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Abstract

This paper examines the economic forces that explain regional growth in Algeria in the period 1998-2005. Since the beginning of structural reforms in the early 1980s, the Algerian economy has experienced a transition from a soviet-kind planned economy to a market economy. Furthermore, from 1990 to 2000, Algeria experienced many political and economic troubles and was even forced by the IMF to follow a structural adjustment program between 1994 and 1998. This paper studies the relation between industrial employment growth per capita in 48 Algerian regions and the geographical location of those regions in terms of immediate neighborhood. Our results demonstrate that there is no convergence process between the Algerian regions. In other words, "rich" Algerian regions stay rich whereas relatively poor regions stay poor. In that vein, the significance of the spatial dependence coefficient may reveal that there are convergence clubs in Algeria. Growth dynamics in Algeria are not equitably distributed.

ملخص

تبحث هذه الورقة في القوى الاقتصادية التي تفسر حالة النمو الإقليمي في الجزائر خلال الفترة من العام 1998 حتى العام 2005. فمنذ بداية حملة الإصلاحات الهيكلية في مطلع الثمانينات من القرن الماضي، مر الاقتصاد الجزائري بمرحلة انتقال من نمط الاقتصاد السائر على الطراز السوفييتي إلي نمط اقتصاد السوق. علاوةً على ذلك، واجهت الجزائر العديد من الأزمات السياسية والاقتصادية بين الأعوام 1990 و2000 وأجبرها صندوق النقد الدولي على إتباع برنامج توفيق الأوضاع الهيكلية بين الأعوام 1994 و1998. وتدرس هذه الورقة العلاقة بين معدل النمو للفرد في التوظيف بالقطاع الصناعي في 48 منطقة جزائرية والموقع الجغرافي لهذه المناطق فيما يتعلق بالجوار المباشر. وتبين النتائج التي خلصنا إليها عدم وجود نقاط التقاء بين مختلف المناطق الجزائرية. وبعبارة أخرى، ظلت المناطق الجزائرية الغنية على غناها، كما ظلت المناطق الفقيرة نسبياً على فقرها. ومن هذا القبيل، فإن أهمية معامل الاعتماد المكاني قد يكشف النقاب عن وجود نوادٍ للالتقاء في الجزائر. وتفتقر ديناميكيات النمو في الجزائر إلي عدالة التوزيع.

Introduction

The article examines the economic forces that explain regional growth in Algeria in the period 1998-2005. Since the beginning of structural reforms at the beginning of the eighties, the Algerian economy has experienced a transition from a soviet-type planned economy to a market economy (Zouache and Ilmane, 2009). Furthermore, from 1990 to 2000, Algeria experienced many political and economic problems and was even forced by the IMF to follow a structural adjustment program between 1994 and 1998. Algeria suffered from two restructuring plans: The Macroeconomic Stabilization Program between 04/1994 and 03/1995 and The Structural Adjustment Program from 04/1995 to 04/1998. In fact, Algeria is not included in the group of economies in transition that includes Central and Eastern European transition economies, the Baltic States and the Commonwealth of Independent States (the United Nations World Economic Survey). Nevertheless, economic studies from the international institutions consider Algeria to be facing a number of challenges, especially with regards to achieving the transition to a market economy (IMF, 2006) in order to guarantee lasting growth (African Economic Outlook, OECD, 2006).

This transition period in Algeria, and the increase in private investments that it has induced, has been followed by the development of the Algerian regions, the *wilayats* that correspond to administrative territories. The first regional observations highlight a regional heterogeneity—notably in terms of employment per capita and of firm creations. In some areas, regional employment growth is significant whereas other regions suffer from a weak activity. Consequently, the paper studies the relation between industrial employment growth per capita in 48 Algerian regions and the geographical location of those regions in terms of immediate neighborhood.

Our approach is in line with Glaeser, Kallal, Scheinkman and Shleifer (1992), Henderson, Kuncoro and Tuner (1995) and Rappaport (1999). Glaser et al. (1992) highlighted the impact of the local industrial structure and of the induced technological externalities on employment growth. Henderson et al. (1995) found a strong convergence speed in local industrial employment from a specification—close to Barro and Sala-i-Martin (1991)—conditioned by the historical and current characteristics of local markets. Rappaport (1999) suggested that the variable population density offered a better natural metric to capture regional variations in productivity and life quality. Rappaport and Sachs (1999) explained the correlation between population density and proximity to the coast by the combined effect of productivity and quality of life. Those characteristics positively contribute to household utility (productivity through wage increases). Several studies, including Barro and Sala-i-Martin (1999), found a better convergence between regions than between states. According to Glaeser et al. (1995), examining regional convergence presents two advantages. Firstly, regions are open economies. There are no barriers to capital, labor and ideas mobility. Regions are economic units more specialized than states—making it more sensible to study regional rather than states convergence. Secondly, new growth theory insists on the diffusion of ideas. Glaeser et al. (1992) find strong evidence on the impact of technological externalities on the growth of regions in a country.

The paper is organized as follows. The second section gives the theoretical framework. The third section presents the econometric model. It explains why the choice of an appropriate spatial specification has an influence on the interpretation of the growth process in a developing country. Section four concludes.

The Framework

The framework is inspired by Glaeser et al. (1992, 1995) and Henderson et al. (1995). We assume a simple production function. Regions are considered as separated economies composed of the same capital and labor market area. In other words, labor and capital markets are perfectly integrated. Thus, regional GDP growth divergences cannot come from saving rates differences or from the difference in the exogenous endowment of resources. Because of the assumption of perfect labor and capital mobility, regions can only diverge relatively to the productivity level and life quality.

The production function in a region *i* at a period *t* is:

$$Y_{it} = A_{it} f(l_{it}) = A_{it} l_{it}^{1-\alpha} \qquad (1)$$

$$0 \prec \alpha \prec 1$$

$$i = \overline{1,48}$$

$$t = \{1998, 2005\}$$

A_{it} represents the productivity level in the *i* region at time *t*. According to Glaeser et al. (1995), *A* is interpreted in a manner that social, technological and political forces acting at the regional level determine total productivity. Explanatory variables integrated in the model are considered as affecting A_{it} seen as the efficient level or the effective level of technological growth (Henderson, 2000). α is a parameter of national production. It is not specific to a region but affects all regions. The choice of this production function should be justified, especially with regards to the presence of a single factor.

The lack of accurate data on regional GDP implies that we cannot directly estimate the production function. To resolve this issue, we use the method developed in Glaeser et al. (1992) and Henderson et al. (1995) who study urban growth through employment growth. The basic idea of this approach is that agglomeration economies improve productivity and cause a faster growth in productive regions. Following Rosenthal and Strange (2004), this approach allows us to indirectly evaluate Algerian regional dynamics through the study of employment growth per region. The main advantage is that data on regional employment growth is available in Algeria. Furthermore, the data is in accordance with a linear specification.

Nevertheless, the *a priori* choice of the employment level is conditioned on the level and the kind of capital existing in the region. The choice of a sufficient period allowing significant variation in employment lowers the effect of regional fixed factors and strengthens the influence of dynamics induced by changes in the initial structure of investment and capital. The simultaneity between the employment growth effect and the regional employment structure effect may cause an endogeneity problem in the model specification. Indeed, employment growth in a region is sensitive to the regional composition of employment (agglomeration effect). In the same time it affects the level and the composition of employment. To take care of this problem, and following Glaeser et al. (1992) and Henderson et al. (1995), the method adopted in this paper is to take as regressors regional variables' delayed relatively to the initial period. According to Glaeser (2000), Rappaport (1999) demonstrates that, when one examines adjustment dynamics resulting from specific regional shocks, working with the variable employment leads to similar results than using either the wage variable or the income variable. Glaeser et al. (1995) and Rappaport (1999) show that income growth and population growth evolve in the same direction. Moreover, the population variable is usually very close to the employment variable (Glaeser et al., 2000).

To consider a single input in this production function means that we cannot capture technological innovations induced by an additional physical capital accumulation. In each region, the technological level, prices and wages are supposed to be perfectly known. If we assume the equilibrium condition, the maximization of the profit function is given by:

$$A_{it} f(l_{it}) - w_{it} l_{it} \qquad (2)$$

which implies:

$$A_{it} f'(l_{it}) = w_{it} \qquad (3)$$

Equation (3) can be rewritten as follows:

$$log \frac{A_{i,t+1}}{A_{it}} = log \frac{w_{i,t+1}}{w_{it}} - log \frac{f'(l_{i,t+1})}{f'(l_{it})} \qquad (4)$$

The local technological level *A* is supposed to grasp different regional technological externalities. The variable *A*, a key variable in our specification, apprehends the degree of local productivity, the technical knowledge of production, the advantages of local production and further particular characteristics linked to the *i* region such as the method of organization and the local industrial structure.

We can look at *A* as a function of all characteristics specific to regions:

$$\log \frac{A_{i,t+1}}{A_{it}} = g_{it}(\text{industrial structure, initial conditions and other variables}) \qquad (5)$$

Rappaport (1999) shows that the wage growth differential induced by productivity growth is partly balanced by the rise of land price due to the population density growth. Under those conditions, Glaeser (2000) explains that the variable wage growth could be utilized as a measure of local productivity growth. Yet, Rappaport (1999) underlines that the difficulty to control the local and inter-regional heterogeneity in labor and land supply makes the utilization of the variables land price and wages quite laborious. He then suggests the population density variable as a better metric to grasp productivity variations and life quality. In that perspective, we propose in our estimation to instrumentalize the wage variable by the population density per square kilometer.

$$\log\left(\frac{w_{i,t+1}}{w_{it}}\right) = h_{it}(\text{var}iation \text{ in population } density) \qquad (6)$$

Initial employment and labor mobility are included in the initial conditions. According to Blanchard and Katz (1992), differences of average employment growth rates between regions are due to immigration rather than to differences between birth growth rates. They find correlation coefficients of 0.84 and 0.91 respectively for the periods 1950-1987 and 1970-1987 in the United States.

Combining equations (4), (5) and (6) gives the following functional form:

$$\log \frac{l_{i,t+1}}{l_{it}} = cnst + \beta * \text{population density} + g_i(\text{industrial structure, initial conditions and other variables}) + \varepsilon_i \qquad (7)$$

Taking account of the dominating industrial structure highlights the kind of externalities existing in a region, and the accumulation mode of information on productivity and technology. In the footsteps of Glaeser et al. (1992), we can pinpoint two kinds of technological externalities. Marshall (1890), Arrow (1962) and Romer's (1986) (MAR) localization externalities, which are more auspicious to the accumulation of technological knowledge inside industries. On the contrary, urban externalities (Jacobs, 1969) allow an accumulation of technological knowledge between industries. A high-specialized region is more affected by MAR externalities than a less-specialized region. The dominating industrial structure variable in a region catches the impact of local technological externalities on the speed of regional employment growth.

Employment Regional Convergence and Spatial Dependencies

Several empirical works in growth theory have integrated spatial effects in their specifications. Spatial dependency is often justified by externalities between regions. Rey and Montouri (1999) show that factors mobility and payment transfers— used to justify regional convergence— have explicit geographical components. To ignore the spatial localization factor can lead to biased estimators and incomplete explanations. In order to correct this issue, Amstrong (1995), Rey and Montouri (1999), Lopez et al. (1999) propose assumptions in line with the economic geography literature and the theory of endogenous growth. Economic geography literature shows that interactions between economic agents lead to the spatial agglomeration of economic activities in a limited number of regions (Fujita et al., 1999). Externalities effects are supposed to be linked to the market size, the access to services, the intensity of economic relations between regions, technological diffusion and the institutional and political similarity between regions. Interactions between heterogeneous firms located in different regions lead to heterogeneous and interdependent regions.

Bernat (1996), Rey and Montouri (1999) are among the first authors who explicitly included the spatial effect in growth econometric specifications. Bernat (1996) tested a simple version of Kaldor laws for several North-American states. Rey and Montouri (1999) tested the absolute β-convergence under spatial heterogeneity and spatial dependence. Those works have been followed by several studies (Fingleton and McCombie, 1998, Lopez et al., 1999, Fingleton, 1999). The suggested specifications include spatial dependence, either through spatial autocorrelation among errors or under a spatial model. The selection among those models is based on statistical criteria proposed in Anselin and Rey (1991) and Florax and Folmer (1992). Apart from the fact that externalities and interactions between regions are the main source of spatial dependencies, those works have allowed for incorporating spatial effects in an ad-hoc manner in empirical specifications. Fingleton and Lopez (2005) conclude that empirical evidences on a preferred specification are mitigated and seem to depend on regions and on the periods.

The choice of a correct spatial specification (substantive or nuisance) has alternative impacts on the interpretation of growth. Within a spatial auto-correlation model, Bernat (1996) explains that the growth of a region is affected by the growth of neighboring regions only through the extent of the gap (positive or negative) of the growth of neighboring regions to average growth. In the spatial auto-regressive model, growth in a region is directly affected by growth in neighboring regions. This effect is independent on the effect of exogenous variables. For a spatial autoregressive model, Rey and Montouri (1999) explain that the distance to equilibrium growth path is not only a function of shocks specific to the region but rather of the complex of the whole shocks that run over. Nevertheless, in a specification with an endogenous spatial delayed variable, the growth rate in a region may be linked to neighboring regions' growth rates after conditioning by the initial level of income.

This section is organized around three moments. Firstly, we will assess if per capita employment growth in a region is related to the growth of neighboring regions. In particular, does this relation reveal a spatial dependency? Spatial auto-correlation means that the observation of a variable in a region is dependent on the observation in neighboring regions. Two elements are at the roots of this auto-correlation. The first comes from the way activities are spatially distributed (Odland, 1998; Haning, 1990). In economic geography, this distribution is conditioned by proximity, labor and capital mobility. The second may derive from an erroneous model specification, like spatially auto-correlated omitted variables (Le Gallo, 2002). Secondly, we will examine the impact of spatial dependency on regional convergence in Algeria. Thirdly, we will investigate the sources of spatial dependency between the Algerian regions.

One of the issues when dealing with spatial data is the "enclave effect". It means that a specific region may present a different behavior from the majority of spatial observations. This effect leads to a skewed distribution of errors following a Student law. Indeed, this phenomenon can be observed as well through a non-constancy of the errors variance as through the presence of spatial outliers.

In the empirical literature, the presence of outliers affecting estimations in convergence models has been noticed in De Long and Summers (1991) and Temple (1998, 1999). The heteroscedacity hypothesis seems to be more appropriate than the traditional Gauss-Markov hypothesis according to which the variance of errors is constant in space. Geweke (1993), taking inspiration from Lange, Little and Taylor (1989) proposes a heteroscedastic linear Bayesian model. He shows that this way of modeling errors is similar to a model that assumes a Student distribution of errors. This approach has been extended to spatial models in LeSage (1997, 2000).

To take account of the enclave effect in our estimations, our model will utilize a heteroscedastic Bayesian approach. Heteroscedastic Bayesian models assume that the errors variances are not constant. Those errors take the form $\varepsilon_i \rightarrow N(0,\sigma^2 V)$ where V is a diagonal matrix containing parameters $(v_1 \quad v_2 \quad . \quad . \quad . \quad v_n)$ to be estimated by the Markov Chain Monte Carlo (MCMC) method and representing the size of variance differences. The terms $(v_1 \quad v_2 \quad . \quad . \quad . \quad v_n)$ have the function of counterbalancing observations that present large variances. The *a priori* distribution of the v_i terms takes the form of a distribution independent on $\chi(r)/r$. LeSage (1997) proposes, for the hyper parameter *r*, to choose *a priori* values evolving between *2* and *7* for all models. If data does not contain extreme values or non-constant variances, those values of *r* produce relatively constant estimated v_i or values close to 1.

The Impact of Per Capita Employment of Neighboring Regions

The first specification highlights the influence of spatial dependency (externality) without the introduction of the conditional effect of control variables. A first order auto-regressive model is given by the following system:

$$e_i = \rho \sum_{j=1}^{n} w_{ij} e_j + \varepsilon_i \qquad \mathrm{i} = 1 \quad . \quad . \quad . \quad n \qquad (1)$$

where

$$e_i = \ln \left(\frac{l_{i,05} / N_{i,05}}{l_{i,98} / N_{i,98}} \right)$$

The matrix form is given by :

$$(1 - \rho W)E = \varepsilon$$

$$\varepsilon_i \rightarrow N\left(0, \sigma^2 V\right)$$

e_i is the (neperian) logarithm of the per capita employment growth rate. W is the contiguity matrix of size $(n \times n)$. In that specification, the growth of employment in a region *i* depends on the weighted average of growth rates of neighboring regions.

Table 1 presents estimations for a normal distribution of errors with a constant variance and the results when we introduce the heteroscedastic effect on estimations (r=4). Both approaches confirm the presence of a spatial dependency in the per capita employment growth rate. There is an externality effect of 0.43 (heteroscedastic model) which shows the scope of the effect of the weighted average growth rate of neighboring regions on a region *i*. An average growth rate of per capita employment of 1 %, weighted by the proximity effect, in the neighboring regions is approximately associated with a growth rate of 0.43 % in the *i* region. Let us note that this specification does not give any information on the causes of observed externalities. It can reflect the effects of shocks due to a complex of factors specific to the regions: labor mobility, complementary industrial structures or similar education level in close regions. Table 1 only shows that growth in a region is dependent on growth in the neighboring regions. In other words, regions with similar levels of per capita employment growth rates tend to gather in space.

The Moran Graph indicates that regions with similar per capita employment growth rates tend to be nearly located. The distribution of growth rate in space seems to be strongly influenced by a proximity effect.

Differences between both approaches in the estimations of Table 1 are explained through the inclusion of a robustness in the estimations. This robustness appears when we take account of the enclave effect in the observations. Regarding model (1), graph 1 highlights the non-constancy of variances. The presence of outliers is confirmed by strong values of v_i estimated with a value of *r=4*.

Spatial Dependency and Regional Convergence

In this section, we wonder if the regional behavior of growth that we found in the former section reflects a regional distribution of certain growth determinants. Accordingly, we estimate an econometric form more general than equation (1):

$$E = const + \rho WE - \left(1 - e^{-\beta T}\right)\ln\left(\frac{l_{98}}{N_{98}}\right) + X\delta + \varepsilon \qquad (2)$$

where

$$E = \left(1 - \rho W\right)^{-1}\left(const - \left(1 - e^{-\beta T}\right)\ln\left(\frac{l_{98}}{N_{98}}\right) + X\delta + \varepsilon\right)$$

E is a $n \times 1$ vector, *W* is the $n \times n$ contiguity matrix, *X* the matrix of exogenous variables of a size $k \times 1$ and $\varepsilon \rightarrow N\left(0, \sigma^2 V\right)$. This specification assumes that employment growth in an *i* region depends on the average growth rate in the neighboring regions, the initial level of per capita employment and on the whole of exogenous variables in the *X* matrix. This matrix echoes the factors that determine divergences in the convergence of regions. The parameter β measures the convergence speed between regions. When β > 0 and the elements of the δ vector are not significant, there is β-absolute convergence. When β > 0 and the elements of the δ vector are significant, there is β-conditional convergence.

Equation (2) highlights the externality effects in regions' growth when one takes into account the effects of variables specific to regions. It must be noted that normally the conditional variables should not be very different in contiguous regions. Accordingly, their introduction can be considered as a robustness test of the results obtained on externalities with equation (1). The variable delayed growth in equation (1) can capture the effect of omitted regional variables but spatially correlated. In order to reduce the endogeneity effect, all data on conditional variables refer to the initial period that is 1998.

In equation (3) below, the Z matrix integrates factors at the origin of differences in growth rates between regions. This matrix may produce spatial auto-correlation in the errors. Externalities between regions can be expressed through errors spatial dependencies in the growth equations. We can thus re-write equation (2) as follows:

$$E = \left(1 - \rho W\right)^{-1}\left(Zb + \varepsilon\right) = \left(1 - \rho W\right)^{-1} Zb + \left(1 - \rho W\right)^{-1} \varepsilon \qquad (3)$$

According to Anselin's (2003) classification, this structure can be associated with the presence of global externalities in the growth process. Growth in each region is influenced by initial employment, conditional variables and by the scope of the position of one region in the regional system. The intensity of this scope is grasped into the W matrix and is inversely related to distance. This is represented in the second term of equation (3) that is by the product of the Z matrix and the inverse of the spatial transformation $\left(1 - \rho W\right)$. Moreover, growth in each region is affected by random internal shocks and by shocks coming from the rest of the regional system integrated in $\left(1 - \rho W\right)^{-1} \varepsilon$ and whose effect decreases with distance. Model (3) sets an important constraint on the structure of spatial externalities so that the spatial diffusion channel is identical in Z and ε.

Table 2 presents a synthesis of the results obtained for the estimation of equation (2) with externalities between regions. The first column shows that growth in per capita employment is not inversely correlated to initial per capita employment. This result shows that there is no convergence toward the equilibrium growth path. This is contrary to what teaches neo-classical growth theory. The conditional variables in the specification (cf. column 2) control the factors that govern divergences in regional growth paths. The significant character of β and of the associated parameters to the rest of exogenous variables highlights the conditional β-convergence.

Considering conditional variables does not make a difference upon the impact of initial employment on per capita regional employment growth. Both methods lead to different results for the following reasons. First, the heteroscedastic method takes the spatial heterogeneity in observations into account. Second, in this method, estimators are more robust to variances differences. Third, calculations of estimators are based on observations weighted relative to variances.

Results in column (2) are extended to include conditional variables. In both cases, results are obtained with an implementation of the contiguity matrix. Coefficient ρ that measures the scope of externalities is significantly different from zero in all cases. Compared to the first order auto-regressive model (1), the inclusion of conditional variables does not reduce the magnitude of externalities. Considering exogenous variables improves the significant aspect of the externality effect. This shows that there is a spill-over effect more confirmed after the introduction of those variables. The reduction of ρ suggests, in the case of the absolute model of column (1), that the lack of a global convergence process between regions lowers the dependence in the variable per capita employment growth. Our estimation indicates that, on average, employment growth in regions benefits from growth in neighboring regions of an order of 0.43 %. It must be noted that the addition of conditional variables does not change the robustness in the estimation of ρ.

The degree of concentration of past industrial activity—measured through the ration of the share of industrial employment in a region on the share of industrial employment relative to national employment—affects positively on employment growth. The coefficient of this variable is significant to an order inferior to 5 %. On the contrary, past activity in the hydrocarbon sector and in the public building and works sector (BP) does not influence per capita regional employment growth. According to those estimations, it seems that to benefit from past industrial fabrics has an impact on regional economic activity. The hydrocarbon sector, so crucial for the Algerian economy, does not seem to have a significant impact on regional growth. The concentration of past activity creates an attractive environment for potential investors. Thus, localization externalities or MAR externalities have a positive impact on per capita regional employment growth. According to our estimation, a rise of 1 % in the level of past industrial concentration in a region raises per capita employment growth in an order of 0.31 %.

Variation in population density has a positive coefficient (0.135) and is statistically significant. Recent works admit the strength of the link between the density of firms and population density. High spatial density improves the production and transmission of ideas. This creates an environment stimulating innovation and growth. Jaffe, Trajtenberg and Henderson (1993) find that the distance to the source of ideas influences communication of new ideas. In the same vein, a high spatial concentration of population and firms facilitates the transmission of those ideas that leads to product and organizational innovations. Rappaport (1999) and Glaeser (2002) consider the population density as the best indicator of productivity growth and of life quality. According to Rappaport (1999), the problem is that population density does not make the demarcation between life quality and productivity growth easy. In a certain sense, the distinction is less important in a regional analysis since both measures contribute positively to utility (directly for life quality and via high wages for productivity). As life quality is a normal good —its demand increases with income— individuals living in less developed countries give a low value to the attributes of life quality relative to developed countries[1].

The effect of inter-regional mobility and of education is not significant. The variable AEP (share of household connected to the drinking water network) measures the public effort to a region. This variable is significant and has a positive impact on employment's regional growth.

Spatial Dependency and Common Regional Shocks

This test aims to identify the sources of the links between regions. Spatial auto-correlations in per capita employment growth can be the result of spatial auto-correlations between the usual determinants of employment growth. In this section, we test the eventuality that the observed correlations are the result of shocks common to geographical areas. The specification that we estimate has the following form:

$$E = Zb + \varepsilon \qquad (4)$$

$$\varepsilon = \lambda W \varepsilon + \mu$$

$$\mu \to N\left(0, \sigma^2 V\right)$$

This form implies that growth in a region *i* does not depend on the growth rate in region *j* but rather that regions suffer from common shocks whose intensity lessen with distance or cancel themselves with the lack of contiguity.

[1] According to Blanchard and Katz (1992), employment increases and decreases at a rate whose value and sign depends on two situations. In employment-attractive regions, employment supply is positive and the labor influx leads to a decrease of wages. This attracts new firms and thus sustains employment growth. In regions characterized by highly attractive firms, labor demand is positive and the new firm influx causes a rise in wages. This stimulates labor influx and thus sustains employment growth.

Equation (4) can be re-written:

$$E = Zb + (1 - \lambda W)^{-1} \mu \qquad (5)$$
$$\mu \to N(0, \sigma^2 I_n)$$

This form shows how a random shock affects per capita employment growth in a region and, through the spatial transformation, the other regions. In equation (5), global externalities are exclusively associated with random shocks.

Results obtained in Tables 2 and 3 give strong evidence on the existence of a spatial effect in the conditional convergence model (column 2) or in the absolute convergence model (column 1). Our results suggest a high auto-correlation in per capita employment growth. Besides, the presence of a significant spatial dependency in the errors implies the propagation, to the rest of the regions, of random shocks in a specific region. Including a positive shock in the error in a specific region induces a large relative effect in this region but also a propagation of this shock to neighboring regions. The magnitude of this shock lowers with distance. Parameters associated with the spatial error and the delayed dependent variable are still significant. This confirms the reality of a strong spatial dependence in the growth of per capita employment between the regions that we study. Moran tests and Lagrange-multiplier tests are highly significant. Now, according to Anselin and Rey (19991), those tests are very powerful to detect both forms of spatial dependency.

4. Conclusion

This paper analyses the impact of localization on growth in Algeria. We find a substantial effect of overflowing on growth with different specifications. The specification uniquely based on per capita employment growth (non-controlled by the exogenous variables) shows a strong spatial dependency between the regions. This specification is in our view crucial since the inclusion of conditional variables in the standard specification does not reduce the effect of overflowing on the regions. The analysis of the Moran graph confirms that the spatial auto-correlation is obvious.

The estimation by the treatment of MCMC method to the sample allows a re-examination of the homogeneity assumption of the errors. The *a priori* introduction of informative values for the parameters ρ, λ and β with the *a priori* heteroscedasticity hypothesis of the errors leads to the improvement of the robustness of the results in the case of either non-constant variances or outliers. The heteroscedastic Bayesian method does not require the specification of a form for the variation of variances in space. This method can automatically detect the non-constancy of variances and the presence of outliers. The *a priori* introduction of information on parameters may be useful to control the multi-functionality and other issues that may alter the precision of estimators. In certain cases, the estimation via Gibbs sampling can give good results when conditioning or identifying issues impede the optimization methods to maximize the likelihood function.

Our results demonstrate that there is no convergence process between the Algerian regions. In other words, “rich” Algerian regions stay rich whereas relatively poor regions stay poor. In that vein, the significance of the spatial dependence coefficient may reveal that there are convergence clubs in Algeria. Growth dynamics in Algeria is not equitably distributed. The hydrocarbon and the public building and works BP sectors do not have externality effects on local economy. The Moran-I test indicates a high significance of spatial dependency.

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The Moran Graph

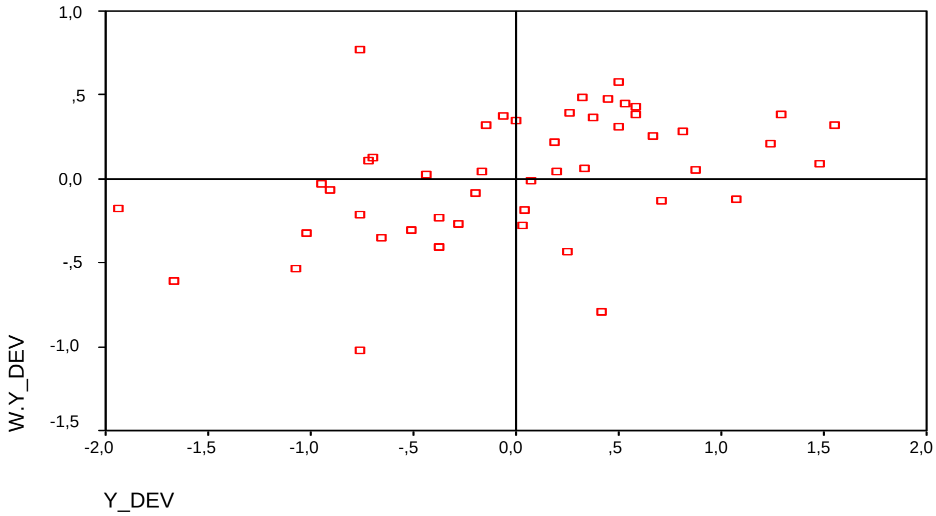

Figure 1: Posterior Mean of vi estimates (r=4)

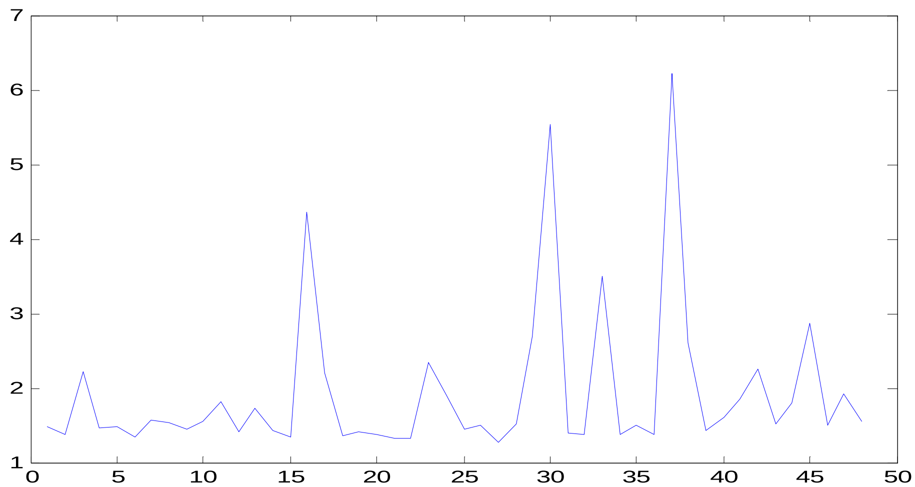

Table 1: Test of Growth Externalities - Dependent Variable: Per Capita Employment Growth Rate (W contiguity matrix)

Parameter	Homoscedastic model R=100	Heteroscedastic model r= 4
ρ	0.4547	0.4379
sign	0.0125	0.0115
R^2	0.1825	0.6490

Table 2: Test of Growth Externalities Conditioned by Exogenous Variables - Dependent Variable: Per Capita Employment Growth Rate (W weighted contiguity matrix)

Variables	(1)		(2)	
	Homoscedastic Model r = 100	Heteroscedastic Model r = 4	Homoscedastic Model r = 100	Heteroscedastic Model r = 4
Constant	-4.0039***	-4.2487***	-7.8826***	-8.1092***
Log per capita initial employment	0.3526***	0.3715***	0.4124**	0.3618**
Industrial concentration index			0.1602	0.3194**
Hydrocarbon and BP concentration			0.0693	0.0240
index			0.0924**	0.1352***
Variation in population density			-1.4668**	-2.3127***
Labor mobility			0,9759	1.9141**
AEP			4.8238	3.5448
Education				
	0.3573**	0.3307**	0.4169**	0.4361**
ρ	0.0330	0.0460	0.0250	0.0104
Sign	0.1723	0.1664	0.3491	0.2187
R				
Moran's-I statistic	2.3410**		2.8253***	
Sign of Moran's I statistic	0.019		0.0047	

Notes: *, ** and *** respectively significant to the 10 %, 5 % and 1 % probability level.

Table 3: Test of the Common Shock Conditioned on Exogenous Variables - Dependent Variable: Per Capita Employment Growth Rate (W weighted contiguity matrix)

Variables	(1)		(2)	
	Homoscedastic Model r = 100	Heteroscedastic Model r = 4	Homoscedastic Model r = 100	Heteroscedastic Model r = 4
Constant	-4.3096***	-4.4080**	-7.0065***	-7.3830***
Log per capita initial	0.3742***	0.3849***	0.3110*	0.3089*
employment			0.2047*	0.2772**
Industrial concentration index			0.0928	0.0537
BP concentration and			0.1136**	0.1259**
hydrocarbon index			-1.7320**	-1.8760**
Variation of population density			0.8131	1.2385
Labor mobility			5.1993	5.1866
AEP				
Education				
	0.5276***	0.4436**	0.6425***	0.5235***
	0.0060	0.0130	0.0020	0.0092
λ	0,2761	0.2649	0.4565	0.4243
Sign				
R				
Moran's-I statistic	2.3410**		2.8253***	
Sign of Moran's- I	0.0192		0.0047	

Notes: * , ** and*** significant inferior to 10 %, 5 % and 1 %