# ECONOMETRICS PROJECT



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I have done two separate study on economic growth-

Study-1:

The Impact of Foreign Debt on Economic Growth: A panel Data Analysis of Lower income, lower middle income and upper middle income Countries.

Study-2:

The Impact of Remittances on The Economic Growth on South Asian Countries: A Panel Data Analysis.

# Study- 1 :The Impact of Foreign Debt on Economic Growth: A panel data Analysis of Lower income, lower middle income and upper middle income countries.

## Introduction:

Foreign debt has been a critical issue for developing countries, especially those in lower income, lower middle income, and upper middle-income categories. The accumulation of foreign debt can lead to financial vulnerabilities and economic instability. Therefore, understanding the relationship between foreign debt and economic growth is crucial for policymakers and researchers alike. This study investigates the impact of foreign debt on economic growth for 66 countries over a 25-year period, with a focus on lower income, lower middle-income, and upper middle-income countries. The study employs panel data analysis and includes control variables such as Gross fixed capital formation (% of GDP), Trade (% of GDP), Inflation, consumer prices (annual %), Population growth (annual %), and FDI net inflows (% of GDP) variables. The study's findings provide insights into the impact of impact of Foreign Debt on Economic Growth of Lower income, lower middle income and upper middle income countries. Foreign debt has a major economic impact, both in the short and long term. Thus, in this study we also find the long impact of lower income, lower middle-income, and upper middle-income countries.

## Data source:

This study employs panel data analysis to investigate the impact of foreign debt on economic growth across 66 countries( lower income, lower middle income , upper middle income countries) with data spanning over 25 years(1997-2021). Data has been collected from world bank site.

## Model specification:

The model used in the study shows the relation between foreign debt and economic growth. In this study GDP per capita growth (annual %) used as s a proxy to measure economic growth, and to represent the foreign debt In this study Total debt service (% of exports of goods, services and primary income) and External debt stocks (% of GNI) used as a proxy measure. Now the control variables that are used in this study are: Gross fixed capital formation (% of GDP) is used as a proxy to measure capital accumulation in the economy. Trade openness measures as Trade (% of GDP) included to examining the impact of trade liberalization on economic growth. Foreign direct investment ( FDI ), net inflows (% of GDP) is an essential factor for economic growth in the developing countries for that reason, it is used as an independent variable in the model. . Population growth (annual %) is also used as a control variable in the model to see the effects of it. Inflation, consumer prices (annual %) is also included in the model because it is an important determinant of economic growth. and also inflation is added to the model a control variable to ensure that the estimated relationship between foreign debt and economic growth is not spurious or biased due to the effects of inflation. In the model or in this study GDP per capita growth (annual %) is the dependent variable and Total debt service (% of exports of goods, services and primary income) and External debt stocks (% of GNI) are the independent variables. This variables are used to see the impact of Foreign Debt on Economic Growth on Lower income, lower middle income and upper middle income countries.

## The Econometric Model:

$$GDP\_pcg_{it} = \alpha_0 + \alpha_1 Tot\_debt\_serv_{it} + \alpha_2 Ext\_debt\_st_{it} + \alpha_3 GFCF_{it} + \alpha_4 Trade_{it} + \alpha_5 Inf\_cp_{it} + \alpha_6 Pop\_gro_{it} + \alpha_7 FDI\_Inflow_{it} + u_{it}$$

Where,

I = Cross section dimensions.

t = Time-series dimensions.

$u_{it}$ = Error term.

$\alpha_0$= Intercept .

$GDP\_pcg_{it}$ = GDP per capita growth.

$Tot\_debt\_serv_{it}$= Total debt service.

$Ext\_debt\_st_{it}$= External debt stocks.

$GFCF_{it}$= Gross fixed capital formation.

$Trade_{it}$= Trade percentage of GDP.

$Inf\_cp_{it}$= Inflation, consumer prices annual percentage.

$Pop\_gro_{it}$= Population growth annual percentage.

$FDI\_Inflow_{it}$= Foreign direct investment ( FDI ), net inflows percentage of GDP.

## METHODOLOGY:

This study employs panel data analysis to investigate the impact of foreign debt on economic growth across 66 countries with data spanning over 25 years. For this study we use the following method in stata software.

- Descriptive statistic.
- Panel Unit Root Test.
- Fixed Effect Model
- Panel ARDL/PMG

### Fixed Effect Model

It is unusual, and when $W_i$ is not regulated and has a connection with Kit, we face a complicated situation. In such a case, OLS estimates will be biased and not consistent because the model has an omitted variable. However, under this condition, the model.

$$Y_{it} = k_{it}\beta + \alpha_i + \varepsilon_{it}$$

Where $\alpha_i = W_i$ α, has all those effects that can be observed, and it enumerates an estimable conditional mean. The Fixed Effect Model considers αi to be a country-specific intercept in the regression model.

## Panel Unit Root Test

The general form of the Panel Unit Root test can be written as we conclude that Economic growth, Initial GDP Schooling, FDI, and FD are stationary at the order I(0), and other variables are at the order I(1).

$$\Delta y_{it} = \rho_i y_{it-1} + z'_{it}\gamma + \mu_{it}$$

Where i= 1,2,.....,N is the individual , for each individual = 1,2,.....,T time series observations are available, $z'_{it}$ shows deterministic component and $\mu_{it}$ indicates the stationary process.

## Panel Autoregressive Distributive Lag (Ardl)/Pmg Approach

The study has used a panel ARDL econometric technique for the estimation of the long-run relationship among the variables. The Panel ARDL model is also called the Panel Mean Group (PMG). The ARDL methodology prevents Endogeneity because it can distinguish between dependent and explanatory variables and can simultaneously estimate the long-term and short-term components of the model. ARDL approach to Cointegration has several advantages and having superiority over other econometric techniques used to find out long-run relationships.

Beside this tests To ensure the validity of the results, a series of diagnostic tests were conducted like heteroskedasticity, serial correlation etc.

## EMPIRICAL RESULTS AND ANALYSIS:

- **Descriptive statistics:**

```
. summarize GDP_pcg Tot_debt_serv Ext_debt_st GFCF Trade  Inf_cp Pop_gro FDI_Inflow
```

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| GDP_pcg | 1,650 | 2.493808 | 4.138753 | -17.17671 | 33.03049 |
| Tot_debt_s~v | 1,650 | 14.57042 | 12.77432 | .1834247 | 133.1774 |
| Ext_debt_st | 1,650 | 47.16362 | 31.81247 | 1.154187 | 283.2539 |
| GFCF | 1,650 | 22.29755 | 6.521849 | 3.462294 | 57.71025 |
| Trade | 1,650 | 71.11159 | 31.78758 | .7568755 | 186.4682 |
| Inf_cp | 1,649 | 8.171257 | 30.16107 | -8.52517 | 1058.374 |
| Pop_gro | 1,650 | 1.476272 | 1.215425 | -3.207518 | 13.24707 |
| FDI_Inflow | 1,650 | 3.529764 | 4.310431 | -37.17265 | 55.0703 |

- **Panel Unit Root Test Results:**

To check the stationarity of data, This study uses Im, Pesaran and Shin Unit Root Test (Im, Pesaran & Shin, 2003) or IPS panel unit root test. From the IPS panel unit root test , we conclude that GDP_pcg,

Tot_debt_serv, GFCF, Trade, Inf_cp, FDI_Inflow are stationary at the order I(0) or we can say they are stationary at level, and Ext_debt_st, Pop_gro are at the order I(1) or they are stationary at first difference. We can see the stata results for GDP_pcg below. Other variable results are in the log file I attached with it.

```
. xtunitroot ips GDP_pcg, trend

Im-Pesaran-Shin unit-root test for GDP_pcg
-----------------------------------------

Ho: All panels contain unit roots           Number of panels  =     66
Ha: Some panels are stationary              Number of periods =     25

AR parameter: Panel-specific                Asymptotics: T,N -> Infinity
Panel means:  Included                                   sequentially
Time trend:   Included

ADF regressions: No lags included
------------------------------------------------------------------------------
                                                Fixed-N exact critical values
                     Statistic      p-value         1%      5%      10%
------------------------------------------------------------------------------
t-bar                 -4.4655                    -2.370  -2.310  -2.280
t-tilde-bar           -3.2233
Z-t-tilde-bar        -18.7415        0.0000
------------------------------------------------------------------------------
```

- **Hausman Test Results:**

Hausman test results are presented below , reject the null hypothesis that random effect is appropriate. On the basis, the Hausman test results suggest fixed effect model is appropriate for the estimation of the model. Null hypothesis rejected at 1% significant level.

```
. hausman fe re

                 ---- Coefficients ----
                |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                |       fe           re         Difference          S.E.
----------------+----------------------------------------------------------------
Tot_debt_s~v    |    -.02278    -.0265406        .0037606        .0056366
 Ext_debt_st    |  -.0226094     -.016573       -.0060363        .0023612
        GFCF    |   .0009006    .0636384       -.0627378        .0121319
       Trade    |   .0475444    .0114117        .0361327        .0057586
      Inf_cp    |  -.0145015    -.0139095        -.000592        .0002241
     Pop_gro    |  -.9533939    -.7818193       -.1715747        .1242379
  FDI_Inflow    |   .1590851    .1609592       -.0018741        .0091772
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       56.10
                Prob>chi2 =      0.0000
```

- **Fixed Effect Model Results:**

The results presented in below reveal that the coefficient of Tot_debt_serv is negative and significant at 5 % significance level, so one percent increase in Tot_debt_serv reduce economic growth in our case GDP_pcg by 0.02 percent. Ext_debt_st or external debt stocks also has a negative and significant relationship with economic growth. The result is significant at 1%. The value of the coefficient is .02.

```
. xtreg GDP_pcg Tot_debt_serv Ext_debt_st GFCF Trade Inf_cp Pop_gro FDI_Inflow, fe

Fixed-effects (within) regression               Number of obs      =      1,650
Group variable: country                         Number of groups   =         66

R-sq:                                           Obs per group:
     within  = 0.1276                                         min =         25
     between = 0.1597                                         avg =       25.0
     overall = 0.1011                                         max =         25

                                                F(7,1577)          =      32.94
corr(u_i, Xb)  = -0.5466                        Prob > F           =     0.0000

------------------------------------------------------------------------------
     GDP_pcg |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Tot_debt_serv |  -.0226615   .0117636    -1.93   0.054    -.0457355    .0004125
  Ext_debt_st |  -.0226544    .004887    -4.64   0.000    -.0322401   -.0130687
        GFCF |   .0013754   .0222042     0.06   0.951    -.0421774    .0449283
       Trade |   .0473287   .0075184     6.30   0.000     .0325815    .0620759
      Inf_cp |  -.0144968   .0030684    -4.72   0.000    -.0205155   -.0084782
      Pop_gro |  -.9547505   .1673406    -5.71   0.000    -1.282984   -.626517
   FDI_Inflow |   .1588456   .0274154     5.79   0.000     .1050712     .21262
        _cons |   1.463357   .7268262     2.01   0.044     .0377091    2.889004
-------------+----------------------------------------------------------------
      sigma_u |   2.148853
      sigma_e |   3.5726973
          rho |   .26565639   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(65, 1577) = 4.06                     Prob > F = 0.0000
```

Gross fixed capital formation or GFCF is positively related to economic growth, but the result is insignificant. Trade also has a positive and significant relationship with economic growth. The result is significant at 1%. Inflation is negative relation with economic growth. The result is significant at 1%. One perscent increase in inflation reduce the economic growth by 0.1 percent. Pop_gro is negatively related to economic growth , result is significant at 1%. FDI_inflow also has a positive and significant relationship with economic growth. The result is significant at 1%. The value of the coefficient is .15. One percent increase in FDI_inflow accelerate economic growth by 0.15 %.

## To ensure the validity of the results, I use a series of diagnostic tests

- **Breusch and Pagan Lagrangian multiplier(LM) test:**

After random effect , we test for "Breusch and Pagan Lagrangian multiplier test for random effects". And from the result we get that , here we can reject the null and conclude that random effects is appropriate. Therefore we cann't run a simple ols regression in this study.

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        GDP_pcg[country,t] = Xb + u[country] + e[country,t]

        Estimated results:
                     |       Var     sd = sqrt(Var)
             ---------+-----------------------------
             GDP_pcg |   17.12927       4.138753
                   e |   12.76417       3.572697
                   u |   1.044484          1.022

        Test:   Var(u) = 0
                             chibar2(01) =   106.38
                          Prob > chibar2 =   0.0000
```

- **Testing for Contemporaneous Correlation: Breusch-Pagan LM test for independence:**

-xttest2

Breusch-Pagan LM test of independence: chi2(2145) = 7009.707, Pr = 0.0000

Based on 25 complete observations over panel units

from the result we can conclude that there is significant contemporaneous correlation in the panel data as there is sufficient evidence to reject the null hypothesis of homoscedasticity or interdependence of residuals.

- **Testing for Contemporaneous Correlation: Pagan CD test:**

```
. xtcsd, pesaran abs


Pesaran's test of cross sectional independence =    61.329, Pr = 0.0000

Average absolute value of the off-diagonal elements =     0.304
```

From the result we can conclude. As p value is 0.000 which indicates evidence of contemporaneous correlation in the data. And the average absolute value of the off-diagonal elements is 0.304. This value suggest that there is a moderate degree of contemporaneous correlation between the error terms in the panel data.

- **Testing for serial correlation:**

```
. xtserial GDP_pcg Tot_debt_serv Ext_debt_st GFCF Trade Inf_cp Pop_gro FDI_Inflow

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      65) =      4.045
           Prob > F =      0.0485
```

The null is no serial correlation. Here we reject the null and conclude that data has autocorrelation present.

- **Testing for Heteroskedasticity:**

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (66)  =    4715.49
Prob>chi2 =      0.0000
```

The null is homoskedasticity ( or constant variance ), we reject the null and conclude heteroskedasticity problem.

For this reason we use robust fixed effects model

- **Robust Fixed-Effects Model:**

Because there exists heteroskedasticity and other problems we use robust fixed effect model. The findings of this model presented in below reveal that the coefficient of Tot_debt_serv is negative and insignificant. Ext_debt_st or external debt stocks also has a negative and significant relationship with economic growth. The result is significant at 1%. The value of the coefficient is .02. so one percent increase in Ext_debt_st reduce economic growth in

```
. xtreg GDP_pcg Tot_debt_serv Ext_debt_st GFCF Trade Inf_cp Pop_gro FDI_Inflow, robust fe

Fixed-effects (within) regression               Number of obs      =      1,650
Group variable: country                         Number of groups   =         66

R-sq:                                           Obs per group:
     within  = 0.1276                                         min =         25
     between = 0.1597                                         avg =       25.0
     overall = 0.1011                                         max =         25

                                                F(7,65)            =      42.53
corr(u_i, Xb)  = -0.5466                        Prob > F           =     0.0000

                                (Std. Err. adjusted for 66 clusters in country)
------------------------------------------------------------------------------
             |               Robust
     GDP_pcg |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
Tot_debt_serv |  -.0226615     .01931    -1.17   0.245    -.0612262    .0159032
  Ext_debt_st |  -.0226544    .008599    -2.63   0.011    -.0398278    -.005481
        GFCF |   .0013754   .0341634     0.04   0.968    -.0668536    .0696045
       Trade |   .0473287    .010936     4.33   0.000     .0254881    .0691693
       Inf_cp |  -.0144968   .0014046   -10.32   0.000     -.017302   -.0116916
      Pop_gro |  -.9547505   .2027827    -4.71   0.000    -1.359736   -.5497654
   FDI_Inflow |   .1588456   .0316943     5.01   0.000     .0955478    .2221435
        _cons |   1.463357    1.18481     1.24   0.221    -.9028727    3.829586
-------------+----------------------------------------------------------------
      sigma_u |   2.148853
      sigma_e |  3.5726973
          rho |  .26565639   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

our case GDP_pcg by 0.02 percent.

Gross fixed capital formation or GFCF is positively related to economic growth, but the result is insignificant. Trade also has a positive and significant relationship with economic growth. The result is significant at 1%. Inflation is negative relation with economic growth. The result is significant at 1%. One perscent increase in inflation reduce the economic growth by 0.1 percent. Pop_gro is negatively related to economic growth , result is significant at 1%. FDI_inflow also has a positive and significant relationship with economic growth. The result is significant at 1%. The value of the coefficient is .15. One percent increase in FDI_inflow accelerate economic growth by 0.15 %.

We also test time fixed effects which is in the log file attached to it. The command that is use is “testparm i.year”.

- **Panel ARDL/ PMG Results:**

We can use ARDL/ PMG because there is I(0) and I(1) both variables are present. The Panel, ARDL/

```
. xtpmg d(GDP_pcg Tot_debt_serv Ext_debt_st GFCF Trade Inf_cp Pop_gro FDI_Inflow), lr( l.GDP_pcg Tot_debt_serv Ext_debt_st GFCF Trade Inf_cp Pop_gro FDI_Inflow)

Iteration 0:   log likelihood =  -3196.229
Iteration 1:   log likelihood = -3177.1844
Iteration 2:   log likelihood = -3175.7409
Iteration 3:   log likelihood = -3175.7306
Iteration 4:   log likelihood = -3175.7306

Pooled Mean Group Regression
(Estimate results saved as pmg)

Panel Variable (i): country                    Number of obs      =      1584
Time Variable (t): year                        Number of groups   =        66
                                               Obs per group: min =        24
                                                             avg =      24.0
                                                             max =        24

                                               Log Likelihood     = -3175.731
```

| D.GDP_pcg | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| __ec | | | | | | |
| Tot_debt_serv | -.0376502 | .0081259 | -4.63 | 0.000 | -.0535766 | -.0217238 |
| Ext_debt_st | -.0063574 | .0042844 | -1.48 | 0.138 | -.0147547 | .0020399 |
| GFCF | .0753817 | .0184757 | 4.08 | 0.000 | .03917 | .1115934 |
| Trade | .0117223 | .0056542 | 2.07 | 0.038 | .0006403 | .0228042 |
| Inf_cp | -.014063 | .0087705 | -1.60 | 0.109 | -.0312528 | .0031268 |
| Pop_gro | -1.843154 | .1597688 | -11.54 | 0.000 | -2.156295 | -1.530013 |
| FDI_Inflow | .127403 | .028932 | 4.40 | 0.000 | .0706974 | .1841085 |
| SR | | | | | | |
| __ec | -.8890485 | .0414799 | -21.43 | 0.000 | -.9703477 | -.8077493 |
| Tot_debt_serv | | | | | | |
| D1. | -.0939102 | .039757 | -2.36 | 0.018 | -.1718326 | -.0159878 |
| Ext_debt_st | | | | | | |
| D1. | -.1788005 | .0238975 | -7.48 | 0.000 | -.2256388 | -.1319622 |
| GFCF | | | | | | |
| D1. | .2761658 | .0656176 | 4.21 | 0.000 | .1475576 | .404774 |
| Trade | | | | | | |
| D1. | .1248964 | .0218421 | 5.72 | 0.000 | .0820866 | .1677061 |
| Inf_cp | | | | | | |
| D1. | -.0383205 | .0246727 | -1.55 | 0.120 | -.086678 | .010037 |
| Pop_gro | | | | | | |
| D1. | .1859609 | 1.736391 | 0.11 | 0.915 | -3.217304 | 3.589225 |
| FDI_Inflow | | | | | | |
| D1. | .0357283 | .0714493 | 0.50 | 0.617 | -.1043098 | .1757665 |
| _cons | 2.706875 | .2506025 | 10.80 | 0.000 | 2.215703 | 3.198047 |

PMG results, indicate that the coefficients of Tot_debt_serv is negative and significant (at 1%) in the long-run, one percent increase in Tot_debt_serv imply decrease in economic growth by 0.03%. Also Ext_debt_st is negatively related to economic growth but the result is not significant in long-run. GFCF has positive and significant relation to economic growth. The result is significant at 1%.the value of the coefficient is 0.07.trade is positively related to economic growth, significant at 1%. Inflation and population growth has negatively related to economic growth where the inflation is not significant but population growth result is significant. FDI inflow also has a positive and significant relation to economic growth, significant at 1%.

## Conclusion:

The prime objective of the study is to examine, The impact of Foreign Debt on Economic Growth on the Lower income, lower middle income and upper middle income countries. We use 66 countries data of 25 years period. From the results we got from the tests we find that total debt service and external debt stocks are negatively effects the economic growth, also inflation and population growth effects the economic growth negatively. GFCF, FDI inflow are accelerate the economic growth.



----P.T.O----

# Study-2: The Impact of remittances on the economic growth on South Asian countries: A Panel Data Analysis.

## Introduction:

The flow of remittances, which refers to the transfer of money from individuals working in foreign countries to their home countries, has become an important source of income for many developing countries. According to the World Bank, remittance flows to developing countries reached an estimated $540 billion in 2020, making it one of the largest sources of external financing for these countries. However, the relationship between remittances and economic growth is not straightforward and has been subject to debate in the literature.

In this panel data analysis, we aim to investigate the impact of remittance on economic growth in South Asian countries. This study findings will contribute to the ongoing debate on the role of remittances in promoting economic development.

## Data source:

This study employs panel data analysis to investigate the impact of remittances on economic growth in south Asian countries with data spanning over 15 years(2002-2016). Data has been collected from world bank site. We take south Asian countries like India, Bangladesh, Pakistan, Nepal data other countries like Maldives , Bhutan, Afghanistan, this countries data are not available for my analysis so I exclude them.

### Methodology & model specification:

The model used in the study shows the relation between remittances and economic growth. In this study GDP per capita (current US$) used as s a proxy to measure economic growth, and to represent the Remittance In this study Personal remittances, received (current US$) used as a proxy measure. Now the control variables that are used in this study are: Gross fixed capital formation (% of GDP) is used as a proxy to measure capital accumulation in the economy. Trade openness measures as Trade (% of GDP) included to examining the impact of trade liberalization on economic growth. Foreign direct investment ( FDI ), net inflows (% of GDP) is an essential factor for economic growth in the developing countries for that reason, it is used as an independent variable in the model. . Population growth (annual %) is also used as a control variable in the model to see the effects of it. Households and NPISHs final consumption expenditure (% of GDP) is also important to add in the model.

n this study data for all variables is collected from the publications of World Bank data set "World Development Indicators". Data set covers annual data from 2002-2016. Gujarati (2003) recommended that standard tests of stationary are mostly applicable for large sample size and as the sample size in the current study is not so huge that is why we have not employed any test for stationary. In order to investigate the impact of worker remittances on economic growth of India, Bangladesh, Pakistan, Nepal countries , regression analysis are employed.

To estimate the parameters of the model, three different panel data models were used:

- Fixed effect model,
- Random effect model, and

- Pooled OLS.

The fixed effect model controls for time-invariant unobserved heterogeneity, while the random effect model accounts for time-varying unobserved heterogeneity. The pooled OLS model treats all observations equally and does not account for unobserved heterogeneity.

To ensure the validity of the results, a series of diagnostic tests were conducted.

## The Econometric Model:

$$lGDP\_pc_{it} = \alpha_0 + \alpha_1 lPer\_remit_{it} + \alpha_2 hf\_con\_exp_{it} + \alpha_3 GFCF_{it} + \alpha_4 Trade_{it} + \alpha_5 Pop\_gro_{it} + \alpha_6 FDI\_Inflow_{it} + \mu_{it}$$

Where,

I = Cross section dimensions.

t = Time-series dimensions.

$\alpha_0$= Intercept

$lGDP\_pc_{it}$ = Natural log of GDP per capita.

$lPer\_remit_{it}$ = log of Personal remittances, received.

$hf\_con\_exp_{it}$= Households final consumption expenditure.

$GFCF_{it}$= Gross fixed capital formation.

$Trade_{it}$= Trade percentage of GDP.

$Pop\_gro_{it}$= Population growth annual percentage.

$FDI\_Inflow_{it}$= Foreign direct investment ( FDI ), net inflows percentage of GDP.

## Empirical results & Analysis:

- **Descriptive Statistics:**

```
. summarize lGDP_pc lPer_remit GFCF hf_con_exp Trade Popu_gr FDI_Inflow
```

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| lGDP_pc | 60 | 6.628897 | .4926939 | 5.475883 | 7.446749 |
| lPer_remit | 60 | 22.93813 | 1.188976 | 20.33537 | 24.9773 |
| GFCF | 60 | 24.08728 | 6.620828 | 12.52063 | 35.81288 |
| hf_con_exp | 60 | 73.0806 | 9.745836 | 54.72486 | 88.43112 |
| Trade | 60 | 39.68288 | 7.990499 | 24.70158 | 55.79372 |
| Popu_gr | 60 | 1.354609 | .5481451 | .1859219 | 2.50886 |
| FDI_Inflow | 60 | 1.077566 | .8973984 | -.0983749 | 3.668323 |

- **Random effect model:**

First we use random effect model to see the impact of remittances on economic growth, the results are given below

```
. xtreg lGDP_pc lPer_remit GFCF hf_con_exp Trade Popu_gr FDI_Inflow, re

Random-effects GLS regression                   Number of obs     =         60
Group variable: country                         Number of groups  =          4

R-sq:                                           Obs per group:
     within  = 0.8469                                         min =         15
     between = 0.9949                                         avg =       15.0
     overall = 0.8923                                         max =         15

                                                Wald chi2(6)      =     439.27
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

| lGDP_pc | Coef. | Std. Err. | z | P>\|z\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| lPer_remit | .5045353 | .0322771 | 15.63 | 0.000 | .4412734 | .5677972 |
| GFCF | -.0049091 | .0075534 | -0.65 | 0.516 | -.0197136 | .0098953 |
| hf_con_exp | .0259308 | .0058911 | 4.40 | 0.000 | .0143844 | .0374772 |
| Trade | -.0013318 | .0040287 | -0.33 | 0.741 | -.0092279 | .0065643 |
| Popu_gr | -.0807103 | .0738019 | -1.09 | 0.274 | -.2253593 | .0639388 |
| FDI_Inflow | .0727526 | .0351023 | 2.07 | 0.038 | .0039534 | .1415518 |
| _cons | -6.637204 | 1.236047 | -5.37 | 0.000 | -9.059812 | -4.214597 |
| sigma_u | 0 | | | | | |
| sigma_e | .1055948 | | | | | |
| rho | 0 | (fraction of variance due to u_i) | | | | |

From the result we got, remittance has a positive ang significant relation with economic growth, significant at 1%. The coefficient value is .50. Gross fixed capital formation is negatively associated with economic growth but the result is not significant. Household final expenditure is positively related to economic growth and the result is significant at 1%.according to the result trade and population growth are negatively related to economic growth but the result is insignificant. FDI inflow which is a important factor, it is positively related to economic growth and significant at 5%.

- **Fixed effect model:**

From the fixed effect regression we get the following results, From the result we got, remittance has a positive ang significant relation with economic growth, significant at 1%. The coefficient value is .74. Gross fixed capital formation is negatively associated with economic growth but the result is not significant. Household final expenditure is positively related to economic growth and the result is significant at 1%.according to the result trade is negatively related to economic growth but the result is insignificant. FDI inflow which is a important factor, it is positively related to economic growth and significant at 5%. Population growth also has a positive and significant relationship with economic growth.

```
. xtreg lGDP_pc lPer_remi GFCF hf_con_exp Trade Popu_gr FDI_Inflow, fe

Fixed-effects (within) regression               Number of obs      =        60
Group variable: country                         Number of groups   =         4

R-sq:                                           Obs per group:
     within  = 0.9430                                         min =        15
     between = 0.8916                                         avg =      15.0
     overall = 0.5999                                         max =        15

                                                F(6,50)            =    137.80
corr(u_i, Xb)  = -0.9338                        Prob > F           =    0.0000

------------------------------------------------------------------------------
     lGDP_pc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  lPer_remit |    .7488258   .0498967    15.01   0.000     .6486052    .8490463
        GFCF |   -.0006473   .0089247    -0.07   0.942     -.018573    .0172784
  hf_con_exp |   -.0289478   .0069573    -4.16   0.000     -.042922   -.0149737
       Trade |   -.0112416   .0030703    -3.66   0.001    -.0174084   -.0050748
    Popu_gr |    .2217644   .0809266     2.74   0.008     .0592185    .3843102
  FDI_Inflow |    .0645619   .0254936     2.53   0.015     .0133566    .1157673
       _cons |   -8.340523   1.063314    -7.84   0.000    -10.47625   -6.204794
-------------+----------------------------------------------------------------
     sigma_u |   .94755384
     sigma_e |    .1055948
         rho |    .9877336   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(3, 50) = 29.43                     Prob > F = 0.0000
```

- **Hausman test:**

  Hausman test results are presented below , reject the null hypothesis that random effect is appropriate. On the basis, the Hausman test results suggest fixed effect model is appropriate for the estimation of the model. Null hypothesis rejected at 1% significant level.

```
. hausman fe re

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E.
-------------+----------------------------------------------------------------
  lPer_remit |    .7488258    .5045353       .2442905        .0380509
        GFCF |   -.0006473   -.0049091       .0042618        .0047535
  hf_con_exp |   -.0289478    .0259308      -.0548786        .0037012
       Trade |   -.0112416   -.0013318      -.0099098              .
    Popu_gr |    .2217644   -.0807103       .3024746        .0332024
  FDI_Inflow |    .0645619    .0727526      -.0081906              .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(6) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       91.80
                Prob>chi2 =      0.0000
```

- **Breusch and Pagan Lagrangian multiplier(LM) test:**

After random effect , we test for "Breusch and Pagan Lagrangian multiplier test for random effects". And from the result we get that , here we cannot reject the null , therefore we can run a pooled ols regression in this study.

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        lGDP_pc[country,t] = Xb + u[country] + e[country,t]

        Estimated results:
                     |       Var     sd = sqrt(Var)
             ---------+------------------------------
             lGDP_pc |    .2427473       .4926939
                   e |    .0111503       .1055948
                   u |          0             0

        Test:   Var(u) = 0
                            chibar2(01) =     0.00
                          Prob > chibar2 =   1.0000
```

- **Pooled OLS:**

From the results we remittance has a positive ang significant relation with economic growth, significant at 1%. The coefficient value is .74. Gross fixed capital formation is negatively associated with economic growth but the result is not significant. Household final expenditure is positively related to economic growth and the result is significant at 1%. According to the result trade is negatively related to economic growth but the result is insignificant. FDI inflow which is a important factor, it is positively related to economic growth and significant at 5%. Population growth also has a negative and insignificant relationship with economic growth.

```
. reg lGDP_pc lPer_remi GFCF hf_con_exp Trade Popu_gr FDI_Inflow

      Source |       SS           df       MS      Number of obs   =        60
-------------+----------------------------------   F(6, 53)        =     73.21
       Model |  12.7801237         6  2.13002062   Prob > F        =    0.0000
    Residual |  1.54196572        53  .029093693   R-squared       =    0.8923
-------------+----------------------------------   Adj R-squared   =    0.8801
       Total |  14.3220895        59  .242747279   Root MSE        =    .17057

------------------------------------------------------------------------------
     lGDP_pc |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  lPer_remit |   .5045353   .0322771    15.63   0.000     .4397957    .5692749
        GFCF |  -.0049091   .0075534    -0.65   0.519    -.0200594    .0102411
  hf_con_exp |   .0259308   .0058911     4.40   0.000     .0141147    .0377469
       Trade |  -.0013318   .0040287    -0.33   0.742    -.0094124    .0067487
     Popu_gr |  -.0807103   .0738019    -1.09   0.279    -.2287381    .0673176
  FDI_Inflow |   .0727526   .0351023     2.07   0.043     .0023464    .1431588
       _cons |  -6.637204   1.236047    -5.37   0.000    -9.116401   -4.158008
------------------------------------------------------------------------------
```

After the pooled regression, we conduct some diagnostic tests

```
. hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of lGDP_pc

         chi2(1)      =     0.38
         Prob > chi2  =   0.5368

. vif

    Variable |       VIF       1/VIF
-------------+----------------------
  hf_con_exp |      6.68    0.149593
        GFCF |      5.07    0.197167
    Popu_gr  |      3.32    0.301315
  lPer_remit |      2.99    0.334821
       Trade |      2.10    0.475849
  FDI_Inflow |      2.01    0.496942
-------------+----------------------
    Mean VIF |      3.70
```

According to the result there is no heteroskedasticity in the model.

And also as the vif values are less then 10 so there is no multicollinearity problem in the model.

Post estimation diagnostic tests after fixed effect

- Testing for heteroskedasticity: from the result, we can conclude that there is no heteroskedasticity problem in the model. As the null hypothesis we can not reject as the p value is 0.4065.
- Testing for serial correlation: the null is no serial correlation. Here we reject the null and conclude that there is presence of serial correlation.
- Testing for cross sectional dependence / contemporaneous correlation:- using Breusch-Pagan LM test for Independence: from the result we can conclude that there is no significant contemporaneous correlation in my panel data as there is insufficient evidence to reject the null hypothesis of homoscedasticity or interdependence of residuals because the p value is 0.7993.

  The results of the above test given below-

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (4)  =        4.00
Prob>chi2 =      0.4065


. xttest2

Correlation matrix of residuals:

               |      __e1       __e2       __e3       __e4
---------------+------------------------------------------------
         __e1  |   .0863384
         __e2  |   .0377871   .2306422
         __e3  |   .0222582   .0282792   .1174374
         __e4  |  -.0135857   .0219259  -.0172809   .1230951

          __e1     __e2     __e3     __e4
__e1    1.0000
__e2    0.2678   1.0000
__e3    0.2210   0.1718   1.0000
__e4   -0.1318   0.1301  -0.1437   1.0000

Breusch-Pagan LM test of independence: chi2(6) =     3.076, Pr = 0.7993
Based on 15 complete observations over panel units

. xtserial lGDP_pc lPer_remit GFCF hf_con_exp Trade Popu_gr FDI_Inflow

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,       3) =     30.347
           Prob > F =      0.0118
```

## Conclusion:

Based on the analysis conducted, it can be concluded that remittance has a positive response to economic growth. The empirical evidence suggests that an increase in remittance can lead to higher levels of economic growth in recipient countries. Remittance can contribute to the growth of the economy by providing a source of income that can be used for consumption or investment. FDI inflow which is now a days is important factor to consider is also positively related to economic growth. We can see the other variable which I used in this study results from above.

However, it is important to note that the positive impact of remittance on economic growth is not uniform across countries or regions. The effectiveness of remittance as a development tool depends on several factors, such as the level of remittance dependency, the structure of the economy, and the quality of institutions. Therefore, policy interventions that encourage and facilitate the productive use of remittance inflows can maximize their potential impact on economic growth.

----------END----------