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Interregional Differences in Adoptive Abilities: An Alternative Framework

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Abstract:
Although the importance of technology adoption has been acknowledged, nevertheless, at a more general level, a critical question arises: how do the overall infrastructure conditions affect the absorptive ability of a regional economy? This question can be stated alternatively as: what are the implications of a 'poor' or a 'superior' infrastructure for regional convergence? It is possible to provide some answers to these questions by constructing a model of regional convergence that encapsulates the impact of infrastructure in the absorptive ability of a regional economy. In this model the possibility that high technological gaps might act as obstacles to convergence is taken explicitly into consideration. The model developed in this paper indicates that convergence towards leading regions is feasible only for regions with sufficient absorptive capacity, which is assumed to be a function of infrastructure conditions in a regional economy.

Key Words: Convergence Clubs, Technological Gap, Technology Adoption

JEL: R11; O33

1. Introduction

Although 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. Indeed, several authors claim that empirical studies on convergence have over-emphasised the role of capital accumulation in generating convergence at the expense of the diffusion of technology. Bernard and Jones (1996), for example, have succinctly put this argument as follows: 'To the extent that the adoption and accumulation of technologies is important for convergence, the empirical convergence literature is misguided' (p. 1037). As acknowledged by Abramovitz (1986), technological progress is driven not only by indigenous innovation but also by the process of technology absorption, and thus the ability of a regional economy to 'catch-up' may substantially depend on its capacity to imitate and adopt innovations developed in more technologically advanced regions. Although some attempts have been made to capture the impact of technology adoption (e.g. de la Fuente, 2000; Rogers, 2004) nevertheless the existing literature is limited to the extent that it only highlights specific aspects of technology adoption without offering a general model that captures its impacts on regional convergence. It is the purpose of this paper to develop a model capable to provide an appropriate framework to analyse some implications of technology adoption in the process of regional convergence.

This effort is organised as follows. Section 2 briefly reviews the existing literature. Section 3 presents a model in which any possibilities for convergence or divergence are attributed to interregional differences in adoptive abilities. This will be the starting point for a more elaborate analysis in Section 4. A fifth section concludes the paper by suggesting avenues for future research.

2. Technology Adoption: A Review of the Literature

In this section we shall discuss some of the theories that have been put forward to explain the evolution of technology. A useful starting point is the neoclassical theory, since the assumptions of this theory actually carry implications for the regional convergence/ divergence debate. In the standard neoclassical model, a factor that promotes, and accelerates, regional convergence is technological progress and diffusion. If the labour force and technology grow at constant rates, and if there is instantaneous diffusion of technology, combined with interregional movements of factors of production, then convergence in levels of labour productivity (or in per capita output) is an inevitable outcome. However, several criticisms have been raised against the conclusions, which such models have yielded, because of various simplifying assumptions underlying the results. Under the assumption of perfect competition it may be argued that technology has such characteristics and is, as Borts and Stein (1964) argue, 'available to all' (p. 8). In recent years, doubts have crept in the validity of this assumption. A process of technology diffusion is not a simple and automatic process. Instead, it requires that lagging economies (countries or regions) should have the appropriate infrastructure or conditions to *adopt* or *absorb* the technological innovations. As Kristensen (1974) points out, technological spillovers are not likely to be effective if the capability of the receiving economy is too low: 'The most rapid economic growth should be expected to take place in countries that have reached a stage at which they can begin to apply a great deal more of the existing knowledge' (p. 24). On similar lines, Abramovitz (1986) recognises this possibility by arguing as follows: 'Countries that are technologically backward have a potentiality for generating growth more rapid than that of more advanced countries, provided their *social capabilities* are sufficiently developed to permit successful exploitation of technologies already employed by the technological leaders' (p. 225) [Emphasis Added]

In other words, if 'social capabilities' or infrastructure conditions are not 'sufficiently developed' then it cannot be presumed that there is an 'advantage of backwardness' associated with a high technological gap[10]. The absorptive ability of an economy is therefore of paramount importance to the convergence process and has already been examined seriously by, for example, Baland and Francois (1996), Keller (1996), Parente and Prescott (1994), all of which consider the implications of technology absorption for economic growth in national economies, and express the absorptive ability in terms of human capital. Other authors approximate the absorptive abilities of an economy in terms of the level of innovation in an economy (e.g. Griffith *et al.*, 2003). In particular, Griffith *et al.* (2003), building upon the arguments of Schumpeter (1934), put forward the idea that Research and Development (hereafter R&D) activities affect not only the degree of innovation but also the absorptive ability of an economy. Four regional studies emphasise the absorptive ability of regions in promoting economic growth, with each highlighting different factors. Acs *et al.* (1994) put emphasis on the average size or age of local firms, Dosi (1988) considers the dominant production structure and the existence of networks, Henderson (2003) uses available human capital in a location while in Drifflied (2006) the spillover effects from foreign direct investment are the focus[11]. However, these models do not consider the implications for convergence, at least in an explicit way.

A link between the absorption of technology and economic convergence is also considered explicitly in a further five models. In particular, Barro and Sala-i-Martin (1997), Detragiache (1998), Rogers (2004), Duczynski (2003), and Howitt and Mayer-Foulkes (2005) examine this relationship for national economies. Duczynski (2003) proposes a model that combines technology diffusion, perfect capital mobility and adjustment cost for capital investment. This model predicts variation in the rates of convergence, with undercapitalised countries exhibiting relatively fast initial rates of convergence. Rogers (2004) implements a form of human capital

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[10] This argument has been dealt with at length in Gerschenkron (1962), which is acknowledged as the initiator of this view. Nevertheless, the central conceptual apparatus derives from Veblen (1925). See also Fagerberg (1994).

[11] Bode (2004) develops a model that distinguishes between spillovers from abroad and local spillovers.

measure in that approximation to the absorptive ability of an economy is expressed in terms of number of students studying abroad. Howitt and Mayer-Foulkes (2005) develop a model on Schumpeterian lines and approximate the ability of an economy to absorb technology in terms of levels of human capital and the endogenous rate of innovation.

De la Fuente (2000) develops a model in which the potential for technology adoption is positively related to the technological gap, i.e. the higher the technological gap, the higher the potential for technology adoption and faster the rate of convergence. However, this model does not consider the possibility that high technological gaps might act as obstacles to convergence.

From this brief review of the existing literature, it is clear that although the importance of technology adoption has been acknowledged, nevertheless, only specific aspects of the *infrastructure conditions* are examined. At a more general level, a critical question arises: how do the overall infrastructure conditions affect the absorptive ability of a regional economy? This question can be stated alternatively as: what are the implications of a 'poor' or a 'superior' infrastructure for regional convergence? This paper aims to answer such questions by developing a model to study the impact of infrastructure in the absorptive ability of a regional economy. The model is presented in the next section.

3. A Model of Technological Catch-up

The growth of technology in a region is the outcome of two sources. The first is a process of intentional creation of technology; a process that takes place exclusively within the 'borders' of a region. As regions are, by definition, open economies technology is also affected by technological improvements that take place in other regions. This constitutes the second source that induces the growth of technology. Alternatively, this refers to the part of technology that is generated from interaction between spatial units. Denoting by C_i the part of technological growth that is due to efforts within the region and by E_i the growth of technology due to implementation of technologies developed in other regions, it is possible to express the growth of technology in a region i in terms of the following general function:

$$\dot{A}_i = f(C_i, E_i) \qquad (1)$$

with the expectation of $f'_{G_{A_i},C_i} > 0$ and $f'_{G_{A_i},E_i} > 0$.

The functional form given by equation (1) can be specified in a multiplicative form. Thus,

$$\dot{A}_i = C_i E_i \qquad (2)$$

It is assumed that both C_i and E_i are affected by the size of the 'technological gap', i.e. $C_i = g(B_i)$ and $E_i = h(B_i)$, where B_i is the difference between an exogenously determined best-practice frontier (X) and the prevailing level of technology in a region, represented by some index A_i: $B_i = \frac{A_i}{X_i}$. The 'advantage of backwardness' operates if two conditions are met, namely $g'_{C_i,B_i} > 0$ and $h'_{C_i,B_i} > 0$. A high technological gap acts as an incentive for technologically backward regions to increase their ability to create and adopt technology, leading to a high growth rate of technology ($f' \cdot g' \cdot h' > 0$). When $g'_{C_i,B_i} < 0$ and $h'_{C_i,B_i} < 0$, a high technological gap constitutes as an obstacle for further growth of technology ($f' \cdot g' \cdot h' < 0$). Once this knowledge is introduced, each element of equation (2) can be written as follows:

$$C_i = \widetilde{C}_i B_i^{\gamma} \qquad (3)$$

$$E_i = \widetilde{E}_i B_i^{\delta} \qquad (4)$$

In equations (3) and (4) $\widetilde{C}_i$ and $\widetilde{E}_i$ denote the autonomous parts of the technological sources while the parameters γ and δ measure the rate at which the prevailing technological gap in a region induces the growth of internally generated technological change and diffusion, respectively. Convergence requires that $\gamma, \delta > 0$.

Equations (2), (3) and (4) can be written in linear form by taking logarithms as follows:

$$g_{A_i} = \dot{a}_i = c_i + \varepsilon_i \tag{5}$$

$$c_i = \widetilde{c}_i + \gamma b_i \tag{6}$$

$$\varepsilon_i = \widetilde{\varepsilon}_i + \delta b_i \tag{7}$$

Inserting equations (6) and (7) in (5) and rearranging yields:

$$\dot{a}_i = \widetilde{\theta}_i + \xi b_i \tag{8}$$

where $\widetilde{\theta}_i = (\widetilde{c}_i + \widetilde{\varepsilon}_i)$ and $\xi = (\gamma + \delta)$

Of particular importance is the parameter ξ, which essentially, measures the degree or the ability of a region to create and implement technological innovations. In other words this parameter can be conceived as an adoptive parameter, reflecting the opportunities for '*technological catch-up*'.

If $\xi > 0$, then there is a case of the 'advantages of backwardness'. It is possible to be $\xi > 0$ if $\gamma < 0$ and $\delta > 0$, which means that although a region is not able to create its own technology, technological growth is possible if $\delta > 0$, i.e. the higher (lower) the technological gap, the higher (lower) the adoption rate and, hence, the enhancement of technological growth. It is conceivable, however, that a value of $\delta < 0$ signifies inappropriate conditions for technology adoption.

Given that the technological distance can be written in logarithmic terms as $b_i = a_i - x_i$, then the technological distances between a leading and a follower region, are given by: $b_l = a_l - x$ and $b_f = a_f - x$, respectively. Using equation (8) we may write:

$$\dot{a}_l = \widetilde{\theta}_l + \xi b_l \tag{9}$$

$$\dot{a}_f = \widetilde{\theta}_f + \xi b_f \tag{10}$$

The growth rate for the technology gap between the two regions ($\dot{b}_{lf}$) is therefore:

$$\dot{b}_{lf} = \dot{a}_l - \dot{a}_f = \left(\widetilde{\theta}_l - \widetilde{\theta}_f\right) + \xi\left(b_l - b_f\right) \tag{11}$$

Defining $b_{lf} = b_f - b_l$ and $\widetilde{\theta}_{lf} = \left(\widetilde{\theta}_l - \widetilde{\theta}_f\right)$, equation (11) can be written as follows:

$$\dot{b}_{lf} = \widetilde{\theta}_{lf} - \xi b_{lf} \tag{12}$$

Equation (12) can be written in terms of a first-order differential equation. Thus,

$$\dot{b}_{lf} + \xi b_{lf} = \widetilde{\theta}_{lf} \tag{13}$$

A general solution (*GS*) of a differential equation is given by a complementary function (*CF*) and a particular solution (*PS*), defined by equations (14) and (15), respectively.

$$b_{lf}^{CF} = \mathbf{A}e^{-\xi t} \tag{14}$$

where $\mathbf{A}$ is an arbitrary constant, to be estimated by the initial conditions.

$$b_{lf}^{PS} = \frac{\widetilde{\theta}_{lf}}{\xi} \tag{15}$$

Adding equation (14) and (15) gives the general solution of equation (13):

$$b_{lf,t} = \mathbf{A}e^{-\xi t} + \frac{\tilde{\theta}_{lf}}{\xi} \tag{16}$$

Setting $t = 0$ in equation (16) yields:

$$\mathbf{A} = b_{lf,0} - \frac{\tilde{\theta}_{lf}}{\xi} \tag{17}$$

Inserting equation (17) into (16) and rearranging terms yields a general solution of equation (13):

$$b_{lf,t} = \left(b_{lf,0} - \frac{\tilde{\theta}_{lf}}{\xi} \right) e^{-\xi t} + \frac{\tilde{\theta}_{lf}}{\xi} \tag{18}$$

Equation (18) can be written as follows:

$$b_{lf,t} = b_{lf,0}e^{-\xi t} + \left(1 - e^{-\xi t}\right)\frac{\tilde{\theta}_{lf}}{\xi} \tag{19}$$

According to equation (19), the evolution of the technological gap depends upon the adoptive parameter ξ. If this parameter differs across regions, then any possibilities for regional convergence are constraint. This consideration can be shown using an example in which the economy is divided into three regions, one 'leader' (l), which is at the technological frontier $(b_l = a_l - x = 0)$, and two followers, i.e. $i = 1, 2$. Assume that the autonomous parts of technology creation and diffusion and the initial technological gaps with the leader are the same for the two region-followers, i.e. $\tilde{\theta}_{lf_1} - \tilde{\theta}_{lf_2} = 0$ and $b_{lf_1} - b_{lf_2} > 0$. Assume further that region 1 exhibits a higher ability in adopting technology, i.e. $\xi_1 - \xi_2 > 0$. If this difference is sustained through time, then a technological catch-up between region 1 and 2 is not feasible. This is attempted to be depicted in Figure 1.

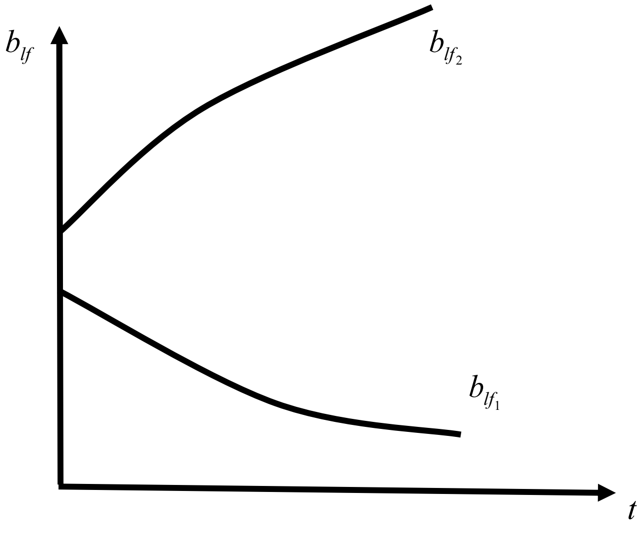

Figure 1: Technological Divergence

It seems thus legitimate to ask, if there is a way for region 2, the 'technologically poor' region to catch up with the 'technologically rich' region 1? A technological catch-up is feasible only if region 2 improves its adoptive ability, i.e. if the value of ξ_2 increases through time. Suppose that ξ_2 begins to increase after some time, let t_n. The technological gap amongst the regions shrinks through time, as it can be seen from Figure 2.

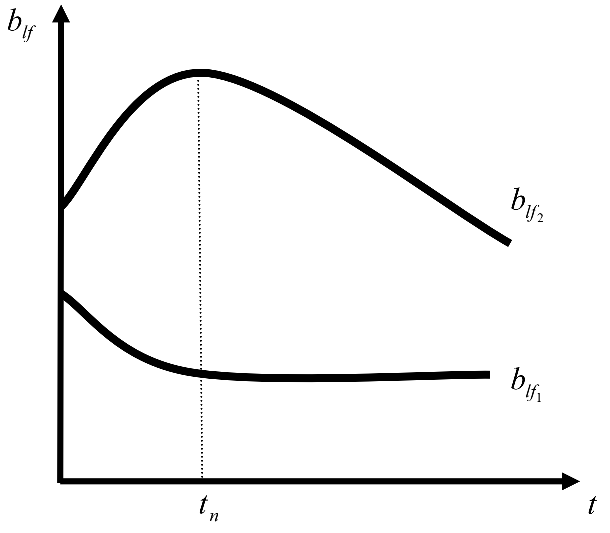

Figure 2: Technological Catch-up

There seems to be little doubt that differences in the adoptive abilities of regions affect the pattern of regional convergence. What is less clear, however, is what causes these abilities to differ across regions. It is quite possible that a significant technological gap is associated with unfavourable conditions for the adoption of new technology. This possibility is introduced in the next section.

4. Technology Adoption: Implications for Regional Convergence

Assume that the rate of technology adoption (ξ) is a non-linear function of the technological gap:

$$\xi_i = \rho b_{lf_i}^{-\pi} \text{ with } \rho, \pi > 0 \qquad (20)$$

The intuition behind equation (20) is that the rate of adoption is not constant but varies across regions, according to the size of the gap. Thus, for a given value of ρ, a high technological gap implies a low capacity to absorb and create technology. The parameter ρ can be interpreted as a constant underlying rate of diffusion, which would apply to all regions if there were no infrastructure/ resource constraints upon technological adoption. However, the existence of such constraints causes the actual rate to diverge from ρ. In other words, the higher the technological gap, the slower the rate of technological adoption (ξ). The probability lies in that direction. And if we take this as a working hypothesis we have a fresh premise from which to start the construction of our argument. The inclusion of the parameter π determines the extent to which the existing gap, and implicitly therefore the existing infrastructure, impacts on the rate of adoption. This parameter can be viewed as a measure of the appropriateness or suitability of regional infrastructure to adopt technology. In this way, the rate of technology adoption is endogenously determined[12].

To introduce these considerations equation (20) is substituted into equation (12):

$$\dot{b}_{lf} = \tilde{\theta}_{lf} - \rho b_{lf}^{(1-\pi)} \qquad (21)$$

In equilibrium $\dot{b}_{lf} = 0$ so that:

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[12] This is in accordance with the literature on New Endogenous Growth Theory. For a more detailed review see Aghion *et al.* (1999), Alesina and Rodrik (1994), among others.

$$\tilde{\theta}_{lf} = \rho b_{lf}^{(1-\pi)} \tag{22}$$

which gives an equilibrium value for the technological gap:

$$b_{lf}^{*} = \phi^{\sigma} \tag{23}$$

where $\phi = \frac{\tilde{\theta}_{lf}}{\rho}$ and $\sigma = \frac{1}{1-\pi}$.

It is interesting to consider the implications for a regional economy when its gap with the leading economy is not at this equilibrium level. The outcome turns upon the value of the parameter π. If $\pi = 0$, then according to equation (20) $\xi_i = \rho$ and the adoption of technology occurs at a constant autonomous rate equal to ρ implying a linear process of convergence, while if $\pi = 1$ the size of the gap becomes irrelevant in the process of technological adoption. Two distinct patterns of convergence arise, however, when $\pi < 1$ and when $\pi > 1$. Figure 1 portrays the pattern of convergence implied by $\pi < 1$.

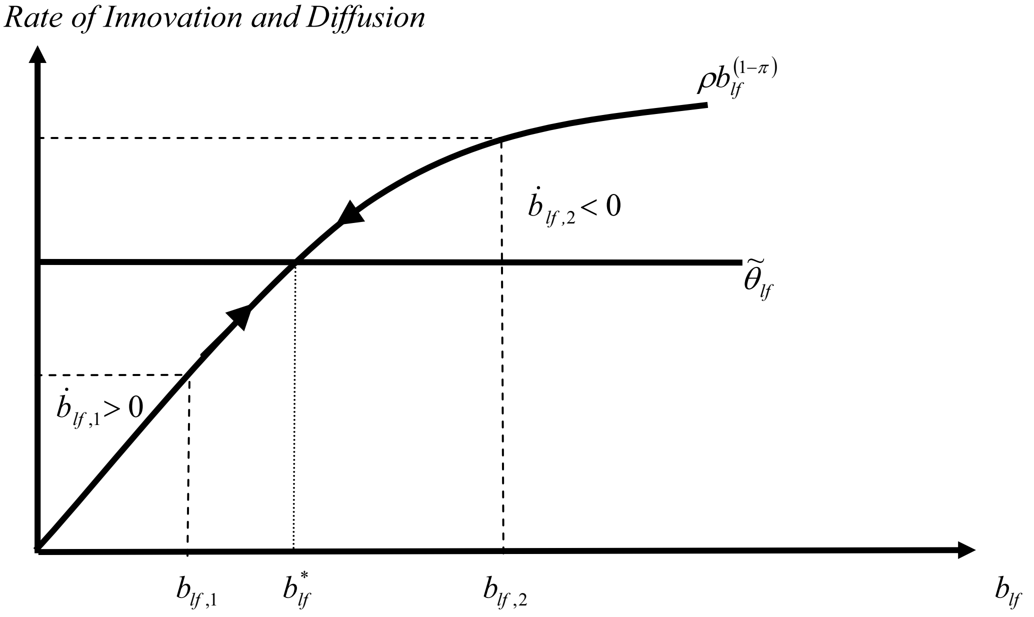

Figure 3: Convergence towards a single equilibrium when $\pi < 1$

As illustrated in Figure 3, the process of convergence is a non-linear one. When the gap between leader and follower is below b_{lf}^{*}, the dynamics of the system cause the gap to grow towards its steady-state value, since the rate of innovation investment outweighs the effect of technology diffusion and, hence, $\dot{b}_{lf_i} > 0 \; \forall i \in [0 \;\; b_{lf}^{*}]$. Conversely, when the gap is greater than b_{lf}^{*}, there is movement towards equilibrium since $\dot{b}_{lf}$ is negative, i.e. $\dot{b}_{lf_i} < 0 \; \forall i \in [b_{lf}^{*} \;\; \infty]$. Assuming, further, that the leading region maintains its leading position over a given time period, then regions with a large technology gap, i.e. above b_{lf}^{*}, converge towards equilibrium but at slower rates compared to those regions where the gap is below b_{lf}^{*}. Thus, when $\pi < 1$ convergence towards a single equilibrium is possible but regions with unfavourable infrastructure conditions reflected in a large technological gap move towards equilibrium at a slower pace.

Up to this point the pattern of convergence is similar to that implied by the standard neoclassical model, although is specified in non-linear terms. Convergence towards a unique equilibrium is still the case, although this non-linearity implies that regions with low (high) initial technological gaps converge at a higher (slower) rate. However, if $\pi > 1$, then convergence towards a unique equilibrium, for all but the leading region, is no longer the case, and b_{lf}^* represents a threshold value now. In this case technology diffusion is represented by a convex function implying that regions converge towards different equilibria, as shown in Figure 4.

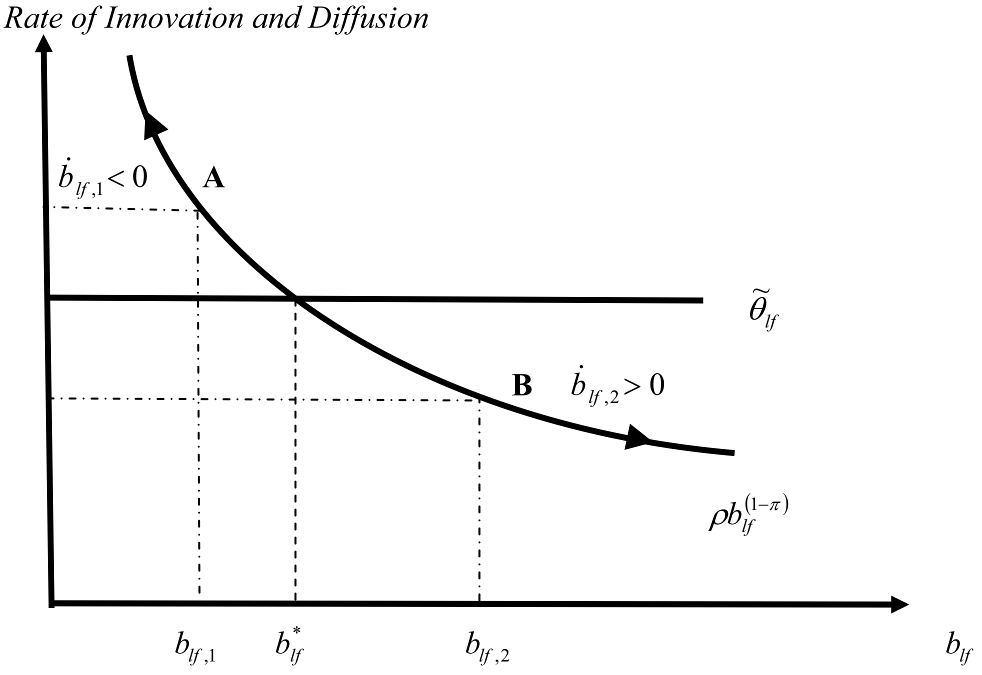

Figure 4: Convergence towards different equilibria when $\pi > 1$

As Figure 4 shows, economies on either side of the threshold b_{lf}^* move in different directions. This pattern of convergence and divergence can be illustrated using a simple example. Assuming that the leading region is at the technological frontier $(b_l = a_l - x = 0)$ so that steady-state equilibrium is, therefore, approximated by the leading region, then convergence with the leading region requires that the gap at a terminal time (T) should be zero, i.e. $b_{lf,T} = 0$. However, as Figure 4 indicates, a zero gap with the leader is not feasible, since by definition the curve $\rho b_{lf}^{(1-\pi)}$ is asymptotic to the axis of the graph. Hence, a more realistic condition would be that the technological gap tends towards zero over a given time period, i.e. $b_{lf,T-0} \to 0$.

For simplicity assume that $\tilde{\theta}_{lf_1} = \tilde{\theta}_{lf_2}$ and ρ is the same for both regions[13]. A crucial assumption for the purposes of this paper is that the initial technological gaps differ between the two region-followers $(b_{lf_1} \neq b_{lf_2})$, with $b_{lf_1} < b_{lf_2}$. If the initial technological gaps differ between these regions $(b_{lf_1} < b_{lf}^* < b_{lf_2})$, then region 1 is able to close the technological gap with the leader, and the gap approaches zero asymptotically. Region 1 is able to adopt technology from the leading region and it is this latter effect which dominates. However, region 2, with a high gap and hence poor infrastructure conditions exhibits too slow a rate of technology absorption and, as a result, the gap with the leader increases over time. It is noticeable that convergence is a property

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[13] Relaxing this assumption leads to similar conclusions. To be more precise, redefining ρ in terms of differences in infrastructure conditions in a region and a leading region, i.e. $\rho_{lf} = \rho_f - \rho_l$, then convergence requires that $\rho_{lf} \to 0$, as $t \to \infty$ while divergence occurs when $\rho_{lf} \to \infty$, as $t \to \infty$.

apparent only for region 1 and the leading region. These regions can be conceived as an *exclusive convergence club.*

In terms of Figure 4, this club includes any region with a technological gap in the range $(0,b_{lf}^*]$, for which $\dot{b}_{lf_i} < 0$, while regions with gaps in the range $[b_{lf}^*,\infty)$, which $\dot{b}_{lf_i} > 0$, diverge from the leader and the remaining regions. In other words, the technological advantages of particular regions would accumulate and militate against convergence for all. In this light, b_{lf}^* is not an 'equilibrium' level for the technology gap, but rather a 'threshold' level, which distinguishes between converging and non-converging regions.

A similar situation emerges if it is assumed a time variation of the parameter π. Some regions are able to adopt technological innovations, developed in time t, in time $t+1$, while others, due to poor infrastructure conditions or large technology gaps, in time $t+n$, with $n>1$. The former group will exhibit relatively higher rates of technology growth and, hence, will be able to converge with the leader while the latter group will probably diverge or exhibit a slow rate of convergence, depending on the length of the time that technology adoption takes place.

These assumptions impose a non-linear process of technological diffusion (i.e. $\pi > 1$) that depends on infrastructure conditions as embodied in the size of the gap at a point in time. To be more precise, if the adoption of technology is related in a particular way to the size of the initial technological gap and associated infrastructure conditions, then two groups of regions can emerge; one which is a convergence club while a second group that does not exhibit an 'equilibrium'. Whether a region belongs to the convergence club depends on its capacity to adopt technology, and this capacity declines the higher the initial technology gap.
In the preceding example it was assumed that $\tilde{\theta}_{lf_1} = \tilde{\theta}_{lf_2}$. A more complicated picture arises if this assumption is relaxed, i.e. when $\tilde{\theta}_{lf_1} \neq \tilde{\theta}_{lf_2}$.

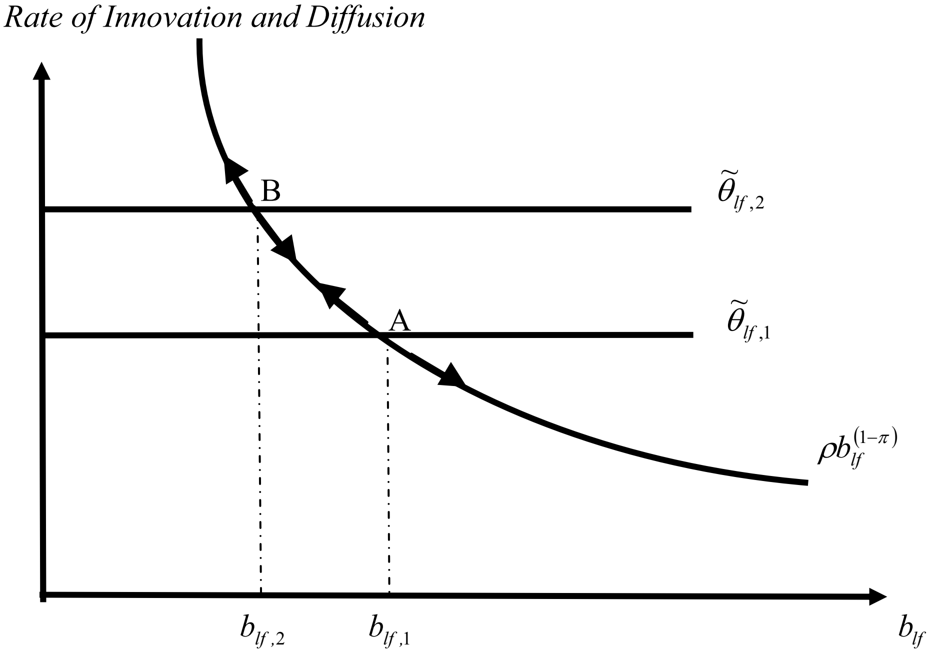

Figure 5: Club Convergence when $\pi > 1$ and $\tilde{\theta}_{lf_1} \neq \tilde{\theta}_{lf_2}$

Figure 5 shows a situation where $\widetilde{\theta}_{lf_1} < \widetilde{\theta}_{lf_2}$ [14]. Point B represents the critical threshold for region 2, showing that a large technological differential requires a high rate of technology absorption in order to prevent the region moving further away from the leading region in terms of overall technology growth. On the other hand, point A is the threshold for region 1, which has a lower technology differential compared to the leader. As a result, the rate of technology absorption that is required to prevent region 1 from following a divergent path, is lower compared to that of region 2. A diverging path for region 1 corresponds to movements to the right of point A. Hence, by imposing different abilities to create and absorb technology, two thresholds exist, one that corresponds to b_{lf_1}, with low $\widetilde{\theta}_{lf}$ and another to b_{lf_2}, with high $\widetilde{\theta}_{lf}$.

This model suggests that only regions with low technology gaps are likely to converge towards a steady-state equilibrium growth path, as represented by the growth rate of the leading region. Regions with relatively large technology gaps may fall progressively behind. Depending on the value of π, two distinct cases can be identified. If $\pi < 1$, then this model predicts a constant equilibrium gap, with different equilibrium positions possible depending upon whether $\widetilde{\theta}_{lf}$ is the same, or different, across regions. The pattern of convergence implied by $\pi > 1$ is the most interesting. In this case, two equilibria emerge, even when all regions share the same characteristics apart from their initial position with regard to the size of the technological gap. From this perspective, convergence amongst regions is feasible only if they share similar structural characteristics, regarding the creation and adoption of technology.

This model argues that even in the case where technology creation is limited to one region, the remaining regions may converge towards the leader provided that they are able to adopt and assimilate technology. The higher the technological distance from the leader, the greater the incentive to adopt technology. However, this model has also shown that a high technological gap may indicate and reflect inappropriate conditions for the adoption of technology, which prevent or constrain convergence with the more technologically advanced regions. Hence, a technological catch-up is feasible only amongst those regions whose conditions are similar or close to those of the technologically advanced regions. In this way club convergence is a probable outcome. This outcome is in accordance with a fast growing literature on club-convergence (e.g. Galor, 1996, 1996a; Galor and Tsiddon, 1997)

A final observation is that the size of this initial gap that distinguishes whether a region follows a convergent or divergent path. Further, if regions also differ with respect to their structural characteristics, then the membership of the convergence club is more ‘complex’ to establish but fundamentally there is still one convergence club. This club is most likely to include regions with structural characteristics similar to the leader and, consequently, convergence towards leading regions is feasible only for regions with sufficient absorptive capacity.

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[14] Such a situation might also occur if region 1 develops a ‘technology-producing’ sector in a subsequent time period (t_1) due to the combined effect of a relatively low initial technological gap and high absorptive ability. In particular, assume that $b_{lf_1,t_0} > b_{lf_1,t_1}$, which signifies that conditions in region 1 are favourable as to allow adoption of technology, that leads to $\theta_{lf_1,t_0} > \theta_{lf_1,t_1}$. If this sequence continues, providing of course that the adoptive ability of this region remains, at least, the same in future periods, then convergence towards the leader is feasible. Thus, we may express this process as: $b_{lf_i,t_n} \rightarrow 0$ and $\theta_{lf_i,t_n} \rightarrow 0$, as $n \rightarrow 0$.

V. Conclusion

Is it not time to abandon the simplistic idea that adoption of technology is an automatic process in favour of the more realistic assumption that this process is strongly related to infrastructure conditions? This possibility has remained, to our knowledge, an unexplored area in regional science. According to the model developed in this paper, regions with high degrees of technology absorption, attributed to better infrastructure conditions, form a convergence club with the technologically leading regions, while regions with a low ability to absorb technology diverge. Convergence towards leading regions is feasible only for regions with sufficient absorptive capacity, which is assumed to be a function of infrastructure conditions in a region.

While this paper has been concerned with the role of technology adoption and has stressed the impact of initial infrastructure conditions, there is no intention of implying that this approach represents the only route to understanding regional growth and convergence. It must be recognised that the foregoing analysis does not provide an exhaustive account of all the factors that affect the process of regional convergence. Improving the model developed in this paper by adding more explanatory elements would open up an interesting avenue for future research.

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