African Journal of Business Management Vol. 5(1), pp. 13-18, 4 January, 2011
Available online at http://www.academicjournals.org/AJBM
DOI: 10.5897/AJBM10.179
ISSN 1993-8233 ©2011 Academic Journals

Full Length Research Paper

Appling new hybrid model to evaluate dynamic relationship in high-tech Industries

Yi-Hsien Wang

Department of Banking and Finance, Chinese Culture University, No.55, Hwa-Kang Road, Yang-Ming-Shan, Taipei, Taiwan 11114, Republic of China. E-mail: holland@mail2000.com.tw.

Accepted 19 May, 2010

Investigating dynamic relationship among stock markets has received considerable attention by both academics and practitioners. Hence, this study presents new integrated model, Grey-VAR Model, to modify Granger causality test procedure that can investigate dynamic relationships of high-tech industries. These results provide evidences that there exist the short-term equilibrium relationship of high-tech industries and the investors can alter portfolio allocation.

Key words: VAR, grey model, dynamic relationship, impulse response.

INTRODUCTION

"Economic Integration" has grown among continental European countries, beginning with regional economies prior to 1948. Globalization not only promotes worldwide economies, but also forms regional economic alliances. Most world commerce consists of regional organizations, with different levels of economic development among Asian regional economies. Newly industrializing countries face economic growth and development challenges with local economies now transitioning to participate in the global economy. Asian markets now face worldwide competition and must communicate and work together to survive and succeed (Brown et al., 2009; Hsu, 2009; Wang et al., 2010). Moreover, Asian stock markets need to actively construct a regional economic alliance organization. Interrelationships among the four most powerful nations: the United States, Russia, China, and Japan, are generally stable and improving, yet there is still no complete harmony. Improved relations and the economic alliance between the United States and Japan remains the most important factor in the Asia-Pacific region. Following the Second World War, the United States became a superpower. The U.S. has the most advanced technology and economy in the world and has traditionally been a dominant economic influence in the Asia-Pacific region (Kim and Mathur, 2008; Chen et al., 2010). It continues to play a very important role in the region's affairs, especially in the evolving economies of both Japan and Taiwan. Japan is the major trade partner of U.S. Japan is the second largest economic power in the Asia-Pacific region and also greatly affects Asia-Pacific security. Japanese interdependent economic relations with Asian-Pacific region, especially the U.S., are so close that it cannot be economically separated from them (Sohn, 2002; Swartz, 2006; Burdekin and Whited, 2009; Chen et al., 2010).

Previous studies have pointed out that dynamic interrelationship with a significant transmission effect exists between these most international stock market. Results revealed that the United States and Japan are the two most powerful influences in each of these seven regional stock markets (Granger, 1969; Chan et al., 1992; Arshanpalli and Doukas, 1993; Chung and Liu, 1994; Choudhry, 1996; Chan et al., 1997; Ghosh et al., 1999; Jang and Wonsik, 2002; Hung, 2009; Mandaci and Torun, 2010). Specific research that investigates the "lead-lag" relationship between Japanese and Taiwanese high-tech industries that has resulted from exposure to U.S. high-tech industrial stocks in the financial markets did not exist prior to this study.

By employing conventional and advanced time-series techniques, this work investigates the dynamic short-term causal relationships and long-term equilibrium relationships among the stock prices of the United States, Japan, and Taiwan. Lead–lag relations and data concerning long-term co-movement among the three variables may provide an excellent asset allocation reference for multinational enterprises and international investors (Johansen, 1988; Neih and Chang, 2003). This paper is organized as follows: Section 2 presents the methodology. Next, section 3 describes the preliminary analysis and presents empirical evidence. Finally, section 4 discusses the results and presents conclusions.

METHODOLOGY

Unit root tests

To accomplish the goal of avoiding "spurious regression", the series must be carefully examined for "stationarity". Since non-stationary regressors invalidate many standard empirical results, a "unit-root" test was developed by econometricians for examining time series stationarity (Granger, 1988). The ADF models are used in the following forms:

$$\Delta x_t = \phi x_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta x_{t-i} + \varepsilon_t \tag{1}$$

$$\Delta x_t = \alpha + \phi x_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta x_{t-i} + \varepsilon_t \tag{2}$$

$$\Delta x_t = \alpha + \phi x_{t-1} + \beta t + \sum_{i=1}^{m} \gamma_i \Delta x_{t-i} + \varepsilon_t \tag{3}$$

The null hypothesis for the ADF test is: H_0: ϕ = 0, with the alternative H_1: $-2 < \phi < 0$. Suitable lag length must be pre-designated to avoid biased estimation if lag length has not been rigorously determined. The Akaike's information criterion (AIC) was used to determine the optimal lag number.

Co-integration tests

This long-run equilibrium relationship is referred to in the literature as co-integration. Applying the idea of Johansen methodologies, a p-dimensional VAR model is constructed with Gaussian errors, which can be described by its first-differenced error-correction form as:

$$\rho_1 \Delta Y_{t-1} - \prod Y_{t-1} + \Phi E_t + \varepsilon_t \tag{4}$$

where Y_t is the vector of the national stock series studied; ε_t is i.i.d. N(0, σ), a white noise process; $\Gamma_i = -I + A_1 + A_2 + \cdots + A_i$ for i=1, 2, . . ., k-1; and $\Pi = I - A_1 - A_2 - \cdots - A_k$. The Π matrix provides information about the long-run relationship among elements of Y_t, and the rank of the Π matrix is the number of linearly independent and stationary linear combinations of stock price indexes studied. Thus, testing for co-integration involves testing for the rank of the Π matrix, r, by examining whether the eigenvalues of Π are significantly different from zero.

Granger-Causality test

Granger causality is applied to examine whether one-way causality or feedback (bi-directional) exists between variables. A VAR model was used in the non-stationary case and no co-integration was found among the variables; otherwise, Granger (1988) proposed that if a co-integrating vector exists among variables, the Vector Error Correction Model (VECM) should be used. The two series, Y_t and Z_t, are considered, with the Granger causality test in the following form:

$$X_t = A_1 + \sum_{i=1}^{n_1} A_2(i) \Delta X_{t-1} + \sum_{j=1}^{m_2} \theta_o(j) \Delta Y_{t-1} + \varepsilon_{X_t} \tag{5}$$

$$Y_t = A_3 + \sum_{i=1}^{n_1} \theta_1(i) \Delta X_{t-1} + \sum_{j=1}^{m_2} A_4(j) \Delta Y_{t-1} + \varepsilon_{Y_t} \tag{6}$$

Where, $\in X_t$ and $\in Y_t$ are stationary random processes intended to capture other relevant information not contained. The lag lengths, n and m, were decided by AIC in our study. The series Y_t fails to cause X_t if $\hat{\theta}_0(j)$ = 0 (j = 1, 2, 3, m_1); and the series X_t fails to Granger cause Y_t if $\hat{\theta}_1(i)$ = 0 (i = 1, 2, 3, n_1). However, the error term is the unexplainable random component and is different from the explanatory variables, and thus ε_t indicates the total unexpected information at time t conditional on the set of past information. Unpredictable random and nonlinear effects always exist regardless of how well-specified an econometric model may be. These effects are also absorbed into the error term. Therefore, ε_t implies the unexpected change and may indicate different information of unclear conditions, thus ε_t is an uncertain time sequence (Dickey and Fuller, 1979). Grey Systems involve the analysis, handling and inter-pretation of indeterminate or uncertain information sequences, and aim to tackle a model that involves partially known parameters or information (Wang and Lin, 2008). The time sequence involving fully known information thus can be described as a "White" sequence, whereas an entirely unknown time sequence can be described as "Black" sequence. Meanwhile, a time sequence containing a mix of "uncertain information sequences" is termed a "Grey" sequence. The Grey theory primarily focuses on "uncertain information sequences" such as unexpected shock of stock return, and transforms uncertain and irregular sequences to further understand the sequence through Grey Prediction (Lin et al., 2008). Additionally, Grey Modeling (GM (1,1)) is employed to reduce the stochastic and nonlinearity of the error term sequence, and then to forecast the parameter estimates to further adjust the trans-formation of the error term sequence. Recently, related researches have used GM(1,1) on the economic and financial applications is expanding rapidly (Deng, 1982, 1990; Wang et al., 2009).

In this paper, we combine new integrated VAR model with the GM(1,1) to improve a natural framework to test the Granger Causality of high-tech industries. In general, the error terms sequence, ε_t , contains a mix of known and unknown information based on the set of past information at time *t.* GM(1,1)-VAR model offers a range of techniques for dealing with "grey" information sequence and therefore potentially assists the prediction of VAR model in an uncertainty time sequence. Consequently, this paper adopts the characteristics of GM(1,1) to modify the error terms and propose the GM(1,1)- VAR model. The procedures of error terms sequence's modification are as follows:

1. Define the original error terms sequence $\varepsilon^{(0)}$, where $\forall \varepsilon^{(0)}(i) \in \varepsilon^{(0)}$, $\varepsilon^{(0)}(i) \in R$, for $i = 1, 2, 3, \cdots, t.$

$$\varepsilon^{(0)} = \{\varepsilon^{(0)}(1), \varepsilon^{(0)}(2), \cdots, \varepsilon^{(0)}(t)\} \tag{7}$$

2. Shift the original error terms sequence by adding the minimum value of the original sequence to meet the non-negative condition and the new sequence $x^{(0)}$ is given by

$$x^{(0)} = \{x^{(0)}(1), x^{(0)}(2), \cdots, x^{(0)}(t)\} \tag{8}$$

Where, $x^{(0)}(i) = \varepsilon^{(0)}(i) + \min\left(\varepsilon^{(0)}(1), \cdots, \varepsilon^{(0)}(t)\right)$ and $x^{(0)}(i) \in R^+$ for $i = 1, 2, 3, \cdots, t.$

3. To obtain the first-order cumulative sum sequence $x^{(1)}$ from $x^{(0)}$ through once of AGO procedure (Accumulated Generating Operation).

$$x^{(1)}=\left\{x^{(1)}(1),x^{(1)}(2),\cdots,x^{(1)}(t)\right\} \tag{9}$$

Where, the generating series for the cumulative summation will be

$$x^{(1)}(i)=\left\{\sum_{k=1}^{i}x^{(0)}(k),\ i=1,2,\cdots,t\right\} \tag{10}$$

4. If the original error terms series $x^{(0)}$ lacks any apparent trend, the generating series $x^{(1)}$ would then have an apparent trend with an absolute value increasing one-by-one. This provides a basis for establishing a calculus model using differential equations. When the differential equation model is of order one and includes just one variable, the model is referred as to as GM(1,1). The general form of GM(1,1) has the following form:

$$\frac{dx^{(1)}}{dt}+ax^{(1)}=b \tag{11}$$

In Equation (11), a is the development coefficient and b is the grey control parameter. From the time response function of the first derivative, the general solution to Equation (12) is:

$$x^{(1)}(i+1)=(x^{(0)}(1)-b/a)e^{-ai}+b/a \tag{12}$$

According to the definition of differential equation:

$$\frac{dx^{(1)}(i)}{di}=\lim_{\Delta i\to 0}\frac{x^{(1)}(i+1)-x^{(1)}(i)}{\Delta i} \tag{13}$$

If $\Delta i=1$, then Equation. (14) can be written as:

$$\frac{x^{(1)}(i+1)-x^{(1)}(i)}{1}=x^{(0)}(i) \tag{14}$$

Then the original differential equation can be described by:

$$x^{(0)}(i)+az^{(1)}(i)=b \tag{15}$$

where $z^{(1)}(i)$ is the background value, and $z^{(1)}(i)=\delta x^{(1)}(i)+(1-\delta)x^{(1)}(i-1),\ i\geq 2.$ δ denotes a horizontal adjustment coefficient, and $0<\delta<1.$

Parameters a and b in Equation (15) can be obtained from $\hat{a}=\begin{bmatrix}a\\b\end{bmatrix}=(B'B)^{-1}B'Y$,

where $Y=\left[x^{(0)}(2)\quad x^{(0)}(3)\quad\cdots\quad x^{(0)}(t)\right]'$ and $B=\begin{bmatrix}-z^{(1)}(2) & 1\\ -z^{(1)}(3) & 1\\ \vdots & 1\\ -z^{(1)}(t) & 1\end{bmatrix}$.

5. Putting a and b obtained from the grey differential equation back into the general equation with $\hat{x}^{(1)}=x^{(0)}(1)=x^{(1)}(1)$. Since the prediction model is not constructed with original sequence but modes from one accumulative addition, reverse addition is required to recover the predicted sequence. From $\hat{x}^{(0)}(i+1)=\hat{x}^{(1)}(i+1)-\hat{x}^{(1)}(i)$, one can obtain Equation (16), which is the dynamic situation of future values generated by the GM(1,1).

$$\hat{x}^{(0)}(i+1)=(1-e^{a})(x^{(0)}(1)-b/a)e^{-ai} \tag{16}$$

Finally, forecasted original error at time t+1 is given by

$$\hat{\varepsilon}^{(0)}(t+1)=(1-e^{a})(X^{(0)}(1)-b/a)e^{-at}-\min(\varepsilon^{(0)}(1),...,\varepsilon^{(0)}(t)) \tag{17}$$

In this paper, we modify the error terms by GM(1,1) in VAR model can be estimated the result by the Granger causality test procedure.

Impulse response function and variance decomposition

Recent studies apply impulse response functions (IRF) and variance decomposition (VDC). An IRF traces a market response to an innovation within the market (Nieh and Lee, 2001; Wang, 2009). The IRF is given in the following expression:

$$Y_t=A+\sum_{i=1}^{m}\theta_i Y_{t-1}+\varepsilon_t \tag{18}$$

where ε_t is a 3 ×1 vector of disturbances and μ is also a 3 ×1 vector of constants. The θ_i are 3×3 matrices with θ_0=I_3 and elements of θ_i are the "impact multipliers", which examine the interaction among the United States, Japanese, and Taiwanese stock markets over the entire path. IRFs show the expected responses of market j to a typical change in market *k*.

The (VDC) measures the market forecast error variance percentage occurring as a result of a shock to its own and other endogenous variables in the VAR. The variance-covariance matrix of the k-step ahead, forecast errors with its decomposition given by the following expression:

$$E(\theta_t-\widehat{E}_{t-k}\theta_t)(\theta_t-\widehat{E}_{t-k}\theta_t)$$

$$=D_oE(\mu_t\mu_t^{'})D_o^{'}+D_1E(\mu_t\mu_t^{'})D_1^{'}+...+D_{k-1}E(\mu_t\mu_t^{'})D_{k-1}^{'} \tag{19}$$

where Y_t is the vector moving Autoregression (VMA) representation of $Y_t=A'+\sum_{t=0}^{\infty}C_i\varepsilon_{t-1}$, C_i is a 3 ×3 matrix with $C_0=I_p$, $D_i= C_i F$, $\mu_t=F^{-1}\varepsilon_t$, and *F* is a lower triangular matrix of the Choleski decomposition.

EMPIRICAL RESULTS

This study was conducted based upon data compiled from the NASDAQ Index, the Nikkei 225 Index and the TAIEX Index which was collected from the Taiwan Economic Journal (TEJ) database during 2004-2008. This study explored the interactive behavior of the stock markets, and revealed obviously dynamic short-term phenomenon that caused short-term trading by investors.

Table 1. Unit root test.

Market	-	1^{st} difference test statistic	Critical value (1%)
U.S.	-2.596	-26.293	-3.439
Japan	-0.880	-26.279	-3.439
Taiwan	-1.901	-24.878	-3.439

Note: 1^{st} difference signifies the symbols for the ADF 1^{st} difference test statistic.

Table 2. Co-integration rank test.

	Trace statistic	Critical value (1%)
Rank = 0	17.455	35.458
Rank≦1	5.497	19.937
Rank≦2	1.321	6.635

Table 3. Granger causality test.

Null Hypothesis	F-Statistics	P-Value
U.S. does not GC Japan	70.512	1.6E-28***
Japan does not GC U.S.	1.209	0.299
U.S. does not GC Taiwan	43.975	1.1E-18***
Taiwan does not GC U.S.	0.0633	0.532
Japan does not GC Taiwan	2.790	0.062*
Taiwan does not GC Japan	0.341	0.711

Notes: 1. ***, ** and * denote significance at the 1, 5 and 10% levels, respectively. 2. The null hypothesis, H_0, is for “no causal relation”. 3. GC means Granger cause.

In the course of the study, inconsistent trading date data were removed from stock indices as trading and non-trading days were inconsistent among the sample stock markets. Table 1 presents the results of ADF test that the stock price series from these three stock markets cannot reject the unit root test as non-stationary. The table indicates whether stock price indices reject the non-stationary unit root test in the first difference and appear stable. Various co-integration estimation methods applied captured the long-run equilibrium relationship among stock price series. They proposed two test statistics for testing the number of co-integrating vectors (or the rank of Π), namely the Trace (Tr) and maximum eigenvalue (L-max) statistics. Trace (Tr) statistics were used in this paper. Results presented in Table 2 show that Trace (Tr) statistics propose no co-integration vector existing among the three variables. The result shows that it is unable to refuse the r = 0 hypothesis under the VAR model 1% significance, showing no co-integrated vectors among the stock price indices of Taiwan, the United States, and Japan during this test period.

Granger-causality test results are presented in Table 3 that the United States stock market has a one-way relationship influencing Japan and Taiwan, while the Japanese stock market has a simultaneous one-way relationship with Taiwan. Significant bi-directional causality is not found among the United States, Japan and Taiwan stock indices. Results indicate the United States stock market influences both Japanese and Taiwanese stock markets, and the Japanese market influences markets in Taiwan. This findings show that Japan does not influence Taiwan nearly as much as do markets in the United States. Since the estimated coefficients of a VAR are difficult to interpret, the IRF and VDC system must both be considered in order to draw valid conclusions. The interactive impact reciprocal explanation according to impulse response functions and forecast error variance decomposition among the United States, Japan and Taiwan is finally analyzed. The United States, Japan and Taiwan are arranged in proper sequential order. Internal competitiveness manifested within Taiwanese, U.S. and Japanese stock markets drive impulse response functions. The United States stock market is however, obviously more independent and powerful than the others. Moreover, the Japanese market is significantly influenced by U.S. stock market, and insignificantly related to Taiwanese market.

The decomposition forecast error variance on the other hand, can be observed in an endogenous variable into percentage volatility of its own and those of other

Table 4. The forecast error variance decomposition.

	Period	U.S (%)	Japan (%)	Taiwan (%)
U.S.	2	99.906	0.080	0.014
	5	99.220	0.336	0.444
	8	99.220	0.336	0.444
	10	99.220	0.336	0.444
Japan	2	21.331	78.514	0.155
	5	21.378	78.412	0.209
	8	21.378	78.411	0.211
	10	21.378	78.411	0.211
Taiwan	2	16.553	10.457	72.990
	5	16.809	10.536	72.655
	8	16.809	10.536	72.655
	10	16.809	10.536	72.655

Notes: 1. The values of the forecast error variance decomposition in an endogenous variable into percentage shocks to its own and other endogenous variables in the VAR. 2. Each number is in a percentage value.

endogenous VAR variables (Table 4). These results provide information about the relative importance (exogenous ordering) of each random innovation to the variables. Analytic results of the decomposition forecast error variance showed that the U.S. stock market has the highest self-explained power with the influence of Japanese and Taiwanese stock markets regarded as secondary, and Taiwanese stock market has a lower self-explained power and is easily influenced by U.S. and Japanese stock markets. Moreover, Japanese stock market variance is more highly affected by U.S. stock market variance than it is by variables within the Taiwanese stock market, indicating a relatively strong stock market relation between Japan and the U.S. Finally, the influence of the Taiwanese stock market is minimal, and its effect upon U.S. and Japanese stock markets is relatively low.

These results are inconsistent with Worthington et al. (2003) and Wang et al. (2010). In knowledge-based economy, U.S. and foreign countries such as Japan and Germany have collected patent royalties paid by foreign companies in the high-tech industries, respectively. The international trading market has gradually increased. The impact of patents or technology licensing is comparable to that of commercial activities; the underlying technology supports an active marketplace. Patent royalties are a major source of corporate income, so corporations must remain vigilant in avoiding patent infringement and the attendant losses of royalty payments.

Conclusion

In this study, time series methodologies were employed to analysis the hi-tech industrial stock market. Hi-Tech industrial interdependence is among the United States, Japan and Taiwan that was determined by utilizing the electronic sector stock index. As the US stock market is the current leading research benchmark, it most powerfully explains its own volatility by variance decompositions in our research. According to the Granger causality test, Japanese stock market also influentially affects Taiwan. The United States developed rapidly in the early twentieth century, with its influence extending throughout the entire Pacific, and its presence in Asia-Pacific affairs is still important today. United States and Japan are two of these major trading partners; the electronics industry plays a critical role in Taiwanese economy. Therefore it may be more appropriate to consider the electronics industry when investigating financial relationships between these three stock markets.

According to research institution IDC, Taiwan has become the third largest manufacturer of electronics products for personal computers, and the world's fourth largest supplier for the high-technology industry. Hence, following the international high-tech countries like the United States and Japan have already been focused on the consumer electronic products, Taiwan will have assembled a complete core electronics industry supply chain (Lin et al., 2008). However, at present, Taiwanese capital and information of high-technology industrial to be highly concentrated, short product cycle and turnover is very fast; therefore, the industry competition is more drastic than other industries. Hence, with the integration trend of high-technology industries, Government had to adjust the industrial structure of high-tech industry and operational model to enhance Taiwanese economic system, capital market structure and competitive advantage of nations.

REFERENCES

Arshanpalli B, Doukas J (1993). International Stock Market Linkages: Evidence from the Pre- and Post-October 1987 Period. J. Bank. Financ., 17: 193-208.

Brown JR, Fazzari SM, Petersen BC (2009). Financing Innovation and Growth: Cash Flow, External Equity and the 1990s R&D Boom. J. Financ., 64: 151-185.

Burdekin RCK, Whited HHIH (2009). Macroeconomic Interdependence between Mainland China and Taiwan: A Cross-Strait Perspective on Globalization. Chinese Econ., 42: 5-39.

Chan KC, Gup BE, Pan M (1992). An Empirical Analysis of Stock Prices in Major Asian Market and the United States. Financ. Rev., 283-307.

Chan KC, Gup BE, Pan MS (1997). International Stock Market Efficiency and Integration: A Study of Eighteen Nation. J. Bus. Financ. Account., 24: 1-18.

Chen KC, Li G, Wu L (2010). Price Discovery for Segmented US-Listed Chinese Stocks: Location or Market Quality? J. Bus. Financ. Account., 37: 242-269.

Choudhry T (1996) Interdependence of Stock Markets: Evidence from Europe during the 1920s and 1930s. Appl. Financ. Econ., 6: 243-249.

Chung PJ, Liu DJ (1994). Common Stochastic Trend in Pacific Rim Stock Markets. Quart. Rev. Econ. Financ., 34: 241-259.

Deng JL (1982) Control Problem of Grey System. Syst. Control Lett., 5: 288-294.

Deng JL (1990). Modeling for Grey Series, J. Grey Syst., 2: 217- 232.

Dickey DA, Fuller WA (1979). Distribution of the Estimator for Autoregressive Times with a Unit Root. J. Am. Stat. Assoc., 74: 427-431.

Ghosh A, Saidi R, Johnson KH (1999). Who Moves the Asia-Pacific Stock Markets - US or Japan? Empirical Evidence Based on the Theory of Cointegration. Financ. Rev, 34: 159-170.

Granger CWJ (1969). Investigating Causal Relations by Econometric Models and Cross-Spectral, Econ., 37: 424-438.

Granger CWJ (1988). Some Recent Developments in a Concept of Causality. J. Econ., 39: 199-211

Hsu PH (2009) Technological Innovations and Aggregate Risk Premiums. J. Financ. Econ., 94: 264-279.

Hung JC (2009). Deregulation and Liberalization of the Chinese Stock Market and the Improvement of Market Efficiency. Q. Rev. Econ. Financ., 49: 843-857.

Jang H, Wonsik S (2002). The Asian Financial Crisis and the Co-movement of Asian Stock Markets. J. Asian Econ., 13: 94-104.

Johansen S (1988). Statistical Analysis of Cointegration Vectors. J. Econ. Dynam. Control, 12: 231-254.

Kim YS, Mathur I (2008). The Impact of Geographic Diversification on Firm Performance. Int. Rev. Financ. Anal., 17: 747-766.

Lin CT, Wang YH, Lin WR (2008). Empirical Analysis on CEO Turnover and Company Performance: Event Study-related GARCH Model. J. Info. Opt. Sci., 29: 583-602.

Mandaci PE, Torun E (2010). Ebb and Flow? Co-integration with Structural Breaks between Emerging Markets in the EMEA and USA. Int. J. Econ. Policy Emerg. Econ., 3: 16-32.

Nieh CC, Lee CF (2001). Dynamic Relationship between Stock Prices and Exchange Rates for G-7 Countries. Q. Rev. Econ. Financ., 41: 477-490.

Neih CC, Chang T (2003). Long-Run Gains from International Equity Diversification: Taiwan's Evidence, 1995-2001. J. Econ. Integrat., 18: 530-544.

Sohn BH (2002). Regionalization of Trade and Investment in East Asia and Prospects for Further Regional Integration. J. Asia Pacific Econ., 7: 160-181.

Swartz P (2006). Global Versus Regional Systematic Risk and International Asset Allocations in Asia. Ann. Econ. Financ., 1: 77-89.

Wang YH, Lin CH (2008). Forecasting Volatility for the Stock Market: A New Hybrid Model, Int. J. Comput. Math., 85: 1697-1707.

Wang YH, Chuang CC, Tsai CM, Chuang YH (2009). Abnormal Stock Returns and Journalism’s Recommendations: Reexamining of Hybrid Grey-Market Model. J. Grey Syst., 23: 309-319.

Wang YH (2009). Using Neural Networks to Forecast Taiwan Stock Index Option Prices: A Hybrid GARCH Approach. Qual. Quant., 43: 833-843.

Wang YH, Shih KH, Chuang YH (2010). Market Behavior of Patent Infringement Litigations. African J. Bus. Manage., 4: 390-395.

Worthington AC, Katsuura M, Higgs H (2003). Price Linkages in Asian Equity Markets: Evidence Bordering the Asian Economic, Currency and Financial Crises. Asia-Pacific Financ. Mark., 10: 29-44.