Co-Movements Of The Indian Stock Market With Other Stock Markets: Implications For Portfolio Diversification

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INTRODUCTION

Studying the co-movements of national stock markets has long been a popular research topic in finance. Low correlations between national stock markets are often presented as evidences in support of the benefit of global portfolio diversification **(see: Levy and Sarnat, 1970, Solnik, 1974, Watson, 1978, Meric and Meric, 1989)**. Global portfolio studies generally emphasize the mean correlation between national stock markets. However, several studies demonstrate that correlation between national stock markets can fluctuate considerably over time **(see: Longin and Solnik , 1995, Meric and Meric, 1996, 1997, 2004, Meric *et al.*, 2002)**. In this paper, the researchers have used time-varying correlation analysis to study the portfolio diversification implications of the co-movements of the Indian stock market, with thirteen other stock markets during the May 15, 2006 -August 5, 2010 period.

Events of global importance tend to have a significant impact on the national stock markets. Empirical studies provide evidence to show that the co-movement patterns of national stock markets change significantly after such events. **Arshanapalli and Doukas (1993), Lee and Kim (1993), Lau and McInish (1993), and Meric *et al.* (2001a,b)** demonstrate that correlation between national stock markets increased and global portfolio diversification benefits decreased significantly after the 1987 global stock market crash. **Meric *et al.* (2000) and Yang *et al.* (2003)** demonstrate that the 1997-1998 emerging markets crisis affected the co-movement patterns of national stock markets significantly and the benefits of global portfolio diversification decreased considerably after the crisis.

In 2008, world economies experienced the worst financial/economic crisis since the great depression. The U.S. stock market fell by about 56 percent during the October 10, 2007-March 9, 2009 period. All other recognized stock markets worldwide experienced similar tailspin. In this paper, the researchers study the impact of the 2008 financial/economic crisis on the co-movements of the Indian stock market with thirteen other stock markets.

THE EFFECTS OF THE 2008 FINANCIAL CRISIS ON THE INDIAN ECONOMY

The global market meltdown had a significant behavioral impact on wary Indian investors, who wanted to see their assets protected during the financial turmoil. Many people saw significant erosion in their investment portfolios over the entire year in 2008, as the stock price in the Bombay Stock Exchange Sensitivity Index (BSE-Sensex) showed a decline from 20,301 on January 1, 2008 to 8509.56 to October 27, 2008.

The withdrawal of Foreign Institutional Investors (FIIs) from the Indian market was conspicuous as the country shed over $11 billion in the first nine months of 2008. This withdrawal led to a sharp decline of India's currency against other currencies, especially 25% against a weaker dollar. The country initially thought that it was immune to the global collapse of the financial system due to the relatively significant roles the nationalized banks play in the country. Overcoming this complacency, the government infused ₹ 25,000 crores (approximately US $6.5 Billion) under the Debt Waiver and Debt Relief Scheme to strengthen the liquidity position of the financial system.

The weaker rupee, which normally would have boosted exports in a stable economy, did not do so due to sluggish

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global markets. For a while, the foreign banks located in major metropolitan cities were thought to have taken the hit due to their exposure to toxic assets. Some private banks were also suspected to have accumulated huge collateral debt obligations and credit default swaps.

In these uncertain environments, the banks cut back on their lending to affect adversely the home, automobile, and consumer durable markets. The Information Technology (IT) market dominated by top five Indian companies accounting for 46 percent of the market share **(Chidambaram, 2008)** lost their grounds. Due to the reason that the IT sector of India has a dominant clientele in U.S. based financial institutions, the downward spiral of the IT sector was a foregone conclusion as 61 percent of the IT revenues came from finance institutions such as Goldman Sachs, Citigroup, etc. **(Prasad and Reddy, 2009)**.

Real estate was affected the worst due to the tightening of credit standards for low income home buyers. Further, large projects and developments were held in abeyance due to the lack of funding to finish the projects already launched due to uncertain economic environments. Apparel industries were affected severely due to their export connections with the western world, especially, with the United States.

In sum, all the above conditions led to higher unemployment and lower disposable income for the people to meet their personal demands. As a result, India's economy that grew by 9% in 2007 exhibited 7.1% growth in 2008. This was a precipitous drop in one year, but would be considered a sound growth, given the prevailing macro-economic conditions.

DATA AND METHODOLOGY

The study covers the following fourteen stock markets: India, U.S., U.K., Germany, Japan, Australia, Hong Kong, Indonesia, Malaysia, New Zealand, Shanghai, Singapore, South Korea, and Taiwan. The daily stock market indexes were downloaded from the Yahoo/Finance database. The daily stock returns were computed as the log difference in the indexes ($\text{Ln } I_t/I_{t-1}$). The study covers the May 15, 2006-August 5, 2010 period. In this time period, May 15, 2006 to October 9, 2007 was the pre-crisis phase. The crisis phase started on October 10, 2007 and lasted until March 9, 2009. March 9, 2009 through August 5, 2010 was the post-crisis bull market period.

Starting with the first month, monthly correlation coefficients were computed between the Indian stock market and each of the thirteen other stock markets by rolling the sample period ahead one trading day at a time. Specifically, the latest daily observation was added while the earliest observation was deleted. A total of 1,085 rolling correlation coefficients were computed for each pair of stock markets. Thus, a total of 14,105 (1,085 x 13) correlation coefficients for thirteen pairs of markets were computed. The rolling correlation coefficients were then used as input in the Principal Component Analysis (PCA) program to combine the other stock markets into distinct principal component clusters in terms of the similarities of their time-varying correlation with the Indian stock market. The PCA technique is widely used in the finance literature to study the co-movements of national equity markets **(see: Makridakis and Wheelwright, 1974, Maldonado and Saunders, 1981, Philippatos *et al.*, 1983, Meric and Meric, 1989)**.

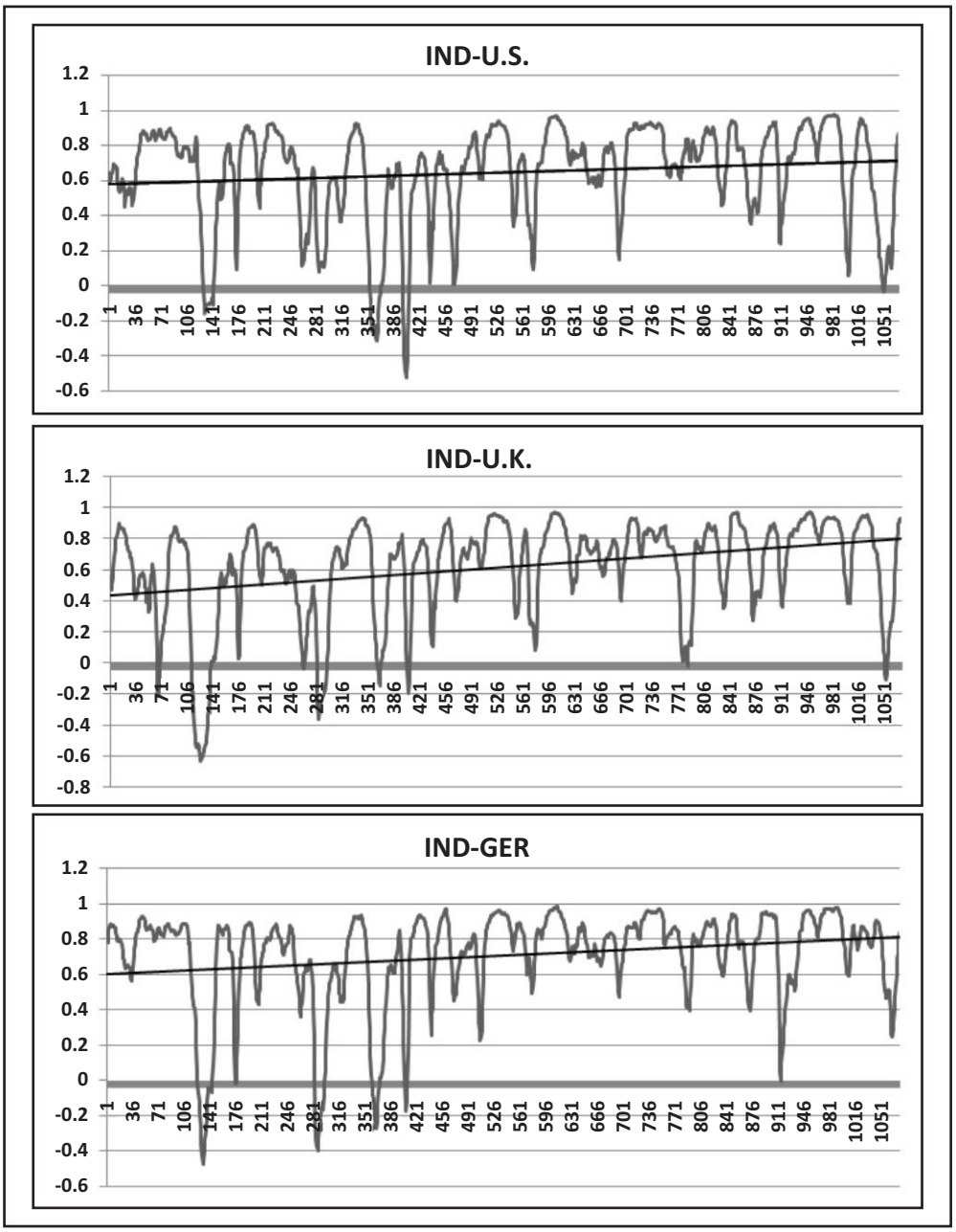
An independent variable *X* Granger-causes a change in dependent variable *Y*, if *Y* can be better forecasted with past values of both *X* and *Y* than just with past values of *Y* alone **(see: Granger, 1969, 1988)**. The causality in the Granger sense does not imply a cause and effect relationship, but one of predictability. In empirical studies, the Granger-causality technique is often used to determine if the index returns of a national stock market can be used to predict the future index returns of another national stock market **(see, e.g., Ratner and Leal, 1996, Meric *et al.*, 2002)**. A detailed discussion of the Granger-causality technique can be found in **Enders (1995)**. In this paper, the researchers have used the Granger-causality technique to study if the daily index returns of the fourteen stock markets covered in the study can be used to predict each other's future daily index returns during the May 15, 2007-August 5, 2010 period.

TIME-VARYING CORRELATION OF THE INDIAN STOCK MARKET WITH THE OTHER STOCK MARKETS

The time-varying correlations of the Indian stock market with the thirteen other stock markets are presented in Figures 1, 2, and 3. In **Figure 1**, the time-varying correlations of the Indian stock market with the U.S., U.K., and German stock markets are shown. The graphs indicate that there is considerable volatility in the correlations of the Indian stock market with the three major stock markets during the May 15, 2007-August 5, 2010 period. In the graph, the

observations 1-361 are for the pre-crisis period, 362-723 for the crisis period, and 724-1085 for the post-crisis period.

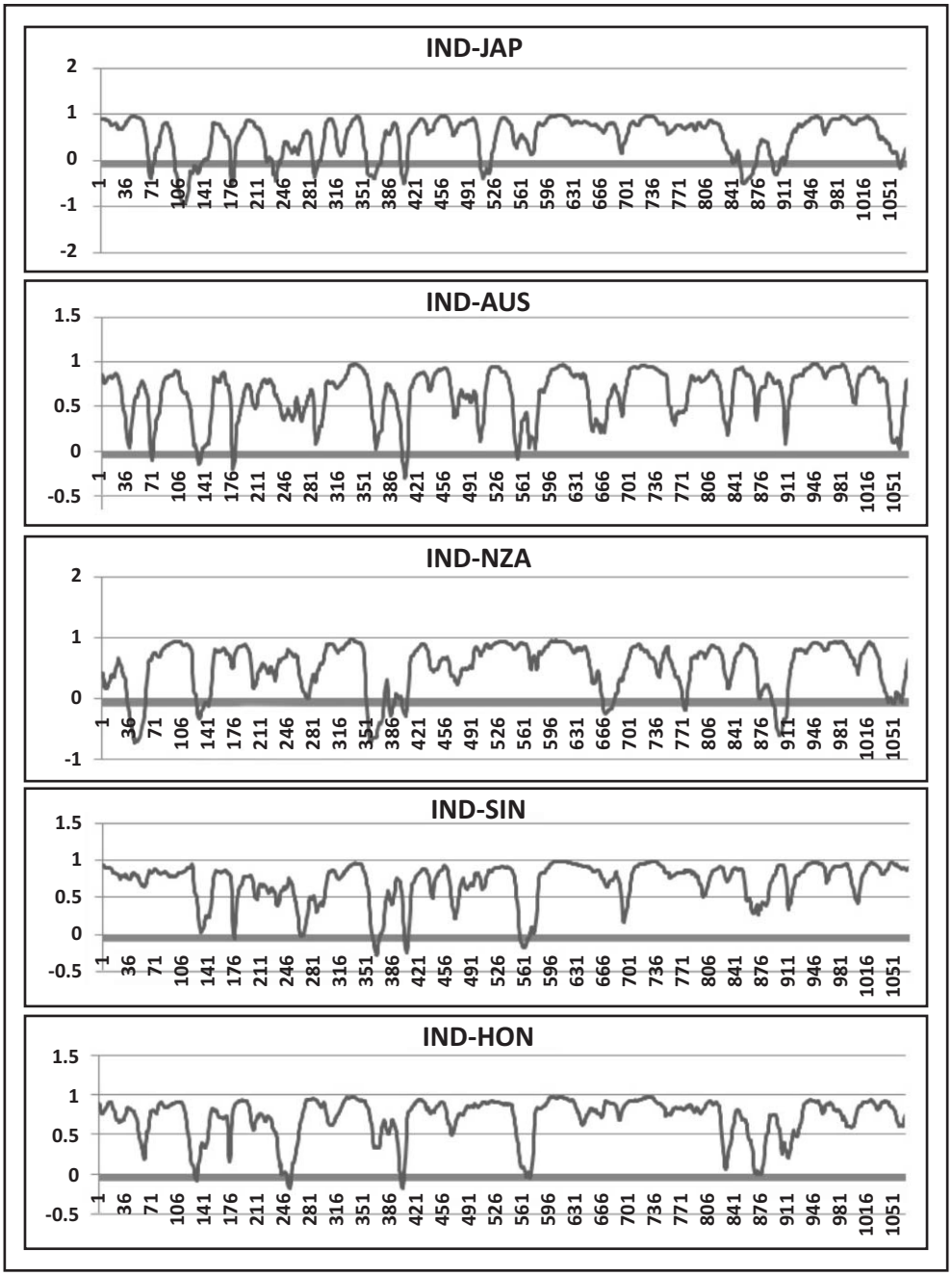
Figure 1 : Moving Correlation Of The Indian Stock Market With The U.S., U.K., And The German Stock Markets



The graphs in Figure 1 indicate that the average correlations of the Indian stock market with the three major stock markets were not very high, often they were even negative, during the pre-crisis period. This indicates that the Indian stock market was a good diversification prospect for global investors in the U.S., the U.K., and Germany from May 15, 2006 to October 9, 2007. The Indian stock market had a negative correlation with the three markets twice during the transition period from the pre-crisis period to the crisis period. However, the average correlation remained quite high with all three stock markets throughout the crisis period. It indicates that India was not a good diversification opportunity for the U.S., U.K., and German investors during the crisis period. In fact, all world stock markets were sharply falling, and global diversification opportunities were almost non-existent for global investors during this

period. The graphs in Figure 1 indicate that the correlation of the Indian stock market with the U.S., U.K., and the German stock markets remained quite high in the post-crisis period. Unlike in the pre-crisis period, the instances of very low or negative correlations were sparse in the post-crisis period. The linear trend lines fitted to the graphs show that the correlations of the Indian stock market with the U.S. U.K., and the German stock markets increased considerably during the May 15, 2006-August 5, 2010 period. It indicates that global diversification opportunities for U.S, U.K., and German investors with the Indian stock market had diminished considerably during this period. The upward slope of the trend lines for the U.K. and the Germany stock markets is quite high. It indicates rapidly decreasing global diversification opportunities with the Indian stock market for investors in these countries.

Figure 2 : Moving Correlation Of The Indian Stock Market With The Japanese, Australian, New Zealand, Hong Kong, And Singapore Stock Markets

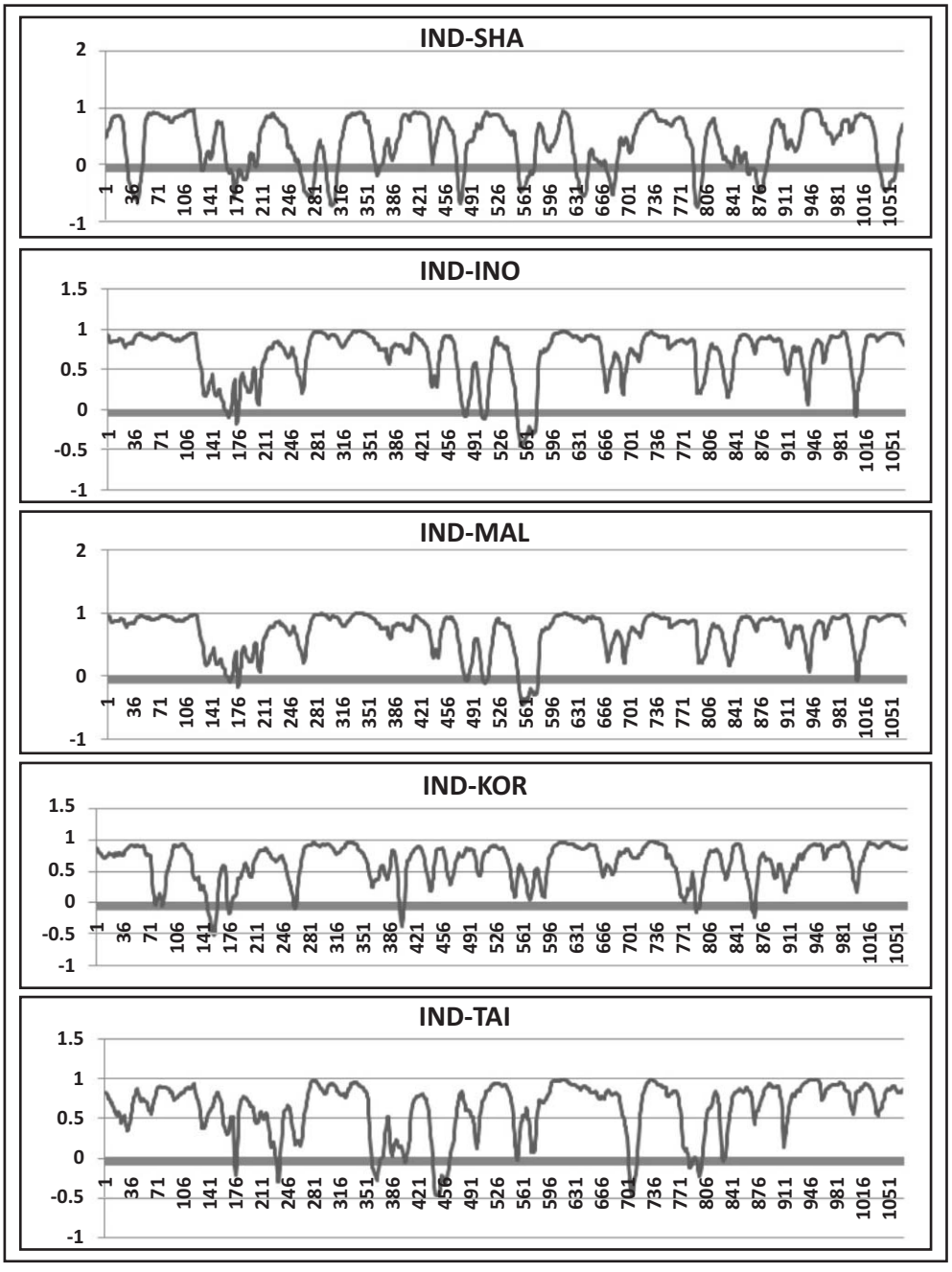


The graphs in Figure 2 show that the correlation of the Indian stock market with the Japanese, Australian, Singapore,

and Hong Kong stock markets somewhat increased from the pre-crisis period to the post-crisis period. It indicates somewhat reduced global diversification benefits with these stock markets for investors in the Indian stock market. The correlation between the Indian stock market and the New Zealand stock market does not appear to have changed substantially from the pre-crisis period to the post-crisis period. The average correlation between the Indian and the Japanese stock markets appears to be quite high during most of the crisis period.

The first graph in Figure 3 indicates no discernable change in the correlation of the Shanghai stock market with the Indian stock market during the May 15, 2006-August 5, 2010 period. It appears that the Indian stock market was quite highly correlated with the South Korean stock market during the crisis period. It also appears that the correlation of the Indian stock market with the Indonesian, Malaysian, and Taiwanese stock markets somewhat increased in the post-crisis period, indicating decreasing diversification benefits with these stock markets.

Figure 3 : Moving Correlation Of The Indian Stock Market With The Shanghai, Indonesian, Malaysian, South Korean, And The Taiwanese Stock Markets



PRINCIPAL COMPONENTS ANALYSIS WITH TIME-VARYING CORRELATION COEFFICIENTS

To determine the clusters of the stock markets with similar time-varying correlation patterns with the Indian stock market, the time-varying Indian correlation coefficients with the other stock markets were used as input in the Principal Component Analysis (PCA) program. The Varimax rotation was employed to maximize the factor loadings of the stock markets in each principal component with similar correlation patterns with the Indian stock market. Using Kaiser's significance rule, statistically significant principal components with eigenvalues greater than unity were retained for analysis **(see: Mardia *et al.*, 1979, Marascuilo and Levin, 1983)**.

There are three statistically significant principal component clusters. The highest factor loadings for the thirteen stock markets in the three principal components are presented in Table 1. If a stock market has a high factor loading in a principal component, it indicates that its time-varying correlation pattern with the Indian stock market is similar to the time-varying correlation patterns of the other stock markets, with high factor loadings in the same principal component.

Table 1 : Principal Components Analysis

Country Pairs	Principal Components		
	1	2	3
Ind-U.K.	0.840		
Ind-Ger	0.833		
Ind-U.S.	0.778		
Ind-Jap	0.768		
Ind-Aus	0.743		
Ind-Sin	0.668		
Ind-Hon	0.575		
Ind-Ino		0.950	
Ind-Mal		0.950	
Ind-Kor		0.670	
Ind-Tai		0.467	
Ind-Sha			0.832
Ind-Nza			0.566

The U.K., German, U.S., Japanese, Singapore, and Hong Kong stock markets have their highest factor loadings in the first principal component. It indicates that these stock markets have similar time-varying correlation patterns with the Indian stock market and, therefore, they are highly correlated. Choosing these stock markets for the same global portfolio would reduce global diversification benefits for investors who invest in India. The Indonesian, Malaysian, South Korean, and Taiwanese stock markets have their highest factor loadings in the second principal component. The Shanghai and the New Zealand stock markets have their highest factor loadings in the third principal component. Stock markets with high factor loadings in the same principal component are highly correlated. There is less correlation between stock markets, with high factor loadings in different principal components. To maximize diversification benefit, investors in the Indian stock market should choose stock markets with high factor loadings in different principal components (e.g., they should choose one stock market with high factor loading from each of the three principal components).

GRANGER-CAUSALITY TESTS

The Sims (1980) test indicates that optimal lag-length is three trading days in the VAR system used in the analysis. The results of the Granger-causality test for the joint hypotheses of zero coefficients on all three lags for each stock market are presented in the Table 2. In the test with the Indian stock market as the dependent variable, the U.S., Hong Kong, New Zealand, and Australian stock markets have statistically significant F values, indicating that the past returns of these stock markets can predict the future returns of the Indian stock market. The F values and the

Table 2 : Granger - Causality Test Results

Stock Market	F Statistic	Significance Level
PANEL A: Stock markets that can predict the Indian stock market		
U.S.	25.857	0.000
Hong Kong	5.165	0.002
New Zealand	3.421	0.017
Australia	3.030	0.029
PANEL B: Stock markets that can be predicted by the Indian stock market		
Malaysia	7.948	0.000
Indonesia	7.935	0.000
South Korea	4.635	0.003
Taiwan	4.110	0.007
Hong Kong	3.470	0.016
Germany	3.295	0.020

significance levels for these stock markets are presented in Panel A of Table 2.

The test statistics in Panel A indicate that the U.S., Hong Kong, New Zealand, and Australian stock markets lead the Indian stock market. The U.S. stock market appears to have a very strong prediction power of the Indian stock market with a very high F value. The past returns of the U.S. stock market can predict the future returns of the Indian stock market with a high degree of accuracy. It appears that the Hong Kong, New Zealand, and Australian stock markets also have a significant prediction power of the Indian stock market with statistically significant F values. The past returns of the Hong Kong, New Zealand, and Australian stock markets can predict the future returns of the Indian stock market.

The F-value test statistics in Panel B indicate that the returns of the Indian stock market lead the returns of the Malaysian, Indonesian, South Korean, Taiwanese, and Hong Kong stock markets in Asia. The past stock returns of the Indian stock market can also predict the future stock returns of the German stock market. It appears that the Indian and the Hong Kong stock markets can both predict each other's returns.

SUMMARY AND CONCLUSION

In this paper, the researchers studied the effects of the 2008 global financial/economic crisis on the co-movement patterns of the Indian stock market with the U.S., U.K., German, Japanese, Australian, Hong Kong, Indonesian, Malaysian, New Zealand, Shanghai, Singapore, South Korean, and Taiwanese stock markets. The findings indicate that there is considerable time-varying volatility in the correlation of the Indian stock market with the other stock markets. The trend analysis results show that correlation between the Indian stock market, and the other national stock markets increased substantially and the benefits of global portfolio diversification decreased considerably from the May 15, 2006-October 9, 2007 pre-crisis period to the March 9, 2009-August 5, 2010 post-crisis period.

The researchers found three statistically significant principal components in terms of the similarities of the co-movement patterns of the Indian stock market with the other stock markets. The U.K., German, U.S., Japanese, Australian, Singapore, and Hong Kong stock markets have similar co-movement patterns with the Indian stock market, and they have high factor loadings in the first principal component. Therefore, these stock markets are highly correlated and investing in more than one of these stock markets would provide a minimal global portfolio diversification benefit to investors who invest in the Indian stock market.

The Indonesian, Malaysian, South Korean, and Taiwanese stock markets have their highest factor loadings in the second principal component. The Shanghai and New Zealand stock markets have their highest factor loadings in the third principal component. Investors in the Indian stock market could maximize their global portfolio diversification benefit by investing in only one stock market, with a high factor loading in each of the three different principal components.

The Granger-Causality test results show that the returns of the U.S., Hong Kong, New Zealand, and Australian stock

markets lead, and they can predict the returns of the Indian stock market. The returns of the Indian stock market can predict the returns of the Malaysian, Indonesian, South Korean, Taiwanese, Hong Kong, and German stock markets. It appears that the Indian and Hong Kong stock markets can both predict each other's stock returns.

BIBLIOGRAPHY

1) Arshanapalli, B., and Doukas J. (1993). "International Stock Market Linkages: Evidence from the Pre- and Post-October 1987 Period", *Journal of Banking and Finance*, Volume 17, Issue 1, pp.193-208.

2) Chidambaram, P. (2008). "Spill Over Effects of Global Crisis will be Tackled", *The Hindu Daily*, November 19, p. 15.

3) Enders W. (1995), *Applied Econometric Time Series*, Wiley, New York.

4) Granger, C. W. J. (1969). "Investigating Causal Relationships by Econometric Models and Cross-Spectral Methods", *Econometrica, Volume* 37, No. 3, pp. 424-438.

5) Granger, C. W. J. (1988). "Some Recent Developments in a Concept of Causality", *Journal of Econometrics*, Volume 39, No. 1/2, pp. 199-211.

6) Lee, S. B., and Kim K. L. (1993). "Does the October 1987 Crash Strengthen the Co-Movements Among National Stock Markets?", *Review of Financial Economics*, Volume 3, No. 1, pp. 89-102.

7) Lau, S. T., and McInish T. H. (1993). "Co-Movements of International Equity Returns: A Comparison of the Pre- and Post-October 19, 1987, Periods", *Global Finance Journal, Volume* 4, No. 1, pp. 1-19.

8) Levy, H., and Sarnat M. (1970). "International Diversification of Investment Portfolios", *American Economic Review*, Volume 60, No. 3, pp. 668-675.

9) Longin, F., and Solnik B. (1995). "Is the Correlation in International Returns Constant: 1960-1990?", *Journal of International Money and Finance,* Volume 14, No. 1, pp. 3-26.

10) Makridakis, S. G., and Wheelwright S. C. (1974). "An Analysis of the Interrelationships Among the Major World Equity Exchanges", *Journal of Business Finance and Accounting, Volume* 1, No. 2, pp. 195-215.

11) Maldonado, R., and Saunders A. (1981). "International Portfolio Diversification and the Inter-Temporal Stability of International Equity Market Relationships, 1957-1978", *Financial Management, Volume* 10, No. 4, pp. 54-63.

12) Marascuilo, L. A., & Levin, J. R. (1983), *Multivariate Statistics in Social Sciences: A Researcher's Guide,* Brooks/Cole Publishing Company, Monterey, California.

13) Mardia, K., Kent, J., & Bibby, J. (1979), *Multivariate Analysis*, Academy Press, New York.

14) Meric, G. & et al. (2001a). "Co-Movements of U.S. and Latin American Equity Markets Before and After the 1987 Crash", *International Review of Financial Analysis*, Volume 10, No. 3, pp. 219-235.

15) Meric, G. & et al. (2001b). "Co-Movements of U.S. and Latin American Equity Markets During the 1997-1998 Emerging Markets Financial Crisis" in I. Meric and G. Meric (eds.), *Global Financial Markets at the Turn of the Century,* Pergamon Press, Elsevier Sciences, Ltd., London.

16) Meric, I., & et al. (2002). "The Linkages between the World's Major Equity Markets in the 2000-2001 Bear Market", *Journal of Investing*, Volume 11, No. 4, pp. 55-62.

17) Meric, I., and Meric G. (1989). "Potential Gains from International Portfolio Diversification and Inter-Temporal Stability and Seasonality in International Stock Market Relationships", *Journal of Banking and Finance*, Volume 13, No. 4/5, pp. 627-640.

18) Meric, I., and Meric G. (1996). "Inter-Temporal Stability in the Long-Term Co-Movements of the World's Stock Markets", *Journal of Multinational Financial Management*, Volume 6, No. 3, pp. 73-83.

19) Meric, I., and Meric G. (1997). "Co-Movements of European Equity Markets Before and After the Crash of 1987", *Multinational Finance Journal,* Volume 1, No. 2, pp. 137-152.

20) Meric, I., and Meric G. (2004). "The Diminishing Benefit of Global Portfolio Diversification", *Global Business and Finance Review, Volume* 9, No. 2, pp. 43-51.

21) Meric, I., Meric, G., and Ratner M. (2000). "1997-1998 Emerging Markets Crisis and the ASEAN-5 Equity Markets", *International Journal of Finance*, Volume 12, No. 3, pp. 1835-1853.

22) Philippatos, G. C., Christofi, A., and Christofi P. (1983). "The Inter-Temporal Stability of International Stock Market Relationships: Another View", *Financial Management*, Volume 12, No. 4, pp. 63-69.

23) Prasad, A., and Reddy C. P. (2009). "Global Financial Crisis and Its Impact on India," *Journal of Social Science*, Volume 21, No. 1, 1-5.

24) Ratner, M., and Leal R. P. C. (1996). "Causality Tests for the Emerging Markets of Latin America", *Journal of Emerging Markets*, Volume 1, No. 1, pp. 29-40.

25) Sims, C. (1980). "Macroeconomics and Reality", *Econometrica*, Volume 48, No. 1, pp. 1-49.

26) Solnik, B. H. (1974). "Why Not Diversify Internationally?", *Financial Analysts Journal*, Volume 30, No. 4, pp. 48-54.

27) Watson, J. (1978). "A Study of Possible Gains from International Investment", *Journal of Business Finance and Accounting*, Volume 5, No. 2, pp. 195-206.

28) Yang, J., Kolari, J. W., and Min I. (2003). "Stock Market Integration and Financial Crisis: The Case of Asia", *Applied Financial Economics*, Volume 13, No. 7, pp. 477-48.