CORRELATION AND SUBSTITUTABILITY BETWEEN TWO MEASURES OF STOCK MARKET SYNCHRONICITY

Mr. ABHISEK SAHA ROY

RESEARCH SCHOLAR, THE UNIVERSITY OF BURDWAN

&

LECTURER OF MANAGEMENT

AJMAL COLLEGE OF ARTS, COMMERCE AND SCIENCE

HOJAI-782435

NAGAON, ASSAM

INDIA

Email- asroy.am@gmail.com / asroy_1987@rediffmail.com

ABSTRACT

It is argued that there is a co-movement of stock prices or rather there is a tendency of stock prices of these developing and developed economies to move in the same direction at a particular period of time with that of the condition of the market index, otherwise there are some idiosyncratic factors involved. This paper explores to find out an answer as to whether there is a co-movement between the stock prices of developed and emerging economy where the sample of developed economy is America and emerging economy is India and the index considered are NASDAQ and SENSEX respectively (Daily data taken from the year 1998 – 2013) by using two measures classical and modern measure which is supported by the literature reviewed so far. Moreover it is examined whether these two measures can be used substitutably to measure the co-movement.

Key Word: - *Idiosyncratic, Synchronicity, Property Right,* R^2 *, Price Informativeness.*

INTRODUCTION: The word Synchronicity has been derived from the latin word *synchronismus* and greek word *synchronismos*. The nearer English meaning of this two words are coincidence in time, simultaneousness or contemporaneousness. According to Cambridge Advance Learner's Dictionary and Thesaurus synchronicity means happening by chance of two or more related or similar events at the same time.

In stock market jargon the word Synchronicity means a situation which captures the tendency of stock market prices to move in the same direction in a particular period of time with that of the condition of the economy. The main objective of this present paper is to find out whether there is any synchronous relationship between the stock prices of a developing and a developed economy. In order to yield high explanatory power, this present paper considered NASDAQ as the developed economy index and SENSEX to be the developing economy index.Durnev, Morck, Yeung, and Zarowin (2003) examine the relationship between firm-specific stock price variation and accounting measures of stock price informativeness. They define firm-specific price variation as the portion of a firm's stock return variation unexplained by market and industry returns. They also define price informativeness as the amount of information stock prices contain about future earnings estimated from a regression of current stock returns against future earnings. They empirically establish that firm-specific stock price variability is positively correlated with the stock price informativeness measured by (i) the aggregated coefficients on future earnings and (ii) the marginal variation of current stock returns explained by future earnings. Therefore, stock price synchronicity is related to the flow of firm-specific information. Durnev, Morck, and Yeung (2004) find that corporate investment is more efficient when R^2 is low, consistent with the notion that low R^2 stocks have more informationally efficient prices.However, Teoh et al. (2009) share opposite views to above. They use the same measure of price informativeness i.e., the aggregated coefficients on future earnings, but different regression method and data sample. Teoh et al. (2009) also apply another approach to examine the information implication of R^2 by investigating the relationship of financial anomalies and price synchronicity. They find lower R^2 stocks observe stronger financial anomalies indicating pricing inefficiency. Teoh et al. (2009) propose two hypotheses of information implication of low R^2 stocks.They are Early Resolution of Uncertainty and Cross-sectional Uncertainty. They test the two hypotheses using the difference of accounting anomalies among low R^2 stocks and high R^2 stocks. They report stronger financial anomalies among low R^2 stocks and according to them that result supports the Cross-sectional Uncertainty hypothesis and rejects the Early Resolution of Uncertainty hypothesis.

Measures of Stock Synchronicity

Usually two measures of stock price synchronicity are used. One is Classical Measure and the other is R^2.

Classical Measure of Synchronicity

The simplest conceptual measure is to count the number of stocks that move in the same direction during a given time period (Morck et al.,2000). This measure lies between 50 and 100 percent is calculated as follows:

$$f_{j,t} = \frac{\max\left[\#UP_{j,t}, \#DOWN_{j,t}\right]}{\#UP_{j,t} + \#DOWN_{j,t}} \quad \text{.....(1)}$$

After log transformation:

$$\text{Synchronicity}^{t} = \ln\left(\frac{f_{j,t}}{1 - f_{j,t}}\right) \quad \text{.....(2)}$$

Here, $f_{j,t}$ is the net change in price of the stocks of a market *j* in time *t* , $\#UP_{j,t}$ and $\#DOWN_{j,t}$ are the number of stock in market *j* whose prices increase and decrease respectively in *t*.

R-Square (R^2) THE MODERN MEASURE:

The second measure takes into consideration the portion of stock returns explained by the market (R^2**).** Sometimes synchronicity and R^2 have been used synonymously. This synchronicity measure uses stock level regression analysis by estimating the following model for stock *i* in period *t* :

$$r_{i,t} = \alpha_0 + \alpha_1 r_{m,t} + \varepsilon_{i,t} \quad \text{.....(3)}$$

Where, $r_{i,t}$ and $r_{m,t}$ are individual and market returns respectively. R^2 is the percentage of variation in return of stock i for the period t explained by variations in market return.

$$R^2 = \left(\frac{Cov(R_i R_m)}{\sigma_i \sigma_m}\right)^2 \quad \text{.....(4)}$$

Where, $Cov(R_i R_m)$ is the covariance between the share returns and market returns and σ_i and σ_m are the standard deviations of scrip ***i*** and market respectively. The interpretation of the residual from equation (3) is that after removing the return effects due to systematic factors, the remaining return volatility is due to idiosyncratic, firm-specific events. A low R^2 from equation (3) is potentially due to firms' returns capturing unique firm-specific information or reflecting greater idiosyncratic noise in returns. A high R^2 suggests a high degree of synchronicity. Roll (1988) points out that typical asset pricing regressions yield relatively low explanatory power and propose that one potential explanation for the decline in explanatory power is the incorporation of private, firm-specific information into prices. Roll (1988) notes that the

incorporation of firm-specific information into prices generally increases the volatility of an individual firm's stock price, which results in lower explanatory power from asset pricing regressions such as equation (3). He finds that the low R^2 from asset pricing models is primarily due to high firm-specific returns volatility and that this volatility is not associated with public news announcements.

Since R^2 is bounded within the intervals [0, 1] a standard econometric remedy is applied by logistic transformations to above. After log transformation we get:

$$\text{Synchronicity}^{t} = \ln\left(\frac{R^2}{1-R^2}\right) \quad \ldots\ldots\ldots(5)$$

To calculate R^2 long period time series data is required. This measure can not be calculated for a short period. This measure is based on standard market model and is able to capture synchronicity of individual shares.

Criticism of R^2 as a measure of synchronicity

Skaife et al. (2006) examine the correlation between synchronicity measures and firm informativeness variables that are reflected in the stock prices, finding some inconsistent correlations between R^2 synchronicity measures and information proxies across the sample countries. This inconsistency raises further questions concerning the reliability of the R^2 statistic measure for stock price synchronicity. They argue that R^2 statistics are not a reliable measure of stock market synchronicity and propose an alternative model. Based on the work of Bekaert et al.(2003), and Lesmond, Ogden, and Trzcinka (1999), they use the percentage of zero-return days as a simplified measure that captures firm-specific information. According to Lesmond et al. (1999) the marginal investor will not trade unless the value of an information signal is sufficient to exceed his trading costs. If the marginal investor does not trade, then there is no change in price, and zero-return results. Zero returns can also occur when trading takes place but price does not change because there is no new valuation-relevant information. Skaife et al. (2006) apply these notions assuming that when sufficient valuation-relevant information arrives in the market, investors trade, and a return is generated. Therefore, they argue that the proportion of zero-return days (i.e., zero-return metric) represents the frequency of a firm's information flows, where a lower zero-return metric (i.e., smaller proportion of zero-return days) reflects more informationally efficient share prices. They repeat their analysis using the proportion of zero-return days metric and find a significant and consistent relationship between the zero-return metric and information proxies. They recommend the proportion of zero-return days as a better measure of stock price synchronicity than the traditional models, and this measure appears to capture the frequency of information arrival which tends to result in lower zero-return days.

OBJECTIVE: For measuring the synchronicity of two country indexes, two measures are considered separately, firstly classical measure and the other one is Modern measure. It is obvious that these two measures will give the implication whether developed economy really affects emerging economy, but whether these two measures can be utilized substitutably is the

main look out of this paper. Classical measure of synchronicity is calculated after finding out the number of co-movement of stock and in modern approach R^2 is considered as the measure of synchronicity. Lastly in order to find out the substitutability of these two measures, correlation is carried out between the two measures. The main area around which the concept of synchronicity revolves is the possibility of any events happening by chance. Now, is the chance is due to firm specific or industry specific or country specific information or due to some idiosyncratic factor. In order to start with this quest, I have taken some basic approach of judging this behavioral pattern. It is assumed that a developed economy has its impact on a developing economy, infact it takes time for an emerging economy to react with the changes that has already occurred in the developed economy. That means it takes time for information to flow, now whether those information will make the emerging economy to sway its movement along with the change that has already underwent in the developed economy or not, is something which has to be looked out for. Now in order to establish the synchronous relationship with the developed economy, the emerging economy must co-move with the change.

DATA & METHODOLOGY: In order to find out this answer, we have first collected sixteen years' time series daily data from January 1998 upto May 2013 of NASDAQ and SENSEX. The data source was basically secondary in nature it is collected from Yahoo Finance. It is believed by many researchers that price reflects every change. Following this principle we have calculated return from the closing price of each respective index for every day. Now, since it takes time for the emerging economy to react, we have taken this lag period as one day, where is the calculated return of NASDAQ and is that of SENSEX. Now, since we have tried to find out the substitutability between the two measures of synchronicity, for the first measure that is the Classical measure, we have matched return of NASDAQ with return of SENSEX and examined the frequency of co-movement for each year between the two countries , now in order to find out the randomness of co-movement we have modified = , a little and considered the total co-movement days in place of], for the classical measure of synchronicity we have applied the formula ln(where ln) means natural logaithm.

Now, regarding the Modern measure of synchronicity, as per the market model,

$$R_i = \beta_0 + \beta_1 R_m + \varepsilon_i$$

Where,

R_i = Return of firm.

β_0 = It is the constant term.

R_m = Market return.

β_1 = Systematic Risk

ε_i = Residual term which can also be denoted as Unsystematic Risk.

For this model to yield a high explanatory power, the return of ith firm must co-move with the return of the market. So to say, it must exhibit synchronous stock price movement. Hence R^2 from the above is the measure of synchronicity. The conventional interpretation of the residual term (ε_i) of the above model is that after removing the return effect due to systematic factors, the remaining volatility is due to unsystematic or idiosyncratic events. A low R^2 is due to firm's return capturing low synchronicity or capturing firm specific information. Now the factors which revolve around the residual term are public information, private information or insiders trading and noise. Now we know that private information or insiders trading is considered illegal by SEBI. Although it may affect the residual term, present research are not considering it. Now the question arises whether a low R^2 is due to firm's return capturing 'firm's specific information' or not. As per the existing literature it is found that there are two schools of thought to answer this question. According to one school of thought the low R^2 represents that firms return capturing firms specific information. To them R^2 starts decreasing as the economy develops. Follower of this school of thought include Morck et al. (2000), Durnev et al.(2004) , Piotroski and Roulstone(2004), Char and Hameed (2006), Bakke and Whited (2006), Fernandes and Ferreira (2008,2009) and many others. They have set some parameters to differentiate between a developed and developing economy / emerging economy, such as GDP, Corporate Governance, Transparency in disclosure of information where they have considered IFRS as well as GAAP, Globalization, Inflation etc. They show that these parameters are inversely related with R^2. Another school of thought are of opinion that firms return does not capitalizes firms specific information but there is an existence of either private information or occasional frenzy information. According to them that R^2 is low when the amount of firm specific uncertainty is high, totally contradicting the views of the former school of thought. This school of thought includes Roll(1988), Trombley(2003), Mashruwala, Rajgopal and Shevlin (2006), Zhang(2006) and many others. Moreover, they have totally rejected the validity of R^2 as a measure of synchronicity. Hollis Ashbangh-Skaife, Joachim Gassen, Ryan LaFond has proved empirically that R^2 is never a proper measure of stock price synchronicity rather it is Zero Return Metric which is a proper measure. In addition them there are many others who question on the validity of R^2. Many have proved that higher R^2 represents higher Informativeness, contradicting the views of former school of thought who explains that higher R^2 represents lower informativeness. Barberis et al (2005), Kumar and Lee (2005) and Greenwood (2005) suggest that non fundamental factors affect stock price synchronicity. Furthermore, the view of Roll (1988) was proved right. But interestingly, Dasgupta et al (2009) have suggested that the views of the former school of thought could be established while working with time series data. For this present paper we are applying R^2 as our modern measure of stock market synchronicity. For this we have regressed the daily data with the structure of $R_t = R_{t-1}$ of each subsequent year and recorded the value of R^2 where NASDAQ is considered as independent variable and SENSEX is considered as dependent variable, and for the synchronicity value we have applied the formula $SYNCH = \ln(R^2 / 1 - R^2)$.

RESULT & DISCUSSION:

TABLE: 1

YEAR	CLASSICAL MEASURE	MODERN MEASURE
1998	0.008368049	-4.701489957
1999	-0.024897286	-6.212606096
2000	0.008230498	-6.906754779
2001	-0.082691087	-4.59511985
2002	0.099882958	-4.59511985
2003	0.335100965	-4.410776048
2004	0.080844003	-4.498799059
2005	0.073513089	-3.377690934
2006	0.123613163	-6.212606096
2007	-0.040805661	-5.109977737
2008	-0.024001152	-6.906754779
2009	0.193077583	-4.057395776
2010	-0.136772817	-6.906754779
2011	-0.123613163	-5.517452896
2012	-0.074109901	-6.906754779
2013	-0.257412008	-5.293304825

After the synchronicity value of the two measures from 1998-2013 are ready, now for judging whether these two measures are substitutable enough, correlation test is carried out and observed result was moderately satisfactory.

TABLE: 2

CORRELATION RESULT	0.4351

Though a relationship of substitutability between the classical and modern measures of synchronicity have been established, there still remains a huge questions around which measure is more suitable in judging the stock market synchronicity.

DESCRIPTIVE STATISTICS:

Descriptive Statistics								
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic

Classical	16	.5925130	-.2574120	.3351010	.009895452	.0354011821	.1416047285	.020
Modern	16	3.5290638	-6.9067548	-3.3776909	-5.388084890	.2884985936	1.1539943745E0	1.332
Valid N (listwise)	16							

From the descriptive statistics we find that R^2 the modern measure of synchronicity has resulted in generating lowest mean -5.388084890 with standard error of .2884985936, highest standard deviation of 1.1539943745 and variance 1.332 respectively.

CONCLUSION:

As per the literature surveyed till now it is clear that there are various views that tries to explain stock price synchronicity, but still now it is not clear whether synchronicity is the derived impact of price Informativeness or some idiosyncratic factor. This present paper tries to explore on the hypothesis that a developing economy in influenced by the operation of a developed economy, which means that the stock prices of the developing economy might show a synchronous nature with the changes in stock prices of the developed economy, if so, then the two measures of synchronicity namely classical and modern must correlate and give the same result and subsequently can be used substitutably. Now as per the hypothesis our empirical result shows that there exists a moderate correlation between the two measures of synchronicity and these two measures are a substitute of one another. But this present paper does not explore the reason of this synchronous behavior of stock price changes between the developed and a developing economy, which is a subject of further research.

References

- Admati, A.(1985). A noisy rational expectations equilibrium for multi-asset securities market. *Econometrica,* 53, 629-65.
- Admati, A. and P. Pfleiderer. (1986). A monopolistic market for information. *Journal of Economic Theory*, 39, 400-438.
- Alford, A and P. Berger. (1999). A simultaneous equation analysis of forecast accuracy, analyst following, and trading volume. *Journal of Accounting, Auditing & Finance*, 219-246.
- Alves, P., Peasnell, K. and Taylor, P. (2012). The Use of the R^2 as a Measure of Firm Specific Information: A Cross-Country

Critique. *Journal of Business Finance & Accounting*, 37, 1-26.

- Ball, R., S. P. Kothari, and A. Robin.(1998). The effect of international institutional factors on properties of accounting earnings. *Working paper, University of Rochester*.
- Barberis, N., Shleifer, A. and Wurgler, J. (2005). Comovement. *Journal of Financial Economics*, 75 (2), 283-317.
- Bekaert, G., Harvey, C. and Lundblad, C. (2003). Equity Market Liberalisation in Emerging Markets. *Journal of Financial Research*, 26 (3), 275–299.
- Beny, Laura. (2000). A Comparative Empirical Investigation of Agency and Market Theories of Insider Trading. *Harvard Law School Doctoral student dissertation paper*.
- Bhattacharya, U., Daouk, H., Jorgenson, B., Kehr, C. (2000) . When an event is not an event: the curious case of an emerging market. *Journal of Financial Economics* ,55, 69-101.
- Bhushan, R.(1989). Firm characteristics and analyst following. *Journal of Accounting and Economics*, 22, 255-274.
- Campbell, J., Lettau, M., Malkiel, G. and Xu, Y. (2001). Have Individual Stocks Become More Volatile? An Empirical Exploration of Idiosyncratic risk. *Journal of Finance*, 56 (1), 1-43.
- Chan, K. and Hameed, A. (2006). Stock price synchronicity and analyst coverage in emerging markets. *Journal of Financial Economics*, 80 (1), 115-147.
- Dasgupta, S., Gan, J. and Gao, N. (2010). Transparency, Price Informativeness and Stock Return Synchronicity : Theory and Evidence. *Journal of Financial and Quantitative Analysis*, 45, 1189-1220.
- De Long, J. Bradford, Shleifer, Andrei, Summers, Lawrence H., and Waldmann, Robert, J. (1989). The Size and Incidence of the Losses from Noise Trading. *Journal of Finance*, 44(3), 681-696.
- Durnev, A., R. Morck, B. Yeung, and P. Zarowin, (2003). Does Greater Firm-Specific Return Variation Mean More or Less Informed Stock Pricing? *Journal of*

Accounting Research , 41(5), 797-836.

- Durnev, A, Randall Morck, and Bernard Yeung.(2004) Value-enhancing capital budgeting and firm specific stock return variation. *The Journal of Finance*, 59, 65-105.
- Durnev, A, Randall Morck; and Bernard Yeung. (2000). Does Firm-specific Information in Stock Prices Guide Capital Allocation? *Working Paper, National Bureau of Economic Research.*
- Francis, B, Iftekhar Hasan, Liang Song and Bernard Yeung. (2012). What determines bank stock price synchronicity? Global evidence. *Bank of Finland Research Discussion Paper 16.*
- French, K. R. and Roll, R. (1986). Stock Return Variances: the arrival of information and the reaction of traders. *Journal of Financial Economics,* 17 (1), 5-26.
- Grossman, S. (1976). On the efficiency of competitive stock markets where traders have diverse information. *Journal of Finance* , 31, 573-585.
- Jin, L. and Mayers, S. (2006). R Square Around the World: New Theory and New Tests. *Journal of Financial Economics,* 79 (1), 257-292.
- Khandaker, S. and Heaney, R. (2008). Do emerging markets have higher stock synchronicity? The international evidence. *9th International Business Research Conference, Melbourne, Australia, World Business Institute.*
- Khandaker, Sarod. (2011). R Square Measure of Stock Synchronicity. *International Review of Business Research Papers*, 7(1), 165-175.
- Khandaker, Sarod. and Richard Heaney .(2009). Do Emerging Markets Have Higher Stock Synchronicity? The International Evidence. *Journal of Business and Policy Research. 4 (1) 79-98.*
- Lesmond, D., J. Ogden, and J. Trzcinka. (1999). A New Estimate of Transaction Costs. *The Review of Financial Studies.* 12, 1113-1141.
- Li, K., Morck, R., Yang, F. and Yeung, B. (2003). Time varying synchronicity in individual stock returns: a cross-country evidence. *Working paper. University of*

Alberta Business School. Alberta, Canada.

- Liu, M. (2007). Analysts' Incentives to Produce Industry-Level versus Firm-Specific Information: Theory and Evidence. *Working paper, University of Kentucky*.
- Morck, R., Yeung, B. and Yu, W. (2000). The information content of stock markets: why do emerging markets have synchronous stock price movements? *Journal of Financial Economics,* 58 (1), 215-260.
- Moyer, R. C., R. E. Chatfield, and P. H. Sisneros. (1989). Security analyst monitoring activity: Agency costs and information demands. *Journal of Financial and Quantitative Analysis*. 24, 503-512.
- Piotroski, J. D., and D. T. Roulstone, (2004). The Influence of Analysts, Institutional Investors and Insiders on the Incorporation of market, Industry and firm-specific Information into Stock Prices. *Accounting Review*, 79, 1119-51.
- Roll, R. (1988) .$\mathbf{R^2}$.*Journal of Finance*, 43, 541-566.
- Shleifer, A. (1994). Establishing property right. Annual Conference on Development Economics. *Working paper. World Bank: 93-117. Washington DC, USA.*
- Skaife, A. H., Gassen, J. and La Ford, R. (2006). Does stock price synchronicity represent firm-specific information? The international evidence. *MIT Sloan Research Paper. 4551-05.*
- Teoh, Siew Hong, Yang, Yong George and Zhang, Yinglei. (2009). R-Square and Market Efficiency. *Available at SSRN: http://ssrn.com/abstract=926948*.
- Xing, X. & Anderson, R. (2011). Stock price synchronicity and public firm-specific information. *Journal of Financial Markets*, 14, 259-276.