Chapter 3
Methodology

3.0 Introduction

The main objective of this study is to investigate the relationship between foreign direct investment and behavior of macroeconomic variables in India over the period of 1990 to 2013. The factors, those encourage or hinder international flows of capital can be categorized into those that are external to the economies receiving the flow and the factors internal to those economies. The magnitude and composition of inflow of FDI is determined by both external development and domestic economic factors (Calvo Guillermo A.et al. 1993). Countries with sound domestic fundamentals attracted capital on a large scale and with a higher proportion of long term investment. There appears to be a strong link between economic fundamentals and foreign direct investment (Edwards, Sebastian, 1991).

There are various econometric methods, measuring the empirical relationship between flow of FDI and macroeconomic variables as discussed in review of literature.As per the literature reviewed differentkind of methods were used.Review of literature found that the most of researchers have used the econometrics methods i.e. Phillips Parron, Augmented Dickey-Fuller test and KPSS (Kwiatkowski, Phillips, Schmidt, and Shin) to check the stationarity; the Johansen co-integration method because this test confirms the number of co-integration equations for further procedure of analysis. VAR and VECM have been also used to check the long run relationship. Engle and Granger causality, Granger Causality, Toda Yamamoto and Granger sim tests were used by different researcher to investigate the causality. Some researcher used the correlation and regression method for relationship.

As the study deals with the time series data, it is required to check whether data is stationary or not. Inthis study we used the ADF and PP test to check whether unit root exists or not.The

difference between these tests, ADF and PP is the test of non-stationary and KPSS is the test of stationary. ADF and PP is more popular test of non-stationary. Johansen co-integration test is also used which confirm the existence of co-integration equations among variables. Therefore, VECM method is most appropriated to investigate the relationships among variables.Engle Granger causality test is used for two variable; Toda and Yamamoto causality test propose an interesting simple procedure requiring the estimation of an augmented VAR; granger sim which is opposite to granger causality test; and Granger Causality test is also used to measure the causality and it is popular and is used in empirical studies. Section 3.1 is the brief description for variables used in this study. Section 3.2 deals with the source of data, section 3.3 deals with the methods which has been used in this study.

3.1 Variablesused in study

Aggregate production in the recipient economy is carried out by combining labour and physical capital. Physical capital can be domestic or foreign owned. FDI affects growth directly, by increasing the stock of physical capital in the recipient economy, as foreign owned capital is accumulated, and indirectly, by inducing human capital development and promoting technological upgrading. It is also important to evaluate the extent of complementand substitution between domestic investment and FDI because a simplistic Schumpeterian view of FDI related innovative investment that emphasises creative destruction through substitution may overlook the scope for complementarily between FDI and domestic investment. Under complementarily, innovations embodied in foreign investment may create, rather than reduce, rent accruing to older technology (Young, 1993).

Each variable has its own significance to evaluate the relation of exogenous and endogenous macroeconomic variables with inflow of foreign direct investment (FDIINFL).The negative macroeconomic environments discourage inflow of foreign direct investment, vice versa. The various macroeconomic variables and their relationship with inflow of FDI used in the

present study are outlined.Dua Pamiet al. (1998) found the causal relationship between economic activity and actual flows of FDI which affect output.Muhammad Shahzad Iqbal, et al. (2010) foundbidirectional causality between FDI and GDP and W. Jos Jansen et al. (2014)found that more synchronized business cycles were associated with stronger FDI relations in the period 1995 to 2011.Kevin Honglin Zhang (2001) found long run FDI-GDP relationship. Kohli Renu (2001) concluded that the Capital flows financed more in investment than consumption.An effective inflation stabilization program can reduce macroeconomic risk and stimulate capital inflow and vice versa (Calvo Guillermo A. et al.1996). Role of FDI in employment creation is an important task; it is more successful and closely related to inflow of FDI per capita (Urmas Vablaneet al.2000). FDI inflow to developing countries increasing the employment for their skill in terms of quasi rent, higher expected employment by multinational has been associated with larger labour quasi rent increasing output (Joshua Aizenman, 2003). Shu-Chen Chang (2006) has not found any significant association between unemployment and inflow of FDI. Bosworth and Collins (1999) found that additional dollar of foreign direct investment is associated with a significant increase in domestic investment. Their findings further supported by Mody Ashoket al.(2002). Restriction on inflow of FDI exist, the level of domestic investment was constrained by available domestic saving (Mody Ashok and et al. 2002). Chung chen, et al.(1995) measured relationship between domestic saving and FDI and found that the effect of FDI on domestic saving was not statistically significant. Calvo Guillermo A. et al.(1996) found that the substantial portion of the surge in capital inflow has channeled to accumulation of foreign exchange reserve. Real exchange rate recorded negative association with inflow of FDI (Goldberg and Klein, 1998).Muhammad Shahzad Iqbal, et al. (2010) foundbidirectional causality beetween FDI and export, GDP and export, and import and export.Elizabeth Asiedu (2002) found that trade openness also promotes FDI. Bajpai Nirupam et al. (2000) said that

commercial borrowing from NRIs became disaster that was the cause when lots of short term capital had come in and lots had moved out and created server payment crises. Investment promotion agencies help to terminate the external assistance by FDI inflow (Jacques Morisset, 2003).

In the present study depending upon the literature the following variables has been used in time series form with the addition of some more endogenous variables which has not been used earlier in Indian context i.e., GNP deflator (GNPDIFL) is used as a proxy of inflation. Okun's formulation of unemployment is used as a proxy of unemployment (UNOKUN).Unemployment as UNOKUN which shows the Phillips curve lies at the root of the aggregate supply curve and the two differs only in terms of gap between unemployment rates and output respectively, it is possible to write,

$U^* - U = \alpha ((y-y^*)/ y^*)$[i] as Unemployment or UNOKUN

where α is a positive constant such that $\alpha = 1-U^*$.

Similarly, a close link has been established between changes in the unemployment rate over time and the deviation of actual output growth from the trend rate of growth. Okun(1983) formally quantified such a relationship which is now known as 'Okun's Law'. It can be written symbolically as;

$U-U_{-1} = -(1/q) (Gy-Gy^*)$[ii] as GOG

where, q is Okun's parameter reflecting the cost of cyclical unemployment; and Gy and Gy* are respectively the actual and trend rates of output growth.

Development expenditure and non-development expenditure, gross domestic saving, gross fixed capital formation is also used.

Foreign reserve, annual exchange rate, trade openness and sources of foreign capital inflow are the components of capital account also used to check the relationship between inflows of FDI as exogenous macroeconomic variables. Component of capital account i.e., net external assistance, net commercial borrowing, rupee debt service and net NRI deposit which are also influenced on inflow of FDI.

Name of the variables which has been used in this study are gap of growth output as GOG, GNP deflator as GNPDIFL, Unemployment as OKUN, Foreign Reserve as FR, Exchange Rate as AER, Gross Fixed Capital Formation as GFCF[iii], Gross Domestic Saving as GDS[iv], Development Expenditure as DE, Non-development Expenditure as NDE, Net[v] External Assistance as NEA, Net Commercial Borrowing as NCB, Rupee Debt Service as RDS and Net NRI Deposit as NNRID.

3.2Source of Data

The nature of present studyrequired the information from secondary source, for the purpose of all the data used in the present study has been collected from authentic and reliable resources including Reserve Bank of India. Okun's formulation of unemployment is used as a proxy of unemployment (UNOKUN) and data of unemployment is generated by the GNP.

3.3 Methods of the study

As discussed in the review of literature different methods has been used to investigate the relationship between macro variables with inflow of foreign direct investment. Unit Root Test, this situation is indicative of a problem of spurious or non-sense results. A test of stationarity(for non-stationarity) that has become widely popular in the unit root test is ADF and PP. Unit Root is measured by the help of Augmented Dicky-Fuller[vi] Test for benchmarking purpose and Phillips Parron Test. Johanson Co-integration Test measure the

co-integrating equation among variables with the help of Trace and Max statistics and Normalized Equation which helps to analyse the long run positive and negative relationship. Vector Error Correction Model is also used to check the speed of adjustment towards equilibrium. Granger Causality test is used to investigate the causality.

3.3.0Test of Stationarity[vii]

In this study we used the ADF and PP test to check the unit root exists in time series or not. ADF and PP is more popular test of non-stationary.

3.3.0.0Augmented Dicky-Fuller Test[viii]

The unit root tests described above are valid if the time series is well characterized by an AR(1) with white noise errors. Many time series, however, have a more complicated dynamic structure than is captured by a simple AR(1) model. Said and Dickey (1984) augment the basic autoregressive unit root test to accommodate general ARMA models with unknown orders and their test is referred to as the augmented dickey fuller test. The ADF test is conducted by estimating the following three models. In the present study, however, only last two i.e., equation (2) and (3) have been utilized.

No intercept no trend model

$$\Delta y_t=\gamma\, y_{t-1}+ \sum_{i=1}^{u} \beta_i \Delta y_{t-i} + \varepsilon_t \qquad \text{....3.1.1}$$

Intercept no-trend model

$$\Delta y_t=\alpha_0 + \gamma\, y_{t-1}+ \sum_{i=1}^{u} \beta_i \Delta y_{t-i} + \varepsilon_t \qquad \text{....3.1.2}$$

Intercept& trend model

$$\Delta y_t=\alpha_0 + \alpha_1 t+ \gamma y_{t-1} + \sum_{i=1}^{u} \beta_i \Delta y_{t-i} + \varepsilon_t \qquad \text{....3.1.3}$$

where $\Delta y_t = y_t + y_{t-1,}$ is the first difference of the series y_t, $\Delta y_{t-1} = y_{t-1} + y_{t-2}$ is the first difference of y_{t-1} series etc. α & β are the parameters to be tested, ε_t is a stochastic disturbance terms. The difference between three equations, (1) to (3) is the exclusion or inclusion of the deterministic elements α_0 and α_1 equation (1) does not include the drift α_0 and time trend $\alpha_1 t$, equation (2) includes α_0 but no time trend and equation (3) includes both $\alpha_0 \& \alpha_1 t$. For carrying out the unit root test in the present study, however, we have confined ourselves to the last two models only.

In all cases the null hypothesis is,$\gamma=0$, the ADF test statistic is the t statistic for the lagged dependent variable. If the ADF statistical value is less than the critical value, then the null hypothesis of a unit root cannot accept and we can conclude that y_t series is a stationary and the order of integration is zero,I(0). The computed values of ADF statistics along with their corresponding critical values pertaining to two models are reported.

3.3.0.1Phillips-Parron Test[ix]

Phillips and Perron (1988) developed a number of unit root tests that have become popular in the analysis of time series. The Phillips-Perron unit root tests differ from the ADF tests mainly in how they deal with serial correlation and heteroskedasticity in the errors. In particular, where the ADF tests use a parametric auto regression to approximate the ARMA structure of the errors in the test regression, the PP tests ignore any serial correlation in the test regression.The test regression for Phillips-Parron(PP) test in the AR(1) process

$$\Delta y_{t-1} = \alpha_0 + \beta y_{t-1} + \varepsilon_t \qquad \ldots 3.1.4$$

while ADF test corrects for higher order serial correlation by adding lagged differenced terms on the right hand side, the PP test makes a correction to the t statistic of the coefficient γ from AR(1) regression to account for the serial correlation in ε_t. So the PP statistics is just modification of ADF t-statistics. The asymptotic distribution of the PP t-statistic is the same

as the ADF, t statistics and therefore the same critical values are still applicable as with the ADF test. The PP test can be performed with inclusion of a constant, a constant and a linear trend or neither in the test regression. In the present study the PP test has been performed by including an intercept, and intercept and time trend only. i.e.

$$\Delta y_{t-1}=\alpha_0 + \beta y_{t-1} + \varepsilon_{1t} \quad \ldots 3.1.5$$

$$\Delta y_{t-1}=\alpha_0 + \alpha_{1t} + \beta y_{t-1} + \varepsilon_{2t} \quad \ldots 3.1.6$$

The PP-test is performed by testing the hypothesis of no stationarity (H_0:β=0) against the hypothesis that the series is integrated of order zero I(0) hence stationary. The computed PP statistics and corresponding critical values. If the computed values of PP-statistic is less than the corresponding critical value, then the null hypothesis of no stationarity cannot accept and hence the series is stationary. The unit roots with help of Phillips-Parron test. Parron test was conducted for two models i.e. intercept model as well as intercept and trend model. The series were tested at level, first difference and second difference.

The time series model requires determining the optimal lag length for the purpose Akaika Information Criterion (AIC) and Schwarz Information Criterion (SIC) are used in this study as the fixed lag by the automatic system generated in Eview.

3.3.1 Johnson Co integration Test[x]

In a two variable model there can be only one co integration vector. But when there are more than two variables in a model the number of co-integration vector can be more than one. In fact, for n number of variables there can be up to n-1 co-integrating vector. This problem cannot be resolved by the Engle-Granger single equation approach. We have three to five variables in our model. Johanson approach for multiple equations is adopted here.

At first stage, the study checks the integration order of the series. After that it employs Johanson Co-integration method[xi] to investigate the relationship between inflow of foreign direct investment and macro variables.

It is well documented that most economic variables are non-stationary in their levels and becomes stationary on (Integrated of order(I)), I(1), I(2).

In present study we are using three to five variables. Johanson's test enables estimating and testing for the presence of multiple co-integration relationship, r, in a single step procedure. The numbers of co-integrated equations are identified with the help of trace and max statistics developed by Johnson. The statistics are formulated as:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n}(1 - r_i) \quad \ldots 3.2.1$$

And

$$\lambda_{max}(r, r + 1) = -T\,(1\text{-}r_{r+1}) \quad \ldots 3.2.2$$

where:

r is the number of co-integrating vector under null hypothesis;

λ is the estimated value of r^{th} characteristic root(eigen value)

T is number of usable observations

When the appropriate values of r are clear these statistics are simply referred to as the λ_{trace} and λ_{max}.

The first statistic tests the null hypothesis that the number of distinct co-integration vector is less than or equal to r against a general alternative. From the previous discussion, it should be

clear that the λ_{trace} and λ_{max} equal to zero when all the λ i=0. The further the estimated characteristic roots are from zero, the more negative is $(1-\lambda_i)$ and larger is the λ_{trace} statistics.

The second statistic tests the null that the number of co-integrating vector is r against the alternative of (r+1) co-integrating vector. Again, if the estimated value of the characteristic root is close to zero, λ_{max} will be small.

It indicates that if there is one co-integrating equation for the given series. The result halts the presence of one co-integration relationship among the variables.

Having established the co-integration among the specified variables, short run behavior of these variables is investigated to serve the purpose, VECM model is employed.

3.3.2 Error Correction Model

One identifying the co-integration behavior among the specified variables, the short run dynamics is investigated using the Error Correction Model (ECM), co-integration general, an ECM derived from the Johanson test can be expressed as follows for chapter 5 and 6:

3.3.2.0Equation for endogenous macroeconomic variables

$$\Delta \mathrm{FDIINFL}_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \mathrm{GNPDIFL}_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta \mathrm{UNOKUN}_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta \mathrm{GOG}_{t-1} + \alpha \mathrm{ECM}_{t-1} + \mathrm{U}_t \ldots\ldots\ldots\ldots 3.3.1$$

Where

ECM=Error Correction Method

$FDIINFL_t$=Inflow of Foreign Direct Investment in year t;

$GNPDIFL_t$=Gross National Product Deflator in year t;

$UNOKUN_t$= Unemployment in year t;

GOG_t= Gap of output growth in year t.

β_0,β_1, β_2,β_3, and α are the parameters.

The error correction model result indicates the speed of adjustment back to long run equilibrium after a short run shock. The error correction term will explore feedback relationship among the variables like GNPDIFL, UNOKUN and GOG. While the parameters like α & β will explore short run influence of independent variables on FDIINFL dependent variable.

$$\Delta FDIINFL_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta DE_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta NDE_{t-1} + \alpha ECM_{t-1} + U_t \ldots .3.3.2$$

Where

ECM=Error Correction Method

$FDIINFL_t$=Inflow of Foreign Direct Investment in year t;

DE_t=Development Expenditure in year t;

NDE_t= Non-development Expenditure in year t;

β_0,$\beta_1$and α are the parameters.

The error correction model result indicates the speed of adjustment back to long run equilibrium after a short run shock. The error correction term will explore feedback relationship among the variables like DE and NDE. While the parameters like α & β will explore short run influence of independent variables on FDIINFL dependent variable.

$$\Delta FDIINFL_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta GFCF_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta GDS_{t-1} + \alpha ECM_{t-1} + U_t \ldots 3.3.4$$

Where

ECM=Error Correction Method

$FDIINFL_t$=Inflow of Foreign Direct Investment in year t;

$GFCF_t$=Gross Fixed Capital Formation in year t;

GDS_t= Gross Domestic Saving in year t;

β_0,$\beta_1$and α are the parameters.

The error correction model result indicates the speed of adjustment back to long run equilibrium after a short run shock. The error correction term will explore feedback relationship among the variables like GFCF and GDS. While the parameters like α & β will explore short run influence of independent variables on FDIINFL dependent variable.

3.3.2.1 Equation for exogenous macroeconomic variables

$$\Delta \mathrm{FDIINFL_t} = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \mathrm{FR_{t-1}} + \sum_{i=1}^{n} \beta_2 \Delta \mathrm{AER_{t-1}} + \sum_{i=1}^{n} \beta_3 \Delta \mathrm{OPEN_{t-1}} + \alpha \mathrm{ECM_{t-1}} + \mathrm{U_t} \quad ..3.3.5$$

Where

ECM=Error Correction Method

$FDIINFL_t$=Inflow of Foreign Direct Investment in year t;

FR_t=Foreign Reserve in year t;

AER_t= Annual Exchange Rate in year t;

$OPEN_t$= Trade openness in year t.

β_0,β_1, β_2,β_3, and α are the parameters.

The error correction model result indicates the speed of adjustment back to long run equilibrium after a short run shock. The error correction term will explore feedback

relationship among the variables like FR, AER and OPEN. While the parameters like α & β will explore short run influence of independent variables on FDIINFL dependent variable.

$$\Delta \mathrm{FDIINFL}_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \mathrm{NEA}_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta \mathrm{NCB}_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta \mathrm{RDS}_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta \mathrm{NNRID}_{t-1} + \alpha \mathrm{ECM}_{t-1} + U_t \quad \ldots 3.3.6$$

Where

ECM=Error Correction Method

$FDIINFL_t$=Inflow of Foreign Direct Investment in year t;

NEA_t=Net External Assistance in year t;

NCB_t= Net Commercial Borrowing in year t;

RDS_t= Rupee Debts Service in year t;

NNRIDt= Net NRI Deposits in year t.

β_0,β_1, β_2,β_3, β_4 and α are the parameters.

The error correction model result indicates the speed of adjustment back to long run equilibrium after a short run shock. The error correction term will explore feedback relationship among the variables like NEA, NCB, RDS and NNRID. While the parameters like α & β will explore short run influence of independent variables on FDIINFL dependent variable.

The size and statistical significance of the coefficient of the ECM measures the tendencies of each variable to return to equilibrium. Choudry (1995), said that even if the coefficient of the lagged charges of the independent variables are not statistical significant, granger causality can still exist.

3.3.3 Granger Causality Tests[xii]

Granger (1969) developed a simple procedure for testing causality. According to this test a variable x_t is said to Granger-Cause y_t, if y_t can be predicted with greater accuracy by using past values of the x_t variable rather than not using such past values, all other terms remaining same.

The Granger-causality test for the case of one equation and two variables proceeds as follows:

First, $y_t$is regressed on lagged y terms as

$$y_t=\alpha_1+\sum_{j=1}^{m}\gamma_j y_{t-j}+ u_{1t} \quad \ldots.3.4.1$$

and find restricted residual sum of squares, RSS_R

Again y_t is regressed on lagged y terms plus lagged x terms as :

$$y_t=\alpha_1+\sum_{i=1}^{n}\beta_i x_{t-i}+ \sum_{j=1}^{m}\gamma_j y_{t-j} + u_{2\,t} \quad \ldots.3.4.2$$

and obtained unrestricted residual sum of squares, RSS_U,

then, $((RSS_R-RSS_U)/m)/(RSS_U/n-k)$ follows the Fm, n-k distribution, k=m+n+1.

The null hypothesis that x_t does not cause y_t ($\sum_{i=1}^{n}\beta_i=0$) cannot accept if the computed value of F-statistic exceeds the tabulated value at a specified level of significance.

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[i] Gregory N. Mankiw, Macroeconomic, Fourth Edition

[ii] A.M. Okun, Potential GNP: Its measurement and Significant.

[iii] GFCF=GDS+NM(net import)

[iv] GDS=GNS-NY-NCT(net income from abroad (NY), and net current transfers (NCT)) or GDP-C

[v] Net= Internal Financial Flow –External Financial Flow (i.e. External Assistance, Commercial Borrowing, NRI Deposits)

[vi] Narayan Paresh Kumar and Smyth Russel, Structural Breaks and Unit Roots in Australian Macroeconomic Time Series, Monash University, Caulfield East, VIC,3145

[vii] D.N.Gujrati, Basic Econometic, 4th Edition

[viii] faculty.washington.edu/ezivot/econ584/notes/unitroot.pdf

[ix] faculty.washington.edu/ezivot/econ584/notes/unitroot.pdf

[x] Kerry Patterson, An Introduction to Applied Econometrics: A time series approach, 2000

[xi] http://web.uvic.ca/~dgiles/downloads/johansen/

[xii] Kerry Patterson, An Introduction to Applied Econometrics: A time series approach, 2000