

IS THERE A LONG-RUN RELATIONSHIP BETWEEN THE INDIAN STOCK MARKET AND THE STOCK MARKETS OF THE DEVELOPED WORLD?

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ABSTRACT

INDIAN ECONOMY HAS BEEN LIBERALISED SINCE JULY 1991. SUBSTANTIAL FOREIGN INVESTMENT HAS FLOWED INTO THE INDIAN STOCK MARKET. MORE THAN HALF OF THE TOTAL FOREIGN INVESTMENT HAS COME FROM THE UNITED STATES. DID THIS PRODUCE A LONG RUN RELATIONSHIP BETWEEN THE INDIAN STOCK MARKET AND THE STOCK MARKETS OF THE DEVELOPED WORLD? USING MULTIVARIATE TECHNIQUES PIONEERED BY JOHANSEN AND JUSELIUS, WE PROVIDE EVIDENCE THAT BOMBAY STOCK MARKET INDEX (SENSEX) SHOWS NO SIGN OF BEING COINTEGRATED TO EITHER THE DOW JONES INDUSTRIAL AVERAGE OR THE MORGAN STANLEY WORLD INDEX OR BOTH. THUS, THE BENEFITS OF DIVERSIFICATION FOR LARGE INTERNATIONAL PENSION FUNDS INTO INDIAN STOCK MARKET STILL EXISTS.

INTRODUCTION

In the past few years, a number of studies have looked at how emerging Asian equity markets have integrated to the equity markets of the developed world. The driving force behind this line of research has been

an attempt to find ways to reduce portfolio risk by international diversification for large pension funds. Most early attempts were crude: they looked at the correlation between the rates of returns of different markets around the globe (see Cheung and Ho (1991) or Hartmann and Khambata (1993)). The problems with correlation are well known: the correlation does not take into account of the essence of time series processes. Correlation remains unaffected as long as pairs of observations are kept unchanged even when the observations are permuted differently. Moreover, if the underlying time series data of the stock market indices are non-stationary (as most of them are), the standard assumptions of classical statistical analyses are violated (For example, we cannot perform a simple test of zero correlation as the test statistic does not have a standard distribution under the null hypothesis). More recent studies have taken into account nonstationarity (for example, Hung and Cheung (1995)). Hung and Cheung have studied Hong Kong, Korea, Malaysia, Singapore and Taiwan together. Unfortunately, liberalisation in these countries had been gradual. So, it is difficult to see a structural break. There are two advantages of studying the Indian stock market for integration: (1) Indian stock market (in Bombay) has been a fully functioning stock market for 120 years. Therefore, the teething problems of a newly created market are minimal. (2) India has a clearly identifiable date for deregulation. Most of the current wave of deregulation

have been in place within a short space of time.

LIBERALISATION IN INDIA

India has pursued an inward looking policy since independence. It has implemented five year plans in the style of the Soviet Union. Successive governments nationalised banks, insurance companies, major industries (such as coal, power generation) and imposed controls through various licensing schemes. In the mid-1980s there were a few feeble attempts at some reforms.

By the middle of 1991, India was at the brink of disaster. The breakup of Soviet Union meant a huge loss of export market. The breakout of the Gulf War led to an enormous reduction in remittance from the expatriate workers. Indian government had hardly any money left to meet its foreign debt obligations. With the prospect of defaulting on the loan of the International Monetary Fund (IMF), the newly elected Prime Minister of India (Mr. P. V. Narasimha Rao) outlined a plan to liberalise the economy. This outline signalled a clear break in policy of liberalization of the domestic economy and integration to the world market.

THE NEW BEGINNING

Faced with loan default, Prime Minister Rao took bold steps to reform all sectors of the economy. He outlined his reform agenda in a fax to the International Monetary Fund. To attract investment funds, he took steps to deregulate the currency (India Rupee), promised access to the domestic market (a trillion dollar economy), instituted lower corporate tax rates, relaxed regulations of repatriation of profits and deregulated domestic financial markets as well (such as privatising the big government-owned banks). (For an extensive discussion on

deregulation of the Indian economy, see Sinha and Sinha (1995)). Functioning of the stock market was facilitated by the establishment of the Securities and Exchange Board of India (SEBI). The SEBI was also given extensive regulatory authority (not unlike the Securities and Exchange Commission in the United States).

DATA

We have weekly observations from the Bombay thirty industrial stock index (Sensex), Dow Jones Industrial Average (DJIA), and the Morgan Stanley World Index (MSWI) taken from various issues of the weekly *Far Eastern Economic Review* during the period of the beginning of January 1989 and to the end of December 1993.

The reason for choosing this time period was to have sufficient observations before and after the implementation of deregulation in equal numbers. For statistical tests used, this symmetry is quite useful (see Campbell and Perron (1991))

In 1991, the weekly figures of DJIA were not reported in the *Far Eastern Economic Review*. An Internet Gopher site version of G10 stock prices were used to fill in that gap. Reported figures are the numbers for ten days prior to the date of publication. Thus, the issue dated January 12, 1991 reported the closing figures for January 2, 1991. In case the stock market was closed on that date (in this case, January 2, 1991), the closing figure for the closing quote of last date of actual transaction is recorded. In case no figures are reported for the magazine in week t , we have imputed the value by taking the average value of week $t-1$ and $t+1$. Out of 765 observations, we had to impute 5 observations.

METHODOLOGY

We use the concept of cointegration due to Engle and Granger (1987). Two (or more) non-stationary time series are cointegrated if there exists a linear combination of the series such that the resulting series is stationary. For equity markets, cointegration implies a long term underlying relationship between the markets. If such a long term relationship exists, it will mean that long term benefits from international diversification is limited.

Our analysis is based on the multivariate tests of cointegration developed by Johansen (1988) and Johansen and Juselius (1990). Let X_t denote the column vector with three indices (Sensex, DJIA, MSWI). The vector autoregressive model (VAR) can then be written as:

$$X_t = b_1 X_{t-1} + b_2 X_{t-2} + \dots + b_k X_{t-k} + v_t \quad (1)$$

with $t = 1, 2, 3, \dots, T$

Therefore, for our specification, we have a 3×1 vector, where k is the number of lags and v_t is white noise (vector). The lag length is suitably chosen. All the reported results are for the

transformed series using logarithms of the original series.

RESULTS

Before we can conduct tests for long run relationship between variables, we have to check to see if the series are non-stationary with unit roots. There are many types of unit root tests. Tests were conducted with trend, without trend using Augmented Dickey-Fuller (ADF) test statistics as described by Dickey and Fuller (1981). Further tests were carried out using Phillips-Perron non-parametric procedure and Lo-MacKinlay (1989) variance ratio procedures. All tests provided the same results regardless of whether they were conducted with the original series or with two parts of the series separately: the original series (and the logged series) showed that the null hypothesis of the presence of unit root could not be rejected. However, with the series differenced once, the null hypothesis that the differenced series had the unit root was overwhelmingly rejected. This result remained unchanged whether we assumed the data generating process to have intercept or not or whether it had trend or not. We also tried various lag lengths in equation (1). The results remained unchanged as long as $k > 3$.

Table 1: Results of Unit Root Tests

Augmented Dickey Fuller test statistics for $\log(\text{Sensex})$, $\log(\text{DJIA})$, $\log(\text{MSWI})$ for the whole time period, the first 130 observations and the last 125 observations

Observations	$\log(\text{Sensex})$	$\log(\text{DJIA})$	$\log(\text{MSWI})$	Critical 95%
253	-0.69439	-1.4938	-2.3238	-2.8731
128	-0.8206	-2.3474	-2.5051	-2.8840
123	-2.2705	-1.0887	-0.2983	-2.8845

Augmented Dickey Fuller test statistics for the log of first differences

Observations	$\Delta \log(\text{Sensex})$	$\Delta \log(\text{DJIA})$	$\Delta \log(\text{MSWI})$	Critical 95%
252	-10.4114	-12.2315	-13.6561	-2.8731
127	-6.6058	-8.6712	-9.5007	-2.8840
122	-6.0119	-8.5631	-9.8593	-2.8845

Note: Reported test statistics are for without trends. Similar results were obtained for with trends (not reported).

Table 2: Results of Johansen-Juselius Tests for Cointegration among Sensex, DJIA and MSWI

Johansen Maximum Likelihood Procedure (Non-trended case); Cointegration LR Test Based on Trace of the Stochastic Matrix; 247 observations from 9 to 255. Maximum lag in VAR = 8

Null	Alternative	Test Statistic	95% Critical
$r=0$	$r \geq 1$	29.9357	34.9100
$r <= 1$	$r \geq 2$	14.9064	19.9640
$r <= 2$	$r=3$	3.5305	9.2430

Johansen Maximum Likelihood Procedure (Non-trended case); Cointegration LR Test Based on Trace of the Stochastic Matrix; 122 observations from 9 to 130. Maximum lag in VAR = 8

Null	Alternative	Test Statistic	95% Critical
$r=0$	$r \geq 1$	29.5921	34.9100
$r <= 1$	$r \geq 2$	15.3798	19.9640
$r <= 2$	$r=3$	7.2203	9.2430

Johansen Maximum Likelihood Procedure (Non-trended case); Cointegration LR Test Based on Trace of the Stochastic Matrix; 125 observations from 131 to 255. Maximum lag in VAR = 8

Null	Alternative	Test Statistic	95% Critical
$r=0$	$r \geq 1$	32.2185	34.9100
$r <= 1$	$r \geq 2$	12.5376	19.9640
$r <= 2$	$r=3$	2.0809	9.2430

Further tests were carried out using Sensex and DJIA by converting Sensex in US dollars. Once again, the qualitative results of Table 2 remained unchanged (in this case, it was meaningless to include MSWI). Also, cointegration tests were conducted to see whether Sensex and MSWI are cointegrated. Again, results remained unchanged.

CONCLUSIONS

Indian stock market is now part of the world-wide investment map. It is important for the international investor to know if inclusion of Indian stocks will actually reduce their portfolio risk without affecting returns. From the evidence it appears that even after opening up of the Indian economy

and the Indian stock market, diversification by international investor into the Indian stock market is still a useful risk reduction strategy.

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