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Foreign Direct Investment of India and China: A Syno-Indian Comparison through Vector Autoregression

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Abstract

India and China are preferred destinations for foreign investors, inspite of their diverse cultural factors and different economic-political systems. The phenomenal growth in Foreign Direct Investment (FDI) of both the economies can be traced back to the active government promotion through various policy measures. Many believe that FDI in China and India has played a largely positive role in their economic development. In order to verify the authenticity of it, a detailed analysis is done with the help of methodology used by Agosin and Mayor (2000) as well as Vector Autoregression (VAR) by making use of time series data of 30 years. The World Bank data expressed in constant prices in US$ at 2005 year base is put to use. Three variables such as FDI, Gross Domestic Product (GDP) and Domestic Investment (DINV) are considered for time series analysis.

The results are verified with the help of Granger-Causality, Cointegration test, Unit root test. The results obtained brings to us startling revelations that over the years FDI.It indicates that emergency measures will have to be taken by both countries.

Keywords: Foreign Direct Investment, India, China, Domestic Investment.

Introduction

India and China emerged as the most attractive destinations for foreign investors in post-90s. However, the FDI pattern and magnitude have been totally different in these two countries. So it is necessary to analyse the impact of FDI on the domestic investment of both the countries.FDI is like a double edged sword with investment boosting and investment destructing properties. It is pertinent to have an analysis of these effect and the impact of FDI on different variables so as to understand the impact of FDI in multi faceted fields. For this purpose the data varying from 1982 to 2012 is taken into consideration.

Earlier Studies

Agosin and Mayor (2000), while evaluating the impact of FDI on development, explained that Multi-national Corporations (MNCs) may crowd-in or crowd-out domestic investments, when their presence stimulate new downstream or upstream investments, or they may displace domestic producers or pre-empting their investment opportunities.

Sun (2002), opines that the foreign investor finances the project by borrowing from the host country's financial market under conditions of scarce resources, domestic interest rates may rise, which may make borrowing unaffordable for some domestic firms. In certain cases it has been observed that, FDI reduces domestic investments that would have been undertaken by domestic producers. If the foreign investment deliberately uses predatory practices to force competitors out of business, or to retard their establishment the crowding would have disastrous impact.

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

Tomsik (2009) bifurcated the impact of FDI into two viz. crowding-in and/or crowding-out effect. Studies by Bosworth and Collins (1999), Hecht, Assaf and Nitzan (2002) and Obstfeld (1998) brought to light several observations on FDI. Kumar and Pradhan (2002), analyzed the relationships between FDI, growth and domestic investment for a sample of 107 developing countries representing Africa, Asia and Latin America and the Caribbean for the period ranging between 1980-99.As per the study, India showed crowding-out impact of FDI on domestic investment.

It was found evidence that FDI had a negative impact on Chinese domestic investment. There is strong evidence that FDI crowded out domestic investment during the late 1980s and 1990s in China, a finding consistent with that of Huang (1998) and Lardy (1998).

Tang, Selvanathan, E.and Selvanathan, S. (2008), by using the technique of multivariate VAR system with error correction model (ECM) and the innovation accounting (variance decomposition and impulse response function analysis) investigated the causal link between FDI, domestic investment and economic growth in China for the period 1988-2003. The results showed that while there is a bi-directional causality between domestic investment and economic growth, there is only a single-directional causality from FDI to domestic investment and to economic growth. Rather than crowding out domestic investment, FDI is found to be complementary with domestic investment. Thus, FDI has not only assisted in overcoming shortage of capital, it has also stimulated economic growth through complementing domestic investment in China.

Wu, Sun and Li (2010), through regression analysis, a strong correlation is found between FDI and the economic development of the Yangtze River Delta region. The Cobb-Douglas production function and Thoro-Swan growth model are used with selected panel data from 2000 to 2008. It was found that FDI in the region resulted in employment creation and it improved the efficiency of labour resources. Furthermore, the empirical analysis revealed that FDI promoted domestic investment to the effect of 2.42 units.

Methodology and Data

The following methodologies are used to gauge the impacts of crowding in and out aspects of the economies of India and China.

Crowding In and Crowding Out Effects

For measuring crowding-in and crowding-out impact of FDI on domestic investment of India and China, data from World Bank Report is used. Three variables viz. FDI, Gross Domestic Product (GDP) and Domestic Investment (DINV) are considered for the purpose of the study. The data which was available into current prices has been converted into constant prices in US $ at 2005 year base prices.
For measurement of Crowding-in and Crowding-out impact, the long term coefficient $\hat{\beta}_{\mathrm{LT}}$ has been used which has been originally developed by Agosin and Mayor (2000) and later on used by Titarenko (2006) and Milva (2008) as follows:

$$\hat{\beta}_{\mathrm{LT}} = \frac{\sum_{j=1}^{3} \hat{\beta}_j}{1-\sum_{j=4}^{5} \hat{\beta}_j} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

The criteria used to determine crowding-in and crowding-out is the value and significance of $\hat{\beta}_{LT}$. There are three possibilities. If β_{LT} =1, it implies that in the long run an increase in FDI of one dollar results in one additional investment amounting one dollar in GDP. Consider now the case in which β_{LT} >1. This is evidence of crowding-in i.e. in the long run, one additional dollar of FDI becomes more than one additional dollar of total investment. If the null β_{LT}<1, there is long-run crowding-out i.e. one additional dollar of FDI leads to less than a one-dollar increase in total investment. In other words, there is displacement of domestic investment by FDI.

Vector Autoregression (VAR) and Impulse Response Function (IRF)

The following are the econometric techniques applied for the study to counter check the impacts of the crowding in and crowding out effects derived with the help of $\hat{\beta}_{LT}$.

VAR

VAR is a multiple time series modelling approach that constructs a model for vector of time series instead of constructing models for individual time series (Sims, 1972 and 1980). VAR model equations, apart from forecasting, are also used to simulate the effect of sudden change (impulse) in one variable on other variables. This technique, known as Impulse Response Function (IRF) enabled to estimate the time scale over which the effect of change in the FDI leads to variations in the concentration of other variables.

The following is the Mathematical Representations of VAR.

If y_t represents an (n×1) vector of n variables, a pth order VAR, denoted as VAR(p) is defined as:

$y_t = c + \phi y_{t-1} + \phi y_{t-2} + \ldots\ldots\ldots\ldots\ldots + \phi_p y_{t-p} + \varepsilon_t$ ……(2)

where c denotes an (n×1) vector of constants and ϕ_j an (n×n) matrix of autoregressive coefficient for j=1,2,…, p. The (n×1) vector ε_t is a vector generalization of white noise:
$E(\varepsilon_t)=0$;

$E(\varepsilon_t \varepsilon_\tau)= \Omega$; for t=τ
=0; otherwise
where Ω(n×n) is a symmetric positive definite matrix (Hamilton, 1994).

The lag length for this analysis is selected using the criterions such as Akaike Information Criterion (AIC), Hannon–Quinn Information Criterion (HIC), and Schwarz Information Criterion (SIC).

Impulse Response Function

A VAR is written in vector MA(∞) form as:

$y_t=\mu + \varepsilon_t + \Psi_1 \varepsilon_{t-1} + \Psi_2 \varepsilon_{t-1} + \ldots\ldots\ldots\ldots$ (Hamilton,1994) …… (3)

Thus, the matrix ψ_s has the interpretation:

$\partial y_{t+s} / \partial \varepsilon'_t = \Psi_s$; …… (4)

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

that is, the row i, column j element of ψ_s identifies the consequences of a one-unit increase in the *j*th variable's innovation at time t (ε_{ij}) for the value of the *i*th variable at time t+s ($y_{i,t+s}$), holding all other innovations at all times constant.

If the first element of ε_t is changed by δ_1, at the same time second element is changed by δ_2,…, and the *n*th element by δ_n, then the combined effect of these changes on the value of the vector y_{t+s} would be given by:

$$\Delta y_{t+s} = (\partial y_{t+s}/\partial \varepsilon_{1t})\delta_1 + (\partial y_{t+s}/\partial \varepsilon_{2t})\delta_2 + \ldots\ldots + (\partial y_{t+s}/\partial \varepsilon_{nt})\delta_n = \Psi_s \delta \quad \ldots\ldots\ldots\ldots (5)$$

Where $\partial = (\partial_1, \partial_2, \ldots\ldots\ldots.., \partial_n)'$.

A plot of the row *i*, column *j element of* φ_s:

$$\partial y_{i,t+s} / \partial \varepsilon_{jt} \qquad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

As a function of *s* is called the impulse response function. It describe the response of $y_{i,t+s}$ to a one-time impulse in y_{jt} with all other variables at time *t* or earlier held constants.

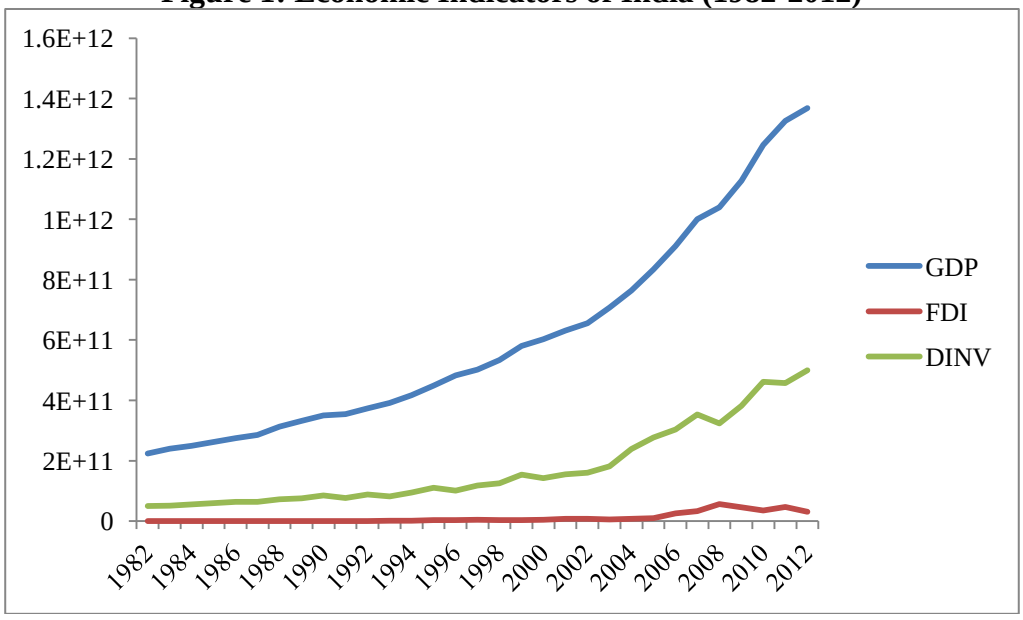
Results of the Analysis

In order to evaluate the crowding-in and crowding-out impacts of FDI on domestic investment of India and China three variables FDI, GDP (Gross Domestic Product) and DINV (Domestic Investment) are considered.

Impact of FDI on Indian Economy (1982-2012)

Here, an attempt is done to check the impact of FDI from 1982 to 2012 on Indian economy. For this purpose, three variables viz. FDI, GDP and DINV (GCF - FDI) as a proxy for domestic investment from the World Bank data are considered.

Figure 1: Economic Indicators of India (1982-2012)



Source:Derived from World Bank Data

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

It is evident from the Chart 1 that the GDP and DINV improved significantly since liberalisation. However, FDI also improved consistently during last three decades. Let's see the impact of FDI on India's economy.

Unit Root Test

To check crowding-in and crowding-out impact of FDI on DINV, a multiple regression analysis is performed and desired lag length of dependent variables was considered. For assessing the lag length of the dependent variables, Unit Root Test of all three variables was performed. The results are as given in Table 1.

Table 1: Unit Root Test Results

Variable	ADF statistics	Critical values	
GDP	-5.468838	1% 5% 10%	-3.711457 -2.981038 -2.629906
FDI	-7.822209	1% 5% 10%	-3.724070 -2.986225 -2.632604
DINV	-5.026716	1% 5% 10%	-3.737853 -2.991878 -2.635542

Source: Derived from Eviews software

As per the results obtained in Augmented Dickey Fuller test, multiple regression analysis is performed for the model as follows:

The Regression equation is as follows:

$$DINV\ t = \beta_0 + \beta_1\ DINV_{t-1} + \beta_2\ FDI_t + \beta_3\ FDI_{t-1} + \beta_4\ GDP_t + \varepsilon \quad \text{.....(7)}$$

Table 2: Empirical Analysis of Economic Indicators of India

Dependent Variable: DINV				
Method: Least Squares				
Sample (adjusted): 1983 2012				
Included observations: 30 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	-1.178193	0.531619	-2.216238	0.0360
FDI(-1)	1.313785	0.486275	2.701735	0.0122
DINV(-1)	0.567369	0.170972	3.318488	0.0028
GDP	0.186848	0.055359	3.375185	0.0024
C	-2.96E+10	1.14E+10	-2.603679	0.0153
R-squared	0.988255	Mean dependent var		1.80E+11
Adjusted R-squared	0.986376	S.D. dependent var		1.37E+11
S.E. of regression	1.60E+10	Akaike info criterion		49.97436
Sum squared resid	6.36E+21	Schwarz criterion		50.20789
Log likelihood	-744.6154	Hannan-Quinn criter.		50.04907
F-statistic	525.9139	Durbin-Watson stat		1.557421
Prob(F-statistic)	0.000000			

Source: Derived from Eviews software

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

The regression results in Table2 explain 98 percent of variation in the dependent variable due to independent variables. Model is statistically significant as Prob (F-stat) is less than 0.00.

To test crowding-in and crowding-out impact,

$$\beta_{LT} = \frac{\beta \sum_2^3 FDI}{1 - \beta_1 DINV\ t-1} \quad \text{.....(8)}$$

And the value of β_{LT} is obtained as

$\beta_{LT} = 0.313$

As the long term coefficient β_{LT} is less than 1, it shows crowding-out impact on Indian economy since 1982 to 2012. In other words, US $1 of FDI crowds out US $ 0.313 of domestic investment from India.

Granger Causality Test

To check the causality between different variables, Granger causality test was performed for variables viz. FDI, GDP and DINV for India.

The Granger Causality results indicates causation between GDP and FDI while opposite is not true. The P-Value is 0.00 and 0.77 respectively. This infers that in the post liberalisation period growth of Indian economy has attracted a considerable amount of FDI but how much growth took place because of FDI is quite ambiguous. The result showed that while there is a single directional causality between DINV and FDI. Rather than crowding in DINV FDI is found to be instrumental in crowding out DINV. There is a single directional causality between GDP and FDI. Thus, it is concluded that though the growth of Indian economy has been instrumental in attracting FDI, FDI has not promoted the spurt in domestic investment.

Table 3: Result of Granger Causality Test

Null Hypothesis	India	
	F-Statistic	Prob.
GDP does not Granger Cause FDI	14.0723	0.0009
FDI does not Granger Cause GDP	0.25566	0.7765
DINV does not Granger Cause FDI	10.1467	0.0006
FDI does not Granger Cause DINV	0.39903	0.6753
DINV does not Granger Cause GDP	1.32169	0.2854
GDP does not Granger Cause DINV	2.05615	0.1499

Source: Derived from Eviews software

Co-integration

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

Test of co-integration has been conducted to examine whether there is any long term causality among variables and if there is long run causality then Vector Error Correction Model (VECM) can be applied or else unrestricted VAR model can be used. Table 4 gives the information about co-integration test results. It shows there exits co integration among the variables in the model.

Table 4: Johansen Test of Co-Integration

Hypothesed number of co-integration	Trace statistics	Eigenvalue
None	53.07560	0.622877
At most 1	24.79404	0.510918
At most 2	4.052725	0.130435

Source: Derived from Eviews software

2.1.e VAR

The estimates of VAR equation of FDI, GDP and DINV are worked out with the help of Eviews software. The R^2 values are 0.65, 0.78 and 0.36 for FDI, GDP and DINV respectively.

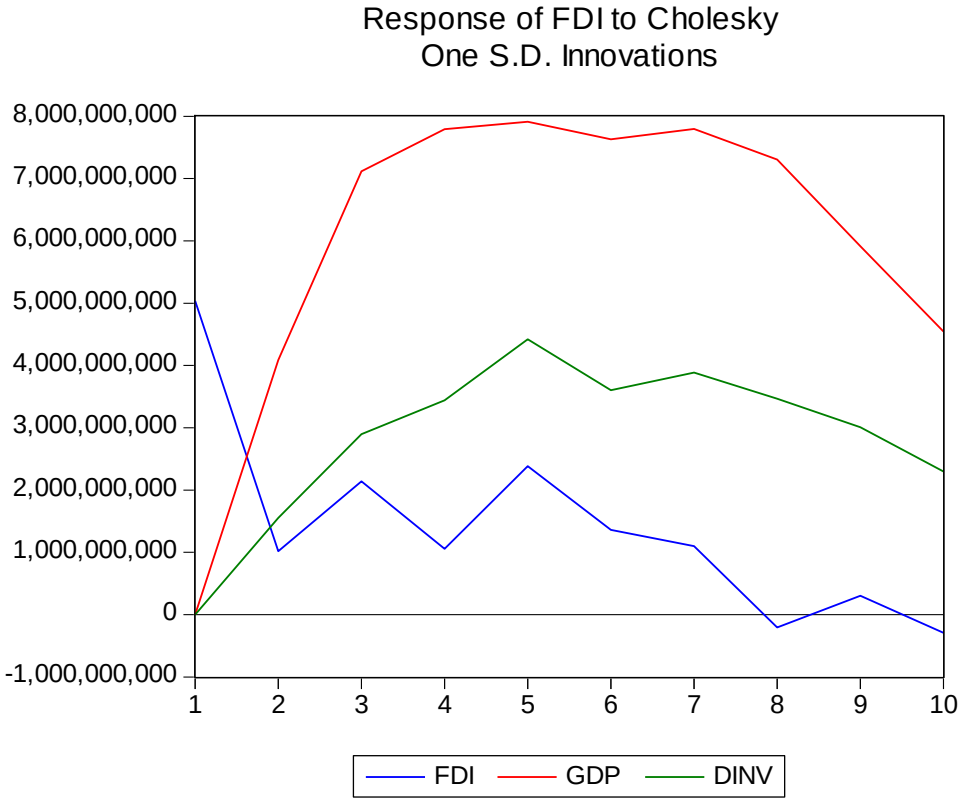
FDI = C(1)* FDI (-1)+C(2)* FDI (2) + C(3)*GDP(1) + C(4)*GDP (-2) + C(5) *DINV(-1) + C(6)*DINV(-2) + C(7) ….....(9)

Impulse Response Function

Impulse Response Function shows how the shock of one standard deviation to variables leads to responses in the FDI. Given a shock in FDI itself, immediately it fluctuates over a period of 10 years. This movement can be observed with the help of Figure 3. When a shock is given in GDP, FDI increases till 7^{th} period and from 8^{th} period it declines continuously and same phenomenon is evident in Figure 3. Lastly, when an impulse in DINV is given FDI initially shows an increase but ultimately decreases from the 7^{th} period which can be captured in Figure 3.

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

Figure 2: Impulse Response Function of India



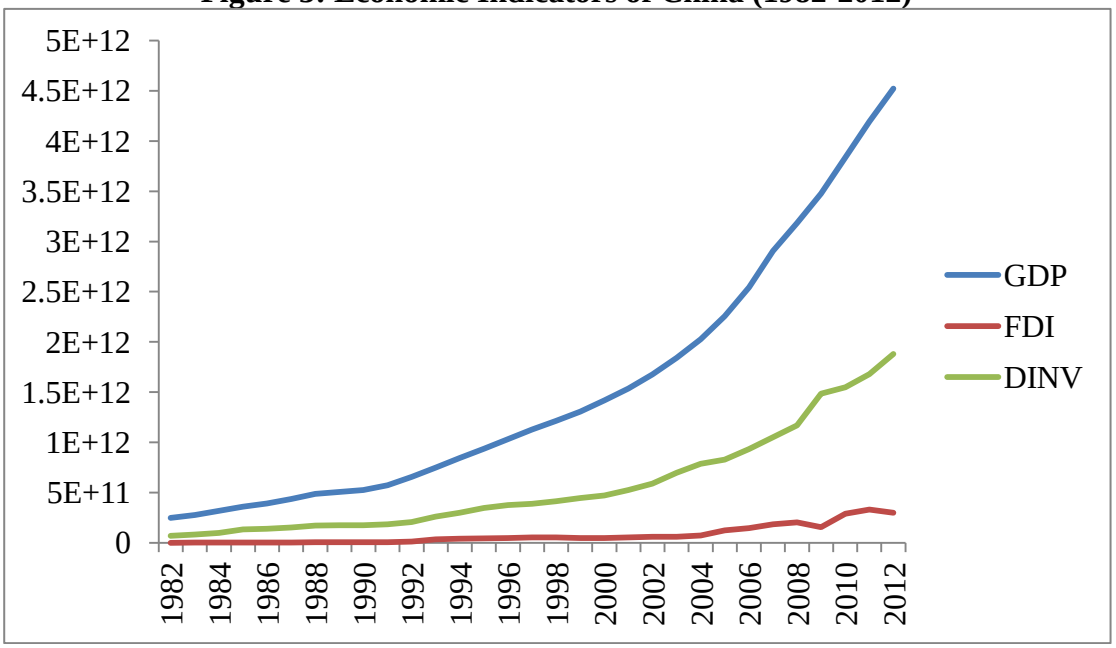
Source: Derived from Eviews software

2.2.a Impact of FDI on China's Domestic Investment (1982-2012)

To assess the impact of FDI on domestic investment in the case of Chinese economy, FDI, GDP and DINV variables were taken into consideration. All variables show an increasing trend over the years sparing few isolated years.

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

Figure 3: Economic Indicators of China (1982-2012)



Source: World bank

Unit Root Test

To check crowding-in and crowding-out impact of FDI on DINV in China, a multiple regression analysis is performed and desired lag length of dependent variables are taken into consideration. Augmented Dickey Fuller Test for testing Unit Root of all three variables was performed. The results are as follows:

Table 5: Unit Root Test Results

Variable	ADF statistics	Critical values	
GDP	-5.035286	1%	-3.699871
		5%	-2.976263
		10%	-2.627420
FDI	-7.645712	1%	-3.689194
		5%	-2.971853
		10%	-2.625121
DINV	-4.782302	1%	-3.724070
		5%	-2.986225
		10%	-2.632604

Source: Derived from Eviews software

As per the results given in Table 8, FDI, DINV and GDP have no unit root at second difference. As per the results obtained in Augmented Dickey- Fuller Test, multiple regression is performed for the model as follows:

The Regression equation is as follows:

$$DINV\ t = \beta_0 + \beta_1\ DINV_{t-1} + \beta_2\ FDI_t + \beta_3\ FDI_{t-1} + \beta_4\ GDP_t + \varepsilon \quad \text{.....(10)}$$

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

Table 6: Empirical Analysis of China's Economic Indicators

Dependent Variable: DINV				
Method: Least Squares				
Date: 07/16/14 Time: 23:00				
Sample (adjusted): 1983 2012				
Included observations: 30 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FDI	-1.187701	0.291083	-4.080279	0.0004
FDI(-1)	0.819511	0.225162	3.639649	0.0012
DINV(-1)	0.876473	0.151982	5.766971	0.0000
GDP	0.121232	0.048015	2.524856	0.0183
C	-2.76E+10	1.29E+10	-2.143964	0.0419
R-squared	0.997380	Mean dependent var		5.89E+11
Adjusted R-squared	0.996961	S.D. dependent var		5.15E+11
S.E. of regression	2.84E+10	Akaike info criterion		51.12713
Sum squared resid	2.01E+22	Schwarz criterion		51.36066
Log likelihood	-761.9070	Hannan-Quinn criter.		51.20184
F-statistic	2379.182	Durbin-Watson stat		1.228993
Prob(F-statistic)	0.000000			

Source: Derived from Eviews software

The results in Table 9 shows that the model explains 99 percent variation in the dependent variable due to independent variables. Prob. (F-stat) is 0.00000 which is less than 0.05 indicates model is statistically significant.

The value of β_{LT} is estimated as,

β_{LT} = -2.98064

As the β_{LT} is less than 1, it shows crowding-out impact on China's economy since 1982 to 2012. In other words, US $ 1 of FDI has crowded out US$ 2.98 of domestic investment in China during the same period. The extent of crowding out experienced in the case of China is much higher when compared to India.

Granger Causality Test

To check the causality between different variables, Granger causality test was performed for variables viz. FDI, GDP and DINV for China as done earlier in the case of India.

The result showed that while there is a bidirectional causality between GDP and FDI. There is only single directional from DINV and FDI and DINV GDP. Rather than crowding in DINV, FDI is found to be instrumental in crowding out DINV.

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

Table 7: Granger Causality Tests for China

Null Hypothesis	china	
	F-Statistic	Prob.
GDP does not Granger Cause FDI	8.43140	0.0017
FDI does not Granger Cause GDP	5.43907	0.0113
DINV does not Granger Cause FDI	33.0855	0.0001
FDI does not Granger Cause DINV	2.17020	0.1360
DINV does not Granger Cause GDP	1.36595	0.2743
GDP does not Granger Cause DINV	5.74363	0.0092

Source: Derived from Eviews software

Co-integration Test

To assess the long term relation between FDI, DINV and GDP, Johansen Co-integration test was performed. The following table represents the result for co-integration test for China. From Table 8, it is evident that there is long run relationship among the variables.

Table 8: Co-integration Test for China

Hypothesed number of co-integration	Trace statistics	Eigenvalue
None	56.56276	0.720053
At most 1	19.64127	0.352059
At most 2	7.056556	0.215987

Source: Derived from Eviews software

VAR

The estimates of VAR equation of FDI, GDP and DINV are worked out with the help of Eviews software. The R^2 values are 0.91, 0.93 and 0.91 for FDI, GDP and DINV respectively. In other words, it can be said that lagged values of FDI and GDP significantly affect the current FDI. The model equation can be written as follows:

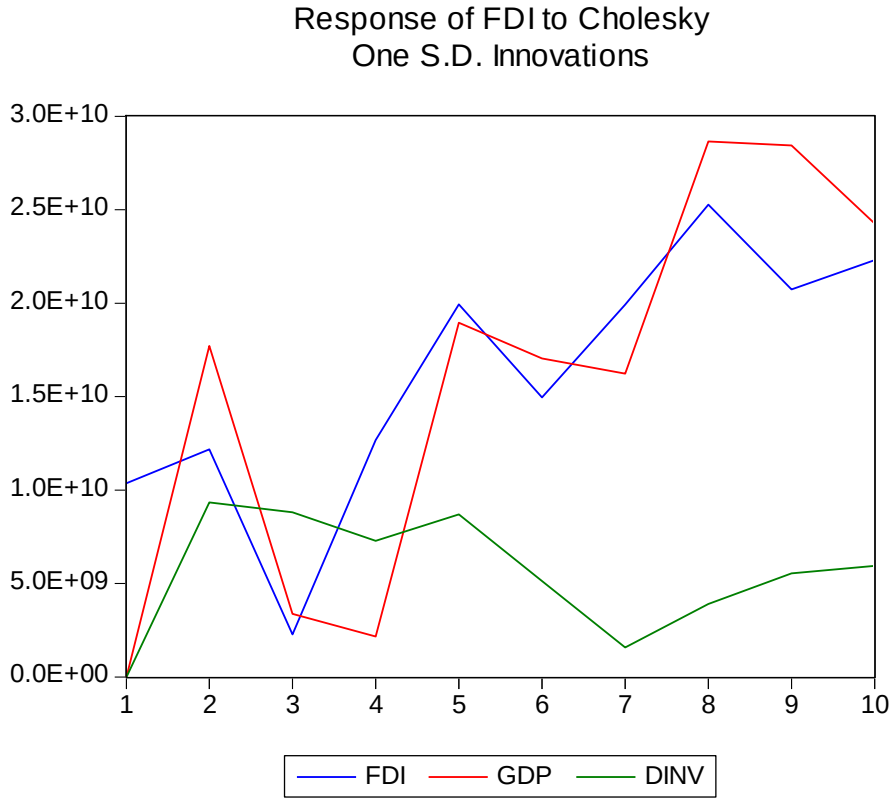
FDI = C(1)* FDI (-1)+C(2)* FDI (2) + C(3)*GDP(1) + C(4)*GDP (-2) + C(5)
*DINV(-1) + C(6)*DINV(-2) + C(7) …… (11)

Impulse Response Function

Impulse Response Function shows how the shock of one standard deviation to variables leads to responses in the FDI. Given a shock in FDI itself, shows drastic fluctuations by way of increase and decrease in value of FDI over the period. This movement can be observed with the help of Figure 5. When a shock is given in GDP, FDI fluctuates over a period of 10 years which is evident in figure. Lastly, when an impulse in DINV is given FDI initially shows an increase but ultimately decreases till the 8th period and eventually takes up negative value at times as captured in Figure 5.

ISSN: 2278-4632
Vol-10 Issue-6 No. 4 June 2020

Figure 4: Impulse Response Function of China



Source: Derived from Eviews software

Conclusion

The study revealed that India and China showed crowding-out impact during the period 1982-2012 . It shows both countries have to take certain pro-active steps towards the massive inflow of FDI. India showed a single directional causality between GDP and FDI, DINV and FDI. Both India and China showed existence of long run relationship among the variables evident from Johansen Cointegration test. For India with shock in GDP, FDI increases till 7th period and from 8th period and when an impulse in DINV is given FDI initially shows an increase but ultimately decreases from the 7th period. The result of Chinese economy shows a bidirectional causality between GDP. VAR estimates show lagged values of FDI and GDP significantly affect the FDI in current period. Impulse Response Function of Chinese economy shows drastic fluctuations by way of increase and decrease in value of FDI over the period with one impulse in GDP and FDI itself. The extent of crowding out of China is much higher when compared to India, contradicting the popular belief.

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