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TESTING THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND INCOME INEQUALITY IN EGYPT FROM 1990 TO 2017: A VAR MODEL ANALYSIS

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Abstract:

Quite many studies have been piloted on the relationship between economic growth and income disparity, with varying results from many countries. The article explores the two-way relationship between economic development and income inequality in Egypt between 1990 and 2017. The study uses the VAR model and variance decomposition to answer the question. Is there a cointegration relationship between these two variables? The results show that economic growth and income inequality have a cointegration relationship; that is, there is a causal effect between the two variables. In this study, the authors have found a positive co-causal relationship between the two research variables with lag 2.

1. Introduction:

Income inequality is growing stronger around the world. Moreover, the rich and the poor gap is widening not because the poor are getting poorer but also getting richer. Income inequality affects the economic development of each country. Many studies are showing that it affects economic development both negatively and positively. The answer to this question is whether the government should reduce income inequality with newly established economic policies. From the perspective of economic theory, income inequality is considered the difference in income between the rich and the poor (Kavya & Shijin, 2020). Wealth can change many aspects of life, such as education, employment, or life satisfaction. Since 1945,

many countries have had strong economic development. The increasing production and the unequal distribution of wealth have led to an increase in the income of a group of people. There is a lot of research showing that income inequality can encourage economic growth and reduce economic growth. Based on conclusions about the impact of income inequality on economic development, each country's government can devise policies to reduce income inequality. There have been many studies that have found adverse effects between inequality and economic growth over a certain period Forbes (2000), Panizza (2002), Kraay (2015) and Dollar & Kraay (2002). Some other studies suggest that the relationship between income inequality is nonlinear and only relative (Shymanska, 2020).

The Arab Spring is one of the events affecting the countries of the Middle East. Although the results of the uprisings were still somewhat limited, only Tunisia was indeed considered successful. Some other countries also have democracy improvements, such as Morocco, Algeria, and other GCC countries. Several other countries are still in conflict, such as Yemen, Libya, and Syria. Egypt is also a country going through many political changes, from the rise of the Muslim Brotherhood to the re-establishment of authoritarian rule. During this period of transition, Egypt's economic growth and high levels of income inequality also increased. It was the sharp increase in income inequality and one of the causes of the Arab Spring uprising.

This paper aims to study the two-way relationship between income inequality and economic growth in Egypt in the period 1990 - 2017. First, the article will analyze the theory and review the existing research on this issue. Data were obtained from CAMAS of Egypt. Then, the author will use the VAR model to examine the cointegration between the variable of income inequality and economic growth.

2. Literature review:

There are a lot of research on the relationship between economic growth and income inequality. However, the empirical findings on the relationship between these two variables are still controversial. Many studies have mentioned a negative relationship between income inequality and economic growth. Since the 1990s, researchers have used least squares (OLS) estimation techniques to test the impact of income inequality on economic growth. Alesina & Rodrik (1994) conducted an empirical study in 46 countries between economic growth and income inequality and found out that the more significant the disparity in wealth and income, the higher the tax rate and the lower the growth rate. Persson and Tabellini also show the impact of income inequality on growth in 56 countries between 1960 and 1985 and offer a negative relationship between income inequality and economic development, i.e., inequality (Li & Zou, 1998). Alesina & Perotti (1996) also analyzed the relationship between economic growth, income distribution, and democracy in 67 countries and found that propensity to invest heavily and human capital can lead to economic growth (Lechheb, Ouakil, & Jouilil, 2019).

Panizza (2002) also used the GMM method to reassess the relationship between income inequality and economic growth in the United States in 1940-1980. Research results have shown a negative relationship between income inequality and economic development. Yao, Wan, and Meng (2019) tested the short-run and long-run relationship between economic growth and income inequality in China in 1987 - 2001. Research results have shown a non-linear and antagonistic relationship with each other in the case of China. Knowles (2005) has also retested the relationship between inequality and growth in 40 countries using comparative data for the 1960s and 1990s. According to the findings, all 40 nations in the survey have a negative association between inequality and growth.

Tabssum and Majeed (2008) argue that countries with high levels of inequality often use the fruits of economic growth less than those with high income and low-income inequality. According to Omar & Inaba (2020), disparities of opportunity exist in emerging nations because people cannot realize their full potential and cannot afford a proper education. This will affect average individual productivity as well as overall economic growth.

Clarke, Xu, and Zou (2006) found an adverse link between income inequality and economic development in democratic and non-democratic countries. The results of the study showed an undetermined cause-and-effect relationship. Furthermore, the effects of other policies that can improve income distribution have also been examined. Mustafa's research has shifted the focus to studying the impact of income inequality on the structure of growth (Touseef-Ur-rehman, Mustafa, & Rashid, 2015). Empirical evidence in Egypt clearly shows that inequality is a component of development by varying factors in aggregate demand. In essence, this study has shown changes in the demand for manufactured goods in response to an increase in real per capita income between 1980 and 2000, in which inequality can be seen.

Nevertheless, income inequality in Egypt has increased significantly during this period. Siami-Namini (2019) study omits income distribution and emphasizes the critical role of income inequality in the agricultural sector. Omar and Inaba (2020) used panel data for advanced economies to estimate the magnitude of the income elasticity of demand for services and products. Research results also show a positive relationship like some previous studies.

Hailemariam and Dzhumashev (2020) examined the relationship between income inequality and economic growth through panel data for many countries for 1965-2014. The author used inequality data with Measurement errors are minimized to enhance comparability across countries. In addition, the author also tests whether the heterogeneity in the calculation method changes the estimated impact of inequality across countries and whether the relationship between income inequality and growth has changed. The results showed that the non-linear effect of income inequality on economic growth remained statistically and economically significant after accounting for heterogeneous factors. Research has also shown that the threshold of inequality for economic growth is higher in countries with developing economies than in countries with developed economies.

The non-linear relationship between income inequality and economic growth has also been demonstrated by many authors, typically Barro, 2000; Banerjee and Duflo, 2003; Benhabib, 2003; Chen, 2003; Lin et al., 2009; Lin and Yeh, 2014; Brueckner and Lederman, 2018. Brueckner and Lederman (2018) discovered a diminishing relationship between income inequality and economic growth through SWIID data. The author has proved that income inequality is one of the driving factors for transformational economic growth. However, there are differences between low-income countries and high-income countries. Income inequality has a negative impact on the growth transition in high-income countries. Barro again shows a non-linear relationship between inequality and growth. Barro's research also shows that inequality can promote growth in high-income countries but slow growth in low-income countries. Chen (2003), Banerjee and Duflo (2003) indicated that income inequality and economic growth have an inverted U-shaped relationship. Their study has shown that it is inappropriate to impose a linear relationship in this case. It is one of the reasons that previous empirical studies have had mixed results.

Most of the above studies use models such as OLS, array data, etc. to assess the relationship between income inequality and economic growth. However, there have been no studies using the VAR model and the cointegration test to determine the Gini coefficient and

economic development link. Therefore, this study will use data on income inequality and economic growth in Egypt and the VAR model to test the relationship between the two factors.

3. Methods and materials:

3.1. Data:

This article uses the Egyptian government's statistical yearbook data for the period 1990 - 2019. The statistical yearbook includes data on Egypt's economic growth over the years. In addition, the statistical yearbook also provides data related to the income gap as measured by the Gini index. The Gini coefficient is used to represent income inequality across regions and classes of a country.

3.2. Variables:

To clarify the bidirectional relationship between economic growth and income inequality, we transformed the data into two variables: GDP representing economic growth, denoted GDP, and the Gini index indicated by GINI. The value of each variable is taken logarithmically to overcome data variation and volatility.

3.3. Method:

The article uses VAR (Vector Convergence) model. VAR is one of the multivariate forecasting algorithms used when two or more time-series influence each other. The structure of each variable is a linear function and represents its past lags and the other variables' past lags. The standard form Var model is shown as follows:

$$X_t = A_0 + A_1X_{t-1}+\ldots.+ A_pX_{t-p} + e_t \text{ in which } t = 1,2,\ldots T$$

In which X_t is the endogenous variable, p is the lag.

A_p is the k-dimensional coefficient matrix

E_t: k-dimensional random vector

The Var model is used to evaluate the two-way correlation between standard endogenous variables and their interactions with minimal economic assumptions. For example, in the literature review, we found an interaction between economic growth and income inequality. Moreover, there is a certain lag in the impact of economic growth on income inequality and vice versa.

4. Results:

4.1. Unit Root Test:

In the Var model, to avoid spurious regression between variables, we test the stationary of the variables in the time series. The results of the stationary test of the regression series are shown in the following table:

Table 1: Augmented Dickey-Fuller test statistic

Variable	Test critical values:	t-Statistic	Prob.*	Level of Stationary
LNGDP	1% level 5% level 10% level	-9.967437 -3.711457 -2.981038 -2.629906	0.0000	1st
LNGINI	1% level 5% level	-4.749780 -3.724070	0.0009	2nd

	10% level	-2.986225 -2.632604		

We can observe from Table 1 that the variables are stationary, LnGDP stops at the first difference, and LnGini stops at the second difference. Thus, all of the above variables satisfy the conditions for the cointegration process.

4.2. Cointegration Test:

This study assumes that Gini affects GDP growth, and therefore, these variables may be co-linked. The cointegration result can lead to an estimate of a fixed variable. The study will perform cointegration testing in VAR. The original Johansen test tested the hypothesis that there was no cointegration between the two variables, and the results are shown in Table 2.

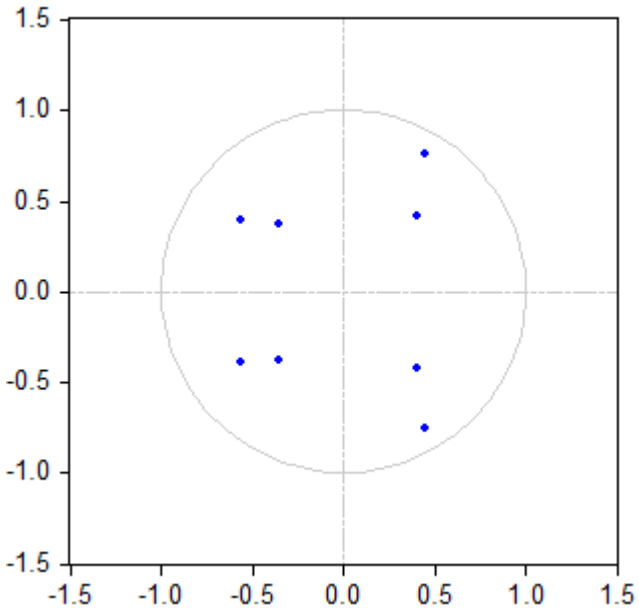
Table 2: Johansen cointegration test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.509812	18.74569	15.49471	0.0156
At most 1	0.164467	3.773388	3.841466	0.0521

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.509812	14.97230	14.26460	0.0386
At most 1	0.164467	3.773388	3.841466	0.0521

In Table 2, the hypothesis of no cointegration between the two variables Gini and GDP is rejected. Instead, we accept the hypothesis that there is cointegration between the two variables. Thus, that there is an interrelationship between Gini and economic growth. Economic growth is the factor that increases Gini, and vice versa, the increase of Gini also has a positive effect on economic growth.

Figure 1: Inverse Roots of AR Characteristic Polynomial



To check the stability of the model, the AR test shows that both values are within the unit circle. This result indicates that the model has strength in accordance with the conditions of the hypothesis.

Table 3: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	45.27680	NA	6.71e-05	-3.934255	-3.835069*	-3.910889
1	46.25549	1.690469	8.86e-05	-3.659590	-3.362033	-3.589495
2	54.42368	12.62356*	6.14e-05*	-4.038516*	-3.542588	-3.921690*
3	55.16139	1.005976	8.51e-05	-3.741945	-3.047645	-3.578389
4	56.19361	1.219890	0.000118	-3.472146	-2.579475	-3.261860

According to the criteria of the above table, combined with the results of testing the model AR(p) and the Akaike information criterion (AIC), Hannan Quinn information criterion (HQIC), and Schwartz information criterion (SBIC), optimal delay length is lag 2

Table 4: VAR model estimates with lag 2

Cointegrating Eq:	CointEq1
D(LNGDP(-1))	1.000000
D(LNGINI(-1),2)	-97.08894 (24.9524) [-3.89096]
C	0.009739

Error Correction:	D(LNGDP,2)	D(LNGINI,3)
CointEq1	-0.100218 (0.09611) [-1.04269]	0.014299 (0.00542) [2.63800]
D(LNGDP(-1),2)	-0.755299 (0.22086) [-3.41984]	-0.002052 (0.01246) [-0.16475]
D(LNGDP(-2),2)	-0.287259 (0.20118) [-1.42787]	-0.016496 (0.01135) [-1.45396]
D(LNGINI(-1),3)	-2.827448 (6.51489) [-0.43400]	0.517166 (0.36742) [1.40757]
D(LNGINI(-2),3)	2.085800 (4.51337) [0.46214]	0.222583 (0.25454) [0.87446]
C	-0.017173 (0.08222) [-0.20887]	0.000356 (0.00464) [0.07681]

4.3 Granger Causality Test

In Table 5, we can draw the following conclusions: with a lag of 2, there is a causal relationship between GDP and GINI. That is, the increase in GDP will drive the increase of Gini after two years.

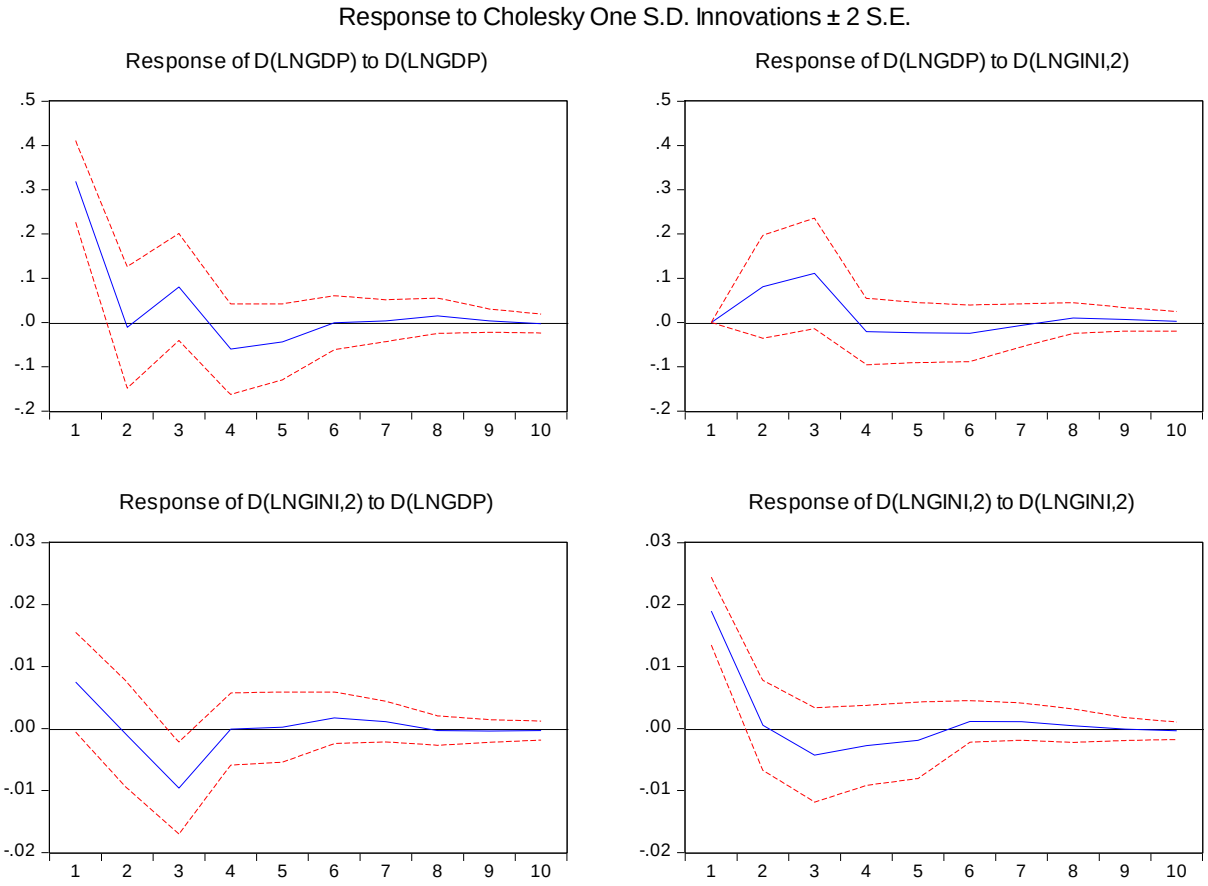
Table 5: Granger Causality

Dependent variable: D(LNGDP)			
Excluded	Chi-sq	df	Prob.
D(LNGINI,2)	5.627635	2	0.0600
All	5.627635	2	0.0600
Dependent variable: D(LNGINI,2)			
Excluded	Chi-sq	df	Prob.
D(LNGDP)	6.839007	2	0.0327
All	6.839007	2	0.0327

4.4. Impulse Response Analysis:

The impulse response functions can supplement the VAR model to describe the long-run shock effect in one or more variables. For example, the results of the impulse response in Figure 3 show that when receiving a shock in the time interval t = 2, the Gini variable quickly moves to 0. That means that the GDP impulse has only a short-term impact on Gini.

Figure 2: Response to CholeskyOne



4.5. Variance Decomposition:

The table of variance shows that starting from the second lag, the change in Gini of 0.61% can explain the change of 93.9% in the GDP variable and the Gini variable's explanatory level for the Gini variable, with GDP increasing gradually, by the 10th period, it reached 15.29%.

On the other hand, period 5 shows the most significant impact of Gini on GDP; the maximum is 72.1%. This result shows the interplay between economic growth and income inequality.

Table 6: Variance Decomposition

Variance Decomposition of D(LNGDP):			
Period	S.E.	D(LNGDP)	D(LNGINI,2)
1	0.318912	100.0000	0.000000

2	0.329155	93.98557	6.014426
3	0.356577	85.18618	14.81382
4	0.362217	85.31708	14.68292
5	0.365585	85.18418	14.81582
6	0.366410	84.80102	15.19898
7	0.366488	84.77616	15.22384
8	0.366934	84.73866	15.26134
9	0.367019	84.71104	15.28896
10	0.367038	84.70762	15.29238

Variance Decomposition of D(LNGINI,2):

Period	S.E.	D(LNGDP)	D(LNGINI,2)
1	0.020384	13.51690	86.48310
2	0.020422	13.77252	86.22748
3	0.022977	28.40715	71.59285
4	0.023139	28.01249	71.98751
5	0.023218	27.83163	72.16837
6	0.023310	28.16229	71.83771
7	0.023363	28.25986	71.74014
8	0.023370	28.26437	71.73563
9	0.023374	28.28498	71.71502
10	0.023379	28.29271	71.70729

Cholesky Ordering: D(LNGDP) D(LNGINI,2)

5. Discussion and conclusion:

The results of this empirical study show a positive correlation between income inequality and economic growth. Research results also show that there is a cointegration relationship between GDP and Gini. Economic growth may reduce the number of poverty, but inequality increases. This increase in income is closely related to the rapid growth of the high-income group. This result suggests that the rich get richer and thus widen the income gap. This study reveals that the government needs to have balanced policies to reduce the increase of income inequality while still stimulating economic development.

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