# The Information Spillover Effects of International Stock Markets on the VN-Index - An Empirical Study

**NGUYỄN HÒA NHÂN**

Doctor of Philosophy, Đà Nẵng University of Economics

nhndhdn@yahoo.com

**ĐẶNG TÙNG LÂM**

Master of Arts, Đà Nẵng University of Economics

dangtlam@gmail.com

**ABSTRACT**

*Using the GARCH-in-Mean model, the present paper examines information spillover effects from some large foreign stock markets on the VN-Index. The empirical results indicate that the return rates of VN-Index are influenced by disclosures from some large stock markets in the world, especially from the US stock market. However, the volatility of VN-Index return rate and its risks are not affected by the information spillover effects from such markets.*

**Keywords**: Information spillover effect; GARCH; stock market; rates of return; volatility of return rate

## 1. RATIONALE

The economic globalization has made countries commercially and financially interdependent; and financial markets in the world are getting closer to each other. Such interdependence also implies that the macroeconomic and financial information of a country, especially large ones, can profoundly influence financial markets. Additionally, significant breakthroughs in IT (i.e. the booming of the Internet) has gradually reduced "isolation" of financial markets and enhanced the immediate response of a market to disclosures from others. Such facts lead to correlations among changes in international stock exchanges.

There have been numerous researches on the information spillover effect among stock markets in the world as well as in the Asia-Pacific region; such as those of Eun and Shim (1989); Hamao, Masulis and Ng (1990); and Koutmos and Booth (1995). Their researches were based on data collated in developed countries and implied that considerable interrelations between markets caused by the information spillover effect did exist. Those who have studied such information spillover effects of developed markets on developing ones include Bekaert and Harvey (1997); Agela (2000); Miyakoshi (2003); and Wongswan (2006). Noteworthily, most empirical researches constructed on data of developed stock markets have found different levels of information spillover effects of developed markets on developing ones.

Unlike developed stock markets, different developing markets are affected by different levels of information spillover effects, which depend on the openness and the forex control in each developing country. Besides, their distinctive features (e.g. transparency of disclosures, general market liquidity, structure of investors, effects from microeconomic structure of the stock market, macroeconomic policies, and size of the economy, etc.) also account for such differences (Bekaert & Harvey, 1997; Angela, 2000; and Wongswan, 2006). It implies that findings of comprehensive researches in some developed countries may not be suitable for and cannot be employed in a certain market, such as Vietnam's stock market. Numerous published researches did not include data of Vietnam's stock market; and as yet there has not been any relevant research in Vietnam.

Indeed, studying levels of information spillover effects from foreign stock markets on Vietnam's one is vital to both investors and macroeconomic authorities. It helps investors punctually adjust their investment portfolio in the hope of taking new

opportunities and preventing unexpected risks. Particularly, for foreign investors, knowledge of the interrelations between changes in Vietnamese and foreign markets will enable them to allocate investments appropriately among target markets, and thereby maximizing profits and diversifying international investment portfolio. Vietnam's macroeconomic authorities, thanks to understanding effects of information from foreign countries on the local market, can actively prevent upheavals, especially negative information from foreign markets.

Due to limitations on the research data, the paper only examines whether or not there exists short-term information spillover effects of some foreign large stock markets on the VN-Index, and which market has the sharpest information spillover effect on the VN-Index (if any). It does not try to analyze factors that may determine such effects on the VN-Index.

## 2. RESEARCH METHODOLOGY

The number of researches on information spillover effects across financial markets in the world has been increasing since Engle (1982) introduced methods of analyzing economic time series (especially financial time series) with time-varying volatility (ARCH), which was then generalized by Bollerslev (1986) and known as GARCH. Up till now, there have been various versions of GARCH and generally been referred to as order of GARCH models. In fact, although there are some other methods of studying information spillover effects (such as Regime Switching model, VAR, etc.), GARCH is most popularly utilized.

Hamao, Masulis and Ng (1990) are pioneers in utilizing GARCH to study information spillover effects across stock markets. Not only does the spillover of information from a certain market into others cause general ups and downs in the whole market, but it also results in unexpected volatility. The market volatility, in its turn, might produce more impacts on trends of changes in the market. Hence, Hamao et al. (1990), in their research, employed the GARCH-in-Mean model, which was proposed by Engle, Lilien and Robbins (1987) and then was also utilized by Susmel and Engle (1994); Lin, Engle and Ito (1994); and Hsin (2004).

This paper is constructed on the approach taken by Hamao, Masulis and Ng (1990). Specifically, the ARMA_GARCH-in-Mean will be employed to estimate the information spillover effects from some chosen developed stock markets on VN-Index. The estimating process includes two phases:

Firstly, the ARMA_GARCH-in-Mean is used to build models of the time-series return rate of each foreign stock index as follows:

$$R_t = \alpha + \sum_{i=1}^{p} \beta_i R_{t-i} + \chi V_t + \delta D_t + \sum_{j=1}^{q} \gamma_j \varepsilon_{t-j} + \varepsilon_t \quad (1)$$

$$V_t = a + \sum_{i=1}^{p} b_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} c_j V_{t-j} \quad (1^*)$$

Where,

$R_t$: The conditioned return rate of each kind of foreign stock index

$V_t$: The conditioned variance of return rate of each kind of foreign stock index

$D_t$: The dummy variable which equals 1 for the transaction day right after weekends or local holidays and zero for other transaction days. Previous researches did indicate profound effects of cumulative information on the ratio of conditioned returns to stock indices right after weekends or local holidays; and thus the dummy variable is used to control such effects.

Secondly, the residual (ε) is estimated from the model (1); and its square value ($\varepsilon^2$) will be utilized in the ARMA_GARCH-in-Mean for the case of VN-Index as follows:

$$R_t^{VN} = \alpha + \sum_{i=1}^{p} \beta_i R_{t-i}^{VN} + \chi V_t^{VN} + \delta D_t^{VN} + \phi X_{t-1,(t)} + \sum_{j=1}^{q} \gamma_j \varepsilon_{t-j}^{VN} + \varepsilon_t^{VN} \quad (2)$$

$$V_t^{VN} = a + \sum_{i=1}^{p} b_i (\varepsilon_{t-i}^{VN})^2 + \sum_{j=1}^{q} c_j V_{t-j}^{VN} + dX_{t-1,(t)}^2 \quad (2^*)$$

Where,

$R^{VN}_t$: The conditioned return rate of VN-Index

$V^{VN}_t$: The conditioned variance of the return rate to VN-Index

$D^{VN}_t$: The dummy variable which equals 1 for the transaction day right after weekends or local holidays, and zero for other transaction days.

$X_{t-1,(t)}$: The residual estimated by ARMA_GARCH-in-Mean for each kind of stock index chosen. It depends on the opening time of each market (sooner or later than Vietnam's market) that the simultaneity value (t) or the lag time (t-1) of variables X and $X^2$ will be appropriately employed in (2) and (2*).

The estimated residual from (1) [which is expressed as $\varepsilon$ in (1) or X in (2)] is reckoned as the unexpected return rate which is produced by effects of new information on foreign markets within the transaction day. In (2) and (2*), coefficients $\phi$ and $d$ indicate effects (if any) of news from foreign stock markets on the return rate and volatility of the ratio of return rate to VN-Index.

## 3. RESEARCH DATA

The paper employs data of indices of some major foreign stock markets such as S&P 500 of the US, FTSE 100 of UK, Nikkei 225 of Japan, and Hang Seng of Hong Kong to study their information spillover effects on VN-Index of Vietnam. The first three formers are widespread utilized in researches on information spillover effects and commonly considered as representatives for the largest financial markets in the world today. The Hang Seng of Hong Kong is used to represent major markets in the Asia-Pacific region. The daily data of chosen stock indices are retrieved from DataStream for the 5-year period from Dec.23, 2005 to Dec.24, 2010. The time series of chosen stock indices are altered by calculating their natural logarithm and then first differences of time series to obtain a stationary time series. After performing Augmented Dickey Fuller (ADF) test, time series data are stationary and deemed as continuously compounded return rate of chosen indices.

Table 1 summarizes the time series of return rate of chosen stock indices. The skewness values indicate that all five time series data possess a skewed distribution (i.e. four skew right and one skews left). Moreover, the Kurtosis values show that the tail of time-series data is heavier than the normal distribution.

**Table 1: Summary of Time-Series Return Rates of the Chosen Stock Indices as from Dec.23, 2005 to Dec.24, 2010.**

| | **VN-Index (Vietnam)** | **S&P 500 (USA)** | **FTSE 100 (UK)** | **Nikkei 225 (Japan)** | **Hang Seng (Hong Kong)** |
|---|---|---|---|---|---|
| Obs. | 1,305 | 1,305 | 1,305 | 1,305 | 1,305 |
| Mean (%) | 0.0326 | -0.0007 | 0.0055 | -0.0336 | 0.0313 |
| Std. Dev. (%) | 1.9137 | 1.5457 | 1.4466 | 1.7523 | 1.9241 |
| Skewness | -0.0696 | -0.2333 | -0.0961 | -0.3943 | 0.086 |

| | | | | | |
|---|---|---|---|---|---|
| Kurtosis | 3.0663 | 11.9734 | 10.309 | 11.1039 | 10.6241 |
| Time-series rate of return | | | | | |
| LB (40) | 199.1831*** | 108.4769*** | 151.8585*** | 59.4641** | 82.1004*** |
| Squared time-series rate of return | | | | | |
| LB (40) | 1087.2775*** | 2934.7929*** | 1989.2060*** | 2439.3396*** | 1699.5987*** |

N.B.:

LB (k) stands for the Ljung-Box Q test which is to test for the autocorrelation of time series at the level k.

*** and ** respectively denote the statistical significance at 1% and 5%.

The Ljung-Box Q tests for the time series rate of return and the squared time-series rate of return also indicate an autocorrelation in the time-series rate of return and a time-varying volatility in the rate of return series. Based on preliminary analyses of such rate of return series, it is definitely appropriate to utilize the GARCH model to build a time-series rate of return model. The author also performs tests as suggested by the Engle approach (1982), and the results indicate the ARCH effects exist in all time-series rate of return of chosen stock indices.

## 4. EMPIRICAL RESULTS

In order to estimate the information spillover effects from foreign stock markets on VN-Index by means of the ARMA_GARCH-in-Mean, the Box Jenkins methodology is employed to determine an appropriate ARMA model. In the research, the ARMA (1,1) model is quite suitable for most time series. The GARCH (1,1)-in-Mean is utilized to build a model of volatility of time series. Testing goodness of fit of such model by the Ljung-Box Q test indicates that there is no autocorrelation among residuals and standardized squared residuals (i.e. the residual turned into white noise). In other words, the ARCH effects are removed by this model structure. Hence, in order to be consistent and facilitate the analyses, the model of ARMA (1,1)_GARCH (1,1)-in-Mean is applied to all time-series rate of return of chosen stock indices.

The models (2) and (2*) can be written as follows:

$$R_t^{VN} = \alpha + \beta R_{t-1}^{VN} + \chi V_t^{VN} + \delta D_t^{VN} + \phi X_{t-1,(t)} + \gamma \varepsilon_{t-1}^{VN} + \varepsilon_t^{VN} \quad (3)$$

$$V_t^{VN} = a + b(\varepsilon_{t-1}^{VN})^2 + cV_{t-1}^{VN} + dX_{t-1,(t)}^2 \quad (3^*)$$

Where,

$R^{VN}_t$: The conditioned rate of return of VN-Index

$V^{VN}_t$: The conditioned variance of the return rate to VN-Index

$D^{VN}_t$: The dummy variable which equals 1 for the transaction day right after weekends or local holidays, and zero for other transaction days.

$X_{t-1,(t)}$: The residual estimated by ARMA(1,1)_GARCH (1,1)-in-Mean for each kind of stock index.

t-1: The lag time employed for S&P 500 and FTSE 100

t: The simultaneity value employed for Nikkei 225 and Hang Seng.

Table 2 presents estimates of effects of foreign stock indices on VN-Index. In fact, stock markets of Japan and Hong Kong open sooner than Vietnam's market, which, in its turn opens sooner than those of the US and UK. Therefore, when estimating such effects, the simultaneity value (t) will be used for Nikkei 225 of Japan and Hang Seng of Hong Kong; and the lag time (t-1) is for FTSE 100 of UK and S&P 500 of the US.

Nonetheless, due to the fact that stock markets of the US and UK open later than Vietnam's one, their daily news only produces effects on VN-Index on the following day (if any). In the meantime, information from stocks markets of Japan and Hong Kong, which open sooner than Vietnam's market, can sharply affect VN-Index within the transaction day.

As clearly indicated in Table 2, the rate of return of VN-Index is affected by information from all four stock markets, especially those of the US and UK with the greatest effects. All $\phi$ coefficients are positive and statistically significant at the level of 1%, implying that good news from leading stock markets can push the VN-Index up, and vice versa.

**Table 2: Estimating Effects of Some Foreign Stocks Indices on VN-Index using ARMA (1,1)_GARCH (1,1)-in-Mean**

| | **S&P 500** | | **FTSE 100** | | **Nikkei 225** | | **Hang Seng** | |
|---|---|---|---|---|---|---|---|---|
| | **Coefficient** | ***t-stat.*** | **Coefficient** | ***t-stat*** | **Coefficient** | ***t-stat*** | **Coefficient** | ***t-stat*** |
| $\alpha$ | -0.055 | *-0.60* | -0.084 | *-0.91* | -0.045 | *-0.50* | -0.072 | *-0.79* |
| $\beta$ | 0.056 | *0.54* | 0.072 | *0.63* | 0.011 | *0.10* | 0.043 | *0.40* |
| $\chi$ | 0.043 | *1.27* | 0.054 | *1.68* | 0.041 | *1.27* | 0.043 | *1.38* |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $\delta$ | 0.011 | *0.14* | -0.006 | *-0.07* | -0.026 | *-0.31* | -0.004 | *-0.05* |
| $\phi$ | 0.286*** | *9.77* | 0.255*** | *8.31* | 0.184*** | *7.20* | 0.078*** | *3.25* |
| $\gamma$ | 0.226** | *2.15* | 0.193 | *1.66* | 0.260** | *2.41* | 0.229** | *2.09* |
| *a* | -2.162*** | *-7.77* | -2.039*** | *-7.52* | -2.031*** | *-7.43* | -2.038*** | *-7.46* |
| *b* | 0.185*** | *8.12* | 0.195*** | *8.19* | 0.195*** | *8.17* | 0.195*** | *8.41* |
| *c* | 0.783*** | *36.66* | 0.769*** | *32.88* | 0.769*** | *31.73* | 0.771*** | *33.41* |
| *d* | 0.017 | *0.60* | 0.027 | *1.09* | 0.013 | *0.87* | 0.014 | *0.72* |

N.B.: ***, **, and * respectively denote the statistical significance at 1%, 5% and 10%.

However, it is worth noting that information from foreign stock markets does not affect the volatility of return rate of VN-Index. All estimated coefficients *d* are not statistically significant, even though they are positive. This finding is also identical to that of preceding researches (e.g. Bekaert and Harvey, 1997; Liu and Pan, 1997; Angela, 2000; and Miyakoshi, 2003) on the information spillover effect from developed markets on developing ones (i.e. the information spillover effects on volatility of the return rate are not the same among markets).

Most previous researches indicated that the information spillover effects from the US stock market on others (i.e. both developed and developing markets) are extremely profound, while effects from other markets on the US market are not significant. It is possible to hypothesize that effects from the stock markets of UK, Japan and Hong Kong on VN-Index of Vietnam as set forth in Table 2 might indeed derive from the US market. In order to test this hypothesis, the models (3) and (3*) are expanded; that is, the spillover effect coefficients of the markets of UK, Japan and Hong Kong are re-estimated; and the S&P 500 of the US is controlled in models (4) and (4*):

$$R_t^{VN} = \alpha + \beta R_{t-1}^{VN} + \chi V_t^{VN} + \delta D_t^{VN} + \phi^{S\&P500} X_{t-1}^{S\&P500} + \phi^i X_{t-1,(t)}^i + \gamma \varepsilon_{t-1}^{VN} + \varepsilon_t^{VN} \quad (3)$$

$$V_t^{VN} = a + b(\varepsilon_{t-1}^{VN})^2 + cV_{t-1}^{VN} + d^{S\&P500}(X_{t-1}^{S\&P500})^2 + d^i(X_{t-1,(t)}^i)^2 \quad (3^*)$$

Where,

$R^{VN}_t$: The conditioned rate of return of VN-Index

$V^{VN}_t$: The conditioned variance of the return rate to VN-Index

$D^{VN}_t$: The dummy variable which equals 1 for the transaction day right after weekends or local holidays, and zero for other transaction days.

$X^{S\&P500}_{t-1}$: The residual estimated by the model of ARMA(1,1)_GARCH(1,1)-in-Mean for S&P 500

$X^{t}_{t-1,(t)}$: The residual estimated by ARMA(1,1)_GARCH (1,1)-in-Mean for FTSE 100, Nikkei 225, and Hang Seng

t-1: The lag time employed for FTSE 100

t: The simultaneity value employed for Nikkei 225 and Hang Seng.

**Table 3: Estimating the Information Spillover Effects from Some Foreign Stocks Indices on VN-Index by using ARMA(1,1)_GARCH(1,1)-in-Mean with Effects of S&P500 Being Controlled**

| | **S&P 500** | | **FTSE 100** | | **Nikkei 225** | | **Hang Seng** | |
|---|---|---|---|---|---|---|---|---|
| | **Coefficient** | ***t-stat.*** | **Coefficient** | ***t-stat*** | **Coefficient** | ***t-stat*** | **Coefficient** | ***t-stat*** |
| *A* | -0.055 | *-0.60* | -0.063 | *-0.68* | -0.048 | *-0.52* | -0.055 | *-0.60* |
| *B* | 0.056 | *0.54* | 0.062 | *0.58* | 0.030 | *0.29* | 0.055 | *0.53* |
| *X* | 0.043 | *1.27* | 0.048 | *1.44* | 0.043 | *1.29* | 0.043 | *1.27* |
| *Δ* | 0.011 | *0.14* | 0.006 | *0.08* | -0.003 | *-0.04* | 0.012 | *0.14* |
| $\Phi^{S\&P500}$ | 0.286*** | *9.77* | 0.216*** | *6.39* | 0.241*** | *7.17* | 0.286*** | *9.51* |
| $\Phi^{FTSE100}$ | | | 0.138*** | *4.14* | | | | |
| $\Phi^{Nikkei225}$ | | | | | 0.082*** | *2.97* | | |
| $\Phi^{HangSeng}$ | | | | | | | 0.000 | *0.02* |
| *Γ* | 0.226** | *2.15* | 0.218** | *2.03* | 0.250** | *2.39* | 0.227** | *2.16* |
| *A* | -2.162*** | *-7.77* | -2.141*** | *-7.61* | -2.084*** | *-7.54* | -2.141*** | *-7.63* |
| *B* | 0.185*** | *8.12* | 0.189*** | *8.23* | 0.190*** | *8.16* | 0.187*** | *8.06* |
| *C* | 0.783*** | *36.66* | 0.778*** | *35.55* | 0.776*** | *33.93* | 0.781*** | *35.57* |
| $d^{S\&P500}$ | 0.017 | *0.60* | 0.001 | *0.01* | -0.017 | *-0.27* | 0.008 | *0.17* |
| $d^{FTSE100}$ | | | 0.025 | *0.48* | | | | |
| $d^{Nikkei225}$ | | | | | 0.017 | *0.57* | | |
| $d^{HangSeng}$ | | | | | | | 0.01 | *0.47* |

N.B.: ***, **, and * respectively denote the statistical significance at 1%, 5% and 10%.

As shown in Table 3, there is no much fluctuation in the coefficients estimating the information spillover effects from the US market on VN-Index in terms of size and statistical significance. The coefficients expressing the information spillover effects from the markets of UK and Japan on Vietnam's market decline substantially; yet they are still statistically significant. Noteworthily, when spillover effects from the US market are controlled, the VN-Index is not influenced by information from the Hong Kong market. This fact, again, consolidates the leading role of the US stock market in casting information spillover effects on other markets, which was figured out in previous researches. However, Vietnam's market is also impacted by news from other big markets such as UK and Japan. Like results drawn from Table 2, information of large foreign markets does not impinge on volatility of VN-Index.

Generally, similar to previous researches on the developing stock markets, findings of this paper solidify spillover effects from the stock markets of the US and UK on Vietnam's one. Surprisingly, the information spillover effects from Japan on Vietnam is not substantial, given that their bilateral commercial relationship and direct investments have been on the increase and that they are both located in the Asia-Pacific region. The most likely explanation for this fact is that the daily opening time of these two markets is nearly the same as was estimated in Table 3. Yet, volatility of the Japan's market can immediately spill over into Vietnam and sharply affects the VN-Index, and thereby reducing effects of residuals of model (1) and bringing in unexpected return rates due to new information of the Japan's market within the transaction day. A similar situation can also face the stock market of Hong Kong. This problem, in further research, should be tackled by using real-time transaction data.

## 5. CONCLUSIONS AND IMPLICATONS

This paper studies information spillover effects from some foreign stock markets on VN-Index. The results show that among chosen markets, effects of the US market on VN-Index are strongest. Yet, the volatility of VN-Index and its risks are not influenced by information from foreign markets. Such findings are really significant to local investors and market managers. Decision on purchase or sale of stocks can be made on the basis of information of previously-opened stock markets. The slight dependence of volatility of VN-index return rate on foreign markets' information implies that Vietnam might be a happy hunting ground for foreign investors to diversify their investment portfolio and maximize benefits.

Nonetheless, the paper has not identified factors affecting the information spillover effects on VN-Index, and hence it is still a subject for further research. Additionally, future research can consider information spillover effects from foreign stock markets on each group of stocks, which may be more significant to local investors ■

## References

Angela, Ng. (2000), "Volatility Spillover Effects from Japan and the US to the Pacific-Basin", *Journal of International Money and Finance*, Vol.19, pp.207-233.

Bekaert, G. & C.R. Harvey (1997), "Emerging Equity Market Volatility", *Journal of Financial Economics*, Vol.43, pp.29-77.

Bollerslev, T. (1986), "Generalized Autoregressive Conditional Heteroskedasticity", *Journal of Econometrics*,Vol.31, pp.307-327.

Engle, R.F. (1982), "Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of United Kingdom Inflation", *Econometrica*, Vol.50, pp.987-1007.

Engle, R.F., D. Lilien & R. Robins (1987), "Estimating Time-Varying Risk Premia in the Term Structure: the ARCH-M Model", *Econometrica*, Vol.55, pp.391-407.

Eun, C. & S. Shim (1989), "International Transmission of Stock Market Movements", *Journal of Financial and Quantitative Analysis*,Vol.24, pp.241-256.

Hamao, Y., R.W. Masulis & V. Ng (1990), "Correlation in Price Changes and Volatility across International Stock Markets", *Review of Financial Studies*,Vol.3, pp.281-307.

Hsin, C.W. (2004), "A Multilateral Approach to Examining the Comovements among Major World Equity Markets", *International Review of Financial Analysis*, Vol.13, pp.433-462.

Koutmos, G. & G.G. Booth (1995), "Asymmetric Volatility Transmission in International Stock Markets", *Journal of International Money and Finance*, Vol.14, pp.747-762.

Liu, Y.A. & M.S. Pan (1997), "Mean and Volatility Spillover Effects in the US and Pacific-Basin Stock Markets", *Multinational Finance Journal*, Vol.1, pp.47-62.

Lin, W.L., R.F. Engle & T. Ito (1994), "Do Bulls and Bears Move across Borders? International Transmission of Stock Returns and Volatility", *Review of Financial Studies*, Vol.7, pp.507-538.

Miyakoshi, T. (2003), "Spillovers of Stock Return Volatility to Asian Equity Markets from Japan and the US", *Journal of International Financial Markets, Institutions and Money*, Vol.13, pp.383-399.

Susmel, R. & R.F. Engle (1994), "Hourly Volatility Spillovers between International Equity Markets", *Journal of International Money and Finance*, Vol.13, pp.3-25.

Wongswan, J. (2006), "Transmission of information across international equity markets", *Review of Financial Studies*, Vol.19, pp.1157-1189.