

УДК 339.234 Tangier

JEL Classification : C21, J24, C23, R11

Koraich al Mahdi, PhD candidate, A member of the Economic, Finance, and Development research team
 Abdelmalek Essaadi University of Tangier, Tangier, Morocco,
 Hamzaoui Moustapha, PhD professor of Economics and Finance,
 Head of research team Economic, Finance, and Development
 Abdelmalek Essaadi University of Tangier, Tangier, Morocco

HUMAN CAPITAL AND REGIONAL GROWTH IN MOROCCO: SPATIAL ECONOMETRIC APPROACH

The aim of this article is to study the impact of human capital on the regional growth between 2000 and 2014, and to identify the relations linking the Moroccan regions with a view to identify the neighborhood effects on the growth of a region, by an approach of spatial econometrics.

The obtained spatial analysis results show that GDP per capita differs from one region to another, the existence of a strong heterogeneity which characterizes the Moroccan regions, as well as the persistence of interregional inequalities in economic growth, and the concentration of national wealth in some regions more than others.

Keywords: Morocco, region, human capital, regional growth, spatial panel econometrics.

According to the OECD definition, human capital covers the knowledge, skills and other qualities of an individual that promote personal, social and economic well-being. According to Adam Smith, men contribute to economic growth. Indeed, the workers, who do higher education, have know-how, an important cultural and intellectual background. They are therefore more productive, which improves their efficiency. This makes them more efficient and efficient. Thus, the theory of human capital ensures that it is more profitable to invest in the education and training of individuals than in machines and factories, the return on investment is more important in the long term, Confirms Gary Becker "People with higher levels education and skills tend to win more than others."

The Moroccan regions follow a certain distribution in heterogeneous groups separating the most developed and the most deteriorated regions. All these disparities lead to an imbalance between the Moroccan regions in terms of standard of living, wealth and all economic growth. All of these distributions lead us to wonder how to mitigate them. In addition, there are a few regional studies interest on spatial inequalities in Morocco. Organizations like HCP¹⁷, DEPF¹⁸ have already studied the determinants of unemployment, labor market etc. The majority of the studies do not introduce the spatial (geographical) dimension in their analysis.

In fact, this article will focus on the aim of spatial econometric analysis, which makes it possible both to evaluate the impact of human capital on the regional growth and to identify the nature of the relations linking the Moroccan regions from a perspective to limit the neighbouring effects on the growth of a region and to analyze the determinants of economic growth in Moroccan regions between 2000 and 2014, by using regional data and drawing on an important factor, namely the human capital¹⁹.

Notwithstanding, we will start first with a review of the literature on human capital and regional growth, citing pioneering work and research in this domain. Secondly, we will also demonstrate the methodology adopted the data sources, the methods and the statistical software used for the econometric analysis. And finally, we will present the results and discussion of our problem with a general conclusion.

¹⁷ The Haut Commissariat au Plan (HCP) or Higher Planning Commission in Morocco is an independent government statistical institution. Established in 2003, HCP is the main source of economic, demographic and social statistical data. URL : <https://hcp.ma>

¹⁸ Department of Economic Studies and Financial Forecast (DEPF), URL: <https://www.finances.gov.ma/depf/SitePages/depf.htm>

¹⁹ Human capital is a collection of traits all the knowledge, talents, skills, abilities, experience, intelligence, training, judgment, and wisdom possessed individually and collectively by individuals in a population. These resources are the total capacity of the people that represents a form of wealth which can be directed to accomplish the goals of the nation or state or a portion thereof.

Literature review: Several empirical studies have shown that human capital have a great benefits for knowledge and productivity; Arrow (1962) and Uzawa (1965), Nelson and Phelps (1966) were the first to study the impact of human capital on economic growth. Then, many studies on human capital and growth are used by different researchers as ; Romer (1986) and Lucas (1988), but the obtained result of Barro and Lee (1994) demonstrate that human capital have a crucial role in explaining growth. Else, Aghion and Howitt (1998) show the positive impact of human capital on growth. Cheshire and Margini (2000), Di Liberto (2008) consider human capital as one of the causes of regional economic growth.

In addition, other studies illustrate a weak relationship between human capital and growth, and the degree of impact differs from one region (country) to another (Bils and Klenow, 2000). In Morocco, there are a few regional studies on spatial inequalities. Organizations like HCP, DEPF have already studied the determinants of unemployment, labor market, regional growth...etc. The majority of the studies did never introduce the spatial (geographical) dimension in their analysis.

The statistical and econometric tools are used to detect and treat spatial effects which have been widely developed in the literature by (Anselin, 1980a), (Anselin and Florax 1995), (Anselin and Bera 1998), (LeSage, 1999). (Anselin, 2001a), defines spatial econometrics as the set of techniques that deal with spatial features in statistical analysis of models. The latter also aims to evaluate the effectiveness of the convergence policies through which the State hopes to reduce the disparities between regions and to verify that an economic region will have a positive impact on the economic growth of its neighbours.

The First Law of Geography, according to Waldo Tobler (1979)²⁰, is "everything is related to everything else, but near things are more related than distant things.", Anselin and Griffiths (1988) deal with the nature of spatial effects and distinguish spatial autocorrelation, which refers to the lack of independence between geographical observations (spatial dependence) and spatial heterogeneity that is related to the differentiation of variables and behaviors in space (spatial non-stationarity). Detection of spatial autocorrelation provides additional information relative to traditional statistics (mean, standard deviation), on how the different values are geographically arranged. Among the tools of spatial econometrics, we find the neighborhood matrix²¹, which allows us to describe the neighborhood of a set of supposedly interacting geographical units. It allows

²⁰ The author of the "First Law of Geography"

²¹ It's equivalent in time series analysis 'the lag operator'

us to model these interactions and to describe the relations that link the geographical units for a best estimate.

Methodology of the research: Firstly, the database is composed of (26 indicators) of human capital for the 12 regions and for fourteen successive years. Subsequently,

the CPA is used to reduce the number of indicators by keeping it as close to reality as possible. This method has led to a reduced number of synthetic indicators summarizing as much information as possible contained in the indicators of the departure.

Total Variance Explained^a

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9,190	35,346	35,346	9,190	35,346	35,346
2	6,509	25,035	60,382	6,509	25,035	60,382
3	3,753	14,435	74,817	3,753	14,435	74,817
4	1,829	7,034	81,851	1,829	7,034	81,851
5	1,333	5,126	86,977	1,333	5,126	86,977
6	1,084	4,168	91,144	1,084	4,168	91,144
7	,783	3,013	94,157			
8	,633	2,435	96,592			
9	,546	2,102	98,694			
10	,230	,883	99,577			
11	,110	,423	100,000			
12	2,049E-015	7,882E-015	100,000			
13	9,537E-016	3,668E-015	100,000			
14	8,121E-016	3,123E-015	100,000			
15	4,438E-016	1,707E-015	100,000			
16	2,754E-016	1,059E-015	100,000			
17	1,497E-016	5,758E-016	100,000			
18	1,046E-016	4,022E-016	100,000			
19	2,686E-017	1,033E-016	100,000			
20	-8,719E-018	-3,353E-017	100,000			
21	-2,200E-016	-8,462E-016	100,000			
22	-2,282E-016	-8,777E-016	100,000			
23	-3,561E-016	-1,370E-015	100,000			
24	-5,207E-016	-2,003E-015	100,000			
25	-7,490E-016	-2,881E-015	100,000			
26	-1,060E-015	-4,077E-015	100,000			

Extraction Method: Principal Component Analysis.

a. Only cases for which Years = 2014 are used in the analysis phase.

Component Matrix ^{a,b}			
	Component		
	1	2	3
Population growth rate	-0,689	-0,029	-0,613
Specialization rates - professional formation-	-0,23	0,858	0,31
Specialization rates - Public sector trainees -	-0,156	0,844	0,319
Number of beds per 10000 inhabitants	-0,221	-0,109	0,835
Number de doctors per 10000 inhabitants	-0,059	0,832	0,445
Rate of new business creation	0,251	0,402	-0,7
Poverty rate	0,869	-0,15	-0,233
Vulnerability rate	0,682	-0,099	-0,135
Percentage of female teachers in higher education	0,705	0,68	0,043
Gender parity in primary school enrollment	-0,647	0,254	-0,092
Gender parity in terms of enrollment in secondary education	-0,723	0,563	-0,06
Gender parity in terms of enrollment in college	-0,868	0,474	-0,051
Illiteracy rate	0,947	-0,118	-0,051
Preschool rates	-0,041	-0,499	0,742
Primary schooling	0,946	-0,07	0,152
Secondary school	-0,068	0,6	0,446
Primary completion rate	-0,163	-0,229	0,731
Proportion of science students	0,66	-0,268	0,319
Percentage of enrollment in tertiary education	0,548	0,441	-0,026
Higher education rates (100 students)	0,673	0,666	-0,003
Number of school rooms per 1000 inhabitants	0,305	-0,777	0,474
Overall activity rate	0,016	0,294	0,125
Female participation rate	0,767	0,288	0,02
Female unemployment rate	-0,902	-0,347	0,084
Overall unemployment rate	-0,762	-0,192	0,034
Density population	0,152	0,879	0,213
Extraction Method: Principal Component Analysis.			
a. 6 components extracted.			
b. Only cases for which Years = 2014 are used in the analysis phase.			

Source: Extract of the results of the PCA, By SPSS software

Secondly, it is necessary to take into consideration elements such as proximity, degree of similarity, natural and cultural properties as well as resources mobilized. These elements are supposed to have an impact on the economic growth of the region in question, as they have effects on neighboring regions.

As a result, Ordinary least squares (OLS) was performed without introducing the spatial component. None of the three factors are significant²², and the synthetic indicators of human capital justify the regional growth rate. So many attempts have been made to introduce the spatial component by performing a regression of spatial lag (SAR) and spatial error (SEM) model and see if this can improve our modelling, but the results are the same. The latter reveal the existence of an inconsistency in the development policies adopted by Morocco, knowing that the existence of such coherence will ensure that the trained human capital will be well exploited and will have a short-term return on the economic level of the regions. Indeed, we find that there is no spatial auto-correlation for a neighbouring matrix (k = 2), and failure to account for individual, spatial or temporal effects can have an impact

on our modelling and causing an estimation bias. For this reason, we have moved from spatial analysis on cross-sectional data to spatial analysis on panel data.

The Spatial Panel Data Models estimate show in [1], and Lag spatial model show in [2], The results of the estimation of these models are presented in the following section.

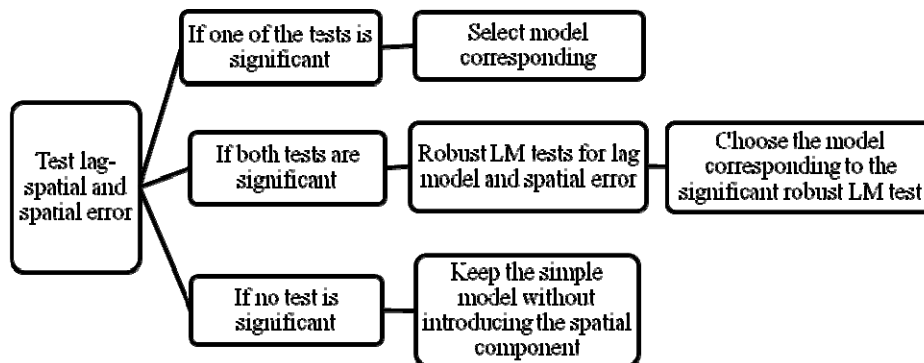
$$PIB/hab_{it} = x_{it}\beta + \mu_i + \eta_t + \varepsilon_{it} \quad [1]$$

$$PIB/hab_{it} = \lambda \sum_{j=1}^N \omega_{ij} PIB/hab_{it} + x_{it}\beta + \mu_i + \eta_t + \varepsilon_{it} \quad [2]$$

With:

PIB/hab_{it} : Is the dependent variable; λ : The parameter of spatial autocorrelation; x_{it} : Is a vector of dimension (1 × K) of the independent variables; β : Is a vector parameter dimension (K×1); ω_{ij} : Is an element of the neighborhood matrix; μ : Represents an individual specific effect (individual effect for i region); η_t : The temporal effect for year t; ε_{it} : The error terms, is distributed N (0,);

The schema of the process selection model is:



Source : Decision model, Anselin (2005)

III. RESULTS AND DISCUSSION ²³ :

Table 1: Estimated models for neighborhood matrix (k = 2)

	MCO	SAR	SEM	Panel model	
				Fixed effects	Lag spatial
Constant	1.9310 [0.9028]	2.9689 [2.1982]	0.5124 [0.6025]	-	-
F1	-0.1717 [1.0451]	0.4690 [0.9318]	1.7123 [0.9113]	-2295.82*** [328.53]	-2.0589*e3*** [3.0134*e2]
F2	0.3630 [0.0459]	-1.0647 [1.6018]	0.3977 [1.6823]	1284.20** [403.06]	1.1880*e3*** [3.5993*e2]
F3	0.2899 [0.0457]	1.2628 [1.6025]	-0.2767 [1.4980]	1072.95** [345.44]	9.9297*e2** [3.0949*e2]
	-	-	-0.6930 '0.1398'	-	-2.0589*e-1* '7.4521*e-2'
Rho	-	-0.1016 '0.7969'	-	-	-

²² None of the synthetic indicators (F1, F2, and F3) of human capital justify the regional growth rate.

²³ Results in this section have been obtained by R and Matlab

Закінчення табл. 1

R^2	0.0368	-	-	0.3327	0.7482
Wald statistic	-	'0.7334'	'0.0019'	-	-
Moran Test	'0.7263'	-	-	-	-
Geary Test	'0.7867'	-	-	-	-
LM Test	'0.0001'	-	-	-	-
LM Robust Test	'0.0000'	-	-	-	-
Test Robuste LM-Lag	'0.0012'	-	-	-	-
Test Robuste LM Error	'0.0013'	-	-	-	-

Legend : * p<0,1; ** p<0,05; *** p<0,01

Note : Estimated models for neighborhood matrix (k = 2), with "p-value" are between '...' and standard Error between [...] and " R^2 " : Measures the quality of the regression.

Source: Elaborated by the authors

The values of the statistics of the two tests (LM_lag_robust and LM_Error) are very significant at the 1% threshold and show that there is indeed a spatial autocorrelation at the level of the (GDP per capita) variable and at the residual level. The results show that the introduction of a component taking into account this autocorrelation is legitimate or even necessary for a better estimate.

However, these results do not provide us with the most suitable model to choose, this is why we will carry out the LM-robust tests for which the results are represented in the table above, according to the results of this test. The two statistics are always significant at the 1% threshold and do not allow us to choose between the lag model and the spatial error model.

To solve this problem, Anselin and Rey (1991) and Florax and Folmer (1992) propose the following decision rule for the choice of the model: "If both tests lead to the rejection of the null hypothesis (H_0 : Spatial autocorrelation) and that the first test of the autoregressive model is more significant than the autocorrelation error test, the autoregressive model is chosen". According to this rule the lag-spatial model with fixed effects and the most suitable one²⁴. For the estimated panel model [1], the results show that the three synthetic indicators of human capital are significant with a threshold of 1% and we have the value of R^2 which is 33.27%. This model accounts for 33% of the GDP/capita variability. Thus, the three explanatory variables are very significant but we have the value of R^2 which is not sufficiently satisfactory. The spatial lag model [2] estimates that, in addition to the synthetic indicators of human capital, the GDP per capita also depends on the spatial component. This is the dependent variable itself that is introduced into the model using the neighboring matrix we have constructed. We note from the results of the estimate that following the introduction of the spatial component, the three synthetic indicators become more significant and the corresponding R^2 is 74.82%. According to the results, we can conclude that the spatial lag model [2] is the one that best adjusts the data and that modeling taking into account spatial autocorrelation is a relevant choice.

The parameter λ of the spatial autocorrelation is significant and it takes a negative sign, indicating that the economic wealth of the neighbors has a reducing impact on that of the region in question, a region that achieves a high level of growth does not exert Of positive spillover effects as expected but rather widens the gap between it and neighboring regions. As a result, regions with significant economic growth tend to improve by absorbing all the opportunities for growth that lend themselves, while

those with lower levels of economic growth are struggling to offset the degrading impacts of high-performing neighbors economically.

Conclusion: Through a spatial econometric analysis, this work enabled us to confirm the existence of a spatial dependence between the 12 regions, whose effects favor inequalities and the persistence of disparities in social and economic infrastructure and Level of schooling and health, and others.

We conclude that the OLS model is inadequate and that the spatial lag model is the one that best adjusts the data, and that taking spatial autocorrelation into account is a relevant choice.

The State must adopt more effective and radical measures to encourage economic activities of a profitable nature in poor regions by equipping its territories with the infrastructure and equipment needed to encourage investors to move more towards these emerging regions instead of the developed regions.

References:

1. Anselin, L., Rey, S. (1991), "Properties of tests for spatial dependence in linear regression models", *Geographical Analysis*, 23, 112-131.
2. Anselin, L., (2001a), "Rao's score test in spatial econometrics", *Journal of Statistical Planning and Inference*, 97, 113-139.
3. Anselin, L. (2001b), "Spatial Econometrics", in: Baltagi B. (ed.), *Companion to Econometrics*, Basil Blackwell, Oxford.
4. Arrow, K. J. (1962). The Economic Implications of Learning by Doing. *The Review of Economic Studies* 29: 155-123. doi: 10.2307/2295952.
5. Aghion, P., Howitt, P. (1998). *Endogenous Growth Theory*. MIT Press, Cambridge MA.
6. Barro, R. J. (1991). Economic growth in a cross-section of countries. *The Quarterly Journal of Economics*, Vol. CVI, 2, pp. 407-443.
7. Baumont, C., Ertur, C., Le Gallo, J. (2002), "Estimation des effets de proximité dans le processus de convergence régionale : une approche par l'économétrie spatiale sur 92 régions européennes (1980-1995)", *Revue d'Economie Régionale et Urbaine*, 2.
8. Cliff, A.D., Ord, J.K. (1981), "Spatial Processes: models and applications", Pion, Londres.
9. Cheshire, P., Margini, S. (2000). Endogenous processes in European regional growth: convergence and policy. *Growth and Change* 31, pp. 455-479.
10. Di Liberto, A. (2008). Education and Italian regional development. *Economics of Education Review* 27, pp. 94-107.
11. Elhorst, J. P. (2014). *Spatial econometrics from cross-sectional data to spatial panels*. New York: Springer.
12. Ertur, C., Le Gallo, J. (2002), "An exploratory spatial data analysis of European regional disparities, 1980-1995", in: Fingleton B. (ed.), *European Regional Growth*, Springer, Berlin.
13. Fischer, M. M. (2011). A spatial mankiw-romer-weil model: theory and evidence. *Annals of Regional Science*, 47, 419-436.
14. Fingleton, B. (2009). Spatial autoregression. *Geographical Analysis* 41 (4), 385-391
15. Floch, J.M. (2012) Détection des disparités socio-économiques : l'apport de la statistique spatiale, Document de travail INSEE H2012/04.
16. Floch, J.M., et Le Saout R. (2016) *Econométrie spatiale : une introduction pratique*, Document de travail INSEE.
17. Florax, R.J.G.M. & Nijkamp, P. (2003), "Misspecification in linear spatial regression models", Tinbergen Institute Discussion Papers 03-081/3, Tinbergen Institute.

²⁴ I conduct a Hausman test to choose between fixed effect or random effect, the hausman test rejected the null hypothesis, The test is very significant p-value=0000

18. Le Gallo, J. (2002), "Disparités géographiques et convergence des régions européennes : une approche par l'économétrie spatiale", Thèse de doctorat, LATEC, Université de Bourgogne.

19. LeSage, J.P., Pace, R.K. (2009), Introduction to Spatial Econometrics. Taylor & Francis, Boca Raton.

20. Nelson, R., Phelps, E., 1966. Investment in humans, technological diffusion, and economic growth. American Economic Review: Papers and Proceedings 51 (2), 69–75.

21. Rey, S.J., Montouri, B.D. (1999), "U.S. regional income convergence: a spatial econometric perspective", Regional Studies, 33, 145-156.

22. R Development Core Team, (2013), A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria, ISBN: 3-900051-07-0.

23. Temple, J. (1999), "The new growth evidence", Journal of Economic Literature, 37, 112-156.

24. Uzawa, H. (1965). Optimum Technical Change in An Aggregative Model of Economic Growth. International Economic Review 6: 18–31.

Надійшла до редколегії 15.07.17

Кораїш Аль Магді, асп., учасник дослідницької групи з питань економіки, фінансів і розвитку

Університет Абдельмалек Ессаїді Танжир, Марокко,

Хамзауї Мустафа, Професор економіки і фінансів, Голова дослідницької групи з питань економіки, фінансів і розвитку

Університету Абдельмалек Ессаїді Танжир, Марокко

ЕВОЛЮЦІЯ СУБ'ЄКТИВНОГО ПІДХОДУ ДО ОПТИМІЗАЦІЇ МІЖНАРОДНИХ ІНВЕСТИЦІЙНИХ ПОРТФЕЛІВ

У статті розглядається вплив людського капіталу на регіональне зростання у Марокко у період 2000-2014 рр., а також визначаються зв'язки, які поєднують між собою марокканські регіони. Автор досліджує роль сусідського ефекту у зростанні регіонів, використовуючи економетричні підходи.

Отримані результати просторового аналізу доводять, що ВВП на душу населення різняться від одного регіону до іншого, присутня сильна гетерогенність, яка характеризує марокканські регіони, так само як і міжрегіональні економічні диспропорції, коли національний добробут концентрується в одних регіонах за рахунок інших.

Ключові слова: Марокко, регіони, людський капітал, регіональне зростання, просторова економетрика

Кораиш Аль Магди, асп., участник исследовательской группы в вопросах экономики, финансов и развития

Университет Абдельмалек Ессаиди Танжир, Марокко,

Хамзауи Мустафа, профессор экономики и финансов, Глава исследовательской группы в вопросах экономики, финансов и развития

Университет Абдельмалек Ессаиди Танжир, Марокко

ЭВОЛЮЦИЯ СУБЪЕКТИВНОГО ПОДХОДА К ОПТИМИЗАЦИИ МЕЖДУНАРОДНЫХ ИНВЕСТИЦИОННЫХ ПОРТФЕЛІВ

В статье рассматривается влияние человеческого капитала на региональное развитие в Марокко в период 2000-2014 гг., а так же определяются связи, которые объединяют между собой марокканские регионы, используя эконометрические подходы.

Полученные результаты пространственного анализа показывают, что ВВП на душу населения отличается от одного региона к другому, так же присутствует сильная гетерогенность, которая характеризует марокканские регионы. В то же время наблюдаются сильные межрегиональные экономические диспропорции, когда национальный доход концентрируется в одних регионах за счет других.

Ключевые слова: Марокко, регионы, человеческий капитал, региональное развитие, пространственная эконометрика.