# A Spatial Analysis of MENA Economic Convergence

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# A Spatial Analysis of MENA Economic Convergence[1]

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## I. Introduction

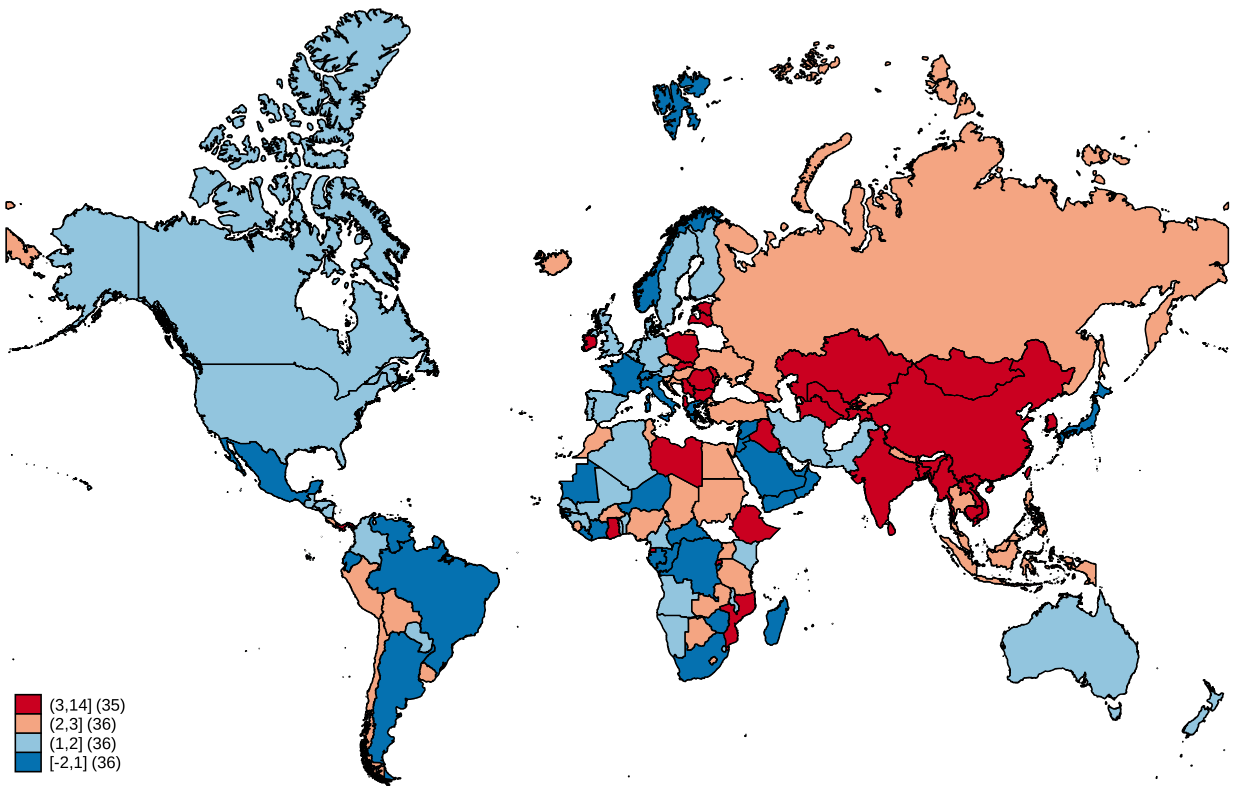
Despite the presence of a vast body economic growth literature, most growth empirical studies treat the subject with little attention to countries and regions' interactions. What is observed at one point tend to be affected by what is happening elsewhere in space. Indeed, spatial autocorrelation occurs when chock in one country is transmitted to other neighboring countries. Over the few last years, spatial effect has been recognized as a key force in the process of economic convergence (Rey and Montouri, 1999). In fact, the geographic world income is not uniformly distributed across the world: rich countries and fast-growing economies are likely to be geographically clustered (i.e., located close to each other's). Accordingly, spatial interdependence in the economic growth context matters, (Tian and Chen, 2010). It seems that a shadow growth effect (growth spillover effects coming from the other countries) exist and should be taken into account when exploring the economic convergence between the countries. For instance, in the last decade, a large body of empirical research about economic convergence process has shown that spatial dependence is worth being considered. It is worthwhile to note that neglecting the spatial interactions would lead to serious misspecification. The income growth and economic convergence in one country will not depend exclusively on the conditions of that country but also will be influenced by those prevailing in a third country. Space, in fact, is not composed of units isolated from each other. What happens in each of them can influence others: there is spatial interaction, (Jayet, 1993).

The purpose of this work is to explore the spatial correlation in terms of economic convergence[3] within the MENA region as well as the connections with other regions by adopting a spatial approach and adopting several methods to understand the convergence mechanism.

[3]Broadly speaking can be defined by the income growth differential between a sample of countries and a list of benchmark countries.

## II. A picture is worth one thousand words

**Fig.1: Panorama of the GDP/Capita in the World**
**(Period average: 1996-2019, 143 countries)**

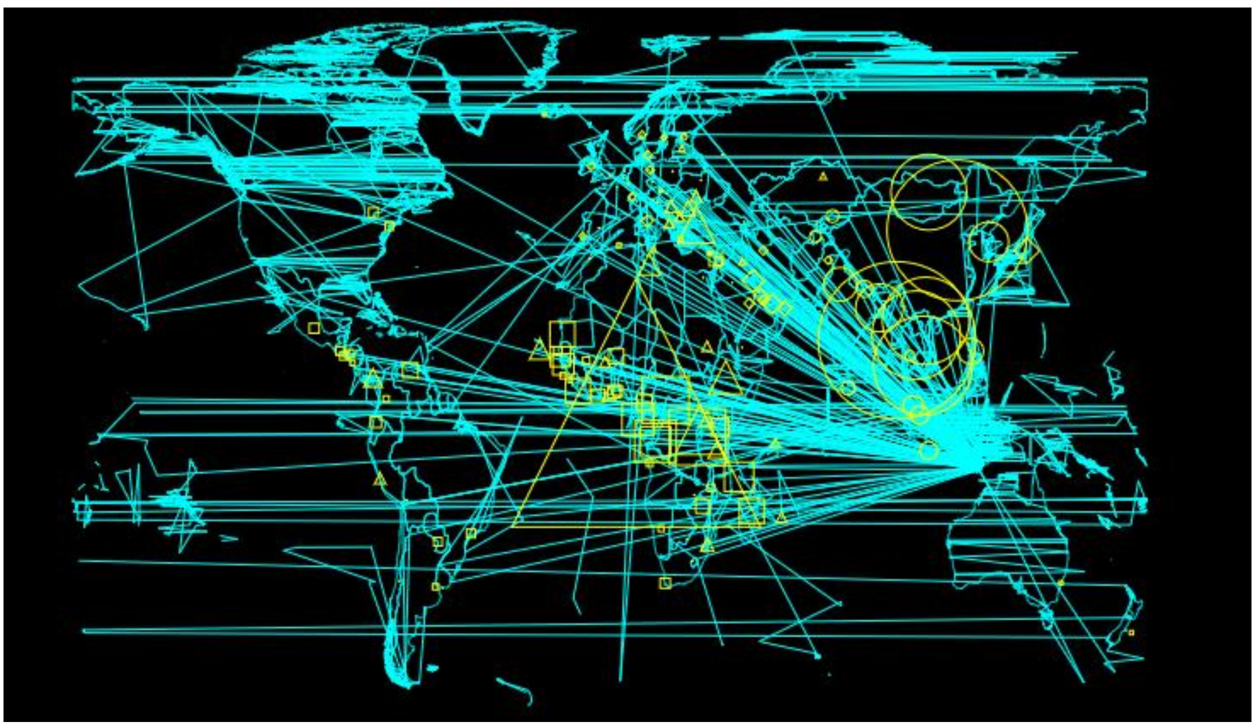



**Source: Author calculation using The World Bank Data**

The Moran's I is becoming a prominent tool in the detection and the visualization of the global spatial autocorrelation. Plenty of information would be provided by this statistic indicator, and we could even say that is "worth one thousand words". In fact, the scatter plot is divided into four quadrants each of which indicates a specific type of spatial dependence. Hence, we will have four types of spatial association presented by the Moran's scatter plot. The upper right and the lower left quadrants indicate the presence or the clustering of similar values: the high values (that is above the mean) are in the upper right while the low values (less than the mean) are found in the upper left. The lower right and upper left quadrants, point out the association of dissimilar values. According to the positive Moran's I values and the scatter plot (see Fig.1) we presume a positive relationship of economic growth within the sample countries (the Moran's

I has a statistically significant positive value and the slope of line fitting the scatter is also positive).When the Moran's I is positive and significant, the presence of clusters of like values is assumed, (Anselin, 1988). This what, we can observe on the world map of GDP per capita with a dominance of a one type of color through the continents, except Africa, where the soft and dark red (high values) coexist with blue colors (low values). One could presume a negative spatial dependence in Africa and a positive association elsewhere. Moreover, it is worthwhile to note that the darkest red color is present in China and its neighbors, leading to think of the presence of significant positive economic growth spillovers in this area.

**Fig.2: Moran Scatter Plot (Average of GDP/Capita Growth),**
**Period: 1996-2019, Sample: 143 countries**



**Source: Author calculation using The World Bank Data**

This is confirmed by Figure.2and indicated by several circles in Asian countries belonging to the upper right quadrant that correspond to pairs of positive values (high-high association). In the opposite side, the low – low values are indicated by a square and generally observed in Africa and South America. The triangle and diamond symbolize respectively the high-low association (the right left quadrant in the Moran scatter plot) and low-high association (the upper left quadrant). For the MENA region we can observe the presence of many squares (low-low association (the lower left part of Moran quadrant) in the Middle East and the presence of high-low association (indicated by a triangle) in the North Africa. It is worthwhile to note the disparities in term of economic growth across the countries and regions. The multicolor presence in the map (Fig.1) as well as the diversity of symbols (Fig.2) contrast with the orthodox neoclassical approach of absolute convergence. Economic disparities exist and poor countries didn't converge to the same steady growth and/or have not caught up developed countries so far. As a matter of fact, it could be interesting to explore other approaches instead of the unrealistic absolute convergence notion. The concept of conditional convergence in one hand, and the idea of the presence of convergence clubs i.e. groups of countries or regions for which we accept the hypothesis of convergence, (Baumol 1986).

## III. Convergence Clubs: To be or not to be

A group of economies is considered a convergence club when their initial conditions are sufficiently similar to allow them converging toward the same long-term while sharing the same characteristics and structural conditions. Therefore, different convergences clubs may exist in the same club and do not converge with each other.

Then, there exist convergence thresholds that let some economies to converge towards equilibrium with high level of product per capita, whilst other economies converge toward equilibriums with low levels of GDP per capita and thus fall into underdevelopment traps. Accordingly, the hypothesis of convergence in clubs refers to the idea of existence of several equilibriums and contrast with standard neoclassical theory and its corollary of the uniqueness of the long term stationary solution. However, growth models with the potential for various equilibriums, such as endogenous growth models, can support the presence of clubs of convergence. Thus, long-term thresholds in the accumulation of production factors or in the degree of development of key economic sectors allow for the generation of several equilibriums. According to Le Galo (2002) the hypothesis of convergence in clubs is related to the existence of multiple equilibriums and requires the development of appropriate empirical procedures. This is what Phillips and Sul (2007) succeeded to achieve by implementing an algorithm (called *log t regression*) to detect convergence clubs via a time non-linear time-varying model. The authors aimed to overcome the pitfalls of the previous economic growth tests (problems of endogeneity and variable omission) without imposing Apart its simplicity, the beauty of the routine created by Phillips and Sul (2007) is robust to the series stationary without imposing restrictive hypothesis. We run the Philips and Sul' routine (see Appendix 2) to detect the presence of convergence clubs on a panel of 143 countries over the period 1996-2019. The test was implemented on the logarithm of GDP per capita growth. In first step, the test is run to create a new GDP per capita variable free from cyclical component before using the created variable to look for the existence of convergence clubs. The tests identify the presence of seven clubs after rejecting (as expected) the hypothesis of global convergence of the whole sample. We can note on six clubs with Qatar belonging to the Club 1 (including 13 different countries like the United States, China, and Norway) and Yemen to the Club 6. The Club where the MENA countries are present the most, is the Club number 2 where we can find Bahrain, Kuwait, Saudi Arabia, Turkey, and United Arab Emirates with other 51 countries. The other MENA countries are distributed equally to the club 3, 4 and 5. The presence of convergence club confirms sustain the idea of multiple equilibriums and reject the uniqueness of long-term stationary solution hypothesis. For the MENA region, we can state according to the test results that they follow different economic path even if they belong to the same region.

## V I . The Spatial approach

To run spatial econometric regressions, we should include a weighted spatial matrix $W$ into the model. This matrix (often built through an ad-hoc procedure of the researcher) represents a theoretical configuration of the space and parameterizes the potential of interaction between observations of each country's pairs$i, j$. The positive and symmetric $n \times n$ spatial matrix[4] is composed by elements $W_{i,j}$ at location $i, j$.

By convention $W_{i,j} = 0$ for the diagonal elements which means that a location cannot be a neighbor wit itself.

$$W = \begin{pmatrix} w_{1,1} & \cdots & w_{1,n} \\ \vdots & \ddots & \vdots \\ w_{n,1} & \cdots & w_{n,n} \end{pmatrix}$$

[4] $n$ is the number of spatial units.

There is a large range of techniques to specify the structure of the spatial weight matrix[5]. For example the weight can be measured by contiguity[6]. Another alternative is to use an inverse distance or a threshold distance[7]. In this study we use an inverse distance $w_{i,j} = \frac{1}{e^{d_{ij}}} = e^{-d_{ij}} \quad \forall\, i \neq j; i,j = 1, \ldots\ldots, N$ describing a primitive and canonical principle of geographic law described concisely Tobler (1970, p.236)[8], "“Everything is related to everything else, but near things are more related than distant things”.

There are many different spatial econometric models available, and the choice should be base according the subject under study. Broadly speaking there are three conventional spatial models namely the Spatial Lag Model or Spatial Autoregressive Model (SAR), the Spatial Error Model (SEM) and the Spatial Durbin model (SDM). We opt for the spatial autoregressive model with fixed effects (SAR-FE) and its dynamic version to detect the regional spillover effects as well as the short run and long run impact.

The SAR model postulates that levels of the dependent variable *y* depend on the levels of *y* in neighboring regions captured by the weighted matrix *W* and represented by$\rho W_y$

$y = \rho W_y + \alpha + \beta X + \varepsilon$ [Eq.1]

The Spatial Error Model (SEM) in this model, the spatial influence comes only through the error terms $\mu = \lambda W_\mu + \varepsilon$ and is not very useful to detect spillover effects.

$y = \alpha + \beta X \mu \mu = \lambda W_\mu + \varepsilon$[Eq.2]

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5 It is recommended to experiment a variety of weighted spatial matrix *W* in the estimation process because results may be very sensitive to the structure of matrix W.

6 $i, j$ locations interact when they are contigus i.e sharing a common border. Then we obtain a binary matrix with value 0 (countries are not contigus) and 1 (countries are contigus).

7 ($i, j$ locations interact when being within a critical distance band).

8 Tobler, W. (1979). “Cellular Geography.” In *Philo.oph"* in Geograph", edited by S. Gale and G. Olsson, pp. 579-86. Dordrecht: Reidel.Cited in (Anselin, 1988, p.8)

The Spatial Durbin Model (SDM): just adds average-neighbor values of the independent variables to the specification through the expression $WX\theta$

$y = \rho W_y + \alpha + \beta X + WX\theta + \varepsilon$[Eq.3]

## IV. The Regression results

We use panel data of 15 MENA countries[9] extracted from the World Bank, the UNCTAD, the IMF, the CEPII and the Heritage Foundation database[10], to run the econometric models over the period 1996-2019.To run the spatial regression models, we follow Tian et al. (2010) by accommodating the Cobb-Douglas function to the spatial dependence concept. In line with Marshallian literature where two kinds of externalities are identified namely technological and pecuniary externalities; the authors stipulate that the main source of spatial effects is coming from externalities through regional interaction in terms of knowledge spillovers, factor mobility and trade. Tian et al. (2010) emphasis on technological externalities supposed to be generated by the accumulation of physical capital and externalities.

The Solow Cobb-Douglas equation proposed by the authors is a classical constant return to scale function taking the following form:

$$y_i(t) = A_i\,(t)K_i^{\propto}(t)L_i^{1-\propto}(t), 0 <\propto< 1 \qquad (1)$$

Where$y_i(t), A_i\,(t), K_i(t)\ and\ L_i(t)$ represent respectively the output, aggregated level of technology, capital and labor, in region *i* and time *t* while$\propto$is a parameter representing the capital elasticity.Moreover, Tian et al. (2010) rely on Ertur and Koch (2007) technology spillover function and assume that the steady growth rate of a region will be endogenously established by the interaction with other regions in term of spatial technology externalities. After resolving the

[9]Algeria, Bahrain, Egypt, Jordan, Kuwait, Iran, Lebanon, Oman, Morocco, Qatar, Saudi Arabia, Sudan, Tunisia, Turkey, and the United Arab Emirates.

[10] For more details about the variables used and data sources see in appendix.

system and making multiple algebraic transformations, Tian et al. (2010) obtain the following basic constrained spatial Durbin model[11]:

$$g_T = \beta_0 + \beta_1 Y_0 + \beta_2 S + \beta_3 NGD + \theta_2 WS + \theta_3 WNGD + \rho W g_T + \varepsilon \quad (2)$$

Where $g_T$, $Y_0$, $S$, $NGD$ are variables (in logarithm) that describe respectively the growth rate of per capita GDP, the initial per capita GDP , the physical capital accumulation, and the sum of population growth rate (n), technology growth rate[12] ($g$) and capita depreciation rate($\delta$)[$NGD = (n + g + \delta)$]. The spatially lagged variables are preceded by the weighted matrix W. Two kind of parameter restrictions are imposed by the authors. The first constraint is in line with Solow growth literature the coefficient $\beta_2$ and $\beta_3$are equal in magnitude and opposite in sign ($\beta_2 = -\beta_3$) and the constraint is imposed to $\theta_2$and $\theta_3$($\theta_2 = -\theta_3$). Finally, the authors augmented the Solow model by adding some control variables.

To estimate the determinants of the convergence of GDP per capita between the MENA countries we use a dataset of 15 countries[13] over the period 1996-2019. The period and countries were selected to supply both balanced panel data and a large sample size dataset to adequately run the spatial regressions. Data are collected from the Penn World Table database (PWT.10) from the University of California and the University of Groningen, The World Bank (World Development Indicators and The Worldwide Governance Indicator) the CEPII, the Heritage Foundation database and the UNCTAD.

First, we run a Solow model by ordinary least square (OLS) before performing spatial regression on the basic and augmented form of Solow equation. In the first model [equation (3)] we regress the growth of GDP per capita dependent variable $G_r = \frac{Y_T - Y_0}{T}$ on the initial per capita GDP (GDP/cap) (per capita GDP of the year 1996), the capital stock (lnck) (proxy of physical capital accumulation), and the sum of population growth, technology growth rate and capital depreciation rate (NGD) [14][$NGD = (n + g + \delta)$]. Moreover, all the variables are expressed in logarithm .

$Gr_{i,t} = \beta_0 + \beta_i X_{i,j} + \epsilon_{i,t}$ where $X_{i,j}$ is the vector of explanatory variables (3)

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[11]For sake of brevity the mathematical algorithm is not replicated in this paper. For more details see Tian et al. (2010).

[12]$\delta$ reflects the advancement of knowledge and is assumed to be exogenous and not country specific.

[13] Algeria, Bahrain, Egypt, Jordan, Kuwait, Iran, Lebanon, Oman, Morocco, Qatar, Saudi Arabia, Sudan, Tunisia, Turkey, and the United Arab Emirates.

[14]Following the economic growth literature $g + \delta$ is supposed to be equal to 0.05.

We start by running the model by OLS on the panel of MENA15 over the period 1996-2019.The restriction that the coefficient on the capital accumulation (CN) and the explanatory variable (NGD) are equal in magnitude and opposite in sign are tested but the Wald test fail reject the null hypothesis (see Table 4).Thereafter restriction has been relaxed.

**Table. 1: Determinants of economic growth (GLS regressions)**

**Period: 1996-2019, Sample: 15**

| **Gr** | **Coef.** | **z** | **P>z** |
|---|---|---|---|
| GDP/Cap1996 | - 0 .004*** | -4.32 | 0.000 |
| CN | -0.0026*** | 6.35 | 0.000 |
| NGD | 0.0026*** | -6.35 | 0.000 |
| _cons | 0.06 | 0.57 | 0.293 |

R-sq=0.34, Wald chi2(3)=96.60, Number of obs=360, T=24, number of groups=15. lnCN =-lnNGD = 0 chi2(1) *** = 35.6 , Prob > chi2 = 0.0000, The standard errors of the regression coefficients have been derived using White consistent cross-section standard errors & covariance. ***, **,* represent respectively statistical significance at 1, 5 and 10% level.

The econometric results show that all the explanatory variables are significant at a statistical level of 1%. The initial per capita GDP and the accumulation of capital have the expected sign. The negative sign of initial per capita GDP is in line with economic growth literature and decreasing return of capital economies' per capita incomes per capita incomes will tend to grow at faster rates than richer economies. We note also that the variable NGD display an expected positive sign.

## Table2. Convergence Estimation of Convergence in MENA Region by SAR-FE Model : Period:1996-2019, Panel: 15

| **Gr** | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|
| VARIABLES | Main | Spatial | Variance | **SR_Direct** | **SR_Indirect** | **SR_Total** | **LR_Direct** | **LR_Indirect** | **LR_Total** |
| | | | | | | | | | |
| **L.Gr** | 0.956*** | | | | | | | | |
| | (0.0235) | | | | | | | | |
| **L.WGr** | -0.132 | | | | | | | | |
| | (0.111) | | | | | | | | |
| **GDP/Cap 1996** | 0 | | | 0.00328 | 0.000816 | 0.00410 | 1.622 | -1.602 | 0.0209 |
| | (0) | | | (0.0304) | (0.00865) | (0.0386) | (35.50) | (35.92) | (6.013) |
| **NCN** | 0.000636** | | | 0.000646** | 0.000192 | 0.000837** | -0.0463 | 0.0725 | 0.0262 |
| | (0.000292) | | | (0.000290) | (0.000141) | (0.000417) | (1.381) | (1.442) | (0.451) |
| **NGD** | -0.00380*** | | | -0.00386*** | -0.00109* | -0.00495*** | 0.204 | -0.596 | -0.392 |
| | (0.000913) | | | (0.000907) | (0.000623) | (0.00144) | (7.108) | (10.12) | (7.756) |
| **EXPORT** | 0.000756 | | | 0.000797 | 0.000229 | 0.00103 | -0.0114 | 0.161 | 0.150 |
| | (0.000488) | | | (0.000493) | (0.000189) | (0.000659) | (0.945) | (2.887) | (2.934) |
| **Labor** | -0.00249*** | | | -0.00254*** | -0.000731 | -0.00327*** | 0.0828 | -0.277 | -0.194 |
| | (0.000710) | | | (0.000736) | (0.000447) | (0.00113) | (3.417) | (4.806) | (3.639) |
| **PCI** | 0.00219 | | | 0.00233 | 0.000819 | 0.00314 | 0.109 | -0.0953 | 0.0133 |
| | (0.00297) | | | (0.00300) | (0.00105) | (0.00398) | (1.310) | (1.423) | (0.595) |
| **Eco.Freedom** | -0.00102 | | | -0.00108 | -0.000368 | -0.00145 | 0.203 | -0.444 | -0.242 |
| | (0.00160) | | | (0.00169) | (0.000571) | (0.00222) | (5.495) | (7.113) | (4.870) |
| **rho** | | 0.208*** | | | | | | | |
| | | (0.0758) | | | | | | | |
| sigma2_e | | | 1.87e-06*** | | | | | | |
| | | | (3.50e-07) | | | | | | |
| | | | | | | | | | |
| Observations | 345 | 345 | 345 | 345 | 345 | 345 | 345 | 345 | 345 |
| R-squared | 0.881 | 0.881 | 0.881 | 0.881 | 0.881 | 0.881 | 0.881 | 0.881 | 0.881 |
| Number of id | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |

*** p<0.01, ** p<0.05, * p<0.

Robust standard errors in parentheses

Table.2 reports the spatial parameter estimates for the SAR-FE model obtained through maximum-likelihood estimation. For the SAR-FE model we respectively regress the GDP/per capita on CN, NGD as well as on the labor, the productive capacity of a country (measures by a UNCTAD composite index: The Productive capacity Index), the Economic Freedom (as measured by the Heritage Foundation), the Stock of FDI, and the Export of goods and services. All the variables are expressed in logarithm. The positive and significant sign (at 1%) of the spatial variable *rho* (ρ) implies the existence of neighboring effects. In other, words the level of GDP per capita in a given MENA country is affected by the average level of GDP per Capita level in neighboring countries. Hence, there is a spatial dependence in the whole region and the closer the countries to each other the bigger the effect. The PCI as well as the economic freedom contribute to increase the convergence speed rate. Export is positively significant at 10% while Labor and FDI show a negative significant sign. Overall, the results obtained coincide closely (with few exceptions) with the expected theoretical assumptions, since most of the explanatory variables show a positive and have significant impact on GDP per capita.

The beauty of the SAR-FE model is that we have the possibility to distinguish between the direct effects and indirect effect. In other words, a change or a variation of a country covariate or regressor will not only be felt in that country (the direct effect) but will also impact the response variable in the neighboring countries especially the closer ones. The indirect effects are of particular interest since they capture the spillovers effects across countries coming from the neighboring countries and exercised by the human accumulation of GDP per capita in that countries while the direct effects assess the spillover effects generated locally. The total effect is obtained by summing the indirect and direct effects (the local versus the foreign effects). The Estimation results show that the principal sources of spillovers are: the accumulation of physical capital (the variable CN) as well as the technical progress, the population growth rate, technology growth rate (variable NGD) whereas the spillovers of from productive capacity of the neighboring countries are significant only at a level of 10%.

## IIV. Conclusion

The beauty of local spatial autocorrelation is to check the existence of clusters or convergence clubs (regions of similar or dissimilar convergence path) and the detection of outliers (atypical localizations). The econometric results and the spatial diagnostic provided through mapping analysis would be very useful to have a panoramic view of the economic convergence within the MENA region and in a worldwide context. This would help policy makers to take better decision by having clearer image and more accurate information about convergence in a worldwide context.

Actually, in the academic circle there is a growing interest in thinking spatially instead of reasoning statistically. The policy makers should also think regionally and do not focus locally. The spillover potential in MENA region is important. From a policy perspective, ignoring and neglecting the spillovers generated via the convergence process could lead to significant shortfall. The economic convergence would level up the well being for the whole region by reducing inequalities, poverty and reinforcing the stability. The policy makers should open the doors to improve the mobility of persons in the region if they want to create a reel synergy effect and take advantage of the huge human and natural resources in this region.

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## Appendix1:Data source

| Indicators | Sources |
|---|---|
| Stock of Foreign direct investment in millions of current US $ | United Nations Conference on Trade and Development, UNCTAD Statistics database online, 2019. http://unctadstat.unctad.org |
| Population growth (annual %)<br>GDP per capita (current US$)<br>GDP per capita growth (annual %) | World Bank, World Development Indicators Database online, 2019. http://data.worldbank.org/indicator |
| Average depreciation rate of the capital stock<br>Capital stock at current PPPs (in mil. 2011US$) | Penn World Tables PWTVersion 9.0 The University of California and The University of Groningen. Database online, 2016. http://cid.econ.ucdavis.edu/pwt.html |
| Distance (Km) between capital cities<br>Latitude and Longitude (in degree) | CEPII- Databasehttp://www.cepii.fr/ |
| The Worldwide Governance Indicators (WGI) project | DanielKaufmann, Natural ResourceGovernance Institute (NRGI) and Brookings Institution and AartKraay, World Bank Development Research Group. https://info.worldbank.org/governance/wgi/ |

# APPENDIX2: Club classification

**Club 1 :(13)**

| China | China, Hong Kong SAR | Ireland | Kazakhstan |
| Luxembourg | Norway | Panama | **Qatar** | Republic of Korea |
| Singapore | Switzerland | Turkmenistan | United States |

log t test:

| Variable | Coeff | SE | T-stat |
|---|---|---|---|
| log(t) | 0.1880 | 0.0512 | 3.6708 |

The number of individuals is 13.
The number of time periods is 24.
The first 8 periods are discarded before regression

**Club 2 :(55)**

Albania | Argentina | Austria | **Bahrain** | Belgium | Botswana |
| Bulgaria | Canada | Chile | Costa Rica | Croatia | Cyprus |
| Czech Republic | Denmark | Estonia | Finland | France | Georgia |
| Germany | Hungary | Iceland | India | Indonesia | Italy | Japan |
| **Kuwait** | Lao People's DR | Latvia | Malaysia | Malta | Mauritius |
| Mongolia | Myanmar | Netherlands | Peru | Poland | Portugal |
| Republic of Moldova | Romania | Russian Federation |
| **Saudi Arabia** | Serbia | Seychelles | Slovakia | Slovenia | Spain |
| Sri Lanka | Sweden | Thailand | **Turkey** | **United Arab Emirates** |
| United Kingdom | Uruguay | Uzbekistan | Viet Nam |

log t test:

| Variable | Coeff | SE | T-stat |
|---|---|---|---|
| log(t) | 0.0805 | 0.0460 | 1.7476 |

The number of individuals is 55.
The number of time periods is 24.
The first 8 periods are discarded before regression.

**Club 3 :(14)**

| Bangladesh | Bolivia (Plurinational State of) | Brazil |
| Cambodia | Colombia | **Egypt** | Equatorial Guinea | Ethiopia |
| **Iraq** | Mexico | **Morocco** | **Oman** | Paraguay | Philippines |

log t test:

| Variable | Coeff | SE | T-stat |
|---|---|---|---|
| log(t) | 0.0712 | 0.0702 | 1.0150 |

The number of individuals is 14.
The number of time periods is 24.
The first 8 periods are discarded before regression.

**Club 4 :(18)**

| **Algeria** | Angola | Cabo Verde | Cote d'Ivoire | Ecuador |
| Eswatini | Gabon | Ghana | **Iran (Islamic Republic of**) |
| Kyrgyzstan | **Lebano**n | Mali | Namibia | South Africa |
| Tajikistan | **Tunisi**a | Ukraine | Zimbabwe |

log t test:

| Variable | Coeff | SE | T-stat |
|---|---|---|---|
| log(t) | 0.0488 | 0.0648 | 0.7534 |

The number of individuals is 18.
The number of time periods is 24.
The first 8 periods are discarded before regression.

**Club 5 :(21)**

| Benin | Cameroon | Congo, Rep. | El Salvador | Guatemala |
| Honduras | **Jordan** | Kenya | Lesotho | **Mauritania** | Nepal |
| Nicaragua | Nigeria | Pakistan | Rwanda | Senegal | **Sudan** |
| **Syrian Arab Republic** | Tanzania | Togo | Zambia |

log t test:

| Variable | Coeff | SE | T-stat |
|---|---|---|---|
| log(t) | 0.1522 | 0.0721 | 2.1100 |

The number of individuals is 21.
The number of time periods is 24.
The first 8 periods are discarded before regression.

Club 6 :(12)

| Burkina Faso | Chad | Comoros | Gambia, The | Guinea |
| Guinea-Bissau | Liberia | Madagascar | Mozambique |
| Sierra Leone | Uganda | **Yemen** |

log t test:

| Variable | Coeff | SE | T-stat |
|---|---|---|---|
| log(t) | 0.9160 | 0.0922 | 9.9396 |

The number of individuals is 12.
The number of time periods is 24.
The first 8 periods are discarded before regression.

**Club 7 :(4)**

| Central African Republic | Congo, Dem. Rep. | Malawi | Niger |

log t test:

```
  Variable |        Coeff            SE        T-stat
-----------+-----------------------------------------
    log(t) |       0.7552        0.2778        2.7190
-----------------------------------------------------
The number of individuals is 4.
The number of time periods is 24.
The first 8 periods are discarded before regression.

----------------------- Not convergent Group 8 :(3) ----------------------
 | Burundi | Greece | Venezuela (Bolivarian Republic of) |
--------------------------------------------------------------------------

log t test:
-----------------------------------------------------
  Variable |        Coeff            SE        T-stat
-----------+-----------------------------------------
    log(t) |      -0.8417        0.0106      -79.3730
-----------------------------------------------------
The number of individuals is 3.
The number of time periods is 24.
The first 8 periods are discarded before regression.
```

.

| log(t) | Club1 | Club2 | Club3 | Club4 | Club5 | Club6 | Club7 | Group8 |
|---|---|---|---|---|---|---|---|---|
| Coeff | 0.188 | 0.080 | 0.071 | 0.049 | 0.152 | 0.916 | 0.755 | -0.842 |
| T-stat | 3.671 | 1.748 | 1.015 | 0.753 | 2.110 | 9.940 | 2.719 | -79.373 |