The Effects of Income Inequality on Economic Growth

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Abstract

This empirical research paper applies cross-section technique for a sample of 52 countries within 1980, 1985 and 1990 to investigate the relationships between income inequality and economic growth and to test the hypothesis that income distribution affects growth indirectly through the channels of fertility, investment and education. Moreover it intends to give a first insight into the relationship between Human Development Index and growth of per capita GDP to understand if a widening in some capabilities can foster economic development. Finally this empirical research will turn to study the specification of the model, in order to find out if it is well behaved.

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Introduction

Nowadays one of the most striking features of the global economy is the marked surge in income inequality within and between countries. In fact in this period there is a growing disparity between affluent and developing nations and notably from the mid to late 1970s income inequality has risen in almost all of the OECD nations. Internationally this trend has been manifest in increasing migrations, unease between wealthy and poor states and the resurgence of religious fundamentalism targeting wealthier countries. At the domestic level it appears to fuelling social tension, in some cases to the extent of provoking nationwide rioting (France 2005 etc). It is with these wider social and political changes in mind that the main focus of this paper is to analyse the effects of income polarization on economic growth, asking ourselves if it is a true indicator of national development. An increasing literature is pointing out that the most important effective source of human development is the expansion of human capabilities (the opportunity to live a full healthy long life, to be educated etc…) within the society and not the economic growth rate . That is the reason why this empirical research aims to study the effect of an increase in individuals' capabilities on economic growth.

In its seminal paper Kuznets underlined that in the first stages of development the nations face both growth rate of per capita GDP and rising concentration of wealth towards the industrial sector while in the later stage, growth leads to an equalizing effect on the incomes of the whole society. As a consequence in the first periods the relationship between level of per capita GDP and the extent of inequality is positive, while in the final stages of development it becomes negative, with an overall relationship through the time that is of an inverted U shape. A second approach called the endogenous fiscal policy theory (Perotti (1993), Persson and Tabellini (1994), Alesina and Rodrick (1994)) states that inequality may retard growth because citizens can ask for more income or asset (lands) redistribution. The main hypothesis is that individuals of democratic states will vote to favor redistribution to the poor when the mean income exceeds the median income. Accordingly the government will increase taxation to finance the redistribution, in turn the incentives to save and to invest will be affected negatively and growth will slow, therefore the relationship between inequality and subsequent growth is negative. The third principal approach called the socio-political instability theory (Alesina and Perotti (1996), Gupta(1990), Hibbs (1973), Venieris and Gupta(1983, 1986)) postulates that a society with a high income concentration tends to provoke violent protests, criminality, assassinations, revolts etc. Businesses fail, labour relations deteriorate as trust in the legal mandate of the government and its institutions dwindle. According to the theory of credit market imperfections, (Gailor and Zeira(1993)) if there is a restrained access to credit, only people with assets can invest in high return activities that will benefit them in the future, such as higher education or vocational training. This situation can be persistent for poor households if there are fixed costs of investment in education. On the contrary a distortion-free redistribution to the poor probably will enhance the productivity and the amount of investments pushing economic growth through this channel. This theory is particularly true for developing nations which have big capital market imperfections. The joint education/fertility decision theory (Becker, Murphy and Tamura 1990) states that the individuals of a society can save across generations in two distinctive ways, giving birth to many children or by a long-term investment in physical capital. When the stock of human capital is big the returns on this factor are higher than the returns in having children but when the former is scarce then the reverse happens; as the enhancement of the stock human capital of parents improves their earnings, there will be a positive income effect on demand of children but a negative substitution effect, because raising children is time intensive. In countries with high levels of human capital the substitution effect will prevail leading to a decrease in fertility and to further increase in human capital investment that as a consequence will foster growth. The more income equality there will be, the more the investment in human capital and the higher the growth. The more unequally distributed is the wealth, the less the human capital investment and the higher the fertility rate. The last theory assumes that the higher the individual level of income, the higher the saving rate, hence a rising inequality will spur higher investments and have a positive effect on economic growth.

A totally different approach to development has been put forward by Amartya Sen, for whom development should be interpreted as essentially human development in which per capita income is only a part but not sole feature. It is based on the concept of capability. Under this line of thinking human development has to be judged by the widening of opportunities in two ways: first, in relation to an expansion of choices people have and secondly in relation to an increase of possible opportunities to choose from. Increasing per capita incomes entails more possibilities but it is not enough to ensure more effective capabilities. In fact possibility of choosing are objectively connected to the social and economic situation we are living, while the capabilities are personal, subjective. For instance a man can be rich but because of social discrimination he cannot choose a certain kind of job they value, etc…

The paper is divided in five sections, in the first we set up the economic model and the questions we are going to answer, in the second we give definitions, sources and present the basic characteristics of the data, in the third we build up the statistical model and its structure, in the fourth section we show the empirical results and finally we summarize the main conclusions in section five.

1. THE ECONOMIC THEORY

My basic model is taken from the framework set up by Robert Barro:

$$\Delta Y_t = Y_{t-1} + H_{t-1} + INV_{t-1} + FER_{t-1} + POP_{t-1}$$

Where ΔY_t identifies the economic growth rate between time t-1 and t, Y_{t-1} is the level per capita income at time t-1, $H_{t-1}$is the stock of human capital at time t-1, INV_{t-1} is the level of investment at time t-1, FER_{t-1} is the total fertility rate at time t-1, POP_{t-1} is the size of the population at time t-1, IM_{t-1} is the income inequality index at time t-1.
I chose this model because clearly it is a keystone for economic growth, in fact Barro does not stress the importance of convergence so much (as the Neoclassics), but he underlines that the important matter is the identification of the key variables in order to sustain development of poor countries.
To this basic set up I added income inequality measure (IM) and the Human Development Index:

$$\Delta Y_t = Y_{t-1} + H_{t-1} + INV_{t-1} + FER_{t-1} + POP_{t-1} + IM_{t-1} + HDI_{t-1}.$$

I encompass the variable IM in the model because I want to analyse if income distribution influences economic growth directly, also I am going to test the effects of income concentration on investment, human capital and log of fertility rate in order to discover some indirect relationship between growth and income inequality, channelled by those variables. Also I am going to study the correspondence between HDI and economic growth in both directions, in order to find if an expansion in human capabilities affects growth significantly and if an increase in growth helps enhance human capabilities within the society. Finally I am going to inspect the specification of my model by running diagnostic tests on structural stability, non-linearity, non-normality, heteroskedasticity.

2. DATA

This cross-sectional study employs a sample of 52 countries and the main source of the data is the U.N.O. database. I extracted data of per capita GDP, Gross Capital Formation, both expressed at current prices in U.S.A. dollars, of Population and of the Human Development Index (HDI). The first variable is defined as: "Gross domestic product is an aggregate measure of production equal to the sum of the gross values added of all resident institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs). The sum of the final uses of goods and services (all uses except intermediate consumption) measured in purchasers' prices, less the value of imports of goods and services, or the sum of primary incomes distributed by resident producer units."[1] The Gross Capital Formation is described as: "Gross capital formation is measured by the total value of the gross fixed capital formation, changes in inventories and acquisitions less disposals of valuables for a unit or sector."[2] The third factor is defined as: "De facto population in a country, area or region as of 1 July of the year."[3] Finally HDI is made up of an average between four indicators, life expectancy at birth, combined gross enrolment ratio for primary, secondary and tertiary schools and per capita GDP in U.S. dollars, therefore it "Focuses on three measurable dimensions of human development: living a long an healthy life, being educated and having a decent standard of living . Thus it combines measures of life expectancy, school enrolment literacy and income to allow a broader view of a country's development than does income alone."[4] I extracted the data of Primary School Enrolment from the University of California's Atlas of Global Inequality which in turn uses the definitions of the World Bank. This variable is labelled as: "The ratio of total enrolment regardless of age, to the population that officially corresponds to the primary school age group (as defined by the national education system). Primary education provides children with basic reading, writing and mathematics skills along with an elementary understanding of such subjects as history, geography, natural science, social science, art and music"[5]. Similarly the data on total fertility rate have been chosen from the University of California's Atlas of Global inequality and this variable is identified as: " The number of children that would be born to a woman if

[1]SOURCE: U.N.O.
[2]SOURCE: U.N.O.
[3]SOURCE: U.N.O.
[4] SOURCE: U.N.O.
[5] SOURCE: WORLD BANK.

she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rate"[6]. Whereas the data of inequality measure have been extracted from the University of Texas Inequality project and they are defined as: " Estimates of gross household income inequality, computed from a regression relationship between the Deninger & Squire inequality measures and the UTIP-UNIDO inequality measures, controlling for the sources characteristics in the D. & S. data and for the share of manufacturing in total employment."[7] Precisely, D. & S. dataset has been criticized especially because their " Inequality measures are based on various income definitions, recipients units and processing procedure that cannot be reconciled to each other even with "high-quality" filtering."[8] Thus the researchers of UTIP employed manufacturing pay data from UNIDO dataset because the latters "Have been measured with reasonable accuracy as a matter of official routine in most countries around the world for nearly forty years……..moreover UNIDO measures are comparable and consistent across countries, since they are based on a two or three digit code of the International Standard Industrial Classification (ISIC) a single systematic accounting framework."[9] Then they computed the inequality data from this source and called them UTIP-UNIDO dataset, "However the data do not measure household income inequality"[10] but "A set of measure of the dispersion of pay across industrial categories in the manufacturing sector"[11]. Finally they regressed D&S inequality measure on the other one and obtained a more accurate and comparable gross household income inequality database. As proxies for human capital and investment respectively I use the variables Primary Scholl Enrolment in the year 1980, that is an educational variable and Gross Capital Formation in 1980. Whereas for growth rate of per capita income I employ the difference of the logarithms of per capita GDP for 1990 and 1980 lastly the logarithm of GDP in 1980 denotes the initial level of income. Moreover I encompassed the lagged values for all the explanatory variables in my model to avoid the direct reverse causation between them and the growth rate .

For all these variables I considered the data for the 1980, 1985 and 1990 years. The sample size is small because of missing data for 20 countries. The quality of data appears to be poor mainly because of incorrectly estimated variables in developing countries and the factor that seems less reliably measured is the one referring to physical capital because its estimation is based on inaccurate depreciation rates. Moreover a big problem of cross-section technique is that the variance of the values of the error terms between countries may vary very much, to inspect this potential

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[6] SOURCE: WORLD BANK.

[7] SOURCE: Galbraith, J., and Kum, H. (2002) "Inequality and economic growth: data and econometric tests" Utip Working Papers, 21.

[8] SOURCE: Galbraith, J., and Kum, H. (2002) "Inequality and economic growth: data and econometric tests" Utip Working Papers, 21.

[9] SOURCE: Galbraith, J., and Kum, H. (2002) "Inequality and economic growth: data and econometric tests" Utip Working Papers, 21.

[10]SOURCE: Galbraith, J., and Kum, H. (2002) "Inequality and economic growth: data and econometric tests" Utip Working Papers, 22.

[11]SOURCE: Galbraith, J., and Kum, H. (2002) "Inequality and economic growth: data and econometric tests" Utip Working Papers, 22.

drawback I runt the White test for heteroskedasticity whose results show the assumption of homoskedasticty holds. Besides the Jarque-Bera test indicates that the residuals are not normally distributed and the analysis of their graph reveals two outliers, namely Bulgaria and Venezuela. The line-graph of the growth rate of per capita GDP indicates that has an unimodal distribution with a peak at the 26th observation corresponding to Japan, with a growth rate of almost a logarithm point (about 15500 US dollars), whereas the nation with the lowest growth rate is Venezuela with a negative value 0.655518, also the standard deviation is small entailing little variation across countries of the economic growth rate. The histogram shows that 25% of the sample has a negative growth whereas 75% of the nations has got positive growth and about 40% of the sample has a growth rate between 0.5 to 1 in logarithm scale. From the graphs regarding the UTIP inequality measure we conclude that the series is bimodal with peaks at 21th and 22th observation, respectively Indonesia with an income inequality 50.26 and India with 50.25 whereas the nation with the highest income equality is Hungary (26.41). Interestingly about 54% of nations has got an income inequality ranging from 40 to 50.26, it means that the inequality is widespread in the sample, probably due to the high percentage of low income nations. The series Human Development Index is unimodal with the peak at the 20th observation, namely Iceland (0.884), whereas Senegal (0.328) has got the smallest value. There is little variation across the countries and about 58% of the sample is in the high value interval 0.725-0.9. The series log per capita GDP is unimodal with the peak at the 45th observation, namely Sweden (9.6554), while the nation with the minimum value is Malawi (5.2992). The variability of the log of per capita GDP is not big across countries. The second scatter in the appendix shows HDI in 1980 has a positive mild relationship with economic growth. Whereas the first scatter indicates a weak negative tendency between UTIP-UNIDO income inequality measure and economic growth. The third scatter reveals that income inequality in 1980 tends to be strongly related to log of fertility rate in 1980, hence a small increase in income concentration tends to have a big impact on fertility rate. The fourth scatter clearly illustrates a very weak positive relationship between gross capital formation in 1980 and economic growth, also the last XY plot exhibits an insignificant positive correspondence between primary school enrolment and economic growth.

DEFINITION OF ABBREVIATED TERMS

DLGDPCAP: GROWTH RATE OF PER CAPITA GDP BETWEEN 1980-1990
LGDPCAP80: LOG OF PER CAPITA GDP IN 1980
INMEA80: UTIP-UNIDO INCOME INEQUALITY MEASURE IN 1980
HDI80: HUMAN DEVELOPMENT INDEX IN 1980
SENR80: SCHOOL ENROLMENT PRIMARY IN 1980
LFER80: LOG OF FERTILITY RATE IN 1980
POP80: POPULATION SIZE IN 1980
GRCF80: GROSS CAPITAL FORMATION IN 1980
GDPCAP80: PER CAPITA GDP IN 1980
DLGDPCAP85-90: GROWTH RATE OF PER CAPITA GDP BETWEEN 1985-1990

CORRELATION MATRIX

	DLGDPCAP	LGDPCAP80	GDPCAP80	HDI80
DLGDPCAP	1.0000	0.499524	0.554221	0.502603
LGDPCAP80	0.499524	1.0000	0.899626	0.939749
GDPCAP80	0.554221	0.899626	1.0000	0.792918
HDI80	0.502603	0.939749	0.792918	1.0000
INMEA80	-0.478487	-0.767374	-0.743222	-0.703391
SENR80	0.075129	0.473283	0.256824	0.642794
LFER80	-0.677080	-0.856240	-0.815568	-0.886518
POP80	0.069726	-0.265791	-0.122147	-0.226007
GRCF80	0.292999	0.325824	0.341213	0.309951

	INMEA80	SENR80	LFER80	POP80	GRCF80
DLGDPCAP	-0.478487	0.075129	-0.677080	0.069726	0.292999
LGDPCAP80	-0.767374	0.473283	-0.856240	-0.265791	0.325824
GDPCAP80	-0.743222	0.256824	-0.815568	-0.122147	0.341213
HDI80	-0.703391	0.642794	-0.886518	-0.226007	0.309951
INMEA80	1.0000	-0.196425	0.775851	0.273745	-0.197924
SENR80	-0.196425	1.0000	-0.427475	-0.118384	0.119726
LFER80	0.775851	-0.427475	1.0000	0.104006	-0.313059
POP80	0.273745	-0.118384	0.104006	1.0000	0.328824
GRCF80	-0.197924	0.119726	-0.313059	0.328824	1.0000

SUMMARY STATISTICS

	MEAN	MEDIAN	MAX.	MIN.	ST. D.	SKE.	KUR.	J.B. TEST	PR.
DLGDPCAP	0.31	0.38	0.99	-0.65	0.41	-0.41	2.37	2.85	0.24
LGDPCAP80	7.96	8.06	9.65	5.29	1.26	-0.37	2.03	3.25	0.19
GDPCAP80	5320.72	3179.55	15606.9	200.17	4995.57	0.73	2.05	6.54	0.037
HDI80	0.70	0.74	0.88	0.32	0.16	-0.77	2.46	5.85	0.053
INMEA80	38.82	40.03	50.26	26.40	6.32	-0.04	2.03	2.05	0.35
SENR80	96.41	99.20	120.39	40.21	16.61	-1.49	5.61	34.19	0.00
LFER80	1.15	1.09	2.05	0.40	0.54	0.18	1.54	4.86	0.08
POP80	40513062	10283356	6.89E+08	228160	1E+08	5.39	34.34	2381.4	0.00
GRCF80	3.7E+10	8E+09	5.6E+11	2.3E+08	9.2E+10	4.37	23.11	1042.2	0.00

SUMMARY STATISTICS OF RESIDUALS

	MEAN__	MEDIAN	MAX.	MIN.	ST. DEV.	SKEW.	KUR.	J.B. TEST	PROB.
RESIDUALS	3.84E-17	0.0072	0.57	-0.81	0.27	-0.81	4.52	10.77	0.0045

W HITE HETEROSKEDASTICITY TEST (NO CROSS TERMS)

	Value	Probability
F-stat	0.940889	0.527133
Obs*R-squared	13.65226	0.475926

3. STATISTICAL MODEL.

The statistical framework reflects the economic model just presented:

$$\mathbf{lngdpcap_{i90}-lngdpcap_{i80}= lgdpcap_{i80}+inmea_{i80}+grcf_{i80}+pop_{i80}+hdi_{i80}+ senr_{i80}+lfer_{i80}}$$

we will replace the difference in the left hand side, that is the growth rate of per capita GDP, with the notation dlgdpcap:

$$\mathbf{dlgdpcap_i= \alpha+\beta lgdp_i cap_{80}+\gamma inmea_{i80}+\delta grcf_{i80}+\lambda pop_{i80}+\xi hdi_{i80}+\varphi senr_{i80}+\psi lfer_{i80}}$$

In addiction the growth rate of GDP can be affected by important variables omitted from the model or by measurement errors, in order to account for these non-systematic or random effects I introduce a stochastic error term:

$$\mathbf{dlgdpcap_i = \alpha + \beta lgdpcap_{i80} + \gamma inmea_{i80} + \delta grcf_{i80} + \lambda pop_{i80} + \xi hdi_{i80} + \varphi senr_{i80} + \psi lfer_{i80} + u}$$

I am going to estimate the model with OLS methods. This estimation procedure has the advantage to choose the estimators in such a way that sum squares of residuals is minimized. Moreover if the four assumptions of Gauss-Markov theorem hold:

1) The expected value of the error term is zero.
2) The variance of the error term is constant (homoskedasticity property).
3) The explanatory variables (the right hand side terms of the equation) are uncorrelated with the error term. This means that the value of the regressor is not random.
4) There is no correlation between the error terms.

The OLS estimator will be the best linear unbiased among all the other estimators (B.L.U.E.), so it will have the smallest variance among all the others. Moreover, on the average, the value of OLS estimator is equal to the true value of the parameters. This means that we can estimate the parameters of the explanatory variables more precisely with this methodology than with all the other techniques that use linear unbiased estimators.

4. RESULTS

Table 1 shows that UTIP-UNIDO income inequality measure in 1980 and Human Development Index in 1980 are not statistically significant (confidence interval of 5%), accordingly there is no direct influence of these two factors on economic growth rate from 1980 and 1990. However table two indicates that the income inequality is significant and thus has got a positive effect on the log of fertility rate. Both the findings may suggest an indirect effect of income inequality on growth rate from 1980 and 1990. Whereas the third and fourth table points out that income inequality has got no influence on investment and human capital. These results are inconsistent with the most part of the literature and that may be the consequence of measurement errors for two reasons, firstly, because of the employment of proxies which contains this problem by definition, secondly because, frequently, especially in poor countries, there are a lot of mistakes in measuring and reporting data. In addition these wrong findings can be the consequence of a highly, imperfect multicollinearity, probably, between primary school enrolment, log of per capita GDP, log of fertility rate and

human development index. In fact the latter is made up of an average of four indicators, illiteracy rate, strictly correlated to primary school enrolment, per capita GDP in US dollars very tightly connected to lgdpcap80 and life expectancy at birth that is a measure of fertility. Also there can be a problem of systematic reverse causation between economic growth rate and some regressors (maybe fertility rate). All these potential problems can make the estimates of the coefficients biased and inconsistent and consequently alter the results of regressions considerably .
The Ramsey Reset test (see table 7) shows that the null hypothesis of linearity of the model cannot be rejected, moreover the inspection of the residuals shows no particular pattern so there is no sign of important variables omitted from the model. In order to test for structural stability I compared the coefficients of the explanatory variables through time (see tables 1 and 6) and I found no evident change in their estimates. Importantly, the coefficient of income inequality appears to be statistically significant in table six, hence this variable has a positive influence on economic growth rate between 1985 and 1990.

DEPENDENT VARIABLE: DLGDPCAP (1980-1990) **TABLE 1**

VARIABLE	COEFFICIENT	ST. ERR.
α	1.735868	0.881326
LGDPCAP80	-0.041689	0.119178
GRCF80	2.99E-13	5.41E-13
HDI80	0.031797	1.199253
INMEA80	0.009464	0.012187
SENR80	-0.006642	0.004196
POP80	1.94E-10	5.12E-10
LFER80	-0.743739	0.206308
ST. ERROR OF REGRESSION		0.299359

DEPENDENT VARIABLE: LFER80 TABLE 2

VARIABLE	COEFFICIENT	ST. ERR.
α	1.387007	0.602316
LGDPCAP80	0.077150	0.085342
INMEA80	0.024648	0.008003
SENR80	0.005505	0.002919
HDI80	-3.267468	0.716686
POP80	-7.55E-10	3.52E-10
GRCF80	1.22E-12	3.90E-13
ST. ERROR OF REGRESSION		0.216306

DEPENDENT VARIABLE: GRCF80 TABLE 3

VARIABLE	COEFFICIENT	ST. ERR.
α	-3.11E+11	2.38E+11
LGDPCAP80	3.33E+10	3.25E+10
INMEA80	7.84E+08	3.36E+09
SENR80	-5.75E+08	1.15E+09
HDI80	9.99E+10	3.30E+11
POP80	415.3306	126.7662
LFER80	1.78E+10	5.68E+10
ST. ERROR OF REGRESSION		8.25E+10

DEPENDENT VARIABLES: SENR80 TABLE 4

VARIABLE	COEFFICIENT	ST. ERR.
α	9.047651	31.27822
LDGPCAP80	-10.82117	3.914168
INMEA80	0.517411	0.426005
HDI80	195.5941	31.05939
POP80	4.08E-09	1.82E-08
GRCF80	-9.55E-12	1.92E-11
LFER80	13.30556	7.055151
ST. ERROR OF REGRESSION		10.63409

DEPENDENT VARIABLE: HDI80 TABLE 5

VARIABLE	COEFFICIENT	ST. ERR.
α	-0.059849	0.115217
DLGDPCAP	0.000502	0.018951
INMEA80	0.001079	0.001534
POP80	-4.39E-11	6.41E-11
GRCF80	2.02E-14	6.82E-14
LFER80	-0.096324	0.025698
SENR80	0.002398	0.000404
LGDPCAP80	0.076067	0.009673
ST. ERROR REGR.		0.037631

DEPENDENT VARIABLE: DLGDPCAP (1985-1990) **TABLE 6**

VARIABLE	COEFFICIENT	ST. ERR
α	1.355700	0.808213
LDGPCAP80	0.024384	0.109291
INMEA80	0.024961	0.011176
HDI80	-0.867829	1.099765
GRCF80	-4.29E-13	4.96E-13
SENR80	-0.003243	0.003848
POP80	-4.26E-10	4.69E-10
LFER80	-0.965713	0.189193
ST. ERROR OF REGRESSION		0.274524

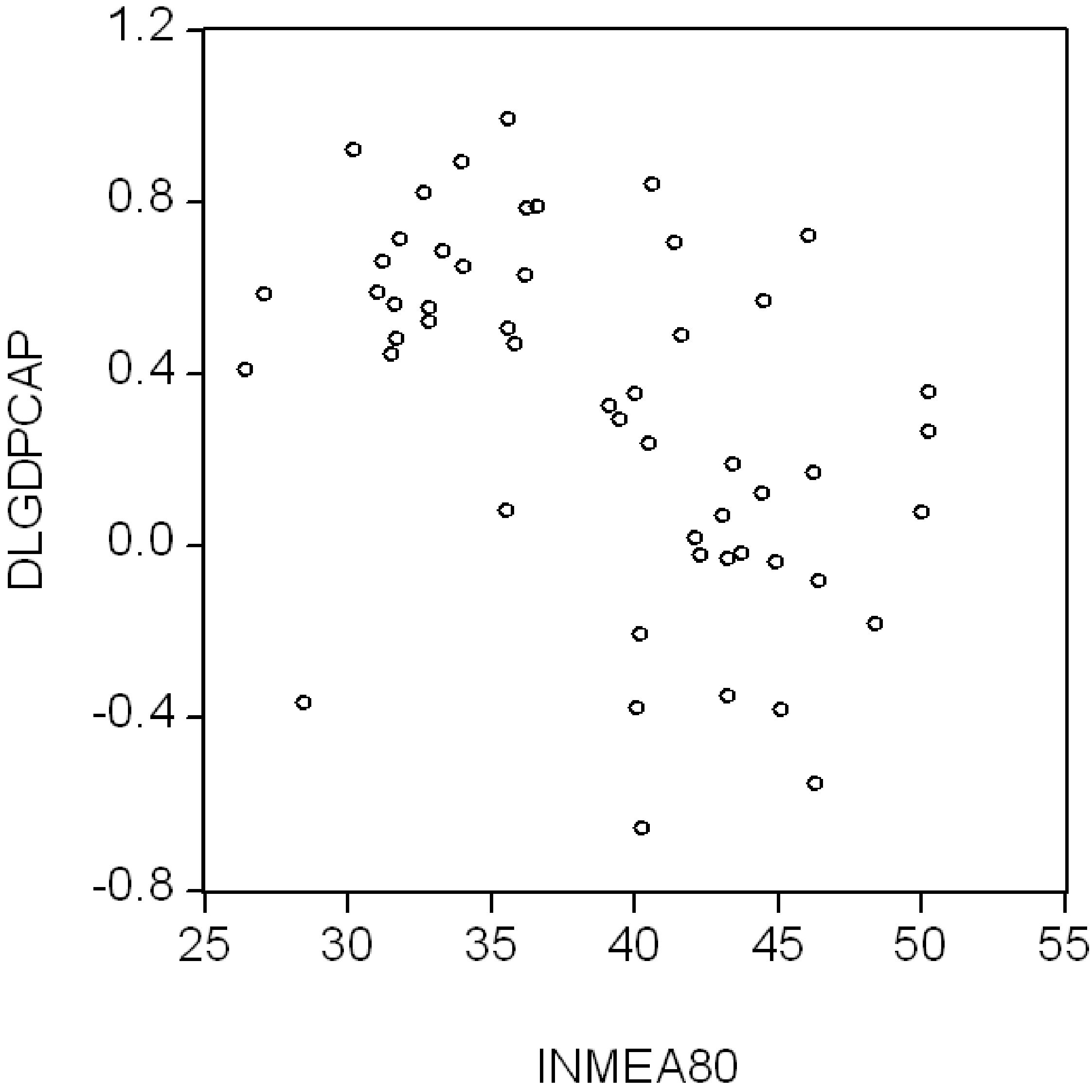
Ramsey Reset test regarding the regression in table 1 **TABLE 7**

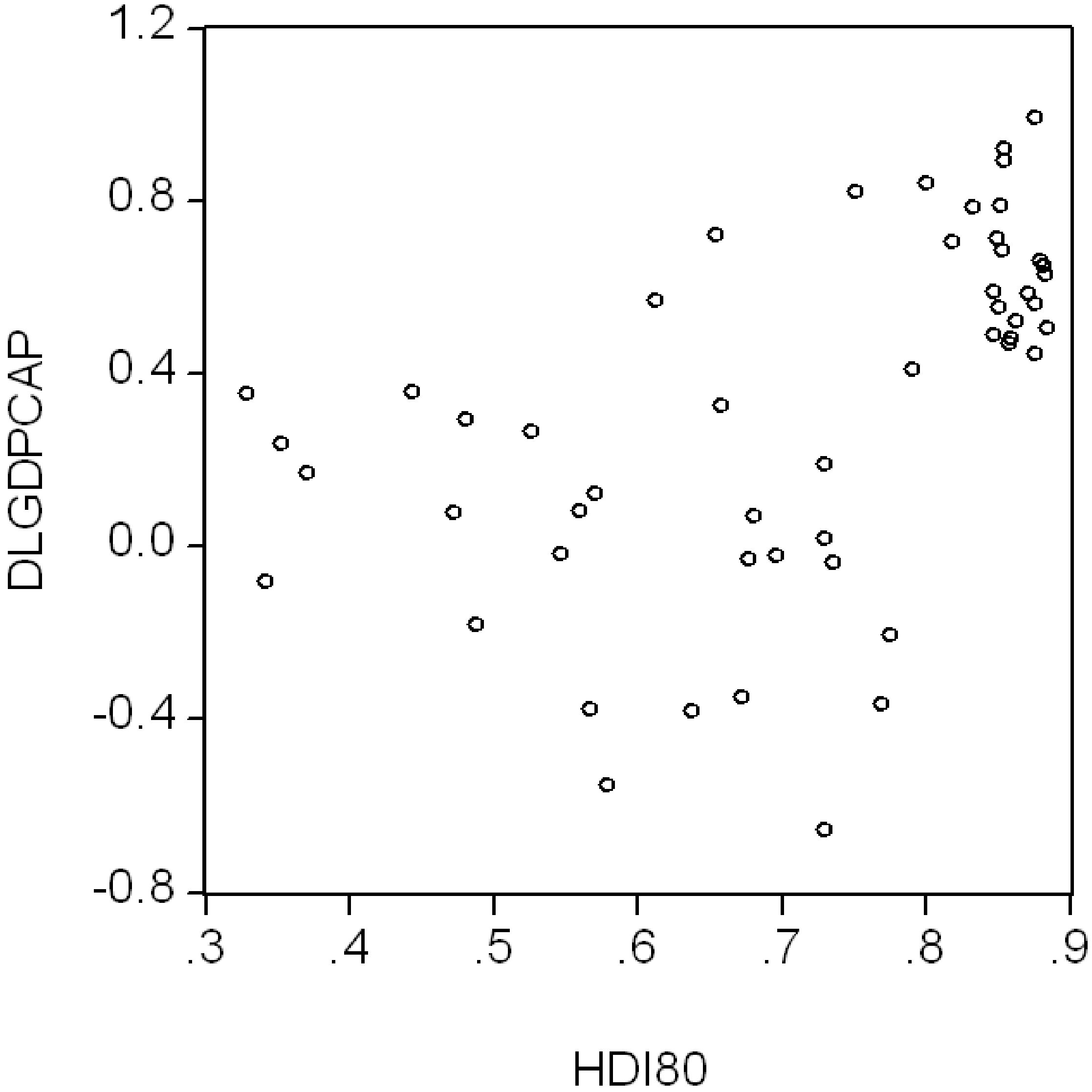
	Value	Probability
F-statistic	0.118630	0.732204
Log likelihood ratio	0.143262	0.705060

3. CONCLUSIONS

According to the main findings of this research paper there is no direct influence of income inequality and of human capabilities achievements on economic growth rate.
Also there appears to be no relationship between the income inequality, investment and human capital, though the results show a positive effect of wealth concentration on the fertility rate and this outcome may suggest an indirect effect of income distribution on economic growth. However the first two outcomes are in opposition to the economic mainstream, this is probably due to measurement errors in the explanatory variables caused by the proxy we employed for human capital and investment or by the imprecisely estimated data of developing nations. Also it may be the consequence of a high but imperfect multicollinearity between some of the regressors such as log of fertility rate (lfer80), human development index (hdi80), Primary School Enrolment (senr80) and log of per capita GDP (lgdpcap80). Finally there can be a systematic reverse causation between some of the variables, probably fertility rate and growth rate of per capita GDP. This potential problem could have made the OLS estimators biased and inconsistent. Moreover the tests and the path of the residuals show no misspecification issue, this is a strong sign of a well-behaved model.

APPENDIX




1.2
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DLGDPCAP
.3
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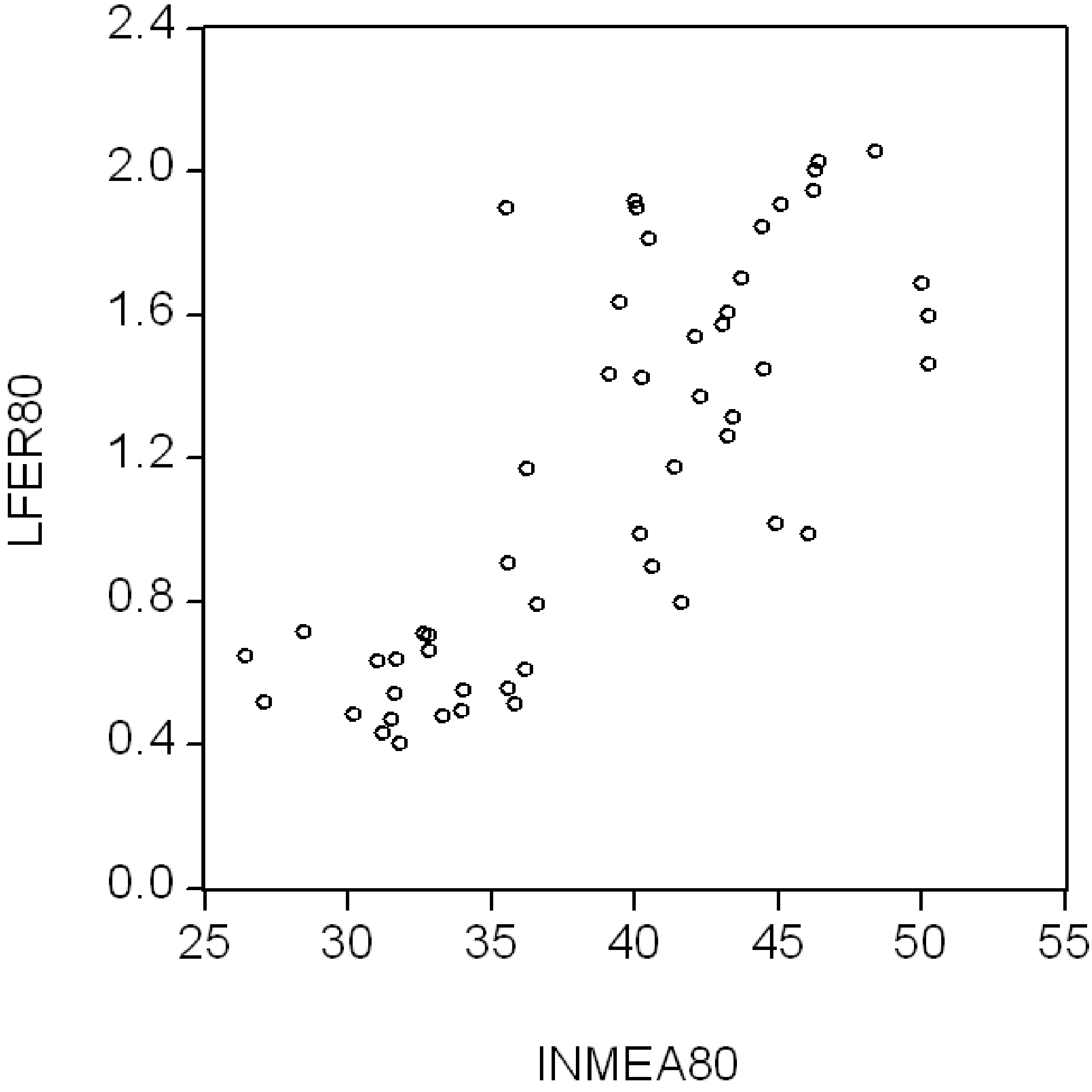
HDI80


2.4
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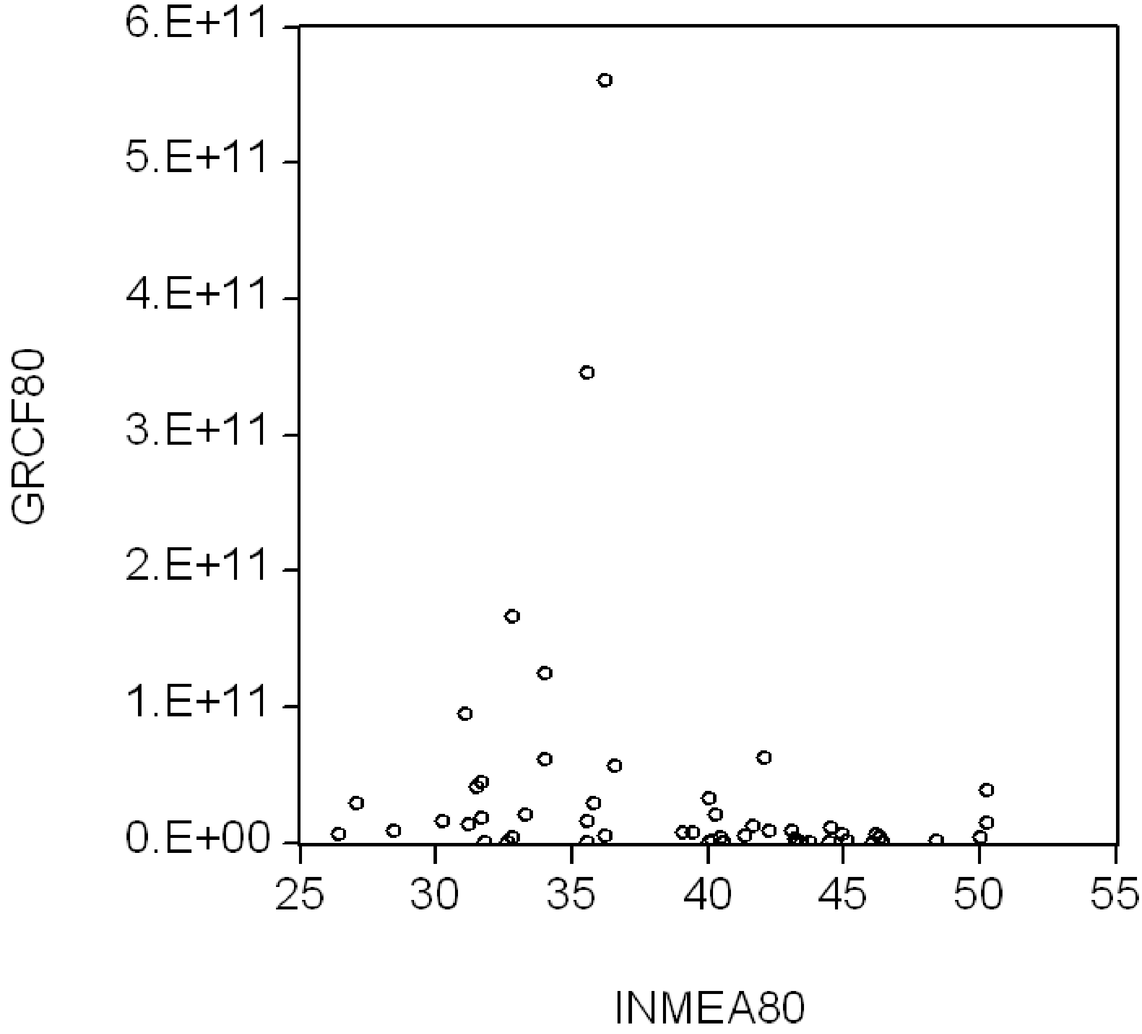
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GRCF80
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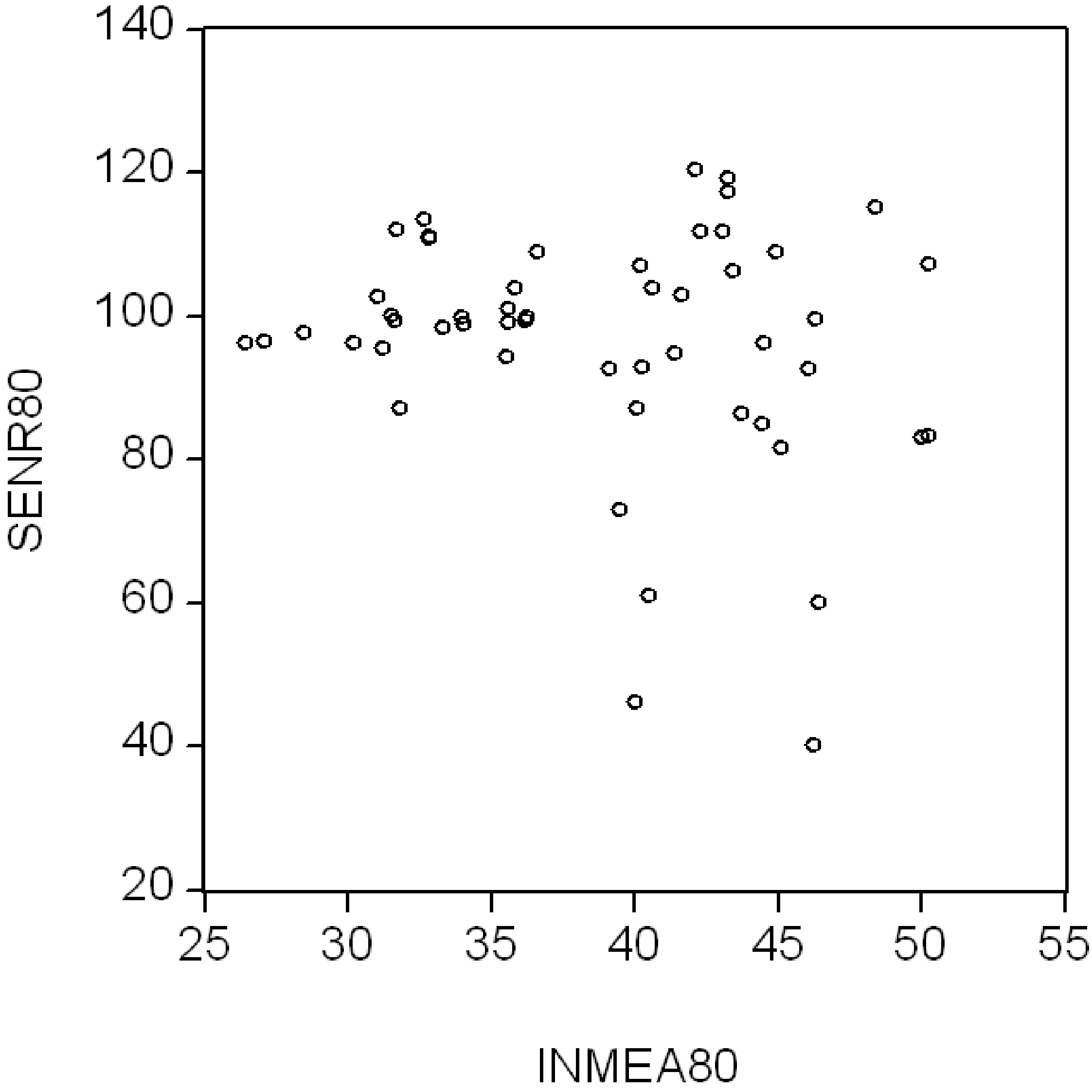
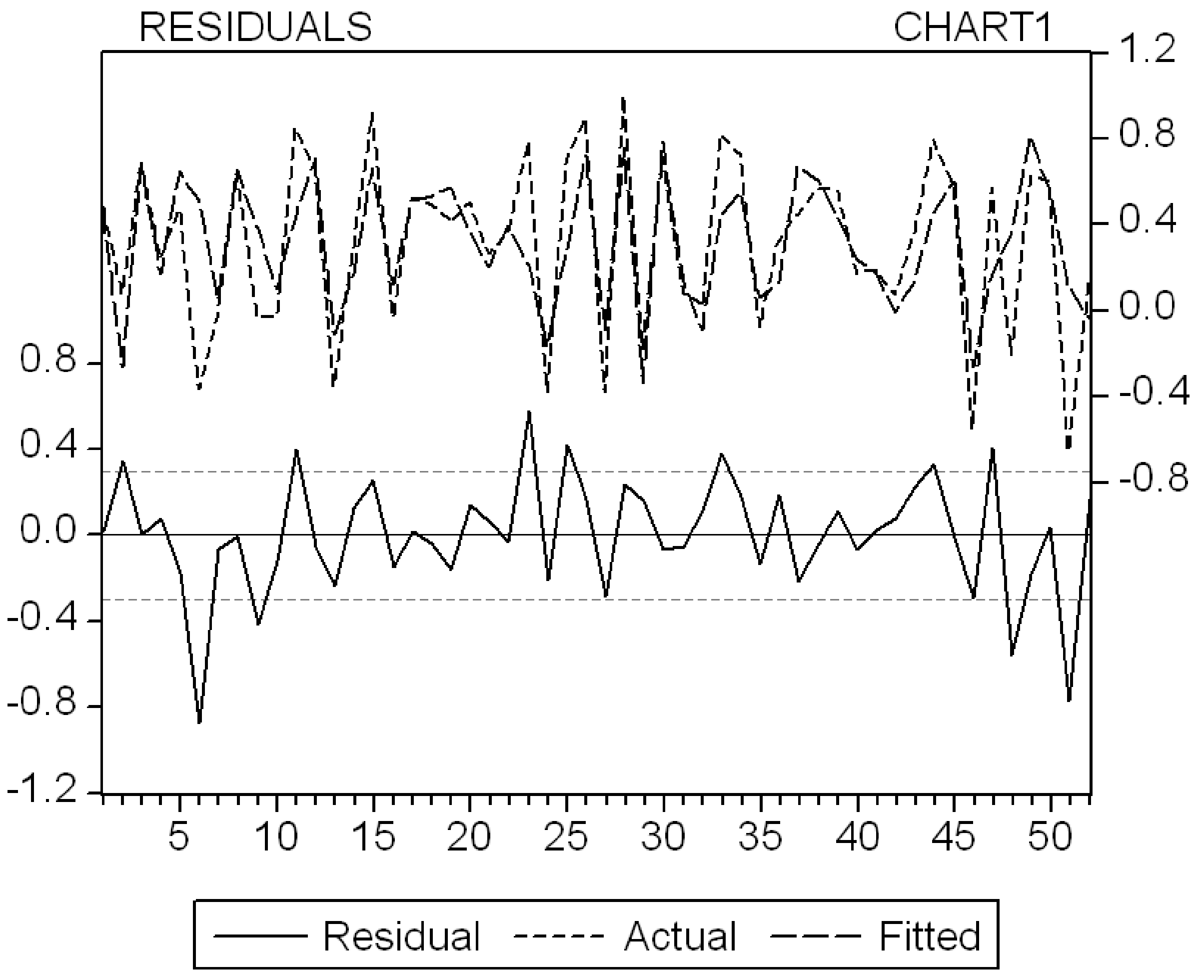
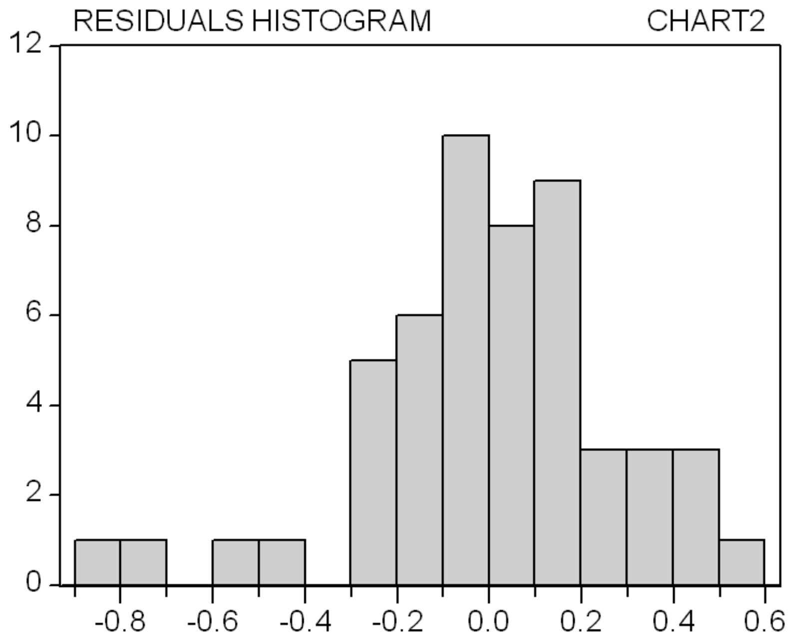
55
INMEA80



140
120
100
80
60
40
20
SENR80
25
30
35
40
45
50
55
INMEA80



RESIDUALS
CHART1
1.2
0.8
0.4
0.0
-0.4
-0.8
0.8
0.4
0.0
-0.4
-0.8
-1.2
5
10
15
20
25
30
35
40
45
50
Residual
Actual
Fitted



Series: Residuals
Sample 1 52
Observations 52

Mean	-1.73E-16
Median	0.007231
Maximum	0.574730
Minimum	-0.873429
Std. Dev.	0.278056
Skewness	-0.812958
Kurtosis	4.526365
Jarque-Bera	10.77568
Probability	0.004572

CHART 3

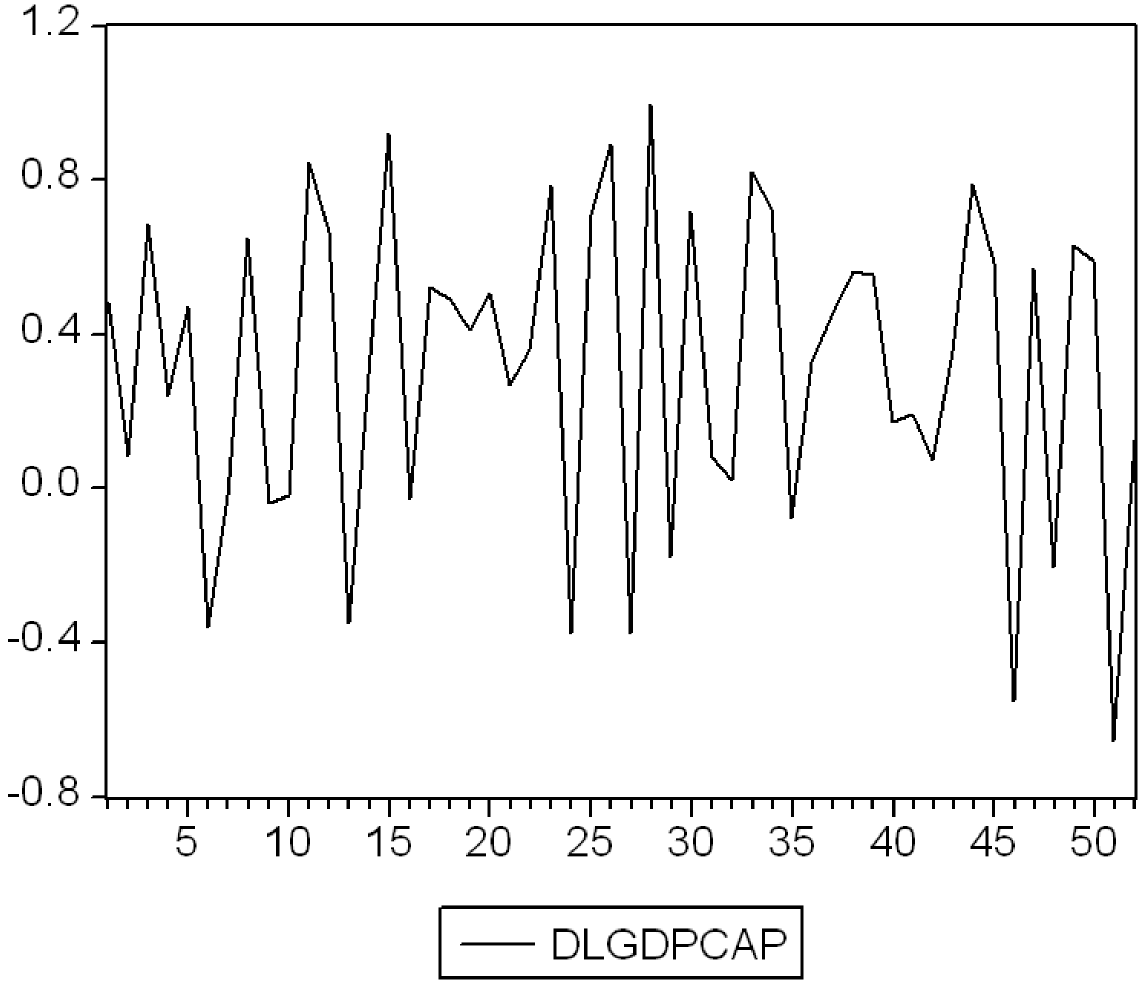
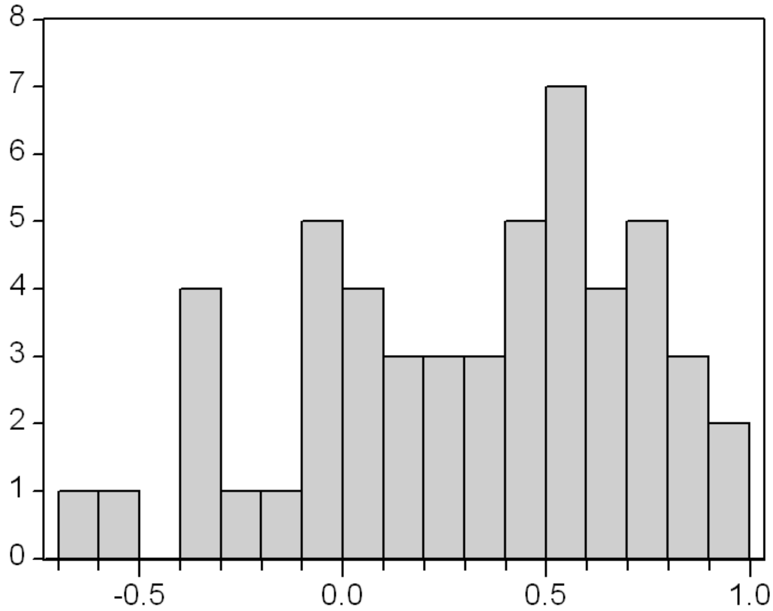


CHART 4



Series: DLGDPCAP
Sample 1 52
Observations 52

Mean	0.315238
Median	0.385688
Maximum	0.994874
Minimum	-0.655518
Std. Dev.	0.411698
Skewness	-0.480169
Kurtosis	2.371980
Jarque-Bera	2.852760
Probability	0.240177

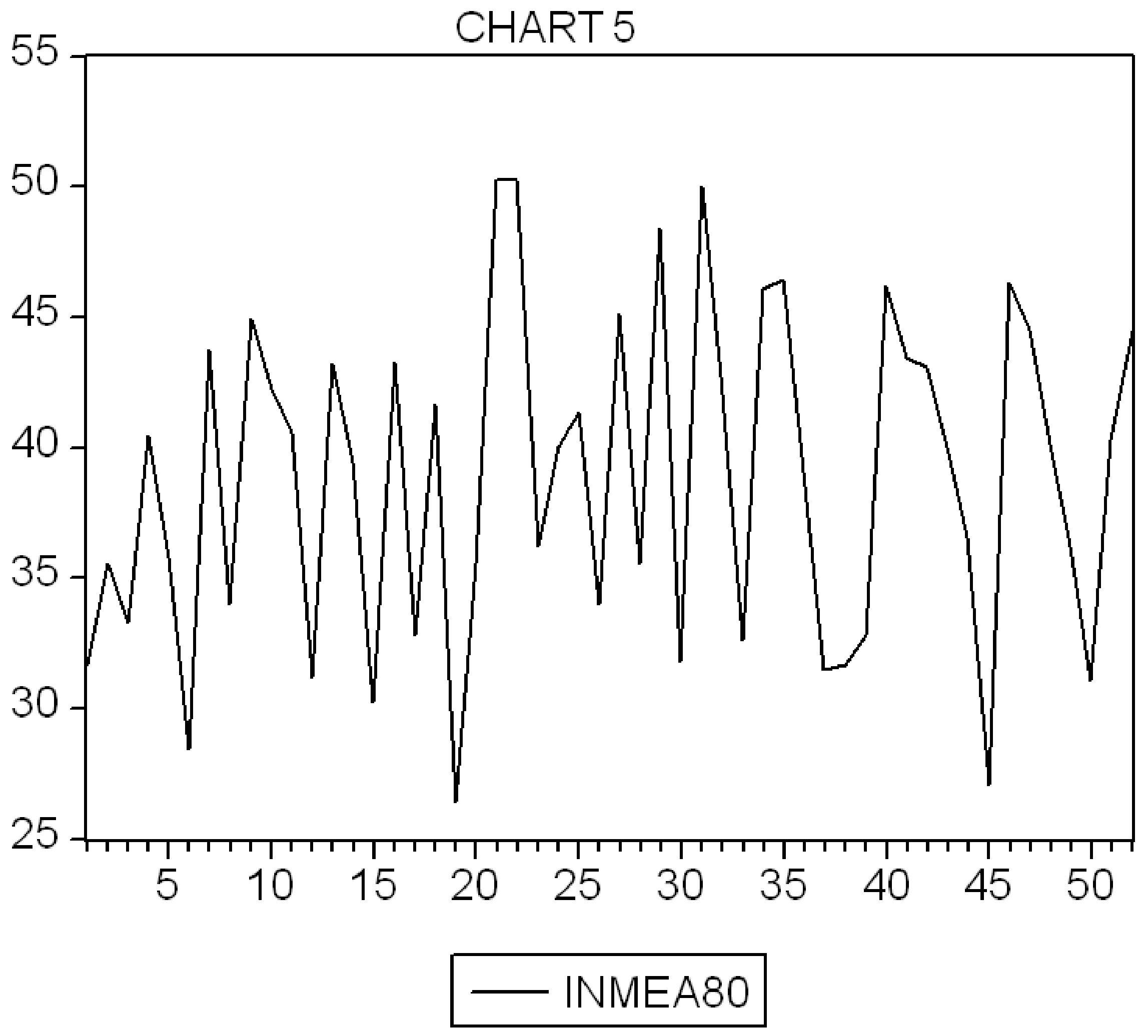
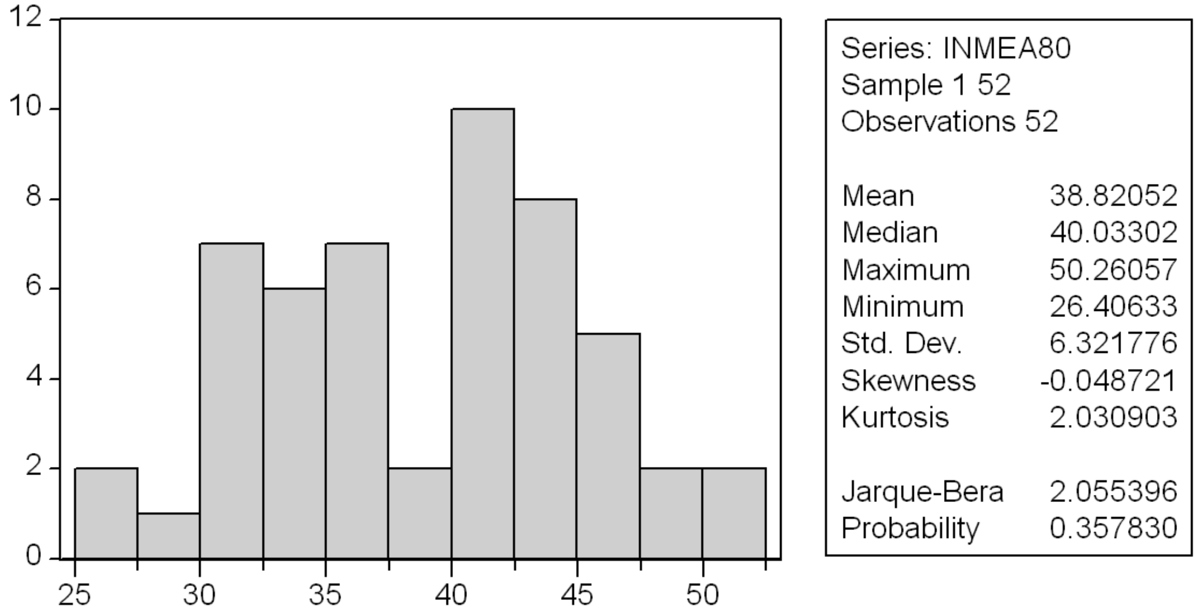


CHART 5
55
50
45
40
35
30
25
5
10
15
20
25
30
35
40
45
50
INMEA80

CHART 6



12
10
8
6
4
2
0
25
30
35
40
45
50
Series: INMEA80
Sample 1 52
Observations 52
Mean 38.82052
Median 40.03302
Maximum 50.26057
Minimum 26.40633
Std. Dev. 6.321776
Skewness -0.048721
Kurtosis 2.030903
Jarque-Bera 2.055396
Probability 0.357830

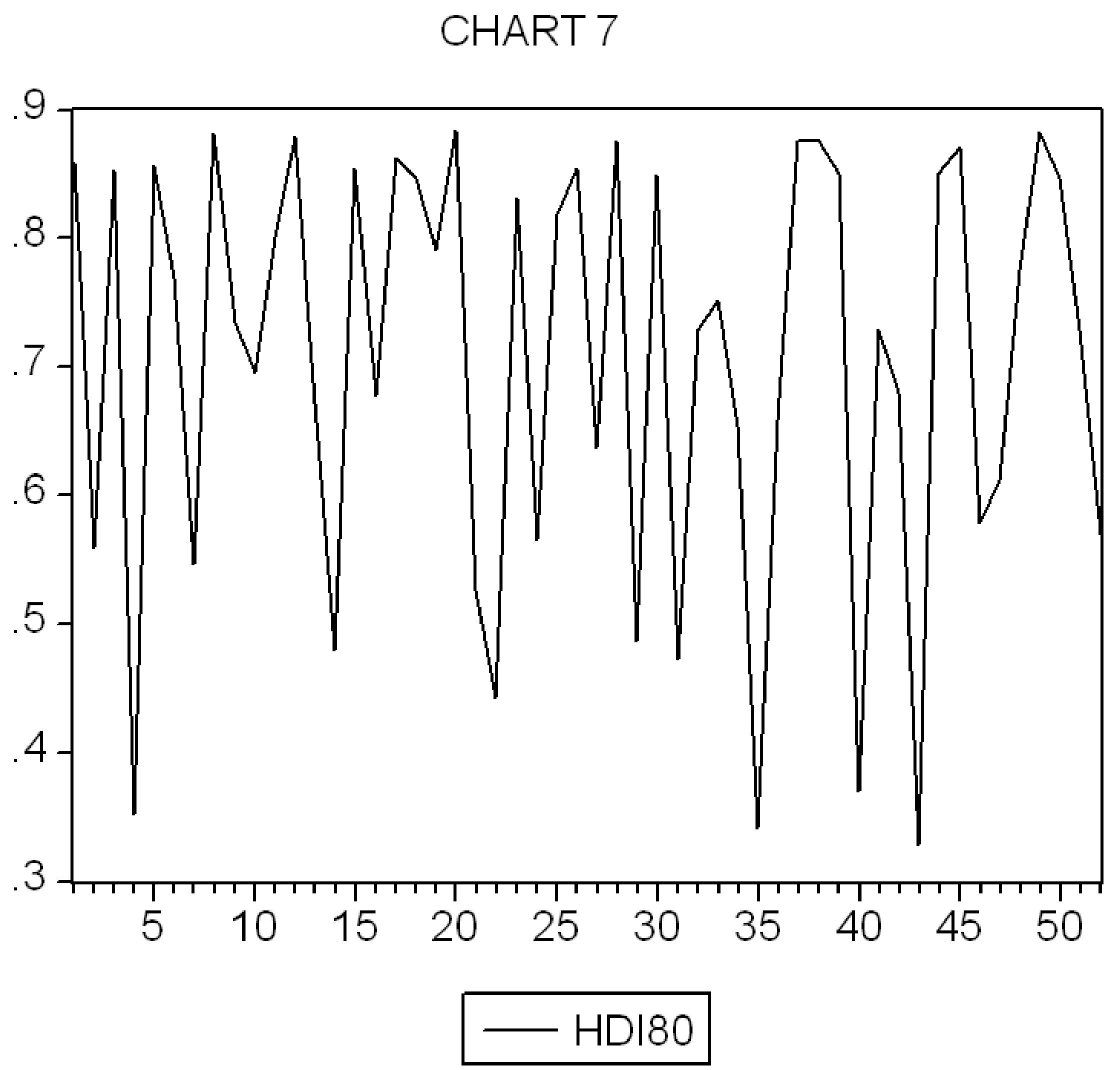


CHART 7
.9
.8
.7
.6
.5
.4
.3
5
10
15
20
25
30
35
40
45
50
HDI80

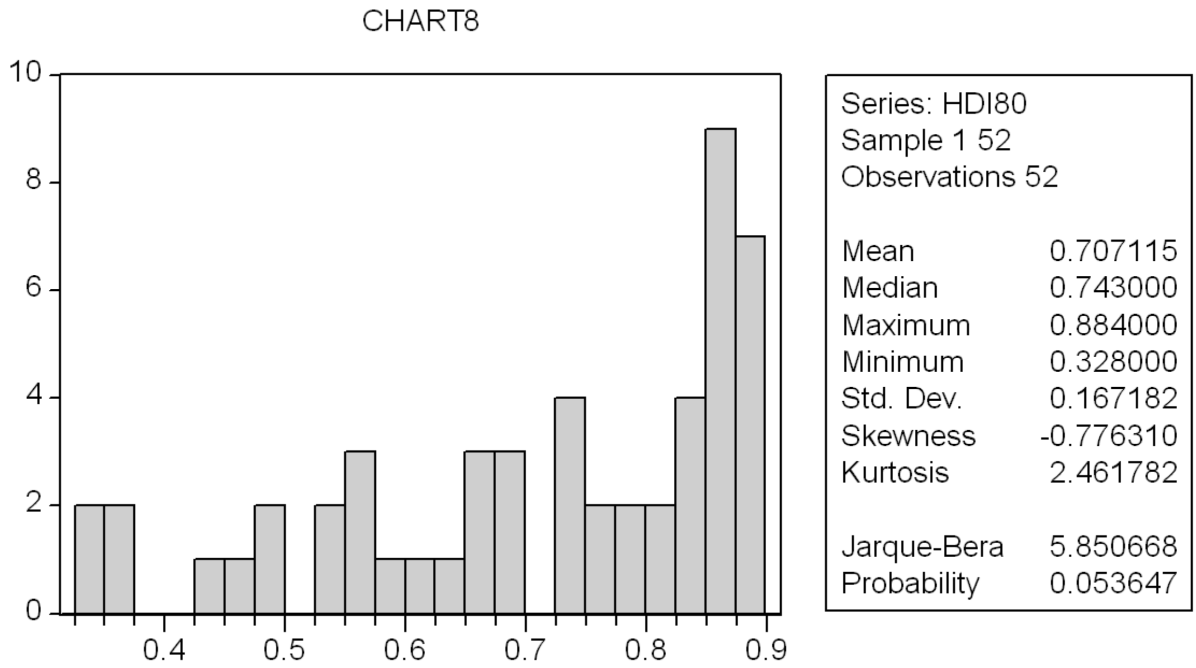


CHART8
10
8
6
4
2
0
0.4
0.5
0.6
0.7
0.8
0.9
Series: HDI80
Sample 1 52
Observations 52
Mean 0.707115
Median 0.743000
Maximum 0.884000
Minimum 0.328000
Std. Dev. 0.167182
Skewness -0.776310
Kurtosis 2.461782
Jarque-Bera 5.850668
Probability 0.053647

CHART 9

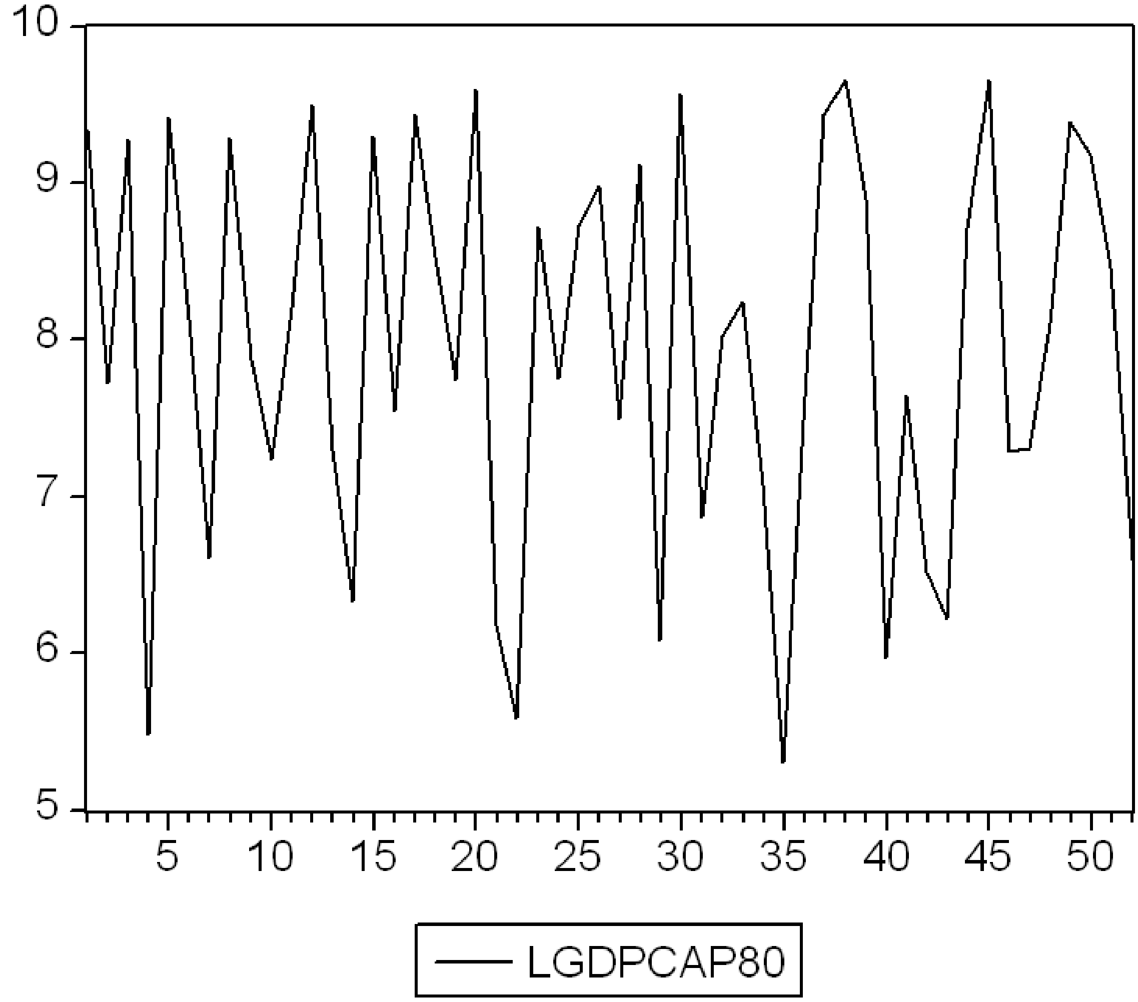
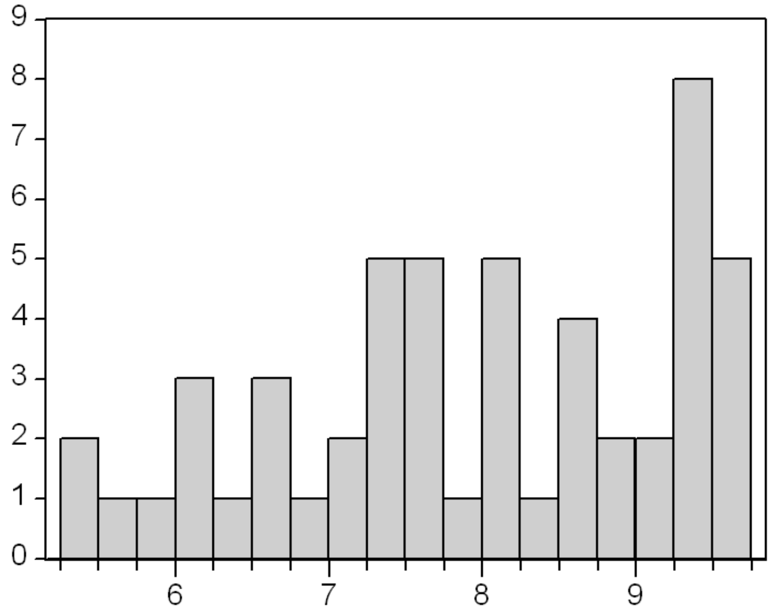


CHART10



Series: LGDPCAP80
Sample 1 52
Observations 52

Mean	7.963416
Median	8.063688
Maximum	9.655472
Minimum	5.299210
Std. Dev.	1.269017
Skewness	-0.374963
Kurtosis	2.030785
Jarque-Bera	3.253827
Probability	0.196535

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