Testing differences in long run growth among spanish regions: Can growth models explain it?.

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ABSTRACT:

In this paper we have estimated long run growth rates for the Spanish regions using the methodology of unit root series with structural break. The results show that each region has its own long run rate in concordance with endogenous growth models prediction.

In terms of convergence this kind of models predict both convergence and divergence among different economies. In the case of Spanish regions we obtain some divergence after the structural break in mid-seventies.

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1.- Introduction

Historically, it is considered, following the neoclassical growth model, that less developed economies must growth on higher rates that developed ones due to decreasing of marginal factor productivity, especially in capital, and at the end of transitional period it must get equal growth rates. This result is obtained using different assumptions considered in the model. It is assumed that the economies have similar structural "production" and specialization and there are free factors mobility and free diffusion of technology among the different economies. So on, if there are not technical progress in the long run the per capita production will be the same, independently of initial conditions and policy interventions in the economy, in the known result of convergence obtained by Barro(1991) and Barro y Sala (1992), among others.

The new literature of growth, the endogenous growth models, try to introduce as endogenous some of the variables that are exogenous in the traditional growth models as endogenous. This difference, that sounds only methodological, has important consequences over the implications of theoretical models. In this kind of models is not an assumption the decreasing marginal productivity of capital, due to different factors, each of one classified in different endogenous growth models. So, if we include public capital in the production function we obtain the model proposed by Barro (1990), if it is human capital, the model proposed by Lucas(1988), and so on[1]. With endogenous models the economies will growth at a rate determined by the behavior of the agents in the economy and could be the same or different among different economies. On the other hand, the long run growth rate in each economy could change on time if the agents notice that same structural changes in the economy could be permanent and changes his behavior accordingly. The theoretical result of these models is that in the long run could exist convergence or divergence, or in same way, we can not talk on convergence properly.

The main focus of this paper is to try, empirically, to obtain the long run growth rates of the Spanish regions; and, on one hand, to contribute to choose between the two kind of models, and, on the other hand, to test indirectly the convergence hypothesis, inside a country, where there is a monetary union and only the market specialization among the regions can explain the differences if there exist in those rates.

This work is in line with the growing interest by empirical evidence on converge. This renewal interest has much to do with the works reinitiated by Barro(1991) and Barro and Sala(1992), and for the expected effects that we will take place inside the countries that will be included in the Monetary Union about growth in the long run. If the convergence is not an automatic effect among countries the UE must introduce structural policies or mechanisms for income distribution inside the Union like there are in the member countries to limit the negative impact in the poorer countries where is expected less lon run growth.

The empirical evidence obtained for others authors have not been enough clear. For countries looks that convergence is not an historical fact either in GDP or per capita GDP growth, only when it include some selected group of countries like OCDE or EU countries we can talk on convergence, with several limitations. This kind of papers (Barro y Sala (1991), Mankiw, Romer and Weill(1992),etc) use cross section methodology and limited extension on time. Recently, Pallardó and Esteve (1997), using time series methodology did not found decisive evidence in favour of convergence in the EU. About the Spanish regions the evidence is mixed too. In this case all precedent works using cross section methodology found same evidence on convergence under certain hypothesis in Mas, Maudos, Pérez and Uriel(1993), and under the hypothesis of a initial income level in Canova and Marcet(1995).

To obtain the steady state rates of growth we use the methodology of unit roots time series. If the series are stationary we can calculate the trend growth rate in the limit when time tends to infinite, as, like we explain further, which will be the steady state growth rate. For this aim, we use regional data obtained from the BBV data bank that covers the longest period we have regional data for 1955-1991, with several variables like GDP, population and labor.

This paper is structured as follows. Section I introduce the aim, methodology and data sources used for us in the paper. Section II explain the unit roots test and obtain the long run growth rates. Section III show the main results obtained for the Spanish regions on main variables like GDP , per capita GDP and labor productivity growth. The paper ends with the work review and focus in the main conclusions.

II.- LONG RUN GROWTH RATES

The question of the existence of unit roots in real GDP series has been deeply investigate in USA with the real business cycles theory. The discussion was introduced by the Nelson and Plosser(1982) paper that found that most economic series has a unit root.

Recently, Perron(1989) has introduced the idea that any serie who has a structural change in time has a unit root using traditional test (Dickey- Fuller,i.e.) and when the structural break is incorporated into the test the serie become stationary. Perron tried to incorporate the structural break into the traditional unit root test. Later, Zivot and Andrews(1992), and Ben-David y Pappell(1994,1995), developed sequential test to determine if there are a structural break in time series with no a priori impositions over the series, and test if the serie is or not stationary when the structural break is incorporated.

Using this methodology, Perron and Zivot and Andrews replied the results of Kydland and Prescott found that most of economic series have had at least a structural break in the time period analyzed(1910-1980), and when the structural break was incorporated in the test that series became stationary. Using this first results, Ben-David and Pappell calculated the period breaks in GDP, per capita GDP and long run growth rates in several countries using Madison data. We use this methodology to calculate both structural break and long run growth in Spanish Regions using BBV data.

II.1.- Unit roots and structural break test

The method to test unit root is to use the augmented Dickey-Fuller test (ADF below) over the GDP and per capita GDP time series for the period considered. The unit root test lie on running the following regression:

$$\Delta y_t = \mu + \beta t + \alpha y_{t-1} + \sum_{j=1}^{k} c_j \Delta y_{t-j} + \varepsilon_t \qquad (1)$$

where:

y_t is the production level over the period in logs.

t is time and represents the trend

ε is an error term that is supposed white noise

Δ is the first difference operator

We contrast the value of the t_α statistic and we reject null hypothesis of unit root if the t-statistic is significantly different from zero, what we know if the value of this statistic is greater than a determined value given by the McKinnon tables. For all the empirical work we use the TSP for Windows econometric program called EVIEWS, where this values are given automatically for each observation number. The lag length k is chosen following Perron criteria, from which we determine k like the last lag significantly different from zero using t-statistic.

Table 1 shows the results of unit roots test for both, GDP and per capita GDP. In all of the 17 cases we can not reject the hypothesis of the existence of a unit root in the series. As we explain previously, when the economic time series show a structural break over the time period we can never reject the null of unit root. The following step in this case is try to test if this failure in reject the null is due to a structural break. Sequential test for structural break was developed by Zivot and Andrews, and consist in estimating the following regression:

$$\Delta y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \alpha y_{t-1} + \sum_{j=1}^{k} c_j \Delta y_{t-j} + \varepsilon_t \qquad (2)$$

Some of the variables that appear in the equation 2 were defined before. DU is a dummy variable, which incorporates the change in mean and DT, is a dummy, for change in trend. The time period for which the structural break occurs is called T_B. The dummy variables has th following values: $DU_t = 1$ if $t>T_B$ and zero otherwise; $DT_t = t$ if $t>T_B$, 0 otherwise; following Ben-David and Pappell(1994). Equation 2 is sequentially estimated for $T_B = 2,...,T-1$, where T is the number of observations after take into account the lag length resulting after taking first differences in the variables.

The unit root test is obtained applying ADF statistic, taking the period when structural break occurs the one for which the value of t_α is maximized. The null hypothesis is that the serie has a unit root against the alternative that the serie is stationary with break. For each period the lag length is chosen using the criteria explained before. Critical values are taken from Ben-David and Pappell(1994).[2]

The results of the test are shown in table 2. It could be seen from the table that we can reject the unit root hypothesis for both, GDP and per capita GDP series in the 17 Spanish regions[3].

To calculate the period for which structural break occurs, we use the test proposed by Zivot and Andrews(1992) for model C and used in Ben-David and Pappell(1995). This test consist in estimate the following regression:

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + \alpha y_{t-1} + \sum_{j=1}^{k} c_j y_{t-j} + \varepsilon_t \qquad (3)$$

where the variables are defined like in equation 2. The equation is estimated sequentially for each period. The period for the structural break is chosen using Sup F_t (or Sup Wald) test, whose value is the maximum when we contrast the null of $\theta = \gamma = 0$, or no structural break. The null is rejected when the statistic is greater than a critical value. The lag length k is chosen like before. The critical values are taken from Ben-David and Pappell(1995). The results for the year when structural break is supposed to take place are shown in table 3, for GDP and per capita GDP. For the most of the regions the structural break takes place in mid-seventies, between 1973 and 1976[4].

II.2.- Steady state growth rates

To show how we calculate steady state growth rates, suppose that k=1, and we do not have the dummy variables DU and DT, and we have not error term. In that case, equation 3 becomes:

$$y_t = \mu + \beta t + c y_{t-1} \qquad (4)$$

with y_t following the temporal path:

$$y_t = Ac^t - \frac{\beta c - (1-c)\mu}{(1-c)^2} + \frac{\beta}{(1-c)} t \qquad (5)$$

where

$$A = y_0 + \frac{\beta c - (1-c)\mu}{(1-c)^2} \qquad (6)$$

The annual growth rate, Δy_t, is:

$$\Delta y_t = \frac{\beta}{1-c} - (1-c)Ac^{t-1} \qquad (7)$$

If 0<c<1, the growth rate asintotically converges to the constant value of:

$$l'\underset{t\to\infty}{im}\Delta y_t = \frac{\beta}{1-c} \qquad (8)$$

If we rewrite equation (4) including the constant and trend dummies:

$$y_t = \mu + \theta\, DU_t + \beta\, t + \gamma\, DT_t + c\, y_{t-1} \qquad (9)$$

The long growth rate is then:

$$\Delta y = \frac{\beta + \gamma}{1-c} \qquad (10)$$

in the period when trend dummy variable is significant.

In the general case with k>0, writing equation (3), the long run growth rates are[5]:

$$\Delta y = \frac{\beta}{1-\sum_{j=1}^{k} c_j} \ ,$$

or (11)

$$\Delta y = \frac{\beta + \gamma}{1-\sum_{j=1}^{k} c_j}$$

when trend dummy variable is included, with $\sum_{j=1}^{K} c_j < 1$.

III.- The long run growth rates in the Spanish regions

We apply this methodology to GDP and per capita GDP in the Spanish regions between 1955-1991. Results are shown in tables 4, 5 and 6. Table 4 shows results for GDP growth, table 5 for per capita GDP and table 6 for labor productivity. The values of table 6 are calculated from table 5 adding the evolution of the rate of working over population in the period. When productivity growth is greater than per capita growth means that the occupied rate has decreasing in the period considered, and viceversa.

The results presented in table 4 show that far away to suppose that the long run growth rate is the same in the Spanish regions, these rates are very different, meaning that each region converges to its own rate. The dispersion among the rates is 33% in terms of the variation coefficient or 19% when we exclude Canarias and Baleares islands. In terms of convergence we would expect that at least the poorer regions have the biggest growth rates.

In figure 1 we represent the long run growth rates and per capita GDP in 1955. The vertical and horizontal cross lines inside represent the values for mean. If there is convergence most of points must be in second and forth quarters in figure. However, this only happen for ten, which are a little more than a half of the regions. Then, is difficult to talk about GDP convergence.

But theory do no talk on convergence in terms of GDP. Population migration play an important role in convergence, and it is more usual to talk in terms of per capita GDP or labor productivity. Tables 5 and 6 present the growth rates and figures 2 and 3 shows the pattern on both series, using similar scale than the one used.

In both series, the data show that long run rates are different among regions. In this case the dispersion of rates is lower than in terms of GDP reflecting that migration played an important role to achieve convergence but not enough. The divergence on growth rates decrease to 13% in both, per capita GDP and productivity. In figures 2 it could be seen that only four and five regions, respectively, fall out on second and fourth quarters.

However, things change after mid-seventies with the structural break. The long run growth rates in all variables diminish being the decreasing greater in terms of per capita

GDP and productivity greater than in GDP terms, reflecting that the structural break in growth was with a change in population and labor migration trend. Dispersion in GDP growth rates do not change among the regions from the period before the break, but sharply increase in terms of per capita GDP and productivity, passing to 26% and 36% respectively.

In terms of convergence, we repeat the plot of figures 1,2 and 3 for the period after the break. In this case in the x-ax we represent the long run growth rate after the break and in the y-ax the per capita GDP in 1975. The vertical and horizontal lines means the same as before.

In terms of GDP things are better for convergence thanks to the improvement of three regions in relative terms – Extremadura, Castilla La Mancha and Galicia- and the worsening of one – Cataluña- increase the number of regions including in the two quarters. But it happens on the contrary in terms of per capita GDP and productivity. In this case not only dispersion increase but deteriorates convergence among regions. Figures 5 and 6 shows that less than a half regions are including in the two relevant quarters indicating that divergence predominates after the structural break.

When we study convergence in terms of per capita income things are different due to income distribution produced by fiscal policy inside the country. Fiscal policy minors considerably differences among regions creating same convergence.

IV.- CONCLUSIONS

In this paper we apply unit root time series methodology to obtain the long run growth rates in the Spanish regions. The main results can be summarized as follows.

We found that GDP and per capita GDP series have a structural break in mid-seventies that affect growth in terms of trend. Taking into account the structural break into the unit root test for the series we can reject the unit root for all Spanish regions. We calculate on these basis the long run growth rate for each region testing growth models and its prediction.

First at all, results show that growth rates are different for each region, reflecting that each economy has his own long run growth rate to which converges. Only endogenous growth models that predict differences in the rate of growth among different economies

explain this results, that is the reason that we have to use this king of models if we have to explain growth. Endogenous models points out different reasons to explain why can exist different growth rates- different preferences in saving and investment, different human capital accumulation, different public capital accumulation, specialization, etc-, any of which can explain this fact. Only more empirical work could show what variable or combination of them explain more.

Second, after structural break the richest regions has the biggest long run growth rates, reflecting the fact, pointed out for others authors (Mas at all(1993),i.e.) that from mid-seventies the convergence among Spanish regions stopped in terms of per capita income. These results, with ours that reflect per capita GDP divergence, imply that fiscal policy has played an important role in income distribution in Spain, not allowing things be worse.

In the case of EU where exist less factor mobility among the countries that inside them, convergence is possible only because European countries has similar structure. When free trade and monetary union consolidate each country will tend to specialize and growth rates will tend to diverge creating increasing divergence. In absence of a common fiscal police this divergence will do income divergence, increasing differences among rich and poor regions.

TABLE Nº 1

UNIT ROOT TEST				
	GDP		**Per capita GDP**	
	k	ADF	k	ADF
ANDALUCIA	1	-1,865	6	-2,926
ARAGON	2	-1,162	7	-2,68
ASTURIAS	1	-1,171	6	-2,788
BALEARES	1	-1,982	1	-2,344
CANARIAS	7	-2,116	1	-1,513
CANTABRIA	0	-1,594	7	-2,483
CAST.Y LEON	1	-2,635	1	-1,569
CAST.MANCHA	1	-2,436	7	-2,481
C.VALENCIANA	1	-1,247	1	-1,162
CATALUÑA	1	-1,527	1	-2,143
EXTREMADURA	5	-3,331	5	-2,21
GALICIA	1	-1,744	1	-2,39
MADRID	1	-1,12	1	-2,21
MURCIA	1	-1,349	7	-1,917
NAVARRA	1	-1,908	1	-1,936
PAIS VASCO	1	-1,559	1	-2,051
RIOJA	1	-3,233	1	-2,891
ESPAÑA	1	-1,503	7	-2,946

McKinon critical values
1% -4,22
5% -3,53
10% -3,40

TABLE Nº 2

UNIT ROOT TEST WITH BREAK

	GDP		Per capita GDP	
	k	ADF	k	ADF
ANDALUCIA	7	-6,75	1	-4,85
ARAGON	7	-4,48	7	-5,37
ASTURIAS	7	-5,42	7	-6,21
BALEARES	1	-5,39	1	-5,57
CANARIAS	7	-4,66	9	-7,28
CANTABRIA	1	-3,6	1	-4,94
CAST.Y LEON	1	-5,77	2	-7,75
CAST.MANCHA	7	-6,35	1	-5,62
C.VALENCIANA	5	-4,94	3	-5,48
CATALUÑA	1	-4,86	1	-5,93
EXTREMADURA	6	-5,78	7	-8,41
GALICIA	1	-5,46	7	-5,07
MADRID	7	-4,78	1	-5,11
MURCIA	8	-5,02	1	-5,31
NAVARRA	7	-4,27	1	-6,13
PAIS VASCO	7	-5,4	1	-5,87
RIOJA	1	-5,79	2	-6,8
ESPAÑA	7	-5,18	7	-5,11

McKinon critical values
1% -4,22
5% -3,53
10% -3,40

TABLE Nº 3

STRUCTURAL BREAK TEST						
	GDP			PER CAPITA GDP		
	Sup F	k	Break Year	Sup F	k	break year
ANDALUCIA	37,96	8	1978	27,12	2	1975
ARAGON	16,83	8	1978	19,88	8	1971
ASTURIAS	20,09	8	1971	21,08	8	1971
BALEARES	43,44	2	1973	27,08	8	1971
CANARIAS	19,29	8	1971	49,66	10	1979
CANTABRIA	14,53	2	1976	29,11	2	1972
CAST.Y LEON	24,54	2	1979	62,76	3	1977
CAST.MANCHA	28,96	8	1971	30,67	2	1971
C.VALENCIANA	22,59	4	1971	28	4	1971
CATALUÑA	23,35	2	1976	29,77	2	1979
EXTREMADURA				123,19	8	1981
GALICIA	31,38	2	1979	21,49	8	1978
MADRID	26,89	8	1975	28,7	3	1979
MURCIA	22,41	9	1977	29,63	2	1975
NAVARRA	9,38	8	1971	34,06	2	1976
PAIS VASCO	20,42	8	1971	38,35	2	1976
RIOJA	21,73	2	1979	39,91	3	1978
ESPAÑA	19,59	8	1971	36,8	8	1971

Valores Críticos	1%	19,9
	2,50%	17,26
	5%	15,44
	10%	13,62

TABLE Nº 4

GDP LONG RUN GROWTH

REGION	BEFORE BREAK	AFTER BREAK	2º/1º	K	BREAK YEAR
ANDALUCIA	5,16	2,65	0,51	8	1978
ARAGON	4,93	2,75	0,55	8	1978
ASTURIAS	5,23	1,77	0,33	8	1971
BALEARES	9,41	4,77	0,05	5	1973
CANARIAS	10,56	4,77	0,55	8	1973
CANTABRIA	4,42	2,41	0,54	2	1976
CAST.YLEON	4,22	3,49	0,82	3	1979
CAST.MANCHA	4,66	2,72	0,58	8	1971
CATALUÑA	6,32	2,99	0,47	2	1976
C.VALENCIANA	5,43	3,36	0,61	4	1971
EXTREMADURA	3,33	3,33	1	7	1979 (A)
GALICIA	5,42	3,64	0,67	2	1979
MADRID	7,51	3,37	0,44	8	1975
MURCIA	6,29	3,22	0,51	9	1977
NAVARRA	5,13	3,09	0,6	8	1971
PAIS VASCO	5,41	1,86	0,34	8	1971
RIOJA	4,33	3,67	0,84	2	1979
ESPAÑA	5,7	3,2		8	1971
CV (all regions)	0,33	0,26			
CV (w. islands)	0,19	0,2			

TABLE Nº 5

Per capita GDP long run growth

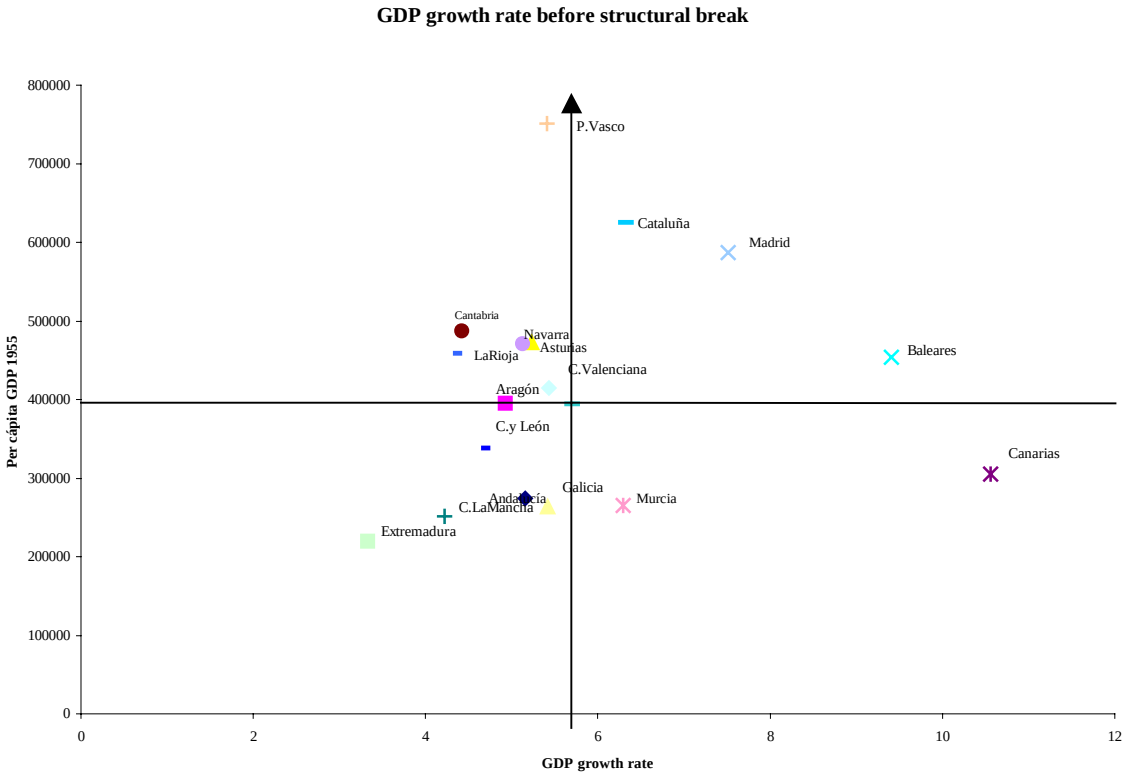
REGION	BEFORE BREAK	AFTER BREAK	2º/1º	K	BREAK YEAR
ANDALUCIA	5,84	1,03	0,17	2	1975
ARAGON	6,07	2,74	0,45	8	1971
ASTURIAS	5,19	1,84	0,35	8	1971
BALEARES	6,17	3,29	0,53	8	1971
CANARIAS	6,37	1,99	0,53	8	1971
CANTABRIA	4,78	1,83	0,38	2	1972
CAST.Y LEON	5,68	1,67	0,29	2	1977
CAST.MANCHA	5,68	2,33	0,41	2	1971
CATALUÑA	4,1	2,62	0,63	2	1979
C.VALENCIANA	4,39	2,29	0,52	4	1971
EXTREMADURA	5	2,4	0,48	8	1971
GALICIA	5,06	3,06	0,6	8	1978
MADRID	4,53	2,23	0,49	3	1980
MURCIA	6,06	1,57	0,25	2	1975
NAVARRA	5,52	2,39	0,43	2	1976
PAIS VASCO	4,47	1,54	0,34	2	1976
RIOJA	4,75	2,52	0,53	3	1978
ESPAÑA	5,25	2,05	0,37	2	1971
CV (All regions)	0,13	0,26	0,30		
CV (w. islands)	0,12	0,25	0,30		

TABLE Nº 6

Productivity long run growth

REGION	BEFORE BREAK	AFTER BREAK	2º/1º	K	BREAK YEAR
BALEARES	6,17	3,29	0,53	8	1971
GALICIA	5,06	3,06	0,6	8	1978
ARAGON	6,07	2,74	0,45	8	1971
CATALUÑA	4,1	2,62	0,63	2	1979
RIOJA	4,75	2,52	0,53	3	1978
EXTREMADURA	5	2,4	0,48	8	1971
NAVARRA	5,52	2,39	0,43	2	1976
CAST.MANCHA	5,68	2,33	0,41	2	1971
C.VALENCIANA	4,39	2,29	0,52	4	1971
MADRID	4,53	2,23	0,49	3	1980
CANARIAS	6,37	1,99	0,53	8	1971
ASTURIAS	5,19	1,84	0,35	8	1971
CANTABRIA	4,78	1,83	0,38	2	1972
CAST.Y LEON	5,68	1,67	0,29	2	1977
MURCIA	6,06	1,57	0,25	2	1975
PAIS VASCO	4,47	1,54	0,34	2	1976
ANDALUCIA	5,84	1,03	0,17	2	1975
ESPAÑA	5,25	2,05	0,37	2	1971
CV (all regions)	0,13	0,26	0,30		
CV (w.islands)	0,12	0,25	0,30		

FIGURE 1



Source : own elaboration

FIGURE 2

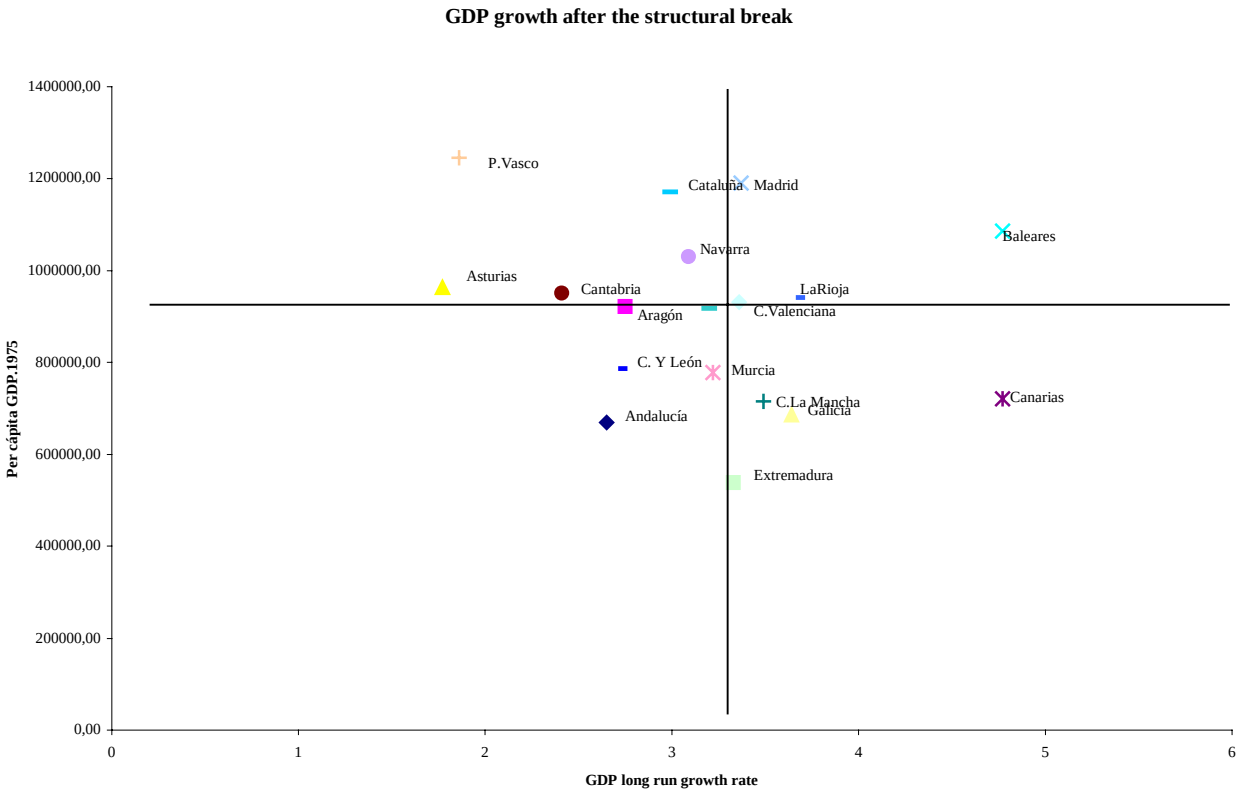


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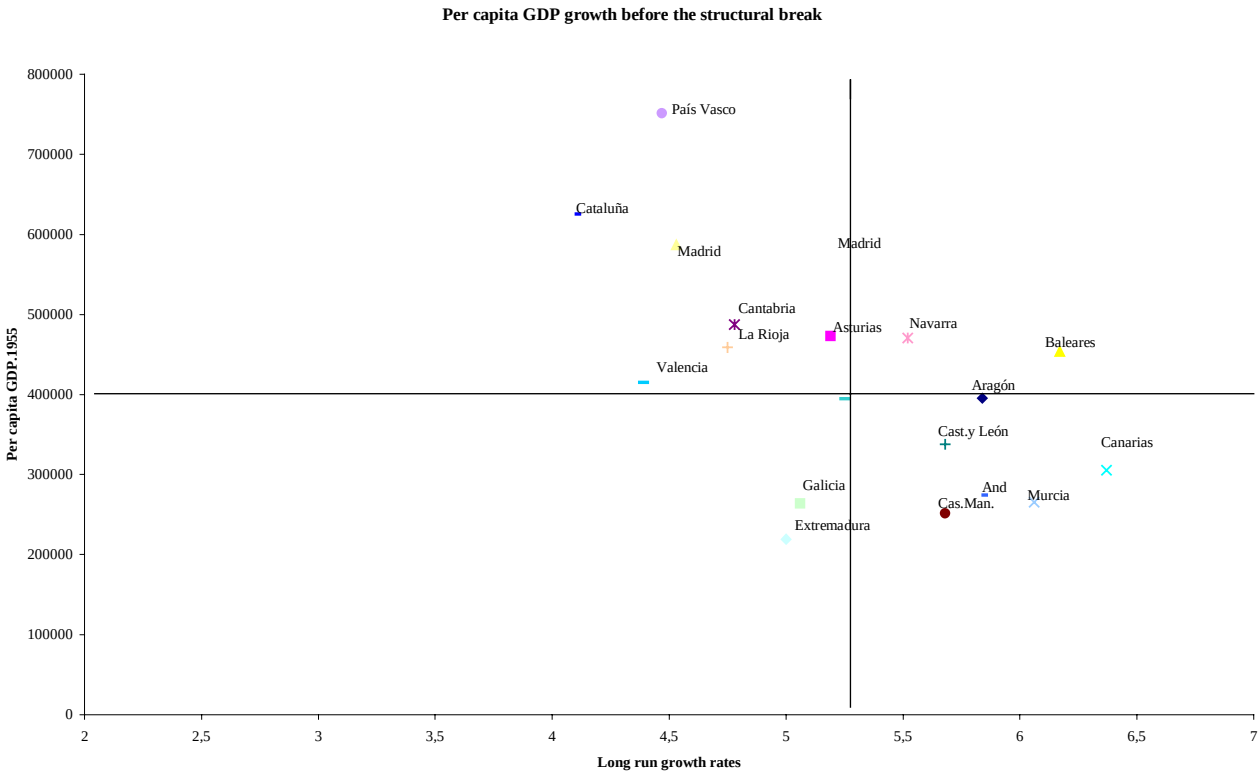
FIGURE 3



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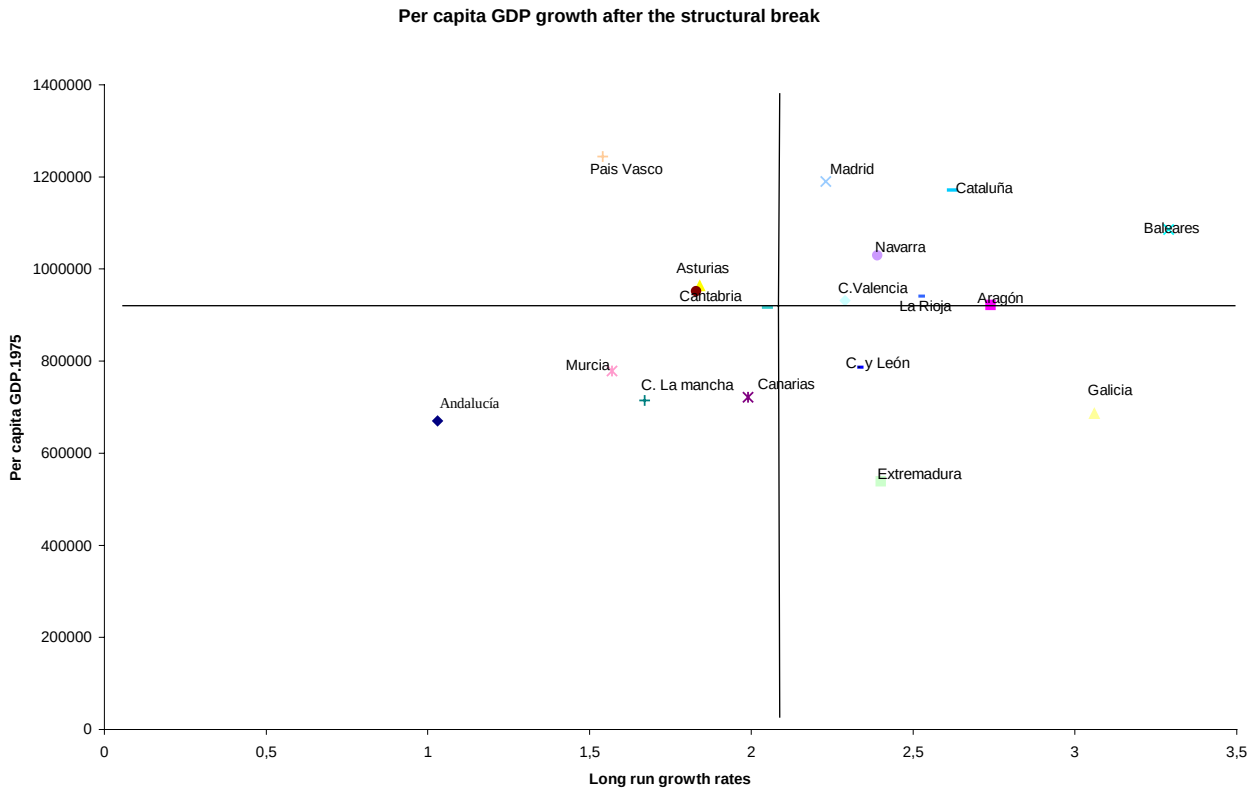

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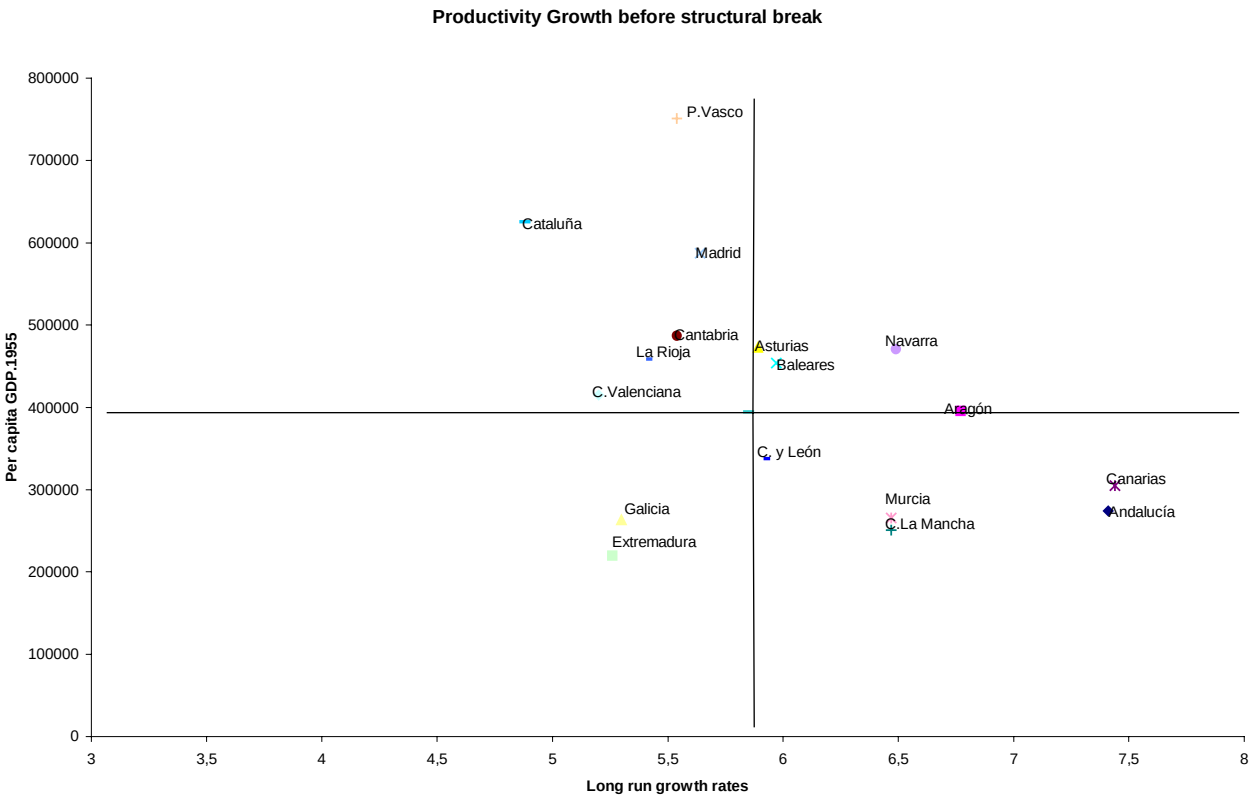

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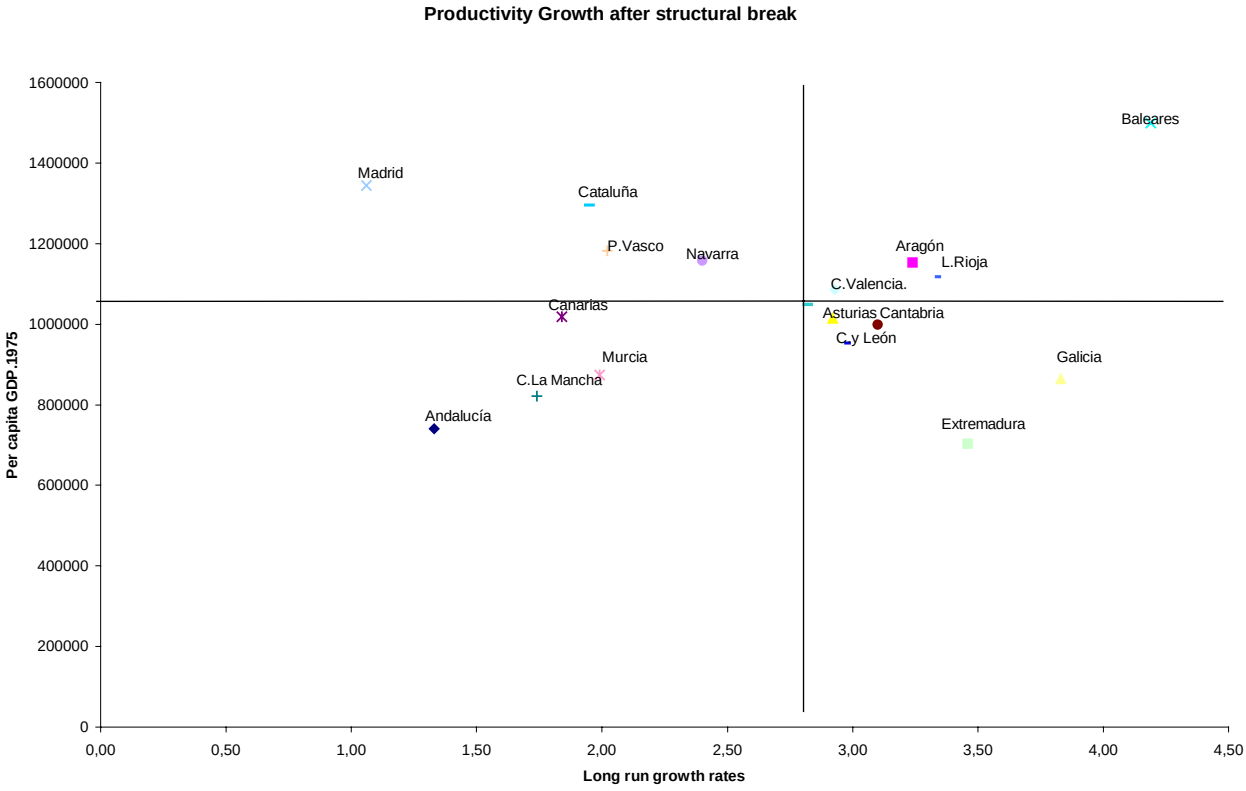
FIGURE 6



Source: Own elaboration

NOTES

[1] There are several kinds of endogenous growth models. These models can be classified by the effects introduced in the production function and the hypothesis about the source of non-decreasing marginal productivity. If there include definitions greater than private capital we obtain the models of Barro(1990) or Lucas(1988) or any combination between them. If it is in the technology were is the hypothesis, we obtain models following the Rebelo(1991´s one. If it is in marginal productivity of labor we can find models "learnig-by-doing" type. If it is in I+D we find same kind of "shumpeterians" models.

[2] We choose Zivot and Andrews model "C" because for the most periods both dummies were significant. The trend break dummy (DT) was always significant.

[3] In this paper we have to take the results with precaution due that period cover by the data is 38 years, which is in the limit for that the unit root test are considered statistically significant.

[4] Extremadura follows model A (Zivot and Andrews(1992) ,i.e. only change in mean and not in trend

[5] Ben-David y Pappell(1994) found this numerical solution in the computer.

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