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Development Gap And Income Concentration In The World (A Cointegration Approach)

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Introduction

In the last decades, developed and developing countries have reached different growth rates and different levels of development. Many factors like the deterioration of the terms of trade, the population growth, the technological gap, the education disparity etc, contributed to a redistribution of the world income and an extent of the development gap. How the development gap and the income concentration are evaluated, and how these variables are related? Historically, it seems that the increasing of the development gap has been accompanied by reinforcing the world income concentration. Can we suggest that the extent of the development gap is a result of the increase of the world income concentration, in the benefit of the developed countries?

This research attempts to estimate the development gap, the income concentration index, and the relationship between them. To achieve these objectives, a sample of 106 countries was selected. The development gap was evaluated by using seven economic and demographic indicators taken from the World Bank publications during the period 1975-1990.

The mathematical concept of Euclidean distance is used to measure the distance of the studied countries from an ideal objective. The Dynamic Algorithm Fisher (Fisher: 1958) was applied to divide the sample of countries into two groups, according to certain mathematical criteria. The development distance between these groups is considered as an estimation of the development gap. Based on income and population distributions, the income concentration index is measured in order to get a time series of the income concentration in the world.

The relationship between development gap and income concentration is estimated by using OLS, ECM, and Johansen cointegration technique.

Few studies have adopted a quantitative measure for the development gap.

Gostkowski (1975) measured the development gap for a set of 50 countries, for the years 1955, 1960, and 1965 depending on seven variables. He used the mean distance as a criterion for dividing the countries in two groups: poor and rich. He calculated for every group a mean distance. The difference between the two means is considered as a measure of the development gap in time (t). By repeating the same procedure for the next time, he measured the growth rate of the development gap.

Alkhatib and Al-Nachawati (1995) proved that Gostkowski 's method has a principal defect: the division of the sample into two groups of countries, which relies on the mean distance alone, does not take into consideration the homogeneity within the groups and the heterogeneity between them. The Dynamic Algorithm Fisher gives the optimal division into two groups. This algorithm uses the variance as a criterion so that the optimal homogeneity within the groups and the optimal heterogeneity between the groups will be warranted (Rao: 1971). This method was applied to a sample of 100 countries in four periods: 1975, 1980, 1985, 1990 and covered five variables.

Other studies measured the concentration coefficients in different levels. These studies seek to evaluate the Gini coefficient for one country, for one group of countries, or for all countries in the world. A complete list is shown in Todaro (1989: 145-158).

Compared with the previous studies, the present research offers three contributions. First, it improves the previous studies of measuring the development gap through the following: the sample is expanded from 100 to 106 countries, the number of estimated development gaps is increased from 4 to 16, and the number of variables is extended from

5 to 7. The second contribution is to estimate the Gini coefficient to measure the income concentration for the entire world. Having two time series for the development gap and the income concentration, the third contribution is to estimate and to test the relationship between these two series.

This study is divided into three sections. The first deals with the measuring of the development gap, the second presents the measuring of the income concentration. While in the third section, we estimate the relationship between the development gap and income concentration. The main findings and the summary are given at the end of the paper.

1- Measuring the Development Gap:

The development path in the world looks like a sports game in which the countries are the contestants. Every country tries to win, advancing towards the end of the race at different speeds. Taken into consideration their speeds and capabilities, the developed countries have better conditions to win than the developing countries.

The countries' objectives are from different types. Some objectives have fixed limit, so that when the countries reach them, the game is over. The variables concerning these objectives are divided into three groups. First, natural variables of upper limit, such as the literacy rate (which can't exceed 100%). Second, natural variables of a lower limit such as the mortality rate, which can't be less than zero. Third, natural variables of slow moving limit, such as the age expectancy at birth which can be specified by natural conditions, and the individual protein consumption that is limited by the body ability of digestion. The countries that have entered the race earlier have reached the natural limit, while those who entered the race later are on their way to compensate their retard. So, the distance between the contestants is shortened according to their own speeds and capabilities. There are other variables that have no limit. The objective here is movable. The developed countries have reached high levels of national income, energy consumption, and enrollment ratio. These countries still push these levels forward, so the late contestants can not reach the movable objectives. On the other hand, the objective speed and the slow motion to reach it, increases the distance between the late contestants and that objective over the time. The advanced contestants reaching the objective after a while, constitute an avant-garde group, and push the objective forward.

While economic development is multidimensional (Todaro, 1989: 86-90), the selection of the contestants needs to take into consideration a wide category of objectives, and the measurement of the distance between forward and backward countries implies suitable analytical tools, like the development gap.

1-1: Theoretical Basis for Measuring the Development Gap:

In a specific moment of time, a group of countries can be presented in bidimensional space, by a set of points. The coordinate (x_j, y_j) represents the values of the development variables in each country (j). Repeating this representation for all the countries in successive periods of time: $(t_1, \ldots t_n)$, we can follow the position of all countries throughout the time (during the race time). We can specify the race end in every period by the maximum values of the variables X and Y. An ideal country or an objective for all other countries, will be represented by the maximum values (Max X, Max Y). There is another way for representing the distance between the countries from the ideal country. The Euclidean distance between each country and the objective country can be used, after a suitable standardization.

Then the distances will be arranged descendingly according to the development levels. The Euclidean distance may contain many development indicators, as many as the variable numbers of the distance.

After calculating the Euclidean distance from the objective, the next step will be the clustering of the distances into two sub-groups, by using Fisher's method. Fisher's method (Fisher: 1958) presented a dynamic programming procedure to obtain optimal partition of E into k-groups that exactly minimizes the sum of squares.

We notice that Fisher's partition may not differ from the mean method, if the sample data can be partitioned into two clearly different groups. That is, when advanced countries (near the objective) are greatly different from developing countries (far from the objective). But Fisher's partition will lead to different result, if there were middle countries that can not be classified to either of the two groups, as we encounter in economic reality. By consequence, this fact will lead to a different measure for development gap and its growth rate.

Let us return to the following important question: how to measure the distance or the gap between the two sets of developed and developing countries? A quantitative method based on the dichotomy partition is proposed by Gostkowski (1975, pp. 41-55). This method uses the mean distance as a criterion to distinguish these two sets of countries. For each set, the mean distance is calculated: (Ml) for the developed countries and (Mh) for the developing countries. The difference (G_t) between the two means is considered as a measure of the gap development in the period (t). By repeating this operation in the second period, the change in the gap development is evaluated.

To apply Gostkowski's method on the example mentioned in Table (1) to the two periods (t_1) and (t_2), we adopt the following steps:

Table (1) Variables values and their Euclidean distances

Cou-ntries	Variables values				Standardized values				Euclidean Distances	
	t1		t2		t1		t2		From the Objective	
	X1	Y1	X2	Y2	NX1	NY1	NX2	NY2	D1	D2
A	1	1	1	2	0.11	0.1	0.11	0.2	1.264959	1.195877
B	1	2	3	4	0.11	0.2	0.33	0.4	1.195877	0.896908
C	2	3	3	3	0.22	0.3	0.33	0.3	1.046392	0.966666
D	3	5	4	6	0.33	0.5	0.44	0.6	0.833333	0.684574
E	4	6	5	5	0.44	0.6	0.56	0.5	0.684574	0.668977
F	5	6	4	7	0.56	0.6	0.44	0.7	0.597938	0.631381
G	6	7	8	6	0.67	0.7	0.89	0.6	0.448454	0.415145
H	7	8	6	10	0.78	0.8	0.67	1	0.298969	0.333333
I	9	10	5	9	1	1	0.56	0.9	0.000000	0.455555
J	8	9	6	8	0.89	0.9	0.67	0.8	0.149484	0.388730

1- We choose the values of the ideal variables (objectives) as the maximum values of each variable X and Y. The maximum value of X is (9) in the period (t_1), and the maximum value of Y is (10) in the period (t_1) or (t_2). By consequence, the ideal in this example is a real country: the country I.

2- The variable X is standardized by dividing its values by the maximum value of X: $x_i = \frac{X_i}{MaxX}$, and the variable Y is standardized by dividing its values by the maximum value of Y: $y_i = \frac{Y_i}{MaxY}$.

3 - The Euclidean distances are calculated by applying the relation:

$$D_i = \sqrt{(x_i - Max\,x)^2 + (y_i - Max\,y)^2}$$

4- The arithmetic mean of the distances Mg is calculated by using the relation $Mg = \frac{\sum D_i}{N}$. It is found that Mg = 0.651998 for t_1, and 0.663715 for t_2.

5- The sample of the ten countries is divided into two sets by comparing D_i and Mg. In the set of the developed countries D_i are less than Mg, and in the set of the developing countries D_i are more than Mg. It is found that the countries of the first set are (F, G, H, J, I) and the countries of the second set are (A, B, C, D, E).

6- The mean (Ml) of the distances for the first set of countries and the mean (Mh) of the distances for the second set of countries are calculated. These means are Ml=0.29896 and Mh= 1.00502 for the first period t_1.

7- The development gap is evaluated by the difference between Mh and Ml where $G_t = Mh - Ml$. For G_1 we get the value of 0.70606 as a measure of the development gap.

8- By repeating the previous steps for the second period, we get the value G_2= 0.43777 as a measure of the development gap for the second period.

9- The difference between G_2 and G_1 expresses the evolution of the development gap. We can observe the decreasing of the gap, where $\Delta G = G_2 - G_1 = -0.26829$. Dividing □G by the value of the development gap in the first period G_1, we get the growth rate of the development gap where:

$$R = (\frac{\Delta G}{G_1}) \times 100 = (\frac{-0.26829}{0.70606} \times 100) = -38\%$$

Then the development gap decreased by 38% from its initial value.

But the method proposed by Gostkowski has a major defect. The partition of the countries into two sets does not take into consideration the variance of the values inside the sets (within) or the variance of the values between the sets (between). This method of clustering is not certainly the best. So we propose to replace the arithmetic mean as a criterion of clustering by the Fisher's algorithm method. We note that Fisher's algorithm gives certainly the best partition into two sets based on the minimum variance between the values of the variables inside the set, and the maximum variance between the sets. So this partition gives two sets, where the homogeneity inside each set and the heterogeneity between the sets are maximum.

By applying Fisher's algorithm to the example in Table (1), we obtain the results of Table (2).

Table (2)
The within variance of the sets considering the criterion partition: Fisher and the arithmetic mean

	First period t_1		Second period t_2	
Criterion Partition	Within Variance	Development Gap	Within Variance	Development Gap
Arithmetic Mean	0.64132	0.70606	0.24164	0.43777
Fisher's Algorithm	0.45700	0.7219	0.1775	0. 509

We see from Table (2), that the within variance calculated on the basis of Fisher's algorithm is less than the within variance calculated on the basis of the arithmetic mean.

1-2: Practical Considerations for Measuring the Development Gap:

We will apply the Fisher's algorithm to a large group of 106 countries to estimate the development gap. The population of the sample is estimated by 4.504 billions inhabitants. It covers about 85 % of the world population in 1990. The studied period is 1975-1990. Considering that the uncovered countries are often developing countries, the data in reality seems to be more dispersed than it is in the sample. It is believed that the estimated development gap is less than the real value. So, the development gap estimation in our study seems to be optimistic.

The multidimensional aspects of development were covered by seven variables classified into two groups. The economic group contains: GNP per capita evaluated in US dollars, energy consumption per capita estimated by equivalent kilos of oil, and the percentage of population in urban areas. The demographic group is composed of age expectancy at birth, infant mortality rate, total fertility rate, and age dependency ratio. The best quantification of development gap needs in fact more economic indicators of great importance, but the shortage of the statistical data faces this objective.

When examining the sample data, during the studied period, we noticed the objective values of the selected variables. The GNP per capita was 32230 U.S dollars in Switzerland in 1990. The energy consumption per capita was 10873 equivalent kilos of oil in the United Arab Emirates in 1990. The percentage of population in urban areas was 100% in Singapore in 1990. The age expectancy at birth was 84.2 years, in Hong Kong in 1990. The infant mortality rate was 0.4%, in Iceland in 1990. The total fertility rate was 1.3 child in Italy in 1989. And the dependency ratio was 0.41 in Singapore in 1990. The values of the GNP per capita, the energy consumption per capita, and the age expectancy at birth, and the percentage of population in urban areas increased in almost all countries. On the other hand, the infant mortality rate and the total fertility ratio decreased. We notice that the objectives represent maximum value for GNP, energy consumption, age expectancy, percentage of urban population, while the objectives represent minimum value for the other variables.

The variables expressed in statistical units like the GNP, the energy consumption, the total dependency ratio, the total fertility ratio, and the age expectancy at birth must be standardized before any attempt of analysis. But the variables measured, as percentage like the urban population percentage, and the infant mortality rate did not need such treatment. We found that the standardization using the maximum value gives better results than those resulted by other methods. The variables of fertility and dependency have been standardized in the same way after taking their inverse values in order to use the maximum value.

1-3: Results for Measuring the Development Gap:

By applying the method of calculating the development gap, we acquire the development gap values and its growth rate. The results are summarized in (Table 3). The development gap, based on the seven variables, has reached 0.56304 in 1975 and 0.79497 in 1990, with an average growth rate of 2.344 % annually. This important result denotes the crisis of the developing countries, so their development conditions have become worse during the studied period, (except the year 1983) which widens the development gap between developed and developing countries. It is worth mentioning that the decrease of the total development gap in the year 1983 was as a result of the decrease of GNP gap. The decrease of the GNP gap by 11.85 % in 1983 is due to the oil income crash in some oil developing countries.

2- Measuring of Income Concentration in the World:

Economic growth in the world was often accompanied by income and population increases. The difference between level and growth income, and number and growth population, has led to a large contrast between the income share and the population share, between developed and developing countries. The population number has increased in developing countries faster than in developed countries. By contrast, the incomes have increased in developed countries faster than in developing countries

The high rate in population growth might be attributed to the lack of education. While the high growth in income in the developed countries might be attributed to its exports which is mainly technologically advanced products, developing countries mainly rely on agricultural products in their exports.

Another reason of the income concentration is the deterioration of the terms of trade. Todaro noted "historically, the prices of the primary commodities have declined relative to manufactured goods. As a result, the terms of trade tend to worsen over time for the non-oilexporting developing countries while showing a relative improvement for the developed countries" (Todaro, p.376), "as for the distributional effects of the trade, it is fair to claim that the principal benefits of world trade have occurred disproportionately to rich nations and within poor nations". So "trade tends to reinforce existing inequalities"(Todaro, 395).

The income share of the developed countries increased from 79.56% in 1975 to 83.75% in 1990, while their population share decreased respectively from 20.24 to 17%. By contrast, the income share of the developing countries decreased from 20.44% in 1975 to 16.25%, while their population share increased respectively from 79.76 to 83%. (Alkhatib, 1995, p.311). So the income share of the developed countries becomes smaller and their population share becomes bigger and vise versa for the developed countries. This evolution led to a large contrast in income and demographic distribution in the world.

To measure income concentration, we calculated the Gini coefficient on the 106 chosen sample countries, during the period 1975-1990. The results are summarized in (Table 3). It is known that the Gini coefficient equals zero in the case of income distribution equality, and the value one in the case of maximum concentration of this distribution. The results show that the income distribution in the world suffers from high concentration. Gini coefficient values were increased from a minimum value of 0.69498 in 1975, to a maximum value of 0.74876 in 1990, with an average growth rate of 0.5% per year. This means that the income concentration which is basically high, continued to rise during the studied period, except for 1980-1982 when the Gini coefficient slightly declined due to oil prices increase.

Table (3): Development Gap & Gini Coefficient

	GAP	GINI
1975	0.56304	0.69498
1976	0.59619	0.70133
1977	0.60001	0.70355
1978	0.61576	0.70416
1979	0.63989	0.70525
1980	0.65157	0.70205
1981	0.66466	0.70007
1982	0.67388	0.69918
1983	0.65768	0.70503
1984	0.65768	0.71310
1985	0.67349	0.71902
1986	0.69636	0.72832
1987	0.72116	0.73588
1988	0.75630	0.74320
1989	0.77734	0.74739
1990	0.79497	0.74876

3- The Relationship Between Development Gap and Income Concentration:

Development gap is considered as a measure of the increased difference in development levels between developed and developing countries. Gini coefficient expresses the concentration of income distribution in the world. We will try to measure and test the relationship between these two variables. To do so, we will suppose that there is a causality relationship between them. In other words, we will test the hypothesis that the income concentration in developed countries and the redistribution of income for their benefit leads to continuous poverty of developing countries. This poverty led to expanding the development gap between developed and developing countries.

3-1: Causality and Regression:

Granger test is employed to ascertain the direction of causality between the development gap and the Gini coefficient. The results are given in Table (4) below:

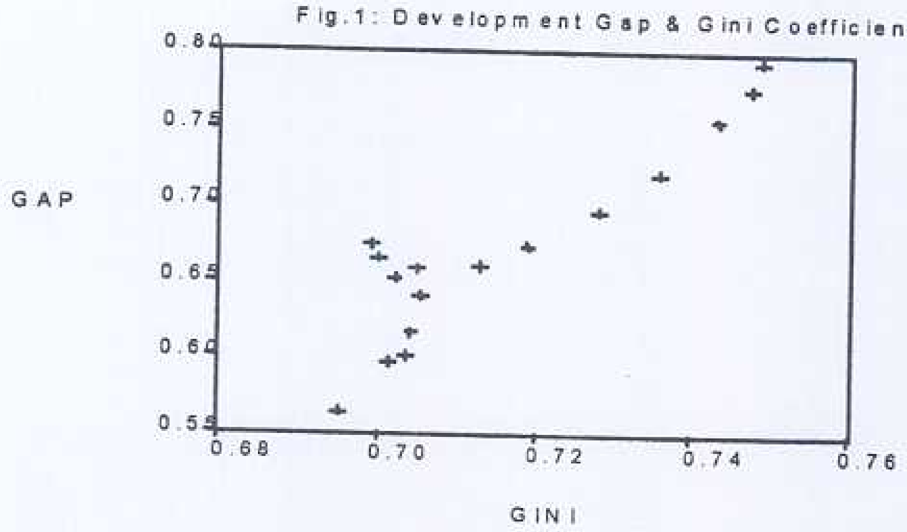
Table (4): Granger Causality

Null hypothesis	F-Statistic & Probability For 1 lag	F-Statistic & Probability For 2 lags	F-Statistic & Probability For 3 lags
lgini is not Granger Caused by lgap	0.176 (0.683)	3.224 (0.083)	1.694 (0.267)
lgap is not Garnger Caused by lgini	16.043 (0.002)	5.811 (0.024)	4.612 (0.050)

(lgap) represents the natural logarithm of development gap, and
(lgini) represents the natural logarithm of the income concentration coefficient.

Using one to three lags and taking 5% level of significance, the conclusion is that the Gini coefficient adds significant explanation to the development gap and permits its prediction. But, the development gap does not play a significant role in the explanation of the Gini coefficient variable.

After testing the direction of the causality between development gap and income concentration index, and examining the dispersion points represented in (Fig. 1), we notice a clear linear relationship with structural breaks. We will estimate the relationship between these two variables by using the ordinary least squares method (OLS), the Error Correction Model (ECM), and the Johansen cointegration technique.



The parameters' estimates of the linear relationship, given by OLS were as follows :

$$\hat{lgap}_t = 0.7144306 + 3.177346\, lgini_t$$

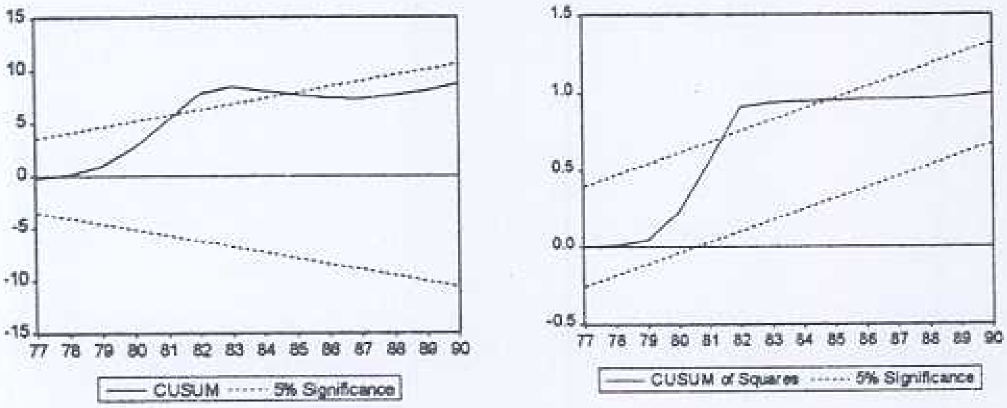
$$(4.888741) \quad (7.667039) \qquad \{1\}$$

$$\bar{R}^2 = 0.793909 \qquad F = 58.78349 \qquad DW = 0.369285$$

$$N = 15 \qquad (0.0000002) \qquad \hat{\sigma} = 0.043794$$

The equation (1) shows significant estimated coefficients at 1% level, but the model suffers from the presence of severe positive autocorrelation problem resulting probably of the poor specification of the static model. CUSUM and CHOW test of structural breaks pointed to a possible departure occurring in 1981.

Fig.(2): Cusum Tests



Cusum test and Cusum squares test plotted in Fig.(2) pointed a strong evidence of a shift in the late 1981. Meanwhile the F-statistic value of the Chow 's breakpoint test is 6.727 revealing that we can't reject the hypothesis of breakpoint in 1981 at 5% level of significance.

As a first step towards remedying this situation, we attempted to estimate a dynamic version of the model by introducing a lag variable. This can be justified economically by the fact that a considerable proportion of the development gap was tied to the income concentration with lengthy gestation lags. The estimations obtained via OLS for this dynamic version were:

$$\widehat{\lg ap}_t = 0.236798 + 0.963896\, lgini_t + 0.741645 \quad lgap_{t-1}$$

(3.424937) (3.357718) (8.820461) {2}

$\overline{R}^2 = 0.974888$ $F = 232.9266$ $LM_{(1)} = 0.106$ $LM_{(2)} = 0.384$

$N = 15$ (0.0000000) (0.750) (0.691)

As expected, the estimated parameters were improved sensibly. From a statistical point of view $\overline{R}^2$ increased to 0.9788 and the LM test indicated the absence of significant autocorrelation effects. All coefficients of interest were significant at 1% level. Based on the lgini coefficient (0.964), the short run elasticity of the income concentration on the development gap was near the unity, whereas its long-run counterpart was equal to (3.731).The development gap is highly responsive over the long-run to the Gini coefficient (income concentration index). However, because of the non-stationarity of the two time series of the model, the OLS led to biased estimated coefficients.

3-2: Stationarity, Unit Roots and Structural Breaks:

Inspection of the graphs of the variables reveals their potential characteristic for non-stationarity. This raises the possibility of consequent spurious regression. There is a strong upward trend throughout the studied period in lgap and lgini. Similarly, lgap and lgini break at 1982 and 1979 respectively, showing an evident structural break before a new rising of these variables.

The existence of a unit root for the two series lgap and lgini will be examined by taking into account the structural shocks which hit the world economy in breaks during the crash oil price in the end of the seventies and the beginning of the eighties. The series were then formally checked for stationarity. We performed initially the Augmented Dickey-Fuller (ADF) test on the levels and first differences of the variables. The results are summarized in Table (5).

Table (5): The Stationarity Tests

lags	Levels		1est difference	
	lgap	lgini	lgap	lgini
0	-1.449	-0.781	-2.164	-1.442
1	-1.521	-3.264	-0.860	-1.140
2	-2.669	-3.114	-0.829	-1.188
3	-3.564	-2.770	-1.161	-1.322

Mackinnon critical values at levels:1%:-4.731,5%=-3.761,10%=-3.322 for differences: 1%=-2.757,5%=-1.968,10%=-1.628

These results show that we can not reject the hypothesis that lgap and lgini series are random walk nonstationary series at 5% level.

However, the visual evidence on structural breaks suggests that we conduct more intensive stationarity testing procedures for these series. A unit root test which doesn't take into consideration the breaks in the series will not have high power. In addition, the sample used is small for these types of tests. Since the breaks are known to have occurred around 1981, we adjust the ADF in the procedure of Perron's(1989) test of shifts in the trend function by including dummy variables to ensure that there are many deterministic regressors as there are deterministic components in the series. The null and alternative hypothesis for a series $\{y_t\}$ allowing for a one-time change in the structure at time T_b (1983 for lgini, 1982 for lgap, and 1981 for the regression) are tested by using the innovational outlier models of Perron as follows:

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_T t + \delta DTB_t + \alpha y_{t-1} + \sum_{j}^{k} c_i \Delta y_{t-1} \qquad \{3\}$$

where:

$$DTB_T = 1 \quad \text{if} \quad t = T_b + 1$$
$$= 0 \quad \text{otherwise}$$
$$DU_t = 1 \quad \text{if} \quad t > T_b$$
$$= 0 \quad \text{otherwise}$$
$$DT_t = t - T_b \quad \text{if} \quad t > T_b$$
$$= 0 \quad \text{otherwise}$$

The previous model introduces both changes in the intercept and growth. The test is conducted by calculating the t-statistics for $H_0: \alpha = 1$. Perron (1989) provides tabulations IV.B and VI.B for the distribution of this t_α statistic for different values of the break ratio $\lambda = \frac{T_b}{T}$. The results for the above version is presented in Table (6) .

Table (6) : Perron's tests

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_T t + \delta DTB_t + \alpha y_{t-1} + \sum_j^k c_i \Delta y_{t-1}$$

Series	t_θ	t_β	t_γ	t_δ	t_α
lgap	-5.2570	3.3531	2.7544	4.0974	2.3592
lgini	2.8414	-2.7104	1.6710	-1.5886	3.0496

First, Perron's tests are applied via the above procedure and second the residuals from this break-type regression was then used in ADF tests. Asymptotic critical values that now depend on what dummy variables are used and where in the sample the break occurred, are available in Perron (1989, 1994). The ADF tests are provided in Table (7) .

Table (7): ADF Tests
Regressions with the Crash

Lags	Residuals	
	lgap	Lgini
0	-4.466	-2.815
1	-4.977	-3.171
2	-2.835	-2.985
3	-2.608	-2.901

Mackinnon critical values at levels:1%:-2.757,5%=-1.968,10%=-1.628

Based on the estimated values of ADF statistics for the residuals of the Perron type break regressions reported in the above table, we can infer that the variables are generally supportive of unit-root in levels and stationary in rates, i.e. they are I(1). We say "generally" because of the approximate nature of the results due to the smallness of the sample. This is in contradiction to the result obtained by applying direct ADF tests where the variables proved non-stationary even in rates. In light of these results, the process of modeling in ECM can be applied and the cointegration analysis becomes appropriate.

3-3: Error Correction Model:

Since the two variables lgap and lgini are stationary after considering the structural breaks, we proceeded to estimate dynamic short- run ECMs. To determine the number of lags involved in the model, the Cross-Correlation Function (CCF) between lgap and lgini is analyzed. This revealed significant relationship at lag 1. This in turn was incorporated in the ECM. The results obtained were:

$$\Delta \lg ap = 0.100281 - 0.228299 e_{-1} + 0.542081 \Delta \lg ini_{-1} + 0.35408 \lg ini_{-2}$$

$$(3.88633) \quad (-5.57361) \quad (4.0167) \quad (2.5094) \qquad \{4\}$$

$$\overline{R}^2 = 0.66133 \quad \hat{\sigma} = 0.01029 \quad F = 7.34645 \quad DW = 1.75811$$

$$(0.0065)$$

The ECM for the development gap passes statistically the appropriate tests for autocorrelation and stability. The coefficient of desequilibrium of ECM was estimated as 0.23 in absolute value, implying that 23% of any desequilibrium in any one-year is compensated for during the following year. This reflects a stable ECM that eventually converges to its long-run path. The long-run elasticity could be derived from the desequilibrium ECM but we preferred to estimate it directly by applying the Johansen cointegration procedure.

3-4:Cointegration:

It is widely recognizable that Engle and Granger test for cointegration is enough if our concern is only to examine the effect of error correction mechanism on development gap for two consequent periods such as t and t-1. However, since our concern is concentrated on the whole structure of the development gap, it is more useful to apply multivariate cointegration analysis of Johansen to reach our goal. Generally speaking, the cointegration relationship describes the long-run relationship between the used series (lgap and lgini). We will deploy Johansen's procedure to estimate the cointegrating relationship(s) connecting these two variables. Johansen cointegration tests were conducted under the assumption of the presence of a linear deterministic trend. The results for lgap and lgini are listed in Table (8).

Table (8): Johansen Cointegration

Eigenvalue : $\hat{\lambda}_i$	$\lambda_{\max} = -T\ln(1-\hat{\lambda}_i)$	$\lambda_{trace} = -T\sum \ln(1-\hat{\lambda}_i)$	Critical values for $\lambda_{\max}$ at 5%	Critical values for λ_{trace} at 5%	Hyp. No. of CE
0.906159	33.126148	60.04834	25.54	42.44	$r \le 0$
0.688501	16.173313	26.92217	18.96	25.32	$r \le 1$
0.535955	10.74884	10.74884	12.25	12.25	$r \le 2$

The result of the LR (Likelihood Ratio) test reveals the presence of a cointegrating equation at the specified significance level. The normalized cointegrating equation was estimated as:

$$\lg ap = -0.271679 + 0.855051 \lg ini - 0.054136 DU + 0.0215424 t$$
$$(0.07644) \qquad (0.00778) \qquad (0.00063) \qquad \{5\}$$

Log likelihood 149.6892

where the figures in brackets denote standard errors. According to these estimates, the development gap was long-run elastic in response to the Gini coefficient. The magnitude of the elasticity (0.86) reveals that the development gap is inelastic. But this value is greater than the short-run elasticity (0.54) obtained from the ECM.

To summarize, the econometric bivariate regression and the time series analysis reflect an evident relationship between the development gap and the income concentration index. The econometric bivarite regression was performed by introducing substantial breaks resulted by the crash in oil price. Taking the breaks into consideration, the variables proved to be stationary and cointegrating. So, the application of the ECM and cointegration seems to be appropriate.

Summary:

This study measures two time series, the first is the development gap based on multidimensional development concept, and the second is the income concentration depending on Gini coefficient. Then the relationship between the two variables representing the expressive role of income concentration on the widening development gap, was estimated. It is shown that when income concentration increased in the world, development gap became wider between developed and developing countries.

The results of this study are conditioned by the validity of the applied methodology: the size of sample, the chosen demographic and economic variables, the distance concept, the standardization method, and the partition and ranking process. It is evident that these results were analyzed in the light of the research hypothesis. It is possible that our findings will be different if some hypotheses are modified.

This study showed that the relation between developed and developing countries has increased income concentration and gap development in the world. Gini coefficient has risen during the period 1975-1990, from 0.69498 to 0.74876, with an average growth rate of 0.5% annually. The development gap widens from 0.563 to 0.795 during the same period, with an average growth rate of 2.344 % per year.

Applying the OLS method, the short run gap development elasticity of income concentration is estimated by a static model at 3.18, and by a dynamic model at 0.96, while the long run elasticity is estimated at 3.73. But the non stationarity of the series biased the previous estimations. The application of the ADF test proved that gap development and Gini coefficient series are I (1) after taking into consideration the structural change. The introduction of the dummy variables ensure the stationarity of the first difference series. The ECM estimated the short run elasticity at 0.54 and the error term desequilibrium at 0.23. The long run equilibrium relationship between development gap and income concentration is tested by the Johansen cointegration technique. The long run elasticity is estimated at 0.86. All estimation techniques confirm significant relationship between income

concentration and gap development. So the development gap is caused and explained by the world income concentration. By consequence, reducing development gap implies more equality in the distribution of the world income.

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فجوة التخلف وتركز الدخول في العالم
(باستخدام منهج التكامل المشترك)

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ملخص

هدفت هذه الدراسة قياس سلسلتين زمنيتين خلال الفترة ١٩٧٥ – ١٩٩٠ : الأولى لفجوة التخلف في العالم بين الدول الغنية والدول الفقيرة ، والثانية لتركز كتلة الدخول في العالم ، كما هدفت تحليل العلاقة بين هاتين السلسلتين باستخدام نموذج تصحيح الخطأ ومنهج التكامل المشترك .

قدرت فجوة التخلف بين الدول الغنية والدول الفقيرة باستخدام مفهوم البعد الإقليدي اعتمادا على عينة من ١٠٦ دولة تمثل حوالي ٨٥% من سكان العالم . واعتمد في التقدير على سبعة مؤشرات اقتصادية واجتماعية هي متوسط الدخل الفردي ، متوسط استهلاك الفرد من الطاقة ، نسبة سكان الحضر إلى مجموع السكان ، نسبة الإعالة الكلية ، معدل الخصوبة الكلية ، العمر المتوقع عند الولادة ، ومعدل وفيات الأطفال. واستخدم الغوريتم فيشر لتجزئة دول العينة بين مجموعتين من الدول إحداهما متقدمة والأخرى متخلفة ، بما يضمن أقل تباين داخل المجموعتين ، وأكبر تباين بين المجموعتين . وقدر مؤشر جيني لقياس تركز الدخول في العالم اعتمادا على متوسط دخل الفرد وعدد السكان في كل دولة باعتبار أن كتلة الدخول في العالم تتوزع بين دول العينة . ولوحظ بشكل عام اتجاه مترافق لاتساع فجوة التخلف في العالم (اتسمت فجوة التخلف من ٠,٥٦ عام ١٩٧٥ إلى ٠,٧٩ عام ١٩٩٠) ولزيادة تركز كتلة الدخول فيه (ازداد مؤشر جيني من ٠,٦٩ عام ١٩٧٥ إلى

٠,٧٥ عام ١٩٩٠) . مما برر دراسة العلاقة بين هذين المتغيرين انطلاقا من افتراض أن زيادة التركز في كتلة الدخول تؤدي إلى اتساع في فجوة التخلف ، وذلك بعد أن أكدت الاختبارات الإحصائية اتجاه العلاقة السببية بين المتغيرين .

وقد تبين من تحليل العلاقة بين المتغيرين ، حدوث انكسار في العلاقة بينهما حوالي عام ١٩٨٣ بسبب انهيار أسعار النفط في تلك الفترة ، واتضح من اختبار ديكي فولر الموسع ، أن هاتين السلسلتين غير مستقرتين سواء تم الاعتماد على مستوي المتغيرات أم على فروقها الأولى . ولكن يمكن رفض فرضية جذر الوحدة للسلسلتين الزمنيتين المذكورتين بعد أخذ الانكسار بعين الاعتبار ، وإدخال المتغيرات الصورية المناسبة المقترحة حسب منهج بيرون . واتضح بتطبيق أسلوب تصحيح الخطأ توطد علاقة ديناميكية قصيرة الأجل بين فجوة التخلف وتركز الدخول . كما بين تطبيق أسلوب جوهانسن للتكامل المشترك توطد علاقة ديناميكية طويلة الأجل بين متغيري العلاقة . مما يبرر الافتراض بأن ازدياد تركز الدخول في العالم لصالح الدول الصناعية الغنية سيؤدي في الأجل البعيد إلى اتساع فجوة التخلف بين الدول الغنية والدول الفقيرة .