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On the Investigation of Determinant Variables on Economic Growth Rate in some African Countries using Panel Data Analysis Approach

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Abstract- In most African Countries, increase in Gross Domestic Products (GDP) has not translated to economic growth and development. For some decades had a lot of contestson economic growth and development has been a serious issues.The focus of this study is to analysing the effects of economic determinants on economic growth rate in some African Countries by employing panel data analysis. Yearly data were used from 1990 to 2013 time period. The data was obtained from the world economic outlook database of the International Monetary Fund (IMF), for probing the effects of these variables on growth rate in some selected African countries which include: Nigeria, Algeria, Angola, Benin, Botswana, Burundi, Cape-Verde, Cameroun, Central African Republic, Chad, Republic Of Congo, Cote di' Voire, Egypt, Equatorial-Guinea, Ethiopia, Gabon, Ghana, Guinea Bissau, Kenya, Lesotho, Madagascar, Mali, Mauritius, Morocco, Mozambique, Niger, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, and Uganda. The effects of 6 macroeconomic variables on GDP were critically examined.

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On the Investigation of Determinant Variables on Economic Growth Rate in some African Countries using Panel Data Analysis Approach

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Abstract- In most African Countries, increase in Gross Domestic Products (GDP) has not translated to economic growth and development. For some decades had a lot of contestson economic growth and development has been a serious issues.The focus of this study is to analysing the effects of economic determinants on economic growth rate in some African Countries by employing panel data analysis. Yearly data were used from 1990 to 2013 time period. The data was obtained from the world economic outlook database of the International Monetary Fund (IMF), for probing the effects of these variables on growth rate in some selected African countries which include: Nigeria, Algeria, Angola, Benin, Botswana, Burundi, Cape-Verde, Cameroun, Central African Republic, Chad, Republic Of Congo, Cote di' Voire, Egypt, Equatorial-Guinea, Ethiopia, Gabon, Ghana, Guinea Bissau, Kenya, Lesotho, Madagascar, Mali, Mauritius, Morocco, Mozambique, Niger, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Tunisia, and Uganda. The effects of 6 macroeconomic variables on GDP were critically examined.

We used 37 Countries GDP as our dependent variable and 6 independent variables used in this study include: Total Investment (totinv), Inflation (inf),Population (popl), current account balance (cab), volume of imports of goods and services (vimgs), and volume of exports of goods and services (vexgs). The results of our analysis shows that total investment, population and volume of exports of goods and services strongly affect the economic growth. We noticed that population of these selected countries positively affect the GDP while total investment and volume of exports negatively affect GDP. On the contrary, inflation, current account balance and volume of imports of goods and services' contribution to the GDP are insignificant.

The results of this study would be useful for individual African governments for developing a suitable and appropriate economic policies and strategies. It will also help investors to understand the economic nature and viability of Africa as a continent as well as its individual countries.

Keywords: african countries, gross domestic products, static panel data models, economic growth and development, macroeconomic variables.

I. Introduction

Literature has shown that in the last three decades, African countries had many situations which have adverse effects on economic growth, these situations as resulted to the continent's economic unsteadiness. Their challenges include economic under development, poverty, youth's unemployment, over-population, political instability, and terrorism among the idle hands in some African countries.

NihatTaş et al (2013)used static linear panel data models to determine the effects of 11 independent macro-economic variables on GDP of 31 EU member, acceding and candidate countries for the period 2002-2012. He opined that level of population affects economic growth positively. While the level of unemployment and total expenditure negatively affects economic growth. And that the research results were especially

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useful for the EU candidate countries like Iceland, Serbia and Turkey for developing convenient economic strategies.

Tsoukas S. (2011) performed his research on five Asian countries using panel. The Asian countries are Indonesia, Korea, Malaysia, Singapore and Thailand over the period 1995–2007. He analysed the connections between firm survival and financial development. He discovered country-level indicators of financial development plays an essential role in influencing firm survival and large firms would benefit the most fromdevelopments in the stock market, while small firms are most harshly dealt with for high levels of financial intermediation.

Beine M., et al (2011) introduceda new panel data approach for investigating the impact of skilled emigration on human capital accumulation. The data covers 147 countries over the1975-2000 period using dynamic regression models. They concluded that skilled migration prospects foster human capital accumulation in low income countries using dynamic regression models to test predictions.Lee C.C. and Chang C.P. (2008) used the new heterogeneous panel co-integration technique to re- examine the long run co-movements and casual relationship between tourism development and economic growth for OECD and non-OECD nations for the 1990-2002 period. They found that tourism development has a greater influence on GDP in the non-OECD countries than in OECD countries.

Sukiassyan G. (2007) empirically weighs that relationship with data from the transition economies of Central and Eastern Europe and the Commonwealth of Independent States. He studiedseveralscopes of the growth-inequality argument. His outcomes for transition countries show a strong but negative contemporaneous growth-inequality association.Lee C.C. and Chang C.P. (2007) engaged a new panel data stationary testing technique with a view to re-examining the dynamic connections between energy consumption per capita and real GDP per capita in 22 developed countries and 18 developing countries. It was discovered that in individual countries, structural breaks occurs near other variables in both developed and the developing countries due to tight association between energy consumption and the GDP.

Bortolotti B., et al (2003) discovers the reasons why governments implement privatization, and the magnitude, degree of privatization processes around the world using panel of34 countries over 1977-1999 time period. They discovered market, budget and institutional constraints which influences privatization.De Haas R. and Van Lelyveld I. (2006)investigated whether indigenous and non-indigenous banks in Central and Eastern Europe respond differently to business cycles and banking disasters. They used a panel database with over 250 banks between 1993 and 2000. They proved that during crises periods, local banks contract their credit. In contrast, foreign banks play astabilizing role by keeping their credit base stable. They also discovered a significant negative affiliation between home country economic growth and host country credit by foreign bank subsidiaries.

II. Macro-Economic Determinants

The model used in this work is made up of six independent variables which are total investment, inflation (average consumer price), current account balance, population, volume of imports of goods and services and volume of exports of goods and services, while the dependent variable of interest is the gross domestic product (GDP). Gross Domestic Product by definition is the value of all goods and services produced in a country over time.Gross Domestic Product can be seen as the economic health of goods and services produced by a country and services used by individuals, firms, foreigners and the governing bodies. GDP entailsgovernment spending,consumer spending, investment expenditure and net exports hence it portrays comprehensive image of an economy. GDP is not only used as a determinant for most government and economic decision-makers for planning and policy design, but also it helps the investors to accomplish their folders by providing them with regulation about the condition of the economy,NihatTaş et al (2013).

Notes

Economic determinants can be described as pointers which are capable to explain important behaviour, characteristic and attribute of economic variable of interest. Balance ofPayments Manual released by International Monetary Fund (IMF) on international standards regarding the compilation of balance of payments statistics in order to provide guidance to member countries, in a more explicitly explained balance of payments as a statistical statement that systematically records all the economic transactions between residents of a country and non-residents for a specific time period.

Notes

The balance of payments statistics is grouped into two major categories Current Account and Capital and Financial Account. The current account contains all transactions that involve real sources (including volume of imports and exports of goods and services) and current transfers while the capital and financial accounts show how these transactions are financed. Deficits and Surpluses are natural consequence economic dealings between countries. They show the degree of a country dependence on borrowing from the rest of the world or the amount of its resources it lend abroad. A country that recorded surplus current account transfers consumption from today to tomorrow by investing abroad and a country with a deficit can increase its investments but must transfer future income abroad to redeem its external debt. Both surpluses and deficits can simply be the result of an appropriate allocation of savings, taking to account different investment opportunities across countries.In particular, countries with a rapidly ageing population may find it opportune to save today to smooth consumption over time.

On the other hand, current account deficits and surpluses are part of the adjustment process in a monetary union. They absorb asymmetric shocks in the absence of independent monetary policy and nominal exchange rate adjustment. To determine the state of economy of a country is via the comparison of general government gross debt, revenue, total investment, total expenditure and national savings. For example, if the government gross debt is low to GDP percentage, itpoint towardsa robust economy, whereas, high government debt with respect to GDP means financial distress for a nation.

III. Methodology

a) The Models

The static random panel data model takes the form:

$$y_{it} = \beta_0 + X_{it}\beta + \mu_i + v_{it}$$
$$u_{it} = \mu_i + v_{it} \qquad i = 1, 2, ..., 37, \qquad t = 1, 2, ..., 24 \tag{3.1}$$

where

y_{it} is the dependent variable (GDP),

X_{it} is the matrix of explanatory variables with coefficients β,

β_0 is the constant term,

μ_i represents unobserved individual effects for N cross sections,

v_{it} represents random or idiosyncratic disturbances.

In an "ideal" model, the majority of the overall variation should be captured in the crosssectional effect. These "effect" are often referred to in the literature as errorcomponents, because in essence, the error term is being broken down into two components: cross-sectional, and idiosyncratic.

b) Fixed Effects Models

These models do not make any assumptions regarding the joint distribution of the X_{it}, and terms. In theory, separate coefficients can be estimated for each individual crosssection or time period using ordinary least squares (OLS), but in practice, some type of transformation must be performed. Consider the one-way fixed effects model:

$$y_{it} = \beta_0 + X_{it}\beta + \mu_i + v_{it}$$

In matrix form, we have

$$\begin{bmatrix} y_1 \\ (TX1) \\ y_2 \\ \vdots \\ \vdots \\ \vdots \\ y_N \\ (NTX1) \end{bmatrix} = \begin{bmatrix} X_1 \\ (TXk) \\ X_2 \\ \vdots \\ \vdots \\ \vdots \\ X_N \\ (NTXk) \end{bmatrix} \begin{bmatrix} \beta_1 \\ (TX1) \\ \beta_2 \\ \vdots \\ \vdots \\ \vdots \\ \beta_k \\ (kX1) \end{bmatrix} + \begin{bmatrix} d_1 & d_2 & .. & .. & .. & d_N \\ & (NTXN) & & & & \end{bmatrix} \begin{bmatrix} i_1\mu_1 \\ (TX1) \\ i_2\mu_2 \\ \vdots \\ \vdots \\ \vdots \\ i_N\mu_N \\ (NTX1) \end{bmatrix} + \begin{bmatrix} v_1 \\ (TX1) \\ v_2 \\ \vdots \\ \vdots \\ \vdots \\ v_N \\ (NTX1) \end{bmatrix} \tag{3.2}$$

where k represents the number of parameters in the model and i_1 represents a matrix of ones with dimension T. Rewriting, we have

$$\begin{bmatrix} y_1 \\ (TX1) \\ y_2 \\ \vdots \\ \vdots \\ \vdots \\ y_N \\ (888X1) \end{bmatrix} = \begin{bmatrix} X_1 \\ (TXk) \\ X_2 \\ \vdots \\ \vdots \\ \vdots \\ X_N \\ (888Xk) \end{bmatrix} \begin{bmatrix} \beta_1 \\ (TX1) \\ \beta_2 \\ \vdots \\ \vdots \\ \vdots \\ \beta_k \\ (kX1) \end{bmatrix} + \begin{bmatrix} i_1\mu_1 \\ (TX1) \\ i_2\mu_2 \\ \vdots \\ \vdots \\ \vdots \\ i_N\mu_N \\ (888X1) \end{bmatrix} + \begin{bmatrix} v_1 \\ (TX1) \\ v_2 \\ \vdots \\ \vdots \\ \vdots \\ v_N \\ (888X1) \end{bmatrix} \tag{3.3}$$

$$d_1 = \begin{bmatrix} 1 \\ 1 \\ 1 \\ 0 \\ 0 \\ : \end{bmatrix} \qquad D = \begin{bmatrix} d_1 & d_2 & .. & .. & .. & d_{37} \\ & (888XN) & & & & \end{bmatrix}$$

The parameter vector is now $\begin{bmatrix} \beta \\ \mu \end{bmatrix}$ as opposed to simply β as in OLS.

IV. Analysis

a) Variable Declaration and Descriptive Statistics

The data used in this study is a panel data set of 37 African countriesfor the 1990-2013 time periods. It is a balanced, macro panel database with N*T*(K+1) = 37x24x7 = 6216 observations. Each variable has N*T = 37x24 = 888 observations. Regressand is GDP (billion dollars) and there are six regressors.

Table 1 presents the independent variables, measuring units and their abbreviations used in the analysis to represent them.

Notes

Table 1 : Predictor variables and their measuring units

Codes	Variables	Units
totinv.	Total investment	% of GDP
Inf	Inflation, average consumer prices	% change
Popl	Population (10,000,000)	Persons
vimgs	Volume of imports of goods and services	% change
vexgs	Volume of exports of goods and services	% change
Cab	Current account balance	% of GDP

Source: International Monetary Fund world economic outlook database.

The descriptive statistics of the variables used in this research are displayed in Table 2. Descriptive statistics values are ordinary and there are no exceptional values in the dataset.The mean value of GDP for 37 countries is $17.84 billion as observed.

Table 2 : Summary of Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Gdp	888	1784.489	2763.974	94.93	23432.39
totinv	888	23.7008	18.19449	2.48	227.479
Inf	888	21.8019	175.6216	-10.874	4146.01
vimgs	888	7.20244	19.1821	-61.368	163.557
vexgs	888	8.383158	28.57126	-70.657	560.871
Popl	888	18.87216	25.15105	.07	169.282
Cab	888	-5.449375	12.53256	-147.997	34.449

Table 3 shows the correlation coefficients between the economic indicators used. The highest correlations among the explanatory variables are coefficient between totinv and cab which is -0.53, though they have negative association. Relationship exists among the predictor variables but its magnitude poses no threat on the analysis.

Table 3 : Correlation Coefficients between the Macro-economic Indicators

	gdp	totinv	inf	vimgs	vexgs	Popl	cab
gdp	1.0000						
totinv	0.2028	1.0000					
inf	-0.0457	0.0245	1.0000				
vimgs	-0.0515	0.1978	0.0235	1.0000			
vexgs	-0.0736	0.2274	-0.0015	0.1889	1.0000		
popl	-0.1519	-0.0974	-0.0070	0.0005	-0.0454	1.0000	
cab	0.1348	-0.5311	-0.0264	-0.2007	-0.1292	0.1535	1.0000

b) Static Linear Panel Data Models

To obtain the association between macro-economic explanatory variables and the dependent variable, the random effects model and the fixed effects model, the most

prominent static linear panel data analysis models, are used. The dependent variable is modelled as a function of 6 determinants.

The fixed effects model is

$$gdp_{it} = \alpha_i + \beta_1 totinv_{it} + \beta_2 \inf_{it} + \beta_3 popl_{it} + \beta_4 vimgs_{it} + \beta_5 vexgs_{it} + \beta_6 cab_{it} + U_{it} \quad (4.1)$$

and the random effects model:

$$gdp_{it} = \beta_1 totinv_{it} + \beta_2 \inf_{it} + \beta_3 popl_{it} + \beta_4 vimgs_{it} + \beta_5 vexgs_{it} + \beta_6 cab_{it} + (\alpha_i + u_{it}) \quad (4.2)$$

Notes

i represent the country number, t stands for the year; U_{it} is the error term for the fixed effects estimators and $(\alpha_i + U_{it})$ is the composite error term for the random effects estimator. When the individual (country) effects are not correlated with the predictors, they are called random effects. Since the country specific effects is uncorrelated with the regressors, then the country specific effects is classified as additional random disturbances. They are known as fixed effects if the country specific effects are correlated with the predictors. But if there is no country specific effect in the model, then, the model assumes the pooled ordinary least squares

$$gdp_{it} = \mu + \beta_1 totinv_{it} + \beta_2 \inf_{it} + \beta_3 popl_{it} + \beta_4 vimgs_{it} + \beta_5 vexgs_{it} + \beta_6 cab_{it} + U_{it} \quad (4.3)$$

Table 4 : Testing for the Country Specific Effects

$H_0 : \alpha_1 = \alpha_2 = \alpha_3 = ... = \alpha_n$	
$F(36,845) = 43.60$	prob > F = 0.0000

The null hypothesis states that the constant term is equal across countries and this is tested to determine if the pooled estimator would produce consistent estimates. It is also referred to as heterogeneity test using F test. Since the p-value =0.000 from table 4, H_0 is rejected, giving us the importance of retaining country specific effects in our analysis. Hence, OLS is inconsistent and inappropriate. Individual countries have different intercept which authenticated the adoption of other estimators rather than OLS.

Table 5 displays the pooled OLS, fixed effects and random effects models results. Since the country specific effects has been confirmed to be retained, then the OLS estimates is unreliable to make conclusions.

Table 5 : Pooled OLS, Fixed Effects and Random Effects Models

Variables	OLS	FE	RE
totinv	62.40823	-71.31068	-51.65046
	5.622320	6.920889	6.833444
	0.0000	0.0000	0.0000
inf	-0.738179	-0.2700644	-0.407897
	0.483264	0.3227281	0.334968
	0.1270	0.403	0.2230
popl	-18.92739	61.44893	24.68474
	3.416879	9.84715	7.957297
	0.0000	0.0000	0.0020
vimgs	-5.364951	3.831325	3.451583
	4.597708	2.85451	2.970446

	0.2436	1.34	0.2450
vexgs	-11.80921	-5.105807	- 6.721481
	3.085253	1.914438	1.991925
	0.0001	0.008	0.0020
cab	78.26949	-8.539097	4.024485
	8.104455	6.611919	6.721481
	0.0000	0.197	0.5490
cons.	1242.818	2289.499	2599.546
	159.5281	214.1394	363.4093
	0.000	0.000	0.000

The Lagrange Multiplier Test helps to decide between a random effects regression and a simple OLS regression. The null hypothesis is that the variances if the country specific effects equals zero. Deducing from Table 6, LM test shows that there is country specific effects.

Table 6 : The Breusch-Pagan Lagrange Multiplier Test Results

Lagrange Multiplier Test Null Hypothesis: $\text{var}(u) = 0$ –Pooled ols regression is appropriate."	
LM $\chi^2_1 = 2211.4$	prob. $> \chi^2 = 0.0000$

In view of this, pooled OLS model presented in the first column is unreliable. Although 4 of the independent variables are estimated to be statistically significant, while the last two columns estimated only 3factors to be statistically significant. These 3 significant variables which are totinv, popl and vexgs were further estimated with the fixed and the random effects models and their output are shown in the first two columns of Table 7 below

Table 7 : Static Linear Panel Data Models with Contemporaneous Correlation

Variables	FE	RE	FE-RB	FE-PCSE
Totinv	-64.12924	-53.57096	-64.12924	-64.12924
	4.966806	5.005964	11.77830	16.39941
	0.000	0.000	0.000	0.0001
Popl	60.45303	26.2126	60.45303	60.45303
	9.655807	7.855872	6.981408	6.746504
	0.000	0.001	0.000	0.0000
Vexgs	-4.995793	-5.613376	-4.995793	-4.995793
	1.889213	1.966326	1.960788	5.509792
	0.008	0.004	0.0110	0.0008
cons	2205.405	2606.534	2205.405	2205.405
	209.5945	359.6452	303.7689	351.8542
	0.000	0.000	0.000	0.0000

Hausman test is used to validate the assumptions of the random effects estimator that the country specific effects are uncorrelated with the explanatory variables and the extra orthogonality conditions are satisfied. The random effects model assumes the country specific effects as a random draw that is uncorrelated with the predictors and the overall error term.

Table 8 : Hausman Specification Test Result

Variables	Fixed Effects (b)	Random Effects (B)	Difference (b-B)
Totinv	-64.12924	-53.57096	-10.55827
Popl	60.45303	26.2126	34.24043
Vexgs	-4.995793	-5.613376	0.6175828

H_o: difference in coefficients not systematic (RE is consistent).
$\chi^2_3 = (b-B)'[(V\_b-V\_B)^{(-1)}](b-B) = 78.846$
prob. $>\chi^2 = 0.0000$

The null hypothesis of the Hausman test is rejected.Therefore, country specific effects are correlated with the predictor variables. Since the random effects estimator is found inconsistent, it gives way for the fixed effects estimator as the only appropriate estimator.

Despite this, all the necessary and in fact important assumptions of the fixed effects estimator must be met, such as homoscedasticity, no serial correlation and no contemporaneous correlation. These entire diagnostic tests must be done before using FE estimator. Modified Wald test is used for testing homoscedasticity (null hypothesis = homoscedasticity

c) Diagnostic Tests

i. *Heteroscedasticity*

This is tested using the Modified Wald test for group-wise heteroscedasticity. The null hypothesis is that the cross sectional variances are equal against the alternative hypothesis that state otherwise. It is Chi-square tested.

$$H_O : \sigma_i^2 = \sigma^2, \chi^2_{37} = 2.8 * 10^5, p > \chi^2_{37} = 0.0000$$

Since the test is significant, we reject the null hypothesis and conclude that the cross sectional variances are not equal, thus, the model has heteroscedasticity.

Serial Correlation: Using the Durbin-Watson statistic (0.120632), it is concluded that there is evidence of positive serial correlation in the residuals since the DW statistic is less than 2.

Table 7 shows the fixed effects model withFE-RB the Huber-White standard errors that is robust to heteroscedasticity and serial correlation, FE-PCSE with panel corrected standard errors that is robust to heteroscedasticity and the cross sectional correlation (contemporaneous correlation) The three models have the same coefficient estimates but with different standard errors. Finally, because of the violations of the assumptions and the nature of the model estimators, the last is used to deduce the relationship between the regressand and the regressors.

$$gdp_{it} = 2205.41 - 64.13totinv_{it} + 60.45popl_{it} - 5.0vexgs_{it} \qquad 4.4$$

The above model (4.4) can be explain thus; the three economic determinants (i.e. totinv, popl and vexgs.), are significant to the GDP given their p-value to be 0.0001,0.0000 and 0.0008 respectively. The coefficient of totinv (-64.13) implies if the total investment rate increases by 1%, the gross domestic product decreases about $0.6413 billion. The estimated coefficient of popl (60.45) indicates that if the population increases by 10million, the gross domestic product increases by about $0.605billion. And the dependent variable (GDP) decreases about $0.05billion if the volume of exports of goods and services increases 1%, because the coefficient of vexgs (-5.0 approximately).

Notes

Notes

V. Conclusion and Suggestions

In this research work, the authors employed the linear static panel data procedures to analyse the cross sectional effects of some crucial macroeconomic determinants (total investment, inflation, population, current account balance, volume of imports of goods and services and volume of exports of goods and services) of African countries during the period 1990-2013. The major deductions include; total investment and volume of exports of goods and services affects economic growth negatively. That is 1% increase in total investment and volume of exports of goods and services yield a decrease of about $0.6413billion and $0.05billion on GDP respectively. Also, level of population has positive effects on economic growth. Because 10million increase in population leads to increase in GDP by over $0.6billion.

Having known the effects of these determinants, African individual state governments should critically look into the significance of the estimated macroeconomic determinants for re-strategizing economic policies as well as using them to improve their decision making. Private investors were advised to study the impact of these economic determinants with a view to maximizing their profit.

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Appendix

Figure 1 : Presents the Panel Line Graph of the GDP for the Individual Countries

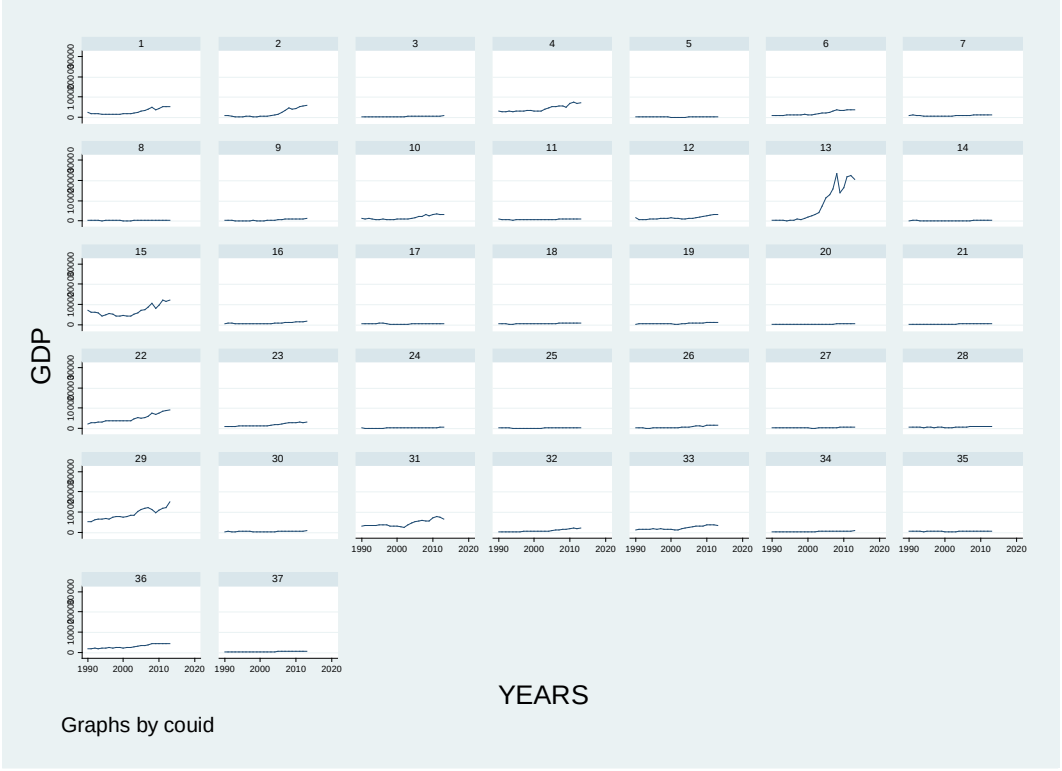
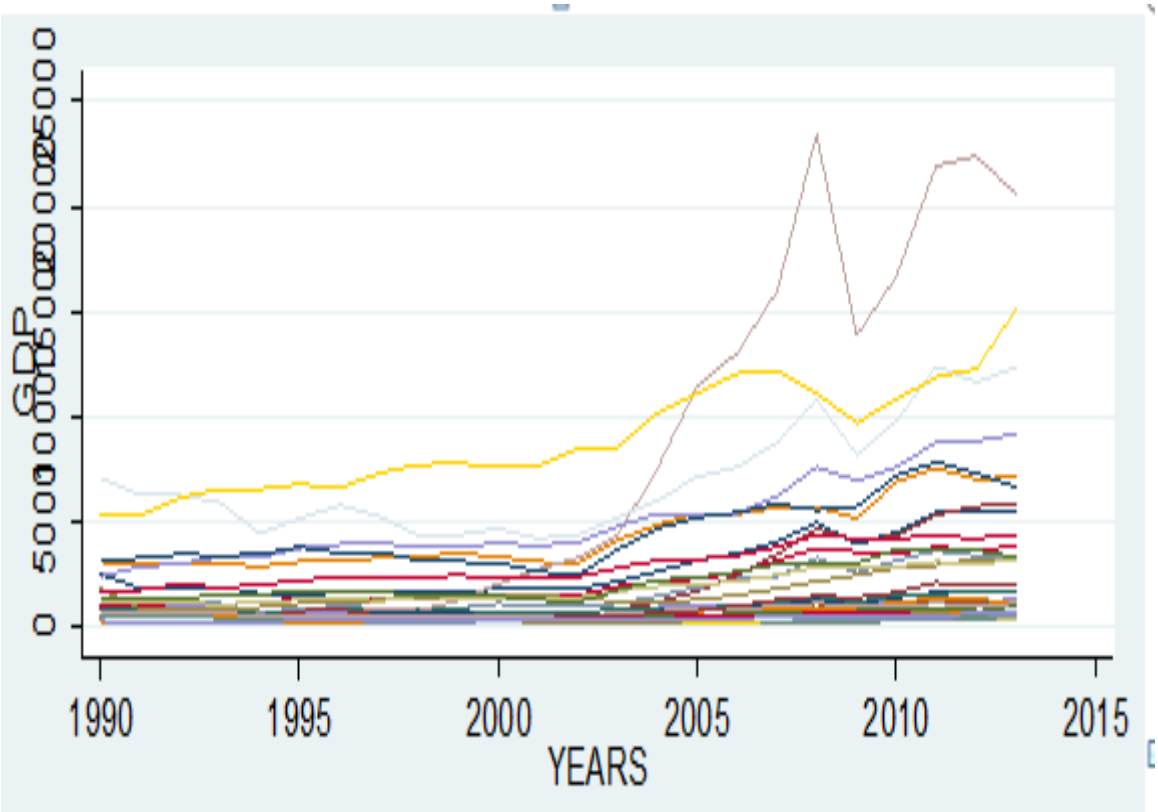


Figure 2 : Represent the Joint Graph of GDP for all the Countries under Investigation



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