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Cross-Market Interdependence among Asia-Pacific Countries: A Dynamic Herding Spillover Approach

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Abstract

This study investigates the cross-market interdependence among Asia-Pacific countries through dynamic herding spillover by using the structural change model of Bai and Perron (1998, 2003) from 2007-2022. The countries selected for the study are China, Japan, South Korea, India, the US, and Thailand. Results of the study depict herding spillover and co-movement among Asia-Pacific countries during turbulent regimes. The study shows mixed results for the sample countries. Pairwise herding co-movement is evident between the US-Japan, Japan-South Korea and South Korea-China during various contagious events such as Covid-19, the Great East Japan Earthquake, the Global Financial Crisis, and the Shanghai stock market crash. India is showing herding spillover from Japan and a co-movement with Thailand only. Moreover, one-way herding spillover is present from the US to South Korea due to the cryptocurrency crash. Furthermore, Thailand and its trading partners are following each other during various events. The stock market in Thailand appears to be highly interconnected with other Asia-Pacific markets and responsive to changes in market structure. All these findings show that the economies of Asia-Pacific countries are correlated with each other through herding spillover during various contagious events. Hence, investors should diversify their trading and asset allocation strategies during these turbulent regimes, as market risk increases during these events.

Keywords: Herding Spillover, Structural Change Model, Asia-Pacific Countries, Break Dates

JEL Classifications: C58, G01, G11, G14, G15, G4

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This paper is a selected paper from Asia Pacific Economic Integration Forum (A-PAC EIF 2022), organized by Faculty of Economics, Thammasat University; Thammasat Business School, Thammasat University; Maharaja Agrasen Institute of Management Studies (MAIMS); The University of Danang - University of Economics and Faculty of Economics & Business Administration, Dalat University; and Entrepreneurship Development Institute of India.

1. Introduction

The Asia-Pacific countries have shown fast and splendid growth despite unprecedented events like the US financial crisis and the Covid-19 pandemic. Recently, 15 East Asian and Pacific nations entered into a free trade agreement named "The Regional Comprehensive Economic Partnership" with effect from 1st January, 2022 which becomes the new center of gravity for global trade as these nations account for 30% of the world's GDP (UNCTAD, 2021). The countries in the Asia-Pacific region have become financially integrated and exhibit high levels of foreign portfolio investment and financial development. This increasing interdependence has gained momentum through the integration of financial markets across the globe. It leads to unexpected shocks and high volatility linkages among the stock markets of various countries (Shi, 2022). Such high-volatility shocks and interlinkages lead to herding spillover among the trading partner nations. Herding is a financial phenomenon in which investors, fund managers, and policymakers mimic each other's actions while ignoring their own personal information. Moreover, herd behavior intensifies market volatility and deviate fundamental prices from their market value (Chiang & Zheng, 2010; Tan et al., 2008). It also creates bubbles in the stock market and irrational decision-making (Lao & Singh, 2011; Litimi, 2017). Herding is prominently observed during highly volatile periods or extreme market movements; therefore, investors need substantial stocks to diversify their portfolios (Chang et al., 2000). It might be highly possible that investors behave similarly, especially during crisis events, while investing in other international financial markets to achieve diversification (Yasir & Önder, 2022). It leads to the herding spillover effect, where the occurrence of events in one country affects the herd behavior of another country. And moreover, high market volatility exacerbates the herding spillover or contagion effect (Syriopoulos & Bakos, 2019). Herding spillover will upsurge the financial risk and challenge the problem of diversification and financial stability (Yasir & Önder, 2022). The study of herding and herding spillover is beneficial for investors, fund managers, and portfolio managers in devising risk diversification strategies (Dewan & Dharni, 2022).

With this goal in mind, the current study opted to investigate the impact of herding spillover in the Asia-Pacific region. The countries included in the study are China, Japan, South Korea, India, the US and Thailand. There are mainly three reasons for including these countries. Firstly, the Asian countries have been chosen as the top 8 with the highest GDP in 2021 (GDP - Countries - List | Asia, 2021) At the initial level, we considered including Saudi Arabia, Taiwan, and Indonesia as these countries fall above Thailand in the top 8 list, but the number of companies listed during the study period (2007-2022) is less than 50% of the total number of constituents in the index in these countries. Consequently, the research does not include these nations. Next, the countries are highly connected to each other in terms of foreign trade. India, China, South Korea, and Japan were among the top 10 trading partners of the US in 2021 (Leading trade partners, 2021). The US and China were among the top 3 trading partners of India in 2021. The US, Japan, South Korea, India, and Thailand were among the top 12 trading partners of China in 2021 China, the US, Japan, and India were among the top 8 trading partners of South Korea in 2021. The US, China, Japan, India, and South Korea

were among the top 15 trading partners of Thailand in 2021[1]. Furthermore, according to the World Investment Report of 2022 released by UNCTAD, FDI inflows rose in the developing Asian region despite COVID-19. FDI in East Asia increased by 16 % in 2021, and China's FDI grew by 21 %. Inflows in the Southeast Asia region have also picked up pace, and new international finance projects have been announced in India (UNCTAD, 2022). This upsurge in FDI may also trigger spillover among these countries as a result of their increased interconnectedness.

This paper adds a number of contributions to the existing body of knowledge. First of all, most studies used the linear model without addressing the multiple structural changes in the data when investigating herding spillover. Examining structural breaks in any time series is crucial because it allows for a more flexible and accurate estimation of the relationship between variables by incorporating potential structural breaks, while ignoring these changes may lead to a misleading conclusion. Further, it may be possible that investors behave differently in tranquil and turbulent regimes (Fu & Wu, 2021). Hence, the present study used the Bai and Perron's (1998, 2003) model to identify the structural break dates in a linear model and investigate the time-varying herding spillover among different market regimes. Furthermore, the Bai and Perron test enables the determination of breaks endogenously by allowing for five breakpoints in the data (Fasanya et al., 2022). Therefore, it is crucial to address this issue in herding spillover as well. Not many studies investigated the cross-market interdependence through herding spillover among Asia-Pacific countries.

The paper is organized as follows: Section 2 describes the literature review, while Section 3 details the study's objectives. Section 4 elaborates on data and methodology, Section 5 presents the results and discussion, and Section 6 concludes with the implications of findings.

2. Literature Review

This section describes the valuable insights into previous studies on herd behavior and its spillover effects over the developed and developing countries. The causes of herding are informational cascades, confirmation bias, complex informational structure and reputational concern (Avery & Zemsky, 1998; Bikhchandani et al., 1992; Bikhchandani & Sharma, 2000; Scharfstein & Stein, 1990). Since herding is related to sentiments or behavior of the investor, hence many researchers have developed models to quantify the herding in the financial market context. Herding can be measured either by collecting primarily the micro data related to the mutual funds & institutional investors or by using market data (Lakonishok et al., 1992; Chang et al., 2000; Christie & Huang, 1995; Hwang & Salmon, 2004; Klein, 2013).

Many studies empirically investigated herding in developed, emerging, and underdeveloped countries and offered mixed results. Some studies found herding in extreme market situations like up/down markets, high/low volatility, or during crisis period (Bekiros et al., 2017; Chiang & Zheng, 2010; K. H. Choi & Yoon, 2020; Lao & Singh, 2011; Litimi, 2017). Benkraiem et al. (2019) investigated herding in small medium enterprises in the UK and French market, giving evidence in favor of herding in small enterprises. Stavroyiannis and Babalos (2020) examined the dynamic herding in

[1] The data for trading partners of all countries is collected from website https://www.worldstopexports.com.

the Eurozone stock market and found negative herd behavior. Likewise, Gleason et al. (2004) checked the herding in the American exchange- traded fund using intraday data in extreme market conditions and found the absence of herd behavior. Herding is more prominent in emerging and developing markets due to the inefficiency of the market, cultural differences, ambiguity in the disclosure of information, and low liquidity (Chang et al., 2000; Lao & Singh, 2011; Mand & Sifat, 2021).

Researchers also mentioned that herding is more pronounced in Asian markets. Chang et al. (2000) explored herding in various international markets, including Hong Kong, Japan, South Korea, and Taiwan. They discovered significant herding proof in the stock markets of South Korea and Taiwan. Chiang and Zheng (2010) studied herding across the various stock markets globally, including those in Asian nations, and demonstrated the presence of herding during upward-trending markets. Zheng et al. (2017) studied sectoral herding in Asian countries and found the presence of herding at the industrial level. Jiang et al. (2022) measured the herding behavior in East Asian and Southeast Asian equity markets during the pandemic situation and disclosed significant herding with wide fluctuations and shocks.

Evidently, many numbers of studies have measured herding in various international stock markets, including emerging nations. But only a few studies have explored cross-country herding or herding spillover across the global market. Balcilar et al. (2013) analyzed cross-country herding between GCC markets using the Regime Switching model. They exhibited indications of herding and volatility spillover in each market during the crash regime. Galariotis et al. (2014) examined herding spillover in the UK and the US stock markets during different crisis periods. The outcomes indicate a significant spillover of herding behavior from the US stock market to the UK market during the Asian crisis and dot-com bubble collapse. Likewise, Chiang and Zheng (2010) also indicated the contagion effect during the crisis period among Asian countries from the US stock market. Jirasakuldech and Emekter (2020) investigated the herding in the Thailand market during the Asian Crisis of 1997 and market structural changes. The outcomes of the study revealed significant herding during the 1997 Asian crisis. Alhaj-Yaseen and Rao (2019) examined the herding spillover in the Chinese financial market from seven countries. Findings showed herding spillover from the US, the UK, Hongkong and Taiwan to China. A recent study by Yasir and Önder (2022) examined the dynamic herding spillover among BRIC countries, including Turkey, from the US market using Bai and Perron's (1998) structural break test. Background studies show that a few studies have examined time-varying herding spillover across the globe by identifying different market regimes.

3. Objectives of the Study

This section highlights the objectives of the study.

3.1 To investigate the presence or absence of herd behavior using structural change model in Asia-Pacific countries.

3.2 To examine cross-market interdependence through herding spillover using structural change model among Asia-Pacific countries.

4. Data and Methodology

Daily stock prices of individual stocks in India, China, South Korea, Japan, the US, and Thailand are obtained from Thomson Reuters DataStream for the period 2007-2022. The 2007–2022 time frame is chosen because it encompasses major crisis events like the global financial crisis and Covid-19. We have selected those countries in which at least 50 percent of the total constituents of the representative index were listed in 2007. To fulfill the first objective, the researchers first indentified the break dates by employing Bai and Perron's (1998, 2003) test for each individual sample country and then analyze the herd behavior in each sample country in the Asia-Pacific region. For the second objective, the researchers first calculated pairwise structural break dates among six sample countries using Bai and Perron's (1998, 2003) model. After that, the study investigated cross-market herding spillover among the six sample countries in Asia-Pacific.

Table 1: Sample Characteristics

Countries	GDP (USD billion)	Name of the Index	Sample Companies
US	22,996	Standard & poor	424
China	17,734	SSE	26
Japan	4937	Nikkei	211
India	3173	Nifty	43
South Korea	1799	KOSPI	131
Thailand	506	SET Composite	373

Source: https://tradingeconomics.com/country-list/gdp-2021

Table 1 shows the countries chosen, the GDP thereof, index information and the sample companies included in the study. We have selected only those companies in each country whose data were available for the overall sample period.

Linear Model for Measuring Herd Behavior

For measuring herd behavior, the most widely used model is cross-sectional absolute deviation named as "Cross-Sectional Absolute Deviation" which is calculated using market return and stock return. This model is proposed by Chang et al. (2000), who stated that the relationship between return dispersion and market return depicts herding at the aggregate market level. For calculating return dispersion, the following formula is used:

$$CSAD_t = \frac{1}{N}\sum_{i=1}^{N}\left|R_{i,t} - R_{m,t}\right| \quad (1)$$

$R_{m,t}$ means the market consensus calculated by taking the cross-sectional average of N companies on a day t. $R_{i,t}$ is the stock return. Now, CSAD is the dependent variable for the equation defined here as follows:

$$CSAD_t = \gamma_0 + \gamma_1\left|R_{m,t}\right| + \gamma_2 R_{m,t}^2 + \varepsilon_t \quad (2)$$

Here, the squared market return is included in the model to capture the herding effect. If the relationship between return dispersion and market return is positive and linear, then there is no herding, and if the coefficient γ_2 is negative and significant, that

means the presence of herding in the stock market. It also shows the presence of a non-linear relationship between market return and return dispersion. The model is run using HAC options, including Quadratic Spectral Kernel's method for calculating the covariance matrix and true standard errors in the presence of heteroscedasticity and serial correlation, similar to Bai and Perron's (2003) study. Since we have a large number of observations, it is advisable to use HAC covariance options.

Descriptive Statistics

Table 2 (see Annexure) specifies a more inherent analysis of return dispersion and absolute market return variables for all six Asia-Pacific countries. The mean value of the return dispersion in Korea is highest, followed by Thailand, China, Japan, and India. The mean of CSAD is lowest for the US. The higher mean value represents the high market variations towards market returns. While the standard deviation for CSAD is higher in the Chinese stock market, indicating the presence of greater market cross-sectional fluctuation due to some unprecedented events. Regarding the absolute market return, the Chinese stock market exhibits high values for both the mean and standard deviation. The augmented Dickey-Fuller test confirms the stationary nature of all the series, whereas the Jarque-Bera statistics specify that all the nations have a significant deviation from the normal distribution.

Structural Change model for detecting Break Dates

Next, the linear model is expanded, and multiple unknown break points are estimated using the Bai and Perron (1998, 2003) multiple structural break test, as per Yasir and Önder's (2022) methodology. Bai and Perron (1998) developed a test based on least squares regression which detects structural shifts in the linear model. There are some assumptions, like the regressors must not have any trending regressors, and break dates are estimated sequentially. Later, Bai and Perron (2003) further improved their own version of the test to increase its size and power . They developed various tests for series with serial correlation and heteroscedasticity. Hence, the following steps are being followed on equation (2) for each country and extended to equation (4) to identify the break dates:

1. The Sup F_t (K) test is used to test the null hypothesis of no structural breaks as compared to the alternate hypothesis of a fixed number of breaks.
2. First, to see whether there is any single break in the model, the study used the double maximum UDMax and WDMax test statistics, which are based on 1 to M globally determined breaks with an error distribution that varies across different break dates. This test is also applied by Cakan et al. (2019). The test statistics for all five counties show the presence of at least one break in the model.
3. Second, to determine the exact number of breaks, the sequential sup$F_T(l+1|l)$ test is used, as given by Bai and Perron (1998). The study doesn't apply the global information criteria test as suggested by Liu et al. (1997) because it doesn't perform well in of the presence of serial correlation and heteroscedasticity in the residuals, as proposed by Bai and Perron (2003).

The null hypothesis of this test is 0, 1, and 2 breaks against the alternative of 1,2 and 3 breaks. The study also allows for error distribution to differ across break dates, similar to the study by Cakan et al. (2019).

Hence, to check the herding among Asia-Pacific countries, a structural change model is presented hereunder.

$$CSAD_t = \gamma_{01} + \gamma_{11}|R_{m,t}| + \gamma_{21}R_{m,t}^2 + \varepsilon_t, \quad t = 1,\ldots\ldots,T_1 \tag{3}$$
$$\vdots$$
$$CSAD_t = \gamma_{0r} + \gamma_{1r}|R_{m,t}| + \gamma_{2r}R_{m,t}^2 + \varepsilon_t, \quad t = T_r,\ldots\ldots,T$$

(T_1,……T_r) denotes the r number of unknown break points.

This technique operates in a similar fashion to the least squares method, where it minimizes the residual sum of squares, represented as:

$$\sum_{i=1}^{r+1}\sum_{t=T_{i-1}+1}^{T_i}\left(CSAD_t - \gamma_{0i} - \gamma_{1i}|R_{m,t}| - \gamma_{2i}R_{m,t}^2\right)^2$$

To examine the herding spillover effect, equation (3) is expanded to incorporate another country's return dispersion and market return as independent variables, following the methodology employed by Chiang and Zheng (2010). The equation for spillover is presented below:

$$CSAD_{j,t} = \gamma_{01} + \gamma_{11}|R_{m,t}| + \gamma_{21}R_{m,t}^2 + \gamma_{31}CSAD_{k,t} + \gamma_{41}R_{m,k,t}^2 + \varepsilon_t, \quad t = 1,\ldots\ldots,T_1 \tag{4}$$
$$\vdots$$
$$CSAD_{j,t} = \gamma_{0r} + \gamma_{1r}|R_{m,t}| + \gamma_{2r}R_{m,t}^2 + \gamma_{3r}CSAD_{k,t} + \gamma_{4r}R_{m,k,t}^2 + \varepsilon_t, \quad t = T_r,\ldots\ldots,T$$

Here, the two additional terms $CSAD_{k,t}$ and $R_{m,k,t}^2$ represent the independent variable of market k. A positive and significant coefficient of γ_{3r} would indicate that the return dispersion of market k has an impact on the return variability of market j. It means there are cross-country volatility shocks. If the coefficient γ_{4r} is both negative and significant, this indicates that the market conditions of market k are the determining factor in the herd behavior of market j, also known as herding spillover.

Table 2: Descriptive Statistics

Statistics	China	India	Japan	Korea	Thailand	US
Panel A- Cross-Sectional Absolute Deviation						
Mean (%)	1.38	1.24	1.12	1.53	1.42	1.06
Standard Deviation (%)	0.70	0.56	0.51	0.59	0.60	0.57
Jarque-Bera Statistics	1229.85***	5819.84***	5559.21***	9100.48***	11225.53***	27534.72***
ADF-test	-10.999***	-8.527***	-10.771***	-8.687***	-7.986***	-6.830***
No. of observation	4026	4026	4026	4026	4026	4026
Panel B- Absolute Market Return ($\|R_{m,t}\|$)						
Mean (%)	1.05	0.82	1.00	0.82	0.52	0.85
Standard Deviation (%)	1.14	0.92	1.09	0.96	0.64	1.07
Jarque-Bera Statistics	13390.88***	149182.1***	63209.76***	118004.6***	144944.4***	95815.5***
ADF-test	-11.698***	-10.137***	-10.736***	-10.247***	-16.593***	-8.830***
No. of observation	4026	4026	4026	4026	4026	4026

*Notes: *** Significant at 1% level. ADF-test indicates the stationarity of the Variables. Jarque-bera statistics indicates the normality of the variables.*
Source: Author's own calculations

5. Results and Discussion

This section exhibits the analytical part of the structural break model for the six Asia-Pacific countries. The first subsection depicts the results of herding using the structural change model for each country. The next subsection highlights the evidence of herding spillover for different pairs of countries undertaken for the study.

5.1 Herding based on Structural change model

Previous studies demonstrate that herding is more exacerbated during high fluctuations or structural shifts in the market. Hence, it is very important to address those events and check out the herd behavior at a time of high uncertainty. To explore the dynamic nature of herd behavior, we employ the methodology introduced by Bai and Perron (1998, 2003).

As advised by Bai and Perron's (2003) methodology, it is not advisable to directly employ the sequential Sup F test of l breaks vs. the alternative of L+1 breaks. We assume a maximum of five breaks and apply a 15% trimming method to ensure that each segment contains at least 15% of the total observations. Initially, the paper utilized a linear model, following which it tested for multiple structural breaks using the outcomes of the linear model. Results of the linear model show evidence of herding for all the countries except South Korea and the US for the whole period 2009-2022.

Next, Table 3 (see Annexure) reports the results of herd behavior using structural change model for China, India, Japan, South Korea, Thailand, and the US. Results related to South Korea match the linear model because the data shows no herding in any of the regimes. In fact, the findings demonstrate evidence of anti-herding in three regimes, consistent with the linear model, as evidenced by the substantial and negative value of the γ_2 coefficient. Next, the coefficients of Japan, China, Thailand, India, and the US are negative and significant in Regime 1, which is within the range of 1/1/2007 to 10/09/2009. And this period is considered a global financial crisis by many studies. Previous studies depicted that the Asian market, including the US is highly influenced by the US global financial crisis and depicts herd behavior (Chiang & Zheng, 2010; Fu & Wu, 2021; Lao & Singh, 2011; Yasir & Önder, 2022; Yasir & Önder Özlem, 2021). Further, the study also detects significant herding in Regime 4 of China, India, and Japan and Regime 5 of Thailand except South Korea and the US, which includes the pandemic period. Given that herd behavior tends to be more dominant during periods of extreme movements, it is plausible that the Covid-19 pandemic may have influenced herding in Asia-Pacific nations. These outcomes match with the recent study by Jiang et al. (2022), which exhibited the greater impact of Covid-19 crisis in Japan and China. The significant coefficient of herding is detected in all regimes in Thailand and China, showing these markets are highly sensitive to extreme shocks. Regime 3 demonstrates a compelling signal of uniformity, as exemplified by the Shanghai Stock Market Crash of 2015 (Shi, 2022). Moreover, herding was also observed during Regime 3 (2012-2015) of the US stock market. The possible reason for the same can be attributed to various events like the Ottawa shooting incident in Canada and the two biggest flash crashes in 2015 in the S&P 500 index (Mitchell, 2021; Yasir & Önder Özlem, 2021). The first crash was on 24th August, 2015 when the S&P 500 declined 5% in a single day, and causing a major sell-off by investors due to herd mentality and the drop of Asian market stocks on the previous day.

5.2 Herding Spillover based on Structural Change model

This section describes estimates of the Equation (4) which shows the volatility and herding spillover among the Asia-Pacific countries. For examining the US spillover to Asian countries, one lag period of US market variables is included as an explanatory variable because Asian market is ahead of the US stock market (Chiang & Zheng, 2010).

Table 4 (see Annexure) exhibits the outcomes of herding and volatility spillover with respect to India. Break dates are calculated for all the countries with respect to India. We detect no indication of spillover herding from China, the US, or South Korea to India in any of the regimes. The results from China match the recent study by Yasir and Önder (2022), which also found no herding spillover from China to India. There is evidence of herding spillover from Japan to India after the post-financial crisis. It may be due to the great East Japan Earthquake of March 2011, and foreign investors continuously bought Japan shares after March 2013 because of the renewed policies by the Japanese government and Bank of Japan Furthermore, herding spillover is observed from Thailand to India in Regime 3, which includes the Covid-19 crisis period and the US-China trade war (Nimanussornkul & Nimanussornkul, 2021; Shi, 2022). The coefficient γ_3 tells the impact of volatility shocks or volatility spillover if it is positive and significant. The study finds evidence of volatility spillover from Japan, Korea, Thailand, and the US to India during global financial crisis indicating Asian markets are highly influenced by the crisis. We did not find evidence of a volatility spillover from China to India before 2016. The study by Mishra et al. (2022) advocates the constrained character of the Chinese economy with respect to other nations in the past, which is one possible explanation for these results. The study yields similar results to Yadav et al. (2023) who stated that there was no spillover from China to other emerging nations, including India, in various sub-period analyses. The paper also reports evidence of volatility spillover from all the markets to India during Covid-19. The possible reason for this is that trade between China and India has grown tremendously in recent years, so information transmission is also increasing (Mishra et al., 2022). And Regime 3 of China also has a volatility spillover impact, which includes the two most important events: one is the US-China Trade wars and the Covid-19 Crisis, as depicted by the study of Shi (2022).

Table 5 (see Annexure) reports the results of herding and volatility spillover in all the countries with respect to China. Herding spillover occurs from Thailand and Japan to China during Regime 4, which covers the major Covid-19 crisis. The reason that can be assigned to this is the high trade linkages of China with Japan and Thailand. Herding spillover is observed after global financial crisis from South Korea to China. As South Korea shares a border with China, events in one country can have an impact on the other, as evidenced by the substantial coefficient of volatility spillover from South Korea to China across all regimes. Also, the "CSAD" of all the countries had a significant impact on the CSAD of China during Covid-19.

Table 6 (see Annexure) shows the results of herding and volatility spillover from all markets with respect to Japan. The coefficient γ_4 is negatively significant from Thailand and the US to Japan, which shows herding spillover. The potential reason for this is that the subprime mortgage crisis affected the stock markets of Japan very negatively in 2007 and that Lehman Brothers shocks in 2009 caused the highest fall of the Nikkei index in the previous 26 years (History of Japanese Market, n.d.) Regime 3 of Korea and Thailand also shows significant evidence of a cross-country herding effect in Japan. The possible reason for this may be the Shanghai Stock Market Crash in mid-2015 which led to a high correlation between China and emerging economies including South Korea and Thailand (Shi, 2022). And we also found evidence of volatility

spillover from China to South Korea and Thailand during the Shanghai Stock Market Crash. Furthermore, during the global financial crisis and Covid-19 regime, volatility co-movements can be seen from Thailand, South Korea, India, and the US to Japan.

Table 7 (see Annexure) reports the results with respect to South Korea. The regime periods, which cover the Covid-19 time period, are showing significant herding spillover from China, Thailand, and Japan to South Korea. Significant herding spillover is observed from Japan to South Korea in all the regimes after global financial crisis. The possible reason for this is that, due to fear of the European sovereign debt crisis, stock markets crashed around the world, including the US (Nikkei crash, 2016). Moreover, significant volatility impacts can be observed from all the markets to Korea, showing the South Korean market's volatility is highly influenced by the other Asia-Pacific countries' volatility. Findings disclose that the herding spillover from the US to South Korea in Regime 4 may be due to cryptocurrency crash in 2018 in the US market (Williams, 2022). It is an interesting finding related to South Korea, which indicates no domestic herding but shows herding spillover with the US. These results are similar to those of Chiang and Zheng (2010) who found no domestic herding in the Latin American market but these countries herd in the US market.

Table 8 (see Annexure) shows the results of herding and volatility spillover with respect to Thailand. Significant herding spillover can be observed in Regime 5 from China to Thailand. Regime 5 of China, which covers the Covid-19 crisis in 2020 and also the US-China trade war in 2018, had volatility linkages with the Asian-Pacific countries (Shi, 2022). The coefficient of herding spillover is negative and significant in Regime 2 from Japan and South Korea to Thailand. The reason can be assigned to the Great East Japan Earthquakes in 2011 and high foreign investment in 2013 (History of Japanese Market, n.d.) Moreover, there is evidence of herding spillover from Japan to South Korea during 2009-2015 so it may be possible that the events in Japan indirectly have an impact on Thailand through South Korea. A significant coefficient of herding spillover is observed in Regime 4 from India to Thailand. It may be because the Indian stock market performed very poorly in 2019 due to the announcement of a high tax surcharge on foreign portfolio investment (Merwin, 2021). Significant cross-country herding is present in Regime 2 from the US to Thailand after the global financial crisis. The paper also demonstrates a noteworthy coefficient of volatility spillover from China to Thailand during Regime 4, which coincided with the Shanghai Stock Market Crash. And its contagion on Asia-Pacific countries started in mid- 2015 and its peak was in January 2016 (Shi,2022). Also, China was Thailand's top trading partner in 2021 and trade linkages increased the chances of volatility shocks. India's volatility contagion is observed in each of the regimes in Thailand. Moreover, the study also investigated whether Asian countries also influence the US stock market or not. Because there is a chunk of literature showing the US spillover to Asian countries but not the opposite.

Table 9 (see Annexure) reports the findings of herding and volatility spillover with respect to the US. We found no evidence of spillover of herd behavior from Asian stock market to the US except in Regime 2 and Regime 4 from Japan and Thailand to the US, respectively. This may be due to the fact that Japan has the largest foreign investment in the US treasury securities (S. Y. Choi, 2022). And due to this, the US stock market is influenced by the Japanese stock market. Further, the Great East Earthquake happened on March 11, year??, and it caused the accident of the Fukushima nuclear power plant, which caused a 10.55% decline in the Nikkei index after Black Monday and the Financial Crisis (History of Japanese Market, n.d.)Volatility spillover is observed from India, Japan, and South Korea to the US in all the regimes, showing the US market is also influenced by the Asian countries. During the pandemic, significant volatility

shocks can be transmitted from Asian countries to the US. It shows that the US was the only volatility transmitter during the financial Crisis of 2008 and a receiver of shocks during Covid-19 (S. Y. Choi, 2022). Overall, the study shows the contagion events through Figures, as shown ahead, to have a clear understanding of the findings. Figure 1 shows the graphical representation of contagion events that lead to the herding spillover or co-movement of Thailand with its trading partners in the Asia-Pacific region. Two sided arrows indicate co-movements between pairs of countries. The study shows the result of Thailand distinctly because Thailand depicts a cooperative movement with each sample country.

Table 3: Results of Herd Behavior using Structural Change Model

China Break Dates 8/20/2009, 11/12/2014, 2/22/2018			**India Break Dates 8/13/2009, 11/10/2015, 4/10/2018**			**Japan Break Dates 8/12/2009, 6/13/2013, 12/21/2016, 2/12/2020**		
Coefficients	γ_1	γ_2	**Coefficients**	γ_1	γ_2	**Coefficients**	γ_1	γ_2
Regime 1 (1/1/2007- 8/19/2009)	0.50***	**-4.90*** **	Regime 1 (1/1/2007- 8/12/2009)	0.439***	**-1.53*** **	Regime 1 (1/12007-8/11/2009)	0.371***	**-1.34*** **
	(7.927)	**(-5.768)**		(12.78)	**(-4.19)**		(11.19)	**(-4.739)**
Regime 2 (8/20/2009- 11/11/2014)	0.411***	-4.59***	Regime 2 (8/13/2009- 11/9/2015)	0.389***	-3.86***	Regime 2 (8/12/2009- 6/12/2013)	.0.275***	0.341
	(7.141)	(-2.824)		(11.09)	(-3.18)		(10.61)	(-0.513)
Regime 3 (11/12/2014- 2/21/2018)	0.661***	-5.59***	Regime 3 (11/10/2015- 4/9/2018)	0.476***	-6.723	Regime 3 (6/13/2013- 12/20/2016)	0.263***	-2.51***
	(11.48)	(-7.138)		(5.886)	(-1.634)		(8.52)	(-4.269)
Regime 4 (2/22/2018- 6/6/2022)	0.448***	**-4.31*** **	Regime 4 (4/10/2018- 6/6/2022)	0.412***	**-1.36*** **	Regime 4 (12/21/2016- 2/11/2020)	0.382***	-7.03***
	(8.164)	**(-3.53)**		(12.98)	**(-4.028)**		(7.745)	(-4.822)
						Regime 5 (2/12/2020- 6/6/2022)	0.30***	-1.564
							(6.755)	(-1.409)
South Korea Break Dates 10/2/2009, 12/31/2013, 4/22/2016			**Thailand Break Dates 10/21/2009, 4/3/2015, 7/28/2017,1/1/2020**			**US Break Dates 8/14/2009, 8/10/2012, 9/17/2015, 2/5/2020**		
Coefficients	γ_1	γ_2	**Coefficients**	γ_1	γ_2	**Coefficients**	γ_1	γ_2
Regime 1 (1/1/2007- 10/1/2009)	0.33***	0.08	Regime 1 (1/1/2007- 10/9/2009)	0.88***	**-2.043***	Regime 1 (1/1/2007- 8/13/2009)	0.43***	-0.981**
	(12.67)	(0.895)		(14.19)	**(-1.873)**		(12.50)	(-2.144)
Regime 2 (10/2/2009- 12/30/2013)	0.313***	0.14***	Regime 2 (10/12/2009- 4/2/2015)	0.72***	-6.32***	Regime 2 (8/14/2009- 8/9/2012)	0.21***	-0.484
	(12.10)	(2.875)		(15.47)	(-4.716)		(9.093)	(-0.928)
Regime 3 (12/31/2013- 4/21/2016)	0.407***	0.23***	Regime 3 (4/3/2015- 7/27/2017)	0.71***	-6.0***	Regime 3 (8/10/2012- 9/16/2015)	0.27***	-5.07***
	(9.644)	(2.860)		(11.18)	(-4.434)		(7.961)	(-3.708)
Regime 4 (4/22/2016- 6/6/2022)	0.291***	0.07***	Regime 4 (7/28/2017- 1/1/2020)	1.15***	-39.90***	Regime 4 (9/17/2015- 2/4/2020)	0.30***	-3.046
	(14.07)	(4.157)		(10.03)	(-5.548)		(6.943)	(-1.522)
			Regime 5 (1/12020- 6/6/2022)	0.84***	**-4.84*** **	Regime 5 (2/5/2020- 6/6/2022)	0.37***	-0.322
				(14.02)	**(-4.73)**		(7.272)	(-0.835)

*Notes: *** Significance at 1% level. ** Significance at 10% level. The values in the parenthesis indicates the t-statistics.*

Source: Author's own calculations

Table 4: Results of Herding Spillover for India based on Structural Change Model

Results for India											
China Break Dates 8/13/2009, 2/15/2016				**Japan Break Dates 11/2/2009, 5/6/2013, 9/11/2015, 5/14/2018**				**US Break Dates 11/02/2009, 5/16/2013, 9/14/2015**			
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4
Regime 1 (1/1/2007-	-1.54***	0.037	0.25	Regime 1 (1/1/2007-	-1.63***	0.144***	0.49**	Regime1 (1/02/2007-	-1.366***	**0.13*** **	0.471
8/12/2009)	(-3.985)	(1.240)	(1.285)	10/30/2009)	(-3.299)	(3.635)	(2.272)	10/30/2009)	(-3.355)	**(2.658)**	(0.187)
Regime 2 (8/13/2009-	-4.15***	0.00	0.075	Regime 2 (11/2/2009-	-7.58***	0.033	-0.31***	Regime 2 (11/02/2009-	-7.756***	0.16***	0.260
2/12/2016)	(-3.467)	(0.044)	(0.528)	5/3/2013)	(-3.672)	(1.102)	(-2.722)	5/15/2013)	(-3.711)	(3.965)	(0.734)
Regime 3 (2/15/2016-	-1.35***	**0.05*** **	0.338	Regime 3 (5/6/2013-	-2.67***	0.12***	-0.264	Regime 3 (5/16/2013-	-3.117***	0.145*	0.735
6/6/2022)	(-4.454)	**(2.679)**	(0.729)	9/10/2015)	(-3.07)	(3.094)	(-0.973)	9/11/2015)	(-3.543)	(1.954)	(0.839)
				Regime 4 (9/11/2015-	-8.78**	0.09***	0.784*	Regime 4 (9/14/2015-	-1.505***	**0.22*** **	-0.090
				5/11/2018)	(-2.162)	(3.451)	(1.827)	6/6/2022)	(-4.730)	**(7.378)**	(-0.49)
				Regime 5 (5/14/2018-	-1.49***	0.22***	0.154				
				6/6/2022)	(-4.883)	(5.816)	(0.291)				
South Korea Break Dates 11/2/2009, 10/2/2015, 4/19/2018				**Thailand Break Dates 8/13/2009, 11/11/2015**							
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4				
Regime 1	-1.51***	**0.22*** **	-0.046	Regime 1	-1.65***	**0.201*** **	0.918				
(1/1/2007-10/30/2009)	(-3.213)	**(6.209)**	(-0.62)	(1/1/2007-8/12/2009)	(-3.746)	**(4.050)**	(-0.853)				
Regime 2	-3.52***	0.05**	-0.014	Regime 2 (8/13/2009-	-4.02***	0.039*	0.065				
(11/2/2009-10/1/2015)	(-3.237)	(2.427)	(-0.47)	11/10/2015)	(-3.392)	(1.718)	(0.175)				
Regime 3	-6.941*	0.16***	-0.013	Regime 3	-0.77***	**0.145*** **	**-2.89*** **				
(10/2/2015-4/18/2018)	(-1.678)	(4.764)	(-1.17)	(11/11/2015-6/6/2022)	(-3.803)	**(6.454)**	**(-5.196)**				
Regime 4	-1.44***	**0.17*** **	0.008								
(4/19/2018-6/6/2022)	(-4.446)	**(5.778)**	(0.388)								

*Notes: *** Significance at 1% level. ** Significance at 10% level. The values in the parenthesis indicates the t-statistics. For calculating US Spillover on Asian Countries, one lag term of $CSAD_{US,\,t-1}$ and $R^2_{m,t-1}$ is used.*

Source: Author's own calculations

Table 5: Results of Herding Spillover for China based on Structural Change Model

Results for China											
India Break Dates 8/20/2009, 11/17/2014, 2/22/2018				**Japan Break Dates 8/20/2009, 11/12/2014, 6/29/2018**				**US Break Dates 8/14/2009, 11/11/2014, 6/29/2018**			
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4
Regime 1 (1/1/2007-	-4.91***	0.037	0.040	Regime 1 (1/1/2007-	-4.85***	0.003	0.339**	Regime1 (1/02/2007-	-4.851***	-0.076	0.68**
8/19/2009)	(-5.809)	(0.986)	(0.227)	8/19/2009)	(-5.647)	(0.071)	(2.124)	8/13/2009)	(-5.754)	(-1.586)	(2.277
Regime 2 (8/20/2009-	-4.60***	0.025	0.402	Regime 2 (8/20/2009-	-4.57***	-0.020	0.259	Regime 2 (8/14/2009-	-4.447***	0.095*	-0.569
11/14/2014)	(-2.837)	(0.696)	(0.483)	11/11/2014)	(-2.811)	(-0.446)	(0.259)	11/10/2014)	(-3.057)	(1.697)	(-1.07)
Regime 3 (11/17/2014-	-5.46***	0.15**	-0.964	Regime 3 (11/12/2014-	-5.39***	0.008	-0.284	Regime 3 (11/11/2014-	-5.416***	0.030	0.314
2/21/2018)	(-6.063)	(2.434)	(-0.94)	6/28/2018)	(-7.167)	(0.175)	(-0.859)	6/28/2018)	(-7.294)	(0.355)	(0.189)
Regime 4 (2/22/2018-	-4.41***	0.057*	-0.307	Regime 4 (6/29/2018-	-4.03***	0.13***	**-1.01*** **	Regime 4 (6/29/2018-	-4.238***	0.084**	-0.292
6/6/2022)	(-3.683)	(1.746)	(-1.59)	6/6/2022)	(-3.323)	(2.919)	**(-2.954)**	6/6/2022)	(-3.322)	(2.204)	(-0.93)
South Korea Break Dates 8/20/2009, 11/17/2014, 4/10/2017				**Thailand Break Dates 8/14/2009, 11/17/2014, 5/08/2017**							
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4				
Regime 1	-4.61***	0.16***	-0.066	Regime 1	-4.91***	0.092*	0.624				
(1/1/2007-8/19/2009)	(-5.743)	(3.668)	(-0.68)	(1/1/2007-8/13/2009)	(-5.877)	(1.891)	(0.777)				
Regime 2	-4.62***	0.10***	-0.07*	Regime 2 (8/14/2009-	-4.47***	0.10***	-1.184*				
(8/20/2009-11/14/2014)	(-2.901)	(2.852)	(-1.82)	11/14/2014)	(-3.095)	(3.047)	(-1.891)				
Regime 3	-5.54***	0.39***	0.015	Regime 3	-5.54***	0.28***	-3.03***				
(11/17/2014-4/7/2017)	(-6.614)	(6.256)	(0.454)	(11/17/2014-5/5/2017)	(-5.912)	(3.925)	(-2.707)				
Regime 4	-3.83***	0.24***	-0.040	Regime 4 (5/8/2017-	-4.47***	0.09***	**-1.06*** **				
(4/10/2017-6/6/2022)	(-3.411)	(6.974)	(-1.10)	6/6/2022)	(-3.820)	(3.429)	**(-3.258)**				

*Notes: *** Significance at 1% level. ** Significance at 10% level. The values in the parenthesis indicates the t-statistics. For calculating US Spillover on Asian Countries, one lag term of $CSAD_{US,\,t-1}$ and $R^2_{m,t-1}$ is used.*

Source: Author's own calculations

Table 6: Results of Herding Spillover for Japan based on Structural Change Model

Results for Japan											
India Break Dates 8/12/2009, 6/13/2013, 2/12/2020				**China Break Dates 8/12/2009, 6/13/2013, 2/12/2020**				**US Break Dates 12/22/2009, 6/3/2013**			
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4
Regime 1 (1/1/2007-	-1.34***	**0.09*** **	-0.245	Regime 1 (1/1/2007-	-1.35***	0.009	0.087	Regime1 (1/02/2007-	-0.96***	**0.37*** **	**-0.88*** **
8/11/2009)	(-4.652)	**(2.690)**	(-1.09)	8/11/2009)	(-4.599)	(0.311)	(0.317)	12/21/2009)	(-3.412)	**(7.969)**	**(-3.238)**
Regime 2 (8/12/2009-	-0.320	0.067**	-0.872	Regime 2 (8/12/2009-	-0.349	-0.022	-0.205	Regime 2 (12/22/2009-	-0.373	0.110*	-1.043**
6/12/2013)	(-0.483)	(2.002)	(-1.23)	6/12/2013)	(-0.525)	(-0.752)	(-0.645)	6/12/2013)	(-0.644)	(1.901)	(-2.374)
Regime 3 (6/13/2013-	-3.06***	0.10***	-0.416	Regime 3 (6/13/2013-	-2.97***	0.010	0.085	Regime 3 (6/13/2013-	-3.06***	**0.31*** **	0.035
2/11/2020)	(-5.358)	(4.628)	(-1.07)	2/11/2020)	(-4.866)	(0.810)	(0.786)	6/6/2022)	(-5.446)	**(14.60)**	(0.158)
Regime 4 (2/12/2020-	-2.405**	0.21***	0.48**	Regime 4 (2/12/2020-	-1.512	**0.085** **	0.438				
6/6/2022)	(-2.094)	(3.456)	(1.999)	6/6/2022)	(-1.486)	**(1.984)**	(0.634)				
South Korea Break Dates 8/12/2009, 6/28/2013, 1/28/2016, 2/12/2020				**Thailand Break Dates 8/13/2009, 6/13/2013, 12/21/2016, 2/12/2020**							
Coefficients	γ_2	γ_3	γ_4	Coefficients	γ_2	γ_3	γ_4				
Regime 1	-1.62***	**0.21*** **	0.087	Regime 1	-1.42***	0.24***	**-2.30** **				
(1/1/2007-8/11/2009)	(-5.389)	**(5.974)**	(1.263)	(1/1/2007-8/12/2009)	(-5.535)	(4.285)	**(-2.069)**				
Regime 2	-0.372	0.08***	-0.044	Regime 2 (8/13/2009-	0.242	0.12***	-0.260				
(8/12/2009-6/27/2013)	(-0.493)	(3.114)	(-1.168)	6/12/2013)	(-0.366)	(3.869)	(-0.466)				
Regime 3	-4.25***	0.08**	**-0.058***	Regime 3	-2.43***	0.060*	**-1.26** **				
(6/28/2013-1/27/2016)	(-4.392)	(2.314)	**(-1.697)**	(6/13/2013-12/20/2016)	(-4.307)	(1.816)	**(-2.167)**				
Regime 4	-2.92***	0.13***	0.015	Regime 4 (12/21/2016-	-7.23***	0.094**	2.469				
(1/28/2016-2/11/2020)	(-5.901)	(3.926)	(0.749)	2/11/2020)	(-5.129)	(2.294)	(0.851)				
Regime 5 (2/12/2020-	-2.28**	**0.25*** **	-0.038	Regime 5 (2/12/2020-	-1.683	**0.18*** **	-0.974				
6/6/2022)	(-2.346)	**(4.505)**	(-0.765)	6/6/2022)	(-1.509)	**(3.856)**	(-1.50)				

*Notes: *** Significance at 1% level. ** Significance at 10% level. The values in the parenthesis indicates the t-statistics. For calculating US Spillover on Asian Countries, one lag term of $CSAD_{US,\,t-1}$ and $R^2_{m,t-1}$ is used.*

Source: Author's own calculations

Table 7: Results of Herding Spillover for South Korea based on Structural Change Model

Results for South Korea

India Break Dates 10/9/2009, 4/22/2016				**China Break Dates 10/9/2009, 6/13/2016**				**Thailand Break Dates 10/2/2009, 12/24/2018**			
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4
Regime 1 (1/1/2007-	0.087	0.23***	-0.203	Regime 1 (1/1/2007-	0.097	0.12***	0.217	Regime1 (1/02/2007-	0.103	0.26***	-0.279
10/8/2009)	(1.057)	(4.165)	(-0.96)	10/8/2009)	(1.184)	(3.292)	(0.679)	10/1/2009)	(1.189)	(5.252)	(-0.15)
Regime 2 (10/9/2009-	0.17***	0.08***	-0.881	Regime 2 (10/9/2009-	0.07***	0.13***	0.41***	Regime 2 (10/02/2009-	0.09***	0.10***	-0.883
4/21/2016)	(4.023)	(2.601)	(-1.15)	6/10/2016)	(3.220)	(6.188)	(2.586)	12/21/2018)	(3.273)	(3.592)	(-1.23)
Regime 3 (4/22/2016-	0.07***	0.19***	-0.132	Regime 3 (6/13/2016-	0.12***	0.25***	**-1.61*** **	Regime 3 (12/24/2018-	0.09**	0.18***	**-1.51*** **
6/6/2022)	(3.967)	(6.338)	(-0.48)	6/6/2022)	(3.178)	(8.370)	**(-3.863)**	6/6/2022)	(2.491)	(4.769)	**(-3.049)**
Japan Break Dates 12/29/2011, 7/3/2014, 11/17/2016				**US Break Dates 10/9/2009, 1/2/2014, 5/18/2016, 12/26/2018**							
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4				
Regime 1	0.046	0.30***	-0.294	Regime 1	0.048	0.14***	0.433				
(1/1/2007-12/28/2011)	(0.759)	(7.502)	(-1.44)	(1/2/2007-10/8/2009)	(0.532)	(3.479)	(1.021)				
Regime 2	0.32***	0.105**	-0.5**	Regime 2 (10/9/2009-	0.13***	0.23***	0.299				
(12/29/2011-7/2/2014)	(7.363)	(2.042)	(-1.97)	1/1/2014)	(2.920)	(4.354)	(0.533)				
Regime 3	0.04**	0.17***	-1.18*	Regime 3	0.133**	0.145	-2.662				
(7/3/2014-11/16/2016)	(2.374)	(3.126)	(-1.78)	(1/2/2014-5/17/2016)	(2.578)	(1.225)	(-1.264)				
Regime 4	0.11***	0.24***	**-1.2****	Regime 4	0.06***	0.33***	**-3.903****				
(11/17/2016-6/6/2022)	(3.304)	(5.328)	**(-2.51)**	(5/18/2016-12/25/2018)	(3.730)	(5.324)	**(-2.540)**				
				Regime 5 (12/26/2018-	0.086**	0.24***	-0.216				
				6/6/2022)	(2.517)	(6.119)	(-0.951)				

*Notes: *** Significance at 1% level. ** Significance at 10% level. The values in the parenthesis indicates the t-statistics. For calculating US Spillover on Asian Countries, one lag term of $CSAD_{US,\,t-1}$ and $R^2_{m,t-1}$ is used.*

Source: Author's own calculations

Table 8: Results of Herding Spillover for Thailand based on Structural Change Model

Results for Thailand										
India Break Dates 6/15/2009, 4/6/2015, 7/28/2017, 1/2/2020				**China Break Dates 10/9/2009, 5/8/2012, 4/3/2015, 7/28/2017, 1/7/2020**				**US Break Dates 7/8/2009, 4/13/2015, 8/10/2017, 1/7/2020**			
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4
Regime 1 (1/1/2007-	-2.73***	0.17***	-0.123	Regime 1 (1/1/2007-	-2.052*	0.048*	0.043	Regime1 (1/02/2007-	-2.25*	0.25***	0.028
6/12/2009)	(-2.636)	(4.830)	(-0.507)	10/8/2009)	(-1.914)	(1.713)	(0.240)	7/7/2009)	(-1.914)	(6.223)	(0.117)
Regime 2 (6/15/2009-	-6.64***	0.053*	-0.704	Regime 2 (10/9/2009-	-5.46***	0.072**	0.947***	Regime 2 (7/8/2009-	-6.42***	0.112***	-1.30***
4/3/2015)	(-4.95)	(1.856)	(-0.994)	5/7/2012)	(-3.278)	(2.339)	(2.951)	4/10/2015)	(-5.023)	(2.736)	(3.573)
Regime 3 (4/6/2015-	-5.92***	0.099**	-0.085	Regime 3 (5/8/2012-	-6.14***	0.030	-0.122	Regime 3 (4/13/2015-	-5.97***	0.053	0.805
7/27/2017)	(-4.227)	(2.038)	(-0.135)	4/2/2015)	(-4.891)	(0.905)	(-0.271)	8/19/2017)	(-4.452)	(1.114)	(0.708)
Regime 4 (7/28/2017-	-39.69***	0.079**	**-1.98****	Regime 4 (4/3/2015-	-5.52***	0.062***	-0.275	Regime 4 (8/10/2017-	-36.2***	-0.007	-0.734
1/1/2020)	(-5.404)	(2.158)	**(-2.158)**	7/27/2017)	(-4.282)	(3.075)	(-1.47)	1/6/2020)	(-5.402)	(-0.138)	(-0.746)
Regime 5 (1/2/2020-	-4.478***	0.222***	-0.155	Regime 5 (7/28/2017-	-36.69***	0.024	-1.44***	Regime 5 (1/7/2020-	-4.75***	0.15***	0.456*
6/6/2022)	(-3.734)	(4.702)	(-0.631)	1/6/2020)	(-5.703)	(0.786)	(-3.036)	6/6/2022)	(-4.015)	(3.611)	(1.683)
				Regime 6 (1/7/2020-	-4.78***	0.13***	-0.61				
				6/6/2022)	(-4.559)	(3.426)	(-1.164)				
Japan Break Dates 7/8/2009, 4/3/2015, 10/28/2019				**South Korea Break Dates 6/11/2009, 4/03/2015, 10/28/2019**							
Coefficients	γ_2	γ_3	γ_4	**Coefficients**	γ_2	γ_3	γ_4				
Regime 1	-3.274***	0.25***	0.345**	Regime 1	-3.56***	0.25***	-0.119				
(1/1/2007-7/7/2009)	(-3.401)	(5.419)	(2.016)	(1/1/2007-6/10/2009)	(-4.094)	(5.055)	(-1.484)				
Regime 2	-6.34***	0.15***	-0.4***	Regime 2 (6/11/2009-	-6.63***	0.10***	-0.07**				
(7/8/2009-4/2/2015)	(-5.097)	(4.056)	(-3.305)	4/2/2015)	(-5.675)	(3.481)	(-2.437)				
Regime 3	-6.44***	0.09***	-0.233	Regime 3	-6.59***	0.059**	0.012				
(4/3/2015-10/25/2019)	(-5.255)	(2.742)	(-1.145)	(4/3/2015-10/25/2019)	(-5.15)	(2.334)	(1.037)				
Regime 4	-4.77***	0.28***	0.374	Regime 4 (10/28/2019-	-4.85***	0.22***	-0.023				
(10/28/2019-6/6/2022)	(-4.548)	(4.391)	(0.471)	6/6/2022)	(-4.07)	(4.749)	(-0.704)				

*Notes: *** Significance at 1% level. ** Significance at 10% level. The values in the parenthesis indicates the t-statistics. For calculating US Spillover on Asian Countries, one lag term of* $CSAD_{US,\,t-1}$ *and* $R^2_{m,t-1}$ *is used.*

Source: Author's own calculations

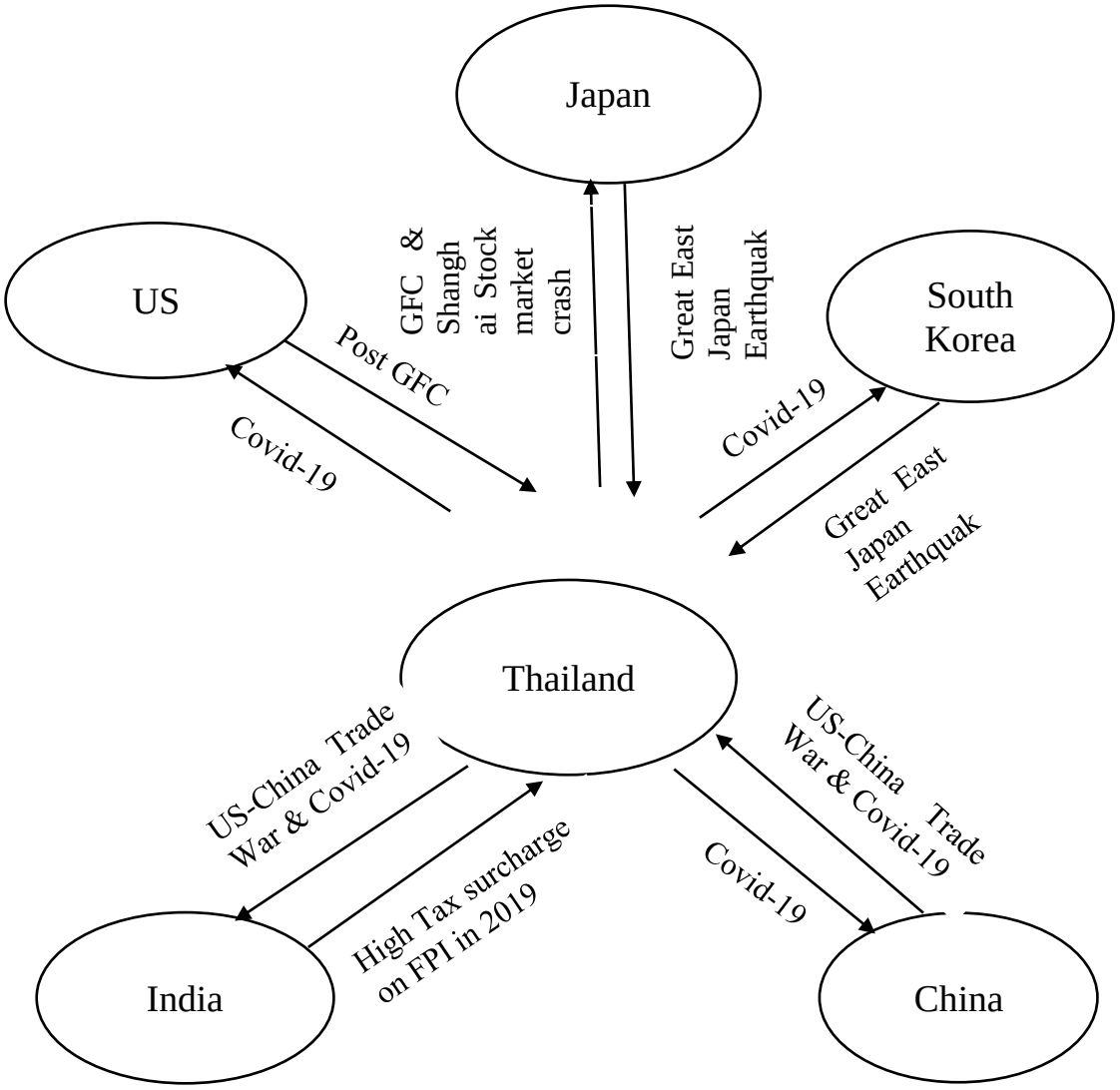
Table 9: Results of Herding Spillover for US based on Structural Change Model

Results for US											
India Break Dates 5/18/2009, 8/10/2012, 9/23/2015, 2/5/2020				**Japan Break Dates 9/21/2009, 8/10/2012, 9/17/2015, 2/4/2020**				**China Break Dates 8/14/2009, 8/10/2012, 9/17/2015, 2/5/2020**			
Coefficients	γ_2	γ_3	γ_4	Coefficients	γ_2	γ_3	γ_4	Coefficients	γ_2	γ_3	γ_4
Regime 1 (1/1/2007-	-1.07**	0.29***	0.196	Regime 1 (1/1/2007-	-0.435	0.327***	0.808***	Regime1 (1/1/2007-	-0.983**	0.01	0.406
5/15/2009)	(-2.366)	(5.512)	(0.334)	9/18/2009)	(-0.747)	(6.863)	(2.975)	8/13/2009)	(-2.187)	(0.312)	(1.221)
Regime 2 (5/18/2009-	-0.689	0.21***	0.152**	Regime 2 (9/21/2009-	-0.347	0.102***	**-0.297*** **	Regime 2 (8/14/2009-	-0.512	0.018	0.058
8/9/2012)	(-1.406)	(8.884)	(2.051)	8/9/2012)	(-0.645)	(3.696)	**(-2.598)**	8/9/2012)	(-0.998)	(0.987)	(0.238)
Regime 3 (8/10/2012-	-5.77***	0.044**	0.360	Regime 3 (8/10/2012-	-5.12***	0.092***	0.060	Regime 3 (8/10/2012-	-5.14***	0.00	0.016
9/22/2015)	(-4.143)	(2.170)	(1.183)	9/16/2015)	(-3.875)	(4.253)	(0.381)	9/16/2015)	(-3.982)	(0.078)	(0.138)
Regime 4 (9/23/2015-	-3.221*	0.14***	-0.511	Regime 4 (9/17/2015-	-3.78***	0.159***	0.560	Regime 4 (9/17/2015-	-3.153	0.04**	0.129
2/4/2020)	(-1.681)	(4.251)	(-0.918)	2/3/2020)	(-2.601)	(5.413)	(0.904)	2/4/2020)	(-1.543)	(2.077)	(0.683)
Regime 5 (2/5/2020-	-0.199	**0.30*** **	0.61***	Regime 5 (2/4/2020-	-0.287	**0.370*** **	0.118	Regime 5 (2/5/2020-	-0.466	**0.074***	1.066
6/6/2022)	(-0.620)	**(4.223)**	(4.414)	6/6/2022)	(-0.825)	**(2.929)**	(0.083)	6/6/2022)	(-1.171)	**(1.837)**	(1.575)
South Korea Break Dates 8/14/2009, 10/29/2012, 9/23/2015, 2/4/2020				**Thailand Break Dates 8/14/2009, 8/10/2012, 9/17/2015, 2/5/2022**							
Coefficients	γ_2	γ_3	γ_4	Coefficients	γ_2	γ_3	γ_4				
Regime 1 (1/1/2007-	-0.951**	0.24***	0.19***	Regime 1 (1/1/2007-	-1.17***	0.251***	0.869				
8/13/2009)	(-2.327)	(5.881)	(2.757)	8/13/2009)	(-2.583)	(4.303)	(0.473)				
Regime 2 (8/14/2009-	-0.696	0.10***	-0.006	Regime 2 (8/14/2009-	-0.473	0.039	0.668				
10/26/2012)	(-1.356)	(4.613)	(-0.179)	8/9/2012)	(-0.914)	(1.735)	(1.546)				
Regime 3 (10/29/2012-	-5.44***	0.08***	0.007	Regime 3	-4.91***	0.014	-0.235				
9/22/2015)	(-3.896)	(3.685)	(0.234)	(8/10/2012-9/16/2015)	(-3.545)	(0.791)	(-0.970)				
Regime 4 (9/23/2015-	-2.883	0.11***	0.004	Regime 4 (9/17/2015-	-2.936	0.062**	**-1.18** **				
2/3/2020)	(-1.459)	(3.515)	(0.404)	2/4/2020)	(-1.452)	(2.330)	**(-2.181)**				
Regime 5 (2/4/2020-6/6/2022	0.332	**0.31*** **	-0.012	Regime 5 (2/5/2020-	-0.242	**0.153** **	-0.731				
	(-1.054)	**(3.477)**	(-0.34)	6/6/2022)	(-0.601)	**(2.416)**	(-0.622)				

*Notes: *** Significance at 1% level. ** Significance at 10% level. The values in the parenthesis indicates the t-statistics. For calculating US Spillover on Asian Countries, one lag term of $CSAD_{US,\ t-1}$ and $R^2_{m,t-1}$ is used.*

Source: Author's own calculations

Figure 1: Contagion Events Leading to Herding Spillover among Thailand an d its Asia-Pacific Trading Partners

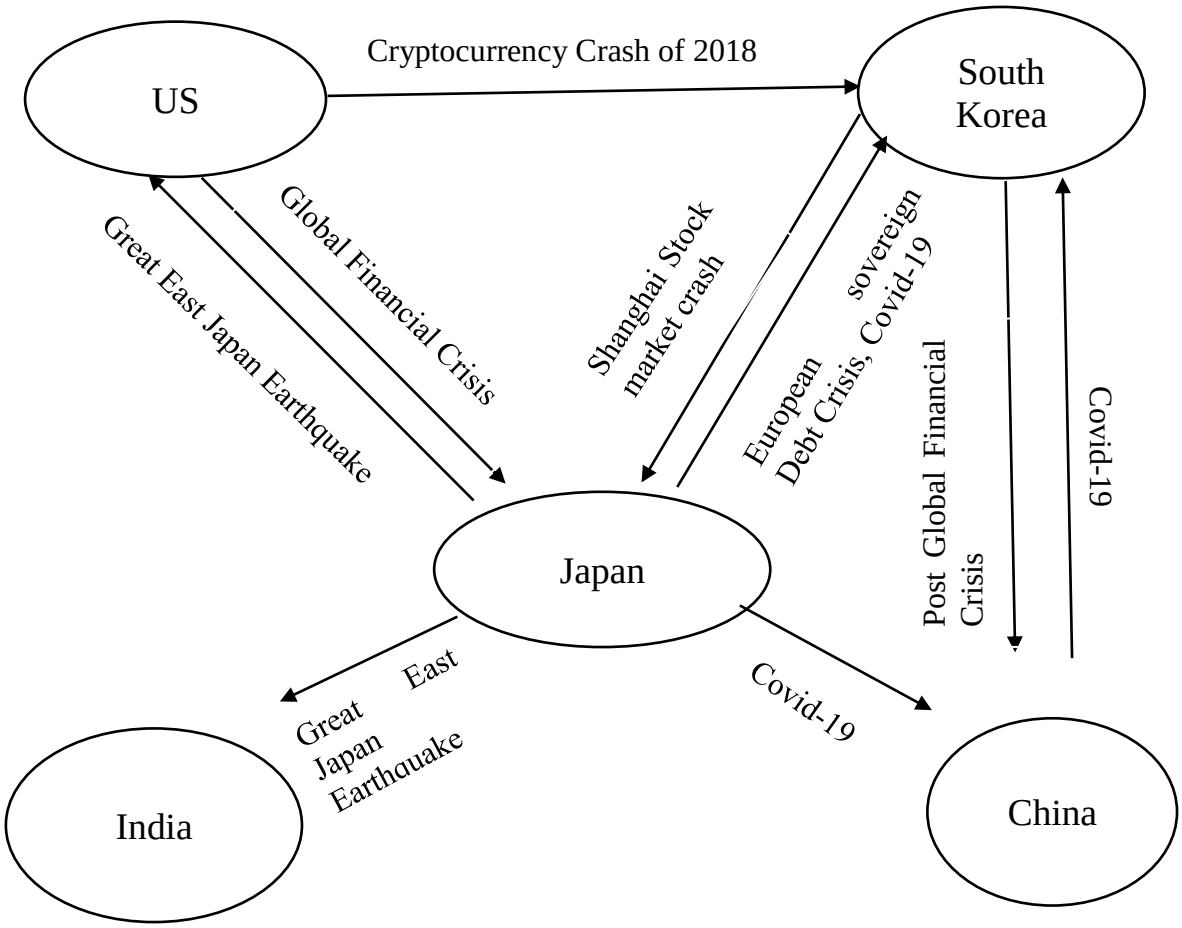


Source: Author's own calculations

It seems that Thailand's economy is very sensitive to market structural changes, as mentioned in the study by Jirasakuldech and Emekter (2020). Findings disclose the presence of herding spillover from China to Thailand due to the US-China trade war and pandemic, and later the same effects are transmitted to India from Thailand due to the same events. Findings also disclose herding spillover from Japan and South Korea to Thailand during the Great East Japan Earthquake. There seems to be a correlation between China and Thailand due to Covid-19 pandemic. Significant two-way herding was found between the US and Thailand during Covid-19 and after the Global Financial Crisis. Figure 2 depicts the graphical representation of the contagion events leading to herding spillover or co-movement among Asia-Pacific countries except Thailand. Cross-country herd behavior is present between Japan and South Korea due to the European sovereign debt crisis and trade tensions between the US and China. There is evidence of herding movement between the US and Japan due to global financial crisis and the Great East Japan Earthquake. Herding spillover was observed from the US to South Korea during the cryptocurrency crash of 2018. Investors in China followed the investors in

Japan during the pandemic. Japan is impacting the herd behavior of India during the Great East Japan Earthquake. Evidence also depicts the herding spillover during Covid-19 from China to South Korea.

Figure 2: Contagion Events Leading to Herding Spillover among Asia-Pacific Countries (Except Thailand)



Source: Author's own calculations

6. Conclusion

The paper investigated herding and herding spillover among the Asia-Pacific countries, including China, Japan, South Korea, Thailand, the US and India spanning, from 2007 to 2022.

The present study has a used structural change model to first identify the break dates and then analyzes the herding spillover in different market regimes. Results depict that herding is profound in all regimes in China and Thailand. For other countries, herding is prominent in some regimes only.

Secondly, the results of the structural change model for herding spillover are mixed for different countries. Evidence clearly exhibits that herding spillover is present only during turbulent regimes or extreme market movements. If we talk about developed countries in the Asia-Pacific region, herding co-movement of Japan with the US, South Korea, and Thailand is observed due to various volatile events like the global financial crisis, Shanghai stock market crash, the Great East Japan Earthquake, and Covid-19 for

the whole sample period. This suggests that Japan's financial market is closely linked to that of other Asia-Pacific nations. The US was also impacted by Japan and Thailand during Covid-19 and the Great East Japan Earthquake. It shows that Asia market participants are not only affected by herding in the US market, as shown by the study of Chiang and Zheng (2010), but US market participants can also herd towards Asia markets. Moreover, there is evidence of a co-movement of South Korea with Japan, and China with? Thailand. For emerging economies, results are somewhat interesting. Amidst the trade war between the US and China and the Covid-19 pandemic, Indian investors are flocking towards Thailand, while, in turn, market participants in Thailand are flocking towards China. It means that in pairwise spillover, one country also got impacted by a third country's events. Further, India had herding spillover only with Japan during the Great East Japan Earthquake. It means the Indian market can be said to be more efficient than other countries during the sample period. During Covid-19, China market participants are leaning towards Thailand and Japan. Also, there is one-way herding spillover from China to South Korea during Covid-19.

The study found interesting results for the stock market of Thailand. Thailand is showing evidence of two-way herding spillover or co-movement with the rest of the sample countries during various crisis and turbulent events like Covid-19, the US-China trade war, the Great East Japan Earthquake and the Shanghai stock market crash. It depicts that Thailand's stock market is highly correlated with other Asia-pacific countries over time. Furthermore, there is evidence of volatility spillover in most of the countries, along with herding spillover and co-movement. Finally, the study discovered that Asia-Pacific nations have experienced increased integration following the global financial crisis, largely due to contagion events, particularly the Covid-19 pandemic.

The verdicts of the paper are of great significance for international investors, portfolio managers andpolicymakers, including central banks. International investors should keep in mind these highly volatile events while devising their strategy for investment in foreign financial markets. Hung (2019) mentioned that investors must check the market linkages while investing in any country. Moreover, portfolio managers should investigate how herding spillover linkages are connected with time and markets. These occurrences have an impact on asset allocation and portfolio diversification, with high risk due to substantial economic integration (Shi, 2022). Policymakers should consider the spillover effects while formulating policies to reduce the financial stability risk created through herding behavior. Since herding behavior can create hurdles in the implementation of monetary policy due to inflationary pressure on particular stocks, the central bank needs to address this issue through interest rate hikes. Krokida et al. (2020) also specified that monetary policy affects domestic and international herding in the financial market. Central banks may need to improve their monitoring of market dynamics and investor behavior by collecting more data on investor sentiment, tracking fund flows more closely, etc. As we found evidence of herding spillover, it increases the contagion risk, so the central banks of different countries need to coordinate to lessen the contagion effect. The present study is limited to six Asia-Pacific countries to study cross-market interdependence through herding spillover. By using a larger sample, more studies can be carried out to gain improved insights. Furthermore, this study can also be extended to analyze the presence of central bank digital currency because the countries we have chosen are still debating the launch of CBDC like South Korea, Japan, and the US.

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