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INTEGRATION OF WORLD STOCK MARKET AN EMPERICAL INVESTIGATION

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Abstract

This paper has analyzed the integration of world stock market with emerging market by using the Granger Causality test and Johansens co integration test. This paper has found one-way significant causality between some of the emerging markets with world markets and concludes that some of the emerging markets have long term equilibrium relationship with world stock market.

Key words: *world market, emerging market, causality test, Johansens co integration test*

INTRODUCTION

The dynamics of globalization is now a major force in shaping development of nations. In recent years, there is a trend towards internationalization of financial markets. Financial integration depends upon the flow of funds from one market to another and one country to another. Internationalization diversification is a strategy for achieving a better risk-return trade-off. The liberalization process of the Indian economy has been a contributing factor towards the increase in financial flows. In April 1992 Government permitted Indian companies to raise equity capital by issuing their products in the international financial markets. The emerging markets are an increasing part of today's investment opportunities. Emerging stock markets play an increasingly important role in developing countries. The developing economies have now become market oriented in approach. So integration of emerging markets with developed markets is of global interest.

The present study aims at assessing the integration between emerging markets and world stock market. This study also investigates the causal relationship between emerging markets and world stock market.

LITERATURE REVIEW

Black (1974) and Stulz (1981), lots of empirical studies have been undertaken to analyze the effects of international capital market segmentation/integration. Using the Fama-Macbeth (1973) technique, his research could not reject the hypothesis of segmentation nor integration for the US market relative to the World market.

Errunza &losq (1985) in their study conclude that securities will command a super risk premium in the presence of segmentation.

Eurrunza, Losq and padmanabhan (1988) tested there different levels of market integration: Complete integration, mild segmentation and complete segmentation. They used the international asset pricing model and a database constructed for a group of emerging markets including Korea for the period of 1975-1987 in the analysis and concludes that the world's market is neither completely segmented nor completely integrated.

Choi and Rajan (1997) empirically tested market segmentation with exchange risk is a significant factor affecting asset returns and many national markets are partially segmented

METHODOLOGY

Unit Root Tests

The initial step in the estimation involves the determination of the times series property of each variable individually by conducting unit root tests. The most popular unit root rest is the ADF (Augment Dickey - Fuller, 1979) test. The test simply includes AR (1) process:

$$X_t = p\, X_{t-1} + e_t$$

Dicky and Fuller (1979) consider three different regression equations that can be used to test for the presence of a unit root.

$$X_t = p\, X_{t-1} + e_t \quad \text{......} (1)$$
$$X_t = a_0 + p\, X_{t-1} + e_t \quad \text{......} (2)$$
$$X_t = a_o + p\, X_{t-1} + a_{1t} + e_t \quad \text{......} (3)$$

The difference between the three regressions concerns the presence of the deterministic elements a_0 and a_{1t}. Equation '1' is a pure random walk model, equation '2' adds an intercept or drift term and equation '3' includes both a drift and linear time trend.

If p=1, the series contains a unit root. In this test the null hypothesis is Ho:P=1 in which case it is said X has a unit root. The alternative is H1:p<1. If the alternative hypothesis is correct then X is stationary. But if the null hypothesis is correct, then the variable is non-stationary so the tests do not apply here.

The Augmented Dickey-Fuller test simply includes AR(p) terms of the ΔXt, term in the three alternative models.

$$\Delta X_t = \gamma X_{t-1} + \sum_{i=1}^{p} {}_i \Delta X_{t-1} + et \quad \text{......} (4)$$

$$\Delta X_t = {}_0 + \gamma X_{t-1} + \sum_{i=1}^{p} {}_i \Delta X_{t-1} + et \quad \text{......} (5)$$

$$X_t = {}_0 + \gamma X_{t-1} + a_{2t} + \sum_{i=1}^{p} {}_i\ X_{t-1} + e_t \quad \text{......} (6)$$

The difference between the three regressions again concerns the presence of the deterministic elements $a_0$and a_{2t}. If $\gamma=0$, the series contains a unit root.

Phillips-Perron (PP) Test

PP proposes a non-parametric method of controlling for higher-order serial correlation in a series. The test regression for the pp test is AR (1) process:

$$\Delta yt = \ + \beta y_{t-1} + \varepsilon t \quad \text{......} (7)$$

The PP-test makes a correction to the t-stastics of the γ co-efficient from the AR (1) regression to account for the serial correlation in ε. The correction is non parametric since it use an estimate for the sect rum of ε at frequency zero that is robust to heteroskedasticity and autocorrelation of unknown from. The Newey-West heteroskedasticity auto correlation consistent estimate:

$$W^2 = \gamma_0 + 2 \sum_{j=1}^{q} \left(1 - \frac{j}{q+1}\right) rj \quad \text{......} (8)$$

$$j = \frac{1}{T} \sum_{t=j+1}^{t} \bar{\in}_t \bar{\in}_{t-j}$$

Where q is the truncation lag. The pp t-statistics is computed as

$$t_{pp} = \frac{o^{1/2}\, t_b}{W} - \frac{(W^2 - \ o) TS_b}{2W} \quad \text{......} (9)$$

Where t_b S_b are the t-statistics and standard error of β and σ is the standard error of the test regression.

Granger-Causality Test

The dynamic linkage is examined using the concept of Granger's (1969) causality. The Granger type causality procedure (Granger, 1969, 1988) is applied to determine the direction of causation among the variables. The causality procedure is conducted based on bivariate system (x, y).

Formally, a time series X_t, Granger-causes another time series Y_t if series Y_t can be predicted better by using past values of (X_t, Y_t) than by using only the historical values of Y_t. In other words, X_t fails to Granger – cause Y_t if for all M>O the conditional probability distribution of Y_{t+m} given (Y_t, Y_{t-1}) is the same as the conditional probability distribution of Y_{t+m} given both (Y_t, Y_{t-1}, ….) and (X_t, Y_{t-1}, ….). That is X_t, does not Granger cause Y_t if

$$Pr(Y_{t+m}/\ _t)=Pr(Y_{t+m}/\Omega_t) \ldots\ldots\ldots\ldots (10)$$

Where Pr denotes conditional probability. Ψ_t is the information set at time t on past values Y_t, and Ω_t is the information set containing values of both X_t and Y_t up to time point t.

Testing causal relations between two stationary series X_t and Y_t can be based on the following bi- variate auto regression (Granger – 1969).

$$Y_t = \ _0 + \sum_{k=1}^{P} a_k Y_{t-k} + \sum_{k=1}^{P} \ _k X_{t-k} + U_t \ldots\ldots (11)$$

$$X_t = \ _0 + \sum_{k=1}^{P} \ _k Y_{t-k} + \sum_{k=1}^{P} \ _k X_{t-k} + V_t \ldots\ldots (12)$$

Where P is a suitably chosen positive integer; αk's and βk's, $_K$=0,1,-----,p are constants; U_t and V_t are usually disturbance terms with zero means and finite variance. The null hypothesis that X_t does not Granger – cause Y_t is rejected if the βk's, $_K$>0 in equation 2 are jointly significantly different from zero using a standard joint test (e.g., an F test). Similarly, Y_t Granger – causes if the φk's, $_K$>0 are jointly different from zero.

Co integration Test

The implication of non-stationary can lead to spurious regression when testing for Granger causality, unless a co integrating vector is present. This makes the testing for a co-integration mandatory. If such a stationary linear combination exists, the non-stationary time series are said to be co integrated. The stationary linear combination is called the co integrating equation and may be interpreted as a long run equilibrium relationship among the variables. Since it is possible that co integrating variables may deviate from their relationship in the short run, but their association would return in the long run. The test employed for determination of co integration between the time series is Johansens test. The Johansens technique for estimating co integration is superior because it is based on well established maximum likelihood procedure that provides test statistics to determine number of co integration vectors as well as their estimates. The existence of more than one co integrating vector implies higher stability in the system.

The co integration testing procedure suggested by Johansen (1991, 1995) to test the restrictions imposed by co integration on the unrestricted VAR involving the series. Considering a VAR of order:

$$Y_t = A_1 Y_{t-1} + \text{-------} A_p Y_{t-p} + BX_t + \varepsilon_t \ldots\ldots\ldots (13)$$

Where Y_t is a K-vector of non-stationary 1(1) variables, X_t is a d vector of deterministic variables and ε_t is a vector of innovations. It can rewrite the VAR as

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{P-1} T_i\, \Delta Y_{t-1} + BX_t + \varepsilon_t \ldots\ldots\ldots (14)$$

$$\text{Where } \Pi = \sum_{i-1}^{P} Ai\text{-}I,\ Ti = -\sum_{j-i+1}^{P} Aj$$

Granger's representations theorem asserts that if the coefficient matrix Π has reduced rank r<k, then there exist Kr matrixes and α & β each with rank r such that $\Pi=\alpha\beta'$ is stationary r is the number of co integrating relations and each column of is the co integrating rector. The elements of α are known

as the adjustment parameters in the vector error the Π matrix in an unrestricted form.

Johansens (1995) test the following possibilities: Series Y have no deterministic trends and the co integration equations do not have intercepts.

$$H2(r): \Pi Y_{t-1}+BX_t=\alpha\beta' Y_{t-1} \quad (15)$$

The likelihood Ratio Test Statistic:

$$Qr=-T \sum_{i-r-1}^{K} \log(1-\lambda i) \quad (16)$$

For r=0, 1------------ K – 1 where λI is the i-th largest Eigen value. Qr is the so called trace statistics and is the test of H1 (r) against H1 (k).

Johansen also proposes an alternative LR Test Statistic, known as the maximum Eigen value statistics, which tests (r) against (r+1). The maximum Eigen value statistic can be computed from the trace statistics as

$$Qmax=-T \log (1-\lambda_{r+1})=Q_r-Q_{r+1} \quad (17)$$

Data

The required time series data have been collected from the Emerging market database of the International Finance Corporation and Morgan Stanley Capital International perspective from Jan-2003 to Jan 2005. A total of eight emerging markets over the two-year period are selected. MSCI excludes investment companies and foreign domiciled companies, to avoid double counting.

EMPERICAL ANALYSIS

The study here employs unit root test to examine the time series properties of concerned variables. Unit root test speaks of whether a series is stationary or non-stationary. For the test of unit root the present study employees the Augmented Dicky Fuller (ADF) and Phillips – Perron (PP) Test both with trends and intercept. The results are shown in the Table 1.

It is evident from the table that all the price series at second difference have a unit root and all are stationary. All these variables exceed the critical values at 1%, 5% and 10% significance level. Again pp test conducted to confirm the results. The results of the pp-test are indicated in the Table 2.

The Table 2 shows that all the variables considered are stationary. This is because the calculated values of all the variables at second difference exceed the critical value at 1%, 5% and 10% significance level in both ADF and PP tests. Hence the null hypotheses of a unit root are rejected and conclude that all the variables are stationary.

Table 1: ADF unit Root Tests for Emerging Market and MSCI index

Variable	First Difference	Second Difference
MSCI index	-2.335173 (.0362)	-4.110562 (0)
Argentina	-1.345370 (.1999)	-3.982929 (0)
Brazil	-1.856750 (.0845	-4.015097 (0)
Chile	-2.211599 (.0455)	-4.231083 (0)
India	-2.345474 (.0355)	-3.969497 (0)
Korea	-2.053347 (.0607)	-4.586073 (0)
Maxico	-2.794671 (.0152)	-4.460547 (0)
Thailand	-1.417614 (.1782)	-4.307734 (0)
Malaysia	-1.417614 (.1782)	--4.307734 (0)

For First Difference
1% Critical value -3.9228
5% Critical value -3.0659
10% Critical value -2.6745

For Second Difference
1% C.V -3.9635
5% C.V -3.0818
10% C.V -2.6829
(P-value are given in parentheses)

Table 2: PP Unit Root Test for Emerging Market and MSCI index

Variables	First Difference	Second Difference
MSCI index	-1.406009 (.1772)	-5.622056 (0)
Argentina	-3.270280 (.0052)	-6.172190 (0)
Brazil	-3.580048 (.0028)	-6.659318 (0)
Chile	-3.358614 (.0061)	-8.286378 (0)
India	-3.135623 (.0067)	-6.440149 (0)
Korea	-2.958287 (.0098)	-6.679899 (0)
Maxico	-3.711943 (.0021)	-6.441063 (0)
Thailand	-3.693627 (.0031)	-9.76824 (0)
Malaysia	-3.817207 (.0017)	-6.438104 (0)

For First Difference

1%	Critical value	-3.8572
5%	Critical value	-3.0400
10%	Critical value	-3.0608

For Second Difference

1%	Critical value	-3.9228
5%	Critical value	-3.0659
10%	Critical value	-2.6745

Table 3: Pair wise Granger Causality Test between Emerging markets and MSCI index.

Null Hypothesis	F - Values	P - Values
Argentina does not Granger cause MSCI index MSCI index does not Granger cause Argentina	0.00568 2.09082	0.99434 0.16632
Brazil does not Granger cause MSCI index MSCI index does not Granger cause Brazil	0.83126 0.42776	0.45910 0.66153
Chile does not Granger cause MSCI index MSCI index does not Granger cause Chile	2.21719 0.22217	0.15155 0.80400
India does not Granger cause MSCI index MSCI index does not Granger cause India	2.09457 1.67172	0.16586 0.22885
Korea does not Granger cause MSCI index MSCI index does not Granger cause Korea	0.73447 0.64938	0.50013 0.53978
Mexico does not Granger cause MSCI index MSCI index does not Granger cause Mexico	1.04075 4.31731**	0.38300 0.03868
Thailand does not Granger cause MSCI index	0.81355	0.46630

MSCI index does not Granger cause Thailand	0.22844	0.79916
Malaysia does not Granger cause MSCI index MSCI index does not Granger cause Malaysia	1.58301 4.63197**	0.24539 0.03230
Brazil does not Granger cause Argentina. Argentina does not Granger cause Brazil	6.35365* 1.70859	0.01313 0.22236
Chile does not Granger cause Argentina Argentina does not Granger cause Chile	3.77230** 2.20734	0.05357 0.15265
India does not Granger cause Argentina Argentina does not Granger cause India	1.94917 0.23952	0.18492 0.79068
Korea does not Granger cause Argentina Argentina does not Granger cause India	0.61593 1.78466	0.55637 0.20964
Mexico does not Granger cause Argentina Argentina does not Granger cause Mexico	0.00692 2.67391***	0.99310 0.10955
Thailand does not Granger cause Argentina Argentina does not Granger cause Thailand	4.45834** 1.13877	0.03566 0.35251
Chile does not Granger cause Brazil Brazil does not Granger cause Chile	2.89801*** 0.32234	0.09400 0.73503
India does not Granger cause Brazil Brazil does not Granger cause India	0.70840 3.38416***	0.51191 0.06832
Korea does not Granger cause Brazil Brazil does not Granger cause Korea	0.40274 3.89882**	0.67719 0.04959
Mexico does not Granger cause Brazil Brazil does not Granger cause Mexico	0.10553 3.10308***	0.90067 0.08199
Thailand does not Granger cause Brazil Brazil does not Granger cause Thailand	1.27997 0.74695	0.31342 0.49461
Malaysia does not Granger cause Brazil Brazil does not Granger cause Malaysia	0.18099 7.38606*	0.83668 0.00811
India does not Granger cause Chile Chile does not Granger cause India	0.10523 7.74005*	0.90094 0.00693
Korea does not Granger cause Chile Chile does not Granger cause Korea	0.77095 2.74958***	0.48418 0.10399
Mexico does not Granger cause Chile Chile does not Granger cause Mexico	0.78643 2.14152	0.47759 0.16020
Thailand does not Granger cause Chile Chile does not Granger cause Thailand	0.00256 5.40724**	0.99745 0.02118
Malaysia does not Granger cause Chile Chile does not Granger cause Malaysia	3.55739*** 8.02794*	0.06122 0.00612
Mexico does not Granger cause India India does not Granger cause Mexico	2.54556 2.52868	0.11980 0.12123
Thailand does not Granger cause India India does not Granger cause Thailand	1.34059 0.27885	0.29821 0.76142
Malaysia does not Granger cause India India does not Granger cause Malaysia	0.59070 3.24528***	0.56927 0.07471
Mexico does not Granger cause Korea Korea does not Granger cause Mexico	1.34331 0.55016	0.29755 0.59074
Thailand does not Granger cause Korea Korea does not Granger cause Thailand	2.98151 0.28353	0.08888 0.75803
Malaysia does not Granger cause Korea Korea does not Granger cause Malaysia	0.31938 3.79538**	0.73259 0.05282

Thailand does not Granger cause Mexico Mexico does not Granger cause Thailand	6.89852* 0.08083	0.01013 0.92285
Malaysia does not Granger cause Mexico Mexico does not Granger cause Malaysia	0.20202 2.16435	0.81980 0.15154
Malaysia does not Granger cause Thailand Thailand does not Granger cause Malaysia	0.34835 8.58791*	0.71276 0.00484

* 1 % Significance Level
** 5% Significance Level
*** 10% Significance Level

The Table 3 depicts the Granger Causality test results for the concerned variables. It is important to find out the impact of World stock market on emerging market. So the causal link between all these variables needs to be explored. The Table 3 reported pair wise Granger causality test results with lags 2 as two year period lag is an appropriate lag order chooses in terms of the Akaike Information Criteria (AIC) for the full sample period. The reported F-values as well as P-values suggest that there is a unidirectional causality between world stock market with Mexico and Malaysia, Brazil with Argentina, Chile with Argentina, Argentina with Mexico, Thailand with Argentina, Argentina with Malaysia, Chile with Brazil, Brazil with India, Brazil with Korea, Brazil with Malaysia, Brazil with Mexico, Chile with India, Chile with Korea, Chile with Thailand, India with Malaysia during this period. The tabular F – values as well as P- value ascertain that there is a unidirectional causality between world stock Market with Mexico and Malaysia, Brazil with Argentina, Chile with Argentina, Argentina with Mexico, Thailand with Argentina, Argentina with Malaysia, Chile with Korea, Brazil with Mexico, Chile with India, Chile with Korea, Chile with Thailand, India with Malaysia, Korea with Malaysia, Thailand with Mexico, Thailand with Malaysia. So from the above analysis it is observed that the movement of one market will affect the movement of another market in short run period.

It is also found from the analysis that there is a bi-directional causality between Malaysia and Chile. This implies that any change in Malaysia stock market will affect Chile's stock market.

Table 4: Multivariate Case of Co integration

Variable	Eigen-value	L. L. Ratio	5% C.V	1% C.V	Hypothesized No. of CE (S)
MSCI Index	.686889	27.82213	24.31	29.75	None*
Argentina	.422034	9.242961	12.53	16.31	At most 1
Brazil	.029015	.471109	3.84	6.51	At most 2

Assumptions: No deterministic trend in the series in levels and no intercept in the co integrating equation.
LR test indicates 1co integrating equations at 5% significance level.

Normalized co integrating coefficients (standard error in parenthesis)

MSCI index	Argentina	Brazil	Log Likelihood
1.0000	-.860780 (.40132)	-.301513 (.50810)	-226.5032

Table 4a: Co Integration Result

Variable	Eigen Value	LL Ratio	5% CV	1% CV	Hypothesized no. of CE (s)
MSCI index	.662343	23.58725	24.31	29.75	None
Chile	.317948	6.215672	12.53	16.31	At most 1
India	.005813	.093284	3.84	6.51	At most 2

Assumptions: No deterministic trend in the series in levels and no intercept in the co integrating equation

LR rejects any co integrating equations at 5% significance level.

Normalized co integrating coefficients (standard error in parenthesis)

MSCI	Chile	India	Log Likelihood
1.0000	-3.018274 (.41834)	8.627512 (2.11841)	-193.3943

Table 4b: Co Integration Result

Variable	Eigen Value	LL Ratio	5% CV	1% CV	Hypothesized no. of CE (s)
MSCI index	.800340	36.20565	24.31	29.75	None**
Korea	.401832	10.42742	12.53	16.31	At most 1
Mexico	.128754	2.205295	3.84	6.51	At most 2

Assumptions: No deterministic trend in the series levels and no intercept in the co integrating equation

LR test indicates 1co integrating equations at 5% significance level.

Normalized co integrating coefficients (standard error in parenthesis)

MSCI index	Korea	Mexico	Log Likelihood
1.0000	-.290611 (.45627)	-.480500 (.03895)	-863.2993

Table – 4c: Co Integration Result

Variable	Eigen Value	LL Ratio	5% CV	1% CV	Hypothesized no. of CE (s)
MSCI Index	.857775	37.74785	24.31	29.75	None**
Thailand	.301822	6.542361	12.53	16.31	At most 1
Malaysia	.048406	.793870	3.84	6.51	At most 2

Assumptions: No deterministic trend in the series in levels and no intercept in the co integrating equation

LR test indicates 1co integrating equations at 5% significance level.

Normalized co integrating coefficients (standard error in parenthesis)

MSCI Index	Thailand	Malaysia	Log Likelihood
1.0000	-.120059 (.14184)	-5.090804 (.10460)	-164.2196

The 4, 4a, 4b indicated co integrating vector at 5% level of significance. So it indicates that there is more than co integrating equations in case of MSCI index. Thus it can be said that world stock market is co integrated with Argentina, Brazil, Korea, Mexico, Thailand and Malaysia. It has a long run equilibrium relationship with these all emerging markets.

CONCLUSION

This paper examined the relationship between world market with emerging market by applying both Granger causality test and Johansen co integration test. The results indicate that there is significant one way causality between world stock market with Mexico and Malaysia, Brazil with Argentina, Chile with Argentina, Argentina with Mexico, Thailand with Argentina, Argentina with Malaysia, Chile with Brazil, Brazil with India, Brazil with Korea, Brazil with Mexico, Chile with India, Chile with Korea, Chile with Thailand, India with Malaysia, Korea with Malaysia, Thailand with Mexico, Thailand with Malaysia.

So it suggests that any change in movement of one market causes the change of movement of another market in short run. It is also found that there is bi-directional causality between Malaysia and Chile. It is said that co integration testing is more reliable approach to analyses the efficiency of stock market. This co integration analysis indicate that the world stock market is efficient one and is co integrated with its emerging market and also have a long run equilibrium relationship with emerging market .However, the findings of the paper are subject to the period of the study selected and the results may change if the study period will change.

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