Spatial Analysis of Income Inequality, Poverty and Economic Growth in the Euro-Med Zone

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Abstract:

There is an extensive literature on the impact of inequality and poverty on economic growth and vice versa. However, the triangle relationship among these three variables can be debatable. Income inequality is generally seen to affect long-term economic growth, although there is no consensus on the direction of the effect. Also, based to Kuznets hypothesis, inequality is affected by growth and this is a u-inverse relation. As well as inequality, poverty is one of the important variables affecting growth, and would be affected by growth. This study tries to consider these relations, interactively. According to the observation types, these relations can be defined through spatial econometric techniques for considering neighboring effects. For this purpose, we analyze spatial relations between poverty, income inequality and economic growth in Euro-Mediterranean countries.
The results show that growth and inequality have spatial dependence and neighbors of each country can influence its economic growth and inequality. The relationship between economic growth and poverty is bilateral, while growth-poverty and poverty-inequality relations are one-way.

JEL Classification: O47, I32, D63
Keywords: Solow-Swan growth model, income inequality, poverty, spatial econometrics, Mediterranean countries.

1. Introduction

Income inequality is generally seen to affect long-term economic growth, although there is no consensus on the direction of the effect. If income inequality affects growth positively, it is possible that the poverty-reducing impact of this growth offsets the direct adverse effect of inequality on welfare, and thus reason to tolerate relatively high inequality. On the other hand, if inequality affects growth negatively, then addressing it immediately should be an important concern (Qin et al, 2009).

As well as inequality, poverty is one on the most important problem in all countries over the world. A key issue for many countries and even for international organizations including "The World Bank" and "The United Nations" is how to attack poverty. In many countries of the world, millions of people are hungry, lacking shelter and clothing, sick and uncared for, illiterate and not schooled. These, all cause to reduce efficiency and productivity of labor, and hence decrease income. Also, being in a geographical region in which there are poor countries is itself a factor of poverty. In fact, there is a poverty trap in such regions. That is, being poor and being in a poor region are factors which lead to longer and deeper poverty.

This study tries to analyses a spatial relation between poverty, income inequality and economic growth in Euro-Mediterranean countries. For this purpose, we use three models for economic growth, inequality and poverty. The growth model is the Solow-Swan (1956) model as used by Barro and Sala-i-martin (1995). Solow-Swan growth model is a widely used growth model and is the starting point for almost all analyses of growth.

Using of spatial econometrics is the value added of this paper. The case of the study is a group of countries and each country is a location (a point) in space. When we deal with data which are collected with reference to locations, it have to paid attention to spatial interaction of those locations, because spatial relations affect collected data of them. In other words, the location aspects of data must be considered in analysis because of spatial dependence. In economics, it is done through spatial econometrics techniques.

We continue the paper as follow. We first review the literature. The third section shows the methodology of the paper. The specified models are estimated for euro-Mediterranean countries and obtained results are illustrated in section 4. The last section of the paper summarizes the results of the paper.

2. Literature Review

The results of different studies show that there is a relationship among economic growth, poverty and income distribution, interactively as figure (1). The Poverty–Growth–Inequality Triangle proposed by Bourguignon (2005) allows a tractable way to quantify the extent of poverty reduction into growth and distribution effects (Datt & Ravallion, 1992).

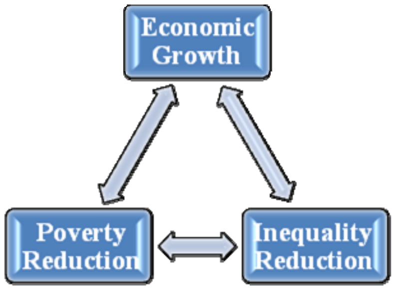

Fig. (1): triangle of economic growth, poverty and inequality.

It has long been recognized that the rate of economic growth in a society and the degree of equality in the distribution of its income and wealth are not independent. The notion that substantial inequality is a stimulus to growth is extremely questionable (Baumol, 2007). A famous postulate on income inequality and growth was put forward by Kuznets (1955). The postulate says that in the course of a country's development, inequality first rises before eventually declining—the inverted-U hypothesis. However, Kuznets hypothesis implies a causal relationship of growth →inequality, i.e. relating inequality to the stages of macro-economic development (Qin et al, 2009). Theories concerning how income inequality affects economic growth are more micro-oriented, i.e. relating heterogeneous consumers' behavior and investment indivisibility to aggregate demand (e.g. see Bagliano & Bertola, 2004).

The question of whether inequality impedes or fosters economic growth once seemed largely settled, with traditional economic theory focusing on inequality's beneficial effects on saving, investment and incentives. In the past two decades, however, research has identified new channels between inequality and growth, suggesting a more subtle relationship than the one advanced by earlier theorists (Quintin & Saving, 2008).

There are two obvious sources of the influence of inequality on growth: (1) low productivity of an impoverished labor force (poverty as a physical and mental handicap), and (2) large financial rewards as incentive for vigorous productive effort. Clearly, these influences work in opposite directions. The first asserts that inequality can be a powerful impediment to growth, while the second claims that the prospect of success in attaining the upper strata in a highly unequal community is a vital and perhaps indispensable stimulus to rapid growth because it supposedly is the fuel that fires the exertions of the entrepreneurs (Baumol, 2007).

Many empirical studies have produced positive evidence of the growth-inequality link, e.g. see (Aghion, Caroli & Garcia-Pe˜nalosa, 1999). Cross-country analyses in this regard are frequently carried out by running regressions of growth rates on various proxies for income inequality and redistribution effects together with relevant control variables. More recent research utilizing panel regression and better quality data has concluded that inequality increases growth (Raffalovich, 2000).

Extensive reviews of the research on inequality and growth have recently appeared in the literature (Benabou 1996; Aghion, Caroli, & Garcia-Penalosa 1999; Baumol 2007; Quintin & Saving 2008; and Qin et al 2009). Benabou (1996) observes that recent cross-country growth regressions "run over a variety of data sets and periods with many different measures of income distribution, deliver a consistent message: initial inequality is detrimental to long-run growth" (p. 13). However, he argues that the evidence does not support the political explanation for this finding. Furthermore, the hypothesis underlying the political explanation, that inequality reduces growth because inequality increases redistribution, is not supported: measures of redistribution are consistently positive in growth regressions.

The impact of poverty on growth is obvious, contrary to inequality. Based on the Waskil's study (1954), poverty decreases efficiency of production factors. When a country has poor labour forces, the education and health of them is weak and they can not work efficient. Hence, production and economic growth declines. This phenomenon increases poverty, and causes to form a poverty-recession loop.

The degree of poverty depends on two factors: average income and income inequality. The increase in average income reduces poverty and the increase in inequality increases it. Thus, the changes in poverty can be composed into two components: one is the growth component relating to change in mean income, and the other is the inequality component relating to change in inequality. The magnitudes of two components provide the relative sensitivity of poverty reduction to growth and inequality. It is obvious that if the growth component dominates over the inequality component, then growth-maximizing policies may be adequate in achieving a rapid reduction in poverty. If the inequality component dominates, then the policies that are pro-poor and thus reduce inequality should be adopted (Kakwani, 1993).

Also it must be considered that as countries become richer, on average the incidence of income poverty falls. Other indicators of well-being, such as average levels of education and health, tend to improve as well. For these reasons, economic growth is a powerful force for poverty reduction. This observation is not the end of the story, for it raises the questions of what causes economic growth and why countries with similar rates of economic growth can have very different rates of poverty reduction.

A World Bank study by Dollar and Kraay (2000) has come out with a much stronger result that the income of the poor rises one-for-one with overall growth. It means that the proportional benefits of growth enjoyed by the poor are the same as those enjoyed by the remainder of the population. An important implication of this research is that growth is good for the poor irrespective of the nature of growth. Thus, the government need not follow pro-poor policies with a focus on poverty reduction. To achieve a rapid reduction in poverty, they should focus on maximizing economic growth while maintaining macroeconomic stability.

The World Bank study, although highly influential, is based on cross-country regressions, which can indicate only average trends. Individual country experiences can be quite different. We can not have the same policy prescription for all countries. For some countries, the growth maximizing policies may be adequate but for other countries, there may be a need to have pro-poor growth policies with a focus on reducing inequality (Kakwani & Pernia, 2000).

3. Methodology

We are going to analyze the models for Euro-Med countries through spatial econometric techniques. In other words, the case is a collection of countries. Each country is a location, a point, in space. When we deal with data which are collected with reference to locations, we must pay attention to spatial interaction of those locations, because spatial relations affect collected data of them. In other words, the location aspect of data must be considered in analysis because of spatial dependence. In economics, it is done through spatial econometrics techniques.[1]

Spatial dependence in a collection of a sample data implies that one observation associated with a location in space which labeled i depends on other observations at locations $i \neq j$. Formally;

$$Yi = F(Yj), \qquad i = 1, 2, \ldots, n \qquad i \neq j. \tag{1}$$

In other words,

$$Cov(Yi,Yj) = E(Yi,Yj)-E(Yi).E(Yj) \neq 0 \qquad \text{for} \quad i \neq j \tag{2}$$

in which Y can be any variable with n observations (Lesage, 1999, pp.3-4).

It is clear that observations that are near each other would reflect a greater degree of spatial dependence than those which have more distant from each other. That is, the strength of spatial dependence between observations would decline with the distance. Briefly, when we analyze a variable in different locations, we must take into account spatial aspects of considered data. For this purpose, according to the locational information, spatial weights matrix W can be generated based upon contiguity or distance and it is used in analysis. In this paper, we use a simple contiguity matrix, so that its element takes values of 0 or 1, in accordance to the absence or presence of a contiguity relationship.[2]

[1] Spatial econometrics is a sub-field of econometrics that deals with the treatment of spatial interaction (spatial auto correlation) and spatial structure (spatial heterogeneity) in regression models (Anselin, 1999).

[2] The contiguity relationship can be defined as linear, rook, bishop, double linear, double rook, or queen contiguity like movements in chess. For further discussion, see Lesage, 1999.

$$W = \begin{bmatrix} 0 & w_{12} & w_{13} & . & w_{1n} \\ w_{21} & 0 & w_{23} & . & w_{2n} \\ w_{31} & w_{32} & 0 & . & w_{3n} \\ . & . & . & . & . \\ w_{n1} & w_{n2} & w_{n3} & . & 0 \end{bmatrix} \qquad (3)$$

W is a contiguity matrix. wij -the element of row i and column j in matrix "W"- is equal to 1, if regions of i and j are contiguous, other wise wij=0 .Spatial matrix is a n×n one for n observations. The elements of the spatial weights are row standardized, so that for each i, ∑wij = 1. Pre-multiplying the spatial matrix by the vector elements of the interested variable, the spatial lag operator of that variable is obtained. Observations of this variable indicate weighted average of the neighbors.

$$Sy = W.y = \begin{bmatrix} 0 & w_{12} & w_{13} & . & w_{1n} \\ w_{21} & 0 & w_{23} & . & w_{2n} \\ w_{31} & w_{32} & 0 & . & w_{3n} \\ . & . & . & . & . \\ w_{n1} & w_{n2} & w_{n3} & . & 0 \end{bmatrix} \begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ . \\ y_n \end{bmatrix} \qquad (4)$$

Then, we can examine spatial dependence through regress the main variable on its spatial lag. If the estimated coefficient is statistically significant, we say there is spatial dependence among contiguous observations. Also, we can test spatial dependence by such indicators as Moran's I statistic, Lagrange multiplier (LM) and robust-LM tests (for further information see Anselin, 1999). In addition, we can show spatial relations through Moran scatter plot, suggested by Anselin 1993, which plots the standardized variable against its spatial lag (also standardized).

We prepare a spatial model to explain our ideas in this paper. The model consists of three separate equations for growth, inequality and poverty, respectively as follow:

$$Growth = \alpha_1 - (1 - e^{-T\beta})L_n y + \gamma_1.HDI + \gamma_2.Gini + \gamma_3.Poverty \qquad (5)$$

$$Gini = \alpha_2 + \theta_1.HDI + \theta_2.Growth + \theta_3.Poverty \qquad (6)$$

$$Poverty = \alpha_3 + \delta_1.HDI + \delta_2.Gini + \delta_3.Growth \quad (7)$$

in which HDI is human development index and β is the speed of convergence as introduced in the Solow growth model. α, γ, θ and δ are constants. These models are estimated for 37 Euro-Med countries in both traditional and spatial forms. The growth rates are for a six year period of time, 2000-2006. The considered time for HDI variable is 2000, and for Gini coefficient and poverty variables are the last year which its data is available (appendix I shows the disparity of these three main variables). The data are collected from world development indicators (WDI, 2007&2008) and UN reports (different years).

4. The Estimation Results

For measuring inequality we use the Gini coefficients, and for poverty we consider the percentage of the population living on less than national poverty line. As mentioned before, there are 37 Euro-Med countries in the sample. We omit others because the lack of data. Therefore, we analyze spatial dependence of their growth, inequality and poverty, and then cluster them in terms of each variable through Moran scatter plot.

Table (1) illustrates the estimation results of the economic growth model both in traditional and spatial auto-regressive model. The estimated coefficient of the Lny is negatively significant and shows the acceptance of the conditional hypothesis. Since we have $\alpha_1 = -(1 - e^{-7\beta})$, the speed of convergence (β) equals 0.027. This specifies that 2.7 percent of the gap between current and steady state incomes is omitted in each year.

The impact of income distribution on economic growth is positive buy statistically no-significant. Poverty has a negative and significant effect on growth. The estimated coefficient of this variable shows that for example if the poor increases 1 percent, economic growth decreases 0.5 percent. We consider HDI as a proxy for other variables affecting economic growth. Its estimated coefficient is positively significant. Higher development (in income per capita, education and health), more economic growth is achievable. R2 equals 0.542, means that about 54 percent of dependent variable changes is explained through considered independent variables. For testing the spatial form of the model we used robust LM statistic. The results clarify that the model is a spatial auto-regression model (SAR). The column 3 of the table demonstrates that the estimated ρ is statistically significant and R2 is augmented, which certify the SAR form for the model. The estimated coefficients are as before, except HDI's coefficient which is insignificant in spatial model. The estimated positive ρ confirms the existence of positive spatial dependence among economic growth rates of considered countries. In the other words, each country growth is influenced positively by its neighbors' growth.

Table (1): Estimation results of economic growth model.

Variables	OLS	SAR
α_1	0.728 (0.27)**	0.550 (0.18)***
$L_n y$	-0.168 (0.04)***	-0.058 (0.02)**
Gini	0.056 (0.38)	-0.171 (0.23)
Poverty	-0.562 (0.27)**	-0.338 (0.17)**
HDI	1.206 (0.52)**	0.164 (0.33)
ρ		0.632 (0.09)***
R^2	0.542	0.794
Robust LM(lag)	9.076 (prob: 0.003)	
Robust LM(error)	1.455 (prob: 0.227)	

***Significant at 1% level. **Significant at 5% level. *Significant at 10% level
(No. of observations is 37. standard errors are in parentheses)
(Source: Research computations).

In table (2), you can find results of income distribution model. The impact of economic growth on income distribution is considered in quadratic form for testing the Kuznets u-inverse hypothesis. Both estimated coefficients of GROWTH and squared GROWTH are statistically significant and their signs confirm existence of u-inverse relation between growth and inequality (Kuznets hypothesis). Therefore, in the growth way, inequality increases first, reaches to a maximum point and then declines.

The estimated coefficient of poverty is insignificant, but HDI's coefficient is negatively significant. It refers to an inverse relation between HDI and inequality, so that lower development level increases Gini coefficient. Spatial tests confirm both spatial lag and spatial error models. Significance of spatial coefficients (ρ and λ) and increased R squared of spatial models is consistent to this result. The estimation results of spatial models are the same as OLS method's ones. But, the poverty coefficient is significant in spatial cases. More poverty, more inequality is. ρ and λ show that if a country is surrounded by high inequality countries, there is a positive regional effect on its inequality (i.e. its inequality rises), and vice versa.

Table (2): Estimation results of income distribution model.

Variables	OLS	SAR	SEM
α_2	0.672 (0.10)***	0.348 (0.11)***	0.544 (0.09)***
Growth	-0.775 (0.18)***	-0.479 (0.15)***	-0.505 (0.17)***
$Growth^2$	1.282 (0.33)***	0.789 (0.26)***	0.824 (0.33)**
Poverty	0.172 (0.11)	0.156 (0.08)*	0.170 (0.08)**
HDI	-0.344 (0.10)***	-0.186 (0.08)**	-0.221 (0.09)**
ρ		0.501 (0.11)***	
λ			0.555 (0.12)***
R^2	0.502	0.685	0.666
Robust LM(lag)	3.437 (prob: 0.064)		
LM(error)	5.855 (prob: 0.016)		

***Significant at 1% level. **Significant at 5% level. *Significant at 10% level
(No. of observations is 37. standard errors are in parentheses)
(Source: Research computations).

Table (3) shows the results of the estimated poverty model. As we can see, there is a negative and significant relationship in quadratic form between growth and poverty. Also, we see a significant negative relationship between HDI and poverty. Spatial tests in this approach confirm that our poverty model is not spatial.

Table (3): Estimation results of poverty model.

Variable	α_3	Gini	Growth^2	HDI
Coefficient	0.367 (0.15)**	0.238 (0.27)	-0.264 (0.14)*	-0.349 (0.13)***
R^2	0.315			
LM(lag)	0.004 (prob: 0.95)	**LM(error)**	0.003 (prob: 0.96)	
Robust(lag)	0.0009 (prob:97)	**Robust(error)**	0.0001 (prob: 0.99)	

***Significant at 1% level. **Significant at 5% level. *Significant at 10% level
(No. of observations is 37. standard errors are in parentheses)
(Source: Research computations).

As we said before, Moran scatter plot is another way for showing spatial auto-correlation. Figurers (1) and (2) display Moran scatter plot for economic growth and inequality respectively (since there is no spatial dependence for poverty, we can not trace Moran scatter plot for that).

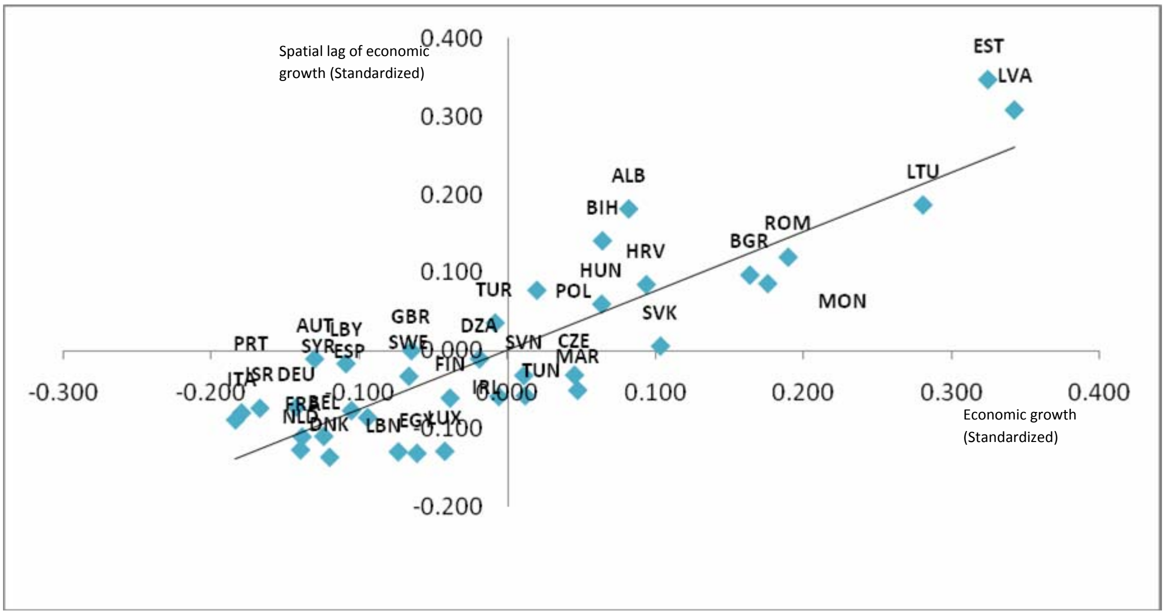

Fig.(1): Moran scatter plot for economic growth in Euro-Med zone.

The four different quadrants of the scatter plot identify four types of local spatial association between a country and its neighbors: (HH) a high growth (inequality) country with high growth (inequality) neighbors (quadrant I); (LH) a low growth (inequality) country surrounded by high growth (inequality) neighbors (quadrant II); (LL) a low growth (inequality) country surrounded by low growth (inequality) neighbors (quadrant III); and (HL) a high growth (inequality) country with low growth (inequality) neighbors (quadrant IV). Quadrants I and III pertain to positive forms of spatial dependence while the remaining two represent negative spatial dependence (Rey and Montoury, 1999).

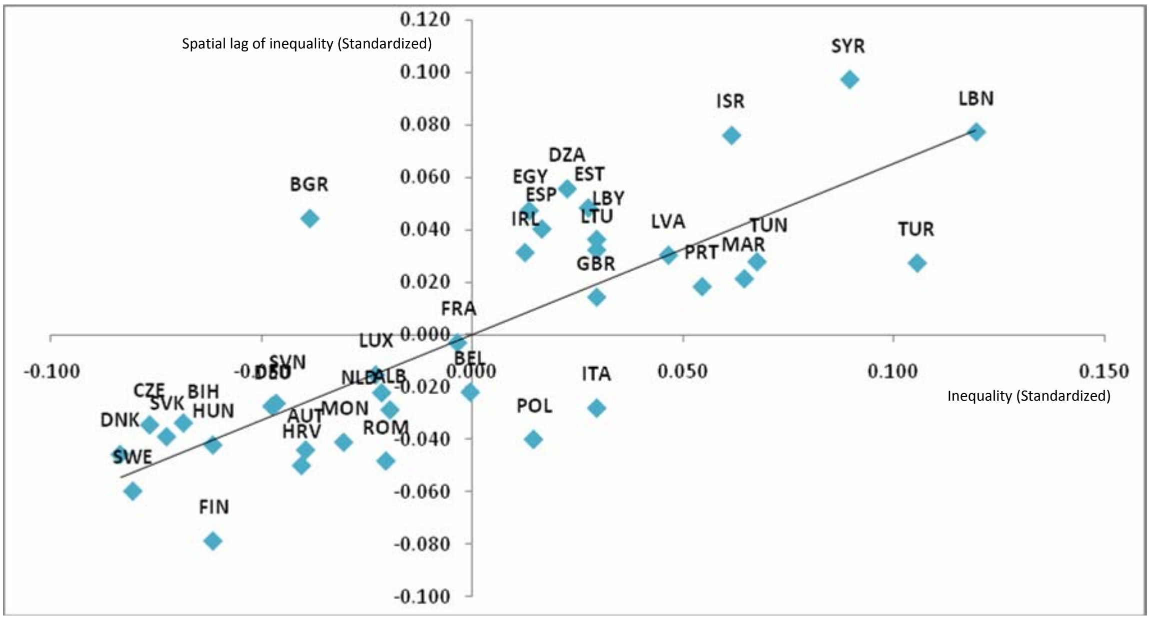

Fig.(2): Moran scatter plot for inequality in Euro-Med zone.

As figure (1) shows, Eastern Europe are classified as HH cluster. Estonia and Latvia are the last ones on the right side of quadrant I; therefore they have had higher growth rates. Meanwhile Mediterranean countries constitute LL cluster in terms of economic growth in 2000-2006. For inequality, countries in the south side of Mediterranean Sea consist of HH cluster, while EU countries form LL cluster.

For showing the relationship of economic growth, inequality and poverty more obviously, we use the conditional map for these variables, as illustrated in figure 3. The vertical axis is Gini coefficient (inequality) and the horizontal axis is poverty. There are nine maps on the diagram. The economic growth rate rises by moving from left to right, and the same is true for Gini through moving form down to up. Countries are colored according to that their Gini coefficients and poverties falling in which range and their colors are based on the growth rate corresponding to the colored strip on the top of the graph. For example, box 1 demonstrates that Tunisia has had a low poverty and growth rate but a high inequality. We can see that most Mediterranean countries are located in the second row and they have relatively low growth rates.

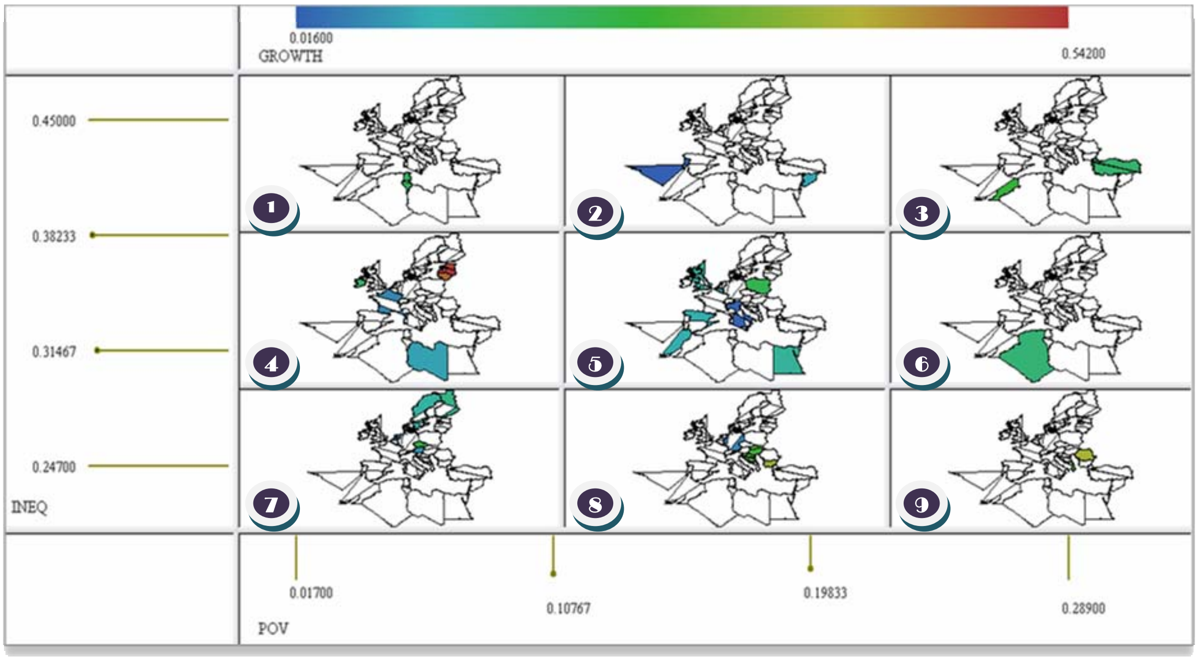

Fig.(3): The conditional map for economic growth, Gini coefficient and poverty.

5. Conclusion

We have considered the relations among economic growth, income distribution and poverty, interactively. As figure (4) shows, the impact of economic growth on poverty and inequality both is in quadratic form, therefore Kuznets u-inverse hypothesis is accepted for euro-Mediterranean countries. Meanwhile, the relationship between economic growth and poverty is bilateral. More poverty decreases economic growth. Inequality effect on growth is statistically insignificant and their relation is one-way. Also, poverty and inequality have a one-way relation, so that more poverty, higher inequality is.

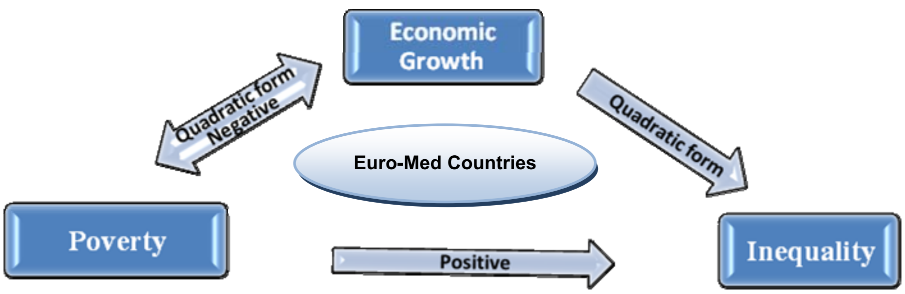

Fig (4): triangle of growth, poverty and inequality in Euro-Med zone.

For including contiguity effects, all tree models are considered in two traditional and spatial econometric forms. The spatial dependence for economic growth and inequality is confirmed, while we could not see any spatial effect for the poverty.

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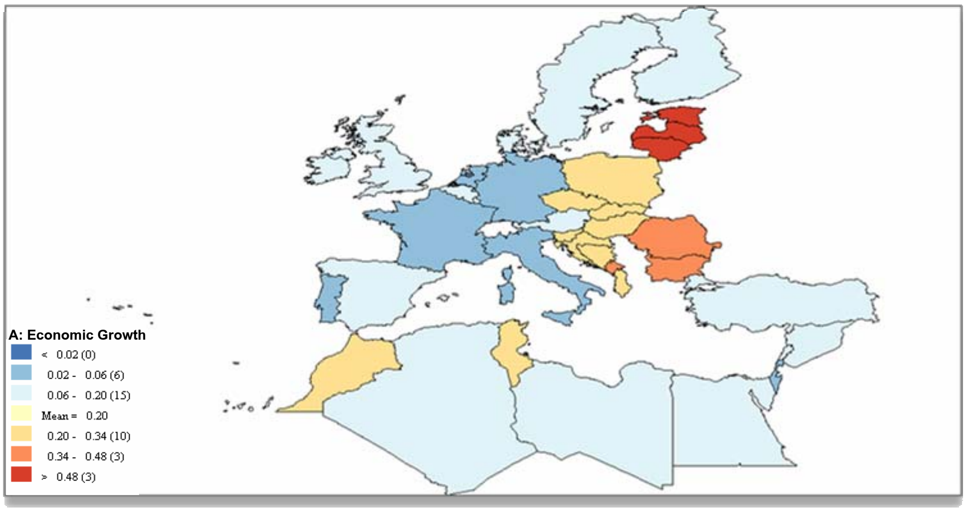
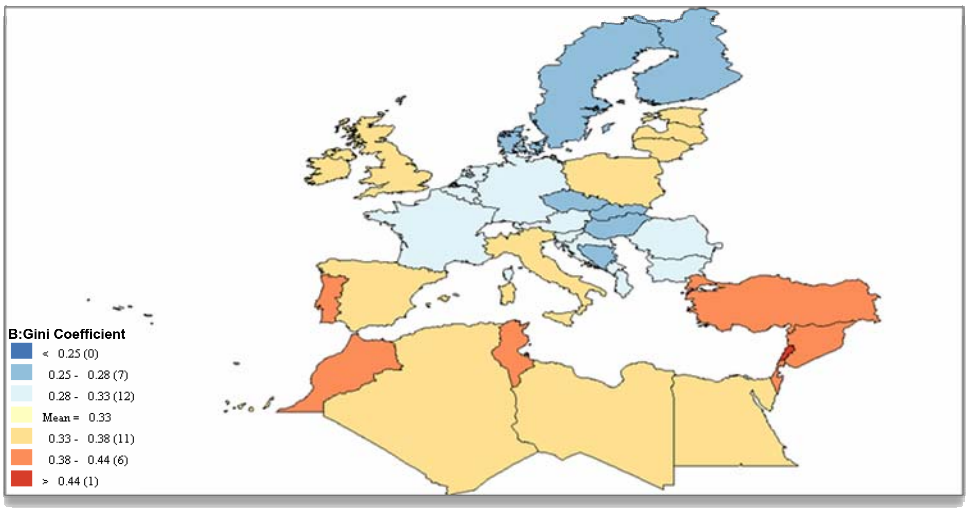
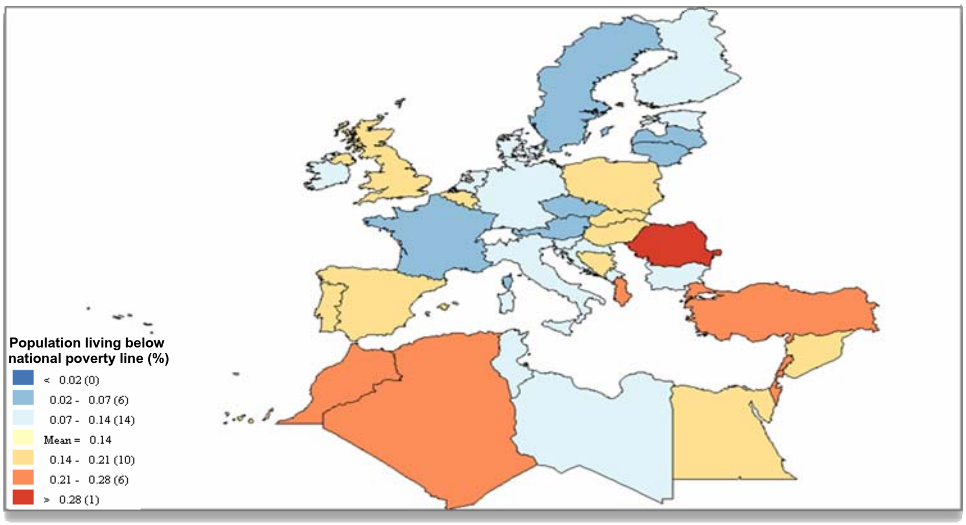
Appendix I.


A: Economic Growth
< 0.02 (0)
0.02 - 0.06 (6)
0.06 - 0.20 (15)
Mean = 0.20
0.20 - 0.34 (10)
0.34 - 0.48 (3)
> 0.48 (3)


B:Gini Coefficient
< 0.25 (0)
0.25 - 0.28 (7)
0.28 - 0.33 (12)
Mean = 0.33
0.33 - 0.38 (11)
0.38 - 0.44 (6)
> 0.44 (1)


Population living below national poverty line (%)
< 0.02 (0)
0.02 - 0.07 (6)
0.07 - 0.14 (14)
Mean = 0.14
0.14 - 0.21 (10)
0.21 - 0.28 (6)
> 0.28 (1)

Distribution of the main variables of the model in EU-Med zone.