Economic Growth and Income Inequality in the Maghreb Countries

BY

Adnan Ahmed Esharif

University of Sfax, Faculty of Economics and Management of Sfax, Tunisia

Abstract

This paper examines the empirical relationship between economic growth and income inequality in the Maghreb countries (Tunisia, Morocco, and Algeria) over the period 2000-2020. The results of this paper indicate that the long-run growth elasticity of income inequality is negative and significant implying that keeping other factors constant; more income inequality reduces economic growth. Moreover, this paper finds evidence that more physical and human capital investment and higher openness to trade have statistically significant impact on enhancing economic growth and reducing poverty.

Keywords: Economic Growth, Income Inequality, Panel cointegration

JEL Classification: O4, I3, O15

1. Introduction

Economic growth is considered a powerful force for reducing poverty. High and sustained economic growth increases the labor demand and wages, which in return will reduce poverty. Similarly, better earnings because of reduction in poverty lead to increase productivity and growth. However, the extent of poverty reduction because of economic growth depends on how the distribution of income changes with economic growth and on initial Inequalities in income. If income inequality increases, then economic growth does not lead to a significant poverty reduction.

A large number of empirical studies have attempted to explore the relationship between income inequality and economic growth.[1] However, there are only few studies that discuss the role of credit market imperfections in growth inequality relationship. Most of earlier studies that highlight the role of credit market imperfections in growth inequality relationship used Ordinary Least Squares to estimate the cross-country growth regression, which has a problem of omitted variable bias. Secondly, due to limited availability of comparable inequality statistics, sample selection remained a problem in most of earlier studies. The resulting estimates of most of these studies found a negative coefficient on inequality suggested that countries with a more equal income distribution (that is a lower Gini index) tend to have higher levels of income.[2]

No country has achieved rapid economic growth by closing themselves off to international trade. Trade openness is defined as the degree to which foreigners and domestic citizen can transact without government-imposed costs that are levied on a transaction between them. For example, tariff, non-tariff barriers, local content requirements, inspection delays raise the cost of buying from abroad.

Despite of having consistent emphasis on how trade promotes growth, the theory also suggested in the presence of distortions like credit market imperfection, political instability, less improved infrastructure, etc., free trade might not be best for growth. For instance, a high real return to capital in unskilled labor-abundant countries exploits their comparative advantage. Even if trade openness leads to more rapid growth, it does not necessarily imply that it is an effective instrument for reducing poverty. If a growth strategy based on trade openness leads to a significant worsening of income inequality of households, it does not lead to significant reduction in poverty. How trade affects income distribution of a country is purely an empirical question. This paper also considers the role of trade openness, physical and human capital investment, and government spending in enhancing economic growth and reducing inequalities.

This study uses panel cointegration methods and improved data on income inequality to assess the possible steady-state

---

[1] Ravallion (1997), Deininger and Squire (1996, 1998), Barro (2000), etc.

[2] Persson and Tabellini (1994), Aghion and Bolton (1997), Galor (2000) etc.

relationship between income inequality and economic growth for 3 countries of Maghreb countries (Tunisia, Morocco and Algeria) over the period 2000-2020. This article is organized as follows. Section 2 presents the general theories describing the causal relationship from income inequality to economic growth. Section 3 presents the data and reports the results of panel unit root and cointegration tests. Estimation details and results are given in Section 4 and Section 5 concludes.

2. Economic Growth and Income Inequality: Theory and Evidence

2.1. Economic Growth and Income Inequality

Income distribution is a controversial topic in macroeconomics. In the early 1955, Kuznets (1955) studied the relationship between the economic growth and income distribution and introduced the famous inverted-U shape relationship between inequality and income, which states that the distribution of income first becomes then, many theoretical works and empirical works have been raised to retest Kuznets' hypothesis. Kaldor (1957) and Pasinetti (1962) assumed that income inequality affected economic growth through the saving-investment mechanism. Because individuals with different income levels will choose different savings rate, the income inequality leads the agent to increase the savings and investment, which in turn increases the growth rate.

Deininger and Squire (1996) using the data for 108 countries over the period 1960-1974 found no systematic relationship between growth and changes in aggregate inequality. According to their analysis, periods of aggregate growth were associated with increased inequality in forty-three cases and with a decrease in inequality in forty-five cases. Similarly, periods of economic decline were associated with increased inequality in five cases and with a more equitable distribution of income in two cases. The simple relationship between current as well as lagged income growth and the change in the Gini coefficient is insignificant for the whole sample as well as for sub-samples defined in terms of country characteristics like rich or poor, equal or unequal, fast-growing or slow-growing economies, suggesting no strong relationship between growth and changes in aggregate inequality.

Deininger and Squire (1998) use new cross-country data on income and asset (land) distribution to show that (i) there is a strong negative relationship between initial inequality in the asset distribution and long-term growth; (ii) inequality reduces income growth for the poor, but not for the rich; and (iii) available longitudinal data provide little support for the Kuznets hypothesis. Policies that increase aggregate investment and facilitate acquisition of assets by the poor might thus be doubly beneficial for growth and poverty reduction

Forbes (2000) found positive effects of income inequality on growth. The author argued that country-specific effects and omitted variables are the cause of a significant negative bias in the estimations of the effects of inequality on growth. She also concluded that fixed-effect estimations yield the consistent result of a positive short and medium-term correlation between inequality and growth.

Smith (2001), examined empirically two hypotheses – subsistence consumption and credit market imperfections – of specific channels of inequality to affect private saving rates, he found that there is econometric evidence that especially at low per capita income levels, income inequality may be associated with higher aggregate saving.

Garbis (2005) examines the empirical relationship between inequality and growth and analyzes the impacts of growth, inequality, and government spending on poverty reduction. A panel dataset for 82 countries for the period 1965–2003 has been assembled with the data averaged over periods of three to seven years, depending on the availability of inequality and poverty data. The empirical results challenge the belief that income inequality has a negative effect on growth and confirm the validity of the Kuznets curve. Credit market imperfections in low- and medium-income countries are identified as the likely reason for the positive link between inequality and growth over the short-to-medium term. In the long term, inequality may have an adverse impact on growth.

In a neoclassical growth framework with a typical political-economy mechanism, Yin and al. (2006) reexamines the relationship between the income inequality and economic growth by introducing government spending into the production function and the utility function. It demonstrates that Kuznets' famous inverted-U shape relationship between inequality and economic growth will hold - the growth rate will be first increasing with the income inequality before the growth rate decreases with inequality.

Penalosa and Turnovsky (2006) develop an endogenous growth model with elastic labor supply, in which agents differ in their initial endowments of physical capital. In this framework, the growth rate and the distribution of income are jointly determined. The key equilibrating variable is the equilibrium labor supply. It determines the rate of return to capital, which in turn affects both the rate of capital accumulation and the distribution of income across agents. Then they examine the impact of various structural shocks on growth and distribution. They found that faster growth is associated with a more unequal, contemporaneous distribution of income, consistent with recent empirical findings.

The results could be summarized in three points. First, initial inequality in the distribution of land appears to be associated with lower subsequent growth. Second, there is no support for a redistributive median-voter-based explanation of initial inequality's effect on growth. Third, imperfections in financial markets for credit appear to be more relevant for investment in human capital rather than physical capital. However, data on land inequality was very limited and it could not be used in the panel data model to check if cross-sectional results hold after controlling for omitted variable bias.

2.2. Role of Credit Market Imperfection

The income approach emphasizes the effect of income inequality on savings and on physical capital accumulation.

Credit market imperfections approach considers the effect of income inequality on the accumulation of human capital (Galor and Zeira, 1993). In a model by Galor and Moav (2004), the engine of economic growth changes from physical capital to physical and human capital in the process of economic development. The process of economic development is divided into two regimes, which have their own steady-state growth paths.

Economies in the first regime are underdeveloped, aggregate physical capital is small, and the rate of return to human capital is lower than the rate of return to physical capital (Galor and Moav, 2004). There are two types of individuals in the economy: those who own the physical capital (the rich) and those who do not (the poor). The poor consume their entire income (wages) and are not engaged in saving and on capital accumulation. Thus, there is temporary steady-state equilibrium where the poor are in poverty trap and the rich get richer. Inequality increases aggregate savings by increasing the income of the rich and greater aggregate savings fuel physical capital accumulation.[3]

In the second regime, physical capital accumulation by the rich has increased the rate of return to human capital so high that it induces human capital accumulation (Galor and Moav, 2004). In this regime, both human and physical capitals are engines for economic development. Since individuals' investment in human capital is subjected to diminishing marginal returns, the return to human capital investments is maximized when investment in human capital is widely spread among the population. Because access to credit is constrained, human capital investment is maximized when income in the economy is distributed evenly. However, in a certain phase of economic development income of every individual becomes so high that credit constraints become less binding. In this locally stable steady-state equilibrium, the effect of inequality on growth becomes less significant.

2.3. Openness to Trade, Economic Growth, and Income Inequality

The idea that trade liberalization has an impact on the country's growth is not new and goes back at least to Adam Smith. New classical model based on constant and decreasing returns to scale as in Solow (1956) and Swan (1956) predicted that a country would have static gains from lowering its trade barriers. Most of the recent studies including Dollar and David (1992), Edwards (1993), Sachs and Warner (1995), and Dollar and Kraay (2001) have found a positive association between trade liberalization and growth. There are number of channels through which trade promotes growth rates by allocating the resources more efficiently. Trade promotes growth by encouraging economies to specialize and produce in areas where they have relative cost advantage over other economies. Over time, this helps economies to employ more

---

[3] In modern less developed economies, it is possible that also human capital drives growth, if the capital and skill-biased technology is imported. In this case, the effect of inequality on growth would be mixed or negative (Galor and Moav, 2004).

of their human, physical, and capital resources in sectors where they get returns in open international markets, boosting productivity and returns to workers.

Trade also expands the markets that local producers can access, allowing them to produce at most efficient scale to keep down the costs. Trade disperses new technologies and ideas, increasing the productivity of local workers and managers. Technology transfers through trade are also more valuable for developing countries, which employ less advance technologies and have little capacity to develop new technologies themselves. Removing trade barriers e.g. tariff on imports gives consumers access to cheaper products, increasing their Purchasing power and living standard. It also provides producers an access to cheap inputs, reducing costs and boosting their competitiveness.

Dollar and Kraay (2001) using data on trade liberalization as a share of GDP in constant prices for 101 countries including 73 developing countries found that trade liberalization leads to faster growth in average incomes and that this growth in average incomes in turn increases the incomes of the poor "proportionately". The poor countries that have reduced trade barriers and participated more in international trade over the past twenty years have seen their growth rates accelerate. In the 1990s, they grew far more rapidly than the rich countries and hence reduced the gap between themselves and the developed world. At the same time, the developing countries that are not participating in globalization are falling further and further behind. Within the globalizing developing countries, there has been no general trend in inequality. Thus, rapid growth has translated into dramatic declines in absolute poverty in countries such as China, India, Thailand, and Vietnam. OLS estimation results showed that per capita GDP growth in the post-1980 globalizers accelerated from 1.4 percent a year in the 1960s and 2.9 percent a year in the 1970s to 3.5 percent in the 1980s and 5.0 percent in the 1990s.

3. Framework of Analysis and Estimation Technique

3.1. Framework of Analysis

There are different channels through which income inequality affects growth rates. Kaldor (1957) suggests that marginal propensity to save of the rich is higher than that of the poor, implying that a higher degree of inequality will yield higher aggregate savings, higher capital accumulation, and growth. In contrast, Persson and Tabellini (1994) and Alsenia and Rodrick (1994) emphasize the four main channels through which income inequality lowers growth rates. First, the impact of inequality on encouraging rent-seeking activities that reduce the security of property rights, second, unequal societies face more difficulties in collective action possibly reflected in political instability, a propensity for populist redistributive policies, or greater volatility in policies - all of which can lower growth, third, the median voter in a more unequal society is relatively poorer and favors a higher (and thus more inefficient) tax burden, fourth, to the extent that inequality in income or assets coexists with imperfect credit markets, poorer people may be unable to invest in their human

and physical capital, with adverse consequences for long-run growth.

Galor and Zeira (1993) argued that income distribution plays an important role in the determination of aggregate economic activity and economic growth. In contrast to the representative agent approach that has dominated the field of macroeconomics for several decades, this study analyzes the role of heterogeneity in the determination of macroeconomic behavior. The research demonstrated that in the presence of capital markets imperfections and local non-convexities in the production of human capital, income distribution affects aggregate output in the long run as well as in the short run. The research developed the hypothesis that equality in sufficiently wealthy economies stimulates investment in human capital and in (individual-specific projects) and enhances economic growth, whereas inequality promotes growth in a sufficiently poor economies, a prediction that was confirmed by initial empirical studies.

Galor's (2000) argues that the classical approach holds at low-income levels but not at later stages of development. In the early stage of development, inequality would promote growth because physical capital is scarce at this stage and its accumulation requires saving. Inequality in income would then result in higher savings and rapid growth. In later stages of economic development, however, as the return to human capital increases owing to capital-skill complementarily, human capital becomes the main engine of growth. Credit constraints, however, become less binding as wages increase, and the adverse effect of income inequality on human capital accumulation subsides, and thus the effect of inequality on the growth process becomes insignificant.

The unified approach complements the research of Galor and Weil (1999, 2000) who developed unified models that encompasses the transition between three distinct regimes that have characterized the process of economic development: the Malthusian Regime, the Post-Malthusian Regime, and the Modern Growth Regime, focusing on the historical evolution of the relationship between population growth, technological change, and economic growth.

Galor and Moav (1999) argue that inequality has a positive effect on capital accumulation but negative effect on human capital accumulation in the presence of credit constraints. In the early stages of development physical capital is scarce, the rate of return to human capital is lower than the return on physical capital and the process of further development is driven mainly by capital accumulation. In the early stages of development, the positive effect of inequality on aggregate saving more than offsets the negative effect on investment in human capital, and, since the marginal propensity to save is an increasing function of the individual's wealth, inequality increases aggregate savings and capital accumulation, enhancing the process of development. In the later stages of development, however, the positive effect of inequality on saving is offset by the negative effect on investment in human capital.

Based on theoretical literature on economic inequalities and some other potential factors that determine economic growth, we develop the following model, which is also in lines with Garbis (2005).

$$GR_{i,t} = \beta_1 GINI_{i,t} + \beta_2 y_{i,t-1} + \beta_3 INV_{i,t} + \beta_{54} SCH + \beta_5 TRADE_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \qquad (1)$$

Where:

GR = Growth rate of GDP per capita,

$GINI$ = Gini index in the current period,

$y_{i,t-1}$ = Initial GDP per capita,

$INV_{i,t}$ = Gross fixed capital formation as a percentage of GDP,

$SCH_{i,t}$ = Secondary school enrolment rate,

$TRADE$ = Sum of exports and imports of goods and services as a % of GDP,

η_i represents unobserved country-specific factors and μ_t is a period-specific effect. The time-specific effect, μ_t, allows to control for international conditions that change over time and affect the growth performance of countries in the sample, while η_i accounting for unobserved country-specific factors that both drive growth and are potentially correlated with the explanatory variables. $\varepsilon_{i,t}$ represents the disturbance term.

3.2. Time Series Analysis of Panel Data

The theoretical models presented above predict steady-state equilibrium relations, or stationary distributions, that may exist between income inequality and the evolution of output. The estimation of these theoretical stationary distributions requires that we know the time series features of the variables in the model. Many models also assume that income distribution and economic development are determined endogenously, which has to be taken into account in the estimation.[4]

3.2.1. Data

We use Gini coefficient to measure income inequality, which is one of the most popular representations of income inequality. It is based on Lorenz Curve, which plots the share of population against the share of income received and has a minimum value of 0 (case of perfect equality) and maximum value of 1 (perfect inequality). Missing values in Income inequality data are the major problem in cross country analysis. Many of developing countries have only one or two observations. Therefore, we expanded the existing database by including the comparable data on poverty and inequality from recent household surveys included in World Bank, IMF Staff reports and Poverty Reduction Strategy Papers.

The human capital indicator measured by secondary school enrolment rate (SCH) and the other independent variables - the GDP per capita, the physical capital (INV), the openness rate (*TRADE*), and the growth rate of GDP per capita (GR) -

---

[4] Bénabou (2005) has actually suggested that endogeneity of income inequality in growth regressions is the primary reason for the observed controversy in empirical growth studies.

are taken from the World Bank Development Indicators (WDI, 2023).

3.2.2. Unit Root Testing

To test for the presence of unit roots on panel data, we use the Im, Pesaran, and Shin (2003) - IPS thereafter. IPS using the likelihood framework, suggest a new more flexible, and computationally simple unit root testing procedure for panels (which is referred as $t-bar$ statistic), that allows for simultaneous stationary and non-stationary series. Moreover, this test allows for residual serial correlation and heterogeneity of the dynamics and error variances across groups. The IPS test is based on the estimation of the following equation:

$$\Delta y_{i,t} = \rho_i y_{i,t-1} + \alpha_{m,i} d_{m,t} + \sum_{j=1}^{p} \lambda_{i,j} \Delta y_{i,t-j} + \varepsilon_{i,t} \quad t = 1,...,T \ , \ i = 1,...,N \qquad (2)$$

where T is the number of observations over time, N denotes the number of individual members in the panel, and $d_{m,t}$ contains deterministic variables. The null hypothesis is defined as $H_0 : \rho_i = 0$ for all $i = 1,...,N$ and the alternative hypothesis is $H_a : \rho_i \prec 0$ for $i = 1,...,N_1$ and $\rho_i = 0$ for $i = N_1 + 1,...,N$, with $0 \prec N_1 \leq N$ that allows for some (but not all) of individual series to have unit roots.

IPS (2003) compute separate unit root test for the N cross-section units and define their $t-bar$ statistic as a simple average of the individual ADF statistics, t_{iT}, for the null as:

$$t-bar = (1/N)\sum_{i=1}^{N} t_{iT}$$. IPS (2003) argue that t_{iT} are

i.i.d. and have finite mean and variance.

Therefore, the standardized $t-bar_{N,T}$ statistic converges to a standard normal distribution as $N \rightarrow \infty$ under the null hypothesis. In order to propose a standardization of the $t-bar_{N,T}$ statistic, the values of the mean and the variance have been computed via Monte Carlo methods for different values of T and p_i's and tabulated by IPS (2003). The results of each one of our five variables are reported in table 1, where all the tests have a unit root under the null hypothesis.

Table 1. Panel Unit Root Tests of IPS

	Variables in levels		Variables in first differences	
	Constant	Constant with trend	constant	Constant with trend
Per capita GDP	2.12	2.32	-4.51***	-4.15***
Gini index	5.6	5.1	-3.02***	-3.15***
Trade	1.82	-0.64	-3.25***	-3.82***
Investment	-0.65	-0.9	-4.1***	-4.23***
Secondary School Enrol.	1.82	-0.72	-3.99***	-4.54***

Notes: * (resp.**,***): rejection of the null hypothesis at 10% (resp. 5%, 1%) significance level. Lags selected according to the SIC with a maximum lag length of 3.

As indicated in Table 1, the tests of panel unit root of according to IPS (2003) confirm that all variables are no stationary in levels but stationary in first differences. We now test for the existence of a long-run relationship between the income inequality and economic growth.

3.2.2. Cointegration Tests

The possible cointegration between inequality and GDP is tested with panel cointegration test developed by Pedroni (1999, 2004). Pedroni proposes a residual-based test for the null of cointegration for dynamic panels with multiple regressors in which the short-run dynamics and the long-run slope coefficients are permitted to be heterogeneous across individuals. The test allows for individual heterogeneous fixed effects and trend terms and no exogeneity requirements are imposed on the regressors on the cointegrating regressions.

Specially, the tests ask for the residuals estimation from static cointegrating long-run relation for a time series panel of observables y_{it}:

$$y_{it} = \alpha_i + \delta_i t + \beta_{1,i} x_{1,it} + \beta_{2,i} x_{2,it} + ... + \beta_{k,i} x_{k,it} + e_{it}$$
$, \ t = 1,...,T \ ; \ i = 1,...,N \qquad (3)$ where as usual T is the number of observations over time and N is the number of units in the panel. It is possible to interpret the model (3) as N different equations, each of which has K regressors. The variables y_{it} and x_{it} are assumed to be I(1), for each member i of the panel, and under the null of no cointegration the residual e_{it} will also be I(1). α_i and δ_i are scalars denoting fixed effects and unit-specific linear trend parameters, respectively and β_i are the cointegration slopes; note that all this coefficients are permitted to vary across individuals, so that considerable heterogeneity is allowed by this specification.

Pedroni considers the use of seven residual-based panel cointegration statistics, four based on pooling the data along the within-dimension (denoted 'panel cointegration statistics')

and three based on pooling along the between-dimension (denoted 'group mean cointegration statistics').

Another distinction between the two sets of test is based on the alternative hypothesis specification. In fact, even if both sets of test verify the null hypothesis of no cointegration: $H_0 : \rho_i = 1 \ \forall i$ where ρ_i is the autoregressive coefficient of estimated residuals under the alternative hypothesis ($\hat{e}_{i,t} = \rho_i \hat{e}_{i,t-1} + v_{i,t}$), alternative hypothesis specification is different:

- the panel cointegration statistics impose a common coefficient under the alternative hypothesis which results:

$$H_a^w : \rho_i = \rho \prec 1, \ \forall i$$

- the group mean cointegration statistics allow for heterogeneous coefficients under the alternative hypothesis and it results: $H_a^b : \rho_i \prec 1 \ \forall i$.

It is straightforward to observe that the first category of four statistics includes a type of non - parametric variance ratio statistic, a panel version of a non-parametric Phillips and Perron (1988) ρ -statistic, a non-parametric form of the average of the Phillips and Perron t -statistic, and an ADF type t -statistic.

The second category of panel cointegration statistics is based on a group mean approach and includes a Phillips and Perron type ρ -statistic, a Phillips and Perron type t -statistic, and an ADF type t -statistic. The comparative advantage of each of these statistics will depend on the underlying data-generating process.

After the calculation of the panel cointegration test statistics the appropriate mean and variance adjustment terms are applied, so that the test statistics are asymptotically standard normally distributed:

$$\frac{\chi_{N,T} - \mu\sqrt{N}}{\sqrt{v}} \Rightarrow N(0,1)$$

where : $\chi_{N,T}$ is one of the seven statistics of Pedroni, μ and v are the functions of moments of the underlying Brownian motion functional. The appropriate mean and variance adjustment terms for different number of regressors and different panel cointegration test statistics are given in Table 2 in Pedroni (1999).[5]

Pedroni (2004) explored finite sample performances of the seven statistics. He showed that in terms of power, all the

proposed statistics do fairly well for $T > 100$. Moreover, Pedroni's (1996) simulations showed that for small time span ($T < 20$), the between dimension (*group t-statistic*) is the most powerful. Given our relatively short time span (T = 29), we will pay a particular attention to the group parametric-t statistic ($ADF - stat$) when testing for cointegration. The result of panel cointegration tests are displayed in table 2.

Table 2. Pedroni's Panel Cointegration Tests

	Test Statistic	P-values
Panel cointegration tests		
$v - stat$	0.05	0.24
$rho - stat$	1.21	0.52
$PP - stat$	-0.11	0.30
$ADF - stat$	-2.26***	0.001
Group mean cointegration tests		
$rho - stat$	-4.15***	0.002
$PP - stat$	-1.05	0.11
$ADF - stat$	-2.11**	0.014

Notes: *(resp.**,***): rejection of the null hypothesis at the 10% (resp. 5%, 1%) significance level. Lags selected according to the SIC with a maximum lag length of 3.

Since simulations made by Pedroni (2004) show that, in small samples, the group-mean parametric test is more powerful than the other tests, we can conclude that the null hypothesis of no cointegration is rejected in our study, and now turn to the estimation of the long run relationship between the income inequality and economic growth.

4. Estimation of the Cointegrating Coefficient of Inequality

Our estimation technique addresses issues of endogeneity and unobserved country characteristics. Therefore, to account for endogeneity and country-specific unobserved characteristics, we use the System GMM dynamic panel estimation method. The option to use System GMM is based on the argument that the existence of weak instruments implies asymptotically that the variance of the coefficient increases and in small samples the coefficients can be biased. To reduce the potential bias and inaccuracy associated with the use of Difference GMM (Arellano and Bond, 1991), Arellano and Bover (1995) and Blundell and Bond (1998) develop a system of regressions in differences and levels. The instruments for the regression in differences are the lagged levels of the explanatory variables and the instruments for the regression in levels are the lagged differences of explanatory variables. These are considered as appropriate instruments under the assumption that although there may be correlation between the levels of explanatory variables and the country specific effect, there is no

---

[5] This table contains the mean and variance values for the cases when there is no heterogeneous intercept, or when there is a heterogeneous intercept or/and a time trend in the heterogeneous regression equation. k is the number of regressors without taking the heterogeneous deterministic terms into account.

correlation between those variables in differences and the country-specific effect.

The consistency of the System GMM estimator is assessed by two specification tests. The Sargan test of over-identifying restrictions tests the overall validity of the instruments. Failure to reject the null hypothesis gives support to the model. The second test examines the null hypothesis that the error term is not serially correlated. Again, failure to reject the null hypothesis gives support to the model.

In Table 3 we report our regression estimates using the System GMM estimation technique. Before we describe our results, we should mention that the specification tests - both the Sargan test of over-identifying restrictions and the test for higher-order correlation - validate our regressions for inference. That is, our instruments are not correlated with the error term and the latter does not display higher-order serial correlation.

Table 3. GMM Estimates of the Cointegrating Coefficient of Inequality

Dependant variable : Growth rate of GDP per capita	
Initial GDP per capita	-0.027 (-4.2)***
Inequality (Gini index)	-0.075 (-3.11)**
Trade	0.002 (0.84)
Investment	0.0016 (1.78)*
Secondary School Enrolment	0.015 (1.65)*
Constant	0.011 (0.41)
Specification Tests (p-values) - Sargan Test - 2nd order correclation	0.28 0.56

Notes: t-stat in parentheses. *, ** and *** indicates significance at 10%, 5% and 1% respectively.

The panel regression results regarding growth inequality relationship given in Table 3 confirms the negative relationship between growth and inequality in the Maghreb countries. The cointegrating coefficient of inequality is negative and statistically significant at the 5% level when panel GMM estimator is used. With respect to the different empirical studies (Alesina and Rodrick (1994), Garbis (2005) and Yin and al. (2006)), we find that income inequality has a substantial negative impact on economic growth. On the other hand, an increase of the Gini coefficient level (say, 5%) would

imply a growth decline of approximately 0.075 percentage points.

We introduce the level of initial GDP per capita (the natural logarithm) as independent variable according to the conditional convergence hypothesis. The initial GDP per capita coefficient is negative, meaning that the conditional convergence hypothesis is evidenced: holding constant other growth determinants, countries with lower GDP per capita tend to grow faster. The initial position of the economy is thus a significant determinant of growth, as recognised by the neoclassical theory. The initial income has a negative effect on economic growth coherent to the theoretical study and statistically significant at a 1% level.

The estimated coefficient of Secondary School Enrolment is positive and statistically significant at a 10% level. This result is consistent with common findings of theoretical literature that suggests a positive relation between human capital and economic growth and of empirical literature (Romer (1990), Mankiw and al. (1992) and Benhabib and Spiegel (1994)).

The investment variable has also the right sign since there found a positive relationship between capital accumulation and growth. Trade openness also positively affects growth. Thus, the more countries are outward-oriented the more this contributes favorably to economic growth. These results are in line with those found by Aguire and Calderon (2005) and Dufrénot and al. (2009), and, more generally with the neoclassical approach according to which the positive impact of trade on growth is explained by comparative advantages, be they in resource endowment or differences in technology.

5. Conclusion

This study attempts to examine the empirical relationship between growth and income inequality in the Maghreb countries over the period 2000-2020. The results of this paper clearly indicate that the long-run growth elasticity of income inequality is negative and significant when panel GMM estimator is used. The results also show negative and highly significant relationship between growth and initial income per capita. Physical capital investment has positive effect on economic growth. The results also suggest that coefficients of openness to trade and human capital investment are positive and robustly significant indicating that both factors have strong impact on economic growth.

A pro-poor economic growth leading to a rapid and sustainable poverty reduction depends upon the interaction of a wide range of policy measures. First, a pro-poor growth strategy does not have to only focus on economic growth, but could also be combined with an active policy of income redistribution. Then, the higher the level of both physical and human capital investment, the higher is the level of output per capita. A better-educated labor force can improve productivity and technological level in the economy, which have a long-run positive effect on economic growth. Finally, governments must create an environment that is conducive to growth. Macroeconomic policy should aim at stability, and openness towards the rest of the world. For all these efforts to be

effective, the government must develop good institutions, and provide good governance.

REFERENCES

1. Aghion, P., and P. Bolton (1997) "Distribution and Economic Growth in Model of Imperfect Capital Markets", *European Economic Review*, 36, 603-611.

2. Alesina, A., and D. Rodrick (1994) "Distributive Politics and Economic Growth", *Quarterly Journal of Economics*, 108, 465-90.

3. Aguirre, A. and C. Calderon (2005) "Real Exchange Rate Misalignments and Economic Performance", *Central Bank of Chile Working Paper*, n°315.

4. Arellano, M., and S. Bond (1991) "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Evidence", *Review of Economic Studies*, 58(2), 277-297.

5. Arellano, M. and O. Bover (1995) "Another Look at the Instrumental Variables Estimation of Error Components Models", *Journal of Econometrics*, 68(1), 29-52.

6. Benhabib, J. and M. Spiegel (1994) "The Role of Human Capital in Economic Development Evidence for Aggregate Cross- Country Data", *Journal of Monetary Economics*, 34, 143-158.

7. Baltagi, B. H. (2001) *Econometric Analysis of Panel Data*, Chichester: UK: Wiley and Sons.

8. Barro, R. (2000) "Inequality and Growth in a Panel of Countries", *Journal of Economic Growth*, 5, 5-32.

9. Bénabou, R. (2005) *Inequality, technology, and the social contract*. In: Aghion P, Durlauf S (eds) Handbook of economic growth. Elsevier, Amsterdam, 1595–1638

10. Blundell, R., and S. Bond (1998) "Initial Conditions and Moment Restrictions in Dynamic Development", *Journal of Econometrics*, 87(1), 115-143.

11. Deininger, K., and L. Squire (1996) "A New Data Set Measuring Income Inequality". *World Bank Economic Review*, 10, 565-92.

12. Deininger, K., and L. Squire (1998) "New Ways of Looking at Old Issues: Inequality and Growth", *Journal of Development Economics*, 57, 259-87.

13. Dollar, D., and A. David (1992) "Outward-Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs 1976-1985", *Economic Development and Cultural Change*, 40(3), 523-44.

14. Dufrénot, G., V. Mignon, and C. Tsangarides (2009) "The Trade Growth Nexus in the Developing Countries: A Quantile Regression Approach", *CEPII Working Paper*, n°4.

15. Dollar, D., and A. Kraay (2001) "Trade, Growth, and Poverty", *Finance and Development*, 38, 16-19.

16. Edwards, S. (1993) "Openness, Trade Liberalization, and Growth in Developing Countries", *Journal of Economic Literature*, 31, 1358-1393.

17. Forbes, K. (2000) "A Reassessment of the Relationship between Inequality and Growth", *American Economic Review*, 90, 869-97.

18. Galor, O. (2000) "Income Distribution and the Process of Development", *European Economic Review*, 44, 706-12.

19. Galor, O., and A. Weil (1999) "From Malthusian Stagnation to Modern Growth", *American Economic Review*, 89, 150-154.

20. Galor, O., and A. Weil (2000) "Population, Technology and Growth: From Malthusian Stagnation to Growth and Beyond", *American Economic Review*, 90, 806-828.

21. Galor, O., and J. Zeira (1993) "Income Distribution and Macroeconomics", *Review of Economic Studies*, 60, 35-52.

22. Galor, O., and O. Moav (1999) "From Physical to Human Capital Accumulation: Inequality in the Process of Development", *CEPR Discussion Paper*, n°2307.

23. Galor, O., and O. Moav (2004) "From Physical to human capital accumulation: inequality and the process of development", *Review of Economic Studies*, 71(4), 1001–1026.

24. Garbis, I., (2005) "Inequality**,** Poverty and Growth: Cross Country Evidence", *IMF Working Paper*, n°28.

25. Im, K. S., M. H. Pesaran, and Y. Shin (2003) "Testing for Unit Root in Heterogeneous Panel", *Journal of Econometrics*, 115(1), 53-74.

26. Kaldor, N. (1957) "A Model of Economic Growth", *Economic Journal*, 57, 591-624.

27. Kuznets, S. (1955) "Economic Growth and Income Inequality", *American Economic Review*, 45(1), 1-28.

28. Mankiw, N., D. Romer, and D. Weil (1992) "A contribution to the empirics of economic growth", *Quarterly Journal of Economics*, 152, 407-437.

29. Pasinetti, L. (1962) "Rate of profit and income distribution in relation to the rate of economic growth", *Review of Economic Studies*, 29, 267−79.

30. Penalosa, C.C., and S.J. Turnovsky (2006) "Growth and income inequality: a canonical model", *Economic Theory*, 28, 25–49.

31. Persson, T., and G. Tabellini (1994) "Is Inequality Harmful for Growth?", *American Economic Review*, 84, 600-621.

32. Pedroni, P. (1996) "Fully modified OLS for heterogeneous cointegrated panels and the case of purchasing power parity, Indiana University", *Working Paper in Economics*, n°20.

33. Pedroni, P. (1999) "Critical for Cointegration Tests in Heterogeneous Panels with Multiple Regressors", *Oxford Bulletin of Economics and Statistics*, 61(1), 653-670.

34. Pedroni, P. (2004) "Panel Cointegration Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis", *Econometric Theory*, 20(3), 597-625.

35. Phillips, P.C.B., and P. Perron (1988) "Testing for a Unit Root in Time Series Regression", *Biometrika*, 75, 335-346.

36. Romer, P. M (1990) "Endegenous Technological Change", *The Journal of Political Economy*, 98(5), 71- 102.

37. Ravallion, M. (1997) "Good and Bad Growth: The Human Development Reports", *World Development*, 25, 631-38.

38. Sachs, J.D., and A.M. Warner (1995) "Economic Reform and the Process of Global Integration", *Brookings Papers on Economic Activity*, 1-95.

39. Solow, R. (1956) "A Contribution to the Theory of Economic Growth", *Quarterly Journal of Economics*, 70, 65-94.

40. Swan, T. (1956) **"**Economic Growth and Capital Accumulation", *Economic Record*, 32, 334-361.

41. Smith, D. (2001) "International Evidence on How Income Inequality and Credit Market Imperfections Affect Private Saving Rates", *Journal of Development Economics*, 64,103-127.

42. World Bank (2023) "World Development Indicators Database".

43. Yin, H., L. Gong, and H. Zou (2006) "Income inequality and economic growth - the Kuznets curve revisited", *Empirical Economics*, 1(2), 196-206.