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Foreign Direct Investment and Inflation Effect On Economic Growth: A Panel Data Analysis

ABSTRACT

Economic growth is one of the important issues for a country which reflect the overall condition of a country. This study is based on the effect of foreign direct investment(FDI) and inflation on economic growth(GDP) and find whether they are co-integrated or not i.e. whether one country has an effect on another country. Also FDI follow economic growth by trade openness which cause the entry of foreign company. Using a panel data set 6 countries of 3 developed and 3 developing country over the period 2000-2019 as well as the methodology of dynamic panel with unit root and co-integration tests that show results shows that there is statistically significant relationship between them.

KEY WORDS: Economic Growth, Foreign direct Investment(FDI), Inflation, Dynamic Panel.

INTRODUCTION

Any countries FDI and inflation are indicating economic growth of the country. Here the role of FDI and inflation is crucial. The effect of FDI completely changed the world economy. Over the past years the world economy witnessed lot of fluctuation in FDI flows across countries which is the evidence of globalization and it has become significant aspect in the developing as well as developed world. As developed country mostly invest in developing country which further help to grow the developed country as well as developing country. Also developed country invest on another developed country. The rate of inflation is central subject of macroeconomics policy which also effect the economic growth as it also shows the economic stability. Among many variables inflation can be stated as an important determinant of economic growth. Inflation has a negative and positive effect on the economic growth i.e. structurally inflation has a positive effect on economic growth whereas monetarists see inflation as detrimental to economic growth **(Fikirte Tsegaye Mamo,2012**). In neo classical views, inflation increases economic growth by shifting the income distribution in favour of higher saving capitalists. This increases saving cause economic growth. Also this aspect has inter-relation i.e. for FDI the country inflation rate also changes as the rate of low inflationary pressure in a country lead to increase the rate of return received from FDI. As the rate of inflation is recorded as low in a country, there is a decline in Nominal Interest Rate. Therefore, the cost of capital expenditure is less.

Here I analyse all the aspects which will help us to conclude the development of top 6 countries basis of GDP growth or economic growth and show whether FDI is the main reason for countries' improvement and also whether one country fall in GDP might be the reason other

country fall in GDP or vice versa, how this change effect the inflation and FDI of the countries. Using panel data analysis, generally FDI inflows boosted economic growth in developing countries, but not in advanced nations. This exceptional growth in FDI inflows has encouraged academic economists and policy makers put more effort to understanding the empirical relationships between GDP growth and FDI inflows. It is appropriate to consider briefly how the present study contributes to the empirical literature on FDI and economic growth. Although a numerous study has examined how FDI inflows, inflation and GDP interrelate with each other, a large majority of this work includes GDP merely as an explanatory variable in the FDI and inflation determinant function. Hence, this study explores the factors determining FDI inflows and inflation of countries during the time frame from 2000 to 2019. A dynamic panel is employed on the panel data set that incorporates data from 6 countries. The main contribution is that the paper uses a unique panel data set of economies over the period 2000-2019, while it makes use of advanced estimation techniques to reach fruitful results. Shows relationship between FDI inflows and inflation in developed and developing economies is investigated by applying the novel methodology of panel unit root and co-integration.
The paper is organized as follows- Section 2 describes the research problem of the study; Section 3 focuses on the relevance of doing this particular study; Section 4 reviews literature in details; Section 5 deals with the research gap and proposes the research objectives; Section 6 and 7 explains the data source and methodology respectively; Section 8 explains empirical analysis and finally Section 8 concludes the paper.

RESEARCH PROBLEM

Formulating the study Problem this paper examines the relationship between FDI, inflation and economic growth between developed and developing countries. Also these countries have highest level of inflow except Japan. For FDI to foreign investors has free access to capital markets in every country. It also expected to increase inflation i.e. Rate of inflation is a crucial factor in influencing the inflow of foreign investment. Also, FDI increase investment opportunities which ultimately improves economic growth.

Now, against this background the focus of this study is examine the GDP growth with data during 2000-2019 period. For understanding the GDP growth, this study looks at the problem mainly how Foreign Direct Investment (FDI) and inflation determining the GDP growth. Examine the behaviour of the developed and developing countries by carrying out unit root test and co-integration. I analyse how Foreign Direct Investment (FDI) and inflation affect the GDP growth by applying co-integration analysis. The present study concentrates on the major developed and developing countries. They are expected to be co- integrated implying that their performance will be similar in real economy. But there might be heterogeneity case for countries which I will prove later. Any changes FDI and inflation will result in a change in economy economic growth. Among all the macroeconomic variables, inflation and Foreign Direct Investment FDI are also the important factors which significantly affect GDP growth. These factors cannot be ignored because any change in any of the factors has an effect on the real economy. So, it is very important to analyse the relationship among them. Therefore, at the end this study will answer the following question; 1. Is there a significant relationship

between FDI, inflation and economic growth? If so, is that relationship a positive or a negative? 2. Whether there is presence of unit root among the variable 3. Are co-integrated among each other or not? i.e. integrated relationship between FDI, inflation and economic growth.

RELEVANCE OF THE PROBLEM

FDI and inflation plays an important role in the process of economic growth. The world economy has witnessed a boost of Foreign Direct Investment (FDI) inflows across different countries which are the most visible sign of globalization. FDI has grown at an exceptional rate since 1980s. Economic growth is the increase in the amount of the goods and services produced by an economy over time. Economists, and researchers have given considerable attention to the relationship between economic growth, foreign direct investment (FDI) and inflation in major countries. It is a widely accepted argument that openness of an economy boosts economic growth whether an economy is developed or developing. After globalization country experienced accelerated economic growth in 1980s. So here I emphasized the relation between developing and developed countries in FDI and inflation and how they effect GDP growth under panel data structure. After globalization and FDI inflow the stock market concept was emerged in the country.

There are several reasons why interaction between Foreign Direct Investment (FDI) and inflation with GDP growth must be studied. To begin with Foreign Direct Investment (FDI) and inflation are found as one of the important determinants of the process of economic growth and development. Therefore, the literature empirically examining the relationship between the inflation and FDI with GDP growth is significant because the rate of high inflation affects the inflows of FDI inflows into the economy and slows down the process of economic growth and development. In general, economists agree that Foreign Direct Investment inflows (FDI) lead to an increased rate of economic growth. A major growth- enhancing characteristic of FDI is the advanced technology that often accompanies foreign capital investment. In addition, domestic investors can also adopt this advanced technology. The roles that inflation, expected and unexpected like, might play in reducing social welfare are quite consensual as the inefficiencies generated by inflation in the allocation mechanisms of the economy are evident: the possible redistributive effects, the increase of the level of uncertainty in the economy leading to distortions in the consumption, saving and investment decisions, the increase in the degree of regressive ness of the tax systems can all lead to a reduction in the overall efficiency of the economy and to a decrease of the growth rate of the economy. So FDI and Inflation is an important issue in the context of development of a country. This study focuses on 6 countries which are differentiated as developed and developing country. In particular, certain research studies argue that openness seems to affect growth which is the intermediate link for the association between FDI and inflation. Since the mid-eighties The rapid expansion in FDI by multinational enterprises (MNEs) may be attributed to significant changes in technologies, greater liberalization of trade and investment regimes, and deregulation and privatization of markets in many countries including developing countries like India.

LITERATURE REVIEW

Several researchers examined the relationships between FDI and inflation factors which could affect the GDP growth and the results of all those studies have provided different conclusions due to differences in the combination of variables, methodologies and statistical tests used for the purpose of analysis.

To begin with **Lenka and Sharma (2014)** illustrated FDI as a Main Determinant of Economic Growth in Panel Data Analysis. FDI is a type of investment that involves the injection of foreign funds in to an enterprise that operates in a different country of origin from the investor. It plays an important role in the process of globalization during the past two decades. The study attempts to empirically investigate the determinant of economic growth. It includes FDI inflow as a percentage of GDP as the dependent variable to determine economic growth. Here real GDP Growth of the country is dependent variable whereas real GDP per capita, Population growth, secondary school attainment, saving as percentage of GDP, the inflation of country and IFDI is the inflows of FDI as a percentage of GDP as independent variable with panel data for the time period 1991-2010 on 62 countries. considered models like Fixed Effect Model, Random Effect Model, and Panel Corrected Standard Method were used for the analysis. Empirical results by Generalized Least Square (GLS) estimation show that Population, Secondary school attainment and savings are positively related with growth rate of the country, that means these are main components for economic development where as inflation and real GDP per capita are negatively related with the growth rate of the country. An inflow of FDI is a key factor for economic development. Here both inflows of FDI and GDP growth are positively related to each other, i.e. if FDI inflows coming to the country that leads to increase the economic growth and upper middle economies countries are highly correlated with GDP growth rate of the country than any other economies in the world.

Some researcher analyse the inflation effect like **Caporin and Maria (2002)** explained the relation between Inflation and Growth in some panel data evidence. Also used the effects of human capital variables (introduced by schooling rates and fertility) and on the country pooling. The analysis has been carried out by panel techniques. the effects of inflation on economic growth using a new and more updated panel where the per Capita GDP Growth Rate as the dependent variable used in all the regressions and log per Capita GDP, Inflation, inflation Standard Deviation, Public Expenditure, Investment used as a proxy of physical capital accumulation this variable is computed as the ratio of gross investment in fixed capital over GDP, Direct Foreign Investment, Public Deficit, Foreign Debt, Schooling Rate Fertility Rate as independent variables. Used test for presence of heteroscedasticity, parameter estimates are computed with random effect estimators (or GLS), the Breusch-Pagan's test statistic for random effects, also use Hausman's specification test statistics and generalised pooling test. Examine dynamic analysis by carried out via the Arellano-Bond (1991) estimator for dynamic panels. lastly point out a clear difference between industrialised and non-industrialised countries, among the last groups there is also evidence of structural differences depending on the inflation level. Our analysis has also shown that the effects of inflation on economic growth greatly varies with the average level of inflation experienced by different economies and that regressions based on a pooling strategy by the average inflation improves the explanatory power of the regressions themselves. All results are also confirmed adding dynamic effects.

Now this part I consider a paper which analyse both FDI and inflation on GDP growth such as **Alshamsi et al. (2015)** analysed the impact of inflation and GDP per capita on foreign direct investment in the case of United Arab Emirate. The foreign direct investment is dependent variables, Gross Domestic Product per capita and inflation rate are independent variables on the span of 33-year time series from the period of 1980 to 2013. This study moves to test for the stationarity of all variables included to determine their order of integration. Then ADF unit root test is applied further test for the co-integration among the variables included in the model of foreign direct investment in the Emirati economy and the test of a co-integration was conducted using the method of ARDL i.e. examining the long-run relationship between the independent and dependent variables the auto regressive distributed lag (ARDL) model is applied in this study. The findings of this study also revealed that GDP per capita had a significant positive relationship with FDI. The findings of the study revealed that real GDP per capita is positively related to FDI. The inflation rate has no impact on the foreign direct investment in the economy of UAE. On the other hand, the short-run coefficients indicate that the GDP per capita has its effect on the foreign direct investment in the Emirati economy. However, for the inflation rate, it has no effect. The coefficients of the short run introduce the dynamic adjustment of all the variables included.

RESEARCH GAP AND OBJECTIVES OF THE STUDY

Lots of researchers shown the effect of FDI and inflation on GDP growth separately to their study and they don't analyse the compare between developed and developing countries in panel data case which I will explain. This study attempts to respond to gap in the literature by examining the impact of inflation rate and FDI inflow on GDP growth between 3 developed and 3 developing countries. To start with, whether the Foreign Direct investment and inflation effect the GDP growth of the country and also which factors effect the most. Also will find the relation between FDI and inflation and examine whether FDI also a reason to change in inflation or not. Examine the co-integration between the variables in developed and developing countries, illustrate whether one country change reason for other country change as we know developed countries are main source of FDI in developing countries.

The main objective of the study is to find the relationship between FDI and inflation on GDP growth between periods 2000 and 2019. The dependent variable of the model used in this study is GDP growth and the independent variables of the model is FDI (Foreign Direct Investment) and Inflation. Analyse the major determinants of Economic growth in like inflows of FDI, inflation and determine which is more significant than others. Also take these variables on the basis of major developed and developing countries and compare the between them. Developed countries like United States, Germany, Japan and developing countries like China, India, Brazil. Also need to note that these country has highest level of FDI inflow except Japan. More precisely, establish whether a relationship exists between the level of inflation and the amount of FDI eventually received by the country and whether the improved level of FDI inflow witnessed since the adoption of 'inflation targeting', could to some extent be attributed to the change in GDP growth.

DATA

The data set used covers 6 countries over the period 2000-2019. The different countries data are collected from the World Bank's World Development Indicators (WDI) database (https://data.worldbank.org/). To examine the impact of FDI and inflation on GDP growth this paper used panel data of three developed United States, Germany, Japan and three developing countries China, India, Brazil and 3 developing countries on the basis of GDP growth.

GDP growth (annual %): Annual percentage growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Inflation, consumer prices (annual %): Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly.

Foreign direct investment, net inflows (% of GDP): Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.

METHODOLOGY

This study is to examine the effect of FDI inflow and inflation on countries growth. This study uses panel data covering the time span 2000-2019. For the purpose of analysis we have collected data from World Bank. And for analysis, the study considers the model as follows:

$$\text{GDP\_growth} = \beta_0 + \beta_1 \text{ FDI} + \beta_2 \text{ inflation} + \xi$$

Where ξ is the disturbance term and $\beta_{1,2}$ are coefficients of independent variables and β_0 is the constant term.

For the purpose of empirical findings want to estimate the effects of foreign investment, and inflation on GDP growth by execute following model.

Linear Dynamic Model: Many economic relationships are dynamic in nature and one of the advantages of panel data is that they allow the researcher to better understand the dynamics of adjustment. Equation (1) shows a dynamic relationship with the presence of a lag dependent variable (by assuming *p* period lag) among the regressors:

$$y_{it} = \phi_0 + \sum_{j=1}^{p} \phi_j y_{i,t-j} + x'_{it}\beta + u_{it} \qquad (1)$$

We decompose the error, u_{it}, into unobserved time-invariant heterogeneity, μ_i, and the idiosyncratic error component ε_{it} :

$$u_{it} = \mu_i + \varepsilon_i \qquad (2)$$

Therefore, one-way error component model in dynamic framework can be specified in the following form:

$$y_{it} = \phi_0 + \phi_1 y_{it-1} + \beta' x_{it} + \mu_i + \varepsilon \qquad (3)$$

To analyse the problems, we consider first a univariate AR (1) model for cross section units $i = 1, 2, \ldots N$:

$$y_{it} = \text{ø}_0 + \mu_i + \text{ø}_1 y_{it-1} + \varepsilon_{it} \qquad (4)$$

The stationarity restriction of (4) requires that $|\text{ø}_1| < 1$.

Since y_{it} is a function of μ_i it follows that y_{it-1} is also a function of μ_i, and y_{it-1} is correlated with the error term u_i this renders the OLS estimator biased and inconsistent even if ε_{it} are not serially correlated. To resolve this problem of endogeneity bias, one possible way is the use of instrumental variable estimator.

Arellano–Bond GMM Estimator: The instrumental variable method suggested by Anderson and Hsiao (1981) does not consider all potential orthogonality conditions. The first-difference d instrumental variable (IV) estimation method can produce consistent estimates, but these estimates are not necessarily efficient. This is because the IV method does not utilise all the available moment conditions.

Arellano and Bond (1991) developed a dynamic panel data model by utilising the orthogonality conditions that exist between lagged values of y_{it} and the disturbances ε_{it}. Derived GMM estimator for the parameters of a dynamic panel data model by taking more instruments available and identify a number of valid instruments in terms of the lag values of the dependent variable. Derived all of the relevant moment conditions for GMM estimation of a dynamic panel data model. The moment conditions are based on the first-differenced model as shown:

$$\Delta y_{it} = \phi_1 \Delta y_{i,t-1} + \Delta \varepsilon_{it}, \quad t = 2, \ldots T$$

The number of moment conditions depends on T. So, for period t, the set of valid instruments will be $(y_{i0}, y_{i1}, \ldots, y_{i,t-2})$, and moment conditions are obtained accordingly. Therefore, for $T = 4$, ($t = 2$, 3 and 4), we have 6 moment conditions: $E(\Delta \varepsilon_{i2} y_{i0}) = 0$

For GMM estimation, let we define, $g_i(\phi_1) = X_i' \left[\Delta Y_i - \phi_1 \Delta Y_{i,-1}\right] = X_i' \Delta \varepsilon_i$

Notice that $g_i(\text{ø}_1)$ is a linear function of φ_1.

Therefore, the moment condition for exogeneity becomes, $E\left(X_i' \Delta \varepsilon_i\right) = 0$

Let we define $\quad s = E\left[g_i(\phi_1) g_i'(\phi_1)\right] = E[X_i' \Delta \varepsilon_i \Delta \varepsilon_i' X_i]$

Under conditional heteroscedasticity, a consistent estimate is

$$\hat{s} = \frac{1}{N} \sum_{i=1}^{n} X_i \, \Delta \hat{\varepsilon} \Delta \hat{\varepsilon}$$

Here, $\hat{\varepsilon}_i = \Delta Y_i - \hat{\phi}_1 \Delta Y_{i,-1}$ are consistent estimates of the first-differenced residuals obtained from a preliminary consistent estimator. The sample moments used for GMM estimation are

$$g_N(\phi_1) = S_{x\Delta y} - S_{x\Delta y_{-1}} \phi_1$$

The efficient GMM estimator is obtained by solving the following problem:

$$\text{Min: } N g'_N(\phi_1) \hat{S}^{-1} g_N(\phi_1) = N \left[S_{x\Delta y} - S_{x\Delta y_{-1}} \phi_1\right]' \hat{S}^{-1} \left[S_{x\Delta y} - S_{x\Delta y_{-1}} \phi_1\right]$$

The solution is

$$\hat{\phi}_1 = \left(S'_{x\Delta y_{-1}} \hat{S}^{-1} S_{x\Delta y_{-1}}\right)^{-1} \left(S'_{x\Delta y_{-1}} \hat{S}^{-1} S_{x\Delta y}\right)$$

This estimator is known as the two-step Arellano–Bond GMM estimator.

Hausman test: To make a decision whether the fixed effect or the random effect is best fitted in a panel, we need to carry out formal testing of hypothesis. The most popular test to compare fixed and random effects models is the Hausman specification test. The null hypothesis of this test is that individual effects are uncorrelated with any regressor in the model (Hausman 1978). In other words, the null hypothesis in Hausman test is that the preferred model is random effects against the alternative the fixed effects.

For presence of heterogeneity and autocorrelation,
from Hauseman test the model follow the random effect and for this case to identify presence of heterogeneity and autocorrelation estimate the following model-

LR test: The one-sided likelihood ratio (LR) tests all have the following form:

$$\text{LR} = -2\log\frac{l(\text{res})}{l(\text{unres})}$$

where l(res) denotes the restricted maximum likelihood value (under the null hypothesis), while l(unres) denotes the unrestricted maximum likelihood value. The LR tests require MLE estimators of the one-way and the two-way models and are comparatively more expensive than their LM counterparts.

For cross section dependency and unit root test,
From the cross section dependency, I will identify whether the model follow first or second generation of unit root. It's mainly follow second generation and in second generation we use Pesaran test and Fisher test but here I consider only Pesaran test as it's give significant result.

Pesaran's CD test: For cross section dependency

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right)$$

and showed that under the null hypothesis of no cross-sectional dependence $CD \rightarrow^{d} N(0,1)$ for $N \rightarrow \infty$ and T sufficiently large.

Pesaran (2003) Test: Pesaran (2003) developed a simple method for testing unit roots under cross-sectional dependence with serially correlated errors. Suppose that y_{it} is generated by the following process:

$$y_{it} = \mu_i + \phi_i y_{it-1} + u_{it} \quad (1)$$

where μ_i is a deterministic component, and the random disturbance is

$$u_{it} = \lambda_i F_t + \varepsilon_{it} \quad (2)$$

From (1) and (2), we have

$$\Delta y_{it} = \mu_i + (\phi_i - 1) y_{it-1} + \lambda_i F_t + \varepsilon_{it} \quad (3)$$

The hypothesis to be tested is

$$H_0: \emptyset_i = 1, \forall i$$

Against the alternative

$$H_1: \begin{cases} \phi_i < 1, \ i = 1, 2, \ldots . N_1 \\ \phi_i = 1, \ i = N_1, 2, \ldots . \boldsymbol{N} \end{cases}$$

In this model, the cross-sectional average of y_t and its lagged values are used as a proxy for the unobserved common factor F_t.

Pesaran's (2003) unit root test is based on the Dickey–Fuller regression augmented with the cross section averages of lagged levels and first differences of the individual series.

$$\Delta y_{it} = \alpha_{1i} + \alpha_{2i} y_{i,t-1} + \alpha_{3i} \bar{y}_{t-1} + \alpha_{4i} \Delta \bar{y}_t + e_{it} \qquad (4)$$

Cross section-specific Augmented Dickey–Fuller (CADF) statistic is obtained from the estimated coefficient $\hat{\alpha}_{2i}$ of Eq. (4) for the i-th cross section unit. The asymptotic null distributions of the CADF statistics are similar and independent of the factor loadings.

Pesaran (2003) used Fisher-type tests which are based on the levels of significance of the individual CADF statistics. Pesaran also modified the *IPS t*-bar test statistic for testing unit root in the presence of cross-sectional dependence and residual serial correlation. This statistic known as cross section-specific augmented IPS test statistic (CIPS):

$$\text{CIPS} = \frac{\sum_{i=1}^{N} \text{CADF}i}{N}$$

For Co-integration test,

There are two types of approach of panel cointegration i.e. one is residual based and another is maximum likelihood based. Here I estimate for residual based Pedroni's co-integration test,

Pedroni's co-integration test: Pedroni (1999, 2004) also proposed several tests for the null hypothesis of co-integration in a panel data model that allows for considerable heterogeneity. His tests can be classified into two categories. The first is group mean statistics (between dimension) and for the second it is panel statistics (within dimension). The test can include time dummies to address cross-sectional dependency by the demeaning the data for each variable as follows: $\bar{\text{y}}_{\text{t}} = \frac{\sum_{i=1}^{N} \bar{y}_{it}}{N}$

To compute the test statistics, we have considered the model:

$$y_{it} = \alpha_i + \beta_{1i} x_{1it} + \beta_{2i} x_{2it} + \cdots \ldots \ldots . + \beta_{ki} x_{kit} + e_{it} \qquad (1)$$

The within dimension based test statistics, panel-ρ and panel-t are computed by taking the first difference of the original series and estimating the residual we have:

$$\Delta y_{it} = \sum_{i=1}^{k} \beta_{ji} \Delta x_{jit} + v_{it}$$

$$\hat{e}_{i,t} = \hat{\gamma}_i \hat{e}_{i,t-1} + \hat{\mu}_{i,t}$$

$$\hat{e}_{i,t} = \hat{\gamma}_i \hat{e}_{i,t-1} + \sum_{k=1}^{K} \hat{\gamma}_{i,k} \Delta \hat{e}_{i,t-k} + \hat{\mu}^*_{i,t}$$

where $i = 1,2,...,N$ is the number of individuals in the panel, $t = 1,2,...,T$ is the number of time periods, $m = 1,2,...,M$ is the number of regressors, and $k = 1,2,...,K$ is the number of lags in the ADF regression (selected automatically by xtpedroni with several available options). A linear time trend $\delta_i t$ can be inserted into the regression at the user's discretion.

Next, several series and parameters are calculated from the regressions above.

$$\widehat{s}_i^{*2} = \frac{1}{T}\sum_{t=1}^{T}\widehat{\mu}_{i,t}^{*2}, \qquad \widetilde{s}_{N,T}^{*2} = \frac{1}{N}\sum_{n=1}^{N}\widehat{s}_i^{*2}$$

$$\widehat{L}_{11i}^{-2} = \frac{1}{T}\sum_{t=1}^{T}\widehat{\eta}_{i,t}^2 + \frac{2}{T}\sum_{s=1}^{k_i}(1-\frac{s}{k_i+1})\sum_{t=s+1}^{T}\widehat{\eta}_{i,t}\widehat{\eta}_{i,t-s}$$

$$\widehat{\lambda}_i = \frac{1}{T}\sum_{s=1}^{k_i}(1-\frac{s}{k_i+1})\sum_{t=s+1}^{T}\widehat{\mu}_{i,t}\widehat{\mu}_{i,t-s}$$

$$\widehat{s}_i^2 = \frac{1}{T}\sum_{t=1}^{T}\widehat{\mu}_{i,t}^2, \quad \widehat{\sigma}_i^2 = \widehat{s}_i^2 + 2\widehat{\lambda}_i, \quad \widetilde{\sigma}_{N,T}^2 = \frac{1}{N}\sum_{n=1}^{N}\widehat{L}_{11i}^{-2}\widehat{\sigma}_i^2$$

The seven statistics can then be constructed from the following equations:

panel v: $T^2N^{\frac{3}{2}}(\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{L}_{11i}^{-2}\widehat{e}_{i,t-1}^2)^{-1}$

Panel ρ: $T\sqrt{N}(\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{L}_{11i}^{-2}\widehat{e}_{i,t-1}^2)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{L}_{11i}^{-2}(\widehat{e}_{i,t-1}\Delta\widehat{e}_{i,t} - \widehat{\lambda}_i)$

Panel t: $(\widetilde{\sigma}_{N,T}^2\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{L}_{11i}^{-2}\widehat{e}_{i,t-1}^2)^{-\frac{1}{2}}\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{L}_{11i}^{-2}(\widehat{e}_{i,t-1}\Delta\widehat{e}_{i,t} - \widehat{\lambda}_i)$

Panel ADF: $s_{N,T}^{*2}\sum_{i=1}^{N}\sum_{t=1}^{T}L_{11i}^{-2}\widehat{e}_{i,t-1}^{*2})^{-\frac{1}{2}}\sum_{i=1}^{N}\sum_{t=1}^{T}L_{11i}^{-2}\widehat{e}_{i,t-1}^{*}\Delta\widehat{e}_{i,t}^{*}$

Group ρ: $T\frac{1}{\sqrt{N}}\sum_{i=1}^{N}(\sum_{t=1}^{T}\widehat{L}_{11i}^{-2}\widehat{e}_{i,t-1}^2)^{-1}\sum_{t=1}^{T}(\widehat{e}_{i,t-1}\Delta\widehat{e}_{i,t} - \widehat{\lambda}_i)$

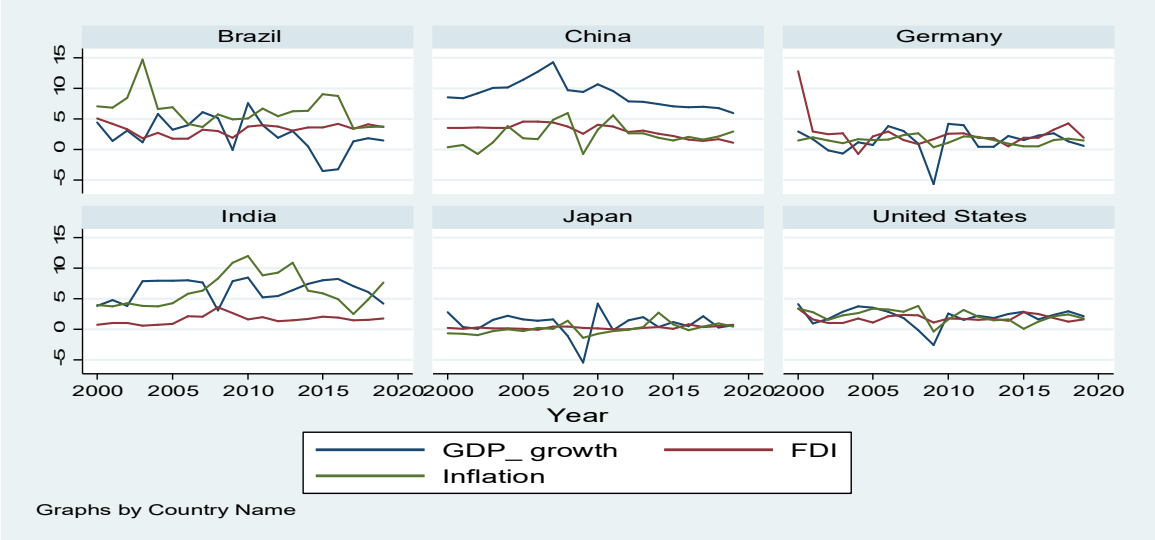
Group t: $\frac{1}{\sqrt{N}}\sum_{i=1}^{N}(\widehat{\sigma}_i^2\sum_{t=1}^{T}\widehat{e}_{i,t-1}^2)^{-\frac{1}{2}}\sum_{t=1}^{T}(\widehat{e}_{i,t-1}\Delta\widehat{e}_{i,t} - \lambda_i)$

Group ADF: $\frac{1}{\sqrt{N}}\sum_{i=1}^{N}(\sum_{t=1}^{T}\widehat{s}_i^{*2}\widehat{e}_{i,t-1}^{*2})^{-\frac{1}{2}}\sum_{t=1}^{T}\widehat{e}_{i,t-1}\Delta\widehat{e}_{i,t}$

The test statistics are then adjusted so that they are distributed as $N(0,1)$ under the null. These test statistics are panel and group of v, rho, t, adf. t computes Pedroni's group mean Panel Dynamic Ordinary Least Squares estimates. Very briefly, it extends the Dynamic OLS technique of estimating the co-integrating vector in a single equation to panel time series data (medium to large N, large T). Dynamic OLS involves adding lags and leads of the regressors to eliminate feedback effects and endogeneity.

EMPIRICAL FINDINGS

The main attention of this paper was to see the relationship between FDI, inflation and economic growth, and to examine the relationship between them with the help of STATA software. This section contains the panel results and interpretation of the results. It entails the application of statistical techniques to provide the basis for the testing of the research hypotheses.



From the above figure I analyse the trending behaviour of the developed and developing countries and we know that FDI inflow comes from developed to developing countries so there might be chance that if some change in developed countries affect the developing countries as well like in 2008 US stock market clash has a huge impact on the world economy that might be the reason of downfall in GDP of other countries as well like in fig the around 2008 the GDP growth fall as well the FDI inflow and the inflation for this the all other countries GDP also falls except China though FDI more or less stagnant throughout the period but in inflation there is more fluctuation and for India around 2008 and its increasing.

Here cross section variable is Code and country and time series variable is years and its strongly balanced where the no. of cross section units is 6 and time series is 20. Describe summary statistics of each and every variable, find that the values for country is missing because country in original data is in string format. Estimate Panel data analysis including OLS pooled regression i.e. a linear regression model not consider time dimension. Here R^2 value is high means the explanatory power of the model is high. Also find in MLRM model the FDI and inflation has positive coefficient but FDI is positively significant with GDP growth but inflation is positively insignificant because the inflation negatively affected growth by reducing investment, and by reducing rate of productivity growth. Where as in compare with FDI and inflation I get positively highly significant with each other as. A high inflation rate also impacts capital preservation of foreign investment. It affects profitability as higher prices can lead to increased costs and lower profits. So, stable inflation rate is desirable to attract foreign capital.

Now from the scatter diagram which is linearly fit where I find the values are close to fitted line from the relation between GDP and FDI or inflation and also for FDI and inflation though

for 1st case the they belong to upper part of the fitted line whereas for 2nd case FDI and inflation belongs to lower part of the fitted line and because of the high value of R^2 the less values are outside. Also in OLS estimates are highly disputable and regressor and error are not correlated. But in reality regressor is related to error term then endogeniety may not hold. In panel we can eliminate the problems i.e. in panel we can identify true effect even there is presence of heterogeneity occur. So now move to panel model, in panel we can resolve the heterogeneity problem in μi and λi, they are unobserved. If they are stochastic then RE. Here I have within estimation and mean corrected estimation, it eliminates the unobserved heterogeneity after elimination we can use OLS. In LSDV model it uses dummy variables for the cross section units and the coefficient of dummy variables measure the unobserved heterogeneity and also find maximum likelihood estimates. It is evident that the results of the Wald test and F-test are significant at a 1% level of significance in all panel-data models but only for FDI and not for inflation. Therefore, conclude that can reject the null hypothesis that the FDI do explain GDP per capita. Also inflation rate, which is the indicator of economic instability, has a positive insignificant impact on FDI. According to the test results random effects were significant, suggesting that a random effects model is superior to pooled OLS model and also LSDV gives better result than pooled regression. In case of the Hausman test, we accept the null hypothesis of correlation between countries unobservable individual effects and economic growth determinants. This implies that for our analysis, a random-effect model is more appropriate. However, if I compare the sign and significance of coefficients associated with the respective variables, find that results reported in FE and RE are the same (except the inflation that is insignificant for both the random-effect model and the fixed-effect model). Also suggests that degree of openness of the economies plays a crucial role in attracting FDI i.e. FDI and its higher inflow in the countries, contribute to higher growth. Also analyse the random-effect model by assuming the period-specific effect which is also random. find that in this case FDI have positive impact on the economic growth i.e. higher inflows of FDI have positive and significant where as inflation has negative and insignificant effect on the economic growth of our panel countries. After that to address the problem of heteroscedasticity and auto correlation in the data, I use several methods like Wooldridge test for autocorrelation in panel data, modified Wald and likelihood ration test for group wise heteroscedasticity in random effect regression model and found that the heteroscedasticity and autocorrelation available in the data (Table-1).

Study also analyses an alternative econometric approach to the normal panel data so as to use a dynamic Panel data framework of Arellano and Bond (1991) model including lags of dependent and independent variables in the estimation. The empirical method adopted for estimation is the panel data approach. Panel data techniques are now widely used to estimate dynamic econometric models in order to capture dynamic effects. So extend my study allowing for the presence of dynamic effects in the regressions and also the impact of cross section dependency in dynamic model estimator is more severe. Observed Anderson and Hsiao test rejected the validity of the instrumental variables i.e. there is no endogeniety problem. Now considered dynamic effects only up to 2 lag. Focusing on countries can observe that in all cases past GDP growth rate affect positively current growth rate. For inflation none on the sign are changed, the positive effect remains. A curious result came that on inflation that seem to positively and significantly affect economic growth at lag 2 because if inflation is increasing,

people will spend more money because they know that it will be less valuable in the future and This causes further increases in GDP but FDI effect negative and significantly for GDP growth at lag 2 because FDI inflows into the primary sector tend to have a negative effect on growth.
Now, from the figure exist several peak points in the respective graph which indicates the non-stationary behaviour of the series. So checking for unit root becomes important. There are two generations in unit root test i.e. first generation and second generation. first generation based on assumption cross section independent whereas second generation assume cross section dependency. To identify which generation is the needed to follow we run for cross section dependency by using Pesaran (2004) test. Also in the Pesaran (2004) test for residual for cross section dependency in ordinary least square and mean group both the cases it rejects the null hypothesis means presence of cross section dependency but in Pesaran (2015) test found that they are weekly dependent for ordinary least square case but strongly depended for the mean group case. Now test unit root for the Pesaran and Fisher unit root test where the series significantly follow only Pesaran test i.e. FDI and GDP growth the variable follow unit root with accept of null hypothesis at 5% critical value though for inflation the case is different it rejects the null hypothesis at 5% critical level i.e. the series is stationary (Table-2). In jointly running 1st and 2nd generation panel unit root tests for multiple variables and lags by using the Maddala and Wu (1999) and the Pesaran (2007) panel unit root tests, found that GDP strongly accept null hypothesis means presence of unit root for both lag 1 period of the countries, for FDI it accepts null hypothesis at lag 1 only not for lag 0 whereas for inflation the series follow alternative hypothesis for both the cases but in with trend lag 0 it follows nonstationary. Though I check for first generation test where both FDI and inflation follow the Levin, Lin and Chu test for presence of unit root test, it means first generation model fails to capture the heterogeneity and dependency.
As the series is non-stationary that mean the possibility of co-integration among them. Though some of the cases it reject null hypothesis that not mean the series follow stationarity beacause the alternative hypothesis is that some variable follow stationarity and some are not that mean there may be nonstationary presence. So the running for co-integration is justified for the model. Here we use Pedroni's co-integration test (Table-3). Here we get two tables one for panel statistics and another group statistics distribution. it allows Stata users to compute Pedroni's seven test statistics under a null of no cointegration in a heterogeneous panel with one or more nonstationary regressors. In Panel Dynamic OLS, a DOLS regression is conducted for each individual, and the results are combined for the entire panel following Pedroni's group mean approach. Variables must exhibit cointegration to be used here. Here I reject null hypothesis for panel and group t andρ at 5% significant level except for v test and accept null hypothesis means cointegration occurs. Also for Pedroni's panel ordinary least square case I reject null hypothesis for both DI and inflation. So FDI and inflation are co-integrated with GDP growth. Analyse co-integration for individual countries that all the countries the FDI and GDP growth are cointegrated with each other except unit 6 I.e. US the FDI is not co-integrated with GDP growth. Now I look for whether FDI and inflation is co-integrated with each other or not, here I examine that for all the countries whether it's developing or developed inflation is cointegrated with FDI except for china where inflation is not related with FDI. They are expected to be co- integrated implying that their performance will be similar in real economy.

Clearly the study interprets the FDI and inflation significant effect the GDP growth and whether calculating separately or jointly it's gives the satisfactory result i.e. for individual countries the FDI and inflation effect the GDP growth and also inflation has effect on FDI and jointly countries FDI and inflation are related with countries GDP.
In the series consider test for multiple breaks at unknown break dates with use of Ditzen, Karavias & Westerlund (2021) test, I found there is total 5 breaks in the series and the estimated break points are 2002, 2005, 2008, 2011, 2014.

CONCLUSION

The study gives an insight in between the FDI and economic growth. From various literatures I concludes that FDI and inflation is playing a significant role in the growth of the economy. Suggest that FDI is an important source of capital, compliments domestic private investment associated with new job opportunities and enhancement of technology transfer and boosts overall economic growth of the countries where as for inflation measure the economic stability of the country when inflation is high, the cost of living gets higher as well, which ultimately leads to a deceleration in economic growth and money generally loses its value over time, it is important for people to invest the money and Investing ensures the economic growth.

The main contribution is that the paper uses a unique panel data set of economies over the period 1981-2004, while it makes use of advanced estimation techniques to reach fruitful results. Thus, for the first time the presence and most importantly the direction of a relationship between FDI and inflation in developed and developing economies is investigated by applying the novel methodology of panel unit root and panel co-integration in dynamic panel. There are strong reasons to believe that there is significant heterogeneity and autocorrelation presence in cross-country FDI and inflation relationship. Also presence of cross section dependency and which further help us to test for unit root where I found that the GDP and FDI series is nonstationary with acceptance of null hypothesis though the inflation is stationary with rejection of null hypothesis. The reason behind non-stationarity of GDP and FDI is that presence of structural break in the series like in the 2008-09 the stock market clash in United States has gone through several changes. So structural break in the series, for this we need to incorporate the break but gives further complication of the study. Applying panel co-integration techniques in dynamics model. This will enable us to generate more credible results since panel data estimation capture the co-integrated relation between FDI, inflation and GDP growth and I found they are co-integrated with each other where FDI positively and inflation negatively related GDP growth which is theoretically satisfied. If the inflows of FDI to the country increase it will help to increase capital formation and will fill the gap between domestic savings and investments. If saving increases, it will increase the investment as well as capital formation in the host country and the production will increase and it will help to increase per capita income and standard of living. During the phase of economic boom, the aggregative level of economic activity is high reflecting in a rising level of FDI and inflation. A high inflation rate also impacts capital stock of foreign investment. It affects profitability as higher prices can lead to increased costs and lower profits. More specifically, macroeconomic stability in terms of a low inflation rate, efficient markets in terms of institutions, trade openness, GDP per capita and better infrastructure are important determinants of FDI.

BIBLIOGRAPHY:

Alshamsi K. H., Hussin M. R.& Azam M. (2015). The impact of inflation and GDP per capita on foreign direct investment: the case of United Arab Emirates. Investment Management and Financial Innovations, 12(3-1), 132-141.

Caporina M. & Di Mariab C. Inflation and Growth: some panel data evidence. Working Paper N.02.09 December 2002. https://www.researchgate.net/publication/228456928

Kotrajaras P., Tubtimtong B., and Wiboonchutikula P.(2011). Does FDI Enhance Economic Growth? New Evidence from East Asia. ASEAN Economic Bulletin. Vol. 28, No. 2

Lenka S. K. & Sharma P. (2014). FDI as a Main Determinant of Economic Growth: A Panel Data Analysis. Annual Research Journal of Symbiosis Centre for Management Studies, Pune Vol. 1, 84–97

Mustafa A. M. M. The Relationship between Foreign Direct Investment and Inflation: Econometric Analysis and Forecasts in the Case of Sri Lanka. (2019). Canadian Center of Science and Education Journal of Politics and Law. Vol. 12, No. 2;

APPENDIX

Table – 1 Heteroscedasticity and auto correlation

Likelihood-ratio test	GDP_growth and FDI	GDP_growth and Inflation
LR chi2(5)	44.46	59.69
Prob > chi2	0.0000	0.0000

Wooldridge test for autocorrelation in panel data
H_0: no first order autocorrelation

	GDP_growth FDI	GDP_growth Inflation
F(1,5)	7.602	6.727
Prob >F	0.0400	0.0486

Table – 2 Unit root test

Pesaran's CADF test
Cross-sectional average in first period extracted and extreme t-values truncated
Deterministic chosen: constant
t-bar test, N, T = (6,20) Obs. = 108
Augmented by 1 lags (average)

	t-bar	cv10	cv5	cv1	Z[t-bar]	P-value
GDP_growth	-1.609	-2.210	-2.340	-2.600	0.289	0.614
FDI	-1.962	-2.210	-2.340	-2.600	-0.552	0.290
Inflation	-2.635	-2.210	-2.340	-2.600	-2.152	0.016

Table – 3 Co-integration

Pedroni's cointegration tests:
Data has not been time-demeaned.

				Test Stats. |		
No. of Panel units	Regressor	No. of obs	Avg obs. per unit:		Panel	Group
6	2	120	20	v	.7943	
				rho	-2.091	-.9761
				t	-4.173	-4.34
				adf	-.7853	-.3778

All test statistics are distributed N (0,1), under a null of no cointegration,
and diverge to negative infinity (save for panel v).

Pedroni's PDOLS (Group mean average): Data has not been time-demeaned.

No. of Panel units:	Lags and leads	No. of obs.:	Avg obs. per unit:	Test Stats.		
6	2	90	15	FDI	8.888	10.02
				Inflation	-1.768	-39.78