Available online at www.sciencedirect.com
SciVerse ScienceDirect
ELSEVIER
Procedia - Social and Behavioral Sciences 62 (2012) 576 – 579
Procedia Social and Behavioral Sciences

WC-BEM 2012

Internal and external sources of regional growth

Stilianos Alexiadis [a*], George M. Korres [b] and Christos Ladias [c]

[a] *Ministry of Rural Development and Foods, Department of Agricultural Policy and Documentation, Athens, Greece*
[b] *Visiting Fellow University of Newcastle, Centre of Urban and Regional Development Studies, and Associate Professor University of the Aegean, Department of Geography*
[c] *Department of Regional Economic Development, University of Central Greece*

Abstract

This paper examines the pattern of regional growth due to their ability to adopt technology. Whether regions exhibit a 'high' or 'low' path of growth depends on the adoption of technological improvements. Technology adoption can be either 'internal' or 'external' to the region. This approach is tested empirically using data for 247 European regions. The results suggest that adoption of technology has a significant and positive effect in regional growth in Europe.

Keywords: Technological Catch-up; Regional Growth; European Regions.

1. Introduction

The debate on regional convergence has bred, and continues to do so, dozens of empirical studies (e.g. Dallerba et al, 2008). Although, in this fast growing literature technological progress has been acknowledged to be of paramount importance in promoting convergence across regions, nevertheless, the impact of the *adoption* of technology has received less attention. In this paper a model is developed that explicitly takes into account technology adoption in an extensive regional context, that of the NUTS-2 regions of the EU, widening thus the range of empirical studies on European regions. Furthermore, two sources that contribute to an efficiency adoption of technology are identified, namely *internal* and *external* sources. It is hoped that this paper will be able to isolate some interesting views on the issue of regional convergence across Europe due to technology diffusion and adoption. This effort is organised as follows. Section 2 develops an empirical model. In Section 3 the econometric estimations are discussed. Section 4 concludes.

2. Regional Convergence and Adoption of Technology

Regional convergence depends on arbitrage possibilities arising from competition and factor mobility were expected to induce a more than average growth performance in lagging regions'' (Hurst et al., 2000, p.9). In the standard neoclassical model, a factor that promotes, and accelerates, regional convergence is technological progress and diffusion. A process of technology diffusion, however, is not a simple and automatic process. Instead, it requires that lagging economies should have the appropriate infrastructure or conditions to *adopt* the technological

* Corresponding author. Tel.: 0030 210 212 5517. *E-mail address*: ax5u010@minagric.gr

The findings, interpretations and conclusions are entirely those of the authors and, do not necessarily represent the official position, policies or views of the Ministry of Rural Development & Foods and/or the Greek Government.

1877-0428 © 2012 Published by Elsevier Ltd. Selection and/or peer review under responsibility of Prof. Dr. Hüseyin Arasli
Open access under CC BY-NC-ND license. doi:10.1016/j.sbspro.2012.09.096

innovations. It is anticipated that the ability of a region to produce technological capital, i.e. the 'intentional creation of technology', as reflected in R&D activities, will have positive effects on the growth of technology in the region. Regarding the second source of technological growth, a high technological gap in a region implies opportunities for adopting technological improvements in the technologically advanced regions. In such circumstances, the further away a region's technology is from that of the most advanced region, the faster will be its rate of technological progress. The logic behind this hypothesis is that technology transfer will be relatively cheap for lagging regions, when compared to regions which are already employing the most modern technologies and which cannot therefore simply imitate existing production techniques in order to promote further growth. Low technology regions can therefore experience faster growth provided, of course, that they possess the necessary infrastructure to facilitate the adoption of technology from the more technically advanced regions. This framework will be tested empirically in the context of the European NUTS-2 regions in Section 3.

3. Some Empirical Results

The empirical literature on regional convergence makes extensive use of the conditional convergence model:

$$g_i = a + b_1 y_{i,0} + b_2 PI_{i,0} + b_3 TG_{i,0} + b_4 FDI_{i,0} + \varepsilon_i \quad (1)$$

In equation (1) y_i represents per capita output, $g_i = (y_{i,T} - y_{i,0})$ is the growth rate , $PI_{i,t}$ is the 'propensity to innovate', expressed in terms of patents per million inhabitants, TG_i is the internal source of technology adoption, defined as the distance between a region's technological level and that of the most advanced technological region with the highest percentage of employment in high-tech manufacturing and knowledge-intensive high-technology services (the region of 'Berkshire, Bucks and Oxfordshire'). Nevertheless, it is possible to identify sources *external* to the regions. $FDI_{i,0}$ represents the inflow of investment from abroad in an attempt to capture the impact of external adoption of technology in regional growth and convergence. Finally, $w_{ij} = \frac{1/d_{ij}}{\sum_j 1/d_{ij}}$ and d_{ij} denotes the distance between two regions *i* and *j*. A regional model of 'technologically-conditioned' convergence usually appears in three versions, i.e. the spatial-error, the spatial-lag and the spatial cross-regressive model. Thus,

$$\mathbf{g_i} = a + b_1 \mathbf{y_{i,0}} + b_2 PI_{i,0} + b_3 TG_{i,0} + b_4 FDI_{i,0} + (\mathbf{I} - \zeta \mathbf{W})^{-1} u_i \quad (2)$$

$$\mathbf{g_i} = a + b_1 \mathbf{y_{i,0}} + b_2 PI_{i,0} + b_3 TG_{i,0} + +b_4 FDI_{i,0} + \rho(\mathbf{W g_i}) + \varepsilon_i \quad (3)$$

$$\mathbf{g_i} = a + b_1 \mathbf{y_{i,0}} + b_2 PI_{i,0} + b_3 TG_{i,0} + b_4 FDI_{i,0} + c(\mathbf{W y_{i,0}}) + \varepsilon_i \quad (4)$$

Estimation of equations (2) and (3) is carried out by the method of two stages least squares (2SLS), as OLS may result in problems of bias (Anselin, 1988) or. In contrast to the two previous models, the spatial cross-regressive model treats the spatial variable as exogenous and, hence, estimation is possible through the OLS method. The results are set out on Table 1.

Table 3. Conditional convergence and the speed of convergence, 1995-2006

Equation (1), OLS		
a	0.5757**	
b_1	-0.0258	
b_2	-0.0408**	
b_3	-0.0474*	
b_4	0.0145*	
R^2 0.2491	ser 0.1326	Implied β 0.0021
Ramsey Reset Test F Statistic [p-value] 1.5995: [0.207]		
Test Statistics (LM) for Heteroscedasticity [p-value]		
White	21.4036 [0.006]	
Breusch-Pagan	24.2439 [0.000]	

Koenker	16.0799 [0.003]	
Test Statistic for Normality of the residuals [p-value]		
Chi-squared 16.9151 [0.000]		
LIK 150.986	AIC -291.971	SBC -274.424

Notes: ** indicates statistical significance at 95% level of confidence, ser denotes the standard error of the regression. AIC, SBC and LIK denote the *Akaike*, the *Schwartz-Bayesian* information criteria and Log-likelihood, respectively.

The convergence coefficient is negative and the rate of convergence is now estimated as 0.21% per annum. The coefficient on the propensity to innovate is negative, suggesting that regions with a high propensity to innovate, normally high productivity regions, grow slower than technologically lagging regions. This might act as source of convergence, provided that the poor regions are able to absorb technology. However, this does not seem to the case. A negative sign is also estimated for the variable representing technology adoption. The existence of a high technology gap and associated low capability for technology adoption is thus inhibiting growth and convergence. A positive coefficient is estimated for the variable describing the external sources of technology adoption, which does not necessarily promote convergence as such, since regions with relatively high initial level of FDI, normally regions with high initial level of productivity, exhibit relatively higher rates of growth. The fact that $b_3 < 0$ and $b_4 > 0$ might explain the low rate of convergence. The test for heteroscedasticity and normality suggest that spatial specifications might be more appropriate. The spatial versions of the model again show statistically significant spatial effects and confirm the impact of spatial interaction between regions upon regional growth patterns. Overall, the spatial equations would also appear to provide a better fit to the data. In particular, according to the both the AIC and SBC criteria and the LIK statistic, the spatial-error is to be preferred. The propensity to innovate variable is again negatively related to growth over the period. While this can be conceived as a convergence effect, nevertheless the impact of the technology adoption variables works in the opposite direction. On average, regions with high technological gaps and FDI at the start of the period grow slower than regions with low gaps, *ceteris paribus*.

Table 2. Spatial Conditional models

	Equation (2)	Equation (3)	Equation (4)
a	0.5671**	0.3891**	0.5898**
b_1	-0.0343**	-0.0019	-0.0176
b_2	-0.0346**	-0.0399**	-0.0384**
b_3	-0.0327*	-0.0351*	-0.0496**
b_4	0.0166**	0.0169**	0.0137*
ζ	0.6124**		
ρ		0.2983**	
c			-0.0146
Implied β	0.0028**	0.00015	0.00147
AIC	-335.145	-306.444	-291.561
SBC	-314.089	-297.967	-270.504

Notes: ** indicates statistical significance at 95% level of confidence. [ser] denotes the standard error of the regression. AIC, SBC and LIK denote the *Akaike*, the *Schwartz-Bayesian* information criteria and Log-likelihood, respectively.

In summary, the evidence presented here clearly supports the arguments previously put forward, that technology adoption is a route by which lagging regions might be able to converge with leading regions, but that this is a process which is likely to be difficult, especially during the early stages of development when conditions in the lagging regions are least supportive. Thus, a high technology gap presents an obstacle to convergence because of the implied poor infrastructure and weak adoptive capacity. These factors work to sustain initial differences across regions.

7. Conclusions

Although an increasing number of empirical studies have paid attention to issues of economic convergence in the EU, the impact of technology adoption in regional convergence has so far received more limited attention. We have attempted in this paper to address this question, using data for 247 NUTS-2 regions of the EU-27 over the period 1995-2006. An important conclusion to emerge from the empirical application is that the EU-27 regions exhibit faster tendencies to converge *after* conditioning for technological differences across regions. While the 'technological gap' approach predicts in principle that the higher the technological distance from the leader, the greater the incentive to adopt technology, the results in this paper imply that not all the lagging regions of Europe are not able to reap the 'benefits of backwardness'. This inability can attributed, possibly to inappropriate infrastructure conditions prevailing in lagging regions, which prevent or constrain convergence with the more technologically advanced regions. Catch-up to the leading regions is feasible only amongst those regions whose conditions are similar or close to those of the technologically advanced regions.

References

Anselin, L. (1988). *Spatial econometrics*: *Methods and models*. Kluwer, Dordrecht

Dallerba, S., Percoco, M. and Piras, G. (2008). The European regional growth process revisited *Spatial Economic Analysis*, 3 (1), 7-25.

Hurst, C., Thisse, J., Vanhoudt, P. (2000). What diagnosis for Europe's ailing regions?. *European Investment Bank Papers*, 5 (1), 9-29.