Effects of the crisis in the resin sector on the demography of rural municipalities in Spain

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Abstract

Aim of study: The aim of this work is to test the positive effect of a substantially developed resin sector on rural demographic evolution. This work shows how in the period between 1970 and 2010 the demographic decline in the interior regions of Spain was more pronounced in areas characterized by the importance of resin-producing forest stands compared to other nearby rural municipalities where this natural resource is not present.

Area of study: The study area consists of a set of rural municipalities in Central Spain, both resin and non-resin producing, in the provinces of Segovia, Avila, Valladolid, Burgos, Soria, Cuenca and Guadalajara.

Material and methods: The relationship between resin production and population in resin and non-resin producing municipalities was modeled by means of linear regression analysis.

Main results: Generally speaking, between 1950 and 1970 the production of resin halted demographic decline in the regions where this activity was substantially developed. However, when the resin sector entered into crisis in the 1970s, and the economic repercussions of this activity gradually ceased to be felt, the demographic decline in the regions which had been involved in resin production was much more acute than in other non-resin-producing rural areas.

Research highlights: This work shows the relationship between resin extraction activity and population evolution in rural municipalities. Sustainable resin exploitation can contribute to the maintenance and development of rural communities, and should be used as a tool for generating employment in rural areas.

Key words: demography; economic crisis; resin sector; rural development.

Introduction

The demographic crisis which occurred as a result of the population exodus towards urban areas with greater economic development (Marsden, 1998) has affected a large number of rural regions in the interior of Spain since 1950 (Paniagua, 2000; Camarero, 2002). The cost to these rural areas has been high, including an aging population, an absence of public services, etc. (Ploeg *et al*., 2000; Blanco Martín, 2002). This is exacerbated by the additional difficulties involved in reversing this situation, due to the lack of any economic activity which might serve to attract new population (Johanson and Rauht, 2002).

This situation is particularly significant in mountain areas (García, 2003; Harrison, 1992) where forestry is the primary activity, and which are therefore ineligible for any subsidies under the European Union's Common Agricultural Policy (CAP) (Mather *et al*., 2006). These rural areas offer clear evidence that the emigration process has not yet terminated and that the social and economic deterioration continues over time (Hoggart and Paniagua, 2001). The analysis of the relationship between demographic evolution and resin production presented in this paper focuses on the rural areas located in the interior of Spain (Castilla-La Mancha and Castilla-León regions) and on their associated industrial sector, as it offers a good example of similar developments in many other mountain areas in Spain.

In Spain, the maritime pine (*Pinus pinaster* Ait.) currently covers an area of approximately 1.4 million hectares, of which 500,000 have been used for resin production at some time throughout the 20th century (Richardson, 1998). Eighty percent of this area is concentrated in seven provinces in the interior of Spain located in the regions of Castilla-La Mancha (Cuenca and Guadalajara) and Castilla-León (Segovia, Avila,

Valladolid, Burgos and Soria) (Trujillo, 1999). Maritime pine is also present and has been used for resin production in a total of 18 provinces (Bordons, 1996). However, the resin sector today only has economic importance in Segovia, with a scant 10,000 hectares under production (Cesefor, 2009).

The seven provinces previously mentioned are characterised for having suffered an important rural exodus, in which the rural population of 1.5 million inhabitants in 1950 fell to about 600,000 nowadays (INE, 2011). Rural population has been defined as people living in villages of less than 5,000 inhabitants. The average population density in these provinces is 15 inhabitants/km^2, and in resin-producing regions this figure drops to 5 inhabitants/km^2 (Miranda *et al*., 2005; Collantes, 2004).

Between 1950 and 1970, as a result of the rise in the cost of labour and the rural emigration which followed industrial development (Bowler and Ilbery, 1997; Grossman and Brussaard, 1992), resin production fell in all developed countries, first gradually and then drastically, leading to the abandonment of most of the resin-producing areas (Hyttinen *et al*., 2002). There is little doubt that the system of resin production has been and continues to be one of the sector's main problems, as resin collection requires a great deal of labour, which represents a high percentage (over 80 %) of total production costs (Zamorano, 1998).

On a worldwide level, China dominates the resin market with a production of 600,000 tons (Guangzhon, 2001). Since the late twentieth century, resin production in developed countries has declined (Pardon and Belmond, 2002; Coppen and Hone, 1995; Outland, 2004) and nowadays only that coming from tall oil is maintained (PCA, Pine Chemicals Association, 2007).

The resin producing sector

In Spain, throughout the 19th and a large part of the 20th century, resin extraction was the basis of the economy and the identity of a large number of rural communities in the interior of the country (Berlanga, 1999). Resin extraction was so important in Spain during the first decades of the 20th century that at one point in the early 1920s Spain was the world's third largest producer (Trujillo, 1999). However, resin production has been in continuous decline since the 60s, when it was a little over 50,000 tons (Bordons, 1996), until the present day, with an output of less than 2,000 tons (Fig. 1) (Allué
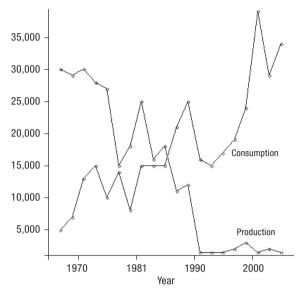

Figure 1. Industrial consumption and production of colophony in Spain. *Source:* Own elaboration based on Allué *et al.,* 2004; MARM, 2010 and Unión Resinera, 2007.

et al., 2004; MARM, 2010 and Unión Resinera, 2007). Moreover, a substantial number of factories dedicated to process resin products have disappeared; and today there are only five companies which process resin. In the first transformation, the products obtained from resin are colophony and its volatile fraction, turpentine or turpentine essence. In the second transformation colophony and turpentine derivatives are obtained through chemical reactions. Nowadays, most of the resin for production of derivatives is imported (De Pedro, 1998; Radich, 1995) for an interior market which has an annual demand for consumption of over 30,000 tons of colophony and 4,000 tons of turpentine (Solís, 1998).

The internal consumption of colophony in Spain, although it is subject to considerable fluctuation, continues to show rapid growth, and in 2001 it reached a historic maximum of 40,000 tons. Fig. 1 shows the evolution of colophony consumption in Spain compared to resin production. It can be noticed that colophony demand is still very high, even though raw material has not a domestic origin.

Regarding to prices, until 2005 it was much more profitable for Spanish companies to import colophony from countries such as China, Indonesia or Brazil (Shen, 1994; Pinto, 2001) even when transport costs were included, given that the price difference was approximately 0.10 e/kg in favour of imported colophony. However, following the increase in oil prices since 2006, this situation has changed (Fig. 2).
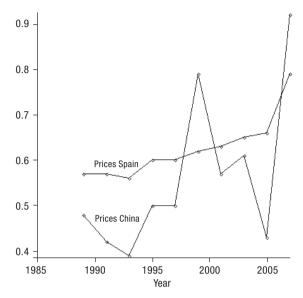
Figure 2. Price of resin products in Spain and China (€/kg). *Source:* Cesefor, 2009.

Table 1. Definition of variables and indices used in the analysis

Name of variable	Description and units of measurement
PROVPOP	Total population (Inhabitants/province)
POPRESMUN	Population in resin-producing municipalities (Inhabitants/province)
POPNONRESM	Population in non-resin-producing municipalities (Inhabitants/province)
WPOPRESMUN	Proportion of population in resin-producing municipalities
WPOPNONRES	Proportion of population in non-resin-producing municipalities
VARTOTPOP	Total population change in a 10-year period (%)
VARPOPRESM	Population change in resin-producing municipalities in a 10-year period (%)
VARPOPNONR	Population change in non-resin-producing municipalities in a 10-year period (%)
RESINPROD	Total annual resin production (t/year)

The objectives of this work are, firstly, to highlight the importance of the exploitation of a renewable natural resource, such as resin, for the maintenance of local economies, and, secondly, to test the positive effect of this kind of forest use on rural demographic evolution compared to other nearby agricultural areas where this natural resource is not present.

Material and methods

Study area and data sources

The study area consists of a set of rural municipalities in Central Spain, both resin and non-resin producing, in the provinces of Segovia, Avila, Valladolid, Burgos, Soria, Cuenca and Guadalajara. Rural municipalities are defined as those having a population under 5,000 inhabitants.

The study period covers from 1950 to 2010 and, for each one of the seven provinces abovementioned, total population and annual resin production data in 1950, 1960, 1970, 1980, 1990, 2000 y 2010 have been used. Therefore, for each one of the variables considered, there are 49 observations, one per province and year. The variables observed and the indices calculated are shown in Table 1.

From actual data on total population and resin production, two additional groups of indices have been calculated: proportion of population in resin- and non-resin-producing municipalities, and percentage population change in resin and non-resin-producing municipalities in a 10-year period.

The proportion of population in resin-producing municipalities gives an idea of the importance of the resin extraction activity in the province, while population change in resin and non-resin-producing municipalities is a piece of information which can be helpful to analyze if resin production has an effect on population decrease along time.

Resin production data (Fig. 1) and population data for the period between 1950 and 2010 were used. To chart the demographic evolution of 120 resin-producing villages in the provinces of Avila, Cuenca, Guadalajara, Burgos, Valladolid, Segovia and Soria, which have traditionally accounted for 80% of resin production in Spain, statistical data from the National Statistical Institute (INE, 2011) were used. The remaining rural communities in these provinces were also considered, and the corresponding comparative analysis was carried out (Figs. 3 and 4).

The distribution of resin-producing and non-resin-producing municipalities was obtained from the historic series on resin production in Spain available from "La Unión Resinera Española" (Unión Resinera, 2007) completed for the last four years through personal interviews. The evolution of resin prices in the period between 1950 and 2010 was obtained from statistics from the Ministry of Environment, Agriculture and
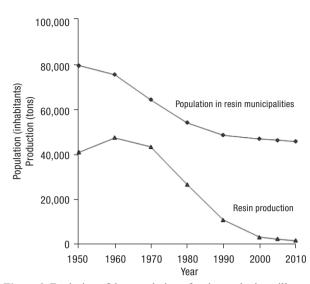
Figure 3. Evolution of the population of resin-producing villages, in relation with resin production (production in tons). *Source:* own elaboration based on INE, 2011 and Unión Resinera, 2007.
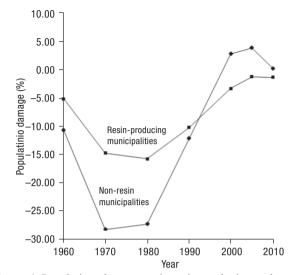

Figure 4. Population change rate in resin-producing and non-resin-producing municipalities. *Source:* own elaboration based on INE, 2011.

Fisheries (MARM, 2010). Finally, the series corresponding to resin production for that period also come from information provided by MARM (2010).

Data analysis

There were analyzed the degree and type of correlation existing between the variables of population level (expressed in number of inhabitants), annual resin production (expressed in tons) and the other indices calculated.

Variable correlation was measured by means of Pearson's, Kendall's and Spearman's coefficients (r, τ and ρ respectively). The correlation matrix for some selected variables is shown in Table 2.

The relationship between population in resin-producing municipalities and resin production was modeled by means of linear regression analysis.

It was essayed a linear regression model including population in resin-producing municipalities as the dependent variable and resin production as the only independent variable. However, resin production can only explain part of the behavior of the variable POPRESMUN, and this behavior responds to some extent to other circumstances which are probably conditioning the level of population in other rural municipalities where resin production is not a significant activity. Bearing this in mind, a linear model in which population in resin-producing municipalities (response variable) is expressed as a function of resin production and population in non-resin-producing municipalities (explanatory variables) was fit. The specification of the model responds to the following equation:

$$POPRESMUN = a + b \cdot RESINPROD - c \cdot POPNONRESM$$

Finally, the model can be used to know if population change in resin-producing municipalities has a similar behavior in the seven provinces and the two regions studied. A means homogeneity contrast is carried out for this purpose.

Data analysis has been carried out using the statistical package SPSS version 11.

Table 2. Correlation among variables

		WPOPRESMUN	WPOPNONRES	VARPOPRESM	VARPOPNONR	RESINPROD
POPRESMUN	r	0.966** (0.000)	−0.063 (0.667)	0.183 (0.245)	−0.035 (0.825)	0.815** (0.000)
	τ	0.702** (0.000)	0.048 (0.629)	0.229* (0.033)	−0.103 (0.335)	0.459** (0.000)
	ρ	0.872** (0.000)	0.067 (0.647)	0.319* (0.040)	−0.150 (0.343)	0.616** (0.000)
POPNONRESM	r	−0.372** (0.008)	0.589** (0.000)	−0.006 (0.968)	−0.133 (0.401)	0.128 (0.381)
	τ	−0.109 (0.270)	0.413** (0.000)	−0.057 (0.595)	−0.124 (0.246)	0.272** (0.006)
	ρ	−0.229 (0.114)	0.585** (0.000)	−0.106 (0.503)	−0.159 (0.314)	0.389** (0.006)

Results

The correlation matrix (Table 2) shows that there is a strong, positive and statistically significant correlation between population in resin-producing municipalities and annual resin production. The decrease in resin production is related to population decrease. However, according to Table 2, the level of population both in resin and non-resin-producing municipalities is not related to population change.

At the same time, the evolution of resin production along time shows that there is a strong, negative and statistically significant correlation (at the 99% confidence level) between annual resin production and the variable representing time (year of measurement). The fall in annual resin production (from 50,000 tons to 2,000 tons) has been described in the first section of this work.

Fig. 3 shows the evolution of the demographic and resin-production variables in the period between 1950 and 2010 for the two regions where resin production was concentrated (Castilla-León and Castilla-La Mancha).

Until 1970 the demographic evolution of resin-producing villages, although negative, was more favourable than the evolution of non-resin-producing villages in the seven provinces analyzed, as a result of the positive effect this sector exercised on the rural economy in these areas. However, the demographic evolution of the resin-producing regions from 1980 onwards (when the resin crisis, which began in the late 60s, became more acute) was more negative than in the other rural communities in these seven provinces, as shown in Fig. 4. Fig. 4 shows the different evolution experienced by the rate of population change in ten-year periods for resin and non-resin-producing municipalities.

One exception is the province of Ávila, where some resin-producing villages also enjoy a highly developed tourist industry, given their proximity to Madrid (under 100 km). In all the provinces studied, the decrease in population in the resin-producing villages was constant throughout the whole study period, despite the fact that the other non-resin-producing villages saw a slight demographic recovery between 1990 and 2010.

The model highlights the fact that the population in resin-producing municipalities is partly responding to a series of causes probably similar to those driving the population of other rural municipalities in which resin extraction is not an important activity (and these effects are captured by POPNONRESM), but it also depends on the level attained by the resin extraction work. The equation of the model obtained is the following:

$$POPRESMUN = 7,908.39 + 2.288 \cdot RESINPROD - 0.058 \cdot POPNONRESM$$

The relationship between the variables is statistically significant for a 99% confidence level ($F_{2,46} = 78.97$; $p = 0.000$). The values of R^2 ($= 77.44\%$) or adjusted R^2 ($= 76.46\%$) give an idea of the variability of POPRESMUN explained by the model. Therefore, the plane defined by the regression equation provides a good fit to the available data.

The model behaves as expected, since the sign of the coefficients associated to the explanatory variables matches the sign of the relationship expressed by the correlation matrix. After examining the residuals of the model, no evidence of serial autocorrelation was found. The absence of multicollinearity was also checked.

The results of the means homogeneity contrast, carried out to analyze the behavior of the variables in the factors province, region and year, are shown in Table 3.

Table 3. Mean homogeneity test (H_0: Equality of means)

Variable	Factor		
	Province	Region	Year
PROVPOP	Reject H_0 $F_{6,42} = 54.32$ $p = 0.000$	Accept H_0 $F_{1,47} = 1.56$ $p = 0.217$	Accept H_0 $F_{6,42} = 0.12$ $p = 0.993$
POPRESMUN	Reject H_0 $F_{6,42} = 88.35$ $p = 0.000$	Reject H_0 $F_{1,47} = 7.81$ $p = 0.008$	Accept H_0 $F_{6,42} = 0.24$ $p = 0.959$
POPNONRESM	Reject H_0 $F_{6,42} = 4.07$ $p = 0.003$	Accept H_0 $F_{1,47} = 1.81$ $p = 0.185$	Reject H_0 $F_{6,42} = 8.90$ $p = 0.000$
WPOPRESMUN	Reject H_0 $F_{6,42} = 349.38$ $p = 0.000$	Reject H_0 $F_{1,47} = 7.49$ $p = 0.009$	Accept H_0 $F_{6,42} = 0.043$ $p = 1.000$
WPOPNONRES	Reject H_0 $F_{6,42} = 5.12$ $p = 0.001$	Reject H_0 $F_{1,47} = 7.59$ $p = 0.008$	Reject H_0 $F_{6,42} = 8.14$ $p = 0.000$
VARTOTPOP	Accept H_0 $F_{6,35} = 1.51$ $p = 0.205$	Accept H_0 $F_{1,40} = 0.15$ $p = 0.698$	Reject H_0 $F_{5,36} = 4.81$ $p = 0.002$
VARPOPRESM	Accept H_0 $F_{6,35} = 2.31$ $p = 0.056$	Reject H_0 $F_{1,40} = 7.27$ $p = 0.010$	Reject H_0 $F_{5,36} = 2.54$ $p = 0.046$
VARPOPNONR	Accept H_0 $F_{6,35} = 0.29$ $p = 0.938$	Accept H_0 $F_{1,40} = 0.03$ $p = 0.859$	Reject H_0 $F_{5,36} = 40.85$ $p = 0.000$
RESINPROD	Reject H_0 $F_{6,42} = 6.56$ $p = 0.000$	Accept H_0 $F_{1,47} = 2.02$ $p = 0.162$	Reject H_0 $F_{6,42} = 4.18$ $p = 0.002$

The means by province of the variables PROVPOP, POPRESMUN, POPNONRESM, WPOPRESMUN y WPOPNONRES are significantly different. However, if the means by region of the same variables are analyzed, only the population in resin-producing municipalities shows a statistically significant difference between Castilla-La Mancha and Castilla-León.

The three variables on population change show non-significant differences between means by province. However, means by region are only significantly different for population change in resin-producing municipalities.

There are no significant differences in resin production by region, but there are differences if the means by province are considered. It is worth mentioning the importance of resin production and the population level of the resin-producing municipalities in the province of Segovia. In fact, if the province of Segovia is excluded from the analysis, resin production in the rest of the provinces does not show significant differences. On the contrary, resin production in Segovia is significantly different from resin production in the other provinces ($F_{1,47} = 41.92$; $p = 0.000$).

Discussion

The statistical analyses highlight the close relation which exists between the decreasing demographic evolution in resin-producing areas and the fall in resin production, as well as the decline in real prices of the product obtained. However, this demographic behaviour may also be influenced by other factors, such as the crisis in the agricultural sector or the lack of young people in rural areas, which are common to other rural municipalities.

The correlation matrix and the regression model obtained show how the crisis in the resin sector has provoked a regressive trend in the demography of the corresponding rural villages. Moreover, even if the current production level is maintained over the next few years, this trend is likely to continue over time, and may lead to the practical disappearance of some of these municipalities in the short/medium term. The only communities which might be excluded are places where the tourist industry is developed or which are near large urban centres, primarily in the provinces of Avila (close to Madrid) and Valladolid.

The destruction between 1950-2005 of over 5,000 jobs directly generated by the Spanish resin sector, to

which a similar number of indirectly-generated jobs throughout the same period should be added, clearly shows the highly negative effect resulting from the practical disappearance of this sector, whose economy was concentrated almost entirely in rural areas of the interior of Spain (Álvarez, 2009).

From the means homogeneity test performed (Table 3), several conclusions can be drawn: first of all, it is absolutely clear that the evolution and weight of the population in resin-producing municipalities shows a significant difference among provinces and among regions. This is due to the strong presence of resin extraction in the province of Segovia, both in terms of volume of resin produced and number of resin-producing municipalities, when compared to the other provinces. On the other hand, the resin extraction activity is more widespread in Castilla-León than in Castilla-La Mancha (Álvarez, 2009).

It is also remarkable how population change rates in resin-producing municipalities (VARPOPRESM) are significantly different between the two regions, since the demographic decline in Castilla La Mancha is more pronounced than in Castilla-León as a consequence of the geographic isolation of the resin-producing municipalities in Castilla-La Mancha and their original demographic weakness (INE, 2011).

Even though the population in resin-producing and non-resin-producing municipalities are not significantly related ($r = -0.226$, $p = 0.118$), there is a certain correlation degree between population change in resin and non-resin-producing municipalities ($r = 0.434$, $p < 0.01$). This result is not strange, since both types of municipalities share some of the causes of rural depopulation. However, population change in resin-producing municipalities does not show any relationship with population change at provincial level ($r = 0.131$, $p = 0.41$), while the latter is related to population change in non-resin-producing municipalities ($r = 0.650$, $p < 0.01$). This result points at the specificities of the resin-producing municipalities.

With regard to the non-resin-producing municipalities, it is worth noting that their population level and their population change rate show a positive evolution since the decade of the 90's, taking advantage of the Madrid influence area, that in many cases has turned these municipalities into second-home residential semi-urban areas (Ortuño and Martín, 2006).

The recovery of resin production could play an important socio-economic role in the economic and demographic recovery of these traditional resin-produc-

cing areas. Moreover, as the resin collectors work in the countryside during the season of high fire risk, this activity would serve a very important conservation function. Given that significant amounts of money are currently being invested in treatments for natural areas (between 15-30 €/ha a year in the fight against forest fires alone) (Ortuño and Martín, 2006), and in the campaign against rural depopulation, it has been estimated that it may be profitable to encourage maintenance of resin collection and production, particularly considering the abovementioned positive effects for fire prevention. The difference in costs between national resin production and imports, considering the differential of 0.10 €/kg (Fig. 2), would only have represented the equivalent of a subsidy of 20 €/ha a year to maintain the production of resin in Spain. This is not the situation today, as the rise in oil prices in the last two years has caused the difference to be favourable to Spanish resin.

Resin from standing trees is a renewable and inexhaustible natural resource, the raw material for an industry which has a minimal rate of contamination, and supplies products in which Spain and the European Union have a deficit (Spain imports a combined volume of colophony and turpentine of nearly 30,000 tons a year, which represents more than 30 million euros annually) (Allué *et al.*, 2004).

Finally, it is important to highlight the economic potential these pine forests would have, were they to be put into production once more. Although it is unlikely that the historical production levels of 55,000 tons will ever be reached again, it would be possible to increase resin supply for the interior market. This would help to maintain enough stocks to weather the periods of extreme fluctuations in the price of colophony and turpentine caused by China. It is important that a structured, complex and stable productive system, brought about through planning and labour over decades, and whose sustained exploitation has contributed —and could do so once again— to the maintenance and development of rural communities, should not be allowed to disappear, or be artificially maintained, but should genuinely be used as a tool for generating employment in rural areas, instead of contributing to the flight from the countryside.

Acknowledgements

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