Will the Spanish Regions Converge in a Near Future?

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ABSTRACT

Spanish poor regions show problems of convergence. In this paper we find that statistical properties of their relevant variables reveal that only permanent positive shocks in the rate of growth of the capital stock can have positive permanent effects on both their output and labor. For developing those regions it would be necessary a very aggressive policy of capital stock investments, able to change agents expectations and able to attract both massive private investments and people.

Key Words: Growth, Convergence, VECM models, Integration orders

I. Introduction

Differences in productivity in the EU regions are in the core of UE worries, in fact, convergence has been one of the main goals pursued and it has been the main reason for creating both the Structural and Cohesion Funds.

On the other hand and despite the money spent, the lack of convergence of many regions is a kind of inescapable fate. This is the case of the Spanish regions, "Comunidades Autónomas" (CCAA). Despite the great amount of money invested, differences in GDP per worker (Y/L) between the richest and the poorest CCAA still persist, with no signs of catching up from the later.

This lack of convergence among regions can be explained by some theories, grouped under the title of "Non-Convergence theories of economic growth" whose most important representative is Myrdal (1957) theory.

In this paper we find empirical evidence supporting the Myrdal theory for the Spanish CCAA. Also we have found a statistical sufficient condition for this theory to be valid, and that it is present in12 CCAA where convergence is not detected.

The 12 CCAA with convergence problems are: Aragón, Asturias, Baleares, Canarias, Cantabria, Castilla-León, Castilla-La Mancha, Extremadura, Galicia, La Rioja, Murcia and Navarra. None of these regions is able to converge to any of the richer CCAA, that is, Andalucía, Cataluña, Madrid, País Vasco and Valencia.

The 12 CCAA of the first group share the same statistical property: Once all variables have been transformed using natural logs, Output (Yc)and Labour (Lc) are integrated variables of order one I(1),while Capital Stock (Kc)is an integrated variable of order two, I(2). The sum of GDP (Ye), Labour (Le) and Capital Stock (Ke) of the remaining 16 variables, once a particular region has been chosen, are also I(2) variables.

This result implies that, just for the poor regions, only the rate of growth of Capital Stock can produce permanent effects on the levels of GDP and Labour. Only a permanent, unitary increase in the Capital Stock rate of growth might yield permanent effects on the levels of both Output and Labour.

A permanent increase in the level of Kc might have effects on the level of Yc and/or Lc, but only of transitory character, its long run effect will be zero. When, inside a poor region, a particular investment in capital stock takes place, output and labour (inside the region) reacts in the short run, but soon these effects will die out.

These investments are more likely to have permanent effects on the output and labour of developed regions, whose variables have the appropriate order of integration, I(2). The same occurs when the investment takes place outside the less developed regions. Poor regions cannot beneficiate, in the long run, from investments, neither inside nor outside these regions themselves, while wealthy ones can do it from inside or outside it. These statistical properties suggest that a kind of circular cumulative effects, á la Myrdal, take place which difficult the desired convergence of poor regions.

In this situation, the only policy able to succeed in the task of getting convergence has to be a very aggressive one. It will be necessary to change the agents´expectations by implementing a policy of growing capital investments. That is, it will be necessary to change, in a permanent way, the capital stock rate of growth making able to attract capital and population to the region. It will give place to a Myrdal cumulative virtuous circle.

Summarizing, the Spanish economy is made up of 17 political/economic regions with a great degree of both political and economic autonomy. Five of them show high development levels and grow in line with their EU counterparts. The remaining 12 show lower growth rates, their levels of Y/L are lower than the former five and what it is more important, their ratios have been always lower than those of the richer ones with no signs at all converging to them. Statistical properties suggest structural economic difficulties for the poor regions to take advantage of capital stock investments, neither inside nor outside the region.

This paper is structured as follows. Section 2 present a summary of the most important non-convergence theories of economic growth. Section 3 discusses the value of the gain in a transfer function model when input and output have different degrees of integration. Section

4 studies the order of integration of Yc, Lc, Kc, Ye, Le and Ke for each one of the 17 Spanish CCAA. Finally, Section 5 concludes.

II. Non-convergence theories of economic growth

One of most discussed topics by economic growth literature has been the problem of convergence/non-convergence between different countries or regions. The convergence hypothesis that poor economies should catch up with the rich ones has generated a huge empiric literature. Historically, economic convergence has been the exception rather than the standard norm.

At some risk of oversimplifying, economic growth models can be classified into two families regarding to their convergence predictions.

On the one hand, the neoclassical growth model, as outlined by the pioneering work of Solow (1956) and Swan (1956), predicts convergence in regional economic performance. This model, using a general equilibrium framework, argues that market forces will lead to a general convergence of per-capita incomes across an integrated space economy over time, so any tendencies to diverge are seen as transitory in nature and will diminish as regions move towards 'steady-state' equilibrium. If economies have the same structural characteristics (identical technology, savings rate, population growth rate and depreciation rate), convergence can occur in an absolute sense (absolute convergence) since they will converge towards the same steady-state. Conversely, if economies are heterogeneous, convergence may occur only in a conditional sense (conditional convergence) since economies will grow toward different steady-state positions [see for a review Barro and Sala-i-Martin (1991, 1992, 2004) and Sala-i-Martin (1996),or, for the Spanish case, De la Fuente (2002) and Cuadrado Roura(2010)]. Therefore, assuming that convergence to a steady-state is taking place, the relevant question concerns about the speed at which this process occurs and, therefore, how long it will take.

On the other hand, in contrast to the neoclassical paradigm, there is a large body of theoretical and empirical work grouped under the name of 'non-convergence theories´. This line of thought supports the argument that interregional disparities are permanent and self-perpetuating and therefore economic divergence is the most likely outcome. Headed by Myrdal´s circular cumulative causation (Myrdal, 1957), these theories assume that resource allocation in space and interregional relations are responsible for unbalanced regional growth. Thus, regional disparities are part of the growth process and do not tend to disappear due to their own inertia, as once regional income disparities occur, there is a strong tendency for these inequalities to be reinforced, justifying a natural tendency to regional divergence. Therefore, without the help of the State, convergence will not occur.

However, between these two extreme perspectives, there is a 'new generation' of regional models of endogenous growth that have provided an alternative view on the process of regional growth and convergence, in the sense that they can encompass both possibilities: convergence and divergence.

The aim of this section is to summarize the main aspects regarding the non-convergence theories.

Among the non-convergence theories, the most representative is the Myrdal´s circular cumulative causation theory (Myrdal, 1957). This theory is based on the idea that growth is a complex phenomenon, involving multiple variables, economic and non-economic, interrelated dynamically and in constant disequilibrium. The feedback effects among variables tend to amplify the shocks. If they are positive for development, feedbacks will tend to reinforce growth, but if the shock is negative, feedback effects will lead the economy to stagnation. In this context, cumulative processes often have endogenous contradictions embedded in their dynamics and while a region may have cumulative upswings, other may experience a cumulative effect of increasing inequalities.

According to Myrdal, an impulsive growth process begins with an initial stimulus. Then, market forces benefit those regions with the most favorable conditions, since they take advantage of a double process. First, in these areas, the initial growth attracts skilled workforce, creating a larger and more dynamic domestic market, which increases demand and growth expectations, and, thereby, stimulates investments in the region. Furthermore, these regions may utilize internal and external (agglomeration) economies of scale and technological advancement that go along with new investments, not only increasing the productivity and competitiveness of the local economy, but also the external demand. In consequence, employment demand increases, generating new flows of workforce. These cumulative effects lead to a grow spiral of 'spread effects', creating a virtuous circle of growth in these regions.

By contrast, the less developed areas lag behind because there is an outflow of growth sources (capital and labor) to more developed regions. Accordingly, domestic demand falls and the lack of growth expectations and incentives, that could attract entrepreneurs and new investments, leaves capital demand at relatively low levels. Consequently, 'backwash effects' are reinforced and this triggers a vicious circle of growth.

From both perspectives, economic growth is a cumulative process that reinforces the tendency to the progress of regression. The essence of circular or cumulative causation is that the effects of individual cumulative mechanisms are related and lead to a growth spiral that benefit developed regions, in detriment of the most backward. Although there are flows between these regions, they only increase the differences between them, contributing to a greater geographic polarization of the economy, justifying a natural tendency to the non-convergence.

Several attempts have been made to formalize the concept of cumulative causation outlined by Myrdal (1957) in order to allow for empirical verification (O´hara,2008). For example, Kaldor (1970) elaborates on and expands the principle of circular cumulative causation within a formal economic model, postulating that the speed at which a region's per-capita output grows is determined by the extent to which regions are able to take advantage of internal scale economies and thus attain the benefits that accrue from greater specialization. In the context of regional cumulative growth, Dixon and Thirlwall's (1975) model is the most prominent (Harris, 2011). According to these authors, regional growth is a function of the demand for a region's exports. A faster growth of output leads to an increase in productivity growth (the

Verdoorn effect) which leads to an increase in a region's price competitiveness. This, in turn, generates a faster growth of the region's exports which, through the 'dynamic super-multiplier', increases the overall rate of growth.

Elements of the cumulative causation have been taken for other non-convergence theories. For example, in the export-base theory, developed in the 1950´s by North, the key driver of regional growth is an exogenous factor: exports. Closed related to this theory, is the Perroux´s Growth Pole Theory (Perroux, 1955), that places Myrdal´s theory into a spatial context. This theory highlights the role of a 'propulsive industry' in economic development, since they induced growth through interindustry linkages due to economies of scale. According to Perroux, economic growth is imbalanced or polarized, in the sense that there are several forces at work which result in the concentration of economic activity into certain 'growth poles'. Other regional divergence theories like centre-periphery approach that implies a polarization of regions intro different clusters: poor or 'peripheral' regions and rich or 'centre-core'regions, with growing disparities and divergence among clusters, or the theory of spatial division of labor, are an expanded version of Myrdal´s theory.

The New Economic Geography literature, pioneered by Krugman (1991), reaches similar conclusions than the cumulative causation model of growth-upon-growth. For Krugman, agglomeration is the key factor determining regional growth (Fujita, Krugman and Venables, 1999). Agglomeration of economic activities in space, due to economies of scales, intensifies regional disparities and the most probable outcome is divergent growth paths.

It is important to consider, whether the concept of endogenous growth would tend to suggest trends to divergence, there are some circumstances in which convergence remains a possibility. In this sense, the theories of endogenous growth, pioneered primarily by the work of Romer (1986) and Lucas (1988), point out that economies which manage to develop a high technological capital stock -and indirectly human capital- will be able to catch up, in the long term, with the most developed.

The overall conclusion is that non-convergence theories are not exclusive but complementary. Although each of them emphasizes the role of one or more factors as determinants of economic growth, they share a common idea: regional growth is a cumulative process, in which market forces tends to persist and increase, instead of decrease, interregional disparities. In sum, convergence doesn´t take place because the cumulative and agglomeration processes that occur during economic growth, mainly favor the most developed economies, leaving the less developed in a precarious state and unable to take advantage of the greater and faster growth of the richest.

III. The gain value in a Transfer Function Model

Consider the following one single input transfer function model (Box and Jenkins, 1976) for non-seasonal time series:

$$y_t = \nu(B)x_t + N_t$$

$$\nabla^d N_t - \mu = \Psi(B) a_t$$

Where y_t is the output time series, x_t is the input time series, $\nu(B)$ is the transfer function:

$$\nu(B) = \nu_0 + \nu_1 B + \nu_2 B^2 + \ldots$$

Where ν_j for j= 0,1,2,… are the weights and B is the rational lag operator. The transfer function $\nu(B)$ describes the dynamic answer of the output to a shock in the input time series. In particular, when the input time series receives a unitary, permanent shock, $g = \sum_{j=0}^{\infty} \nu_j$ ("the gain") measures the long run answer of the output to this type of shock in the input.

N_t is the non-stationary noise of the transfer function model (TFM). It follows a general ARIMA(p,d,q) model, where: μ is the mean of $\nabla^d N_t$, $\Psi(B) = 1 + \psi_1 B + \psi_2 B^2 + \ldots$

Is a infinite polinomial in B where $\sum_{j=0}^{\infty} \psi_j < \infty$. Finally a_t represents a white noise process.

The standard case occurs when "d" is the integration order of both input and output, but it has not to be necessarily so; "d" is the minimum number of differences needed for N_t to be I(0) but input and output could be integrated variables of different orders. For instance, if the input is an I(2) variable and the output is I(1), the TFM linking them would be:

$$y_t = \nu(B) \nabla x_t + N_t$$

$$\nabla N_t - \mu = \Psi(B) a_t$$

In this case "d" would be equal to 1 and the transfer function between y_t and x_t would be:

$$\nu^*(B) = \nu(B) \nabla$$

As $\nu^*(B)$ has a unit root, this implies $g^* = 0$ which means that any permanent shock in x_t will not have a permanent effect on y_t. Thus, only transitory effects on y_t can be expected even if the level of x_t changes in a permanent way.

This happens in our analysis when y_t is the group (1) CCAA labor or the CCAA GDP and x_t is the CCAA capital stock or out of the CCAA capital stock, labor or GDP.

It is important to note that the gain of $\nu(B)$ could be different from cero, which means that permanent changes in the level of ∇x_t can have permanent effects on y_t. In our case, permanent changes in the rate of growth of the capital stock can have permanent effects on both the levels of CCAA labor and CCAA GDP.

IV. Empirical Analysis

This section presents the order of integration of Yc, Lc, Kc, Ye, Le and Ke for the 17 Spanish CCAA. Also it summarizes the estimated long run elasticities of GDP (own region and remaining regions) and Labor (own region and remaining regions) with respect to the capital stock of the same region (own region) and the capital stock outside the region (remaining regions).

Table 1 shows the p- values for the ADF test where the null hypothesis is the presence of an extra unit root in the rates of growth of output ($\mathrm{dYc}_t = \nabla \ln(\mathrm{Yc}_t)$), labor ($\mathrm{dLc}_t = \nabla \ln(\mathrm{Lc}_t)$)and capital stock ($\mathrm{dKc}_t = \nabla \ln(\mathrm{Kc}_t)$) for each region, as well as for the presence of an extra unit root in the rates of growth of output ($\mathrm{dYe}_t = \nabla \ln(\mathrm{Ye}_t)$), labor ($\mathrm{dLe}_t = \nabla \ln(\mathrm{Le}_t)$) and capital stock ($\mathrm{dKe}_t = \nabla \ln(\mathrm{Ke}_t)$) of the remaining regions when one region, in particular, has been selected. The letter "c" in the name of the variables means "own region", while letter "e" means "outside the region".

Note that if a rate of growth is an I(d) variable, it implies that its corresponding level (the natural log of the variable) is an I(d+1) variable.

Table 1: P- values for the ADF test

REGION	VARIABLES					
	$\nabla \ln(Yc_t)$	$\nabla \ln(Lc_t)$	$\nabla \ln(Kc_t)$	$\nabla \ln(Ye_t)$	$\nabla \ln(Le_t)$	$\nabla \ln(Ke_t)$
Andalucía	0.1208	0.1006	0.3672	0.1351	0.1724	0.3670
Cataluña	0.1557	.01565	0.5582	0.2818	0.966	0.4466
Madrid	0.1178	0.0935	0.5028	0.2756	0.0783	0.4402
País Vasco	0.1595	0.0643	0.5058	0.2956	0.1018	0.4544
Valencia	0.1204	0.1245	0.3201	0.2905	0.0868	0.4069
Aragón	0.0218	0.0045	0.3333	0.1515	0.1013	0.4115
Asturias	0.0005	0.0077	0.3080	0.1390	0.1820	0.4344
Baleares	0.0015	0.0317	0.1709	0.2994	0.0956	0.4336
Canarias	0.0333	0.0294	0.2171	0.2904	0.1019	0.4368
Cantabria	0.0168	0.0149	0.6375	0.3027	0.1015	0.4450
Castilla León	0.0168	0.0355	0.4150	0.2958	0.1042	0.4620
Castilla Mancha	0.0080	0.0362	0.7245	0.3057	0.1044	0.3878
Extremadura	0.0004	0.0039	0.1576	0.3034	0.0966	0.4171
Galicia	0.0348	0.018	0.5588	0.3020	0.1023	0.4402
Murcia	0.0347	0.0135	0.6619	0.3004	0.1044	0.4301
Navarra	0.0163	0.0321	0.4236	0.3045	0.1002	0.4412
La Rioja	0.0106	0.0121	0.7164	0.3021	0.1011	0.4338
H_0: There isan extra unit rootin the variable						

For all regions, $\nabla \ln(Ye_t)$, $\nabla \ln(Le_t)$ and $\nabla \ln(Ke_t)$ are I(1) variables, that is, the level of the sum of output, sum of labor and sum of capital stock for the remaining regions, once a region has been selected, are I(2) variables.

The rate of growth of capital stock, $\nabla \ln(Kc_t)$**,** is also an I(1) variable,for all CCAA.

Output and labor rates of growth are I(1) variables for the five rich, but I(0) for the remaining twelve.As all rates of growth of the foreign sector variables, of any region, are I(1), while $\nabla \ln(Yc_t)$ and $\nabla \ln(Lc_t)$ are I(0) for these 12 regions, only permanent shocks in the rates of growth of foreign variables might have permanent effects on the levels of output ($\ln(Yc_t)$) and labor ($\ln(Lc_t)$) of these 12 poorer regions. A transitory shock in any of the rates of growth of the foreign variables (which is a permanent shock in their levels) will have only transitory effects on their levels of output and labor. Only the big five can get a permanent advantage of a permanent positive activity shock outside their borders. Poor regions might enjoy of transitory effects, but only the big five regions will enjoy positive long run effects.

The next relevant question has to do with the effects of capital stock investments and their effects inside the region. Again the big five, with all rates of growth being I(1), can experience positive, long run effects on $\ln(Yc_t)$ and $\ln(Lc_t)$ from a permanent shock in $\ln(Kc_t)$. The levels of output and labor, $\ln(Yc_t)$ and $\ln(Lc_t)$, of small/middle size regions, will not be affected in the long-run, by positive and permanent shocks in their own capital stocks.

Table 2 contains the estimated long run elasticities of own output (Yc), own labor (Lc), foreign output (Ye), foreign labor (Le) with respect to own capital stock (Kc). Also this table contains the estimated long run elasticities of own output (Yc), own labor (Lc) foreign output (Ye) and foreign labor (Le) with respect to foreign capital stock (Ke). This Table has been obtained from the corresponding Vector Error Correction Models (VECM) elaborated for each region. The cointegration analysis has been carried out by the Johansen method (Johansen, 1991).

Table 2: Long TermElasticities

	Elasticity respect to Kc_t				**Elasticity respect to Ke_t**			
REGION	Yc_t	Lc_t	Ye_t	Le_t	Yc_t	Lc_t	Ye_t	Le_t
Andalucía	0.24	0.50	0.22	0.40	1.27	2.67	1.21	2.16
Aragón	0.00	0.00	0.00	0.00	0.00	0.00	1.73	3.18
Asturias	0.00	0.00	0.00	0.00	0.00	0.00	1.75	3.17
Baleares	0.00	0.00	0.00	0.00	0.00	0.00	1.77	3.22
Canarias	0.00	0.00	0.00	0.00	0.00	0.00	1.79	3.26
Cantabria	0.00	0.00	0.00	0.00	0.00	0.00	1.73	3.18
Castilla la Mancha	0.00	0.00	0.00	0.00	0.00	0.00	1.74	3.20
Castilla y León	0.00	0.00	0.00	0.00	0.00	0.00	1.80	3.26
Cataluña	1.20	2.03	1.18	2.22	0.66	1.11	0.64	1.21
Extremadura	0.00	0.00	0.00	0.00	0.00	0.00	1.75	3.17
Galicia	0.00	0.00	0.00	0.00	0.00	0.00	1.74	3.28

La Rioja	0.00	0.00	0.00	0.00	0.00	0.00	1.73	3.19
Madrid	0.80	1.24	0.80	1.47	0.84	1.32	0.84	1.56
Murcia	0.00	0.00	0.00	0.00	0.00	0.00	1.74	3.18
Navarra	0.00	0.00	0.00	0.00	0.00	0.00	1.70	3.20
País Vasco	0.31	0.44	0.29	0.55	0.71	1.02	0.68	1.28
Valencia	0.71	1.21	0.58	1.12	2.03	3.45	1.67	3.21

Table 2: Long TermElasticities

REGION	Elasticity respect to Kc_t				Elasticity respect to Ke_t			
	Yc_t	Lc_t	Ye_t	Le_t	Yc_t	Lc_t	Ye_t	Le_t
Andalucía	0.24	0.50	0.22	0.40	1.27	2.67	1.21	2.16
Cataluña	1.20	2.03	1.17	2.22	0.65	1.11	0.64	1.21
Madrid	0.80	1.24	0.80	1.47	0.84	1.32	0.84	1.56
País Vasco	0.31	0.44	0.29	0.55	0.71	1.02	0.68	1.28
Valencia	0.71	1.21	0.58	1.12	2.03	3.45	1.67	3.21
Aragón	0.00	0.00	0.00	0.00	0.00	0.00	1.72	3.18
Asturias	0.00	0.00	0.00	0.00	0.00	0.00	1.74	3.17
baleares	0.00	0.00	0.00	0.00	0.00	0.00	1.79	3.23
canarias	0.00	0.00	0.00	0.00	0.00	0.00	1.79	3.26
Cantabria	0.00	0.00	0.00	0.00	0.00	0.00	1.72	3.18
Castilla y León	0.00	0.00	0.00	0.00	0.00	0.00	1.80	3.26
Castilla la Mancha	0.00	0.00	0.00	0.00	0.00	0.00	1.73	3.20
Extremadura	0.00	0.00	0.00	0.00	0.00	0.00	1.76	3.18
Galicia	0.00	0.00	0.00	0.00	0.00	0.00	1.74	3.28
La Rioja	0.00	0.00	0.00	0.00	0.00	0.00	1.71	3.16
Murcia	0.00	0.00	0.00	0.00	0.00	0.00	1.91	2.08
Navarra	0.00	0.00	0.00	0.00	0.00	0.00	1.70	3.20

These results confirm, as it could not be otherwise, the general theoretical result exposed in Section III.

V. Conclusions

This paper combines two important results, one related to the properties of the Spanish regions time series data and the second, an important theoretical result related to the gain of a transfer function when inputand output have different orders of integration.

Result 1:

Different regions in Spain show different statistical properties for GDP, Labor and Capital Stock.

For the richest regions,Andalucía, Cataluña, Madrid, País Vasco and Valencia, the six variables considered (Output, Labor and Capital Stock for the region and Output, Labor and Capital Stock for the remaining 16 regions) are all integrated of order 2variables.

For the remaining 12 regions, all with problems of convergence with respect to those of the richest,own labor and own output are I(1) while own capital stock, as well as foreign output, foreign labor and foreign capital stockare all I(2).

Result 2:

It has been proved that the long run response (gain) of an I(1) variable to a permanent, unitary shock of an I(2) variable is zero. The response of theI(1) variable can be different from zero,

but just in the short-run. Only permanent changes in the rate of growth of theI(2) variable can lead to permanent changes in the level of the I(1) variable.

Combining these two results allows us to reach to important conclusions about the lack of convergence in Spain of poor regions toward the rich ones:

1. Permanent increases in the level of rich regions capital stock affect, positively and permanently, only to Labor and GDP of rich regions. Poor regions can be transiently affected only.
2. Labor and Output of poor regions do not react, in the long run, to permanent changes in the level of capital stock, whatever its origin is: interior or exterior.
3. Only permanent increases in the rate of growth of capital stock can affect permanently the levels of output or labor of the poor regions. That is, only with a policy of massive investments will be able to change the agents´ expectations and to generate a kind of Myrdal´s positive virtuous circle of growth.

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