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A Causal Linkage between FDI Inflows with Select Macroeconomic Variables in India – An Econometric Analysis

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Abstract: *The paper endeavour to explore the short run and long run causal relationship between select macroeconomic variables (GDP, Exchange Rate & Inflation Rate) and FDI inflows in Indian context by applying Cointegration test followed by Vector autoregression (restricted/unrestricted) model and Granger-causality test. Further, by employing simple regression model, it tries to calculate the exponential growth rate of FDI inflows in India. Eventually, Chow test has been employed to detect the presence of significant structural break in the data series of FDI inflows. However, the results show that there prevails long run equilibrium among the concerned variables. The Granger-causality test results conclude that exchange rate and GDP statistically significantly influence FDI, whereas, inflation rate is insignificant variable to predict FDI inflows. Further, the growth analysis result claims that the total FDI inflows grow exponentially at a rate of 23% per annum. However, as stated by the results of Chow test, 1991-92 (the year of initiation of New Economic Policy in India) is a statistically significant structural break year in the context of FDI inflows in India.*

Keywords: *FDI, New economic policy, Unit root test, Cointegration test, Vector error correction model, Granger-causality test, Structural break, Chow test.*

I. Introduction

Foreign direct investment (FDI) can be termed as package of resources that complements the financial flows and makes a distinctive contribution to the development process. Foreign direct investment projects typically involve a transfer of technology and managerial skills from the source country to the recipient country and also provide greater access to world market for the recipient country's exports. Foreign Direct Investment (FDI) is fund flow between the countries in the form of inflow or outflow by which one can able to gain some benefit from their investment whereas another can exploit the opportunity to enhance the productivity and find out better position through investment with the purpose of long term then it is contributes positively towards economy. Depending on the industry sector and type of business, a foreign direct investment may be an attractive and viable option. The studies try to find out the implications which affect the economic scenario and also measure the level of predominance by the factors for economic contribution to India.

1.1 Evaluation of India's FDI Policy Measures

The liberal policy measures towards FDI designed in the wake of structural adjustment and macroeconomic reforms in India since mid 1991 have helped attract foreign investors significantly. The amount of approved investment has grown enormously. Though the actual inflow of FDI has not picked up so fast, it has improved and significantly strengthened the capital account of the balance of payments of the country. India is still on a lower ladder among some major FDI receiving countries of Asia. Nevertheless, only six or seven countries claim well over one half of the total FDI flows.

With the opening up of new areas for foreign investors, a huge amount of approval and actual inflow is also found in non-traditional areas, such as fuel and power, services and some consumer goods.

Though the automatic approval route was introduced for speedier clearance of FDI proposals, its reach and role have been marginal. The policy lacked thrust on attracting investment in sectors that offered comparative cost advantage. Well-developed and strategically located platforms in the form of Export Processing Zones (EPZs) or technology parks have not been provided for mobilizing investment into these sectors. The thrust was not on export orientation due to conservative sector-specific policies. Rigid labour laws had been other serious impediments to FDI inflows. Besides, there was lack of transparency and clarity about micro-level procedure at the state level. To sum up, it can be said that the Indian Government has created a healthy atmosphere for FDI inflow by introducing Structural adjustment and Stabilization policy.

Table I: Country-Wise Contributions of FDI Inflows in India (In US million dollars)

Countries	2007-08	2008-09	2009-10	2010-11	2011-12	% of change
Mauritius	**9518**	**10165**	**9801**	**5616**	**8142**	**-14.4568**
Singapore	2827	3360	2218	1540	3306	16.94376
USA	**950**	**1236**	**2212**	**1071**	**994**	**4.631579**
Cyprus	570	1211	1623	571	1568	175.0877
Japan	457	266	971	1256	2089	357.1116
Netherlands	601	682	804	1417	1289	114.4759
UK	508	690	643	538	2760	443.3071
Germany	486	611	602	163	368	-24.2798
UAE	226	234	373	188	346	53.09735
France	136	437	283	486	589	333.0882
Switzerland	192	135	96	133	211	9.895833
Hong Kong SAR	106	155	137	209	262	147.1698
Spain	**48**	**363**	**125**	**183**	**251**	**422.9167**
South Korea	86	95	159	136	226	162.7907
Luxembourg	**15**	**23**	**40**	**248**	**89**	**493.3333**
Others	2699	3034	2374	1184	989	-63.5791
Total inflow	19425	22697	22461	14939	23473	20.83912
						Source: official website of RBI

The country-wise inflows in FDI in India have been shown in the above table covering the period between 2007-08 and 2011-12. However, for most of the countries, the FDI inflows had increased overtime. In the year 2007-08, Mauritius contributed maximum FDI inflows in India followed by Singapore whereas the minimum FDI inflows in India were from Luxembourg. However, throughout the period of analysis, the main contributors of FDI inflows were Mauritius, Singapore, USA, Japan, Netherlands & UK. However, the inflows fell in percentage for Mauritius over the period. Mauritius and Germany accounted a negative percentage change in FDI inflows in India. 2011-12 is the year of maximum FDI inflows in India. Again Mauritius is the biggest contributor of it followed by Singapore. The total FDI inflows also increased at a rate of 20% throughout the period. India experienced the highest percentage change in FDI inflows from Spain. Inflows from USA experienced the lowest percentage change among all the countries.

Table II: Region-Wise Distribution of FDI Inflows in India

Rupees in crores (US$ in million)

RBI's regional offices	States covered	2010-11 (April - March)	2011-12 (Apr-March)	2012-13 (April-Nov)	Cumulative inflows	%age to total Inflows (in terms of US$)
Mumbai	**Maharashtra, Dadra & Nagar Haveli, Daman & Diu**	**27,669 (6,097)**	**44,664 (9,553)**	**35,966 (6,613)**	**282,100 (61,234)**	**33%**
New Delhi	**Delhi, parts of UP & Haryana**	**12,184 (2,677)**	**37,403 (7,983)**	**14,064 (2,593)**	**165,155 (35,665)**	**19%**
Bangalore	Karnataka	6,133 (1,332)	7,235 (1,533)	3,653 (673)	47,545 (10,434)	6%
Chennai	Tamil Nadu,Pondicherry	6,115 (1,352)	6,711 (1,422)	7,903 (1,451)	45,462 (9,724)	5%
Ahmedabad	Gujarat	3,294 (724)	4,730 (1,001)	2,050 (378)	38,474 (8,535)	5%
Hyderabad	Andhra Pradesh	5,753 (1,262)	4,039 (848)	4,197 (773)	34,798 (7,582)	4%
Kolkata	West Bengal, Sikkim, Andaman & Nicobar Islands	426 (95)	1,817 (394)	1,444 (263)	9,629 (2,145)	1%
Chandigarh	Chandigarh, Punjab, Haryana, Himachal Pradesh	1,892 (416)	624 (130)	167 (31)	5,477 (1,185)	1%
Bhopal	Madhya Pradesh, Chhattisgarh	2,093 (451)	569 (123)	608 (110)	4,187 (886)	1%
Kochi	Kerala. Lakshadweep	167 (37)	2,274 (471)	246 (46)	4,178 (885)	1%
Panaji	Goa	1,376 (302)	181 (38)	37 (7)	3,544 (769)	0.4%
Jaipur	Rajasthan	230 (51)	161 (33)	508 (94)	3,119 (647)	0.4%
Bhubaneswar	Orissa	68 (15)	125 (28)	285 (52)	1,617 (341)	0.2%
Kanpur	Uttar Pradesh, Uttaranchal	514 (112)	635 (140)	124 (23)	1,571 (339)	0.2%
Guwahati	**Assam, Arunachal Pradesh,**	**37**	**5**	**27**	**348**	**0%**

	Manipur, Meghalaya, Mizoram, Nagaland, Tripura.	**(8)**	**(1)**	**(5)**	**(78)**	
Patna	**Bihar, Jharkhand**	**25 (5)**	**123 (24)**	**21 (4)**	**170 (34)**	**0%**
Region not indicated		**29,344 (6,447)**	**53,851 (11,399)**	**14,925 (2,731)**	**213,324 (46,221)**	**24.8%**
Total		97,320 (21,383)	165,146 (35,121)	86,225 (15,846)	860,698 (186,704)	100.00%
Source: official website of RBI						

The above table represents the region-wise FDI inflows in India in three financial years. Among the various states, Maharashtra, Dadra & Nagar Haveli, Daman & Diu experienced the maximum FDI inflows over the entire period accounting to 33% of the total FDI inflows followed by Delhi, parts of UP & Haryana accounting to 19% of the total inflows. The western states of the country are relatively affluent states in terms of FDI inflows. However, the regions not indicated also account to a 24.8% of the total inflows. The most neglected regions in India are the north-eastern states, Bihar and Jharkhand that experience nearly 0% of the FDI inflows. Goa, Rajasthan, Orissa, Uttar Pradesh and Uttaranchal are also the neglected regions in terms of FDI inflows.

Table III: Sector-Wise FDI Inflows in India (In US $ Million)

Sectors	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**%of change**
Manufacture	**3726**	**4777**	**5143**	**4793**	**9337**	**150.5904**
Construction	**2551**	**2237**	**3516**	**1599**	**2634**	**3.253626**
Financial Services	3850	4430	2206	1353	2603	-32.3896
Real Estate Activities	1336	1886	2191	444	340	-74.5509
Electricity & other Energy Generation, Distribution & Transmission	829	669	1877	1338	1395	68.27503
Communication Services	**66**	**2067**	**1852**	**1228**	**1458**	**2109.091**
Business services	1158	643	1554	569	1590	37.3057
Miscellaneous services	1901	1458	888	509	801	-57.8643
Computer services	1035	1647	866	843	736	-28.8889
Restaurants & Hotels	280	343	671	218	870	210.7143
Retail & Wholesale Trade	200	294	536	391	567	183.5
Mining	461	105	268	592	204	-55.7484
Transport	816	401	220	344	410	-49.7549
Trading	176	400	198	156	6	-96.5909
Education, Research & Development	**156**	**243**	**91**	**56**	**103**	**-33.9744**
Others	884	1097	384	506	419	-52.6018
Source: official website of RBI						

The above table shows the sectoral distribution of FDI inflows in India covering the period 2007-08 & 2011-12. Manufacturing sector absorbed maximum FDI inflows over the entire period followed by financial services and construction. However, trading and education, research & development sectors are the most neglected sectors. Moreover, the sectors like financial services, real estate, computer services mining, transport, trading and research & education experienced a fall in FDI inflows over the period. Communication services experienced a huge increase in FDI inflow followed by restaurants and hotel sector. However, the FDI inflows in construction sector remained steady over the period. The percentage change in FDI inflows in this sector is 3.25% which is the lowest among all the sectors.

Objectives of the Paper

- To explore short run and long run relationships between total FDI inflows and inflation rate (CPI), exchange rate and economic growth in the context of India.
- Growth analysis of total FDI inflows in India from 1975-76 to 2011-12.
- Finding out the significant structural break in total FDI inflows.

II. Emprical Literature Review

Saleem et. al. (2013) in their paper tried to find out the impact of economic growth and inflation rate on FDI in context of Pakistan. FDI has been considered as an explained variable and GDP and inflation rate as the explanatory variable. The study covers the period 1990 to 2011. The paper starts its empirical analysis with descriptive statistics of all the concerned variables in order to test for the normality of the frequency distributions. Further, regression analysis concludes that both the explanatory variables have positive impact on FDI. Also the overall model turns out to be significant.

Enu et. al. (2013) in their paper examined the determinants of FDI inflows in Ghana. The study covered the period 1980 to 2012. FDI has been treated as the explained variable and GDP growth, Exchange rate, Inflation rate and Trade openness are the explanatory variables. The paper applied unit root test for non-stationarity in the data-series, cointegration test and estimation of VAR model for presence of long run relationship among the variables, Granger-causality test for short run relationship among the variables. However, the results conclude that the policies that encourage FDI inflows should moderate the exchange rate depreciation and increase the trade openness. Harrison Oluchukwu Okafor (2012) in his paper examined on the impact of the pull factors on FDI inflow in Nigeria. The study covered the period from 1970 to 2009. The determinants include Real GDP, Inflation rate, Interest rate, Net export and Real exchange rate. The empirical analysis includes unit root test, Cointegration test and regression analysis. The results claim that real GDP has a positive impact on FDI inflow. On the other hand, interest rate has a high but negative relationship with FDI. Real exchange rate equally had a positive statistical relationship with foreign direct investment inflow. Moreover, inflation rate and net-export were found to be insignificant. Onuorah and Chi-Chi (2013) in their paper tried to investigate the long run relationship among FDI and the macroeconomic variables in Nigeria. The study covered the period 1980 to 2010. The determinants of FDI include GDP, Exchange rate, Interest rate, Inflation rate and money supply. The empirical analysis considered unit root test for non-stationarity, Cointegration test followed by VAR estimation. However, the paper concluded that GDP has a significant and negative relation with FDI. However, apart from GDP all the variables have positive and direct impact on FDI inflows.

Shahzad and Al-Swidi (2013) in their paper examined the moderating role of political stability on the relationships between the macroeconomic variables and FDI inflows in Pakistan. The study covered the period 1991 to 2011. The determinant variables include GDP growth rate, Total exports, inflation rate, Total imports and Balance of payments. The empirical analysis included the unit root test of non-stationarity and regression analysis to study for the impact of macroeconomic variables on FDI inflows. The result concluded that the GDP growth rate and Balance of Payment tends to be a significant determinant of FDI inflows when the moderating effect of the Political stability is accounted for. Nazir, Sarwar and Sami Ullah (2012) in their paper examined the impact of capital inflows on domestic inflation in context of Pakistan. The study covered the period 1980 to 2010. the variables incorporated are exports, FDI, Remittances and Inflation rate. The paper applied unit root test for non-stationarity, Cointegration test and VECM were used to check for the long run and short run relationship among the variables. The results show that there prevails long run and significant relationship. The error correction term for INF growth bears the correct sign i.e. it is negative and statistically insignificant.

III. Selection of Variables

Macroeconomic indicators of an economy are considered as the major pull factors of net FDI inflows to a country. The analysis of above theoretical rationale and existing literature also provides a base in choosing the right combination of explanatory variables that explains the variations in the flows of FDI in the country. The study applies the simple and multiple regression method to find out the explanatory variables of the FDI inflows in the country. The regression analysis has been carried out in two steps.

However, after thorough analysis of the different combination of the explanatory variables, the present study includes the following macroeconomic indicators: economic growth (growth in real GDP at Factor cost), inflation rate (Consumer Price Index) and exchange rate (Rupees to US dollars) and foreign direct investment (FDI as percentage of GDP at Factor Cost). These macroeconomic indicators are considered as the pull factors of net FDI inflows in the country. In other words, it is said that FDI inflows in India as a percentage of GDP is considered as the function of these said macroeconomic indicators.

Inflation Rate (INF)

Inflation rate is an important aspect of a country's good economic fundamentals. Rate of inflation is a crucial factor in influencing the FDI inflows. The high rate of inflation signifies economic instability and source or peril and confusion associated with lapse appropriate government policies, especially the monetary fiscal policy mix. By and large, the high rates of inflation are associated with the lesser FDI inflows. The study of Akinboade et al (2006) stated that low inflation is a sign of internal economic stability in the country. High inflation rates reflect the inability of the government to balance its budget and the failure of the central bank to conduct appropriate monetary policy.

Gross Domestic Product (GDP)

GDP growth rate refers to the growth rate of gross domestic product. Economic growth rate have an effect on the domestic market, such that countries with expanding domestic markets should attract higher levels of FDI. Since 1991 India has emerged as one of the wealthiest economies in the developing world. During this period, the economy has grown constantly and this has been accompanied by increase in life expectancy,

literacy rates, and food security. In this analysis annual growth in GDP at Factor Cost has been taken as an indicator to economic growth.

Exchange Rates (EXR)

It refers to the exchange rate variable. Exchange rate is a key determinant of international finance as the world economies are globalised ones. There are a number of factor which affect the exchange rate viz. government policy, competitive advantages, market size, international trade, domestic financial market, rate of inflation, interest rate etc. Annual rates of the variable have been taken from the year 1975-76 to 2011-12.

IV. Data Source and Methodology

The study is entirely based on secondary data. The objectives of the study are examined by using time series data covering period from 1975-76 to 2011-12. Relevant data for the study are obtained from the official website of the Reserve Bank of India (RBI) and www.indexmundi.com.

The study has used the following specifications in order to evaluate the short run and long run impact of macroeconomic variables on Total FDI inflows. The following mathematical model is used for analysis.

$\text{Log (FDI)} = \beta_1 \text{Log (GDP)} + \beta_2 \text{Log (EXR)} + \beta_3 \text{INF} + \text{Error}$..... (1) where

FDI= Total FDI Inflows in India converted into Indian Rupee.

GDP= Real GDP at Factor Cost.

INF= Rate of Inflation (CPI).

EXR= Exchange Rate (Rupees/US dollars).

In order to fulfil the objectives of the paper, some econometric tests are used.

4.1. Test for the stationarity of the data series by applying Augmented Dicky-Fuller (ADF) Test.

The models in which ADF test is applied are as follows:-

$$\Delta Y_t = \alpha_i + \beta_i t + \Upsilon_i Y_{t-1} + \delta_1{}^i \Delta Y_{t-1} + \ldots\ldots\ldots + \delta_{p-1}{}^i \Delta Y_{t-p+1} + \epsilon_{it} \ldots\ldots \quad (2)$$

$i=1,\ldots,4$ (4 endogenous variables)

Where 'Y' denotes the endogenous variables.

Here, α is a constant, β is the coefficient of the trend term (t) and p is the lag order of the autoregressive process. The following null hypothesis is tested:-

H_0: $\Upsilon = 0$ against

H_1: $\Upsilon < 0$

In order to find test the above hypothesis, a computed t-statistic has been formulated as

$ADF\tau = \hat{\Upsilon} / SE(\hat{\Upsilon})$ where $\hat{\Upsilon}$ is the estimated Υ.

If the absolute value of the computed ADF test statistic turns out to be greater than that of its theoretical value at 5% level of significance, we reject our null hypothesis where the null hypothesis is the presence of unit root or absence of stationarity. If the original series turns out to be non-stationary then we again go for unit root test at first difference. This process will continue until and unless the series turns out to be stationary.

4.2 To find out the optimal lag-length of the Vector Autoregression (VAR).

The lag length determination is important as when the lag length differs from its true value, the estimates of a VAR turn out to be inconsistent, so are the impulse response functions (Braun & Mittnik, 1993). The optimal lag length is chosen using an explicit statistical criterion such as Akaike Information Criterion (AIC) defined as:-

$AIC = \log|\sum| + (2k^2p)/T$..... (3)

Where k= no. of variables in the model, p= no. of lag terms in the model, T= no. of observation,

$\sum$ = Variance-Covariance matrix.

4.3. To find out long run relationship between FDI and other macroeconomic variables by applying Johansen Cointegration Test.

Cointegration analysis is inherently multivariate, as a single time series cannot be cointegrated. If two time series data are non-stationary, i.e. they have trend and their pattern of trend is also similar, then we say that their linear combination, i.e. the error term is stationary. Hence, we can perform any econometric test on the non-stationary process itself. In that case, the two variables are cointegrated. On the other way, if the two variables are non-stationary but they are cointegrated then we can say that their linear combination is stationary and hence, any econometric test can be applied on the non-stationary series itself. Hence, if the two time-series variables are integrated of same order, then they must be cointegrated.

We formulate two statistics, Eigen value and trace statistic defined as:

Trace statistic: $\text{Trace} = -T \sum \text{Log}(1-\lambda^1{}_t) \qquad t=r+1,\ldots, p$

Where $\lambda^1{}_{r+1},\ldots, \lambda^1{}_p$ are (p-r) no. of estimated eigen values.

Maximum Eigen value statistic: $\lambda_{max}(r, r+1) = -T \log(1-\lambda^1_{r+1})$

If the absolute value of the computed Trace/Maximum Eigen Value statistic is greater than its critical value, then we reject our null hypothesis of no cointegration and claim that there exists at least one-way cointegration relation between the variables at 5% level of significance.

As in this paper, four endogenous variables are taken into consideration, hence, there can be at most 3 cointegration relations.

4.4. As per Engel and Granger (1987), if the variables are cointegrated, then there must prevail vector error correction mechanism (VECM).

This implies that the changes in explained variables are the functions of the level of disequilibrium in the cointegrating relation, which is reflected by the error correction term and the changes in other explanatory variables. If the variables are not cointegrated, then we go for estimating unrestricted VAR model where the error correction term is absent. VECM is appropriate to find out the short run dynamics.

$$\Delta FDI_t = \mu_1+\sum\alpha_i\Delta FDI_{t-1}+\sum\beta_i\Delta GDP_{t-1}+\sum\lambda_i\Delta INF_{t-1}+ \sum\gamma_i\Delta EXR_{t-1}+\sum\delta_i ECM_{r,\,t-1}+\epsilon_{5t} \quad (4)$$

$i = 1, 2, \ldots, m$; r = no. of cointegration relation.

4.5. Finding out the causal relationship among the aforesaid variables applying Granger-Causality test.

The following Vector Autoregressions (VAR) are tested.

$$\Delta FDI_t = \sum\alpha_i^1\Delta FDI_{t-i}+ \sum\beta_j^1\Delta X_{t-j}+U_{1t} \quad (5) \qquad \Delta X_t= \sum\lambda_j^1 \Delta X_{t-j}+ \sum\delta_i^1\Delta FDI_{t-i}+ U_{2t} \quad (6)$$

$i=1,2\ldots..m$; $j= 1,2,\ldots..n$; X = Explanatory variables.

The error terms are uncorrelated. We jointly test for the estimated lagged coefficients $\sum\alpha_i$ and $\sum\lambda_j$ are different from zero by running an F-test. When the null-hypothesis of insignificance of the model is rejected at 5% level of significance, we claim that there prevails causal relationship among the variables. However, it is a short run approach.

4.6 Growth Analysis of FDI.

We compute a simple linear regression model to find out the growth rate of total FDI inflows.

$\text{Log}(FDI)_t = a+ bt + u_{3t}$ ..... (7) where,

't' is the trend term which is treated as an explanatory variable and log (FDI) is the logarithmic form of Total FDI inflows in US dollars which is the explained variable.

We perform a simple regression analysis and estimate the model by OLS method. In order to find out the growth of FDI, we multiply the estimated slope coefficient of the trend term (t) by 100.

4.7. Structural Break Analysis

A series of data can often contain a structural break, due to a change in policy or sudden shock to the economy. In order to test for a structural break, we often use the Chow test.

In order to analyse significant structural break in the data series, we divide the entire data into two sub-periods, 1975-76 to 1990-91and 1991-92 to 2011-12. Hence, we run regression taking two sub-samples. The models are as follows:

- $\text{Log}(FDI)_t = a + bt + u_{4t}$ ..... (8)....for the entire period.
- $\text{Log}(FDI)_t = a_1 + b_1t + u_{5t}$..... (9)....for the 1st sub-period.
- $\text{Log}(FDI)_t = a_2 + b_2t + u_{6t}$..... (10)...for the 2nd sub-period.

Chow test is the statistical test for finding out significant structural break point in the data series. It is applied when we try to test the following hypothesis:

H_0: $a_1=a_2$ & $b_1=b_2$ (no significant break point) against

H_1: either $a_1 \neq a_2$ or $b_1 \neq b_2$ or both

Two sub-periods can be dissimilar if their intercept terms are different or their slope terms are different or both. In order to test the above hypothesis, we formulate an F-statistic defined as:-

$$F= \frac{[RSS_1-(RSS_2+ RSS_3)]/K}{(RSS_2 + RSS_3)/ n_1+n_2-2k} \quad \text{follows} \quad F_{k,\, n1+n2-2k,\, \mu}$$

Where,

RSS_1 is the residual sum of squares of the estimated model for the entire period.

RSS_2 is the residual sum of squares of the estimated model for the 1st sub-period.

RSS_3 is the residual sum of squares of the estimated model for the 2nd sub-period.

n_1= number of observation in 1st sub-sample

n_2 = number of observation in 2nd sub-sample. K= number of explanatory variables in the model.

μ is the level of significance.

If the estimated F-statistic turns out to be significant, then we reject the null hypothesis and claim that the two sub-regression models are dissimilar. Here, 1991-92 has been treated as a break year when various

structural changes occurred in the economy due the initiation of Liberalization, Globalization and Privatization policies (New economic policy) of the Indian government.

V. Empirical Analysis

Unit Root Test: In this context, GDP and EXR are integrated of order 1 [I (1)], i.e. they are stationary at first difference. However, FDI and INF are integrated of order zero [I(0)], i.e. they are stationary at level itself. As the concerned variables are integrated of different orders, it implies that the pattern of trend among the variables is not similar. Hence, we must test for the stationarity of their linear combination (error term), before analysing the short run and long run relationships among the variables. Stationary error term confirms the presence of long run relationship among the variables. However, in this context, the error term turns out to be stationary at level itself at 5% level of significance such that we further go for the Cointegration test. We need not go for any transformation of the variables due to stationary error term.

Cointegration Test

The result of the cointegration test has been represented in Table VI. The optimal lag length chosen by AIC is 1. Johansen & Juselius (1990) Trace statistic test of cointegration investigates presence of 1 cointegrating equation among the concerned variables. However, the maximum Eigen value test claims no cointegration relation among the variables. In such situations, when the two test statistics give different results, the trace statistic gives more robust results. Thus, the null hypothesis of no cointegration is strictly rejected at 5% level of significance, implying long run relation among the variables. The existence of long run relationship among the variables rules out the spurious correlations. Thus, there exists at least one-way causality among the variables in long run.

The normalised cointegrating equation is:

Log (FDI) = 2.06+ 1.66 Log (GDP) + 2.11 Log (EXR) + 0.13INF..... (8)

(1.76) (2.76) (4.57)

The values in the parenthesis represent the estimated t-statistics of the estimated slope coefficients. All the three explanatory variables have positive impact on FDI in long run. However, GDP is a statistically insignificant variable whereas, the other two are statistically significant. Moreover, a 1% rise in exchange rate (Rupee/USD) induces 2.11% rise in FDI, i.e. a more than proportionate rise in FDI in India. On the other hand, inflation positively affects FDI less than proportionately.

Vector Error Correction Mechanism/Restricted VAR Model (VECM): Table VII represents the estimated coefficients of the error correction term (long run impact) and the lagged values of all the time series data (short run impacts). All the variables are been converted in difference form by the software itself. There exists 1 cointegration equation in this context implying existence of an error correction term that adjusts itself to reach the long run equilibrium. However, in this context, the error correction term, though negative yet statistically insignificant which implies that it does not respond to the previous period disequilibrium. However, the lagged values of all the variables are statistically insignificant to predict the present value of FDI. Moreover, the overall model turns out to be statistically insignificant (R-Squared = 0.16 & Adjusted R-Squared = 0.02). Negative value of the Log-likelihood estimate claims for the absence of multicollinearity among the explanatory variables.

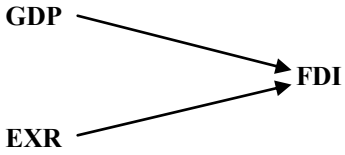
However we have t-values of the error correction terms but no p-values. Thus to obtain p-values and to further confirm short run impact of the macroeconomic variables on the explained variable we will follow VECM equation and conduct Ordinary Least square Analysis at 95% confidence interval.

D(FDI) = C(1)*[FDI(-1) - 1.659150162*GDP(-1) - 0.1279416404*INF(-1) - 4.813310911*EXR(-1) + 2.066759635] + C(2)*D[FDI(-1)] + C(3)*D[GDP(-1)] + C(5)*D[EXR(-1)] + C(6).....VEC Model.....(9)

Above model is the error correction model. Overall there are 6 coefficients. C (1) shows the convergence of the error correction term towards long run equilibrium. This coefficient should be negative and statistically significant. C (1) is though negative yet statistically insignificant. C (2),….., C (5) are the coefficients of the lagged values of the variables showing the short run impacts, of which none are statistically significant. C (6) is the intercept term. The Durbin-Watson d-statistic is close to 2 (d-statistic=2.047) implying absence of serial correlation in the model. Further, the LM test confirms absence of serial correlation at the optimum lag-length 1 (p-value=0.90).

Granger-Causality Test: Table IX shows the granger-causality test results. It shows the short run relationship among FDI and select explanatory variables (GDP, EXR & INF). GDP and EXR are the statistically significant variables to predict the present value of FDI in short run. However, the converse is not true stating unidirectional relationship between them. However, there exists no such short run relationship between INF and FDI.

Figure I: Granger-Causality Test Results



Growth Analysis: The estimated model equation is as follows:-

Log (FDI) = 20.31+0.23t..... (10)

The exponential growth rate of FDI in the past four decades is 0.23 x 100 = 23% per annum.

Chow Test: The results for the chow test of structural break point have been summarized in the following table:

Table IV: Chow Test Result

Statistics	Probabilty
F-statistics	0.00001

Here, 1991-92 has been chosen as a break year when the government initiated the Liberalization, Privatization and Globalization (LPG) policy in India. The p-value of F-statistic is less than 0.05 which means that the null hypothesis of no significant break point has been rejected. Hence, the known break year, 1991-92 is statistically significant in the terms of total FDI inflows in India. Hence, the new economic policy which was initiated in the year 1991 had made a significant impact on the FDI inflows in India.

VI. Summary and Conclusion

The present study tried to explore the short run and long run impact of the select macroeconomic variables (GDP, EXR & INF) on FDI in the context of India by applying Cointegration test followed by Vector error correction mechanism (VECM) and Granger-Causality test. It also tried to analyse the exponential growth rate of FDI over the period of our analysis by running simple regression model. Further, it has been analysed whether, 1991-92, the year of initiation of New Economic Policy in India, is a statistically significant year in terms of FDI inflows in India.

Before applying any statistical test on the data series, it is important to find out the order of integration of the variables by applying ADF test of stationarity. However, it is found that GDP and EXR are integrated of order one [I (1)], whereas, FDI and INF are integrated of order zero [I(0)]. Due to the different order of integration of the concerned variables, i.e. different patterns of trend in the data series, we checked for the stationarity of their linear combination (error term). However, the results claim that the linear combination is I (0) such that the existence of short run and long run relationships are further confirmed by applying various statistical tests on the original data series itself.

The Cointegration test along with VECM results claim for the presence of long run equilibrium. Moreover, the lagged values of the concerned variables showing the short run impact turn out to be statistically insignificant. The Granger-Causality test results show unidirectional relationship between FDI and GDP and FDI and EXR, with EXR and GDP granger causing FDI. Further, the growth analysis of FDI concludes for a 23% per annum exponential growth rate of FDI in India over the entire period of our analysis. Moreover, the Chow test of structural break found out 1991-92 to be a statistically significant year in terms of FDI in India. Hence, the New Economic Policy initiated in 1991-92 had made a significant impact on FDI in India.

However, this research paper can be modified further by measuring the unexpected changes in FDI and predicting its effects on the future values of the select macroeconomic variables (GDP, EXR & INF) through Impulse response function (IRF) and Variance decomposition analysis. Moreover, incorporation of more relevant macroeconomic variables like interest rate, trade openness, foreign exchange reserves, unemployment rate etc can improve the statistical results of the research paper.

Appendix

Table V: Unit Root Test Results

CONSTANT & TREND						
	LEVEL			DIFFERENCE		
VARIABLES	ESTIMATED T-STATISTIC	CRITICAL VALUE (5% LEVEL OF SIGNIFICANCE)	DECISION	ESTIMATED T-STATISTIC	CRITICAL VALUE (5% LEVEL OF SIGNIFICANCE)	DECISION
FDI	-3.63	-3.54	Reject Ho			
GDP	-1.23	-3.54	Accept Ho	-7.06	-3.54	Reject Ho
EXR	-1.09	-3.54	Accept Ho	-5.57	-3.54	Reject Ho
INF	-5.24	-3.54	Reject Ho			
Error	-4.17	-3.54	Reject Ho			

Table VI: Cointegration Test Results

						Optimal Lag Length (as suggested by AIC Criterion):1	
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	Critical Value (at 5% level of significance)	Prob (Trace Statistic)	Maximum Eigen Value	Critical value (at 5% level of significance)	Prob (Trace Statistic)
None *	0.52	51.01	47.85	0.02	25.56	27.58	0.09
At most 1 *	0.35	25.44	29.80	0.14	15.37	21.13	0.26
At most 2 *	0.23	10.07	15.49	0.27	9.06	14.26	0.28
At most 3 *	0.03	1.01	3.84	0.31	1.01	3.84	0.31

Table VII: Vector Error Correction Results

Dependent Variable: D(GDP)	Coefficients	t-statistic	P-Value
Cointegration Eq 1	**-0.19**	**-1.51**	**0.14**
D[GDP(-1)]	3.49	0.65	0.52
D[EXR(-1)]	0.21	0.13	0.89
D[FDI(-1)]	0.09	0.45	0.65
D[INF(-1)]	-0.02	-1.45	0.14
Constant	-0.01	-0.08	0.94
R^2	0.16		
Adjusted R^2	**0.02**		
F-stat	1.14		
D-W stat	**2.04**		
Log Likelihood	**-8.43**		

Table VIII: VEC Residual Serial Correlation (LM Test) Results

Lags	LM-Stat	Prob
1	**9.211241**	**0.9045**
2	11.11508	0.8023
3	14.17118	0.586

Table IX: Granger-Causality Test Results

Null Hypothesis:	Obs	F-Statistic	Probability
GDP does not Granger Cause FDI	36	13.6781	0.00079
FDI does not Granger Cause GDP		3.91457	0.05627
INF does not Granger Cause FDI	36	2.04249	0.16236
FDI does not Granger Cause INF		0.00305	0.95629
EXR does not Granger Cause FDI	36	8.83425	0.00548
FDI does not Granger Cause EXR		0.00055	0.9815

Table X: Growth Analysis Results

	Coeffcient	**Std Error**	**T-Statistic**	**Prob**	**R-Squared**	**Adjusted R-Squared**	**F-Statistic**	**PROB (F-Statistic)**
Constant	20.31	0.12	**160.56**	0.00				
Time	**0.23**	0.01	**19.28**	0.00	0.91	**0.91**	**371.75**	**0.00**

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