Are the Asian FDI Inflows Cointegrated with the Indian FDI Inflows? Empirical Research Findings

Rudra Prakash Pradhan*

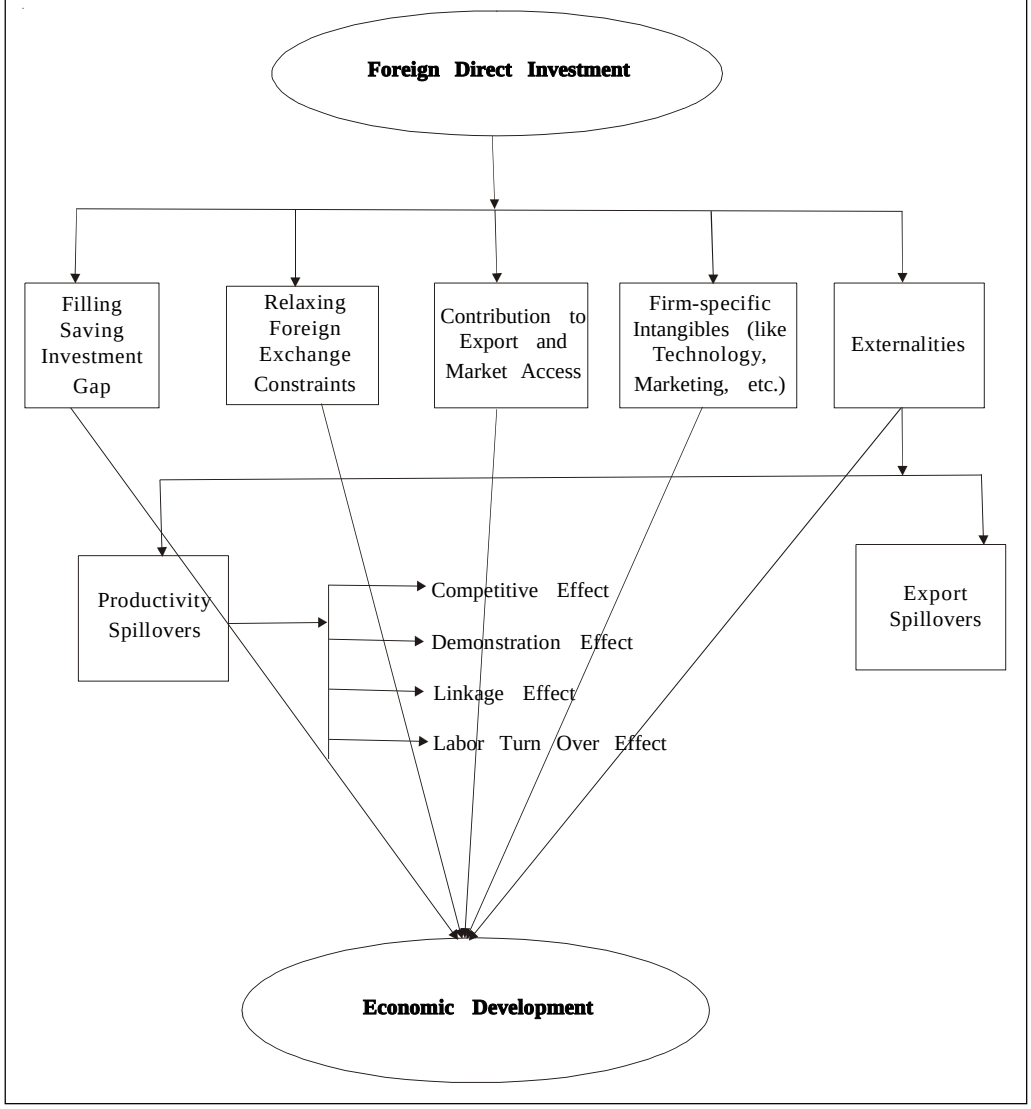
The paper investigates the linkage of Foreign Direct Investment (FDI) inflows between India and four other Asian countries, viz., Japan, Hong Kong, Singapore and Malaysia. The empirical investigation follows annual data of FDI inflows during 1970-71 to 2004-05. The technique employed for the same is cointegration test, which is followed by the unit root test. The empirical results clarify that FDI inflows of four Asian countries along with India, have a unit root at the level data, but found to be stationary at the first difference level. The cointegration test finally confirmed that the FDI inflows of four Asian countries are cointegrated with India's FDI inflows. The implication of this finding is that the FDI inflows of India can be used to predict the FDI inflows of Japan, Singapore, Hong Kong and Malaysia.

Introduction

Foreign Direct Investment (FDI) is widely perceived as an important resource base for expediting the economic development of a country (Okamoto and Sjoholm, 2005; Hermes and Lensink, 2003; Pradhan, 2003; Tardivo and Dias, 2003; Zebregs, 2002; Zhang and Felmingham, 2002; Dua and Rashid, 1998). However, in developing countries, its importance is much higher (Agarwal, 1997), due to the fact that FDI can fulfill its saving-investment gap, relaxing foreign exchange constraints and flows as a bundle of capital, technology, competitiveness, market access, etc. (See Figure 1). For this reason, most of the developing countries offer a welcoming attitude to Multinational Enterprises (MNEs), which are usually associated with FDI (Kumar, 2005). They offer various packages such as creation of Special Economic Zones (SEZs), streamlined administration, flexible labor laws, Intellectual Property Rights (IPRs) protection, opening up of additional sectors, access to world markets, trade openness, fiscal incentives, infrastructure base and so on, to attract the same (Pradhan, 2006; Rakshit, 2006; Venkateswarlu and Rao, 2004; GOI, 2003; Chai, 1998; Lim, 1983). On the other hand, MNEs of developed countries are also enthusiastically come to developing countries for investing their capital, as they recognize that FDI is one of the significant factors that can strengthen their international competitiveness. Besides, market fluctuations of other neighboring countries can also influence the FDI inflows in a country.

* Faculty, Economics and Finance Group, Birla Institute of Technology and Science (BITS), Pilani, Rajasthan, India. E-mail: rudrap@bits-pilani.ac.in.

Figure 1: Linkage between Foreign Direct Investment and Economic Development



In short, the inflows of FDI in any developing country in the world more or less depends upon three important sources, such as welcoming attitude of resident countries; the interest of MNEs; and the market behavior of other countries. But in this paper, we highlight the third issue only. That is to investigate, whether the FDI inflows of a particular country is affected by the FDI inflows of other countries. The above hypothesis has been examined by the cointegration technique, and to investigate this, we have taken India and four other emerging Asian countries such as Japan, Hong Kong, Singapore and Malaysia. The rest of the paper describes the econometric modeling and data descriptions; discusses the empirical results; and finally, offers the concluding remarks.

Econometric Modeling and Data Descriptions

Cointegration is an efficient statistical technique, which is usually used to know the long run equilibrium relationship between two time series variables. The technique properly handles the non-stationary problems that frequently exist in most of the time series variables. The cointegration technique follows two-step procedures. First, testing unit root and then establishing cointegration between the two time series variables. While the former problems handle through unit root test, the latter problems deals with cointegration test. But it is important to note that the first test is an essential precondition for the cointegration test, without which the cointegration test gives biased results. Unit root test applies to clarify the stationarity problems and for this, we apply Dickey-Fuller (DF)/Augmented Dickey-Fuller (ADF) test [Dickey and Fuller, 1979; 1981; Dickey *et al*., 1986]. The test follows regressing equation (1) or (2) by applying Ordinary Least Squares (OLS) method, i.e.,:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \varepsilon_t \qquad ...(1)$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta Y_{t-i} + \varepsilon_t \qquad ...(2)$$

where, t is time trend; Δ is forward difference operator; ε_t is white noise error with zero mean and unit variance; $\beta_1, \beta_2, \alpha_1, \ldots \alpha_m$ are the parameters to be estimated; Y_{t-1} is the variable of interest; and p is the lag length, which has been chosen by Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC). The objective of this estimation is to calculate τ-statistics and that has been tested under the null hypothesis $H_0 : \delta = 0$ (Y_t is non-stationary) against the alternative hypothesis $H_1 : \delta \neq 0$ (Y_t is stationary). But to determine the order of integration, the equation (1 or 2) is to be modified by second order forward difference operator. Once we confirm the stationarity of time series variable, one can apply cointegration test. Two time series variables (say X_t and Y_t) are said to be cointegrated, if they are integrated of same order. The test of cointegration follows three step procedures [Engel and Granger, 1987; Sephton and Larsen, 1991; Deadman and Charemza, 1992; Enders, 1995]:

Step 1: Test, whether two variables are integrated of the same order and number of times each variable has to be differenced in order to turn the time series stationary.

Step 2: Set a linear relationship between the two time series variables. That is,

$$Y_t = \alpha + \beta X_t + \in_t \qquad ...(3)$$

where, the parameter 'β' should be statistically significant.

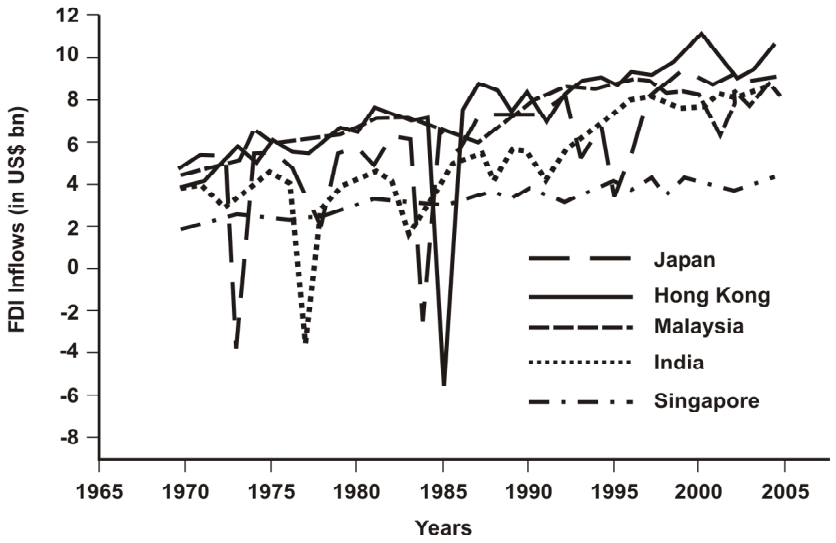
Step 3: Test, whether the residual of equation (3) is stationary and for this, we employ DF/ ADF test. And the procedure is to regress equation (4) or (5), which is as follows:

$$\Delta u_t = \phi u_{t-1} + \varepsilon_t \quad \text{...(4)}$$

$$\Delta u_t = \phi u_{t-1} + \sum_{i=1}^{p} b_i \Delta u_{t-i} + \varepsilon_t \quad \text{...(5)}$$

where, ε is white noise error term; p is lag length, which has been chosen by AIC or SBC; U_{t-1} is a variable of interest; and the estimated coefficient 'Φ' follows τ-statistics. In other words, the test for the stationarity of the residuals essentially involves the significance of the Φ coefficient. If Φ is negative and significantly different from zero, the residual U_t in the cointegrating equation is stationary and the hypothesis of cointegration is accepted, otherwise it will be rejected. The empirical investigation has been carried out in the Asian economy, taking India on one side and four other emerging Asian countries such as Japan, Hong Kong, Singapore and Malaysia on the other. The data follows annual FDI inflows during the period 1970-71 to 2004-05. The necessary information is secondary in nature and has been collected from the World Investment Report (WIR), 2005. The empirical results and its discussion are reported in the subsequent section.

Figure 2: The Visual Plots of FDI Inflows in the Asian Countries



Source: *World Investment Report, 2005.*

Results and Discussion

Figure 2 represents the visual plot of FDI inflows of the five Asian countries during the period 1970-71 to 2004-05. It clearly reflects that there is large-scale volatility of FDI inflows in Japan and that is followed by India and Hong Kong. But it is very convergent in Singapore

and Malaysia. Though they drift apart from each other in the short run, they have inherent tendency to move together towards equilibrium in the long run.

The sole aim of this paper is to investigate the existence of cointegration of FDI inflows between India and four other Asian countries (i.e., Japan, Singapore, Malaysia and Hong Kong). Eventually, our target is to test two hypotheses: First, test for *I(1)* of the individual series; Second, *I(0)* of a linear combination. The physical interpretation of the first hypothesis is to test the existence of unit roots in the individual FDI inflows. And this has been conducted by using Augmented Dickey-Fuller (ADF) test and the task is to verify the rejection/acceptance of null hypothesis of non-stationary [i.e., *I(1)*] against the alternative hypothesis of stationary [i.e., *I(0)*]. The results of unit root test are reported in Table 1. It indicates that there is presence of unit root at the level data, as the null hypothesis of non-stationarity (i.e., unit root) cannot be rejected because the calculated τ-statistics is substantially lower to its critical value (See McKinnon, 1991). This is true for all the five Asian countries that we have been taken under the present study.

Table 1: Results of Unit Root Test

Countries	Level Data		First Difference Level	
	Calculated ADF Statistics	Conclusion	Calculated ADF Statistics	Conclusion
India	-2.179	*I(1)*	-7.889	*I(0)*
Japan	-1.962	*I(1)*	-7.350	*I(0)*
Hong Kong	-2.246	*I(1)*	-9.031	*I(0)*
Singapore	-1.495	*I(1)*	-6.088	*I(0)*
Malaysia	-1.957	*I(1)*	-7.216	*I(0)*

Note: For the critical values of DF test, see McKinnon (1991) and Engle and Yoo, (1987).

The empirical results indicate that FDI inflows of all the five Asian countries are non-stationary, i.e., *I(1).* But they found stationary at the first difference level, as the null hypothesis of unit root has been rejected because the calculated τ-statistics is substantially higher to its critical value. This indicates that FDI inflows of the five Asian countries are non-stationary at the level data, but found stationary at the first difference level. Hence, they are all integrated of same order, i.e., *I(1).*

Since FDI inflows of five Asian countries are integrated of same order and non-stationary at the level data, cointegration technique can be applied to its level data. Thus, our next step is to examine, whether the FDI inflows of India is cointegrated with FDI inflows of Japan, Hong Kong, Singapore and Malaysia. We do the same by estimating the linear equation by OLS technique, where the dependent variable is India's FDI inflows and independent variable is FDI inflows of other four Asian countries. Here, we have to verify two things:

- First, the 'β' coefficients should be statistically significant [see equation (3) of the previous section]; and
- Second, the error term should be stationary in nature [that means 'Φ' should be significant (see equation 4 and 5)]. The results of cointegration test are reported in Tables 2 and 3.

Table 2: Results of Cointegration Test (Linearity Test)					
Countries	**Constant**	**Coefficient**	**Probability Level**	**R^2**	**DW**
Japan	3.917 (6.318)	0.248 (2.591)	P < 0.014	0.169	0.908
Hong Kong	2.042 (2.076)	0.433 (3.429)	P < 0.002	0.263	1.300
Singapore	-3.897 (-2.906)	2.753 (6.908)	P < 0.000	0.591	1.523
Malaysia	-3.243 (-1.717)	1.194 (4.528)	P < 0.000	0.383	1.070

Note: The results follows the estimated equation of $Y_t = \alpha + \beta X_t + \varepsilon_t$, where dependent variable follows India's FDI inflows and independent variable follows FDI inflows of other four emerging ASIAN countries.

Table 3: Results of Cointegration Test (Stationarity Test)				
Country	**Coefficient**	**DF Statistics**	**R^2**	**DW**
Japan	-0.456	-3.413	0.221	2.191
Hong Kong	-0.654	-3.881	0.320	2.036
Singapore	-0.796	-4.739	0.412	2.067
Malaysia	-0.547	-3.463	0.273	2.075

Note: The estimated results follows the estimated equation of $\Delta U_t = \alpha + \Phi U_{t-1} + \varepsilon_t$. For the critical values of DF-statistics, see McKinnon (1991), Engle and Yoo (1987).

The results confirm that all the 'β' coefficients of cointegrating regression are statistically significant (See Table 2), and hence, the first condition of cointegration test has been verified. Further, the Dickey-Fuller test clarified that all the 'Φ' coefficients are statistically significant (See Table 3), as the calculated τ-statistics is substantially higher to its critical value (See McKinnon, 1991). This confirmed the null hypotheses of non-cointegration have been rejected for all the four emerging Asian countries. The implication of this result is that the FDI inflows of Japan, Malaysia, Singapore and Hong Kong are cointegrated with the FDI inflows of India. In other words, with the FDI inflows of India, one can predict the FDI inflows of other four emerging ASIAN countries. The above empirical results clarified that these countries are fully cointegrated so far as FDI inflows is concerned.

Conclusion

The study establishes the linkage of FDI inflows between India and four other emerging Asian countries, viz., Japan, Hong Kong, Singapore and Malaysia. The empirical investigation has been made on annual data of FDI inflows during 1970-71 to 2004-05. The statistical technique used for the same is cointegration test, which is followed with unit root test. The empirical results of unit root test clarified that the FDI inflows of five Asian countries have a unit root (i.e., non-stationary) at the level data, but they found stationary at the first difference level. This suggests that they are all integrated in order, and satisfied the essential condition of cointegration test.

The empirical results of cointegration test confirmed that the FDI inflows of India are cointegrated with the FDI inflows of Japan, Hong Kong, Singapore and Malaysia. This implies that FDI inflows of these emerging Asian countries are dependent on FDI inflows of India. The implication of this finding is that India's inflows of FDI can be used to predict the inflows of FDI in the other four emerging Asian countries. It is also noted that, since they are cointegrated, the volatility of India's FDI inflows may affect the FDI inflows of other four Asian countries. The study eventually suggests that the government of the respective country must be very careful about the finding, otherwise the volatility of India's FDI inflows may disrupt their FDI inflows in the economy. ❖

Reference # 42J-2007-03-03-01

References

1. Agarwal R N (1997), "Foreign Portfolio Investment in Some Developing Countries: A Study of Determinants and Macroeconomic Impact", *Indian Economic Review*, Vol. 32, No. 2, pp. 217-229.
2. Chai J C H (1998), *China: Transition to a Market Economy*, Oxford, Clarendon.
3. Deadman D F and Charemza W W (1992), *New Directions in Econometrics: General to Specific Modeling, Cointegration and Vector Autoregression*, London, Edward Elgar.
4. Dickey D A and Fuller W A (1979), "Distribution of the Estimators for Autoregressive Time Series with a Unit Root", *Journal of the American Statistical Association*, Vol. 74, No. 366, pp. 427-431.
5. Dickey D A and Fuller W A (1981), "Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root", *Econometrica*, Vol. 49, No. 4, pp. 1057-1072.
6. Dickey D A, Bell W R and Miller R B (1986), "Unit Roots in Time Series Models: Tests and Implications", *American Statistician*, Vol. 40, No. 1, pp. 12-26.
7. Dua P and Rashid A I (1998), "Foreign Direct Investment and Economic Activity in India", *Indian Economic Review*, Vol. 33, No. 2, pp. 153-168.
8. Enders W (1995), *Applied Econometric Time Series*, New York, Jhon Wiley and Sons.
9. Engel R F and Granger C W J (1987), "Cointegration and Error Correction: Representation, Estimation and Testing", *Econometrica*, Vol. 55, No. 2, pp. 251-276.
10. Engel R F and Yoo B S (1987), "Forecasting and Testing in Cointegrated Systems", *Journal of Econometrics*, Vol. 35, pp. 143-159.
11. GOI (2003), "Report of the Steering Group on Foreign Direct Investment, Planning Commission of India", New Delhi, Government of India (GOI).
12. Hermes N and Lensink R (2003), "Foreign Direct Investment, Financial Development and Economic Growth", *Journal of Development Studies*, Vol. 40, No. 1, pp. 142-163.
13. Kumar N (2005), "Liberalization, Foreign Direct Investment Flows and Development: Indian Experience in the 1990s", *Economic and Political Weekly*, Vol. 40, No. 14, pp. 1459-1468.

14. Lim D (1983), "Fiscal Incentives and Direct Foreign Investment in Less Developed Countries", *Journal of Development Studies*, Vol. 19, No. 2, pp. 207-212.

15. MacKinnon K G (1991), "Critical Values for Cointegration Tests", in Engle, R F and Granger, C W J (Eds.), *Long Run Economic Relationships: Readings in Cointegration*, Oxford, Oxford University Press.

16. Okamoto Y and Sjoholm F (2005), "FDI and the Dynamics of Productivity in Indonesian Manufacturing", *Journal of Development Studies*, Vol. 41, No. 1, pp. 160-182.

17. Pradhan J P (2003), "Foreign Direct Investment and Economic Growth in Developing Countries: Further Evidence from Panel Data", *Asian Economic Review*, Vol. 45, No. 2, pp. 197-217.

18. Pradhan R P (2006), "FDI in the Globalization Era: Chinese and Indian Experiences", *Prajnan*, Vol. 34, No. 4, pp. 323-343.

19. Rakshit M (2006), "On Liberalizing Foreign Institutional Investments", *Economic and Political Weekly*, Vol. 41, No. 11, pp. 991-1000.

20. Sephton P S and Larsen H K (1991), "Tests of Exchange Market Efficiency: Fragile Evidence from Cointegration Tests", *Journal of International Money and Finance*, Vol. 10, No. 4, pp. 561-570.

21. Tardivo G and Dias R T (2003), "Foreign Direct Investment Models: Empirical Evidence from Italy", *Journal of Financial Management and Analysis*, Vol. 16, No. 1, pp. 36-52.

22. Venkateswarlu R and M V S K Rao (2004), "On the Determinants of FDI and Portfolio Inflows: A Cross-country Study", *The IUP Journal of Applied Finance*, Vol. 10, No. 9, pp. 56-72.

23. World Investment Report (WIR) (2005), Geneva: United Nations Conference on Trade and Development (UNCTAD).

24. Zebregs H (2002), "Foreign Direct Investment and Output Growth", in Tseng W and Rodlauer M (Eds.), *China: Competing in the Global Economy, Washington, International Montary Fund* (IMF).

25. Zhang Q and Felmingham B (2002), "The Role of FDI, Exports and Spillover Effects in the Regional Development of China", *Journal of Development Studies*, Vol. 38, No. 4, pp. 157-178.