

Regions efficiency and Spatial Disparities: Case study from Algerian regions

Mokhtar IDRISSE

Ph.D. candidate student
Aboubekr belkaid University -Tlemcen
idrissimokhtar@gmail.com

Youcef SOUAR

Professor of economics
Dr.moulay Tahar University -Saida
syoucef12@yahoo.fr

Receive date: 2017-10-14 ,Accepted date: 2018-07-09 & Publication date:2018-08-18

Abstract :

The aims of this paper is to evaluate Algerian region's efficiency through the use of one of econometrics methods specialized to evaluate efficiency, which leads to evaluate the work and efforts of local governments to enhance economic growth of regions and improve the economic and social development indicators. The paper studies the efficiency of Algerian regions through a group of indicators like input and output, which indicate the level of health and education services in each region. by using the DEA method especially the output-oriented model for regions efficiency evaluation.

The main results that have been obtained by this study and through the selected sample show that some regions are efficient either technical efficiency or scale efficiency .some regions did not achieve efficiency neither technical nor scale efficiency. According to CCR model the average of technical efficiency reached to 83.9%. while for the BCC Model the scale efficiency reached to 94.7%. This result reflects the existing of disparity between Algerian regions which urges that local governments reduces them.

Keywords: spatial disparity ,regional efficiency, economic development.

Jel Classification Codes : R11, R15, R58

Corresponding Author.: Mokhtar IDRISSE . idrissimokhtar@gmail.com

Introduction :

One of the economic development problems in modern economies is the growing of disparities and spatial variations in development levels, which is becoming a feature of developed countries as well as countries that didn't achieve growth and economic development .particularly in infrastructure .Because they directly affect people's lives and their decent living States cannot control geographical disparities (regional or spatial) among regions ,but it can balanced the levels of economic and social development through effective policies of reallocation and redistribution of resources.

Algeria started to expand its infrastructure projects from 1999Across all regions and cities .As part of its economic public investment expansion policy In order to ensure equitable distribution of infrastructure and public services among regions , also to achieve a global and balanced economic development at the macroeconomic level .In addition. Algerian government has done a lot of economic and political policies to encourage and improve the investment climate through the creation of many institutions to promote more investment whether local or foreign indirect investment.

What Algeria has spent over the past years through a massive program of investment may provide opportunities for many regions to improve their level of development Which will inevitably allow the rehabilitation of the regions and help to the diversity of Algerian economy For example It has been financing the investment projects in 2005 with an amount of 100 billion dollars. To 286 billion dollars in public investment program of 2010-2014(Abdurrahman Mebtoul.2016) .These amounts indicate the volume of spending on rehabilitating the national economy especially to reinforce the infrastructure across regions. But the question that can be raised here is :Does this huge public infrastructure investment stimulate the economic growth of regions?. Several studies show that public investment have not only a positive impact but it is possible to have negative impacts Also There is a difference of this impact between long term and short term.

Despite all these effort of Algerian government through the huge public investment spending. The performance of the Algerian economy remains weak particularly in the current word economic crisis, which showed that there is a major challenge to the independence of the national economy from oil markets and natural resources dependency.

Based on this critical situation in the Algerian economy, we can formulate the research problem of this article by rising the following question: **what is the level of efficiency of Algerian regions and how can we explain differences in efficiency between regions?**

1-Literature Review

The aim of this section is to illustrate important results from several studies about Efficiency region's at the spatial dimension of development politics and their impact on the spatial disparities between regions, in first there are some studies that evaluate the efficiency of local government spending and some them have evaluated the efficiency through the production of locale government regions .among these studies we can mention the following studies below.

Charnes et al.(1989) studied the economic performance of 28 China's cities in 1983 and 1984.by using DEA method to investigate the performance and

efficiency of china's regions through the use of inputs and outputs which proved an effective method in determining the economies of scale for the regions production . Heikki A.Loikkanen (2001.2002) This paper studied the efficiency of 83 Finnish regions during 1988-1999 on labour market area by using DEA and Tobit model the results of this study indicate that efficient regions are located in the south and the inefficient one are located in the periphery and they are characterized by their weak economic development level and they are small regions.

A.Afonso, Sonia Fernandes (2006): in this study the researcher analyses the expenditure efficiency of local government in Lisbon Region by using non-parametric technique it calls (Free Disposal Hull) in order to measure efficiency in municipalities expenditure. The results of this research suggest that some municipalities (RLVT municipalities) can be preferment without increase in local spending .this results show that some municipal expenditure is not necessary.

Corrado lo Storto (2012) in this study the Author researchs to investigate economic scale thought calculating of technical efficiency across major Italian municipalities. The results show that municipalities can be efficient not only by the scale But through its managerial capability and also by its services provided Whether small or large municipalities.

Giedrė Dzemydaitė & al (2013) evaluated the regional disparities through analyzing regional infrastructure, human capital efficiency, and linkages among Lithuanian regions. This study finds out that to improve efficiency of regions and their growth rate ,it is recommended to invest in indirect factors .in the other hand and for the inefficient regions,it is recommended to make more direct interventions related with investment in economic activities because current investments give insufficient returns in the inefficient Lithuanian regions .

Michaela.Stanickova(2014) analyzed the level of efficiency achieved in individual regions .this study focused on the competitiveness by using of DEA method. Which helped regions achieve perfect competitiveness and maintain its level of development through using inputs to produce perfectly outputs.

Lamia Mokaddem(2014,2015) studied the efficiency among Tunisian regions by using DEA and tobit model ,the study argued that spatial efficiency of Tunisian regions is explained by spatial factors and There is also a disparity between regions in Tunisia in term of efficiency .

2-Theoretical framework of Regional efficiency:

The spatial development and efficiency of regions depends on the organization of most economic activities in the space and effective allocation of resources in order to reduce disparity at the spatial or national level. It has become imposed to develop planning strategies at the regional and spatial level in order to exploit the Potential and local resources .in other hand to make regions more productive and more competitive.

Blakely (1994) defines regional development as a process that local government and local organization participate or engage to stimulate and promote employment and business activity in each region in order to sustain development and the main goal of local economic development is to enhance growth in major sectors that improve the community, by using potential (natural and human institutional) local resources.(Robert J. Stimson& all ,2002).

In recent years. Many interests are focus on the subject of spatial and regional disparities among regions, which have been considered as reasons for the hindrance

of development paths in several countries. Which forced countries to focus on the regional and local politics in order to facilitate life and provision of basic human needs in each area. In contrast, the traditional vision that seek to improve the global purely economic indicators (e.g. growth rate ,global employment rate...etc.).The following table indicates some comparison between traditional development policies and local and regional development.

Table01:Comparison between traditional development policies and local and regional development.

Traditionnel développement policiers	Local and regional development
1-Top-down approach in which decisions about the areas where intervention is needed are taken in the national Centre 2-Managed by the national central administration 3-Sectoral approach to development 4-Development of large industrial projects that will foster other economic activity, 5-Financial support, incentives and subsidies as the main factor of attraction of economic activity	1-Promotion of development in all territories with the initiative often coming from below 2-Decentralized,verticalcooperation between different tiers of government and horizontal cooperation between public and private bodies 3-Territorial approach to development (locality, milieu) 4-Use of the development potential of each area, in order to stimulate a progressive adjustment of the local economic system to the changing economic environment 5-Provision of key conditions for the development of economic activity

Source: Andy Pike, Andrés Rodríguez-Poseand John Tomaney,(2006), " Local and Regional Development" ,published by Routledge 270 Madison Ave, New York, NY 10016, p17

Algeria has made great efforts in order to achieve the Millennium Development Goals through the improving of social indicators at all levels and in all regions in order to balance the levels of development among regions. In terms of health, the statistics indicate that the per capita expenditure on health care(current US \$) in Algeria has moved from 54 \$ in 1995 to 362\$ in 2014 ,we observe also the surged of the indicator of life expectancy at birth from 71 years in 2000 to over 75.5 years in 2009. In education the value of literacy rate for Algeria during the period from 1987 to2006 moved from 49.63 percent in 1987 to 72.65 percent in 2006(the global economy,2014). Also with regard to the preprimary school enrollment For That indicator has reached to 79.21%.for the indicator of the enrolment rate for children under 6 years was recorded with rising to almost 97.96% in 2009 from 43% in 1966(DIALOGUE NOTE2011.)Despite all this improvement in these indicators ,They did not reach the level of international classifications in health and education systems .In the infrastructure sector ,the government spent as part of its efforts to enhance economic growth and provide the regions with modern public services(education ,health, agriculture, Industries , Transport, energy, information and communication technology) .The government has been working to distribute these infrastructure investments through all regions and here,the role of local governments is very important to benefit from the execution and implementation of this investments program in order to diversify the economic structure and make also regions without large rate of inequality and disparities.

3- Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is a mathematical programming technique that has found a number of practical applications for measuring the efficiency of similar units, such as a set of hospitals, a set of schools, a set of banks, a set of regions. It's called DMUs (Decision-Making Unit). Therefore, DEA aims to measure how efficiently a DMU uses the resources (input) available to generate a set of outputs. It was developed by Charnes et al. (1978) (CCR model hereafter), DEA is based on the production. It was applied to compute efficiency. This term was first addressed by Farrell (1957) on the seminal article in order to develop a comparative measure for production efficiency. Therefore, we consider it important to define some key terms of this approach:

DMU (decision-making unit): it means in the DEA approach the entity whose transforming inputs into outputs and whose performances are to be evaluated. It can be a set of banks, a set of firms, a set of hospitals, a set of schools, regions...ect.

Pareto-Koopmans Defines Efficiency as The performance of a DMU is efficient if and only if it is not possible to improve any input or output without worsening any other input or output.

TE (technical efficiency): is measured as the ratio between the observed output and the maximum output, under the assumption of fixed input, or, alternatively, as the ratio between the observed input and the minimum input under the assumption of fixed output. In the literature, there are two main definitions of technical efficiency. (Francesco Porcelli, 2009)

AE (allocative efficiency): allocative (or price) efficiency refers to the ability to combine inputs and outputs in optimal proportions in the light of prevailing prices, and is measured in terms of behavioral goal of the production unit like, for example, observed vs. optimum cost or observed profit vs. optimum profit. (Francesco Porcelli, 2009)

EE (economics (total) efficiency): is the product of technical and allocative efficiency (overall efficiency). It can be interpreted as the potential reduction in production costs (cost efficiency) or the potential increase in revenue (revenue efficiency) that a farm could apply in order to operate at the point of technical and allocative efficiency. Economic efficiency enables conclusions to be drawn on whether the farm operates at optimal or suboptimal size.

ER (scale efficiency): A unit is said to be scale efficient when its size of operations is optimal so that any modifications on its size will render the unit less efficient. The value for scale efficiency is obtained by dividing the aggregate efficiency by the technical efficiency. Scale efficiency can be obtained by the residual between efficiency under constant returns and efficiency under variable returns to scale (Luca Cesaro & al, 2009).

3-1-DEA Models: CCR ratio model (Charnes, Cooper and Rhodes, 1978)

This model of DEA supposes that there are n DMUs: DMU_1 , DMU_2 , and DMU_n , with common input and output items (m input, s output) for each DMUs, the efficiency of each DMUs is obtained by solving the following fractional programming problem to obtain values for the input "weights" and the output "weights" as variables for the CCR model :

$$\begin{aligned}
 & \text{Max}_{u,v} \quad \theta = \frac{\sum_{s=1}^t u_s y_{sj0}}{\sum_{i=1}^m v_m x_{mj0}} \\
 & \text{subject to} \quad \frac{\sum_{s=1}^t u_s y_{sj0}}{\sum_{i=1}^m v_m x_{mj0}} \leq 1 \quad \text{for } j = 1; \dots \dots n \\
 & \quad \quad \quad u_s v_m \geq 0 \quad \text{for } s \text{ and } m
 \end{aligned}$$

u_s : Weights given to the output s , v_m : weights given to the input

y_{sj} : Amount of output s produced by the DMU $_j$

x_{mj} : Amount of input m produced by the DMU $_j$

The objective of this mathematical formulation of linear programming is to find weights $u_s v_m$ that maximize the cited above with the constraints of the ratio of “virtual output” vs. “virtual input” should not exceed 1 for every DMU. after convert the above formulation to a linear programming formulation for easier solution. in order to determine the score efficiency A DMU is efficient at CCR model if and only if $\theta = 1$. and all optimum slack values are zero (Lawrence M. Seiford, 1999). After the evaluating of efficiency scores we can be identified the causes of inefficiency DMU. An inefficient DMU can be made more efficient by projection onto the frontier. In an input orientation, one improves efficiency through proportional reduction of inputs, whereas an output orientation requires proportional augmentation of outputs (WILLIAM W. COOPER & al, 2002)

3-2-BCC model (Banker, Charnes and Cooper, 1984).

The BCC model of DEA suppose that there are n DMUs: DMU $_1$, DMU $_2$, and DMU $_n$. produce the same s output (s output) for each DMUs and using the input m , the efficiency of each DMUs is obtained by solving the following fractional programming problem to obtain values for the input “weights” and the output “weights” as variables for the CCR model :

$$\begin{aligned}
 & \max Z = \frac{\sum_{s=1}^s u_s y_{s0}}{\sum_{r=1}^m v_r x_{r0}} - u_0 \\
 & \text{subject to} \quad \sum_{s=1}^s u_s y_{sj} - \sum_{i=1}^m v_m x_{mj} - u_0 \leq 0 \quad \text{for } j = 1; \dots \dots n \\
 & \quad \quad \quad v_m x_{m0} = 1 \\
 & \quad \quad \quad u_s \geq \varepsilon, \quad v_m \geq \varepsilon, \quad u_0 \text{ free in sign} \\
 & \quad \quad \quad x_{mj}, y_{sj} \geq 0 \quad \forall s, m
 \end{aligned}$$

u_s : Weights given to the output s , v_m : weights given to the input

y_{sj} : Amount of output s produced by the DMU $_j$

x_{mj} : Amount of input m produced by the DMU $_j$

Z : the optimal efficiency score, ε : infinitesimal constant u : dual variable

Is DMUs efficient if and only if $\theta = 1$. and all optimum slack values are zero (Lawrence M. Seiford, 1999)

4-Data

The empirical application carried out in this paper is based on data which was prepared by the Algerian National Statistical Office (ONS) 2013. It is about 28 Algerian cities from different regions and the variables that we have used to study regional efficiency and disparities like input and output variables are:

Input indicators: In this paper, we use some indicator as input (Number of teachers, Number of school, safe water (Liters / day / capita), Number of doctors).

Output indicators: We use as output indicator the following variables (Number of hospital days, Number of bachelor literacy rate).

5-Methodology:

The Objective of studying efficiency of Algerian region's is an endeavor to how region's used their economic and social resources to achieve a certain level of development. We applied output-oriented DEA model under CRS and VRS Model. It was based on the empirical literature review especially the study of LAMIA MOKADDEM (2015).

According to the relationship between input and output, Pearson correlation analysis indicate that there are a positive significant correlation between inputs and outputs used in this study.

6-Results and discussions:

From the application of DEA through the CCR and the BCC Output Oriented Model, the main results (**Table 01**) Show that the mean of technical efficiency of Algerian regions is 83.9% over the study period. This results indicate that there are some regions that have not been explored, only 8 are totally efficient from 28 region by a proportion of 28.57%. These cities are (Laghouat, Blida, Alger, Djelfa, Mostaganem, Ouargla, Bordj Bou Arreridj, Tipaza). We can see also that the efficiency regions is between lowest efficiency score 42.3% (Biskra) to the highest score 99.9% (Ghardaïa). There are 19 cities have efficiency score between 60.3% to 99.9% by a proportion of 67.85%. This results indicate that the major of regions have medium efficiency, which indicates that they do not use their resources effectively when we compared with other region which have achieved the total efficiency. But at overall this results indicate The Government's interest in improving the development situation at the level of all cities, but the lack of efficiency remains either spatial factors controlling inefficiency or other factors impeding the use of resources.

The same results for the BCC output oriented model. We find that 12 region from 28 are totally efficient by a proportion of 42.85% and these cities are (Laghouat, Blida, Alger, Djelfa, Mostaganem, Ouargla, Bordj Bou Arreridj, Tipaza) as for the regions that did not achieve the total technical efficiency (Bejaia, Sidi Belabbes, Ghardaïa, Oran) which means that there is a need to improve output through the oriented VRS model.

The results indicated in (**Table 01**) Show that the average of pure technical efficiency of Algerian regions is 94.7% over the study period. This results indicate that there are some regions that have not explored their optimal resources. This means that the resources used could be reduced by 5.3% for the same level of production.

We observe also that the average of scale efficiency between Algerian cities is 88.2%. As well, cities that have a full scale efficiency according to BCC model is 8

cities with a proportion of 28.57% (Laghouat, Blida, Alger ,Djelfa ,Mostaganem , Ouargla ,Bordj Bou Arreridj ,Tipaza) .also there are 20 city that did not achieve the scale efficiency by a proportion 71.42% and .15% of this proportion which operate under the increasing scale efficiency model and 85 % Which operate under the decreasing scale efficiency model(drs) .

what we observed here that efficiency is not confined to a certain part of the north or south, or west or east But there are regions that have achieved efficiency from the East, the West and the North As indicated by the results Which reflect the efforts made by the government and local decision makers to achieve certain level of development of regions and reduce disparities and spatial inequality between regions. But it remains that Poor management of resources is the main reason for not achieving the efficiency by region (in-efficiency).

Finally ,this results indicate that there are disparities between Algerian regions. Which obliged the decision makers and the local government to enhance the growth of development indicators and reinforce regional and spatial strategies to reduce inequality especially in education and health because there are the sources of income and any kinds of development.

Table 02: The efficiency score of Algerian regions by O-CCR and O-BCC models

	TE- CRS	CRS-TE	VRS-TE	SCALE	
1	0.760	0.760	0.901	0.843	drs
2	1.000	1.000	1	1	-
3	0.999	0.999	1.000	0.999	irs
4	0.423	0.423	0.870	0.486	drs
5	1.000	1.000	1.000	1.000	-
6	0.911	0.911	0.987	0.923	irs
7	1.000	1.000	1.000	1.000	-
8	1.000	1.000	1.000	1.000	-
9	0.658	0.658	0.931	0.706	drs
10	0.743	0.743	0.897	0.828	drs
11	0.758	0.758	0.835	0.908	drs
12	0.622	0.622	0.915	0.680	drs
13	0.883	0.883	1.000	0.883	drs
14	0.642	0.642	0.993	0.647	drs
15	0.903	0.903	0.955	0.945	drs
16	1.000	1.000	1.000	1.000	-
17	0.603	0.603	0.853	0.706	drs
18	0.712	0.712	0.882	0.808	drs
19	1.000	1.000	1.000	1.000	-
20	1.000	1.000	1.000	1.000	-
21	0.859	0.859	0.863	0.995	irs
22	1.000	1.000	1.000	1.000	-
23	0.832	0.832	0.948	0.877	drs
24	0.826	0.826	0.918	0.899	drs
25	0.990	0.990	1.000	0.990	drs
26	0.779	0.779	0.844	0.922	drs
27	0.654	0.654	0.912	0.717	drs

28	0.939	0.939	1.000	0.939	drs
mean	0.839	0.839	0.947	0.882	

Source: Author's estimates from DEAP Version 2.1 software outputs results.

Conclusion:

Nowadays it is time more than ever that economic policy takes into account the regional and spatial dimension in development strategies especially in the Algerian context. The DEA models applied in order to evaluate the region's performance. This technic can be applied in different fields of economic disciplinary which can evaluate the efficiency of activities and works of decision makers.

The general conclusion of studding regional efficiency is to evaluate regional and local government working to promote economic and human development indicators With an attempt to reduce disparities among regions Especially the basic needs such as education and health. So it must be upgraded with the greatest possible attention and development.

The final conclusion attained through analysis of efficiency at the Algerian regions indicate that some regions attained the objective goals of their economic and social strategies while others did not .it means that the lack of efficiency is linked to local government activities and not to the central government strategies .Thus The focus of interest must be put on local spheres (regions).it means that local government are required to manage their resources with efficient allocation in order to create economic activities which will contribute to create employments , competition between regions and interaction between them.

What can be observed about Algerian regions is the unavailability of regional or spatial data that reflects the participation of each region in national productivity for example GDP/regions or GDP per capita/ region, Which makes it difficult to study economic phenomena at the spatial level as well as the inability of researchers to identify the sources of spatial disparities .Good development is the spatially good development (world Banque Report),2009.

References :

abderrahmane Mebtoul,(2016) «L'expérience algérienne de la dépense publique 2000/2015 et la théorie de Keynes»: consulter le <http://www.maghrebemergent.com/economie/algerie/55212-l-experience-algerienne-de-la-dépense-publique-2000-2015-et-la-theorie-de-keynes-contribution.html>.(consulter le 05/09/2017)

AbrahamCharnesWilliam W.CooperShanling Li,(1989), « Using data envelopment analysis to evaluate efficiency in the economic performance of Chinese cities » ,Socio-Economic Planning Sciences,Vol. 23,, n° 6, p 325-344

Loikkanen Heikki A, Susiluoto Ilkka, (2002), «An evaluation of economic efficiency of finnish regions by DEA and Tobit models», 42nd Congress of the European Regional Science Dortmund, Germany,p1-21

Afonso A. and Fernandes S. (2006), «Measuring local government spending efficiency: evidence for the Lisbon region», Regional Studies, vol.40, p.39–53.

Corrado lo Storto. (2013). «Evaluating Technical Efficiency of Italian Major Municipalities: a Data Envelopment Analysis model», Social and Behavioral Sciences vol. 81, p 346 – 350

Giedrė Dzemydaitė, Birutė Galinienė.(2013), «Evaluation of regional efficiency disparities by efficient frontier analysis», EKONOMIKA Vol. 92, n° 4, p..21-36

Michaela. Stanickova ,(2014), «Measuring the efficiency of EU13 NUTS 2 Regions based on RCI Approach» .XVII Mezinárodní kolokviumo regionálních vědách,Hustopeče Ostrava, Czech Republic p76-84

- Lamia Mokaddem**,(2014) ,«Evaluation of Tunisian regions efficiency using DEA and TOBIT models», Working Paper 862,<http://erf.org.eg/wp-content/uploads/2015/12/862.pdf>, (consulté le 20 aout 2017).
- Stimson, Robert J., Stough, Roger R., Roberts, Brian H.**, (2002), Regional Economic Development Analysis and Planning Strategy. Springer-Verlag Berlin Heidelberg New York.
- Andy Pike, Andrés Rodríguez-Pose and John Tomaney**. (2006), Local and Regional Development , published by Routledge 270 Madison Ave, New York, NY 10016.
- African development bank group**,(2011) ,«Algeria-country DIALOGUE NOTE 2011-2012», :<https://www.afdb.org>. (consulté le 02 septembre 2017).
- Francesco Porcelli**, (2009), «Measurement of Technical Efficiency. A brief survey on parametric and non-parametric techniques»
http://www.warwick.ac.uk/fac/soc/economics/staff/phd_students/porcelli/porcelli_dea_sfm.pdf. (consulté le 22 aout 2017)
- Luca Cesaro Sonia Marongiu ,Filippo Arfini ,Michele Donati, Maria Giacinta Capelli**,(2009) , «Methodology for analyzing competitiveness, efficiency and economy of scale. Use and applications of DEA», FACEPA Deliverable No. D5.1.3, p.1-42
http://facepa.slu.se/documents/Deliverable_D5-1-3_CUB.pdf (consulté le 04 juin 2017)
- Lawrence M. Seiford & Joe Zhu**,(1999), «An investigation of returns to scale in data envelopment Analysis», Omega, Int. J. Mgmt. Sci. vol. 27, p.1-11
- William W. Cooper ,Lawrence M. Seiford, Kaoru Tone**,(2002) ,Data envelopment analysis :A Comprehensive Text with Models ,Applications, References and DEA-Solver Software Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow.
Website : http://www.theglobaleconomy.com/Algeria/Health_spending_as_percent_of_GDP/ .(consulté 22 aout 2017).

List of tables

Number	Title of the table	page
Table 01	Comparison between traditional development policies and local and regional development	
Table 02	The efficiency score of Algerian regions by O-CCR and O-BCC models	