.115	0.087	0.040	0.042	0.100	0.026	0.107	-0.060
Argentina	0.027	0.016	0.002	-0.008	0.038	0.013	0.013	0.015	-0.030	-0.012	0.070	0.017	0.018
GFC 1	0.175***	-0.015	0.026	0.113**	0.109	0.058	0.092***	0.020	0.136***	0.140***	0.123	0.099***	0.002
GFC 2	0.173***	0.110***	0.009	0.102	0.085	0.024	0.083***	0.049**	0.087***	0.081***	0.114	0.068***	0.083***

Notes: This table reports the regression output of Eq.(8). $\rho_{i,j}$ is the time-varying correlation between the stock returns of Hong Kong and the stock returns of selected economies. ρ_{t-1} is the time-varying correlation lag one period. *Mexico* is the dummy variable for the Mexican crisis (1/1/95-31/3/95), *Asia 1* is the dummy variable for the first phase of Asian crisis (2/7/97-17/11/97), *Asia 2* is the dummy variable for the second phase of Asian crisis (18/11/97-31/12/98), *Russia* is the dummy variable for the Russian crisis (17/08/98-31/12/98), *LTCM* is the dummy variable for the LTCM crisis (23/9/98-15/10/98), *Brazil* is the dummy variable for the Brazilian crisis (7/1/99-25/2/99), *Dot-Com* is the dummy variable for Dot-Com crisis (28/2/00-7/6/00), *Argentina* is the dummy variable for Argentinean crisis (11/10/01-3/3/05), *GFC 1* is the dummy variable for the first phase of GFC (26/7/07-9/3/09), and *GFC 2* is the dummy variable for the second phase of GFC (10/3/09-30/7/10). The sample countries are Australia (AU), Canada (CA), Chile (CL), Hong Kong (HK), Indonesia (ID), Japan (JP), Korea (KR), Malaysia (MY), Mexico (MX), Peru (PE), Philippine (PH), Taiwan (TW), Thailand (TH) and the U.S. (US). *** and ** indicate statistical significance at 1% and 5% levels, respectively.

Table 9
Tests of Changes in Dynamic Correlations between US Stock Market Returns versus Selected Stock Market Returns during Different Crisis Periods

	AU	*CA*	*CL*	*HK*	*ID*	*JP*	*KR*	*MY*	*PE*	*PH*	*TW*	*TH*	*US*
Constant	0.193***	0.221**	0.066	0.169***	0.073***	0.131***	0.160***	0.046***	0.026	0.175***	0.097***	0.075***	0.055***
ρ_{t-1}	0.986***	0.997***	0.998***	0.988***	0.991***	0.988***	0.987***	0.993***	0.999***	0.992***	0.987***	0.988***	0.992***
Mexico	0.032	-0.035	-0.025	0.031	-0.009	-0.051	-0.047**	0.053	-0.108	-0.020	-0.019	0.102***	0.013
Asia 1	-0.033	0.108	0.135	-0.026	-0.067	-0.029	-0.008	-0.008	0.180**	0.101	-0.034	-0.107	0.008
Asia 2	0.043	-0.003	0.004	0.067**	0.026	0.038	0.029	0.035	-0.021	0.036	0.126***	0.014	0.072**
Russia	0.033	0.042	0.001	-0.001	-0.068	0.032	-0.030	-0.048	0.027	-0.019	-0.009	0.036	-0.049
LTCM	-0.056	-0.005	0.119	-0.022	-0.068	-0.040	0.038	0.012	0.086	0.117	-0.058	-0.131	-0.131
Brazil	0.051	-0.092	-0.061	-0.020	0.029	0.047	0.037	-0.043	0.018	0.132**	0.203**	0.222**	-0.001
Dot-Com	-0.016	0.023	0.053	-0.060	-0.051	-0.089	-0.044	-0.063	0.043	-0.002	-0.027	0.136***	-0.019
Argentina	-0.008	0.017	0.008	0.018	-0.001	0.062***	0.034**	-0.011	0.005	0.022	-0.038**	0.087***	0.014
GFC 1	-0.014	0.022	0.049**	0.002	0.053**	0.025	0.046**	0.011	0.024	0.089***	-0.024	0.056**	0.070***
GFC 2	0.063**	0.044***	0.022	0.083***	0.062**	0.037	0.091***	0.086***	-0.002	0.196***	-0.027	0.095***	0.073**

Notes: This table reports the regression output of Eq. (8) ρ_{ij} is the time-varying correlation between the stock returns of the U.S. and the stock returns of selected economies. ρ_{t-1} is the time-varying correlation lag one period. *Mexico* is the dummy variable for the Mexican crisis (1/1/95-31/3/95), *Asia 1* is the dummy variable for the first phase of Asian crisis (2/7/97-17/11/97), *Asia 2* is the dummy variable for the second phase of Asian crisis (18/11/97-31/12/98), *Russia* is the dummy variable for the Russian crisis (17/08/98-31/12/98), *LTCM* is the dummy variable for the LTCM crisis (23/9/98-15/10/98), *Brazil* is the dummy variable for the Brazilian crisis (7/1/99-25/2/99), *Dot-Com* is the dummy variable for Dot-Com crisis (28/2/00-7/6/00), *Argentina* is the dummy variable for Argentinean crisis (11/10/01-3/3/05), *GFC 1* is the dummy variable for the first phase of GFC (26/7/07-9/3/09), and *GFC 2* is the dummy variable for the second phase of GFC (10/3/09-30/7/10). The sample countries are Australia (AU), Canada (CA), Chile (CL), Hong Kong (HK), Indonesia (ID), Japan (JP), Korea (KR), Malaysia (MY), Mexico (MX), Peru (PE), Philippine (PH), Taiwan (TW), Thailand (TH) and the U.S. (US). *** and ** indicate statistical significance at 1% and 5% levels, respectively.

markets are well developed and demonstrate a high integration level relative to other countries, investors are more likely to think alike of the two markets, resulting in a higher possibility of a positive contagion effect. This also corresponds to the 'neighbourhood effect' proposed by Haile and Pozo (2008), where they argue that when neighbouring countries are in crisis, the probability of a crisis in the country also increases due to the macroeconomic similarities. Unlike stock markets, government bond markets are generally guaranteed by the governments, thus, investors are less likely to withdraw their funds from the markets due to fear. We therefore observe that contagion effects are not as significant in the bond markets as compared to those in the international equity markets.

Table 10
Tests of Changes in Dynamic Correlations between US Bond Market Returns versus Selected Bond Market Returns during Different Crisis Periods

	AU	*CA*	*JP*	*NZ*	*SG*
Constant	0.116***	0.957***	0.131***	0.147***	0.189**
ρR_{t-1}	0.988***	0.988***	0.983***	0.984***	0.995***
Mexico	0.112	-0.083	-0.193	-0.018	-0.067
Asia 1	0.023	0.062**	0.130	-0.188	-0.021
Asia 2	0.030	-0.044	0.032	0.071	-0.008
Russia	-0.118	-0.214	0.331	-0.086	0.000
LTCM	0.514	0.424	-0.119	0.363	0.276
Brazil	0.053	0.040	0.121	0.037	0.081
Dot-Com	0.101	0.013	-0.116	-0.034	-0.020
Argentina	0.040	0.055**	0.015	0.041	0.040
GFC 1	0.049	0.003	0.056	0.011	0.014
GFC 2	0.052	-0.024	-0.055	0.032	-0.078

Notes: This table reports the regression output of Eq.(8). $\rho_{i,j}$ is the time-varying correlation between the bond returns of the U.S. and the bond returns of selected economies. ρ_{t-1} is the time-varying correlation lag one period. *Mexico* is the dummy variable for the Mexican crisis (1/1/95-31/3/95), *Asia 1* is the dummy variable for the first phase of Asian crisis (2/7/97-17/11/97), *Asia 2* is the dummy variable for the second phase of Asian crisis (18/11/97-31/12/98), *Russia* is the dummy variable for the Russian crisis (17/08/98-31/12/98), *LTCM* is the dummy variable for the LTCM crisis (23/9/98-15/10/98), *Brazil* is the dummy variable for the Brazilian crisis (7/1/99-25/2/99), *Dot-Com* is the dummy variable for Dot-Com crisis (28/2/00-7/6/00), *Argentina* is the dummy variable for Argentinean crisis (11/10/01-3/3/05), *GFC 1* is the dummy variable for the first phase of GFC (26/7/07-9/3/09), and *GFC 2* is the dummy variable for the second phase of GFC (10/3/09-30/7/10). *** and ** indicate statistical significance at 1% and 5% levels, respectively.

4.2.1.3. Flight-to-Quality from Stock to U.S. Bond Markets

Table 11 presents the changes in correlation between US government bond market return and other APEC countries' stock markets returns. We find significant negative change in correlations during the crisis periods, indicating the existence of the flight-to-quality phenomenon. However, similar to the stock markets, the level of flight-to-quality phenomenon is closely linked to the severity of a crisis. Consistent with Illmanen (2003) and Baur and Lucey (2009), this study also finds that flight-to-quality phenomenon is more noticeable when stock markets are more volatile, such as during the Asian crisis and the GFC. Specifically, investors in the equity markets are concerned about the possibility of an overall crash in the international stock markets during the crises. Hence, they withdraw their funds from stock markets and invest in U.S. Treasury bill,

Table 11
Tests of Changes in Dynamic Correlations between US Bond Market Returns versus Selected Stock Market Returns during Different Crisis Periods

	AU	*CA*	*CL*	*HK*	*ID*	*JP*	*KR*	*MY*	*MX*	*PE*	*PH*	*TW*	*TH*	*US*
Constant	-0.017	0.017	-0.010	-0.028**	-0.016	-0.038***	-0.039***	-0.044***	-0.001	-0.022	-0.010	-0.059***	-0.030**	0.019
ρR_{t-1}	0.992***	0.999***	0.995***	0.992***	0.990***	0.990***	0.987***	0.991***	0.997***	0.995***	0.988***	0.987***	0.990***	0.999***
Mexico	0.018	0.059	0.069	-0.005	-0.100	-0.092	-0.067	0.067	0.092	0.054	-0.152	0.007	-0.044	0.139**
Asia 1	0.001	-0.117	-0.027	-0.009	0.022	0.035	-0.068	-0.044	-0.063	-0.065	-0.088	-0.038	0.027	-0.130
Asia 2	0.008	-0.107***	-0.038	-0.096***	-0.101***	-0.069**	-0.057	-0.063	-0.093**	-0.056	-0.071	-0.032	-0.093***	-0.099***
Russia	-0.073	-0.023	-0.198**	0.051	0.095	0.013	0.025	0.068	-0.099	-0.054	-0.059	-0.134**	0.094	-0.101
LTCM	0.034	-0.080	0.272	-0.279	-0.340	-0.030	-0.038	-0.045	0.175	0.128	-0.159	-0.249	-0.283	0.122
Brazil	-0.137**	0.073	-0.023	-0.157	-0.048	0.114	-0.201**	0.066	-0.012	-0.095	-0.186	0.053	-0.218	0.061
Dot-Com	0.098	-0.135**	-0.105	0.065	-0.030	0.067	0.080	0.070	-0.109	-0.023	0.113	0.058	0.025	-0.082
Argentina	-0.052***	-0.027	-0.042**	-0.044**	-0.018	-0.054***	-0.072***	0.020	-0.035	-0.029	-0.036	-0.042**	-0.038	-0.030
GFC 1	-0.040	-0.100***	-0.154***	-0.046	-0.081**	-0.061**	-0.132***	-0.033	-0.111***	-0.099***	-0.047	-0.098***	-0.068**	-0.105***
GFC 2	-0.024	-0.047	-0.084**	-0.045	-0.048	-0.039	-0.11***	-0.028	-0.068	-0.108***	-0.012	-0.048	-0.035	-0.055

Notes: This table reports the regression output of Eq. (8). $\rho_{i,j}$ is the time-varying correlation between the bond returns of the U.S. and the stock returns of selected economies. ρ_{t-1} is the time-varying correlation lag one period. *Mexico* is the dummy variable for the Mexican crisis (1/1/95-31/3/95), *Asia 1* is the dummy variable for the first phase of Asian crisis (2/7/97-17/11/97), *Asia 2* is the dummy variable for the second phase of Asian crisis (18/11/97-31/12/98), *Russia* is the dummy variable for the Russian crisis (17/08/98-31/12/98), *LTCM* is the dummy variable for the LTCM crisis (23/9/98-15/10/98), *Brazil* is the dummy variable for the Brazilian crisis (7/1/99-25/2/99), *Dot-Com* is the dummy variable for Dot-Com crisis (28/2/00-7/6/00), *Argentina* is the dummy variable for Argentinean crisis (11/10/01-3/3/05), *GFC 1* is the dummy variable for the first phase of GFC (26/7/07-9/3/09), and *GFC 2* is the dummy variable for the second phase of GFC (10/3/09-30/7/10). The sample countries are Australia (AU), Canada (CA), Chile (CL), Hong Kong (HK), Indonesia (ID), Japan (JP), Korea (KR), Malaysia (MY), Mexico (MX), Peru (PE), Philippine (PH), Taiwan (TW), Thailand (TH) and the U.S. (US). *** and ** indicate statistical significance at 1% and 5% levels, respectively.

which are less likely to default during the market turmoils. The change in correlations between stock and bond market returns becomes negative in the face of a crisis, causing a flight-to-quality phenomenon. An implication of this finding is that governments should facilitate the development of their local bond markets to enable investors to diversify their investments, thereby limiting a wipe-out of asset returns during a financial crisis.

4.2.2. Logistic Regressions

Panels A and B of Table 12 present the descriptive statistics (in percentage) for the independent variables in both the contagion logit regression and flight-to-quality logit regression, respectively. Among the independent variables, TED is the most volatile variable as evidenced by the higher standard deviation (43.07) relative to other variables. This is possibly due to TED being an investor sentiment factor, which fluctuates more than the macroeconomic factors.

Table 12
Descriptive Statistics of Investor Sentiment and Fundamental Economic Factors in the Logistic Regressions

	VIX	*CSI*	*TED*	*OIL*	*RER*	*DIR*	*DINF*	*DGDP*	*DCAB*
Panel A: Contagion logit regression (DCON)									
Mean	0.156	-0.081	6.189	0.037	-0.002	-0.1288	4.1717	2.4962	2.1585
Median	-0.316	-0.760	-2.564	0.000	0.000	0.000	2.7570	3.466	1.715
Std. Dev.	6.239	5.146	43.071	2.508	1.130	17.36	7.2960	3.953	5.468
Panel B: Flight-to-quality logit regression (DFTQ)									
Mean	0.154	-0.093	6.156	0.036	0.008	-0.160	4.200	2.459	2.742
Median	-0.316	-0.760	-2.817	0.000	0.000	0.000	2.762	3.466	2.144
Std. Dev.	6.235	5.155	43.055	2.507	0.983	19.99	7.32	4.167	5.445

Note: Numbers reported in the table are expressed as percentage (%).

Panels A and B of Table 13 present the results of contagion logit regression and flight-to-quality logit regression, respectively. The results are significant and of mixed sign for the macroeconomic differential variables (namely, DINF, DGDP and DCAB). Contrary to expectations, an increase in DINF and DCAB (i.e. less similar macroeconomic factors between countries) increases the odds of contagion during crisis periods by 1% and 5% respectively. While the coefficient on DGDP confirms our expectations that the smaller the differentials, the more likely contagion exist during market turmoils, the coefficient of OIL indicates that an increase in world oil price reduces the odds of contagion by 0.6%. This is possibly because oil price is positively associated with the market index as indicated in Ewing and Thompson (2007). Hence, an increase in oil price leads to an increase in stock returns, diminishing the fear for stock market crash and probability of contagion effects. In addition, consistent with expectation, there is a negative relationship between the change in CSI and probability of contagion, since CSI is positively correlated with contemporaneous stock returns as indicated by prior literature (Charoenrook, 2005; Fisher & Statman, 2003). For a 1% increase in CSI, we expect to see a 1.4% decrease in the odds of contagion.

Similar to the contagion logit regression, the results for flight-to-quality logit regression (as shown in Panel B) also reveal that most control variables are significant. However, the

results for the control variables are again mixed. As expected, higher DGDP and DCAB (less similarities in macroeconomic environment) decrease the odds of flight-to-quality by 8.8% and 7.5%, respectively. In terms of the investor sentiment factors, CSI decreases 1.7% and and TED increases 0.1% the odds of flight-to-quality. This association is as expected because an increase in TED spread (proxy for credit risks) lowers the stock market returns (Lashgari, 2000), encouraging the market participants to invest their funds in the bond markets, which results in a flight-to-quality phenomenon.

Overall, after controlling for macroeconomic factors, investors sentiment factors still play an important role in determining the existence of both contagion and flight-to-quality phenomenon. Specifically, among the investor sentiment factors, Consumer Sentiment Index is the most significant factor in explaining the presence of contagion and flight-to-quality during the crisis periods. Therefore, the contagion effect identified in this study is argued to be beyond the countries' fundamental economic links as defined in the contagion literature. This evidence is in favour of the justification for the local government and IMF to provide financial aids to crisis affected country during the crisis periods, as crashes are propagated through the channel of investor sentiments and herding behaviours.

4.3. Robustness Tests

To evaluate the robustness of the model, a series of robustness tests have been conducted. First, we include more countries, which were previously excluded due to data availability, for a shorter time period. Four more stock markets (New Zealand, Russia, Singapore and Vietnam) and three more bond markets (Hong Kong, Korea and Taiwan) which are members of the APEC are included in the sample. The sample periods are from 1/1/2001 to 30/7/2010 with 2498 observations for stock markets; 1/7/2000 to 30/7/2010 with 2629 observations for bond markets. The results (unreported) are consistent with our previous findings. It is concluded that contagion effect exists in stock but not in the bond markets during market turmoils. The evidence also supports the existence of flight-to-quality phenomenon during crisis periods.

Second, we employ different cut-off dates of the crisis periods as defined in prior literature. According to Mathur *et al.* (2002), Mexican crisis ends on 31/1/1995 when funds for U.S. support package become available. This date is employed as the end date of Mexican crisis in the robustness test. For the Asian crisis, Kallberg *et al.* (2005) define the start of the second phase of Asian crisis as on 20/10/1997, when the crashes propagated to Hong Kong and the Hong Kong Dollar fell victim to speculation. In terms of the Russian and the LTCM crises, the alternative start date is 3/8/1998 and 31/8/1998, respectively (Dungey et al., 2006). Eventually, Bartram and Bodnar (2009) argue that the GFC has been ongoing since the early 2007 when Freddie and Fannie made the announcement of ceasing to buy subprime mortgages on 27/2/2007. The real collapse of the equity markets are on 15/9/2008, when Lehman Brothers bankrupted and AIG was bailed out. Therefore, we define the alternative start and end date of regime 1 of GFC as from 27/2/2007 to 14/9/2008 and regime 2 of GFC from 15/9/2008 to 30/7/2010. Overall, the results (unreported) are robust to the changes of crisis period dates, where correlation changes are significantly positive, resulting in positive correlations within stock markets (contagion effect), and significant negative correlation changes across bond and stock markets (flight-to-quality phenomenon) during the Asian crisis and the GFC.

Table 13
Determinants of Causes of Contagion and Flight-to-quality using the Logistic Regression

	Constant	*VIX*	*CSI*	*TED*	*OIL*	*RER*	*DIR*	*DINF*	*DGDP*	*DCAB*
Panel A: Contagion logit regression (Dependent Variable: DCON)										
β	-0.930***	0.002	-0.014***	0.000	-0.006**	0.010	-0.001	0.010***	-0.060***	0.049***
	(-65.800)	(1.447)	(-10.138	(0.935)	(-2.134)	(1.779)	(-1.205)	(10.066)	(-17.796)	(28.260)
McFadden R-squared		0.008								
LR statistic		1110.863								
Prob (LR statistic)		0.0000								
Panel B: Flight-to-quality logit regression (Dependent Variable: DFTQ)										
β	0.244***	0.001	-0.017***	0.001***	-0.004	0.003	0.003	0.008***	-0.084***	-0.072***
	(8.539)	(0.339)	(-7.086)	(3.304)	(-0.790)	(0.1935)	(0.6219)	(3.4277)	(-13.079)	(-22.436)
McFadden R-squared		0.024								
LR statistic 917.89										
Prob(LR statistic)		0.0000								

Note: Panel A reports results from the logit regression where contagion dummy is dependent variable and take on value of 1 when contagion exists and 0 otherwise. Panel B reports results from the logit regression where flight-to-quality dummy is dependent variable and take on value of 1 when flight-to-quality exists and 0 otherwise. Z-statistics are reported in the blanket.5T*** and ** indicate statistical significance at 1% and 5% levels, respectively.

5. SUMMARY AND CONCLUSIONS

The aim of this paper is to examine whether contagion and flight-to-quality phenomena exist in stock and bond markets among the APEC countries across eight crises periods between 1995 to 2010. In addition, this paper investigates the determinants of both contagion and flight-to-quality phenomena. The results show that contagion effects are present in the stock markets of APEC countries but only between the bond markets of US and Canada during crisis periods. Moreover, we also find evidence of flight-to-quality phenomenon from the stock market to the U.S. government bond markets during the crises. The levels of contagion and flight-to-quality are closely associated with the severity of the crisis since they are more prominent during the Asian crisis and the GFC. During the Asian crisis and the GFC, investors withdrew funds from stock markets due to the fear of global stock market crashes (contagion effect), and invested in the bond market in search of a more secured return (flight-to-quality phenomenon). The results from the logit models further demonstrate that, after controlling for the fundamental economic factors, the Consumer Sentiment Index still plays an important role in determining both the contagion and flight-to-quality phenomena. These findings suggest that short-term policies aimed at stabilizing the economy, such as foreign exchange intervention, government guarantee on the banking sector, can possibly limit the spread of the crisis. Our findings have several implications for policy makers, practitioners and investors.

For international practitioners and investors, the ability to forecast market volatility and correlations between asset markets is important. Our results demonstrate that during the high-stressed periods, diversification benefits within the stock markets are reduced due to contagion effect. Our findings suggest that investors need to consider diversifying their investments across asset classes such as stock and bond markets, as the presence of flight-to-quality to the bond market can limit the losses incurred in the stock markets. For policy makers, the flight-to-quality phenomenon in APEC region reinforces the importance of establishing well-functioning local bond markets to limit the negative impact from financial crisis, and to foster the stability of capital markets in the APEC region.

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