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# Market Herding and Market Stress in the EMEAP Economies

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## Abstract

Ascertaining the extent of market herding and market stress has gained particular importance for regulators, especially central banks. On the one hand, analyzing market herding is important as price trends tend to raise questions on whether sustained increases in asset prices reflect true improvements in the profitability of business or is just a consequence of market herding. On the other hand, uptrend in prices, which are driven by market herding is unsustainable and poses risks of asset price bubbles. Likewise, efforts to identify the build-up of stress in the financial system have been at the forefront of policymakers' agenda, underscoring the large losses incurred by economic agents and the economy, at large, in the past crises. For this study, econometric methods were used in identifying alarming trends in market herding and critical levels of market stress in the EMEAP region. In estimating the degree of market herding, this study used the Hwang and Salmon (2004) model, which basically measures the relative dispersion of the betas for all the assets in the markets, taking into account the equilibrium conditions in the Capital Asset Pricing Model. In estimating market stress, this study adopts a Principal Component Analysis in estimating an overall index to capture financial market conditions. Results of the Hwang and Salmon (2004) model shows that investors' herding behavior in the 11 EMEAP member economies generally correspond to the prevailing levels of market stress in their respective economies, resonating well with economic theory: market herding is high (low) when market stress is low (high).

JEL Classification: C38, E44, G12, G18

Keywords: financial markets, macroeconomy, capital asset pricing model, principal components analysis, government policy and regulation

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[1] EMEAP, the Executives' Meeting of East Asia-Pacific Central Banks, is a cooperative organization of central banks and monetary authorities (hereinafter simply referred to as central banks) in the East Asia and Pacific region. Its primary objective is to strengthen the cooperative relationship among its members. It comprises the central banks of eleven economies: Reserve Bank of Australia, People's Bank of China, Hong Kong Monetary Authority, Bank Indonesia, Bank of Japan, Bank of Korea, Bank Negara Malaysia, Reserve Bank of New Zealand, Bangko Sentral ng Pilipinas, Monetary Authority of Singapore, and Bank of Thailand.

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# Market Herding and Market Stress in the EMEAP Economies

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## 1. Introduction

Measuring the extent of market herding and market stress is important for regulators, particularly central banks.

Market herding is important because price trends tend to raise questions on whether sustained increases in prices reflect true improvements in the profitability of businesses or is simply a consequence of market herding. This question is non-trivial. Stock price index increases, for example, which are driven by greater profitability and stronger fundamentals are sustainable. On the other hand, uptrend in prices which are driven by market herding is unsustainable and poses risks of asset price bubbles, with prices abruptly and sharply declining once market herding reverses.[3] Determining the source of price movements—whether these are driven by fundamentals or market herding—is therefore critical so that regulatory authorities can correctly assess market stress conditions and address financial stability issues.

Similarly, efforts to identify the build-up of stress in the financial system have been at the forefront of policymakers' agenda given large losses incurred by economic agents and the economy, at large, in the aftermath of a crisis. The Global Financial Crisis (GFC) in 2008-2009 highlighted the importance of understanding and measuring financial stress in the financial system. The crisis underscored the need to develop tools that could measure the state of instability or stress to mitigate potential systemic or contagion effects.

Econometric methods are therefore useful in identifying any alarming trends in market herding and critical levels of market stress. Moreover, past data can be analyzed to identify

[2] This study is undertaken by Ms. Carolina P. Austria, a former Bank Officer at the Department of Economic Research (DER) of the Bangko Sentral ng Pilipinas (BSP), with Ms. Bernadette Marie M. Bondoc and Mr. Christofer A. Martin, Bank Officers V (Senior Bank Economists) at the DER of the BSP, as part of the EMEAP Monetary and Financial Stability Committee (MFSC) Research Agenda for 2018-2020. This paper is an extension of an earlier paper of Ms. Austria entitled "Estimating the Extent of Market Herding in the Philippine Equities Market," published in the Bangko Sentral Review in 2017. The authors are thankful to Mr. Mauro Jasmin, Jr. (Bank Officer V, DER) for providing useful literature and assistance in the estimation of the financial market stress indices. The authors are likewise thankful to Dr. Francisco Dakila, Jr. (Deputy Governor, MES), Ms. Iluminada Sicat (Senior Assistant Governor, MPSS), Mr. Dennis Lapid (Director, DER), Dr. Joselito Basilio (Director, BSP Research Academy) and Ms. Lara Ganapin (Bank Officer V, DER) for their helpful comments in improving the draft. The usual disclaimer applies. Views, errors and omissions are sole responsibilities of the authors, and not those of the institution represented.

[3] Asset price reversals and extreme volatility pose important financial stability concerns such that equity index is one of the most commonly used variables in economic literature to assess financial stability, with above trend growth in index or very high levels of market-to-book value considered indicative of an equity price bubble. To cite, Gadanecz and Jayaram (2009) listed six main sectors which are commonly used in the literature to assess financial stability: real sector (GDP growth, fiscal position of the government, and inflation), corporate sector (leverage, expense ratios, net foreign exchange exposure to equity, number of applications for protection against creditors), household sector (net assets, net disposable income), external sector (real exchange rates, foreign exchange reserves, current account, capital flows, maturity/currency mismatches), financial sector (monetary aggregates, real interest rate, risk measures for the banking sector, banks' capital and liquidity ratios, loan book quality, stand-alone credit ratings, and concentration/systemic focus of banks' lending activities), and financial markets (equity indices, corporate spreads, liquidity premia, and volatility).

correlations of local market herding versus local market stress. These data could also help identify co-movements of market herding and market stress across economies. Determining and analyzing these trends and correlations are in turn useful in drawing policy implications for regulators.

Measuring the extent of market herding and market stress, however, is not an easy task. Market herding is time varying, can be volatile and has to be estimated and derived from other data, often with a low degree of confidence. Meanwhile, measures of market stress need to be able to effectively identify stress events. Furthermore, determining index variables as well as the weights of these components is a challenging task.

Although difficult, measuring market herding and market stress is not entirely impossible. For market herding, Hwang and Salmon (2004), for example, posited that the degree of market herding can be measured using the relative dispersion of the betas for all the assets in the markets. When there is herding towards the market portfolio, the cross-sectional variance of the estimated betas will decrease so that investors herd around the market consensus. This approach, hereafter termed the Hwang and Salmon model, has been used in a number of economies including South Korea and the United States (Hwang and Salmon, 2004); Ukraine (Zaharheyeva, 2008); France, UK, Italy, and Germany (Khan and Hassairi, 2011); Romania (Pop, 2011); the Euro area (Mobarek & Mollah, 2014); Bangladesh (Ahsan and Sarkar, 2012); Canada (Hachicha, 2010); and Central and Eastern Europe (Angela-Maria, Maria, and Miruna, 2015).

On the other hand, a plethora of studies have identified indicators that could detect financial stress, which lead to corrections in asset valuations, asset fire sales, or other forms of contagion, that may amplify financial shocks and disrupt financial intermediation. Borio and Lowe (2002), for instance, noted that periods of rapid and sustained increase in credit growth and asset prices tend to be followed by episodes of financial crises. Illing and Liu (2006) and Misina and Tkacz (2008) computed financial stress indices that could capture expected loss, risk, and conditions of uncertainty in the financial markets. Hakkio and Keeton (2009) identified key features of financial stress that could interrupt the normal functioning of a financial market, such include episodes of increased uncertainty about the fundamental value of assets and behavior of investors, rise in asymmetry of information, and decreased willingness to hold risky and illiquid assets. A number of central banks and monetary authorities have developed their own financial stress indices (FSIs). In particular, Hollo, Kremer and Duca (2012) formulated a financial stress index for the European Central Bank (ECB), while Federal Reserve banks in the US likewise published stress indices such as the Kansas City Financial Stress Index (KCFI), Cleveland Financial Stress Index (CFSI), and the St. Louis Financial Stress Index (STLFSI).

Building on the aforementioned estimation methodologies in the literature, this paper provides a similar market herding and market stress estimates for 11 EMEAP economies. This paper is structured as follows: Section 2 briefly discusses related literature while Section 3 presents and analyzes the estimates for the EMEAP economies. Section 4 describes policy responses on market herding and market stress. Section 5 presents the conclusion and some policy implications.

## 2. Related Literature

### 2.1 Market Herding

Economic and finance models are underpinned by concepts of market efficiency. Many models assume that market prices, particularly in the long term, are anchored on fundamental values and that market agents make rational decisions consistently. However, this is not always true. There are many inefficient market behavior including reflexivity or the market's tendency to self-fulfill its expectations (Soros, 2003); under weighting of outcomes that are merely probable in comparison with outcomes that are obtained with certainty, which results in excessive risk aversion or risk seeking or in the attractiveness of both insurance and gambling (Kahneman and Tversky, 1979); and under reaction of stock prices to news such as earning announcements and over reaction to a series of good or bad news (Barberis et al., 1998).

Market agents are also observed to engage in market herding, where they follow a trend, imitate the observed decisions of others, or match the movements in the market rather than follow their own beliefs and information (Hwang and Salmon, 2004). Andreassen and Kraus, for example, noted in an experiment that subjects tracked prices: they sell when prices rise and buy when prices fall even when the prices offered was a random walk (Barberis et al, 1998). De Bondt (1983) had similar results. He found that a forecast change in stock price level is higher after a series of past price increases than a series of price decreases, indicating that investors chase trends once they believe that these exist.

There are various explanations for market herding. To cite, Shleifer and Vishny (1997) noted that textbook discussions of market efficiency assume that arbitrage in financial markets requires no capital and entails no risk. This is not true in reality as all arbitrage require capital and are risky. Moreover, professional arbitrage is conducted by a relatively small number of highly specialized investors who rely on other people's money and are, therefore, required to report the short and medium-term results of their operations. Such short investing horizon and risk aversion sometimes motivate investors to simply follow the market.

Long et al. (1990), on the other hand, argued that market dynamics limit the opportunities for arbitrage. Short-horizon arbitrageurs take the opposite trading position of market herders or trend chasers believing that a given trend is untenable and would soon reverse. However, it is possible that market herders or trend chasers might take even more extreme positions and further reinforce the ongoing movement in price trends. If the arbitrageur is forced to liquidate his position before the prices move toward the true fundamental values, he suffers a loss. This uncertainty creates a fear of loss which limits an arbitrageur's activities and induce him or her to simply imitate the market. Information asymmetry could also explain market herding. Market agents sometimes think that other market participants are better informed than they are driving them to set aside their own information in favor of perceived market trends (Hwang and Salmon, 2004).

Hwang and Salmon (2004) stated that a presence of an event uncertainty (wherein asset value deviates from its expected value) causes reappearance of herding behavior. However, the effect of this herding is bounded and the impact on asset pricing may be small if the bound is small. Meanwhile, a presence of event uncertainty with term-composition

uncertainty (i.e., reflecting the fact that there is uncertainty about the average accuracy of trader's information) causes prevalent herding behavior, thus, significant movement in asset pricing can emerge. Hwang and Salmon (2004) specified that this form of correlated behavior can be in principle separated from what Bikhchandani and Sharma (2001) refer to as "spurious" or unintentional herding where similar actions of independent individuals are influenced by the movement of fundamentals. This paper follows the Hwang and Salmon (2004) definition of herding, retaining simplicity and using the term herding in its common pejorative sense which implies the suppression of private information and imitation without reference to fundamentals. Form of herding will be viewed as related to market sentiment, which is a non-observable process as it is naturally latent. The independent collective actions following common observable fundamental signals will be referred to as correlated fundamentals adjustment in the market or simply fundamentals adjustment. Leaving aside issues of what may be rational or irrational motives for herding, it is clearly important to be able to discriminate empirically between these two cases of common or correlated movements within the market; one of which potentially leads to market inefficiency whereas the other simply reflects an efficient reallocation of assets on the basis of common fundamental news. Considering both motivations represent collective movements in the market towards some position or view and hence a preference towards some class of assets, Hwang and Salmon (2004) has developed statistical method that discriminate between these two cases, which will be applied in this paper.

Various methods may be used to estimate market herding. Mensah and Yang (2008), for example, estimated market herding via the dispersion of analysts' earnings forecasts. Christie and Huang (1995), on the other hand, analyzed the cross-sectional standard deviation of individual stock returns and ran a regression on a constant and two dummy variables designed to capture extreme positive and negative market returns. They argued that during periods of market stress rational asset pricing would imply positive coefficients on those dummy variables, while herding behavior would result in negative coefficients. This approach is reasonable but has been criticized for the reason that market stress does not necessarily imply that the market as a whole should show either large negative or positive returns. It is possible that herding could pertain to a considerable reallocation towards a particular sector. This, of course, would not show as a dramatic change in the aggregate data. Thus, defining herding as only arising when there are large positive or negative returns for the aggregate market could exclude certain types of herding behaviors.

Another approach to measuring market herding was proposed by Hwang and Salmon (2004) who argued that the degree of market herding can be measured using the relative dispersion of the betas for all the assets in the markets. When there is herding towards the market portfolio, the cross-sectional variance of the estimated betas will decrease so that investors herd around the market consensus. Their logic is as follows. In the Capital Asset Pricing Model (CAPM), the following equilibrium holds:

$$\mathbf{E_t(r_{it}) = \beta_{imt} E_t(r_{mt})}$$

where $E_t$ *is the term for expectations*
$r_{it}$ *is the return on asset i at time t*
$\beta_{imt}$ *is the systematic risk measure for market*
$r_{mt}$ *is the return on market at time t*

The conventional CAPM assumes that $\beta_{imt}$ does not change over time. Ghysels (1998), for example, states that having an assumption of constant beta in pricing is better as betas change very slowly over time as well as it yields on average better predictions. However, Hwang and Salmon (2004) argued that there is considerable evidence that the betas do in fact vary over time. Such variation in the betas could happen when a firm changes its capital structure substantially or if a company changes its main business area from manufacturing to the service sector. However, since changes in business structure and focus happen slowly, Hwang and Salmon (2004) posited that a significant portion of the time variation in $\beta_{imt}$ reflect changes in investor herding rather than fundamental changes in $\beta_{imt}$ or the equilibrium relationship between $E_t(r_{mt})$ and $E_t(r_{it})$. When herding occurs, the betas become biased as investors beliefs shift to follow markets sentiments. That is, investors disregard the equilibrium (or true CAPM) value for $\beta_{imt}$ and move towards matching the returns on the individual assets with that of the market. For example, when the market increases significantly, investors will try to buy overvalued assets (relative to the market) and sell undervalued assets. Such trading strategies result in a lower standard deviation in the betas for the individual assets for that particular time period.

Investors disregard the equilibrium relationship ($\beta_{imt}$) and will try to let individual asset return to track well that of the market when investors' sentiment shift in order to follow the overall market performance. Hwang and Salmon (2004) cited examples: when the market increases significantly, investors will often try to buy underperforming assets (relative to the market increase) and sell overperforming assets. Suppose the market index increases by 20 percent. Then we would expect a 10 percent increase for any asset with a beta of 0.5 and 30 percent increase for an asset with a beta of 1.5 in equilibrium. However, when there is herding toward the market portfolio, investors would buy the asset with a beta of 0.5 since it appears to be relatively cheap compared to the market, and thus, its price would increase. On the other hand, investors would sell an asset with a beta of 1.5 since the asset would appear to be relatively expensive compared to the market. This behavior would also take place when market goes down significantly. We can also think of the adverse cases (i.e., adverse herding), when high betas (betas larger than one) become higher and low betas (betas less than one) become lower. In this case individual returns become more sensitive to the large beta stocks but less sensitive to the low beta stocks. According to study, this represents mean reversion towards the long-term equilibrium $\beta_{imt}$ and, if herding exists, there must be some systematic adjustment towards the equilibrium CAPM from mispricing both above and below equilibrium.

Hwang and Salmon (2004) noted that the results of their research resonate with Christie and Huang (1995) who concluded that during market crises, herding begins to disappear. However, when the market is quiet and investors are confident of the direction to which markets are heading, market herding increases. Conversely, if there is an occurrence of a shock

in an economy, behavior of the market is difficult to read. Thus, investors tend to look into the fundamental value of firms (via adverse herding) and asset prices consequently returning towards the long-term equilibrium of risk-return relationship.

The above concepts on market herding estimation were operationalized by Hwang and Salmon (2004) as follows:

a. Run the standard CAPM model per month using daily data to determine the betas of each of the stocks which comprise the index. For example, if there are 500 stocks, then there will be 500 regression equations for each month, with each month containing 20 or 21 data points. The regression equation is as follows:

$$\mathbf{r_{itd}} = \mathbf{\alpha^{b}_{itd}} + \mathbf{\beta^{b}_{imt} r_{mt}} + \mathbf{\epsilon_{itd}}$$

where $r_{itd}$ is the daily return on asset i,
$\alpha^{b}_{itd}$ is the constant coefficient or the manager's alpha, asset i at time t,
$\beta_{imt}$ is the systematic risk measure,
$r_{mt}$ is the market return at time t, and
$\epsilon_{itd}$ is the error term.

b. Compute for the log of the standard deviation of the betas obtained for each month using the formula below. Note that the dispersion of the betas is a crucial variable in determining market herding. When the market is herding, the standard deviation is low. When the market is not herding, the standard deviation is high.

$$\mathbf{Std_c}\widehat{\mathbf{\tilde{\beta}^{b}_{imt}}} = \sqrt{\frac{\sum_{i=1}^{N_t}\left(\widetilde{\mathbf{\beta^{b}_{imt}}} - \overline{\mathbf{\tilde{\beta}^{b}_{imt}}}\right)}{\mathbf{N_t}}}$$

where $\mathrm{Std_c}\widehat{\tilde{\beta}^{b}_{imt}}$ is standard deviation of the betas of the stocks, $\widetilde{\beta^{b}_{imt}}$ is the beta for each stock per month, $\overline{\tilde{\beta}^{b}_{imt}}$ is the average beta for all stock per month, and $N_t$ is the sample size

c. To control for market return and market volatility, a state-space model which will provide the proxy for the herding measure can be used, as follows:

$$\mathbf{ln}\left[\mathbf{Std_c}(\mathbf{\beta^{b}_{imt}})\right] = \mathbf{\mu_m} + \mathbf{H_{mt}} + \mathbf{c_{m1} ln\sigma_{mt}} + \mathbf{c_{m2} r_{mt}} + \mathbf{v_{mt}}$$

$$\mathbf{H_{mt}} = \mathbf{\emptyset_m H_{mt-1}} + \mathbf{\eta_{mt}}$$

where $\ln\left[\mathrm{Std_c}(\beta^{b}_{imt})\right]$ is the log of the standard deviation of the betas of the stocks for each month, $\mu_m$ is the constant, $H_{mt}$ the state variable for market herding, $\ln\sigma_{mt}$ is the market volatility variable, $c_{m2} r_{mt}$ is the market return variable, $v_{mt}$ is the error term for the signal equation, and $\eta_{mt}$ is the error term for the state equation

d. To arrive at the quantifiable herding measure, $\boldsymbol{H_{mt}}$ is transformed using the formula below. Note that the greater the value of $H_{mt}$, the greater is the market's tendency to herd, and that the degree of herding is measured as the log of the standard deviation of the betas obtained for each month.

$$\mathbf{H_{mt}} = \mathbf{ln(1 - h_{kt})}$$

where $H_{mt}$ is the resulting measure of market herding

Hwang and Salmon (2004) applied the above approach to the US, UK, and South Korean stock markets. The results show the following: (1) macroeconomic factors are found to be weak in explaining herding patterns. The movement and persistence of herding in the direction of the market (performance) are not correlated with market conditions as expressed in return volatility and the level of the mean return; (2) herding towards market portfolio is evident when the market is rising and when it is falling.

Decisive change in investors herding behavior was identified during the Asian and the Russian financial crises. Contrary to a common belief, these crises appear to stimulate a return towards efficiency rather than increased level of herding; and (3) their examination of herding relationships across markets and herding objectives revealed some common patterns but far from perfect co-movements; a correlation of only 0.435 in herding between the US and the UK markets for instance. This, for the authors, emphasizes that market sentiment does not necessarily transmit internationally.

## 2.2 Market Stress

Meanwhile, efforts to identify the build-up of stress in the financial system have been at the forefront of policymakers' agenda given large losses incurred by economic agents and the economy at large in the aftermath of the previous crises. The GFC highlighted the importance of understanding and measuring stress in the financial system. The crisis underscored the need to develop tools (such as financial stress indices) that could measure the state of financial stress to mitigate potential systemic or contagion effects.

There is a plethora of literature available that tries to compute for financial stress indices. Illing and Liu (2006) computed for the financial stress index for Canadian financial system. The index is composed of 11 financial market variables, which were aggregated on the basis of weights determined by the relative size of the market to which each of the indicators pertain as compared to a broad measure of total credit in the economy. The variables were chosen according to which variant performs best in capturing crisis events in the Canadian financial system.

Hakkio and Keeton (2009) developed Kansas City Financial Stress Index (KCFSI) for the Federal Reserve Bank of Kansas City. It is composed of 11 financial market indicators and aggregated using principal component analysis (PCA). The idea is that financial stress is the factor most responsible for the observed correlation between the indicators. Patterned after the KCFSI, Kliesen and Smith (2010) developed the St. Louis Fed Financial Stress Index (STLFSI) composed of 18 weekly financial market indicators.

Oet et al. (2011) developed the Cleveland Financial Stress Index (CFSI) for the Federal Reserve Bank of Cleveland which integrated 11 daily financial market indicators and grouped into four sectors (debt, equity, foreign exchange and banking markets). The raw indicators are normalized by transforming the values of each series into the corresponding value of their empirical cumulative distribution function (CDF). The transformed indicators are then aggregated into the composite indicator by applying time-varying credit weights which are proportional to the quarterly financing flows through the four markets concerned.

Holló, Kremer and Duca (2012) developed the Composite Indicator of Systemic Stress (CISS) for the European Central Bank (ECB) with the objective of measuring the current state of instability, that is, the current level of frictions, stresses and strains (or the absence thereof) in the financial system and to summarize it into a single statistic. The CISS is an index of 15 mostly market-based financial stress measures equally split into five categories, namely: 1) the financial intermediary sector; 2) money markets; 3) equity markets; 4) bond markets; and 5) foreign exchange markets. The 15 individual "raw stress indicators" are then standardized by means of transformation into order statistics, and the arithmetic averages of the three transformed "stress factors" in each sub-market constitute the five sub-indices of financial stress. The CISS adopted the portfolio-theoretic aggregation method which takes into account the time-varying cross-correlations between the 5 sub-indices (i.e., situations in which stress prevails in several markets segments are given more weight, thus capturing the idea that financial stress is more systemic).

Rosenberg (2012) established the Bloomberg Financial Conditions Index (BFCI) for the Asia-ex Japan (with 9 variables), US (with 14 variables), and Euro area (with 6 variables). All the indices were grouped into money, bond, and equities market. Given that capital flows play an important role in driving monetary conditions and asset prices in Asia, the Asia-ex Japan BFCI took into account those flows in constructing the index. The US BFCI, on the other hand, included an asset bubble sub-index and an equilibrium yield gap sub-index aside from the three markets mentioned. The BFCI provides a useful gauge to assess the level of stress in the Asia, US, and Euro area financial markets.

## 3. Data and Results

### 3.1 Market Herding Estimates

Using daily data from 1 August 1995 to 30 April 2020, we investigated market herding in 11 economies from the southeast Asia and Pacific regions, namely, Australia, China, Hong Kong, Indonesia, Japan, South Korea, Malaysia, New Zealand, Philippines, Singapore and Thailand. The period covers the 1997 Asian Financial Crisis (AFC), 2008 GFC, and partly the coronavirus disease 2019 (COVID-19) pandemic.[4]

To calculate the herd estimates, we used the constituents of stock market indices in each economy as follows: S&P/ASX 200 for Australia (200 stocks), FTSE China 50 index for China (50 stocks), HK Hang Seng index for Hong Kong (50 stocks), LQ45 index for Indonesia (45 stocks), Nikkei 225 for Japan (225 stocks), Korea Kospi 200 for South Korea (202 stocks), FTSE Bursa Malaysia KLCI for Malaysia (30 stocks), NZ Exchange 50 for New Zealand (50 stocks), PSEi for the Philippines (30 stocks), Straits Times Index for Singapore (30 stocks), and SET50 index for Thailand (50 stocks).

We used the state space model approach of Hwang and Salmon (2004) to determine the monthly market herding measures for each economy.

[4] Period coverage for China (1 August 2003 – 130 April 2020), New Zealand (1 January 2001 – 130 April 2020) and Singapore (1 October 1999 – 130 April 2020) differ due to data availability.

Using daily data of stock price indices over monthly intervals, the corresponding betas were estimated and cross-section standard deviations of the betas were computed. This yields the monthly time series of the said betas and standard deviations. Statistical properties of the $Std_c(\beta^b_{imt})$ on the market portfolio are reported in **Table 1**. The table shows that the computed cross-sectional standard deviations of the estimated betas for all EMEAP member countries are significantly different from zero and positively skewed. Computed $Std_c(\beta^b_{imt})$ generally shows significant kurtosis and the Jarque-Bera statistics for normality show that data do not comply with Gaussianity. To address the normality assumption, $Std_c(\beta^b_{imt})$ was transformed to its logarithmic form in order that the positive skewness in the estimated cross-sectional standard deviations of the betas disappears and the log-cross-sectional standard deviations of betas do not deviate significantly from Gaussianity. Thus, we can infer that the state space model approach can be estimated using Kalman filter.

**Table 1. Properties of the Cross-sectional Standard Deviation of Betas on the Market Returns**

| Statistical Properties | Australia | China | Hong Kong | Indonesia | Japan | South Korea | Malaysia | New Zealand | Philippines | Singapore | Thailand |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cross-sectional Standard Deviation of OLS Betas | | | | | | | | | | |
| **Mean** | 2.6682 | - 0.8262 | 0.6975 | 1.5630 | 0.4458 | 0.6194 | 0.9100 | 3.1833 | - 0.0038 | 0.9735 | 0.8967 |
| **Standard Deviation** | 10.5115 | 0.4250 | 1.7493 | 7.4041 | 0.1555 | 0.3638 | 1.2686 | 10.0644 | 0.8247 | 1.5475 | 1.1098 |
| **Skewness** | 14.8164 | 1.1472 | 17.4793 | 15.8854 | 1.8430 | 8.1268 | 12.6011 | 8.9482 | 1.5475 | 7.2577 | 8.0991 |
| **Excess Kurtosis** | 244.0314 | 5.3178 | 324.7281 | 267.8196 | 10.6914 | 108.3200 | 173.5517 | 93.7698 | 5.7957 | 67.9669 | 87.9058 |
| | | | | | | | | | | | |
| **Jarque-Bera** | 852669.4 | 92.62833 | 1645150 | 951481.8 | 1139.654 | 178391.5 | 466899.4 | 85951.01 | 273.2404 | 47452.79 | 95882.79 |
| **Probability** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: Authors' estimates

Reported below are the monthly market herding estimates, which also present some critical periods of market stress. Figures 1-11 present charts on market herding estimates in each EMEAP member countries, which show that substantial declines in herding measures were noted on dates that correspond to or were close to critical periods of market stress, including the AFC (1997); the GFC (2008); as well as some political uncertainties, natural disasters, and health crisis.

**Figure 1. Australia Market Herding Estimates**

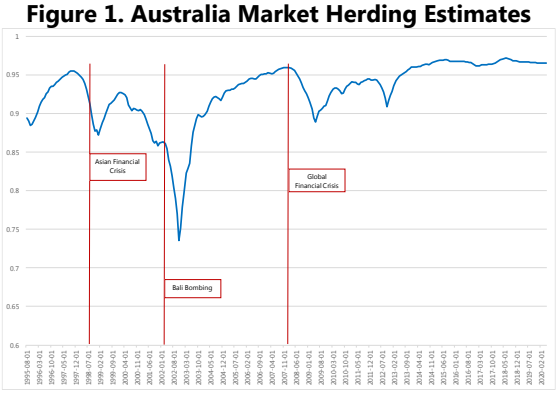



**Figure 2. Hong Kong Market Herding Estimates**

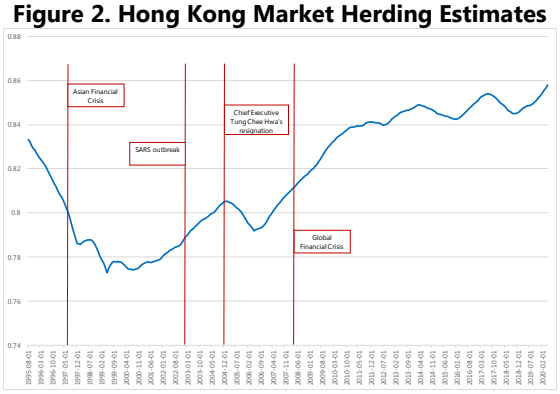


**Figure 3. China Market Herding Estimates**

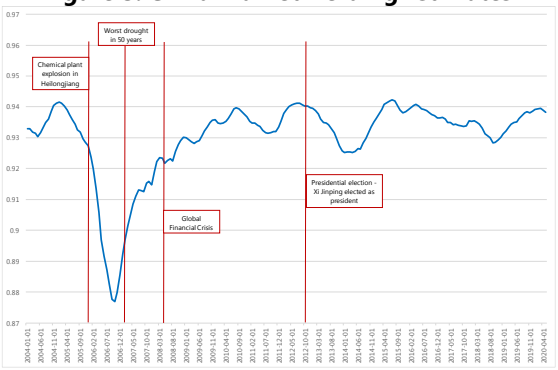



**Figure 4. Indonesia Market Herding Estimates**

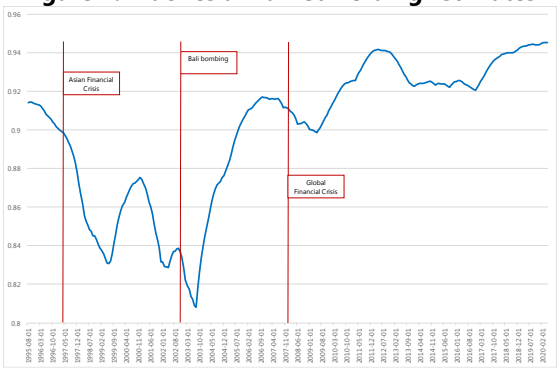



**Figure 5. Japan Market Herding Estimates**

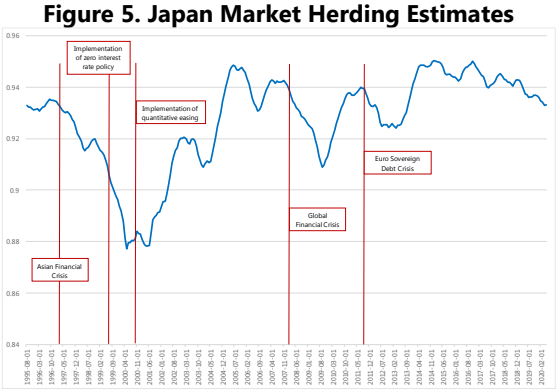



**Figure 6. New Zealand Market Herding Estimates**

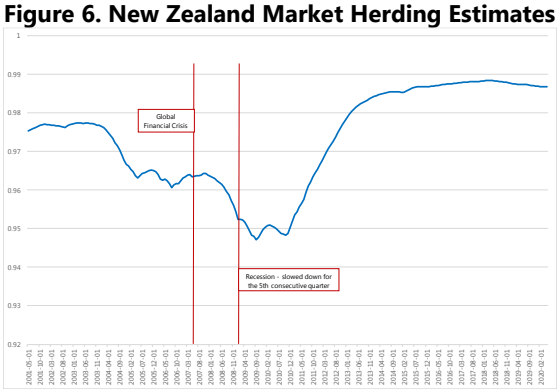



**Figure 7. South Korea Market Herding Estimates**

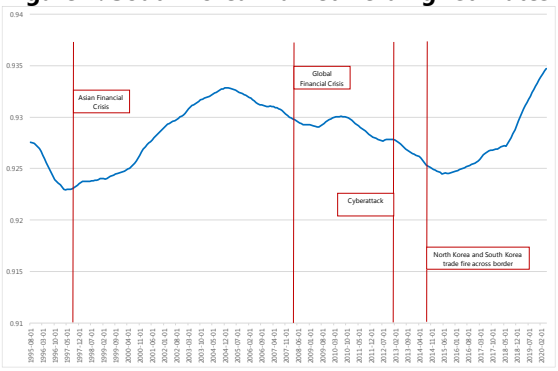



**Figure 8. Philippines Market Herding Estimates**

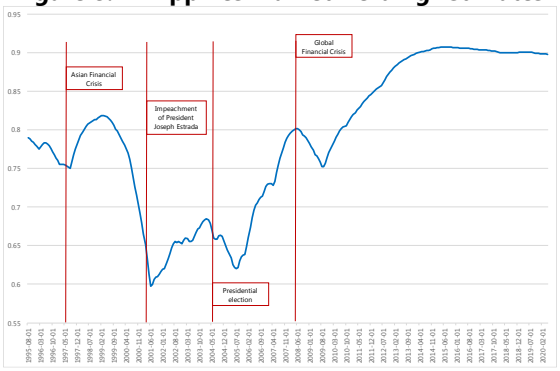



**Figure 9. Malaysia Market Herding Estimates**

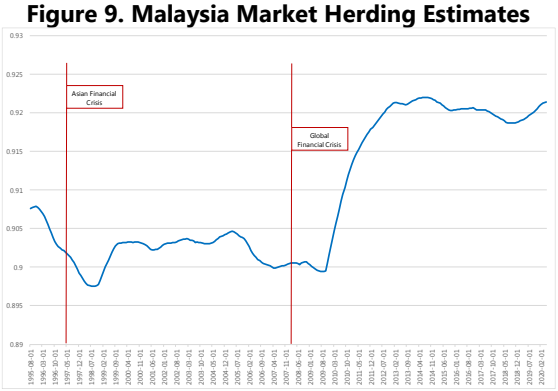



**Figure 10. Singapore Market Herding Estimates**

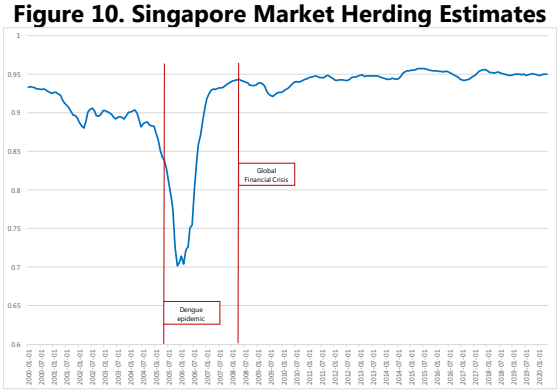
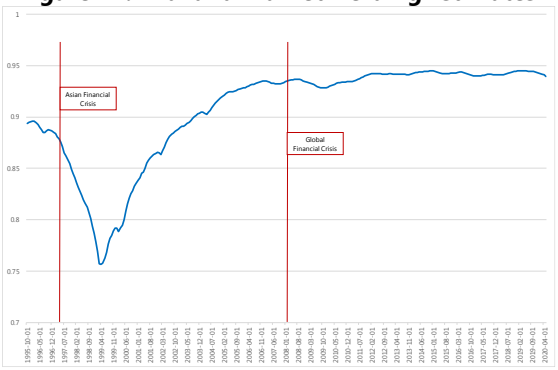


**Figure 11. Thailand Market Herding Estimates**




Source: Authors' estimates

The results show that the market herding currently appears to be at high levels, with market herding measures consistently higher than the levels observed during the 1997 AFC and the 2008 GFC. Such levels could imply that the current uptrend in the equities market is not driven solely by strong corporate and macroeconomic fundamentals, but also by market herding behavior, therefore, implying the risk of a sharp drop similar to the 1997 and 2008 crises.

Besides the AFC and the GFC, substantial declines in market herding could well be associated with some significant domestic events in each economy which, in turn, resulted in critical periods of market stress. Examples of which are as follow:

- **China**: The chemical plant explosion in Heilongjiang that caused loss of water supplies to millions of people in November 2005. [China market herding estimates registered a lowest point of 0.877 in April 2006 and a peak of 0.944 in December 2019].
- **Indonesia**: Terrorist attack in Bali, Indonesia in October 2002, killing 202 people who are mostly tourists. [Indonesia market herding estimates registered a lowest point of 0.808 in March 2003 and a peak of 0.948 in May 2020].
- **Japan**: Implementation of zero interest rate policy in 1999 and the quantitative easing measures in March 2001. [Japan market herding estimates registered a lowest point of 0.877 in January 2000 and a peak of 0.950 in March 2014].
- **Philippines**: Impeachment of President Joseph E. Estrada in November 2000 and the people power revolution in January 2001, which removed the incumbent government. [Philippines market herding estimates registered a lowest point of 0.598 in February 2001 and a peak of 0.907 in August 2014].

**Table 2. Range of Market Herding Estimates**

| Market Herding Estimates | Australia | China | Hong Kong | Indonesia | Japan | South Korea | Malaysia | New Zealand | Philippines | Singapore | Thailand |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lowest | 0.735 | 0.877 | 0.773 | 0.808 | 0.877 | 0.923 | 0.898 | 0.947 | 0.598 | 0.702 | 0.757 |
| Highest | 0.972 | 0.944 | 0.867 | 0.948 | 0.950 | 0.935 | 0.922 | 0.988 | 0.907 | 0.958 | 0.945 |
| *Difference* | *0.237* | *0.067* | *0.094* | *0.140* | *0.073* | *0.013* | *0.025* | *0.041* | *0.310* | *0.256* | *0.189* |

Source: Authors' estimates

Moreover, investors' cognitive and behavioral bias, algorithmic trading, investor structure and securities market mechanism are among the other drivers of herding behaviors cited by EMEAP-member economies.

- **Malaysia:** With the US dollar as the foremost global funding currency, movements in the domestic financial market is highly synchronized with developments surrounding the US dollar from a global perspective. During times of high risk aversion, increased expectations for US dollar strengthening had prompted expectations for an exchange rate depreciation and led to persistent outflows from domestic assets, as seen in the recent stress period. Such behavior reinforces the feedback loop leading to large depreciation and volatility in the exchange rate. However, while the US dollar plays a significant role in determining returns, idiosyncratic factors could exacerbate negative sentiments during period of risk aversion.
- **South Korea:** For the stock market, investors' overaction to market information (company performance, economic indices, news etc.) and individual investors chasing the investment trends of foreign investors (trend-chasing investment) are noted as major drivers. For the foreign exchange (FX) market, speculative demand is one of the major drivers for herding behavior.
- **Thailand:** Two drivers of herding behavior were identified: (1) increase in size of index funds, and (2) algorithmic trading.
  - *Increase in size of index funds* - Global funds who manage with reference to a benchmark, especially passive funds and exchange-traded funds (ETFs), have been of growing importance for emerging markets, including Thailand. These funds track only a few numbers of benchmarks, which limits the diversification of allocation strategies, resulting in highly correlated behavior among these funds. By design, they also have lower price sensitivity, which could trigger herding behavior during benchmark revision or rebalancing periods.
  - *Algorithmic trading* - Algorithmic trading which has been gaining traction in Thailand, is a new approach that might also lead to one-way herding effects.
- **China:** Three drivers of herding behavior were identified: (1) investors' cognitive and behavioral bias, (2) investor structure, and (3) securities market mechanism which needs to be further improved. On investor structure, the Chinese securities market has a history of just more than 20 years, and investment managers generally have a relatively short working time and lack the concept of long-term investment. The evaluation system of investment manager is not mature. Investment managers pay more attention to short-term returns and more often participate in speculation of hot spots in the market, resulting in herd effect. On securities market mechanism, the information disclosure mechanism is still to be enhanced. On the other hand, hedging mechanisms need to be improved, especially short selling mechanisms. In the absence of short selling, investors buy high and sell low, which may lead to herding.

Another interesting observation is that, looking at the trend of the estimates of market herding in January to April 2020, the graphs show that there appears to be a downward movement in herding measures in all EMEAP economies (excluding Hong Kong and Indonesia), which could indicate that herding behavior of investors are starting to dissipate

and based their sentiments on changes in macroeconomic fundamentals, amid the uncertainties due to the COVID-19 pandemic.

On the relationship between herding in the different markets, **Table 3** presents correlation matrix of cross-country market herding measures. Australia, Hong Kong, Indonesia, Malaysia, Philippines, and Thailand generally have high degree of correlations with other EMEAP economies. Meanwhile, we find no significant correlation between China, South Korea and Japan with other countries. Also, one interesting observation is that South Korea is negatively correlated with all EMEAP economies. Given the correlation measures between countries, the economic meaning of these relationships is not clear. Nevertheless, several studies on market herding point to non-uniform herding behavior in the different economies, requiring that herding estimates be calculated specifically for each market.

**Table 3. Relationship between Herding in the Different Markets**

| | Australia | China | Hong Kong | Indonesia | Japan | South Korea | Malaysia | New Zealand | Philippines | Singapore | Thailand |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Australia** | 1.00 | 0.01 | 0.53 | 0.64 | 0.73 | -0.25 | 0.61 | 0.73 | 0.67 | 0.32 | 0.70 |
| **China** | 0.01 | 1.00 | 0.63 | 0.21 | -0.03 | -0.12 | 0.56 | 0.33 | 0.41 | 0.39 | 0.14 |
| **Hong Kong** | 0.53 | 0.63 | 1.00 | 0.78 | 0.19 | -0.30 | 0.90 | 0.63 | 0.92 | 0.69 | 0.70 |
| **Indonesia** | 0.64 | 0.21 | 0.78 | 1.00 | 0.32 | -0.15 | 0.73 | 0.46 | 0.79 | 0.45 | 0.86 |
| **Japan** | 0.73 | -0.03 | 0.19 | 0.32 | 1.00 | -0.33 | 0.36 | 0.44 | 0.28 | -0.04 | 0.49 |
| **South Korea** | -0.25 | -0.12 | -0.30 | -0.15 | -0.33 | 1.00 | -0.38 | -0.28 | -0.50 | -0.39 | -0.52 |
| **Malaysia** | 0.61 | 0.56 | 0.90 | 0.73 | 0.36 | -0.38 | 1.00 | 0.80 | 0.86 | 0.52 | 0.70 |
| **New Zealand** | 0.73 | 0.33 | 0.63 | 0.46 | 0.44 | -0.28 | 0.80 | 1.00 | 0.68 | 0.34 | 0.49 |
| **Philippines** | 0.67 | 0.41 | 0.92 | 0.79 | 0.28 | -0.50 | 0.86 | 0.68 | 1.00 | 0.77 | 0.84 |
| **Singapore** | 0.32 | 0.39 | 0.69 | 0.45 | -0.04 | -0.39 | 0.52 | 0.34 | 0.77 | 1.00 | 0.52 |
| **Thailand** | 0.70 | 0.14 | 0.70 | 0.86 | 0.49 | -0.52 | 0.70 | 0.49 | 0.84 | 0.52 | 1.00 |

Low Moderate High

Source: Authors' estimates

## 3.2 Financial Market Stress Index

In estimating market stress, this study adopts the estimation by Balakrishnan, Danninger, Elekdag and Tytell (2009) in coming up with Financial Stress indices (FSIs). The FSI, for this study, comprises six variables, which are aggregated into an overall index to capture financial market conditions. The six indicators are: 1) 3-month Treasury bill rate (primary/secondary market rate); 2) 10-year bond yields (primary/secondary market rate); 3) Stock market index; 4) Exchange rate (LCY/USD); 5) 30-day stock market volatility; and 6) 30-day exchange rate volatility. The six indicators aid in associating the degree of financial stress with large swings in asset prices, abrupt changes regarding uncertainty and the appetite for risks.

The choice of the indicators was limited by several data considerations: 1) indicators should be available on a monthly basis without a lag; 2) dataset for all indicators should be from a period that would allow comparison with past episodes of financial stress; and 3) indicators should be expressed in prices, yields and volatility measures—such measures should be available on a daily basis and contain the largest amount of information and are the quickest to reflect the changes in financial conditions. Since the variables used in computing for the stress index are expressed in different units (i.e., yields, asset prices, and volatility), there is a need to convert these into a common unit to allow aggregation into a single composite index.

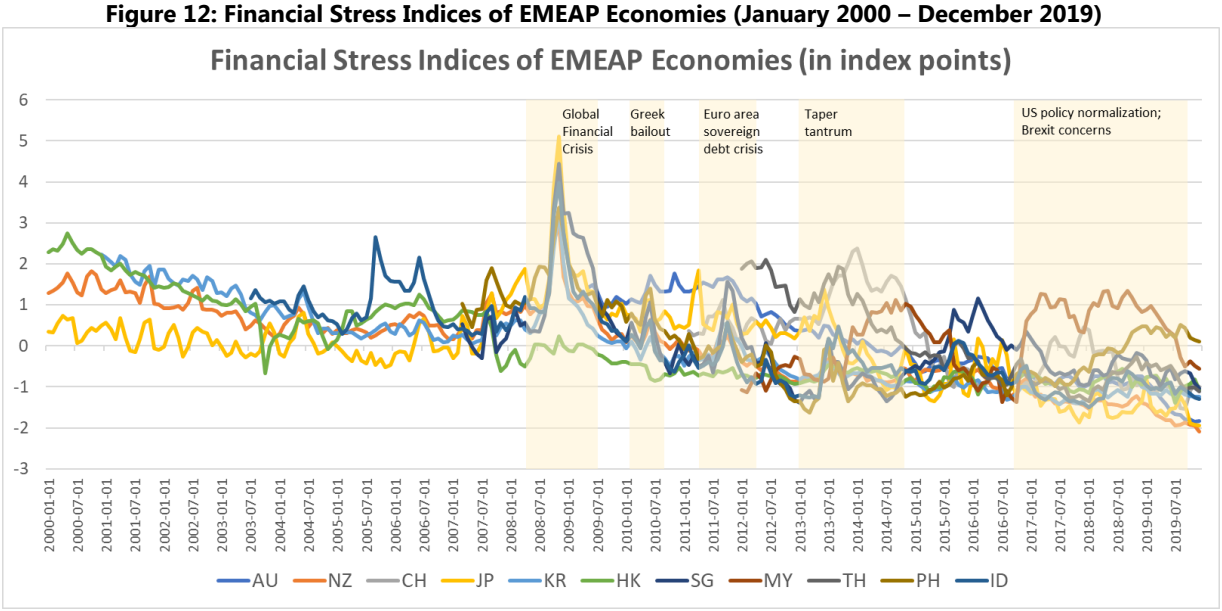
To yield the aggregate FSI for an individual EMEAP-member country, the six indicators, spanning from January 2020 to April 2020, are transformed and summed up using **Principal Component Analysis (PCA)** as follows:

$$\boldsymbol{Financial\ Stress\ Index\ (FSI)} = 3mo\ Tbill\ rate + 10yr\ bond\ yield + Stock\ market\ index + FX + Stock\ market\ volatility + FX\ volatility$$

The PCA is a procedure that transforms a number of correlated variables into a (smaller) number of uncorrelated variables called *principal components*. The PCA method assumes that financial stress is the primary factor influencing co-movement, and extracting this factor provides an index that would measure financial stress. The factor is identified by the first principal component (i.e., first eigenvalue) of the correlation matrix computed for the standardized indicators. It must be noted that, while the PCA automatically assigns a weight for each indicator, the weight does not represent the actual share of that indicator to the actual size of the market. The use of the PCA for this study is patterned after the Kansas City Fed Stress Index (KCFSI) and the St. Louis Fed Stress Index (STLFSI). Note that the higher the FSI is, the greater is the financial stress.

As shown in Figure 12, the computed FSIs for each EMEAP economy are quite benign. The financial stress levels in the region has subsided since the spikes during the 2008-2009 crisis, which could be an indication of the improved resilience in the region's financial systems. Nonetheless, the FSIs show that financial systems remain prone to increased volatility from potential global shocks—as seen from the soft peaks during the Greek bailout, the Euro are sovereign debt crisis, the taper tantrum, and the US policy normalization and Brexit phase.

**Figure 12: Financial Stress Indices of EMEAP Economies (January 2000 – December 2019)**




Note: Length of computed FSIs differ due to data availability. FSI series starts from January 2000 for New Zealand, Japan and Hong Kong; December 2000 for South Korea; July 2003 for Indonesia; March 2007 for Singapore and Philippines; May 2009 for Australia; February 2011 for China; January 2012 for Malaysia and Thailand.
Source: Authors' estimates

Heading into the COVID-19 health crisis, although the impact of the pandemic to economic performance could be more severe than during the GFC due to both supply and

demand disruptions globally, the extent of stress in domestic financial markets is relatively less severe and temporary amid improved structural resilience and different initial conditions of respective economies and financial systems in the EMEAP region, as compared with the stress conditions experienced during the GFC.

- **Australia**: Market stress levels in domestic financial markets increased significantly over March 2020, with bid-ask spreads on government bonds widening, the spread between state and federal government bonds increasing, and the equity market falling sharply. The stress was driven by extreme uncertainty around COVID-19 and its economic and social impacts, which drove decline in risky asset prices, margin calls, and forced deleveraging in a range of financial markets as previously profitable trades turned bad. The stresses seen in the financial markets around the onset of the COVID-19 crisis, in comparison with the GFC, arose more suddenly and saw sharper moves but were corrected more quickly and have been less severe in aggregate thus far.[5]

- **New Zealand**: In March 2020, increased risk aversion and fears of liquidity shortages caused short-term interbank interest rates to increase. Liquidity conditions in the New Zealand government bond market, and broader fixed incomes markets also deteriorated. Bid-ask spreads in these markets rose significantly, with the market finding it difficult to price bonds effectively. Overall, it is likely that the liquidity stress was much greater in the GFC. This is largely due to the fact that the GFC shock had the potential to bring down the banking system (which is much more important for credit provision in New Zealand), whereas the initial part of the COVID-19 shock made capital market funding more volatile and expensive for a month or so.

- **South Korea**: Although a slight uptick in financial stress was observed at the early stage of the spread of COVID-19 brought about by the volatilities in financial markets, the observed level of financial stress was still moderate compared to the GFC levels. Nonetheless, the level of financial stress was kept at bay, amid COVID-19, owing to the timely responses of monetary and fiscal authorities.

- **Hong Kong**: The decline and volatility seen in the stock market in March 2020 were moderate compared with those during the AFC and GFC, and stock prices quickly stabilized. Interbank interest rates were generally trending down and staying low, albeit brief and modest rises in March.

- **Singapore**: Since the start of 2020, amidst a series of negative sentiments driven by the trade tension between US and China and subsequently the COVID-19 outbreak, Singapore's stock market has been trending downwards. Especially in the

[5] For example, the bank bill/OIS spread did not increase as much during the initial phase of the COVID-19 crisis as it did during the GFC, where liquidity and counterparty credit concerns rose quickly. Reserve Bank of Australia's actions contributed to this, with the Bank supplying much more surplus liquidity, compared with the GFC, and thus stabilizing money market and other longer-term rates. Similarly, the spread of state government bonds to federal government bonds rose less during the COVID-19 crisis, and returned to pre-crisis levels more quickly, while equity markets fell less, and have retraced losses more quickly.

month of March 2020, the Straits Times Index (STI) observed a period of successive large single-day drops due to the unfavorable economic outlook.

- **Malaysia**: Amidst heightened global risk aversion due to the pandemic, domestic financial markets experienced undue pressure following large capital outflows and increased exchange rate volatility. The increased demand for safe-haven US dollars resulted in liquidity strains in domestic foreign exchange market and spikes in onshore USD funding cost. While the exchange rate depreciated to reflect the outflows and strengthening USD, the extreme uncertainties surrounding global and domestic developments contributed to a sharp rise in exchange rate volatility as investors remained susceptible to changes in sentiment. Adjustments also occurred in domestic bond and equity market with substantial widening in the benchmark yield and decline in equity prices, as the uncertain outlook on the economy led to higher domestic risk premia.

- **Thailand**: Due to uncertainties over COVID-19, the Thai economy experienced significant portfolio outflows in March 2020, majority of which are from equities and bond securities flows, which were higher than outflows recorded at the peak of the GFC. However, the monthly flows into Thailand have gradually turned positive at the end of Q2/2020 as massive fiscal and monetary measures undertaken by developed countries and the reopening of most economies have helped support financial market sentiment. Further, the Bank of Thailand (BOT) observed some pressures in USD funding as seen by a drop in USD/THB cross currency basis towards the end of March 2020. Nonetheless, USD funding condition has subsequently improved after Fed introduced a set of US Dollar liquidity provisions, including USD swap line with foreign central banks.

- **Philippines**: With the onset of the domestic outbreak, domestic financial markets saw heightened volatility as concerns over the COVID-19 pandemic led investors to move toward safe haven assets. The Philippine Stock Exchange index (PSEI) declined sharply on uncertainties over economic damages of the COVID-19 outbreak and the lockdown measures to contain the outbreak, dropping to an eight-year low on 19 March 2020 at 4,623.42 index points. In the domestic funding and debt markets, Concerns over the outbreak has also translated to a temporary increase in risk premium in the local debt markets and the sharp rise in debt spreads. Meanwhile, the domestic currency remained relatively stable amid COVID-19 fears. Nonetheless, the markets have recovered by the end of March, following the various policy responses of fiscal authorities and the BSP's monetary and regulatory easing measures.

- **Indonesia**. The degree of pressure arising from the COVID-19 pandemic on Indonesian financial markets was relatively lower compared with those observed during the AFC and GFC. Such observation is reflected in the decrease of stock price index and in stock price volatility. Following investors' increasing concerns on the

pandemic, Indonesia capital markets experienced significant foreign capital outflow in stock market and in government bond market in March 2020.[6]

Given the extremely high uncertainties over the consequences and the duration of COVID-19 pandemic and the magnitude of their impact on the domestic and global economy, it is difficult to compare the current health crisis with the previous crises (AFC and GFC). While the FSIs are useful, analytical tools and additional information are still necessary to come up with a cogent analysis of financial markets.

### 3.3 Market Herding and the Financial Stress Index

In overlaying the computed FSIs with the estimated market herding measurement in all EMEAP economies (see Figures 13-23), similar findings were obtained with that of the observations of Austria (2017). Generally, in all economies, market herding is observed to track well the respective FSI of the EMEAP economies, with the data resonating well with economic theory: market herding is high (low) when market stress is low (high). In particular, market herding was (generally) on a sharp downtrend after the AFC and the GFC as the market experienced severe stress; in recent years before 2020, market herding is observed to be high in the majority of EMEAP economies (specifically, in Hong Kong, China, Indonesia, New Zealand, South Korea, Malaysia, and the Philippines) given the low overall market stress conditions. However, in 2020, market herding has been on a downward movement in all EMEAP economies (excluding Hong Kong and Indonesia), indicating increasing market stress conditions amid the uncertainties due to the COVID-19 pandemic. It appears that market herding behavior is affected by many factors and performance in multiple markets. Evidently, market agents consider the overall market situation in their decisions, not only financial market variables, but as well as other macroeconomic variables such as inflation, economic growth, and interest rates.

To date, although declining in 2020 due to uncertainties brought about by the global health crisis due to COVID-19 pandemic, market herding remains high. Thus, herding behavior of the market should be closely monitored.

**Figure 13. Australia MH Estimates and FSI**

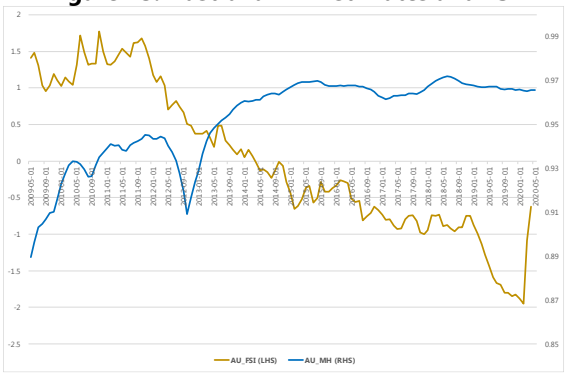
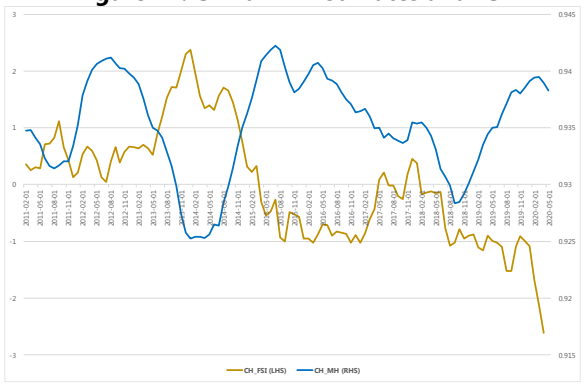



**Figure 14. China MH Estimates and FSI**




[6] Otoritas Jasa Keuangan (OJK) Press Release dated 27 March 2020

**Figure 15. Hong Kong MH Estimates and FSI**

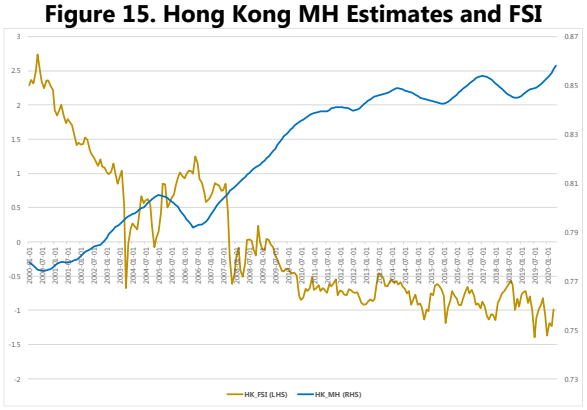



**Figure 16. Malaysia MH Estimates and FSI**

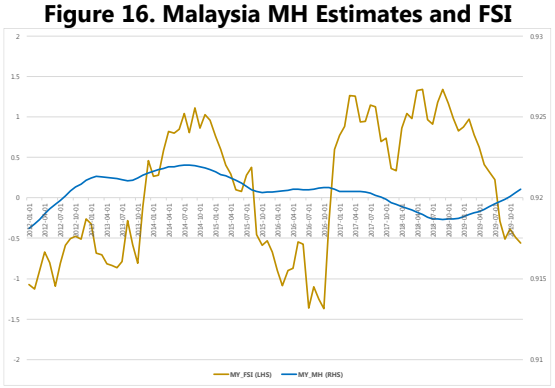



**Figure 17. Indonesia MH Estimates and FSI**

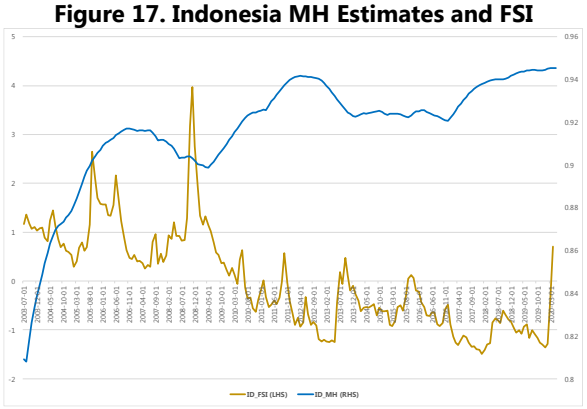



**Figure 18. New Zealand MH Estimates and FSI**

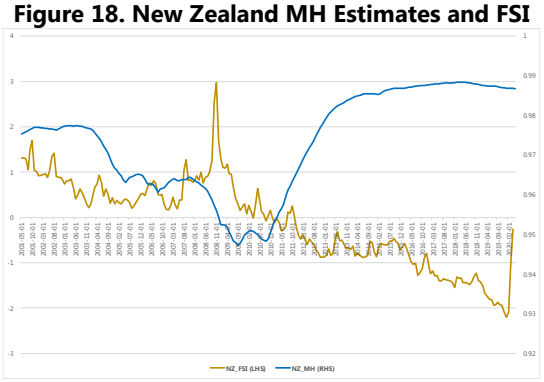



**Figure 19. Japan MH Estimates and FSI**

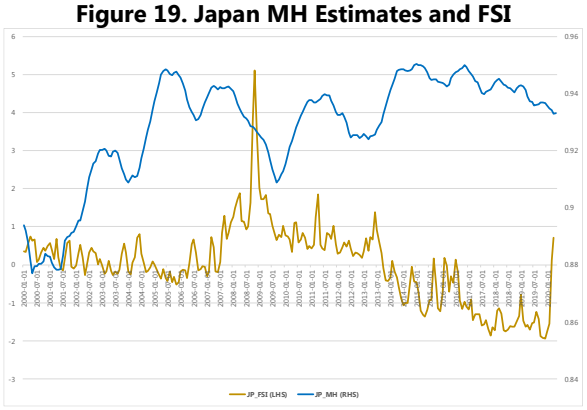



**Figure 20. Philippines MH Estimates and FSI**

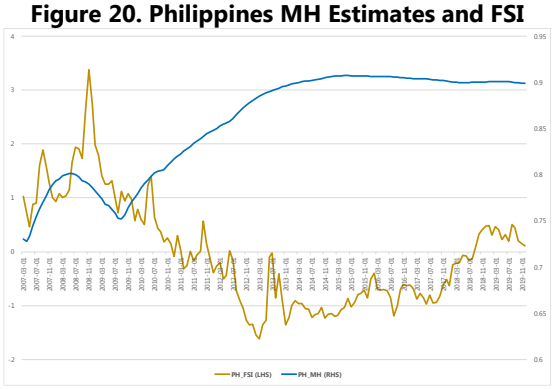



**Figure 21. South Korea MH Estimates and FSI**

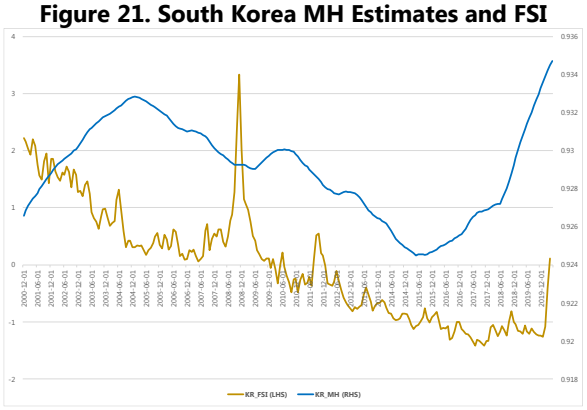



**Figure 22. Singapore MH Estimates and FSI**

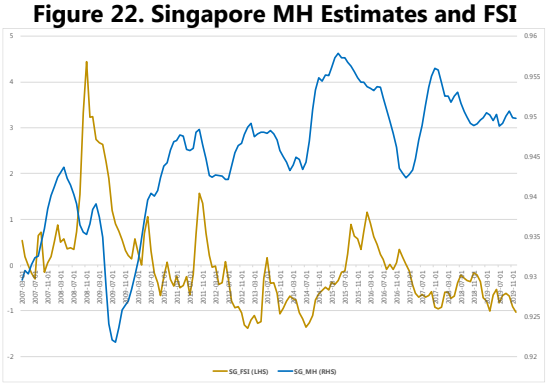
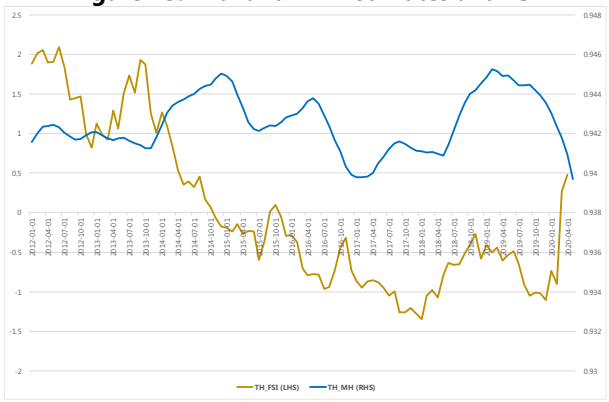


**Figure 23. Thailand MH Estimates and FSI**




Source: Authors' estimates

## 4. Policy Responses on Market Herding and Market Stress

Determining the presence of market herding in the financial market is essential to policy makers in order to assess market stress conditions efficiently and address financial stability issues through the implementation of appropriate policies and regulations.

Policymakers, especially in emerging economies, have increasingly used macroprudential tools to address financial stability concerns arising from financial cycles, which also capture influence of market players' behavior. Some examples are credit-related measures such as caps on loan-to-value ratio and debt-to-income ratio, and ceiling on credit or credit growth; liquidity-related measures such as limits on net open currency positions or currency and maturity mismatch, and reserve requirements; and capital-related measures such as countercyclical capital requirements and dynamic provisioning.

At the same time, fiscal policies can be an essential tool to contain the build-up of financial vulnerabilities. According to a 2016 study by Bank of International Settlements (BIS), there is a two-way link between the balance sheets of banks and the public sector, potentially creating for an adverse feedback loop, wherein financial and fiscal risks reinforce each other. For instance, the adjustment in the structural component of fiscal policy can generate significant impact to financial stability: the composition of taxes and subsidies can influence market players' decisions on leverage. In many countries, tax structure overly gives incentives to debt over equity, leading to unwarranted leverage and greater financial vulnerabilities.

Furthermore, monetary policy actions can also address financial booms and busts. Literature points that central bank monetary policy affects economic expectations as well as investor sentiments, thus impacting herding behavior of market participants. A study by Borio and Zhu (2012) introduced the concept of risk-taking channel of monetary policy transmission, which is the link between monetary policy and the perception and pricing of risk by economic agents. This monetary policy transmission channel validates that monetary authorities should also closely take into consideration market behavior in terms of the measurement and pricing of risk as these could create asset price bubbles.

Tables 4 and 5 present policy responses/regulations implemented by some EMEAP-member countries' monetary authorities and/or government regulators in dampening the impact of market herding and mitigating market stress, respectively.

**Table 4: Policy Responses or Regulations Implemented by EMEAP-Member Countries in Dampening Market Herding Behavior**

| Regulations/Policies | Instigating Body | Policy Objective(s) | Policy Effectiveness |
|---|---|---|---|
| **MALAYSIA** | | | |
| **Period: Asian Financial Crisis (AFC) in 1998**<br><br>For portfolio funds brought in before 15 February 1999:<br>• Exit levy at a decreasing rate on repatriation of principal capital within 1 year. No levy on repatriation of profits within the 12-month holding period.<br>• However, profits on investment made after the 12-month holding period is subject to repatriation levy of 10%.<br><br>For portfolio funds brought in on or after 15 February 1999<br>• No exit levy on repatriation of principal capital. Profits made and repatriated within the 12 months holding period are subject to 30% levy.<br>• Profits on investment repatriated after 12-month holding period is subject to 10%<br><br>The levies were finally lifted on 2 May 2001.<br>*Reference:*<br>*BNM Annual Report 1998* | Bank Negara Malaysia (BNM) | Immediately discourage non-resident investors to bring capital out | • Reduced degree of free-flow of capital has granted some degree of independence in monetary policy<br>• Stability in the financial market enables the authorities to implement growth-oriented policies and undertake structural reforms (rebuilding other sectors of the economy)<br>• Facilitate restructuring in the banking system in 1999 |
| **SOUTH KOREA** | | | |
| Activation of a Circuit breaker<br><br>Implementation of a sidecar - a rule that lets the KRX suspends futures trading of equities during periods of extreme market volatility<br><br>Imposition of daily price limits | Korea Exchange (KRX) | To mitigate sharp price changes and alert investors<br><br>To mitigate the impact of sharp futures price changes on the stock market<br><br>To promote fair pricing and prevent harm to investors from sharp market price changes | |
| Strengthening communication with the FX market | Bank of Korea (BOK), Ministry of Economy and Finance (MOEF) | To curb herd behavior in FX Market | |

| Regulations/Policies | Instigating Body | Policy Objective(s) | Policy Effectiveness |
|---|---|---|---|
| | | | |
| **THAILAND** | | | |
| Measures to discourage hot money flows undertaken by NRs<br>- Reduce the limit on outstanding of non-resident Baht accounts (NRBAs)<br>- Tighten the reporting requirements for NR' holdings of bonds by disclosing the ultimate beneficial owners | BOT | To limit short term and volatile capital flows, as well as enhance surveillance system | BOT benefits from the enhancement of surveillance systems over the long run |
| **CHINA** | | | |
| Improvement of security market rules | China Securities Regulatory Commission (CSRC) | Promote the price discovery. | effective |
| Enhancement of regulations on investor protection | CSRC | Regulate the operation of market entities and enhance the market transparency. | effective |
| Introduction of medium and long-term investors | CSRC | Optimize investor structures and stabilize market expectations. | effective |
| Strengthen investors education | People's Bank of China (PBOC), CSRC | Improve investors' risk management and promote rational investment. | effective |

Policy measures implemented by EMEAP economies during periods of financial market stress spans from ensuring adequate funding sources, liquidity and credit in the financial system, managing volatility and ensuring orderly conditions in the FX and equities market.

**Table 5: Policy Responses or Regulations Implemented by EMEAP-Member Countries in Mitigating Market Stress**

| Country | Instigating Body | Description | Objective |
|---|---|---|---|
| **Large-scale asset purchases** | | | |
| Australia | RBA | In March 2020, the RBA announced that it is prepared to purchase Australian Government Securities (AGS) and securities issued by the state and territory central borrowing authorities in the secondary market. The size and composition of purchases will be determined subject to market conditions and will vary across auctions. | Target the yield on 3-year Australian Government bonds of around 0.25 percent and ensure good market function in the government bond markets |
| New Zealand | RBNZ | In March 2020, the Monetary Policy Committee has decided to implement a Large-Scale Asset Purchase Programme (LSAP) to purchase up to NZD$60 billion of New Zealand government bonds.<br><br>Furthermore, a total of NZD$3 billion local government bonds was added to the $60bn LSAP programme, in consideration of local government bonds' important role in determining interest rates faced by firms and households. | Address liquidity stresses in the domestic government bond market, and lower/flatten the yield curve<br><br>Improve liquidity conditions in the local |

| Country | Instigating Body | Description | Objective |
|---|---|---|---|
| | | | government bond market |
| **Term funding facility** | | | |
| Australia | RBA | The central bank provided a term funding facility for the banking system, with particular support for credit to small and medium-sized businesses. | Ease financial conditions – lower banks' funding costs and support provision of credit to businesses, especially small and medium-sized enterprises |
| New Zealand | RBNZ | The central bank created a term auction facility (TAF) that gives banks the ability to access term funding with collateralized loans available out to a term of 12 months. | Reduce short term interest rates |
| **Liquidity support** | | | |
| Australia | RBA | The central bank expanded the provision of liquidity to banks via increased dealing in open market operations. | Ease financial conditions |
| Australia | Australian Office of Financial Management (AOFM) | A Structured Finance Support Fund (SFSF) was created to make targeted investments in structured finance markets used by smaller lenders that provide consumer and business finance, investing in rated term securitizations and in rated and unrated securitization warehouses. | Ease financial conditions |
| New Zealand | RBNZ | RBNZ significantly increased the amount of settlement cash in the system and removed banks' credit tiers to provide flexibility for the Reserve Bank's open market operations. | Reduce short term interest rates |
| Thailand | BOT, Ministry of Finance | During the COVID-19 pandemic, a Corporate Bond Stabilization Fund (BSF) was established to invest in high-quality, newly-issued bonds by corporates that cannot fully rollover maturing corporate bonds.<br><br>A Mutual Fund Liquidity Facility (MFLF) was also established to provide favorable funding to financial institutions who provide liquidity support to money market and fixed income funds. | Help restore liquidity and confidence in money market funds and fixed income funds as well as corporate bond market during periods of extreme market volatility |
| **Circuit breakers** | | | |
| Hong Kong | Hong Kong Exchange and Clearing Limited (HKEX) | In 2016, HKEX launched the Volatility Control Mechanism (VCM). The VCM, which was further enhanced in 2020, is triggered if a stock is away from the last traded price 5 mins ago by: ±10% for LargeCap; ±15% for MidCap; and ±20% for SmallCap.<br>During a 5-min cooling off period, trading is allowed within the fixed price band (±10% for LargeCap; ±15% for MidCap; and ±20% for SmallCap), after which normal trading resumes.<br>The VCM covers about 500 stocks, with 90% of market capitalization. | Prevent extreme price volatility arising from trading incidents;<br>Reduce systemic risks caused by interlinked products; and<br>Maintain a fair and orderly market |

| Country | Instigating Body | Description | Objective |
|---|---|---|---|
| Singapore | Singapore Exchange Limited (SGX) | The SGX has circuit breaker rules in place. The circuit breaker is activated when an incoming order could potentially match an existing order in the order book at a price that is outside the circuit breaker dynamic price bands (i.e., 10% from an applicable reference price).[7] When this occurs, a five-minute cooling off period is triggered, and the incoming order is rejected and will not be matched at a price outside the price band. During this cooling-off period, trading can still take place within the price bands. All existing orders will not be affected and new orders can continue to be placed in the order book as long as they do not result in the potential matching of trades outside the price band. | Manage volatility and ensure order in the stock market |
| Malaysia | Securities Commission; Bursa Malaysia | Circuit breaker is triggered automatically when the FTSE Bursa Malaysia KLCI ("FBMKLCI") records a decline of 10%, 15% and 20% within a trading day, based on the previous day's closing index level. This will temporarily halt trading on Bursa Malaysia. | Ensure orderly functioning of the equities market |
| Philippines | Securities and Exchange Commission; Philippine Stock Exchange (PSE) | In May 2020, the Philippine Stock Exchange (PSE) used a new three-level circuit breaker, essentially lowering the static threshold of securities:<br>• Level 1 circuit breaker is still based on the original circuit breaker policy introduced in 2008, where a 15-minute market-wide halt is implemented when the PSE index (PSEi) drops by 10% from the previous trading session's level.<br>• Level 2 circuit breaker is tripped when the PSEi falls by 15% from the previous trading day's closing level and involves a 30-minute trading halt.<br>• Level 3 circuit breaker will be triggered and trading will be halted for one hour if the PSEi plunges by 20% from the previous trading session's closing level. | Manage the volatility and maintain order in the stock market |
| Indonesia | Financial Services Authority; Indonesia Stock Exchange (IDX); Indonesian Clearing and Guarantee Corporation; Indonesia Central Securities Depository | In March 2020, regulatory authorities implemented a trading halt for 30 minutes in the event the Jakarta Stock Exchange Composite Index (JCI) experiences a 5% decline.<br><br>In addition, authorities changed the "automatic rejection" limit in IDX's Trading Regulation from 10% to 7%. | Reduce stock market volatility |

[7] The dynamic reference price during continuous trading phase is the last traded price as of five minutes prior to each potential trade. If no trades were executed in the trading day's continuous matching phase, the dynamic reference price will be the trading day's first reference price.

| Country | Instigating Body | Description | Objective |
|---|---|---|---|
| **Measures to maintain stability in the FX market** | | | |
| Australia | RBA | The RBA has established US dollar swap arrangements with the US Federal Reserve. | Alleviate tightness in USD funding markets |
| China | PBC; State Administration of Foreign Exchange (SAFE) | China's exchange rate regime has undergone gradual reform since the move away from a fixed exchange rate in 2005 towards a more flexible exchange rate regime The renminbi has become more flexible over time (i.e., permitting the yuan to fluctuate within a wider band) allowing a greater role for market forces. Since the pandemic, SAFE has strengthened monitoring cross-border balance of payments to deal with market stress and reduce herd behaviors. | Maintain the stability of the domestic currency |
| Korea | BOK; Ministry of Economy and Finance; Financial Services Commission (FSC); Financial Supervisory Service (FSS) | In Korea, FX macroprudential measures such as putting ceilings on FX derivatives positions and adjustment of FX liquidity coverage ratios (LCR) were put in place to manage FX financing. | Smoothly manage FX financing of financial companies |
| Malaysia | BNM | In 2016, BNM issued FX administration rules to address volatility in the FX market:<br>a. Resident exporters are required to convert at least 75% of export of goods proceeds into ringgit. They are allowed to retain export proceeds in foreign currency beyond 25% to meet their foreign currency obligations.<br>b. Domestic trade in goods and services between residents must be settled in ringgit only.<br>c. Limit on investment abroad by residents with domestic ringgit borrowing is streamlined to include investment in foreign currency asset onshore.<br>d. Onshore ringgit hedging market is liberalized and deregulated. | Enhance depth and liquidity of onshore financial market |
| Thailand | BOT | BOT monitors volatility in FX spot and swap market as well as ensures their proper functioning, while continuing to relax rules to reduce capital flow imbalance by: a) increasing the amount of proceeds exporters can hold overseas; and b) liberalizing foreign currency deposits (FCDs) and allowing insurance companies to invest more abroad. | Reduce short term market volatility and promote capital flow balance over the long run |
| Philippines | BSP | The BSP has combined FX intervention and monetary measures with market-based FX regulations to ensure stability in the FX market:<br>• Liberalizing FX rules (with appropriate safeguards)<br>• Maintaining a healthy level of reserve buffers<br>• Adjusting macroprudential measures (i.e., adjusting risk weight for Non-Deliverable Forwards)<br>• Deployment of liquidity enhancing and management tools (such as the US dollar repo facility, Exporters' dollar and yen | Ensure orderly market conditions avoid excessive volatility in the exchange rate |

| Country | Instigating Body | Description | Objective |
|---|---|---|---|
| | | rediscounting facilities (EDYRF), and Enhanced guidelines on the Currency Rate Risk Protection Program (CRPP) | |
| Indonesia | BI | The BI intensified the triple intervention policy in the spot and domestic non-deliverable forwards markets in April 2020. | Manage volatility in the FX market |
| **Margin policies and counter party monitoring** | | | |
| Singapore | MAS; central counterparties (CCPs) | CCPs have been managing the volatility in the market through their robust margin policies and counterparty monitoring. This includes monitoring not only the counterparties, but also their counterparties' top clients and clients' positions to ensure that they are aware of any possible interconnectedness and exposure.<br><br>MAS has also engaged key exchanges and clearing houses to:<br>a. Step up risk monitoring for potential news that would impact investor sentiment;<br>b. Inform MAS immediately of any large movements (> 4%) in key indices (e.g. STI) and underlying markets for the top contracts as well as of any large margin calls made; and<br>c. Ensure that margins posted by clearing members remain sufficient even in the presence of future large price swings. Within MAS, the relevant departments are also kept apprised of any large margin calls made. The relevant risk-based capital ratios of the affected clearing members are circulated as a sanity check on the sufficiency of their financial resources. | Manage volatility in financial markets and ensure financial stability |

Note: The policy responses were provided by colleagues from EMEAP central banks: Reserve Bank of Australia (RBA); Reserve Bank of New Zealand (RBNZ); Bank of Japan (BOJ); People's Bank of China (PBC), Bank of Korea (BOK), Hong Kong Monetary Authority (HKMA); Monetary Authority of Singapore (MAS); Bank Negara Malaysia (BNM); Bank of Thailand (BOT); Bangko Sentral ng Pilipinas (BSP); and Bank Indonesia (BI).

## 5. Conclusion and Policy Implications

The Hwang and Salmon (2004) model shows that investors' herding behavior in the 11 EMEAP member economies generally correspond to the prevailing levels of market stress in their respective economies. Low levels of herding measures were seen on dates that correspond to or were close to critical period of market stress, especially during the 2008 GFC, as well as during the Greek bailout, the Euro area sovereign debt crisis, the taper tantrum, and the US policy normalization and Brexit phase.

Similar with the observations of Austria (2017), market herding levels in all economies are currently observed at high levels (amid generally low market stress conditions), which are consistently higher than the levels during the 1997 AFC and the 2008 GFC. These estimates could imply that the current uptrend in the equities market is not driven solely by investors' sentiment toward developments in corporate and macroeconomic fundamentals, but also by investors' market herding behavior. As such, there is currently the risk of an abrupt downward

shift in market herding similar to those observed during the 1997 and 2008 crises. Coincidentally, we have seen that market herding levels have started to decline in 2020 due, in part, to uncertainties brought about by the global health crisis relating to the spread of COVID-19. Nevertheless, herding behavior of the market should be closely monitored.

Moreover, we observed the different correlation patterns of market herding behavior between EMEAP economies, from high degree of correlation to low or no significant relationship at all. One interesting observation though is that herding behavior in South Korea is negatively correlated with all EMEAP economies. These observations are in accordance with empirical literature suggesting non-uniformity of herding behavior in different economies and the notion that market sentiment may not always transfer internationally. Further investigation of differences in market herding behavior across economies presents an area of related future research on the topic.

Furthermore, the estimated market herding measurement seems to generally track well the computed FSI in all EMEAP economies, with the data resonating well with economic theory: market herding is high (low) when market stress is low (high). It appears that market herding behavior is affected by many factors and performance in multiple markets. Evidently, market agents consider the overall market situation in their decisions, not only financial market variables but as well as macroeconomic variables such as inflation, economic growth, interest rates, etc.

The estimated market herding and market stress measures as well as identified relationship of the two (i.e., market herding estimate is high when market stress is low and vice-versa) could prove useful for analyzing the conditions in an economy's equity markets and, consequently, will help inform policies to address the impact of market herding in an economy and to mitigate market stress.

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