Volatility transmissions in Philippine foreign and stock exchange markets

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Abstract

As the furthermost popular measure of risk in many financial activities, recent developments such as initiation of new methodologies should be explored to keep up with the market dynamics. This study examines Philippine Stock and Foreign Exchange Market from 1 January 1987 through 1 January 2020. Modified iterated cumulative sum of squares (MICSS) algorithm is implemented to trace structural breaks in the variance. Local political events are blamed for stock market disruptions, but financial crises have an impact on foreign exchange markets. General autoregressive conditional heteroscedasticity (GARCH) model is then employed in estimating persistence in volatility and a framework to test for spillover effects (hypotheses of heat wave and meteor shower). Substantial drop of volatility persistence is seen in the model, once structural breaks are present. With respect to volatility dynamics, heat waves' supremacy is observed for both markets.

***Keywords**:* Foreign exchange, GARCH, modified iterative structural breaks, stock market, volatility

JEL Classification Codes: C22, G11

1. Introduction

Volatility has been the most popular measure of risk in many financial activities. By definition, superior volatility suggests an unstable finance market. On the other hand, smaller volatility corresponds to the relatively stable market. Stock markets have a significant role in the finance sector by promoting economic development (Ho and Odhiambo, 2016). Particularly, the Philippines, is considered as one of the pioneers of establishing stock markets in Asia. It has transformed rapidly due to extensive reforms. In 2020, the Philippine Stock Exchange was valued at Php 13.1 trillion in terms of market capitalization (World Federation of Exchanges, 2020). Partly due to COVID-19 pandemic, market capitalization for 2020 was lower by 6.1% compared to 2019 which was reported at Php13.9 trillion.

In an economy devoid of arbitrage, the rate at which information enters the market directly affects price volatility (Ross, 1989). It is expected that the information flow does not limit to one market only. With this, shockwaves from one market are transmitted to other markets. This transmission is known as effects of volatility spillover, pronounced to be a variance causality (Granger, 1969). With the events happening locally and globally and the increased interdependence on the operation of both financial markets, it is important to account factors that could affect volatility and its transmission between markets.

Recent advancement on analytical tools and techniques used to investigate this topic emerged wherein abundant pragmatic studies were steered upon to determine volatility persistence, as well as, the causal relationship across financial markets. One of the techniques used in this topic are still well within the framework of GARCH models and innovations of the model were made. Specifically, Thampanya *et al.* (2020) uses Exponential GARCH to include the restriction of symmetry for standard GARCH (Nelson, 1991) and to evaluate the scale of volatility returns. Meanwhile, GARCH(1,1) model is used to capture volatility asymmetries present in the series.

We studied the market transmission of volatility in stock and foreign exchange markets in the Philippines through detection of structural breaks and its potential impacts via GARCH models. This paper also examines how each financial market reacts from the arrival of new information, in the global and local scale. This study's remaining sections are arranged as follows: Part 4 includes the findings and discussion, while Part 5 offers the conclusion. Part 3 gives an overview of the data, and the econometric approach and Part 2 discusses the review of previous literature.

2. Review of related literature

Volatility is widely used as one of the most important indicators in many financial activities including asset pricing, hedging and other trading strategies. As a result, volatility has become one of the most crucial factors that have drawn considerable attention to both academics and practitioners. Volatility studies in the Philippines can be found in Bautista (2003), Mapa (2003), Asai and Unite (2008), Almonares (2019), and

Etac and Ceballos (2019). Early studies on the market volatility in the Philippines can be found in Bautista (2003), who investigated the weekly aggregate stock market over a 14-year period from 1987 to 2000 using Regine-switching-ARCH. The study found four high volatility episodes in the data series wherein high stock return volatility preceded a bust cycle of the economy. Volatilities found were associated with local events, such as the series of attempted military coup in late 1980s, lifting of the remaining foreign exchange and capital account restrictions in 1993 and on the onset of Asian financial crisis in 1997. This study seems to confirm the conclusions in studies abroad, such as in Bailey and Chung (1995) and Bekaer and Harvey (1997) that emerging markets are more likely to be influenced by local events.

3. Methods

3.1. Data description

This paper utilizes the closing price (daily adjusted) of the PSEi traded in the Stock Exchange and Philippine Peso (PhP) effective exchange rate against US Dollar (USD). For PSEi, daily adjusted closing price is used as it validate the stocks at its closing price in relation to other attributes such as stock splits and dividend distribution and rights offerings. Aside from the usual buy and sell activity, stock prices may change due to political, financial, and economic events (Bautista, 2003). Both data series covers post-people power revolution until the pre-COVID19 pandemic from the period of 1 January 1987 to 30 January 2020 with 8,473 and 8,158 observations for PSEi and PhP/USP, respectively. The logarithm difference was used to convert daily prices into returns, as illustrated in Figure 1. Hence, there are evident clusters that tend to persist on several periods.

As presented (Table 1), the average values for both series is closed to zero. Specifically, positive skewness indicates that both series have an asymmetric tail distribution approaching positive values. Moreover, both return series has excess kurtosis implying higher likelihood of observing zenith positive or negative return shocks as compared to normal distribution. Exhibiting heavy tails which provides important implications for the dynamics of returns as well the modelling strategy for the dynamics of volatility. Furthermore, both series are not normally distributed based Jarque-Bera normality test. With respect to the test (Augmented Dickey-Fuller [ADF]), the series are both stationary at levels which indicates an absence of unit root. Meanwhile, ARCH effect is found in the return series' variance. It is evident that the series is leptokurtic with heteroskedastic variance, signifying a model fit for ARMA[a]-GARCH.

[a] Autoregressive Moving Average (ARMA)

Table-1. Summary (statistics) of Stocks & Foreign Exchange

	Stock	*FX*
Average	0.000334	0.000111
Standard Deviation	0.161776	0.004548
Skew.	0.081523	0.954386
Excess Kurtosis	11.69652	83.76677
Jarque-Bera	47607.22 [0.0000]	2386098 [0.0000]
ADF	-78.98 [0.0001]	-23.90 [0.0000]
ARCH LM TR^2 (1)	420.45 [0.0000]	195.29 [0.0000]
Observations	8,350	8,157

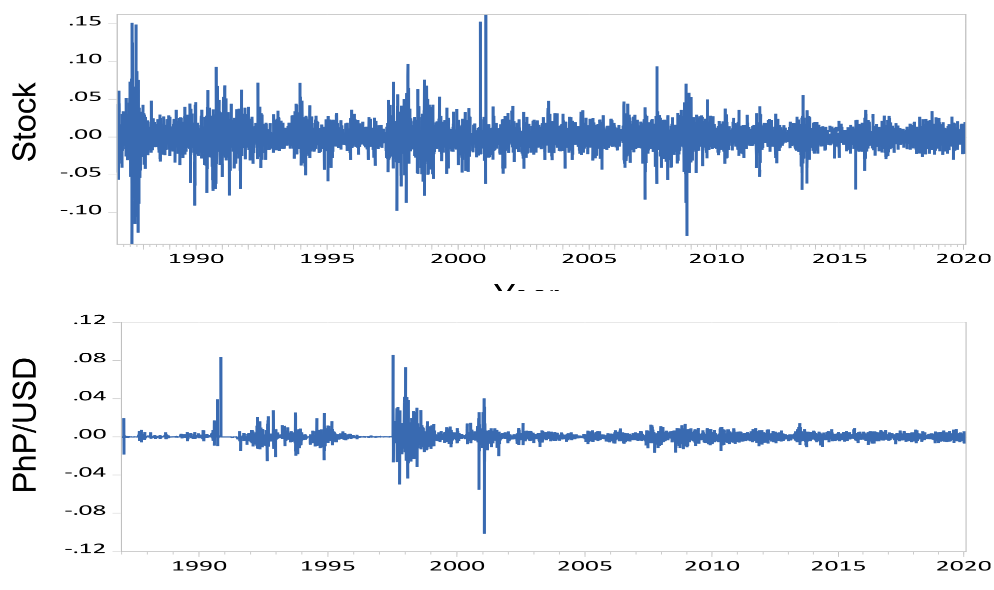

Figure-1. Plot for Stock Return and Php/USD Exchange Rate, 1987 to 2020.

Source: Philippine Stock Exchange

3.2 Modified Iterated Cumulative Sum of Squares (MICSS) Algorithm

When used on financial time series, the MICSS (Inclan and Tiao, 1994) may result in erroneous structural break estimation. The data series' fourth moment (Equation 1) characteristics and conditional heteroskedasticity, which are improperly addressed in ICSS, were taken into account when creating the improved IT test (Sanso et al., 2004).

$$K_2 = \sup_k \left| \sqrt{1/T} G_k \right| \qquad (1)$$

where,

$$G_k = \widehat{\omega}_4^{-\frac{1}{2}}\left(C_k - \frac{k}{T}C_T\right) \tag{2}$$

and $\widehat{\omega}_4$ is a consistent estimator of ω_4

$$\widehat{\omega}_4 = \frac{1}{T}\sum_{t=1}^{T}(\varepsilon_t^2 - \hat{\sigma}^2)^2 + \frac{2}{T}\sum_{l=1}^{m} w\,(l,m) \sum_{t=l+1}^{T}(\varepsilon_t^2 - \hat{\sigma}^2)\,(\varepsilon_{t-1}^2 - \hat{\sigma}^2) \tag{3}$$

In Equation (3), $\hat{\sigma}^2$ is the data sequence variance; $w(l,m)$ represents Bartlett kernel function given by $w(l,m) = 1 - \frac{l}{m+1}$ with $1 < l < m$.; and m (bandwidth) determines the amount of cross products included (Newey and West , 1994) in Equation (3).

3.3 GARCH Model

This paper utilizes standardized GARCH(p,q) (Bollerslev, 1986) as shown in Equation 4 and 5.

$$r_t = \mu + \varepsilon_t, \qquad \varepsilon_t |\, I_{t-1} \sim N(0, \sigma_t^2) \tag{4}$$

$$h_t = \omega + \sum_{i=1}^{q}\alpha_i\varepsilon_{t-i}^2 + \sum_{i=1}^{p}\beta_i h_{t-1} \tag{5}$$

where ε_t is a discrete real-time process (stochastic) and I_t is the information set until period t. To guarantee plus values for the conditional variance h_t, $\omega > 0$, $\alpha_i \geq 0$ $(i = 1, \dots, q)$ and $\beta_i \geq 0$ $(i = 1, \dots, p)$. Moreover, the procedure contracts to ARCH(q) when $p = 0$, hence, $p \geq 0$ and $q > 0$ to satisfy the GARCH process. The sum of α_i and β_i, serve as a measure of volatility persistence. Potential breaks in structure for unconditional variance are not taken into consideration by the usual GARCH model (Ross, 2013). However, in dealing with time series financial data, it manifests greater chances of fluctuations and its volatility will potentially incur structural breaks because of sporadic political and economic events. Thus, if these factors are ignored this can lead to overestimation of volatility persistence. Previous studies investigated this spurious GARCH estimation (Diebold, 1986; Lamoureux and Lastrapes, 1990). Variables (dummy) are included to account unique breaks discovered, in order to address this problem, and the results are then included the traditional model of GARCH:

$$h_t = \omega' + D_{1t}\delta_1 + D_{2t}\delta_2 + \cdots + D_{nt}\delta_n + \sum_{i=1}^{p}\alpha_i\varepsilon_{t-i}^2 + \sum_{i=1}^{q}\beta_i h_{t-1} \tag{6}$$

Where variables (dummy) $D_{it}, i = 1,2,\dots,n$ corresponds to the list of structural breaks detected in n. Per D_{it}, it takes a value of 1 for the breaks, and 0 otherwise. Meanwhile, $\delta_i, i = 1,2,\dots,n$ refer to coefficients of dummy variables while ω' is the new term (deterministic) subsequently in the exclusion of the break's effects (structural). With the introduction of variables (dummy) to GARCH model, it is predictable to acquire a compact persistence (volatility) (Todea & Petrescu, 2012; Kang et al., 2009; Kasman, 2009; Wang and Moore, 2009; Aggarwal et al., 1999; Malik & Hassa ,2004).

3.4 Meteor Shower and Heat Wave Hypothesis

In the marketplace process, foreign exchange and stock markets have similar operation schedule. Historical data on date *t-1* as well as the current data from one market to another are included in the information set for both marketplaces. The process in GARCH(p,q) is employed to detect existence of premise for meteor shower and heat wave (Equation 5).

$$h_{i,t} = \alpha_0 + \sum_{i=1}^{q} \alpha_{ii}\varepsilon_{i,t-i}^2 + \sum_{i=1}^{p} \beta_{ii} h_{i,t-1} + \gamma_i \eta_{i,t-i}^2 \tag{7}$$

According to the heat wave hypothesis, modifications to conditional variance in a single market are exclusively dependent on prior or contemporaneous shocks to that market. The idea of meteor shower, on the other hand, permits volatility to spread from one market to another. Testing hypothesis of heat wave is straight forward by having a null hypothesis of $\beta_i = 0$ while the null hypothesis for meteor showers is $\gamma_i = 0$. Additionally, the likelihood ratio (LR) test is used to test against meteor showers, which aggregate the effects from other markets. The model that accommodates breaks (structural) is also tested to check on how structural breaks affect volatility spillover. By doing this test, the cause of daily volatility of a return series will be specified. Finally, interpretation of coefficients will focus on α_i (ARCH) and β_i (GARCH) terms.

4. Discussions

4.1 Structural break timing

The MICSS application to the series found significant timing which is tabulated in Table 2. Specifically, the detailed list of significant events – either political, economic and global or local, that could possibly explain the existence of each disruption in the series are presented. MICSS algorithm was implemented in GAUSS Light software to detect the breaks.

Over the period of 1987 until 2020, 10 breaks were detected for the Philippine Stock Market while; while 6 breaks were detected in Philippine Peso per US Dollar exchange rate. Based on timings, it is apparent that markets for stock exchange is more sensitive from political and local events. Structural breaks found are mostly in late 1980's and early 1990's wherein major political events have happened partly due to unstable governance in general. The first break, dated 29 January 1987, can be attributed to the Pro-Marcos coup attempt in which hundreds of dissident soldiers stormed and taking control of the media and military facilities in the area of Manila. The last structural break detected was on 8 July 2009. These findings have is aligned with Bautista (2003) and Aggarwal et al. (1999), wherein they have documented that stock volatility in the Philippine seemed to be linked to nation-specific events of economics and political in nature.

Table 2. Events and time periods for structural breaks

Periods	Shocks
Philippine Stock Exchange	
29 January 1987	Pro-Marcos Coup Attempt
24 June 1987	-
28 October 1987	-
04 February 1988	Political Event
29 September 1989	Death of Ferdinand Marcos
01 April 1991	Mt. Pinatubo Eruption
03 July 1992	-
16 September 1993	-
03 March 1994	-
08 July 2009	-
Philippine Foreign Exchange Rate Market	
14 July 1997	1997-98 Asian Financial Crisis
19 June 1998	-
16 August 2001	-
11 May 2007	2007 – 2008 Financial Crisis
25 June 2010	-
03 October 2013	-

Shifting to floating exchange rate system since 1970, the exchange rate to any foreign currency is more likely susceptible to international events such financial crises. The first identified break was at the beginning of crisis (financial) in Asia and the other one was before the start of the 2007 – 2008 financial crisis. There was abrupt impact to the financial system of the Philippines because of the 1997 crisis (Alburo, 1999) but the effects were seen through a piercing devaluation of the Philippine currency. From having stability in the exchange rate averaging PhP26.4 per US Dollar in June 1997, it depreciated to PhP42.7 in January 1998. With the peso being heavily affected, the PSE also suffered significant losses during the crisis. Surprisingly, the PSEi dropped by 41 percent in 1997 measured at yearend (PSE, 2000). Yap et al. (2009) also documented the same observation during the 2007-2008 Global Financial Market when PSEi plunge by

24% from Jul 2008 to Jan 2009 (Ho and Odhiambo, 2015). In a similar vein, there was instability in the exchange rate, with the peso depreciating by 16.6% between March 2008 and November 2008. However, both the peso and stock market this time was one of the least affected in the region of Asia and the Pacific.

4.2 Estimation results

Stock and foreign exchange returns were first fitted to a GARCH model wherein structural breaks are neglected. The best model to be used in the estimation were identified based on the diagnostic tests conducted for each of the series. Dummy variables were then created after identifying the change points conforming to individual breaks. Specifically, 8,350 observations of the PSEi results, with values of 1 from the start to the end of the series, and 0 elsewhere, make up the dummy variables. The same procedure is done for the exchange rate returns having 8,157 observations.

An ARMA(1,2)−GARCH (2,2) was modeled for PSEi and ARMA(0,2)−GARCH(2,1) model for exchange rate. Both models were analyzed using Eviews with the assumption of normal (Gaussian) error distribution. The summary of the estimation of models utilized which provides results for accommodated and neglected structural breaks (revealed in Table 3). Model estimates without the consideration of structural breaks reflect a strong GARCH effect for both return series foreign exchange rate series which can be seen in β_i coefficients. In the same table, the decrease of persistence in volatility is calculated as the summation of α_i and β_i. Thus, this can evident for both PSEi and PhP/USD exchange rate returns when we considered structural breaks in the model. The estimated α_i coefficient in the model catches the ARCH effects which can be an indicator on how volatility reacts to new information. Meanwhile, β_i coefficient catches effect of GARCH indicating the persistence (of volatility). The summation of α_i and β_i, then characterizes the general measure of persistence (volatility).

It can be observed that for both series, the strong effect of GARCH in the model, where structural breaks are ignored, have reverted when breaks are accommodated. Aside from the reduced GARCH effects, it was also observed that coefficients – either α or β, after the structural breaks were added, it converted to insignificant, particularly for stock returns. This estimation result seemed to agree with Aggarwal et al. (1999) wherein reduced GARCH coefficient were observed and losing its significance when dummy variables are added in the model. Overall, volatility persistence in the stock exchange market is higher compared to the foreign currency market.

The results of the model ARMA(1,2)-GARCH(2,2) and ARMA(0,2)-GARCH(2,1) for stock and exchange rate returns, respectively, tend to confirm with earlier studies in this topic. In fact, volatility persistence has substantially reduced in both return series in accordance to breaks which are present in the model. The results further suggest that degree of volatility persistence to previous studies may be overestimated (Wang and Moore, 2009). Moreover, residual diagnostics for both model supports the validity of ARMA(1,2)−GARCH(2,2) and ARMA(0,2)−GARCH(2,1) results. As shown in the standardized residuals test, both stock and exchange rate returns were modelled adequately even if the breaks are present or not as indicated in squared standardized residuals or Ljung-Box Q^2. Nonetheless, the standardized residuals continue to exhibit serial correlation, as indicated by the Ljung-Box test or the Ljung-Box Q (Table 3). The LR test also confirms that obliging breaks in the model is advantageous compared to stagnant variance. The volatility for both series based on the selected models is shown graphically in Figure-2.

It can be noted from the figures that during July 1987, a sharp rise in the conditional variance in the stock returns relative to the foreign currencies. Notable increase was again observed in September 2001 and October 2008. As for the foreign exchange market, the first sharp rise is observed in November 1990 and dies out until July 1997 which marked a significant volatility until another sharp rise in January 1998. Another sharp rise is also observed in January 2001 although it dies out after. In general, the rise and fall of the conditional variances at different periods suggest that both markets are not free from the spillover effect of the volatility.

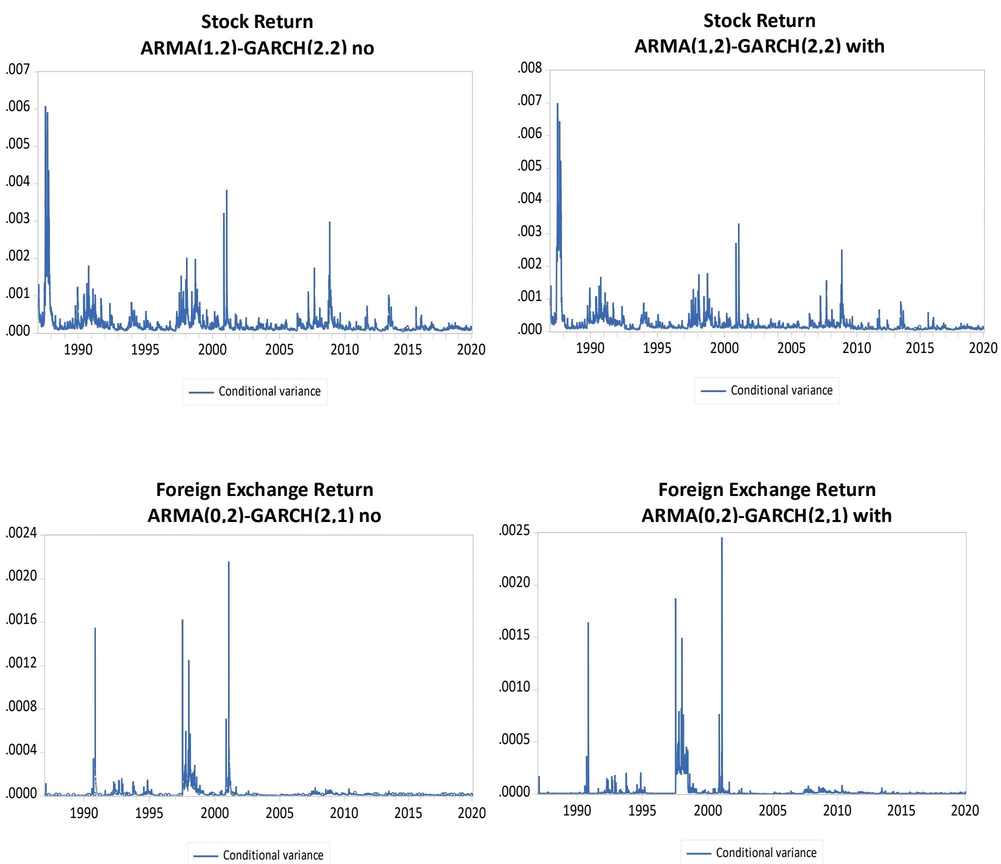

Figure-2. Volatility based on the model specification

Table-3. Estimates for stock and foreign exchange returns

	Stock		Foreign Exchange	
Model	ARMA(1,2)−GARCH(2,2)		ARMA(0,2)−GARCH(2,1)	
Break/Breaks	Accom.	Neg.	Accom.	Neg.
μ	0.000543***	0.000593***	5.38E-05	5.96E-05
	(0.000149)	*(0.00015)*	*(3.52E-05)*	*(4.84E-05)*
ω	0.000116	5.51E-07***	2.71E-06***	2.82E-07***
	(0.000115)	*(9.25E-08)*	*(1.54E-07)*	*(6.24E-09)*
α_1	0.113514***	0.136269***	0.233658***	0.219115***
	(0.010737)	*(0.009121)*	*(0.012039)*	*(1.04E-02)*
α_2	0.049453	-0.123206***	0.021217	-0.177827***
	(0.051807)	*(7.56E-03)*	*(0.018132)*	*(1.05E-02)*
β_1	0.500557	1.643644***	0.593265***	0.940878***
	(0.423579)	*(0.0368)*	*(2.31E-02)*	*(1.32E-03)*
β_2	0.236343	-0.659111***		
	(0.338952)	*(0.034254)*		
δ_1	-7.44E-05		7.13E-05***	
	(0.000112)		*(2.71E-06)*	
δ_2	0.000387**		-7.13E-05***	
	(0.000165)		*(2.70E-06)*	
δ_3	-0.000386**		-1.83E-06***	
	(0.000166)		*(2.21E-07)*	
δ_4	-2.69E-05		2.60E-06***	
	(2.38E-05)		*(3.66E-07)*	
δ_5	4.13E-05***		-1.72E-06***	
	(1.41E-05)		*(3.71E-07)*	
δ_6	-1.92E-05***		-4.37E-07***	
	(7.80E-06)		*(1.72E-07)*	
δ_7	-2.72E-05***			
	(9.65E-06)			
δ_8	3.83E-05***			
	(1.50E-05)			
δ_9	-2.80E-05**			
	(1.23E-05)			
δ_{10}	-1.02E-05***			
	(3.49E-06)			
Persistence (Volatility)	0.899867	0.997596	0.84814	0.982166
Log Likelihood	24549.72	24477.74	35498.27	34994.53
LR	143.96***		1007.48***	
Standardized Residuals Test				
Jarque-Bera	28941.16***	57986.63***	7242056***	37870434***

	Stock		Foreign Exchange	
Model	ARMA(1,2)−GARCH(2,2)		ARMA(0,2)−GARCH(2,1)	
Break/Breaks	Accom.	Neg.	Accom.	Neg.
Ljung-Box Q(1)	4.3258	8.9201	9.2093	0.8793
Ljung-Box Q(5)	7.4768**	14.950***	12.392***	4.6522
Ljung-Box Q(10)	15.799**	24.298***	15.879**	8.8187
Ljung-Box $Q^2(1)$	0.0242	0.1163	0.0025	0.0011
Ljung-Box $Q^2(5)$	0.8251	0.2844	0.0402	0.0246
Ljung-Box $Q^2(10)$	2.3250	0.9839	0.1116	0.0726
LM ARCH (1)	0.0242	0.1162	0.0025	0.0011

*Note: ***, **, * represent level of significance 1%, 5%, 10% respectively; Standard errors are in the parenthesis; Volatility persistence is calculated as $\sum \alpha_i + \beta_i$;*

4.3 Volatility spillovers: Stock returns vs. foreign exchange market

4.3.1 Heat Wave effect

Looking at the heat wave section in Table-4 and Table-5 , results from both models indicate a significant α_i (ARCH) and β_i (GARCH) terms, with and without the consideration of structural breaks. Firstly, the results of spillover investigation (Table-4), without consideration for structural break, suggest that a positive and significant heat wave effect is present in the stock returns. In particular, the ARCH parameters that include the presence of spillover effects are all significant. The GARCH term, which accounts for the persistence in the effect of the shock, is also significant which means that there is persistence in stock volatility. Similarly, this can be observed in the results if structural breaks are accommodated. It can be inferred that since GARCH coefficient in the model (with and without structural breaks) are significant, the persistence of the volatility will last after two periods.

The heat wave column in Table-5 for the foreign exchange returns also indicates a significant α_i and β coefficients, with and without the consideration of structural breaks. The significant α_i terms in the model suggest that heat wave effect is present in the returns (exchange rate) with and without the consideration of structural breaks. The same is observed in β or the GARCH term, closed to unity, which is positively significant. This means that there is volatility persistence in exchange rate returns which will last after one period.

These outcomes for both models, accounting for structural breakdowns or not, imply that the examined series are impacted by their inherent volatility. This is corroborated by Engle et al.'s (1990) study, which found that a market's conditional variance is solely dependent on previous market shocks.

4.3.2 Meteor Shower effect

To test the hypothesis, the squared standardized residuals estimated from one market were incorporated to other market. The likelihood ratio (LR) test is used to rule out meteor showers. Referring to hypothesis (null), there is rejection in heat waves for all significance levels for both. The meteor shower column presents the estimation results based on the models used to fit stock and foreign exchange returns (Table 4 and 5). Considering the potential meteor shower outcomes coming from currency to stock exchange, the estimation result indicates that, regardless of whether structural breaks are taken into account in the model or not, the hypothesis (null) of the heat wave outcome may be excluded at least 5% significant level. Although, for the model with no structural breaks considered, only α_1 is significant in the ARCH term but is sufficient enough to know that there is a meteor shower outcome imminent from the market of currency exchange. In GARCH term of the model, only $\beta_1$is significant which means that volatility in currency market influences the stock exchange volatility. Because only the GARCH term, β_1 is significant in the persistence to volatility lasting after one period. Meanwhile, on the model that accommodates structural breaks, all estimates are significant and similar conclusion can be drawn from the model does not consider structural breaks. However, since both β_1 and β_2 are significant, persistence to volatility will last for two periods.

Meteor shower column in Table-5 presents the estimation results on the possible meteor shower effect from stock exchange to currency market. Outcomes indicate that entire coefficients (GARCH /ARCH) are important (significant) suggesting that heat wave effect can be rejected, whether structure breaks are considered or not in the model. This means that stock market volatility influences currency market volatility. Moreover, persistence of stock return shocks will also last for one period.

GARCH terms are paralleled taking into consideration the meteor shower effect and heat wave. Although the results provide evidence that heat wave null hypothesis can be rejected. However, results also indicate that the magnitude of own volatility is greater compared to the effect of volatility from other market. This further implies that stock and foreign exchange market are more sensitive to its own past volatility. This finding is opposite Engle et al. (1990) results, in which external shocks or inter-market effects is more important than its previous day domestic shock. In this case, the finding of a presence of meteor showers among foreign currency and stock exchange is weak compared to the heat wave effect. Hence, heat wave effects dominate the studied financial markets (Atenga and Mougoue, 2021).

Table-4 and 5 present estimates of the meteor shower model aggregating the squared standardized residuals or information from other market represented by, η_{t-1}. The estimates are negative and very small but significant when structural breaks are neglected. This suggests that information from other market are less likely important than the past information generated by the markets itself. The same results were observed once breaks are neglected. Although the aggregate news effect from foreign exchange market has noteworthy positive effect toward the stock market, the value is too small and can be negligible. The results in aggregating the information from one market to another implies that magnitude of the volatility due to other market is very low.

5. Conclusions and Recommendations

The Philippine stock exchange and currency market volatility is analyzed using from January 1, 1987, to January 1, 2020. Structural breaks have been found when MICSS algorithm was employed in the study. Ten breaks were found in stock exchange and six breaks in the for-currency market for three decades. Smaller breaks specify a comparatively steady structure of market. Moreover, stock exchange is more sensitive to domestic political shocks. The currency market is vulnerable to international events like the 1997 and 2008 Financial Crisis.

When structural breaks are accommodated into the model, volatility significantly reduced. This implies that neglecting breaks in structure can result to spurious volatility persistence. With this, the outcomes further suggests that persistence (in volatility) may be overestimated (based on past studies). Volatility persistence in stock market is higher compared to foreign exchange. The spillover effects have shown the dominance of heat waves for both market – with or without structural breaks. Volatility persistence across markets does not die out easily.

Given the empirical findings, it is recommended for financial executives and researchers may need to consider structural breaks in modelling volatility of any financial asset that exhibits excess kurtosis (high volatility). Furthermore, the PSE and BSP should provide occasional or periodic resources in their own repositories on the reasons to fluctuating stock and exchange rates. This will help fund managers, researchers and academe in looking at the history of the fluctuations.

Given the limitations of the study, there are still promising innovations that can be ventured upon in the future. Bayesian estimation of GARCH models can be used for future studies to analyze the volatile transmissions of these markets. Moreover, in terms of period covered, further analyses should consider exploring simulation studies to determine the scale or threshold to which the test in the break method would fail. Furthermore, it also a great venture to investigate a group of markets like emerging markets in ASEAN countries with the same length of time periods.

Table-4. ARMA(1,2)−GARCH(2,2) Estimates for Spillover Effects (Stock Market and EXC → PSEi)

			Heat Wave		Meteor Shower	
	PSEi Returns				EXC → PSEi	
Action on Break(s)	Accommodated	Neglected	Accommodated	Neglected	Accommodated	Neglected
ω	0.000116	5.51E-07***	-0.000007*	0.0000003***	0.000204	0.00003***
	(0.000115)	*(9.25E-08)*	*(4.08E-06)*	*(3.99E-08)*	*(0.000176)*	*(6.88E-06)*
α_1	0.113514***	0.136269***	0.136635***	0.156769***	0.120959***	0.124738***
	(0.010737)	*(0.009121)*	*(0.008396)*	*(0.003491)*	(0.005763)	*(0.009636)*
α_2	0.049453	-0.123206***	-0.123922***	-0.148547***	0.109032***	0.033735
	(0.051807)	*(7.56E-03)*	*(0.00803)*	*(3.80E-03)*	*(0.006404)*	*(0.039182)*
β_1	0.500557	1.643644***	1.637970***	1.68115***	-0.132943***	0.604356**
	(0.423579)	*(0.0368)*	*(0.033586)*	*(0.002211)*	*(0.021473)*	*(0.275119)*
β_2	0.236343	-0.659111***	-0.657429***	-0.690673***	0.768294***	0.098062
	(0.338952)	*(0.034254)*	*(0.03051)*	*(0.002434)*	*(0.019067)*	*(0.204127)*
η_{t-1}					0.000004***	-0.000003***
					(8.80E-07)	*(2.68E-07)*
LL	24549.72	24477.74	24572.92	24500.63	23923.01	23715.90
LR (1)					1299.82***	1569.46***

Table-5. ARMA(0,2)−GARCH(2,1) Estimates for Spillover Effects (Foreign Exchange Market and PSEi → EXC)

			Heat Wave		Meteor Shower	
	Foreign Exchange Returns				PSEi → EXC	
Action on Break(s)	Accommodated	Neglected	Accommodated	Neglected	Accommodated	Neglected
ω	2.71E-06***	2.82E-07***	1.17E-08***	2.92E-07***	9.15E-07***	1.22E-05***
	(1.54E-07)	*(6.24E-09)*	*(4.51E-10)*	*(6.06E-09)*	*(2.85E-08)*	*(7.35E-07)*
α_1	0.233658***	0.219115***	0.465309***	0.221293***	0.194261***	0.142461***
	(0.012039)	*(1.04E-02)*	*(0.013936)*	*(0.010759)*	*(0.010576)*	*(0.005502)*
α_2	0.021217	-0.177827***	-3.54E-01***	-0.179835***	-8.15E-02***	4.67E-02***
	(0.018132)	*(1.05E-02)*	*(1.34E-02)*	*(1.08E-02)*	*(1.10E-02)*	*(0.017961)*
β_1	0.593265***	0.940878***	0.921383***	0.939880***	0.845242***	0.534324***
	(2.31E-02)	*(1.32E-03)*	*(0.00062)*	*(0.001256)*	*(0.003127)*	*(3.00E-02)*
η_{t-1}					-8.21E-07***	-3.15E-06***
					(1.55E-08)	*(2.46E-07)*
LL	35498.27	34994.53	36516.94	34998.94	35630.92	33038.16
LR (1)					1772.04***	3921.56***

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