Has the Great Recession affected the convergence process? The case of Spanish provinces

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Abstract

This paper explores potential convergence across the Spanish provinces, paying special attention to the influence of the recent international crisis on this process. To this end, we have taken the traditional per capita gross domestic product and the multidimensional index of human development as references. Our results show the formation of several clubs whose composition and convergence pattern has been modified by the recent crisis: the previously increasing differences in the average per capita gross domestic product between clubs have been attenuated, whilst the decreasing disparities in the average human development index have been stabilized. However, the behavior of the clubs in the last period of the sample suggests that these differences may increase notably in the post crisis years.

Keywords: convergence; Human Development Index; urban provinces; crisis.

JEL Classification: C22; R10; O47.

1. Introduction

The analysis of the growth path of a group of economies has received much attention since the publication of the seminal papers of Barro et al. (1991) and Barro and Sala-i-Martí (1992). This attraction can be easily understood if we bear in mind that this type of research is crucial for designing adequate policies to decrease disparities. Given this interest, the progress of the convergence theory has been intense. The early research was based on the analysis of the absolute convergence hypothesis, which predicts that there is a global equilibrium to which all countries will tend so the per capita income will grow faster in the poorest states than in the richest ones. As absolute convergence was not supported by the data, the concept of conditional convergence was introduced. Conditional convergence states that only economies with identical structural characteristics also share the steady state, so the income of states close to their long-run equilibrium will grow slower whatever the initial conditions. Empirically, advances in time series analysis offered new possibilities, from papers based on the analysis of relatively simply concepts such as β-convergence and σ-convergence, both related to the absolute convergence hypothesis, to other methodologies that cover conditional convergence and include non-parametric estimations and econometric innovations such as the inclusion of structural breaks. These advances were reflected in the contributions of Carlino and Mills (1993, 1996), Bernard and Durlauf (1995), Evans and Karras (1996), Loewy and Papell (1996), Nahar and Inder (2002), Strazicich et al. (2004), Carrió-i-Silvestre and Germán-Soto (2007) and Ceylan and Abiyev (2016). Apart from absolute and conditional convergence, a new concept was developed, club convergence. This concept states that regions with identical initial and structural conditions converge to the same long-run equilibrium (Barro and Sala-i-Martin, 2004). Club convergence analysis has received a new impulse thanks to the methodology proposed by Phillips and Sul (2007, 2009), who developed some new and very powerful techniques for testing the null hypothesis of convergence while, at the same time, providing useful tools to determine the formation of convergence clubs. This approach examines whether regions in the same area could be creating convergence groups, and has the advantage of not biasing the results in favor of the divergence hypothesis since it contemplates several long-run equilibria (Galor, 1996).[1] Furthermore, it exhibits good performance in commonly employed sample sizes, especially when compared to alternative methodologies such as the standard unit root/cointegration approach.

The literature has generally selected the per capita GDP as the macroeconomic aggregate that best measures economic conditions. However, this aggregate cannot represent real human welfare because other related aspects such as health, education level and the degree of satisfaction of the citizens are ignored. Hence, the use of broader measures to assess the evolution of a group of regions seems reasonable, especially if the current economic environment is based on the application of austerity policies that affect education and health care, for example. Although other measures are also possible,[2] an interesting index is the Human Development Index (HDI), which has been published since 1990 by the United Nations Development Programme in its annual Human Development Report. This index provides information about the capacities of an economy and not about economic performance, as in the per capita GDP. Consequently, the HDI can offer alternative results in the analysis of convergence among groups of economies. Examples of the use of this index to test for convergence are Nissan (2002), Marchante and Ortega (2006) and Yang et al. (2016).

A recent analysis carried out by Montañés and Olmos (2014) studies the convergence of the Spanish regions by comparing the results obtained when both GDP and HDI are used. The results obtained from the use of the two measures exhibit some differences at the end of the sample (2010), but they tend to show similar results at the beginning of the sample (1980). This fact invites us to use both variables to analyze convergence, given their marked complementary relationship. Furthermore, these authors conclude that the evolution of the Spanish regions can be better understood as the sum of several divergent patterns of behavior rather than as a real convergence process. The authors could not answer the question of whether there are convergence clubs or not using unit root techniques. Nevertheless, the sample used by these authors considers aggregated geographical areas, the Spanish regions, and covers the period from 1980-2010. With this data, the total effects of the economic crisis that Spain has suffered since 2008 could not be properly assessed. The crisis may have increased the differences between regions or, on the other hand, the distances may have been reduced. In any case, there is no information on the impact of the crisis on the convergence process and, consequently, it seems appropriate to further analyze the behavior of Spain over this period. Against this background, the aim of this paper is to extend previous results by, first, using a higher level of territorial disaggregation (provinces instead of regions), second, extending the sample until 2014, which could help us to analyze the influence of the recent economic crisis on the convergence process across the Spanish provinces and, third, employing a more suitable methodology, the Phillips and Sul (2007, 2009) approach. Furthermore, we estimate a probit model in order to determine the structural factors that form the clubs and, therefore, define the evolution of the Spanish provinces.

The rest of the paper is organized as follows. Section 2 describes the database. Section 3 presents the methodology employed in the paper, the results obtained from the convergence analysis and the exploration of the sources that generate the different clubs of behavior. The paper ends with a review of the most important insights.

2. The effect of the crisis on the Spanish provinces: data and descriptive analysis

As we have previously stated, the objective of this paper is to analyze whether the recent international crisis has affected the convergence process in the Spanish provinces. Now, it is necessary to decide on which variable to focus in order to analyze the convergence process. Most of the previous convergence papers are based on the use of the per capita GDP. Nevertheless, this measure can hide the effect of the crisis on other essential aspects of a society, especially if we take into account that the provincial, regional and central governments have implemented austerity measures. These policies are aimed at reducing the deficit of the public administrations and, consequently, have had restrictive effects on public health and education. It is foreseeable that the crisis has altered not only the levels of economic wellbeing, but also those of health and education attained since the 1980s. Thus, it seems advisable to use an indicator, such as the well-known Human Development Index (HDI), that takes into account these three aspects: material wellbeing, health and education. This index is based on the idea of Amartya Sen of reflecting capabilities and opportunities more than realizations (see Sen, 1985). Its definition has recently changed and its current version can be stated as follows:

$$HDI_{it} = \sqrt[3]{HI_{it} * EI_{it} * MWI_{it}} \qquad t = 1,2,\ldots,N \qquad (1)$$

where HI, EI and MWI mean a Health Index, an Education Index and a Material Wellbeing Index, respectively. The HI depends on the life expectancy at birth (LE) and is defined as follows:

$$HI_{it} = \frac{LE_{it} - \min LE}{\max LE - \min LE} \qquad (2)$$

with $\min LE$ and $\max LE$ being 20 and 85 years, respectively. The education index is obtained as follows:

$$EI_{it} = \frac{MYSI_{it} + EYS_{it}}{2} \qquad (3)$$

where $MYSI$ represents average years of schooling index and EYS is the expected years of schooling index. These indexes are obtained as follows:

$$MYSI_{it} = \frac{MYS_{it}}{15} \qquad (4)$$

$$EYSI_{it} = \frac{EYS_{it}}{18} \qquad (5)$$

Finally, MWI is an income index that can be defined as follows:

$$MWI_{it} = \frac{\ln\left(GNI_{it}\right) - \ln\left(100\right)}{\ln\left(75{,}000_{it}\right) - \ln\left(100\right)} \qquad (6)$$

where GNI_{it} is the Gross National Income of each *i-th* province at period *t*.

Throughout this paper, we will combine the use of the more standard per capita GDP with the use of the HDI that, in our view, can help us to better understand the type of effects that the crisis has had on the Spanish convergence process.

Having defined the variables that we will focus on, the next problem we face is the level of territorial disaggregation to be used. In our view, it seems advisable to use the most disaggregated information possible, in our case, provincial data, which is equivalent to the TL3 used by the OECD and to the NUTS-3 defined by Eurostat. It is true that most papers use less disaggregated data, as is the case of the previously mentioned regional analysis developed in Montañés and Olmos (2014) and other analysis of European regions such as Azomahou et al. (2011). However, we should bear in mind that the use of regional data may not always provide very useful insights. Here we are considering cases where the regions are divided into infra-regional territories, namely, provinces that behave heterogeneously. Given that the regional data is a weighted average of all of them, the conclusions based on aggregated data cannot be very informative. Spanish regions are often composed of very heterogeneous provinces. For instance, we can consider the case of Aragon. The activity in this region is mainly concentrated in the cities of Huesca, Teruel and Zaragoza, which give their names to the three homonymous provinces. 50% of the population of Aragon lives in the city of Zaragoza and 72% in its province. The productive structure is also diverse if we analyze it from a provincial perspective. For instance, the weight of the manufacturing industry in Zaragoza almost doubles that of Huesca and Teruel. Similarly, the contribution of agriculture to GDP is clearly higher in Huesca than in Teruel and Zaragoza. This example is not only related to a particular region, but can be extended to the rest of Spain. To appreciate this,

Figure 1 reflects the Theil index of inequality for the regional and provincial GDP. As we can see, the degree of inequality is always greater for the provincial case. Furthermore, the evolution of the two statistics after the Great Recession is rather different: inequality grows using provincial data, whilst it hardly varies for the regional data. Therefore, the conclusions that emerge from a regional analysis cannot offer insights as rich as those obtained from a more disaggregated study.

Having determined the level of territorial disaggregation, we must address the issue of the information availability. The Valencian Institute of Economic Research (IVIE) has a long tradition of estimating the values of the HDI for Spanish regions and provinces.[3] We can cite the works of Herrero et al. (2010a, 2010b) and Herrero et al. (2010c) in this regard. However, this data is only available until 2010 for the Spanish regions and until 2007 for the Spanish provinces. Given that our objective is to assess the influence of the crisis on the convergence process, it is necessary to update the HDI values in order to have a post-crisis interval that is large enough so as to be able to observe the changes in the convergence trajectories. For this reason, we have calculated the HDI for the different Spanish provinces from 1980 to 2014. Nevertheless, given that provincial statistics do not have the level of detail that regional statistics provide, we have had to make small modifications in the definitions of the partial indexes that comprise the HDI. First, we have only considered the value of the *MYSI* in order to obtain the *EI*, given that the *EYS* data are not available by province. Second, and for the same reasons, instead of using the GNI, we have used the provincial GDP, using the corresponding CPI as deflator.

Lastly, it is important to note that, in order to be able to compare the results with previous convergence works, we have included the real per capita GDP data in the study, which allows us to analyze the convergence process from different perspectives.

2. 1. Descriptive analysis

The values for the Spanish provinces cover the 1980-2014 period and the data sources are reflected in Appendix A. Spain is divided into 50 provinces grouped into 17 regions. Additionally, there are two autonomous cities (Ceuta and Melilla), but we have preferred to omit them from the study due to their small dimensions and administrative peculiarities. Thus, we will base the study on the abovementioned 50 provinces. A detailed list of these provinces can be found in Appendix B.

Table 1 presents the initial and final values of the two measurements we are going to use, per capita GDP and HDI, as well as their growth rates for the periods 1980-2007, 2007-2014 and 1980-2014. As we can appreciate, provinces that form the regions traditionally considered as economic engines (País Vasco, Navarra, Cataluña and Madrid) reach the highest positions for the per capita GDP and the HDI in 1980 and in 2014, with the exceptions of some other northern provinces (Zaragoza, La Rioja, Burgos and Valladolid). The first group of provinces were the first to be industrialized, though the services sector has been gaining ground recently. The other end of the ranking is made up of the interior and southern provinces, where the agricultural sector has been the main source of economic growth. These provinces with lower initial values also have lower final values. The Spearman's rank correlation coefficient takes the value of 0.85 when the 1980 and 2007 levels of HDI are compared and 0.87 when the values of 1980 and 2014 are compared. For the per capita GDP, the results are similar: 0.90 and 0.85 for the same two intervals. Therefore, it seems clear that the provinces that are in a lower position at the beginning of the sample do not improve significantly with respect to the leaders. Nevertheless, a simple analysis of the growth rates of the different provinces permits us to observe that the provinces with small initial values have grown more, in general, than those with the largest initial values, both for the HDI data and for the per capita GDP data. This fact leads us to think that, though the rank positions are similar in 1980 and 2014, the disparities could have been reduced over the sample. To explore this possibility, Figure 2 reflects the coefficient of variation of the two measures, adopting the value 100 for the year 1980. As we can see, the degree of variation of the HDI is greater than that of the

GDP even though the HDI contains variables such as life expectancy and schooling years, which exhibit smooth changes over time. This feature is important, given that a major criticism of this index is, precisely, its lack of variation. We can also observe that there is a negative trend for both coefficients, which implies that the distance between the Spanish provinces has reduced. Furthermore, if we focus on the period 2007-2014, it seems that the Great Recession favored the reduction of the dispersion of both measures. This is true until 2014, when both coefficients of variation clearly boom, indicating the slowing down of the convergence between the Spanish provinces.

Another interesting way to analyze the data is in terms of the typology of the province. The OECD classifies the TL3 regions, provinces in the Spanish case, into Predominantly Urban (PU), Intermediate (INT), Predominantly Rural Close to a city (PRC) and Predominantly Rural Remote (PRR) to take into account demographical and urbanization differences among them. This classification is based on population density criteria and on the size of the urban centers located within a region. Table 2 shows the average growth rates of the provinces for the three periods in which we have divided the sample. The first result we should point out is that the behavior of the PU provinces is similar to that of the INT. If we take the per capita GDP as a reference, we see that PU and INT provinces have very similar growth rates until 2007, while the crisis has had a remarkable effect on them, decreasing to -2.9% and -3.1%, respectively. Something similar occurs when we use the HDI although, in this case, the growth rates up to 2007 are much more modest, around 0.7%, and, during the period 2008-2014, the growth rate diminishes to 0.2%.

The behavior of rural provinces, PRC and PRR, shows a different panorama. Using the per capita GDP, we see that rural provinces grow more than the rest, especially the PRR, which have a growth rate of over 3% until 2007. This growth rate becomes negative in the following period, but less than the PRC and non-rural provinces. Something similar occurs when we use the HDI. There are no great differences in the growth of this indicator until 2007, even though the PRR provinces show a slightly higher rate. In the period following the crisis, the growth rate of the rural provinces close to a city is higher than the growth rate of the urban and PRR provinces.

This descriptive analysis leads us to several conclusions. The first is that there does not seem to be a clear convergence pattern between the Spanish provinces, in part due to the great distance between them at the beginning of the sample. This result indicates the presence of differentiated behavior clubs, which would confirm Montañés and Olmos (2014), in the sense that the evolution of the Spanish economy is more the sum of regional divergent processes than the consequence of convergence between the regions. As in Dijkstra et al. (2015), the PU provinces show lower growth rates of the per capita GDP and the HDI in the period 2008-2014, whilst PRC provinces evolve more favorably. However, in contrast to these authors, INT provinces show a higher drop in growth rates, whilst the slowdown of PRR provinces is moderate.

In any case, these conclusions have been obtained from a simple descriptive analysis of the data. Therefore, more appropriate techniques should be used to verify whether the crisis unleashed in 2007 has had an effect on the convergence process, a question that will be addressed in the following section.

3. Testing for convergence: Methodology and results

This section first discusses the methodology that we have employed for determining the presence of convergence. Most previous convergence analyses of the variable X over an objective value X^* have been traditionally based on the study of the presence of a unit root in the ratio $\ln(X_{it}/X^*)$, where *i*=1,2,…,N and *t*=1,2,… T, reflect the cross-sectional and the sample size dimensions, respectively. However, we will employ the methodology proposed in Phillips and Sul (2007), given that it offers some advantages over the standard unit-root based analysis, especially in the lack of statistical power of the latter in small samples. Furthermore, these authors develop a method for detecting the existence of convergence clubs, a quite feasible hypothesis according to the results of the previous section. As we have previously mentioned, this methodology has been applied to the traditional GDP, but it has been used to analyze other wellbeing/social measures such as happiness in Apergis and Georgellis (2015) and US divorce rates in González-Val and Marcén (2015).

3.1. Methodology

We have followed the papers of Phillips and Sul (2007) and Phillips and Sul (2009), PS hereinafter, where they develop a very interesting framework to, first, test for the convergence hypothesis and, if this is rejected, to analyze the existence of clubs of regions that show similar patterns of behavior.

Following these authors, let us consider that X_{it} represents the variable of interest (in the present case, the HDI or the per capita GDP) with i=1, 2,…, 50 and *t* provides the time dimension. This variable can be decomposed as $X_{it} = \delta_{it}\mu_t$, where μ_t is the common component and δ_{it} is the idiosyncratic one. PS suggest testing for convergence by analyzing whether δ_{it} converges towards δ. To do so, they first define the relative transition component:

$$h_{it} = \frac{X_{it}}{N^{-1}\sum_{i=1}^{N} X_{it}} = \frac{\delta_{it}}{N^{-1}\sum_{i=1}^{N} \delta_{it}} \quad (7)$$

In the presence of convergence, h_{it} should converge towards unity, whilst its cross-sectional variation (H_{it}) should approach 0 as *T*, the sample size, moves toward infinity,

$$H_{it} = N^{-1}\sum_{i=1}^{N}\left(h_{it} - 1\right)^2 \rightarrow 0 \quad as \quad T \rightarrow \infty \quad (8)$$

PS test for convergence by estimating the following equation:

$$log\frac{H_1}{H_t} - 2log[\log(t)] = \alpha + \beta\log(t) + u_t,\ t = [rT] + 1, \ldots, T \quad (9)$$

where r takes values around a 1/3 of the sample, as in PS. Equation (9) is commonly known as the *log-t* regression. The presence of convergence is tested by means of a standard *t*-statistic and, according to PS, the null hypothesis of convergence is rejected whenever this *t*-statistic takes values lower than -1.65. If we reject convergence, we can use the PS algorithm to consider the existence of clubs.[4]

Finally, given that we want to analyze the effect of the Great Recession on the convergence level, we apply this methodology to the periods 1980-2007 and 1980-2014. We are aware that the total period includes behavior prior to the Great Recession, but we do not have enough observations to test for convergence in this particular period and, additionally, the performance of the provinces at the end of the sample is crucial to determine the possible presence of convergence. If there are changes during the 2008-2014 period, this may alter both the results of testing for convergence and of clustering the Spanish provinces. Consequently, the comparison of the results of the two periods can offer us interesting insights into the effect of the Great Recession on the convergence process.

3.2. Results

In Panel A of Tables 3 and 4, we present the results of the PS statistic to test for the convergence hypothesis for the HDI and the per capita GDP, both for the total of the available sample and for the period prior to the arrival of the crisis. As can be seen, the PS statistic rejects the convergence hypothesis for both variables and for the two samples used. Hence, there do not seem to be great changes from this perspective and one could conclude that the crisis did not affect the convergence process. However, we must take into account that the convergence statistic is much closer to its critical value when we use the total sample. Thus, the crisis may have had some kind of effect, which makes it necessary to study the existence of convergence clubs and to analyze them to see if they have changed after 2008.

The data presented in Panel B of Table 3 informs us of the presence of seven differentiated clubs, which are shown in Figure 3(a), in the evolution of the HDI until the year 2007. This result confirms the outcome of Montañés and Olmos (2014) in the sense that the Spanish economy is quite atomized and reflects the sum of several divergent processes. If we expand the sample to the year 2014, the results change significantly, as can be seen in Table 3 and in Figure 3(b). Now the aggregation of the provinces increases since there are only 5 clubs, so some of the convergence patterns have merged since the onset of the crisis.

The geographic distribution of the clubs does not follow a specific pattern. If we consider the composition of the clubs until 2007, the different regions have provinces in several clubs, with the exception of the País Vasco and the Islas Canarias, all of whose provinces are in Club 1 and Club 3, respectively. Though there is no clear geographic pattern, the northern half of the country, the eastern provinces, the Islas Canarias and Sevilla and its surrounding provinces belong to higher groups (Clubs 1-3), whilst lower clubs are composed of interior and some southern provinces. For the analysis of the entire sample, once again the regions contain provinces which belong to various groups, with the exception of the Islas Canarias, all of whose provinces are in Club 4. The northeast of the country, Madrid, Sevilla, Valladolid and La Coruña form Clubs 1-3, whilst Clubs 4-5 are made up of provinces from the rest of the country, mainly interior and southern. It is noteworthy that Álava, Guipúzcoa and Madrid are the only provinces in Club 1, which suggests that traditional economic drivers, such as the País Vasco and the national capital, also have a higher steady state. Likewise, it is worth highlighting the limited pull of Madrid, given that it is surrounded by provinces that belong to lower clubs. In spite of the great importance of this province, it is not able to generate enough positive synergies in these provinces; they only serve as dormitory provinces. Lastly, provinces that include the capital of a multiprovincial region mainly belong to Clubs 1 and 2, with the exception of the Islas Canarias, Castilla-La Mancha, Extremadura and País Vasco.

To verify whether the composition of the clubs varies for the two samples being considered, we have calculated the statistics of Mood and of Kruskal-Wallis, assigning the value i to Club i-th (i=1,2,…). Mood's statistic tests the null hypothesis that the medians of the populations from which two or more samples are drawn are identical, whilst the Kruskal-Wallis statistic tests whether two samples are from the same population. The values of these statistics for the HDI case are reflected in Table 5. They clearly reject their respective null hypothesis even for the restrictive 1% significance level. Therefore, we can state that there is statistical evidence that the convergence in terms of HDI has been affected by the advent of the crisis.

In order to better understand the behavior of the clubs, we have calculated an index for each one, taking the average value of the HDI for each province in Clubs 1-5 when the entire available sample is used. Figure 4 shows its behavior. We can observe that Club 1 has, on average, a higher level of HDI throughout the entire sample; meanwhile, Club 5 has the lowest average over the sample. Thus, intermediate positions correspond, from higher to lower, to Clubs 2-4. With regard to the evolution of the HDI, the clubs maintain, generally, an increasing pattern that is broken in 2012, a year in which the growth is negative.[5] But the growth rate is not constant over time. The index for Club 1 shows an average growth of 0.72% until 2007 and 0.24% after that. On the contrary, the values of Club 5 have a better behavior in both periods (0.82% and 0.27%, respectively). So, the distance between the two clubs has shortened since the beginning of the sample. We reach similar conclusions when Clubs 2-4 are analyzed. Nevertheless, as the analysis of the coefficients of variation previously showed, we can observe that the distance between the two extreme indexes increases at the end of the sample, which could announce a new increase of the divergence as the leading group of provinces recovers.

The analysis of the convergence in terms of per capita GDP is shown in Table 4 and in Figure 5. The results allow us to reject the convergence hypothesis for the two samples considered, in line with Tortosa-Ausina et al. (2005) who find scarce evidence of the convergence hypothesis in the per capita income for the Spanish provinces during 1965-1997, especially after the 1970s. However, when these authors take spatial dependence into account, the convergence hypothesis is reinforced, as Maza and Villaverde (2009) also find for 1985-2003. The cause of the importance of the spatial factor could be linked to mere geographical factors, or it could go beyond them. So, as with the HDI, we analyze the possible existence of convergence clubs for the two periods. The results can be seen in Panel B of Table 4. If we take the sample until 2007, we observe the existence of four highly differentiated clubs with 2, 10, 20 and 18 provinces, respectively. The first group includes Álava and Madrid, as occurred in the HDI analysis. The second group mainly includes most of the northeastern peninsular provinces and Almería. Finally, Clubs 3 and 4 contain the northwest and south areas, the interior and the island provinces.

If we expand the sample to 2014, the results change notably. We now have only two clubs. The first is comprised of the provinces located in the northern half of the country plus a few interior, southern and island provinces. If we take into account the values of the Mood and Kruskal-Wallis statistics, presented in Table 5, we again obtain clear evidence that the crisis has changed the composition of the clubs.

To examine the trajectories of the two clubs over the sample, we have calculated an index that reflects the average value of the per capita GDP for each of them. Figure 6 shows its evolution. As we can see, both the indices show (for most of the observations) continuous growth until 2007, after which they decrease by a rate slightly higher than 17% and 20%, respectively. Their trajectory runs almost parallel for many years, the difference between the clubs being around 2,000€ until the beginning of the 2000s. After this, the distance rises to 4,600€ in 2008, falling later to a value of around 4,000€. Therefore, we see that the crisis has reduced the distance between the two groups, though this seems to be due more to the negative effect that it had on per capita GDP than to the efforts of the provinces in Club 2 to reach those of Club 1, as would have been desirable.

If we compare these results with those obtained in Montañés and Olmos (2014) for the Spanish regions, we can observe that the idea that the Spanish economy is the aggregation of some divergent forces is clearly reinforced. Furthermore, the use of provincial data allows us to see how the provinces that include the capital of the region tend to exhibit a better behavior than the rest of the provinces. Finally, the extension of the database to 2014 shows that the

Great Recession has favored the convergence process and that the distance between the different groups diminished until 2013. Nevertheless, it seems that the recovery of the Spanish economy inverted this trend. These distances have again increased, so there is a clear risk of the convergence process reverting to its pre-crisis situation.

Finally, we consider it of interest to compare the provincial results with those obtained using regional data. We should note that regional data are also available for 2015-2016, which allows us to enlarge the sample and can provide insights on the effect of the recovery of the Spanish economy on convergence. The evolution of the estimation of the parameter β of equation (9) for both regional and provincial data is reflected in Figure 7 when the sample covers the period 1980-*m*, with $m = 2006, 2007, \ldots, 2016$. We first observe that the evolution of $\hat{\beta}$ is quite similar for per capita GDP, but it presents some differences for the HDI. In any event, this estimation is always a long way from 0, which implies that the convergence null hypothesis is always rejected for the two measures considered. We can also appreciate, especially for the per capita GDP, that the estimation of this parameter approaches the non-rejection zone during the Great Recession while it moves slightly away from it in 2014-2016. This fact again suggests that the recovery of the Spanish economy may generate a new divergent process, reinforcing the idea that this economy is made up of the sum of non-convergent forces.

3.3. Has the crisis especially affected urban provinces?

Having presented evidence that the crisis has affected the convergence process among the Spanish provinces, the second question is whether there are different behaviors depending on the degree of urbanization of the provinces, as Dijkstra et al. (2015) show for the European case.

First of all, taking the HDI data, we see that for the 1980-2007 period, Clubs 1 and 2 are comprised of 6 PU and 5 INT. So, only non-rural provinces are found in these clubs. The opposite occurs with the lowest clubs (6 and 7), which are composed of rural provinces (3 PRC and 4 PRR). Middle clubs 3-5 are a mix of urban and rural provinces, but urban and intermediate ones dominate in Clubs 3 and 4 and rural provinces form half of Club 5. When the sample is extended to 2014, we have seen that the number of clubs decreases to five. But this effect does not have a severe impact on the distribution of urban and rural provinces: Club 1 is composed of 3 non-rural provinces (2 PU and 1 INT), only one rural province appears in Club 2 (4 PU, 7 INT and 1 PRC), Club 3 is made up of 2 non-rural provinces (1 PU and 1 INT), Club 4 is a mix of rural and non-rural provinces (3 PU, 14 INT, 6 PRC and 3 PRR) and, finally, Club 5 only contains rural provinces (2 PRC and 4 PRR).

If we now take the per capita GDP as a reference, the results change. We see that, from 1980-2007, Club 1 is composed of 2 non-rural provinces: 1 PU and 1 INT. Club 2 is made up of 10 provinces: 4 PU, 4 INT, 4 PRC and 6 PRR. Club 3 includes 13 non-rural provinces and 7 rural provinces (3 PU, 10 INT, 3 PRC and 4 PRR). The remaining 18 provinces are in Club 4 and the proportion of rural and non-rural provinces is similar: 2 PU, 8 INT, 4 PRC and 4 PRR. Though non-rural provinces are mainly contained in higher clubs and, consequently, rural provinces dominate lower clubs, the distribution is more heterogeneous than in the HDI analysis. When the sample is extended to 2014, the results are different since there are only two clubs. The most numerous, Club 1, is approximately created by the merging of the previous Clubs 1-3, and includes 34 provinces, 23 non-rural (9 PU and 14 INT) and 11 rural provinces (5 PRC and 6 PRR). Meanwhile, Club 2, with a composition similar to the Club 4 formed when the sample ends in 2007, includes 13 provinces, of which 8 are non-rural (1 PU and 7 INT) and 5 are rural (3 PRC and 2 PRR). Once again, it is evident that there is no clear distribution of rural and non-rural provinces between the two clubs. However, we can appreciate the movement of PRC and PRR provinces from lower clubs to the highest club when the total sample is considered and, therefore, the cluster analysis cannot support the results obtained by Dijkstra et al. (2015) regarding the worse behavior of PRR provinces from the onset of the crisis.

In any case, it seems appropriate to carry out a more in-depth analysis to study whether there are statistically significant differences in the determinants of the formation of the clubs for the two periods. To this end, we have estimated diverse probit models that help us discern which variables are relevant when explaining the formation of the clubs previously estimated, as in Bartkowska and Riedl (2012).[6] The dependent variable takes the value i-1, where i represents the number assigned to each club. There are many potential variables that can help us explain why these clubs are formed and they cover diverse aspects of the economic and social activity of a province. Some of them are limited due to the lack of data. The variables we have used respond to the following characteristics of the provinces:

- Geographical and spatial factors: a possible explanation may come from the existence of a geographical factor. In order to capture it, we have considered a climate variable, the number of sunny days (*SUN*), as Kim and Rous (2012) do to explain the evolution of housing prices in the USA.
- Education: this variable has been found to be a very reliable determinant of urban and regional growth, as can be seen in Glaeser and Saiz (2004), Moretti (2004), Shapiro (2006) and Glaeser et al. (2014). To measure education, we have used the average of the percentage of the population with higher studies (*STUD*), as in Crespo-Cuaresma et al. (2014) and Bartkowska and Riedl (2012).
- Creativity: some recent investigations suggest that economic development is driven in large measure by lifestyle factors such as tolerance and diversity, urban infrastructure and entertainment, as suggested by the seminal works of Howkins (2001) and Florida (2004). The papers of Marrocu and Paci (2012, 2013) provide evidence that the creative class combined with a high level education can drive the growth of a particular region or city. Thus, we consider the inclusion of a variable that could capture the creativeness of the Spanish provinces in the model. In the absence of a measure, we have considered the

average number of books per capita (*BPC*) published in the province during the period 1990-2007.

- Economic structure: we have employed the percentage of workers of the industrial (*ILF*) and the service (*SLF*) sectors.
- Tourism sector: this sector is very important for the Spanish economy, representing around 11% of the Spanish GDP. Furthermore, it is considered a key sector for the recuperation of the Spanish economy from the Great Recession, given the recent recovery of this sector. We have employed the average stay of travelers by province (*STAY*).
- Technological Innovation: the relationship between innovation and growth is well known since the very important contribution of Mclaurin (1953). More recently, Montañés and Olmos (2014) have found that the evolution of R&D expenditure can help us to understand the lack of convergence across the Spanish regions. We have used the values of provincial R&D expenditure (measured by its percentage over the provincial GDP) as a proxy of provincial innovation (*INNOV*).
- Dummy variables: we have also considered dummy variables for provinces which include the capital of the region (*DCAP*), for provinces which are islands (*DISL*), for provinces that constitute a single-province region (*DSPR*) and for provinces which have a foral condition (*DFUE*).[7] Finally, we include a dummy for each province class (*DPU*, *DINT*, *DPR*, *DPRC*, *DPRR*).

When selecting the best estimated models, we have followed a strategy from the general to the specific, eliminating from the model the initial variables that are not significant. The results obtained are shown in Table 6. First of all, we must highlight that, in the case of HDI, the relevant variables are the structure of the economy, in particular the weight of the industrial sector, the degree of technological innovation and the type of province. Consequently, we conclude that PU provinces with a high weight of the industrial sector and that are more technologically developed are more likely to belong to higher clubs. By contrast, rural provinces have little probability of being in these clubs, with the coefficients of both PRR and PRC being statistically equal. When we consider the whole sample, the estimated model varies. For instance, we can see that the *DCAP* variable is now more relevant, clearly capturing the influence of the *DPU* variable, which becomes statistically insignificant. In this case, it seems that services and all activities, not only economic, that surround a capital city give them an advantage over the rest of the provinces and make it more likely that they will be in the group with the highest HDI values. Similarly, being a rural province, but close to a city, means a greater probability of belonging to lower clubs, which would indicate the scarce pull capacity of the urban provinces. Furthermore, if we compare the estimated coefficients, we see that the probability of a PRR province being in lower clubs has decreased, whilst that of a PRC has clearly increased.

The estimations for the case of per capita GDP are shown in Panel B of Table 6. We see that the explanatory variables of the model are different from the ones used in the HDI case, with the exception of technological innovation, which also increases the probability of belonging to higher clubs. Furthermore, it is evident that being an urban or rural province does not affect the probability of belonging in one group or another. Conversely, if the province is an island, it has more probability of belonging to lower clubs. Finally, we should note that the estimations are similar for both periods, but the relevant variables have a lower impact when the whole sample is considered, so we can conclude that clubs are more heterogeneous after the crisis.

4. Conclusions

In this paper, we have studied the convergence process across Spanish provinces, paying special attention to the effect the crisis may have had on this process. The results obtained show that the evolution of the Spanish economy is made up more of clearly diverging forces than of the sum of the convergent behaviors. In fact, using two different indicators, the per capita GDP and the HDI, the presence of different convergence clubs has been shown.

In addition, we must highlight that the crisis has clearly modified the convergence pattern. There are fewer clubs after the crisis, both for the HDI and the per capita GDP, showing the merging of some long-run equilibria. Not only have the number and composition of the different clubs changed, but we also observe a clear effect on their average evolution. Regarding the HDI, the disparities among clubs have been stabilized after a long period of decreasing continuously, whilst the differences in the per capita GDP have decreased after the onset of the crisis. Thus, the disparities among the groups show a countercyclical behavior for the HDI and a procyclical behavior for the per capita GDP. These patterns are reinforced by the latest data available, suggesting that the distances could decrease for the HDI and increase for the per capita GDP over the next few years as the leading provinces recover from the effect of the crisis. It would be interesting to verify whether this centrifugal effect will continue, destroying some of the convergence attained, or whether it has been just a passing episode. However, some additional new data will be necessary to do this and, therefore, it will have to be left for future research.

Distinguishing among the degree of urbanization of the provinces, we have found that rural provinces have had a better behavior than urban and intermediate provinces, especially the predominantly remote rural provinces. Moreover, we have analyzed the sources of the formation of the different clubs. The results of the estimation of a probit model show that the degree of technological innovation is a relevant variable for belonging to higher clubs, both for the HDI and for the per capital GDP samples. The recent crisis has lowered the probability of the predominantly remote rural provinces belonging to lower clubs. Moreover, the provinces that agglomerate the services of the region capital tend to belong to higher clubs. This reveals some comparative advantages over the rural provinces but, at the same time, their capacity to create a significantly positive influence over the surrounding provinces is doubtful. These results, along with the abovementioned analysis of the evolution of the provinces, are important because the results of Dijkstra et al. (2015), referring to the group of European regions, does not seem to be totally valid for the Spanish case.

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NOTES

[1] See the papers of Bartkowska and Riedl (2012), Ghosh et al. (2013), Monfort et al. (2013) and Apergis and Georgellis (2015). See also Chen et al. (2013) or Wang et al. (2014), amongst many others, for other applications of this methodology.

[2] See Apergis and Georgellis (2015).

[3] These data are available at http://www.ivie.es/es/banco/desarrollo_humano.php

[4] See Phillips and Sul (2007, 2009) for a description of the use of this algorithm.

[5] Excluding Club 4, with a growth rate of close to zero.

[6] We should note that the cross-sectional dimension is not very large (N=50) and, consequently, the results should be interpreted with some caution.

[7] *Foral* provinces have special regional laws that provide some fiscal advantages.

Table 1. Levels and growth. Per capita GDP and HDI.

Province	P.c. GDP 1980	Growth P.c. GDP 1980-2007	Growth P.c. GDP 2007-2014	Growth P.c. GDP 1980-2014	P.c. GDP 2014	HDI 1980	Growth HDI 1980-2007	Growth HDI 2007-2014	Growth HDI 1980-2014	HDI 2014
ALA	23.2	2.0%	-2.7%	1.0%	33.0	0.72	0.7%	0.2%	0.6%	0.88
ALB	9.6	2.6%	-2.3%	1.6%	16.8	0.64	0.8%	0.4%	0.7%	0.82
ALI	13.8	1.6%	-3.4%	0.6%	17.0	0.67	0.8%	0.1%	0.6%	0.83
ALM	9.3	3.2%	-4.2%	1.7%	16.8	0.64	0.9%	0.1%	0.7%	0.81
AVI	10.5	2.4%	-2.6%	1.3%	16.8	0.65	0.7%	0.2%	0.6%	0.81
BAD	6.7	3.5%	-2.8%	2.2%	14.5	0.61	1.0%	0.3%	0.8%	0.81
BAL	13.4	2.7%	-3.1%	1.5%	22.6	0.67	0.8%	0.3%	0.7%	0.85
BAR	17.2	2.2%	-3.0%	1.1%	25.3	0.71	0.7%	0.2%	0.6%	0.86
BUR	13.7	2.7%	-2.6%	1.6%	24.0	0.68	0.7%	0.2%	0.6%	0.84
CAC	6.5	3.6%	-2.0%	2.5%	15.1	0.63	0.8%	0.2%	0.7%	0.80
CAD	10.8	2.2%	-3.8%	0.9%	15.0	0.64	0.8%	0.3%	0.7%	0.81
CAS	15.8	1.8%	-3.1%	0.8%	21.0	0.67	0.8%	0.3%	0.7%	0.84
CDR	9.6	2.9%	-3.5%	1.6%	16.7	0.64	0.8%	0.1%	0.7%	0.80
COR	9.8	2.4%	-3.0%	1.3%	15.4	0.64	0.8%	0.2%	0.7%	0.81
CRÑ	12.2	2.4%	-2.5%	1.4%	19.7	0.67	0.7%	0.3%	0.6%	0.84
CUE	9.5	2.9%	-2.4%	1.9%	18.1	0.64	0.7%	0.4%	0.6%	0.80
GIR	17.5	2.2%	-3.5%	1.0%	24.8	0.69	0.6%	0.4%	0.6%	0.85
GRA	8.7	2.8%	-2.6%	1.7%	15.6	0.64	0.8%	0.3%	0.7%	0.82
GUA	12.3	2.3%	-3.7%	1.0%	17.7	0.67	0.7%	0.2%	0.6%	0.83
GUI	17.9	2.4%	-2.6%	1.4%	28.6	0.71	0.7%	0.2%	0.6%	0.88
HLV	11.3	2.1%	-3.5%	0.9%	15.6	0.64	0.8%	0.1%	0.7%	0.81
HSC	13.6	2.7%	-2.3%	1.6%	24.0	0.67	0.7%	0.4%	0.6%	0.84
JAE	8.6	2.7%	-2.9%	1.5%	14.6	0.62	0.9%	0.3%	0.8%	0.80
LEO	10.6	2.7%	-3.0%	1.6%	18.3	0.68	0.7%	0.1%	0.6%	0.82
LLE	16.3	2.3%	-2.1%	1.4%	26.5	0.68	0.7%	0.5%	0.6%	0.85
RIO	16.9	1.8%	-2.6%	0.9%	23.4	0.69	0.6%	0.3%	0.6%	0.85
LUG	9.9	2.7%	-1.3%	1.9%	19.1	0.64	0.7%	0.5%	0.7%	0.81
MAD	15.9	2.9%	-2.3%	1.8%	29.6	0.71	0.7%	0.3%	0.6%	0.88
MAL	10.1	2.5%	-3.3%	1.3%	15.9	0.65	0.8%	0.2%	0.7%	0.82
MUR	12.6	2.0%	-3.1%	0.9%	17.5	0.66	0.7%	0.2%	0.6%	0.83
NAV	17.9	2.1%	-2.5%	1.2%	27.1	0.71	0.7%	0.2%	0.6%	0.87
OUR	7.0	3.8%	-1.4%	2.7%	18.0	0.62	0.8%	0.4%	0.7%	0.81
AST	11.8	2.6%	-3.4%	1.3%	18.8	0.69	0.6%	0.2%	0.5%	0.84
PAL	13.3	2.5%	-3.0%	1.4%	21.7	0.67	0.7%	0.1%	0.6%	0.82
PGC	13.3	2.0%	-3.0%	0.9%	18.5	0.67	0.8%	0.2%	0.6%	0.83
PON	10.2	2.9%	-3.0%	1.7%	18.1	0.67	0.8%	0.3%	0.7%	0.84
SAL	8.5	3.3%	-2.8%	2.1%	17.5	0.66	0.7%	0.4%	0.7%	0.83
SCT	11.8	2.4%	-3.3%	1.2%	18.2	0.67	0.7%	0.3%	0.6%	0.83
CAN	12.4	2.5%	-3.4%	1.3%	19.4	0.69	0.6%	0.3%	0.6%	0.84
SEG	11.7	2.8%	-3.8%	1.5%	19.4	0.68	0.6%	0.3%	0.6%	0.82
SEV	10.2	2.8%	-3.1%	1.6%	17.5	0.65	0.9%	0.2%	0.7%	0.84
SOR	11.6	2.8%	-1.9%	1.8%	22.1	0.68	0.7%	0.4%	0.6%	0.84
TAR	16.8	2.2%	-2.6%	1.2%	25.3	0.69	0.6%	0.3%	0.6%	0.84
TER	14.8	2.2%	-2.1%	1.4%	23.9	0.67	0.7%	0.2%	0.6%	0.83

TOL	10.6	2.6%	-4.5%	1.1%	15.7	0.64	0.8%	0.1%	0.7%	0.81
VAL	12.6	2.5%	-3.1%	1.3%	19.9	0.68	0.7%	0.2%	0.6%	0.85
VLD	13.4	2.4%	-2.8%	1.4%	21.5	0.68	0.8%	0.3%	0.7%	0.86
VZC	17.3	2.1%	-1.9%	1.3%	26.9	0.71	0.7%	0.3%	0.6%	0.87
ZAM	8.4	3.1%	-1.8%	2.1%	17.1	0.65	0.7%	0.1%	0.6%	0.79
ZAR	12.6	3.2%	-3.5%	1.8%	23.6	0.69	0.8%	0.1%	0.6%	0.85

This table presents the values for the HDI and the per capita GDP for the Spanish provinces in 1980 and 2014. The growth of these variables for the pre-crisis, the post-crisis and the whole periods is also displayed. The per capita GDP is measured in thousands € (2010 constant euros). P.c.: per capita.

Table 2. Growth rates for the Spanish provinces. Per capita GDP and HDI.

	Panel A. Per capita GDP			Panel B. HDI		
	1980-2007	2008-2014	1980-2014	1980-2007	2008-2014	1980-2014
PU	2.47%	-2.91%	1.37%	0.73%	0.23%	0.63%
INT	2.38%	-3.09%	1.26%	0.72%	0.24%	0.63%
PRC	2.68%	-2.68%	1.59%	0.73%	0.32%	0.65%
PRR	3.04%	-2.28%	1.95%	0.77%	0.24%	0.67%

This table presents the average growth rates for the different periods of the OECD TL3 Spanish provinces. PU: Predominantly Urban; INT: Intermediate; PRC: Predominantly Rural close to a City; PRR: Predominantly Remote Rural. Panel A refers to the per capita GDP and Panel B to the HDI.

Table 3. PS methodology. HDI.

Panel A. Testing for convergence	
1980-2007	1980-2014
-1.332 (-19.904)	-1.261 (-14.771)
Panel B. Estimated Clubs	
1980-2007	1980-2014
Club 1 ALA GUI MAD	*Club 1* ALA GUI MAD
Club 2 CAS GIR NAV VLD VZC ZAR BAR VAL	*Club 2* NAV VLD BAL BAR CAS CRÑ LLE RIO CAN SEV VAL ZAR
Club 3 ALI BAD BAL BUR CRÑ LLE RIO MUR AST PGC PON SCT CAN SEV TAR ALB CAD HSC MAL TER	*Club 3* GIR VZC
Club 4 GUA SAL SOR	*Club 4* ALB ALI BAD BUR HLV HSC AST PON SAL TAR TER PGC SOR TOL GUA MUR SCT SEG ALM GRA LEO MAL PAL CAD COR LUG
Club 5 ALM AVI COR GRA HLV JAE LEO OUR PAL	*Club 5* AVI CAC CDR CUE JAE OUR
Club 6 CAC CDR SEG TOL	
Club 7 CUE LUG ZAM	

This table presents the results of applying the Phillips and Sul methodology to the HDI. First, Panel A shows the estimation results of equation (9). Panel B lists the members of each club. *t*-ratios in parentheses.

Table 4. PS methodology. Per capita GDP.

<table>
<tr><th colspan="2">Panel A. Testing for convergence</th></tr>
<tr><td>2007</td><td>2014</td></tr>
<tr><td>-0.429
(-10.293)</td><td>-0.335
(-6.919)</td></tr>
<tr><th colspan="2">Panel B. Estimated Clubs</th></tr>
<tr><td>2007</td><td>2014</td></tr>
<tr><td>Club 1
ALA MAD</td><td rowspan="3">Club 1
GUI MAD BAD BAR BUR
CRÑ GIR HSC LLE LUG
NAV OUR PAL TAR VZC
ZAR BAL CDR CUE GRA
LEO RIO MAL AST PON
SAL SCT CAN SEV SOR
TER VAL VLD ZAM</td></tr>
<tr><td>Club 2
ALM BAR GIR GUI HSC
LLE NAV TAR VZC ZAR</td></tr>
<tr><td>Club 3
BAD BAL BUR CAS CDR
CRÑ RIO OUR AST PAL
PON SAL SCT CAN SEG
SEV SOR TER VAL VLD</td></tr>
<tr><td>Club 4
ALB ALI AVI CAC CAD
COR CUE GRA GUA HLV
JAE LEO LUG MAL MUR
PGC TOL ZAM</td><td>Club 2
ALB ALM AVI CAC CAD
CAS COR GUA HLV JAE
MUR PGC SEG</td></tr>
</table>

This table presents the results of applying the Phillips and Sul methodology to the per capita GDP. First, Panel A shows the estimation results of equation (9). Panel B lists the members of each club. *t*-ratios in parentheses.

Table 5. Mood and Kruskal-Wallis statistics. HDI and per capita GDP.

	HDI	Per capita GDP
Mood	15.71*	14.76*
Kruskal-Wallis	32.87*	14.45*

This table reflects the Mood and the Kruskal-Wallis statistics. Mood's statistic tests whether the medians of the estimated clubs are similar when comparing the results obtained for the 1980-2007 and 1980-2014 samples. The Kruskal-Wallis statistic tests whether these two estimated clubs are from the same population. Both statistics asymptotically follow a chi-squared distribution of G-1 degrees of freedom, G being the number of groups.

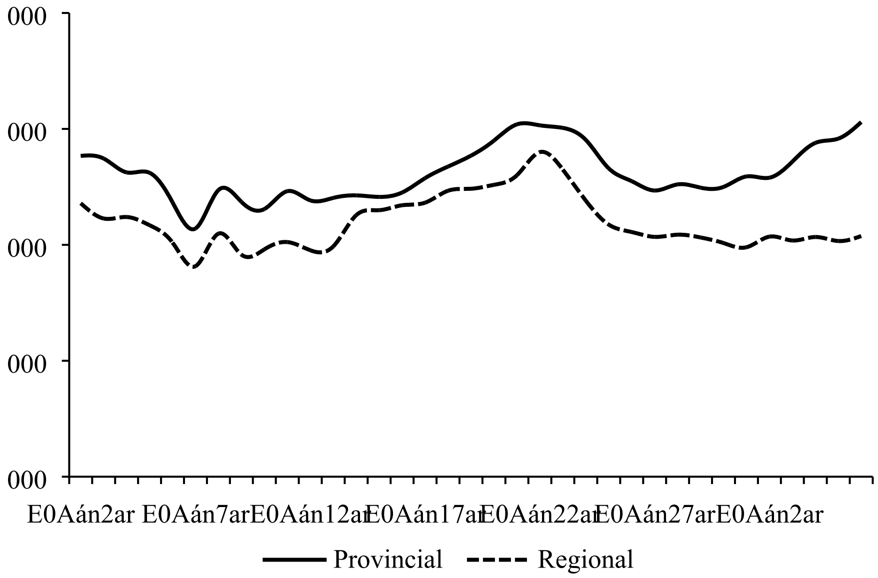
* means the rejection of the null hypothesis that the median of the two populations are identical using a 1% significance level.

Table 6. Estimation of the probit model. HDI and per capita GDP.

Panel A. HDI			Panel B. Per capita GDP		
Variables	1980-2007	1980-2014	Variables	1980-2007	1980-2014
ILF	-0.18	-0.10	*DISL*	2.49	1.55
	(-4.95)	(-3.31)		(3.70)	(1.69)
INNOV	-4.92	-3.40	*INNOV*	-6.88	-4.08
	(-5.06)	(-3.15)		(-4.82)	(-2.84)
DCAP	-1.26	-1.75			
	(-1.98)	(-3.10)			
DPU	-1.40				
	(-2.92)				
DPRR	1.93	1.27			
	(3.49)	(1.65)			
DPRC	1.84	2.90			
	(3.25)	(4.66)			
Pseudo R^2	0.54	0.51	Pseudo R^2	0.40	0.19

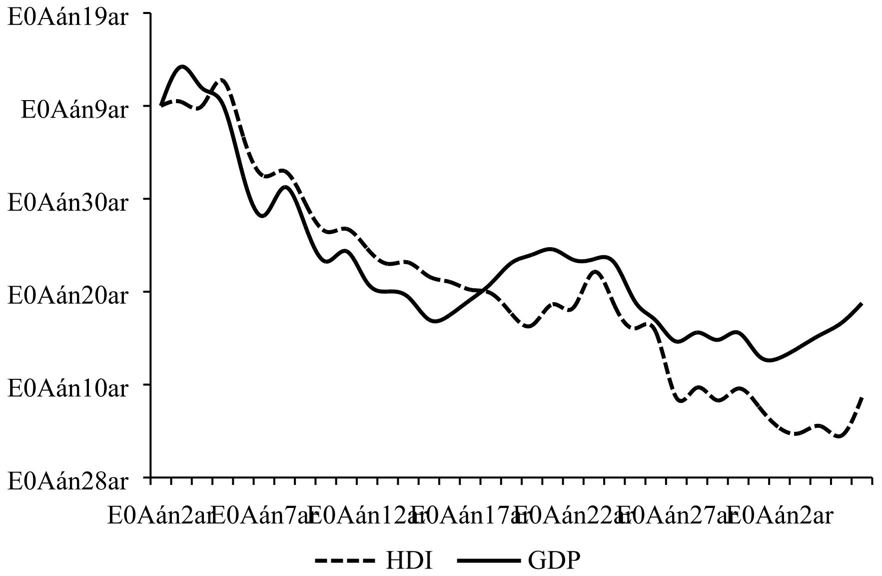
This table presents the coefficient estimates of the ordered probit model. *t*-ratios in parentheses. Panel A refers to the HDI for the periods 1980-2007 and 1980-2014, and Panel B to the per capita GDP for the same periods.

Figure 1. Theil Index of inequality for provincial and regional GDP, 1980-2014



This figure reflects the Theil inequality coefficient for both provincial and regional GDP.

Figure 2. Coefficient of variation. HDI and per capita GDP, 1980-2014



This figure reflects the coefficient of variation of both per capita GDP and HDI, taking the value 100 for the year 1980.

Figure 3. Estimated clubs. HDI

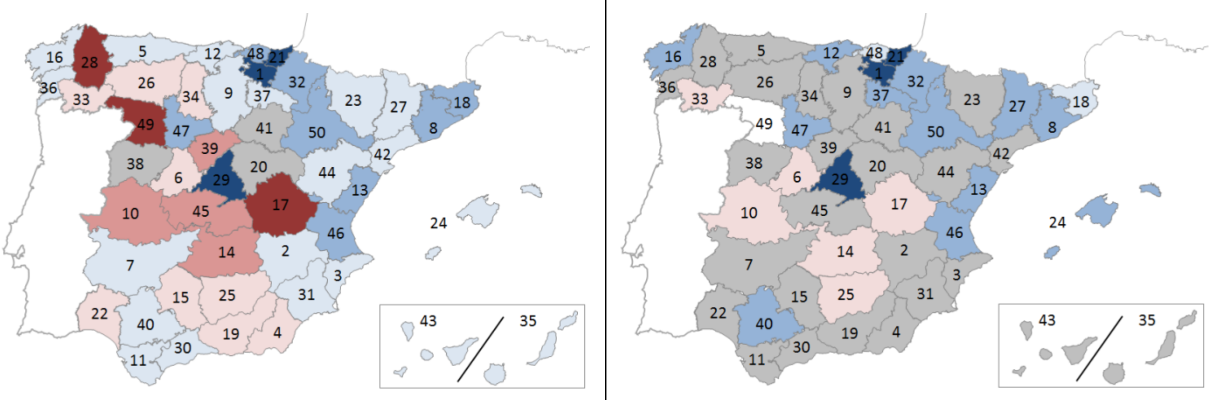
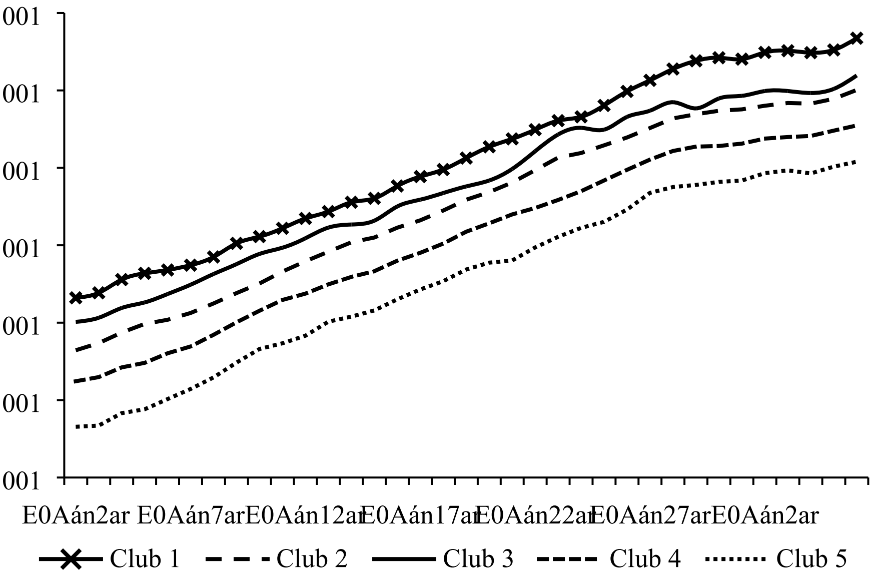


Figure 3(a). HDI 1980-2007 | Figure 3(b). HDI 1980-2014

Club 1 | Club 2 | Club 3 | Club 4 | Club 5 | Club 6 | Club 7 | Not assigned

This figure presents the final classification of the Spanish provinces for the HDI into the estimated clubs. Figure 3(a) considers the sample 1980-2007 and Figure 3(b) the sample 1980-2014.

Figure 4. Average values of the provinces in Clubs 1-5. HDI



This figure presents the evolution for the average HDI of Clubs 1-5 when the sample 1980-2014 is considered.

Figure 5. Estimated clubs. Per capita GDP

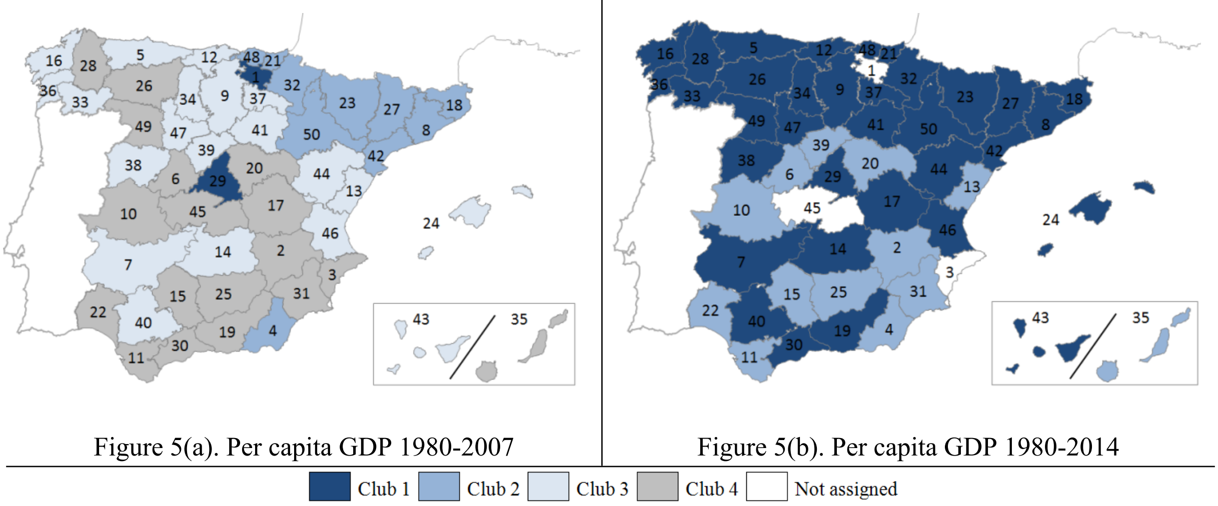
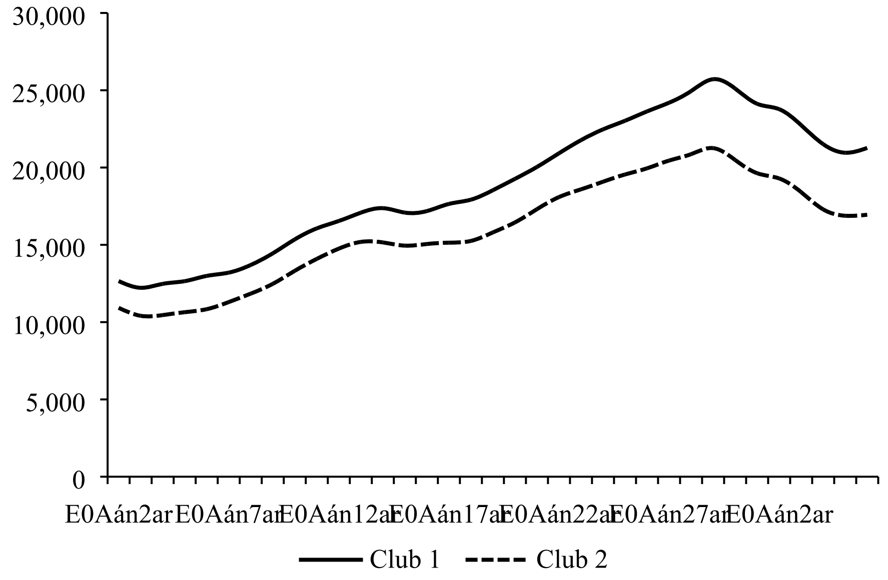


Figure 5(a). Per capita GDP 1980-2007

Figure 5(b). Per capita GDP 1980-2014

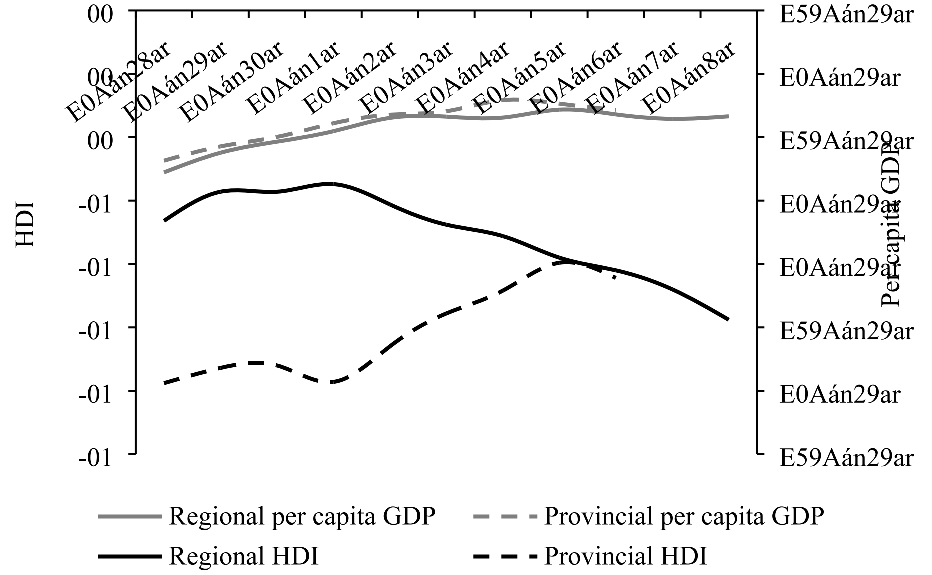
This figure presents the final classification of the Spanish provinces for the per capita GDP into the estimated clubs. Figure 5(a) considers the sample 1980-2007 and Figure 5(b) the sample 1980-2014.

Figure 6. Average values of the provinces in Clubs 1 and 2. Per capita GDP (€)



This figure presents the evolution of the average per capita GDP of Clubs 1 and 2 when the 1980-2014 sample is considered.

Figure 7. Recursive estimation of parameter β, provincial and regional data.



This figure reflects the value of the estimation of the parameter β (equation 9) calculated for the provincial and the regional per capita GDP and HDI for the sample 1980-i, with i = 2006, 2007, ...

Appendix A

The data have been obtained from the following sources:

- Per capita GDP: In order to obtain this variable, we have first joined the different databases of the provincial GDP, available at the web page of the Spanish Institute of Statistics (INE) (www.ine.es). We have transformed the data to real terms by using the annual average of the consumer price index and, finally, we have divided by the population of the corresponding provinces. Population and consumer price index are also available at the abovementioned web page. Regional data have been obtained from the BD Mores database, using constant price data at 2011, for 1980-2013. Data for 2014-2016 have been obtained by applying the growth rates of regional data of INE.
- Average Years of Schooling: Provincial and regional data are available at the IVIE web page (http://www.ivie.es/es/banco/caphum/series.php) for the 1980-2013 sample. Data for 2014-2016 have been predicted by using the evolution of the percentage of population with tertiary studies in Spain.
- Life expectancy at birth: These data have been obtained from the INE web page.

Appendix B

Table B.1. List of provinces

Nº	Province	Acronym	Region	Class	Other characteristics
1	Álava	ALA	País Vasco	INT	Foral
2	Albacete	ALB	Castilla-La Mancha	PRC	
3	Alicante	ALI	Comunidad Valenciana	INT	
4	Almería	ALM	Andalucía	INT	
5	Asturias	AST	Principado de Asturias	INT	Uniprovincial
6	Ávila	AVI	Castilla y León	PRR	
7	Badajoz	BAD	Extremadura	PRR	
8	Barcelona	BAR	Cataluña	PU	
9	Burgos	BUR	Castilla y León	INT	
10	Cáceres	CAC	Extremadura	PRR	
11	Cádiz	CAD	Andalucía	INT	
12	Cantabria	CAN	Cantabria	INT	Uniprovincial
13	Castellón	CAS	Comunidad Valenciana	INT	
14	Ciudad real	CDR	Castilla-La Mancha	PRR	
15	Córdoba	COR	Andalucía	INT	
16	Coruña, A	CRÑ	Galicia	INT	
17	Cuenca	CUE	Castilla-La Mancha	PRR	
18	Girona	GIR	Cataluña	INT	
19	Granada	GRA	Andalucía	INT	
20	Guadalajara	GUA	Castilla-La Mancha	INT	
21	Guipúzcoa	GUI	País Vasco	PU	Foral
22	Huelva	HLV	Andalucía	INT	
23	Huesca	HSC	Aragón	PRC	
24	Illes Balears	BAL	Illes Balears	INT	Uniprovincial, insular
25	Jaén	JAE	Andalucía	PRC	
26	León	LEO	Castilla y León	INT	
27	Lleida	LLE	Cataluña	PRC	
28	Lugo	LUG	Galicia	PRC	
29	Madrid	MAD	Comunidad de Madrid	PU	Uniprovincial
30	Málaga	MAL	Andalucía	PU	
31	Murcia	MUR	Región de Murcia	INT	Uniprovincial
32	Navarra	NAV	Comunidad Foral de Navarra	INT	Foral, Uniprovincial
33	Ourense	OUR	Galicia	PRC	
34	Palencia	PAL	Castilla y León	PRC	
35	Palmas, Las	PGC	Canarias	PU	Insular
36	Pontevedra	PON	Galicia	INT	
37	Rioja, La	RIO	La Rioja	INT	Uniprovincial
38	Salamanca	SAL	Castilla y León	INT	
39	Segovia	SEG	Castilla y León	PRC	
40	Sevilla	SEV	Andalucía	PU	
41	Soria	SOR	Castilla y León	PRR	
42	Tarragona	TAR	Cataluña	INT	

43	Santa Cruz de Tenerife	SCT	Canarias	PU	Insular
44	Teruel	TER	Aragón	PRR	
45	Toledo	TOL	Castilla-La Mancha	PRC	
46	Valencia	VAL	Comunidad Valenciana	PU	
47	Valladolid	VLD	Castilla y León	INT	
48	Vizcaya	VZC	País Vasco	PU	Foral
49	Zamora	ZAM	Castilla y León	PRR	
50	Zaragoza	ZAR	Aragón	PU	