Population decline and associated social phenomena: a case study in Asturias (Spain)

Maties Reus Pons

S2366894

m.reus.pons@student.rug.nl

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Supervisor: prof. dr. C. H. Mulder

Master of Science in Population Studies

Population Research Centre

Rijksuniversiteit Groningen

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ABSTRACT. The aim of this study is to determine the major components of population change in Asturias, as well as to find empirical evidence of several social phenomena that can be expected to be associated with population decline from a theoretical point of view. These social phenomena are ageing, human capital, economic resources, housing, local services, and tourism. Bivariate linear regression models are calculated as sophisticated description to prove these associations, as the causality direction is not clear from a theoretical point of view. A multivariate regression model is calculated as well. For those variables for which no appropriate data is available to calculate a regression model, a more simple analysis and literature review is done to prove the associations. The relationships between population decline and ageing, human capital, economic resources, and local services have been proved. Tourism has been found to be a key variable that moderates and even reverses population decline in the areas where it is more developed. Unfortunately, the association between population decline and housing could not be proven due to a lack of appropriate data. The Koenker tests suggest that the relationships modelled are stationary and that geographically weighted regression models would not add any relevant information to the study.

KEY WORDS: population decline, social phenomena, natural balance, migration balance, Asturias, Spain.

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List of abbreviations

BOE. Official state gazette (Spain).
BOPA. Official Asturian gazette.
COL. Private or state-subsidised schools.
CP. Public primary school.
CPEB. Public school offering both primary and secondary education.
CRA. Rural aggregated schools.
EDUCASTUR. Asturian official page of education.
EH. School residence.
ESO. Compulsory secondary school.
GWR. Geographically weighted regression.
IES. Public school offering both compulsory and non-compulsory secondary education.
IESO. Public school offering compulsory secondary education only.
INE. National statistical institute (Spain).
LOMCE. Organic law to improve the education quality.
NUTS2. Nomenclature of units for territorial statistics. The number refers to the second level of classification, which corresponds to the Autonomous Communities in Spain.
OLS. Ordinary least squares (linear regression).
SADEI. Asturian society for economic and industrial studies.
SESPA. Asturian health service.
VIF. Variance inflation factor.

1. Introduction

According to some authors, demographic decline is a broad concept which can either mean a reduction in population, in the number of households or in the working age population (Verwest, 2011). Demographic decline is experienced mainly on a local level, and is likely to continue in the near future in many European regions (Kröhnert et al., 2008).

This thesis is focused on population decline, although some references to the other types of shrinkage may appear, as they are not independent of each other. Population decline can be defined as a decrease in population in a particular area over a certain period of time (Verwest, 2011).

1.1. Background

According to Kröhnert et al. (2008), we can talk about the Spanish centrifuge. Spain's population is in fact one of the most unevenly distributed around the world, as it concentrates mostly at or near the coast, with Madrid being the only exception in what many authors call the demographic desert in the centre of the Iberian Peninsula. "Even though *Castilla y León*, *Castilla-La Mancha*, *Extremadura* and *Aragón* account for over 50 per cent of the country's total area, they are home to no more than 15 per cent of its population" (Kröhnert et al., 2008, p. 78).

This is the result of a massive rural to urban migration process which started in the nineteenth century, coinciding with the industrialization process and the crisis of traditional agrarian economies, and which became much more intense during the 20th century. Several authors have already described this process and the related population decrease in many of the Spanish regions (Collantes, 2001; Collantes et al., 2004).

Nowadays population still continues to decline in most of those rural areas as a consequence of that long-lasting emigration process. This has led to high agrarian specialization, little diversification and a negative natural balance of the population due to the increasingly ageing people who inhabit these tiny villages (Ayuda Bosque et al., 2000, 2002). The decrease in population also brings some financial difficulties in providing services to the population living there: this problem is even worse in mountainous areas, where some studies have shown that the costs of providing these services are higher (Vallés and Zárate, 2011).

In contrast, some of these traditional emigration areas have increased their population during the last decades, mainly due to immigration processes (Solé et al. 2012). Unfortunately, these migration processes apply only to some specific rural areas, such as rural areas bordering growing urban areas which benefit from counter urbanization processes, or coastal or mountainous areas where there has been some development in tourism (García and Sáchez, 2005). A case study in the Pyrenees demonstrates the importance of the development of tourism to invert the shrinking demographic trend, while the subsidies in agriculture have proven to fail in that sense (Laguna, 2006).

1.1.1. The case of Asturias and its population

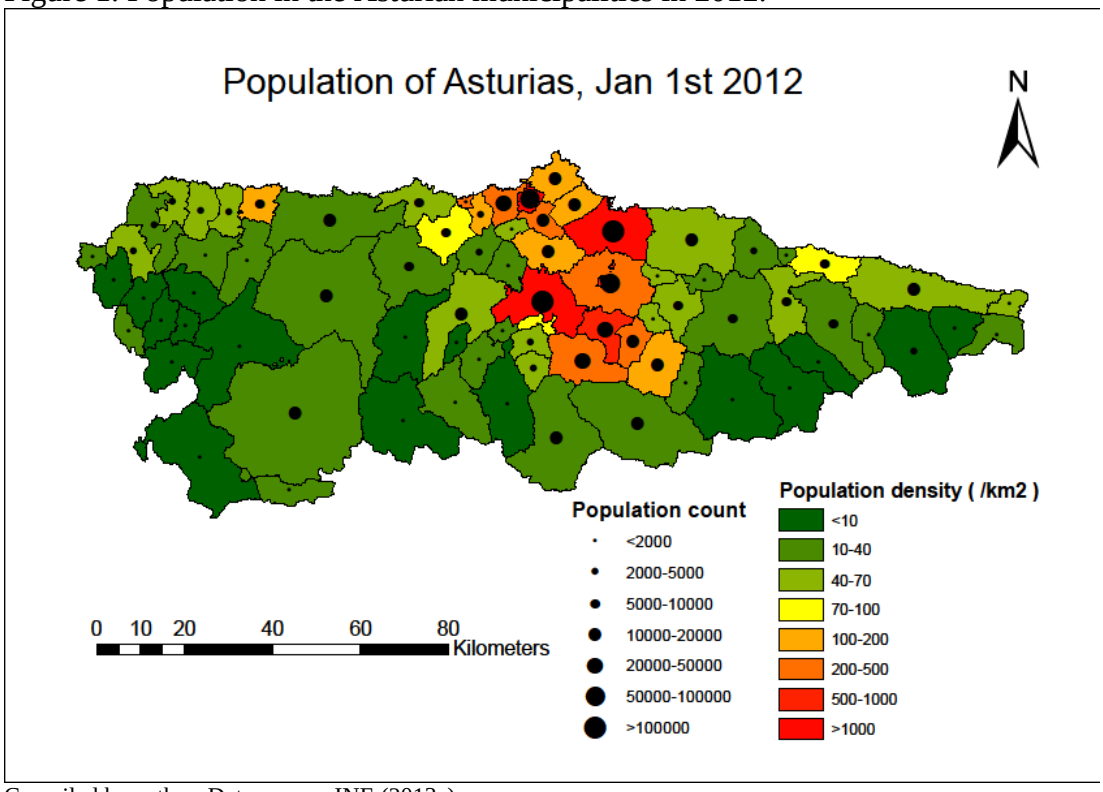
The case of Asturias is slightly different from that of many of the other Spanish regions which have suffered or suffer from population decline. Asturias was one of the first industrialized regions in Spain, and since the 19th century it became a major immigration area in Spain, attracting labour force from other parts of Spain to work in mining and heavy industry in its central region (Martínez and Mínguez, 2005). This already created an initial difference between its central economically growing region, and the eastern, western, and southern mountainous areas, which became emigration areas. Nowadays, this regional difference is easily seen in population terms, as the central Asturian region still accounts for the vast majority of the population in the Autonomous Community. In table 1, an approximation has been made by considering this central Asturian region as the contiguous municipalities with higher population densities than the regional average. According to this definition, almost 80% of the total population live in less than 15% of the regional area. Figure 1 displays these population disparities at a municipal level.

Table 1. Population, area and population density of the central Asturian region.

	Population 2012	Area Km^2	Pop. Density $/Km^2$
Central Asturian region	843,561	1,427.61	590.89
Asturias (whole region)	1,077,360	10,602.41	101.61

Compiled by author. Data source: INE (2013c).

Figure 1. Population in the Asturian municipalities in 2012.



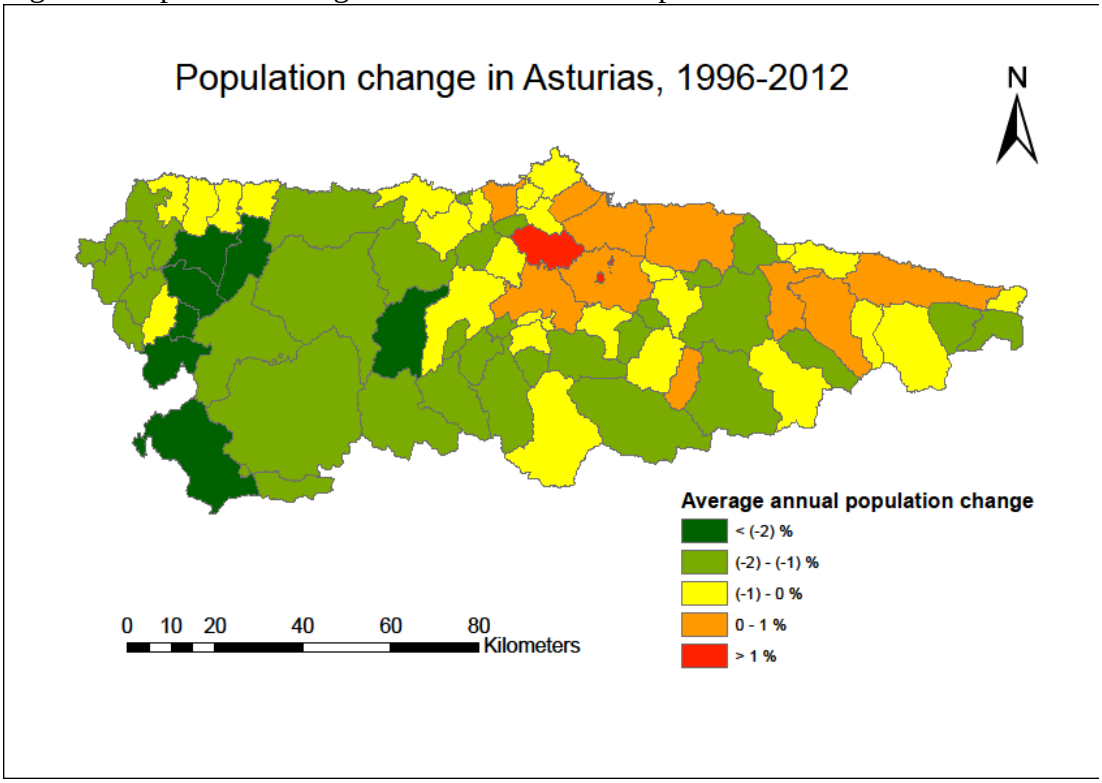
Compiled by author. Data source: INE (2013c).

However, the situation has changed since the 1973 economic crisis. The mining industry has since then been in crisis and as a result the former mining areas have begun to lose population. As a consequence, these areas are suffering degradation processes

too. The same can be said about middle cities specialised in heavy industry that are still in a reconversion process. Thus, from the initial industrial district (central Asturias), the main economic region has been reduced to a corridor between the two main cities, Oviedo and Gijón, which is now the area that leads both economic and demographic growth in the region. Some authors even advocate the concept of *Ciudad Astur* (Asturian City), (Martínez and Mínguez, 2005), hoping that projects and policies may help to regenerate the currently declining central areas and reinforce the central Asturian region as a whole.

During the last fifteen years, the Spanish population has grown rapidly due to an unprecedented immigration flow since the first population censuses in the 19th century. To briefly quantify this enormous increase in the immigration flows, we can refer to the official population figures. In 1996 542,314 foreigners were living in Spain, whereas in 2011 this number had increased to 5,751,487 (INE, 2013c). During the same period, Asturias was the only Autonomous Community in Spain that has slightly lost population. This is the result of a long-lasting economic crisis, which makes the region less attractive for immigrants; but also due to the low fertility in the region, which has been the lowest among all European Union regions (NUTS 2), according to Kröhnert et al. (2008), who report the total fertility rate at 0.93. Official estimations state that the total fertility rate has increased to 1.05 children per woman in 2011 (INE, 2013d). In any case, fertility is still the lowest amongst the Spanish regions, altogether with the Canary Islands, far below the Spanish average, of 1.36 children per woman. As a result of these demographic trends, some population projections forecast a decrease of 12% to 18% of Asturias' current population by 2030. This is expected to be the greatest population decline in the Iberian Peninsula (Kröhnert et al., 2008).

Figure 2. Population change in the Asturian municipalities from 1996 to 2012.



Compiled by author. Data source: INE (2013c).

In the case of Asturias, population decline becomes evident when one looks at the municipal level. If we take a look at figure 2, we can see that the corridor between Oviedo and Gijón slightly grows in population, while the former mining and industrial middle-cities in central Asturias decline in population. The rural areas to the East, West, and southern mountains decline in population too. However, some municipalities to the East are gaining population too, probably due to a certain touristic development in the area. Herrán Alonso et al. (2008) have classified the different municipalities of Asturias according to demographic, economic, social and territorial factors. They provide a final classification with ten different types of municipalities: three types are urban to peri-urban, six types of rural municipalities, and an extra type for those municipalities considered in between. Therefore, the situation is far more complex than just long-declining rural areas, declining mining and industrial areas, and growing major cities.

Some demographic and sociocultural indicators suggest that Asturias is a disfavoured region within the Spanish context. The male life expectancy at birth in 2011, of 77.50 years of age, is the lowest of all the Spanish Autonomous Communities (excluding the African cities of Ceuta and Melilla), far below the national average, of 79.16 years of age. Female life expectancy at birth, of 84.55 years of age, is not the lowest but still below the Spanish average, of 84.97 years of age (INE, 2013d). Per capita income, of 21,451 euro in 2011, is below the Spanish average too, of 23,054 euro (INE, 2013e). The unemployment rate is excessively high at the moment, as it is in the rest of the country, and hits 25.32% of the working age population, according to the estimates of the first third in 2013 (SADEI, 2013). Although differences with other regions have diminished, the Asturian economically active population is still slightly overrepresented in both the primary and secondary sectors in comparison to the Spanish average, as can be seen in table 2.

Table 2. Share of workers per economic sector in Asturias and Spain.

	Agriculture	Industry	Construction	Services
Asturias	5.03	14.79	7.46	72.74
Spain	4.35	13.93	6.31	75.42

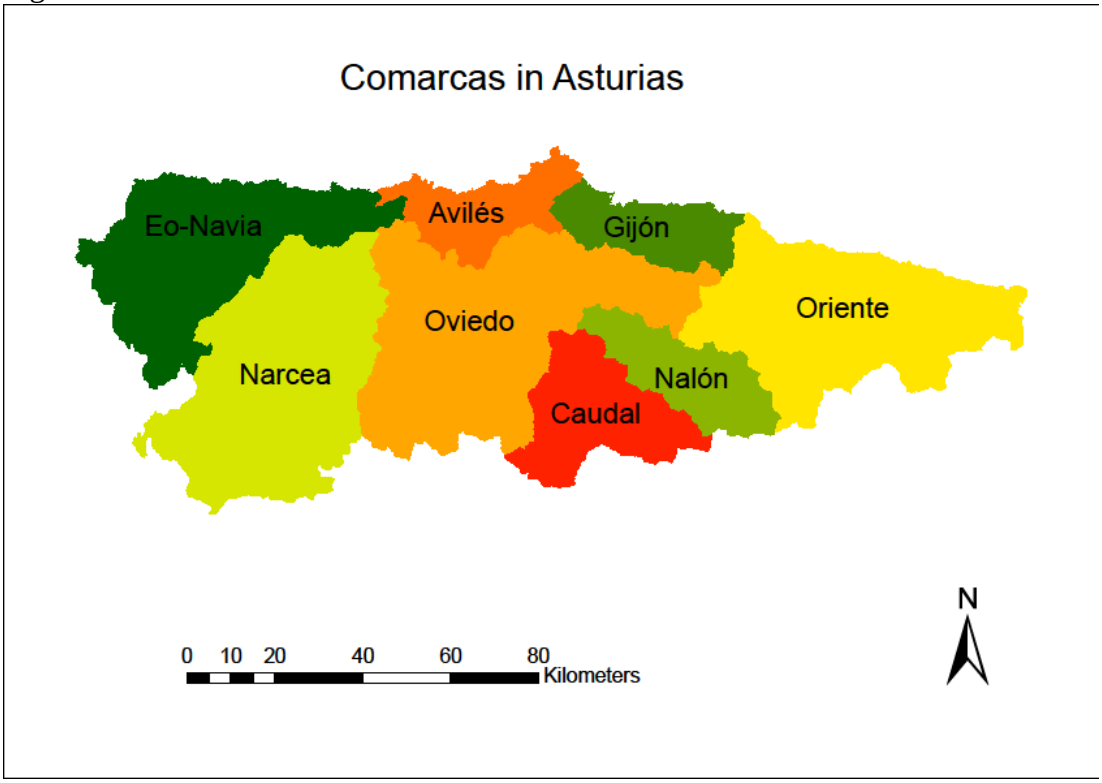
Compiled by author. Data source: INE (2013f).

The population in Asturias is also perhaps the one showing the clearest signs of an ageing population structure within Spain. The average population age in 2012, of 46.29 years of age, is the oldest amongst the Spanish regions, and far above the national average, of 41.51 years of age. The share of people above 65 years of age is also amongst the highest (22.68%), and the grey pressure (share of people of 65 years of age or more divided by the share of people under 15 years of age) is the largest, 197.44, far above the Spanish average, of 108.34 (INE, 2013d). This implies that in Asturias there are twice as many people over 64 years of age as people younger than 15 years of age.

Asturias is subdivided into eight sub-regional units (*comarcas*), as can be seen in figure 3. These sub-regions are used for statistical purposes. The three main cities and their hinterland form a *comarca* of the same name, namely Oviedo, Gijón and Avilés. However, the *comarca* of Oviedo, the capital, is much larger than the other two, and includes many rural, sparsely populated and declining municipalities to the South and West of the city. In this sense, the demographic situation and trend in these areas is opposite to that of Oviedo and its surroundings. The *comarcas* of the Caudal and Nalón valleys are located in the valleys of the same name and have their capitals in Mieres and

Langreo, old industrial middle-sized cities which are currently in decline. The Eo-Navia, Narcea and Oriente *comarcas* are mainly rural.

Figure 3. *Comarcas* in Asturias.



Compiled by author. Data source: SADEI (2013).

1.2. Objective and research questions

Although the main focus of this thesis is population decline, some growing municipalities can be identified too, even when speaking of a generally declining region such as Asturias. For this reason, the objective and research questions have been formulated in terms of population change, a more general term, instead of population decline.

1.2.1. Objective

The objective of this study is to determine the major components of population change in a European economically disfavoured area, as well as to find empirical evidence of the social phenomena that can be expected to be associated with population change from a theoretical point of view. This is done through a case study in the Autonomous Community of Asturias (Spain) at a municipal level.

1.2.2. Research questions

Which are the major components of population change in the different Asturian municipalities?

-To what extent is population change determined by the natural balance?

-To what extent is population change determined by the migration balance?

How is the relation between population change and several social phenomena?

-How is the relation between population change and ageing?

-How is the relation between population change and human capital?
-How is the relation between population change and economic resources?
-How is the relation between population change and housing?
-How is the relation between population change and local services?
-How is the relation between population change and tourism?

1.3. Scientific and societal relevance of the thesis

1.3.1. Scientific relevance

The analysis of the components of population change allows us to determine how these components influence the actual population change, and how this influence differs between the various municipalities analysed.

The analysis of the relation between population change and several social phenomena that could be associated with it from a theoretical perspective can be seen as another validation of some of the theories related to population decline.

1.3.2. Societal relevance

Although many Spanish rural areas have experienced population decline in the past, Asturias has been the only region in Spain that has not grown in population during the last 15 years, the fastest population growing period in modern Spain. For this reason, Asturias can be considered as a model region for population decline and social phenomena associated with it. This permits a better understanding of population decline and how society adapts to this new situation, especially when considering some of the unwanted events related to population decline. This knowledge can be applied to develop adequate policies and planning in possible future declining regions.

1.4. Structure of the thesis

In this introduction, the background, objective, research questions, and scientific and societal relevance of the thesis have been presented. The thesis is structured in four additional major parts: theoretical framework, data and methods, results, and conclusions.

In the theoretical framework section, a review of the main theories on population decline is presented, especially on those theories that relate population decline to several social phenomena: ageing, human capital, economic resources, housing, availability of local services, and tourism. The section ends with the conceptual model that represents the main concepts that form part of this study, as well as the relationships between them. The hypotheses of the study are presented as well.

In the data and methods section, information is provided on the availability and quality of the data used in the analysis. The different analysis methods applied are specified as well.

In the results section, results from the analysis are shown and discussed. Furthermore, a link with the theoretical framework of these results is presented in order to be able to answer the research questions.

The conclusions section summarizes the main findings of the thesis, and emphasizes how these findings can answer the research questions initially formulated, how well it has been possible to answer them, and what remains to be done.

Finally, an appendix is included with three maps that display the geographical location of the 78 municipalities in Asturias. As many references are made to specific municipalities in the text, this appendix is designed as a reference guide, in order to make the reading easier. Although the map of the *comarcas* or sub-regions is already in the introduction, it is also added to the appendix, as references to these sub-regional units are common in the text too.

2. Theoretical Framework

2.1 Population decline and its components: a general approach

Population decline can either be attributed to a negative natural balance, a negative migration balance, or a combination of both. These are the result of "universal processes related to the demographic transition to structural low fertility on the one hand, and economic geographic processes of concentration and urbanization on the other" (Galjaard et al., 2012, p. 294).

The theory of the second demographic transition was developed to complement the demographic transition theory when many European countries appeared to have their birth rates below the replacement level (2.1 children per woman). If these birth rates were maintained, they could in the long term result in a negative natural balance, and possibly population decline. Currently, many developed countries show birth rates below this replacement level (Verwest, 2011). This decline in fertility can partly be explained by modernization, which permits an easy access to contraceptives. In any case, this modernization has not only technological implications, as willingness to control fertility is also required to effectively diminish fertility rates. This latter aspect is related to a much broader change in society and its values during the second half of the 20th century. As child mortality diminished, a change in values towards the quality of children, instead of the quantity, has taken place in many societies (Van de Kaa, 1994).

Despite the wide range of explanations for this societal change leading to low fertility, a general theory to explain fertility changes does not exist (Lutz et al., 2006). Some authors strongly believe that the main factor for fertility decline is the postponement of motherhood, based on the fact that fertility rates have begun to rise again once the mean age at first birth has stabilized (Goldstein et al., 2009). Some other authors state that there is a possibility that low fertility rates over a prolonged period of time can in the end result in a downward spiral to fewer future births, as a result of demographical causes (the negative momentum of population growth derived from an ageing population structure), as well as socioeconomic causes (the ideal family size is reduced, and furthermore the mismatch between aspirations and expected income can lead to a change in both the tempo and quantum, i.e., fewer children and postponed). This is called the low fertility trap hypothesis (Lutz et al., 2006).

In the case of migration, out-migration can lead to population decline in areas that "have experienced some form of structural change triggered by external developments" (Galjaard et al., 2012, p. 299). This is both the case of many rural areas throughout Europe (Stockdale, 2004) and old industrialized regions (Verwest, 2011). Selective outmigration can lead to the concentration of particular groups (elderly and poor mainly), and reduce the quality of the spatial environment (Verwest, 2011).

International immigration, on the other hand, could help reduce or even reverse population decline, both through the direct arrival of new inhabitants and through the higher fertility rates these migrant populations often display. Certainly, without international migration most of the European regions would be declining in population right now. Indeed, one of the traditional policy approaches to deal with population decline has been trying to attract new residents (Niedomysl, 2007; Haartsen and Venhorst, 2010). However, Reher (2007) states that this is just a temporary and inadequate solution, as the fertility rates of the migrants quickly adjust to those of the

hosting population. Furthermore, van Dalen and Henkens (2011) demonstrate that a large part of the Dutch population fears international immigration more than the possibility of population decline. This is coherent with the existing experiences of international migration, with a resulting weak integration of the newcomers in the host society, and problems of discrimination and racism (Castles and Miller, 2009).

Both natural and migration balances can be explained by a range of sociocultural and economic developments, as well as spatial planning policy. Sociocultural developments, such as individualisation or postponement of motherhood, can lead to a decrease in the total fertility rate; while economic developments can influence a selective migration, but also the decision to have a child, depending on a situation of prosperity or recession. Economic developments have also contributed to the increase of life expectancy, reducing mortality rates and slowing down population decline, or at least postponing it. Spatial planning policy may also cause population decline in certain areas, due to restrictive policies, or because the planned housing types and target groups do not really match the housing demand (Verwest, 2011). An example of it could be the situation in Delfzijl, where there is a large housing oversupply, as housing construction has been intense, while the municipality has not been able to attract new residents due to its peripheral location (Mulder, 2006). In the end, the way in which sociocultural and economic developments, and spatial planning policy, can affect population change is really complex.

2.2 Population decline and associated social phenomena

"Shrinking municipalities and regions are often confronted, not only with a decline in the size of their population, households, and working age population, but also with a changing composition. Examples of such changes are a decrease in the share of young people up to 19 years of age, an increase in the share of people over the age of 65, a decrease in the share of highly educated people, an increase in the share of poorly educated people, a decrease in the share of high-income groups, and an increase in the share of low-income groups" (Verwest, 2010, p. 10). We can therefore claim that population decline is selective (Stockdale, 2004; Haartsen and Venhorst, 2010; Verwest, 2010).

Many social phenomena are related to population decline. These social phenomena do not only relate to changes in the population structure (ageing, human capital and economic resources), but also to other social phenomena associated with population decline, such as the availability of local services or changes in the housing market.

2.2.1. Population decline and ageing

Probably one of the most obvious social phenomena associated with population decline is ageing, as a result of a decrease in fertility, an increased life expectancy, and the out-migration of youth. Population decline and ageing may share common causes, but no causal relation can be identified between them. "Any decline in birth rates promotes population ageing. Decline only follows (excepting the effects of migration) when the birth rate falls below the death rate" (Coleman and Rowthorn, 2011, p. 223). Other authors stress that an ageing population decreases the share of people in their reproductive period, and therefore can also become the cause for a negative natural balance, and therefore population decline (negative momentum of population growth), (Van Dam et al., 2006, cited by Verwest, 2011, p. 27). As ageing can be a result of the

out-migration of youth, the previous statement demonstrates that natural and migration balances are not independent components of population variation, but that changes in one of them can in the end affect the other. Some other authors go even further, and state that when changes in demographic behaviour leading to lower fertility rates are projected onto an ageing population, these are reinforced (Haartsen and Venhorst, 2010).

Low fertility rates can cause both ageing and population decline, while immigration usually tends to reduce or even reverse them. Low mortality rates have an opposite effect on both variables, as they increase ageing, but mitigate population decline (Coleman and Rowthorn, 2011).

2.2.2. Population decline and human capital

Human capital can be defined as the knowledge and skills acquired by an individual (Brown and Lauder, 2000, cited by Stockdale, 2004, p. 168), and can be identified as a key element of endogenous development, and an important factor for the local society and local wellbeing (Stockdale, 2004; Haartsen and Van Wissen, 2012).

The human capital theory of migration, developed by Sjaastad in 1962, has been a common framework for the study of migration, seen as an investment, which would only take place if expected benefits exceed expected costs of migration (Cooke, 2008). This theory explains the youth out-migration from both remote rural and old industrialized areas in recession, in search for education and better employment opportunities. As a result, an ageing and poorly qualified population is left behind (Stockdale, 2004).

Youth migration from rural to urban areas in search for education and work, is a global phenomenon (Galjaard et al., 2012), and necessary to increase the human capital of the younger generations. Indeed, "scholarship has always been mobile and international" (Coleman and Rowthorn, 2011, p. 234). However, the rural environment does not offer job-related opportunities related to the skills developed and the desired lifestyle of those young migrants, who rarely return. This can be seen as a "missed opportunity to attract a greater share of return migrants following the completion of their studies" (Stockdale, 2004, p. 188), whose human capital is strongly needed to generate endogenous local development, improve liveability, and in general make the area more attractive.

2.2.3. Population decline and economy

Population decline areas show evidence of a lower average household income (Verwest, 2011), as they are mainly remote rural areas (Stockdale, 2004) and old industrialized areas in crisis (Verwest, 2011). Both types of areas also have economic indicators, such as per capita income or unemployment, in a disadvantageous position in relation to the core urban areas.

Population decline also affects the demand for goods and services, while it reduces the labour supply (reduction in the working age population), (Reher, 2007). This shift in the demand for goods and services has a clear effect on the housing market (section 2.2.4) and the provision of local services (section 2.2.5). There is strong disagreement amongst scholars on the possible economic consequences linked to a reduction in the labour supply (Verwest, 2011). Coleman and Rowthorn (2011) provide a large set of

counterarguments and solutions for some of the most feared negative economic consequences of population decline, and also state some directly positive consequences of it (less congestion, better environmental quality, better use of the natural resources, average person wealthier).

2.2.4. Population decline and the housing market

Housing supply can attract migrants and avoid out-migration to a certain extent, as well as encourage household formation and therefore childbearing, considering of course that there is an unmet demand and the region is not so peripheral (Mulder, 2006).

A reduction in the housing demand could lead to an oversupply and a reduction of housing prices, which in turn results in a lower wealth for home-owners (Mulder, 2006; Haartsen and Venhorst, 2010; Van Dalen and Henkens, 2011). In any case, the possible effects on the housing market depend more on the household decline rather than in the population decline itself. The number of households is expected to increase even if population is declining, as the average number of people per household keeps diminishing as a result of an increasing individualism (Haartsen and Venhorst, 2010; Verwest, 2011).

2.2.5. Population decline and the attractiveness of an area: local services and tourism

"The factors influencing residential choices and attracting people to particular places have been altered fundamentally during the late 1990s. While it used to be thought that choosing between places to live was solely dictated by employment considerations, other aspects may have come into play enabling other factors to influence destination choices" (Fotheringham et al., 2000, cited by Niedomysl, 2010, p. 98). This can be explained by three main causes: an increased share of elderly people with less job-related constraints, the time-space convergence as a result of the technological advances, and a certain wellbeing that has permitted a change in life values and the possibility for people to focus upon immaterial aspects of life (Niedomysl, 2010).

Based on this evidence, Niedomysl (2010) has developed a conceptual framework of place attractiveness from a migration perspective. The model splits people's requirements in three categories or factors: needs, demands and preferences, which range from those basic elements required for survival (needs), to those more immaterial elements that add "that something extra" (preferences). However, the separation between the factors is not always clear and may vary between migrants. The three categories are displayed in a pyramid, which reminds of Maslow's theory on the hierarchy of needs (1943). The attractiveness of places will increase as more factors are fulfilled, while the possible destinations will diminish. Finally, three concepts are necessary as a context in the model: a life course perspective (needs, demands and preferences may change during a person's life), resources and constraints (that make possible or inhibit the movement), and the geographical level (the number of considered factors is greater at a larger scale level). In the end, "people either move to places where the supply can match their preferences or come to like the attributes available where they live" (Niedomysl, 2008, p. 1124), that is, people will become used to their environment or either migrate to a place that suits better their expectations.

Migrants' motivations and preferences are very diverse, and range from the physical and social characteristics of a place, to more personal reasons such as living close to family

or friends. Only in popular rural areas does the traditional idea of the rural idyll seem to reflect migration decisions. Rural areas located close to protected natural areas are a clear example of this (Bijker and Haartsen, 2012). The development of tourism can make a rural area more attractive and popular, and mitigate or even reverse population decline by attracting immigrants (García and Sánchez, 2005; Laguna, 2006).

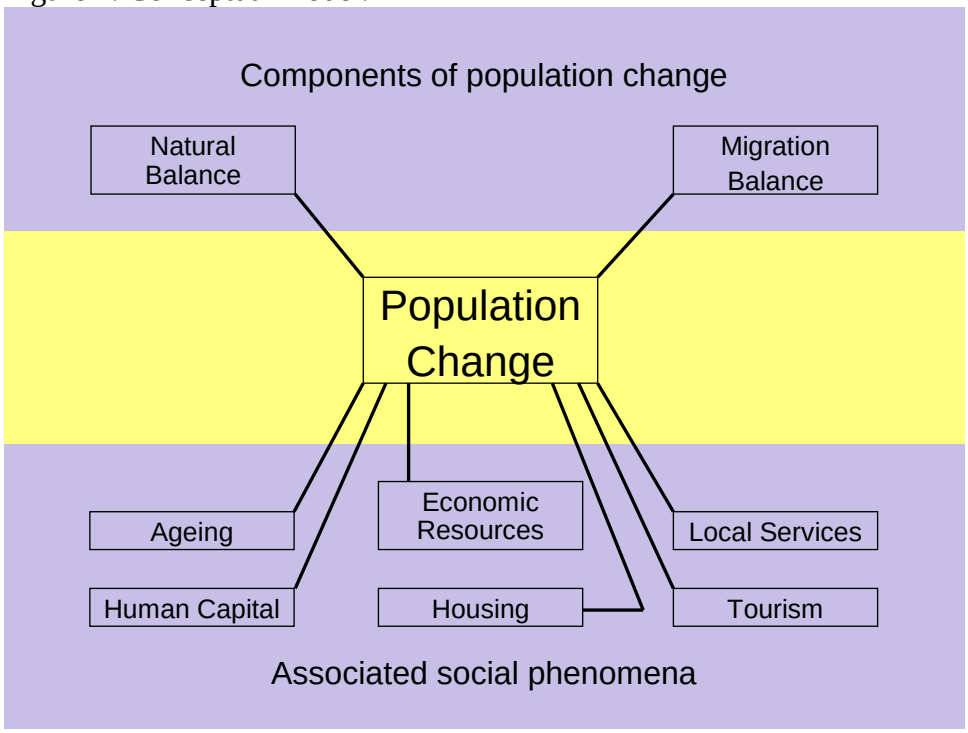
The availability of local services, whether these are public or private, does indeed play a role in the attractiveness of an area. A decline in the availability of local services can reduce the attractiveness of an area, especially amongst some population subgroups (those with less mobility), and therefore induce population decline (Verwest, 2011). At the same time, population decline may also cause a decrease in the services and facilities available, as the demand for these services and the labour supply fall, leading to a growing dependency on neighbouring towns and cities (Stockdale, 2004). It is important to take into account the 'free-rider' effects on local services' use, as services located in the cities and main regional town centres may be used by the population living in nearby municipalities too (Niedomysl, 2008).

Furthermore, ageing can also induce a change in the demand for services, increasing the demand for some of them (health services), and decreasing the demand for others (schooling), (Verwest, 2011). This could lead to the closure or merger of schools due to financial and staffing problems, which derives from a sharp decline in the number of pupils. Despite traditional views that see a local school closure as 'the death' of a village (Egelund and Laustsen, 2006, cited by Haartsen and Van Wissen, 2012, p. 494), recent research confirms that parents tend to use "their cultural capital and spatial power to shop around to find what they believed to be the right school" (Walker and Clark, 2010, cited by Haartsen and Van Wissen, 2012, p. 494). Therefore, Haartsen and Van Wissen (2012) conclude that school closures do not have such devastating effects on a village, if the community has a strong local network to maintain the social capital.

2.3 Conceptual model and hypotheses

This study is highly conditioned by the availability of data at a municipal level in Asturias. The intention is to assess to what extent population change is caused by natural and migration balances, and to find empirical evidence of the association of the aforementioned social phenomena with population decline. It is important to note that even though linear regression may be used to assess the relation between population decline and some of its associated social phenomena, it is to be done as a sophisticated description, and not under strict causality conditions. In addition, as seen in this chapter, causes and consequences are often not easily distinguishable, as the same associated social phenomenon can either be a cause or a consequence of population decline, or even just a phenomenon with a shared common cause with population decline but without any causal relationship. Population decline is indeed a very complex phenomenon, and no general theory on its causes and consequences has been developed yet. The resulting conceptual model can be seen in figure 4.

Figure 4. Conceptual model.



Compiled by author.

According to theory, a series of hypotheses can be formulated:

An inverse correlation between population change and ageing can be expected.

A direct correlation between population change and human capital can be expected.

A direct correlation between population change and economic resources can be expected.

A direct correlation between population change and housing can be expected.

Less availability and closure of local services is expected in declining areas. However, a shift in the demand caused by an ageing population might cause an increase in the provision of certain services (e.g. health care).

It is expected that tourism enhances population growth in those areas with a high touristic development.

3. Data and Methods

3.1. Data sources

In this study secondary data have been used. Much of them derive from either the Spanish National Statistical Institute (INE) or the Asturian Society for Economic and Industrial Studies (SADEI), the regional statistical institution. Due to the spatial resolution of the study, which is designed at a municipal level, it is often possible to find more spatially disaggregated data from the regional statistical institution.

3.1.1. Population data: different sources and limitations

Population data come from the population register. The population register (*padrón municipal de habitantes*) is the administrative register where information about the inhabitants of the different municipalities is recorded. Everyone living in Spain is obliged to register in the municipality of their usual place of residence. Municipalities are responsible for their own population registers, but they must send their information monthly to the National Statistical Institute, which is in charge of doing the necessary checks and corrections to avoid possible mistakes and double counting. The final population figures according to the population register are declared official via a Royal Decree and published every year (INE, 2013a).

Data on vital events and natural balance come from the civil register, which was introduced in Spain in 1870. In the register, information about both births and deaths is recorded. It is important to note that both children to residents born abroad and children to non-residents born in Spain are included. This results in an overestimation of the number of births. The same applies to deaths, which are also overestimated (Eurostat, 2003).

The residential moves' statistics are obtained via the information in the population register through registrations and deregistrations due to residential moves (INE, 2013b). Due to the high non-deregistering proportion among those who leave the country, the 2006 register reform made possible the automatic deregistration for those foreign residents (nationals outside the Schengen area) in the case their residence permit is not updated, which should be done every two years (INE, 2013a). Still, further cooperation is needed between the different European population registers for migration issues, as deregistration is not automatic for Schengen nationals.

According to theory, migration implies a long-distance move, as opposed to a residential mobility, and a change in the daily activity space. Therefore, "migration is a relocation not only of the place of residence, but also of activities in other life course trajectories" (Mulder and Hooimeijer, 1999, p. 179). According to this definition, residential moves between neighbouring municipalities cannot be considered as internal migration from a theoretical point of view. However, in a study at a municipal level, residential moves between neighbouring municipalities are indeed a component of population growth or decline. Therefore, it is important to notice that although the term internal migration balance is used for convenience, some of the residential moves within municipalities in the region cannot be considered as migration strictly.

Due to the fact that population data come from different sources and that statistic definitions do not correspond perfectly with theoretical demographic definitions

(overestimation of births and deaths, underestimation of emigration), the balancing equation of population change must be adjusted with administrative corrections.

Data on population per municipality can be accessed through the SADEI, yearly from 1991 to 2012, except for 1997, when there are no data available. Previously data refer to the first of May. From 1998 onwards, data refer to population on the first of January. Data on natural balance per municipality (births minus deaths) are also available at the SADEI from 1990 to 2011. Data on internal migration are available at the SADEI from 2001 to 2011. Data on external migration are available at the SADEI from 2002 to 2011. Considering the availability of data, it is only possible to analyse population change and its components from 2002 to 2012. It is important to notice that the internal migration balance refers to moves within municipalities of Asturias, and external migration balance to moves from or to anywhere else, be it another region in Spain or another country.

Data on ageing come from the population register as well, and can be accessed easily through the SADEI for every single year when there is data on population, that is, from 1991 to 2012, except for 1997.

3.1.2. Other types of data

For data on human capital we rely on the share of highly educated people and the share of people with no studies. The effect of these variables on population change should be of the opposite sign. Data on educational level can be accessed through the SADEI, and come from population censuses in 1991 and 2001. Unfortunately, no data based on the census of 2011 are available yet.

Data on economic resources are accessed through the statistics on per capita income at a municipal level. These statistics can be accessed at the SADEI biannually from 1980 to 2008, and derive from the economic statistical studies performed by the institution (SADEI, 2008).

Data on construction licenses can be accessed at the SADEI annually from 2000 to 2011. These data derive from the annual construction yearbooks elaborated by the SADEI, that compile data from different construction related organisations, the government and the INE (SADEI, 2011a).

Data on schooling can be found at the SADEI on the total number of schools and pupils per municipality, annually from the academic year 1999/00 to the academic year 2010/2011. These data derive from the statistical series about education in Asturias compiled by the SADEI based on the information available at the schools' registers (SADEI, 2011b). Furthermore, literature research has been done on the Asturian official page of education (EDUCASTUR), the Official State Gazette (BOE), and the Official Asturian Gazette (BOPA).

Data on health care can be found at the SADEI on the total number of health centres per municipality, every two years from 1998 to 2002, and annually from 2006 to 2010. These data are compiled by the SADEI from the Asturian Health Service (SESPA). SESPA compiles at the moment annual reports that provide information on the health situation in Asturias. The last one currently available is the annual report for 2011.

Data on tourism can be found at the SADEI too. Information on the total number of tourist guests that can be hosted within each municipality is available for 2002, 2004, and annually from 2006 to 2010. We refer to this data as the touristic lodging capacity, or the number of touristic lodging spaces.

3.2. Methods

It is important to note that population change, be it growth or decline, is analysed at a municipal level, and that the situation might differ considerably from the larger towns to the most remote and rural areas within the same municipality. Although Asturias is, along with Galicia, the only Autonomous Community in Spain where municipalities are further subdivided into parishes, statistical information at the parish level is very scarce (population by sex) and most of the variables considered (age, educational level, income, construction licences...) are not available at a parish level. Therefore it is not possible to undertake any analysis at a larger scale than the municipal one.

3.2.1. Determining the main components of population change

As we have data on total population change (PC), natural balance (NB), internal migration balance (IB) and external migration balance (EB) from 2002 to 2012, it is easy to derive the population change that can be attributed to administrative corrections (AC) via the balancing equation of population change:

$$PC = NB + IB + EB + AC$$

Therefore:

$$AC = PC - NB - IB - EB$$

Once we have the absolute figures for population change and each of its components, it is possible to try to quantify to what extent the different population change components are responsible for the final population change. We can do so by calculating the ratios (r_i) to determine the extent to which each of the components is responsible for the final population change. If we add these values, their sum is one, but individual values can exceed one and be either positive or negative, depending on their contribution in the same or opposite direction of the final population change.

For forces leading in the same direction as population change, their ratio (R) is calculated. This ratio (R) has been calculated by dividing the largest initial ratio (r_i) by the second largest. If this ratio is lower than two, then it is considered that both forces highly contribute to the final population change. If the ratio is higher than two, then population change is attributed mainly to the most important component. In the case that there is a third component leading in the same direction as population change, we can consider that the three components highly contribute to the final population change if the ratio (R) of the largest initial ratio divided by the smallest one is lower than two. However, this situation is unlikely.

Although administrative corrections also form part of the balancing equation of population change, they cannot be considered theoretically as components of population change. For this reason, they have been included in the calculations, but they are not considered as components of population change when interpreting the results.

3.2.2. Determining the types of municipalities according to population change

Firstly, a distinction has been made between growing and declining municipalities. However, a third category has been established, consisting of municipalities with a stagnating population. It has been considered that stagnating municipalities are those whose total population growth or decline during the period, 2002 to 2012, does not exceed 5% of the total population at the beginning of the period.

Once these initial three categories have been settled, it is possible to establish subcategories according to the main components of population decline in the case of declining municipalities. In the case of growing and stagnating municipalities this sub-categorization is not done, as the groups are already quite small and homogeneous.

3.2.3. Population change and its relation to ageing, human capital, economic resources and housing

To analyse the relationship between population decline and ageing, human capital, economic resources and housing, linear regression techniques are used. Population change is considered as the dependent variable, while the different variables referring to social phenomena associated with population change are considered as independent variables. Each data value refers to one of the 78 municipalities in Asturias. Independent bivariate regressions are done for each of the independent variables considered. It is important to note that linear regression techniques are used as a sophisticated description of the relationship between variables, and not under strict causality conditions. Regressions have been done by using SPSS and ArcGIS.

Considering that data come from population registers and censuses, as well as economic and construction studies and compilations, and that it is not a sample, significance levels are not informative. The only informative values are the r^2 coefficient and the regression coefficients. The r^2 coefficient gives information on the percentage of the variation that the model can explain. The regression coefficients should have the same sign as theory suggests. Additional graphs are made to verify the linearity of the associations between the variables on a plot. These graphs also display the 95% confidence intervals. Despite not working with a sample, and the fact that confidence intervals have no statistical meaning, it is possible to calculate them and this can help us identify the municipalities which differ the most from the general trend.

The dependent variable, population change, is expressed as the mean annual population change rate (MAPCR) during the period considered, which is calculated according to the following formula:

$$MAPCR = ((P_f / P_o) \wedge (1 / n) - 1) * 100$$

Where:

P_f is the population at the end of the period considered.

P_o is the population at the beginning of the period considered.

n is the length of the period, expressed in years.

In the case of the relationship between population change and ageing, two independent variables and models are considered: the relationship between population change and the share of population of 65 years of age or more, and the relationship between population change and the grey pressure. The grey pressure, as defined by the INE, is the share of population of 65 years of age or more divided by the share of population younger than 15 years of age, and multiplied by 100. The period considered in the analysis is 1996 to 2012, that is, 16 years. The final value for each of the independent variables is calculated as the mean of each of the individual annual values of the series.

The association between ageing and population decline is expected to differ according to the type of municipality, which is determined as specified in section 3.2.2. For this reason, we analyse the evolution of the share of elderly people in the different groups of declining municipalities, while an analysis of their population change is done. To do so, a weighted average of the share of elderly people has been calculated for all municipalities belonging to the same decline type. The weights are simply the population of each municipality divided by the total population of all municipalities belonging to the same declining type.

In the case of the relationship between population change and human capital, two independent variables and models are considered as well, the relationship between population change and the share of highly educated people (those with a university degree), and the relationship between population change and the share of people with no education at all (consisting of the categories no education and illiterate in the data set). As data on education level come from censuses, data are not as up-to-date as in the case of the other variables considered. Therefore we consider the most recent data, that of the census of 2001, as the mid-approximation for the period 1996 to 2006.

An extra multivariate linear regression is added in the case of human capital, including both the share of highly educated people and the share of people without education as independent variables. Although both variables could be related in principle, the fact that the share of people with middle education (primary or secondary education) is left out of consideration grants that the independent variables are not too strongly correlated with each other.

In the case of the relationship between population change and economic resources, per capita income is considered as the independent variable. The most recent data, from 2000 to 2008, are used. As there are currently no data available after 2008, and the data are biannual, a gap of two years is permitted, so that the period that reflects population change is that from 1998 to 2010. As the data on income is expressed in euro, regression coefficients are expected to be small. To avoid this, a relative measure of income is calculated. In this sense, the maximum value for each year (that of the municipality with the highest income) is considered to be 100, and the rest of the values are proportionally assigned. The final values for income are the average of the set of values we have every two years per municipality.

In the case of the relationship between population change and housing, construction licenses per 1,000 inhabitants are considered as the independent variable. As the licenses are clearly given throughout the year, we consider the average population from the beginning and the end of the year (next January 1st) to derive the licenses per 1,000 inhabitants. Following the same reasoning, a series of construction licenses from 2000 to 2011 (complete years) can be compared with the population change during the period

2000 to 2012 (January 1st as the reference date). The final value considered is the average of each single annual value per municipality. Unfortunately, data on construction licenses is incomplete for five municipalities (Amieva, Cabrales, Castropol, Santa Eulalia de Oscos, and Somiedo), for which we only have three to eight values of the 12 possible annual values. This could certainly create a bias on the final average, as the scarce data available tend to be clustered at the beginning of the period. Due to this reason, these municipalities are left out of the regression analysis. In the case of Avilés, one value is missing too, but data are considered enough to proceed with the analysis.

Once the bivariate regression models have been calculated to verify the associations between the social phenomena considered and population change, a multivariate regression model is added with those variables whose association with population decline could be proven.

Finally, the results of the bivariate and multivariate regression models are analysed in detail to check if a geographically weighted regression model would improve the results.

3.2.4. Population change and its relation to local services: education and health

The first approximation to the educational situation in Asturias might be the evolution of the number of primary and secondary schools. However, at first glance, data on the number of schools and pupils seem to be biased. There seems to be an incongruence between those municipalities with no primary schools and their number of pupils. While some municipalities with no primary school have a certain number of pupils, other municipalities have no pupils at all (according to the data). Further research on the school directory of Asturias available at EDUCASTUR allows for a clarification of this initial apparent incongruence (section 4.2.7).

Furthermore, research on laws, especially those granting the creation, closure or merger of schools has been done through research in both the BOE and the BOPA, in order to determine the current situation of education services in Asturias.

As with the number of schools, it is possible to see the trend in the number of health centres in Asturias. These are further subdivided into health centres (*centros de salud*) and minor health centres (*consultorios medicos*). The latter ones are located in sparsely populated areas and have much more restricted opening times.

The annual report for 2011 compiled by SESPA provides a lot of information about the health situation in Asturias during that year. Amongst many other issues, information can be found about the satisfaction of the users of the health facilities.

3.2.5. Population change and its relation to tourism

To analyse the relationship between population change and tourism, we can refer to the total number of touristic lodging spaces available per municipality. These data can also be easily transformed into touristic lodging spaces per 1,000 inhabitants.

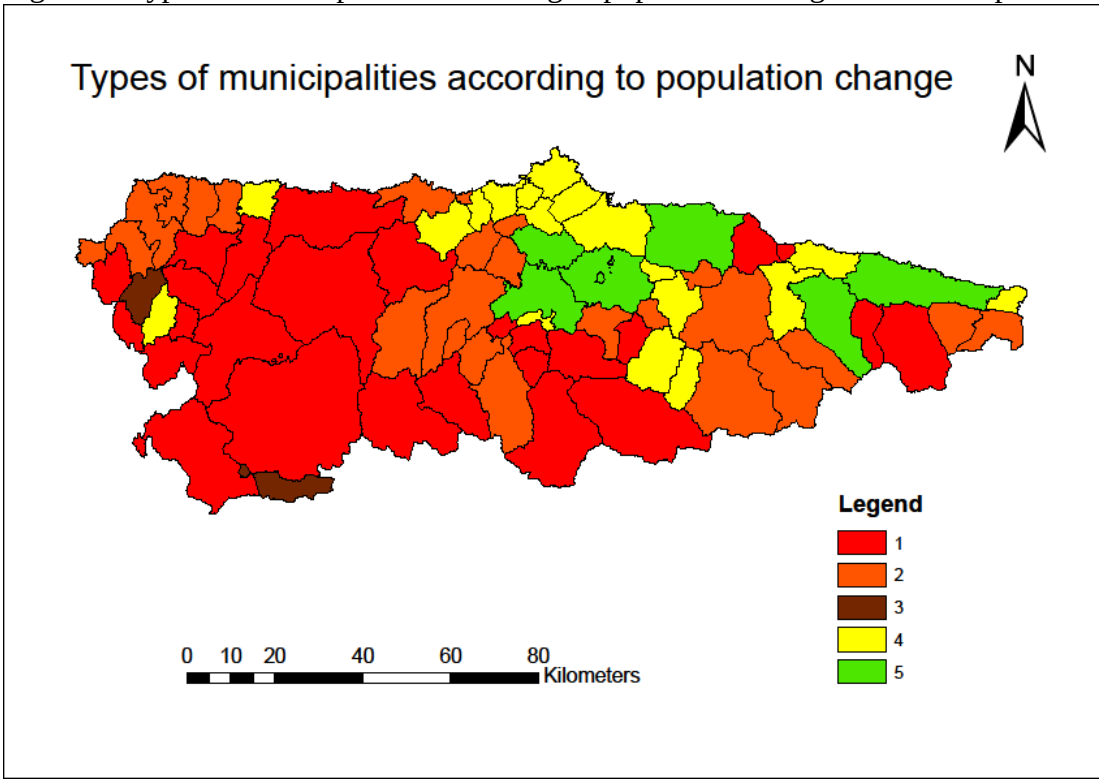
4. Results

4.1. The main components of population change

The first objective of this study was to analyse the influence of the components of population change on the total population change. These components are the natural balance and the migration balance. The latter one has been subdivided into internal migration balance and external migration balance.

According to the analysis of the components of population change as specified in section 3.2.1., and the categorisation of municipalities as stated in section 3.2.2., we can distinguish five types of municipalities, as shown in figure 5:

Figure 5. Types of municipalities according to population change and its components.



Compiled by author. Data source: SADEI (2013).

Type one refers to municipalities where both a negative natural balance and a negative internal migration balance are the main forces leading to population decline. External migration balance is positive in most municipalities, except for Grandas de Salime and Illano, both of which are very remote and sparsely populated. At this point it might be important to remember that an appendix has been included with the location of all municipalities within Asturias.

Type one municipalities cover most of the western part of the region and a large part of the southern mountains and valleys. Most of the municipalities in this group are rural. However, to the South of Oviedo, the capital, there are also old industrial and mining cities and middle-size municipalities located in the Nalón and Caudal valleys, such as Mieres, Lena, Aller or San Martín del Rey Aurelio, which also belong to this group. Only four municipalities in the East of the region are categorised under type one.

When considering the declining rate, we can state that most municipalities categorised under type one exhibit a strong population decline, which exceeds 10% of their initial population at the end of the period. Noticeable exceptions to this rule are the municipality of Morcín, the closest municipality to the capital, and three of the municipalities in the East of Asturias (Cabrales, Caravia and Onís), which may have benefitted from some touristic development. In contrast, Colunga, the fourth municipality of this group on the East, displays a much greater rate of decline. This could be the result of its geographical location, between the central core region and the main touristic centres in the East of Asturias, but far from both.

Type two refers to municipalities where the main force leading to population decline is the natural balance. This does not necessarily imply that the internal migration balance is positive, but that its effect is not enough to be considered as a leading force of population decline. Again, external migration balance is positive in most municipalities, except in Castropol, Peñamellera Alta, San Tirso de Abres, and Yernes y Tameza. The first three are located on the edges of Asturias, far from its central dynamic region, and the latter is the least populated municipality in the region (166 inhabitants in 2012).

Broadly speaking, the geographical situation of type two municipalities is not as peripheral as those municipalities categorised under type one. This may be the reason for a less important negative internal migration balance, or even a slightly positive one. Type two municipalities occupy the western coastal strip, most of the area on the eastern interior, and the remaining south central area. Nevertheless, in this case municipalities in the south central area tend to be closer to the capital than those municipalities in the same area categorised under type one. Again, most of them are rural municipalities, although the industrial city of Langreo is a remarkable exception.

In general, type two municipalities display lower declining rates than type one municipalities. Approximately half of the municipalities categorised under this group exhibit declining rates lower than 10% of their initial population at the end of the period.

Type three municipalities are other declining municipalities that do not fit under any of the previous categories. There are only two municipalities categorised as such, Degaña and Villanueva de Oscos. In Degaña population decline is mainly caused by a negative internal migration balance. Being one of the municipalities with the lowest ageing population in Asturias (Herrán et al., 2010) can partially explain the fact that the natural balance there is not as negative as in other municipalities. However, its highly peripheral situation is responsible for a large negative internal migration balance. In Villanueva de Oscos decline is caused mainly by a negative natural balance and a negative external migration balance, whereas internal migration balance is not that important. This could be partially due to the peripheral location, but also to the very small population in the municipality (345 inhabitants in 2012), as it is the only municipality where external migration is important enough to be considered as a leading force of population decline.

Type four municipalities refer to municipalities with a stagnating population. As few municipalities are categorised as stagnating, and their population change components are similar, no further subdivision has been made. These municipalities exhibit a growth or decline rate that does not exceed 5% of their initial population by the end of the period.

The natural balance is negative in all of these municipalities, contributing towards population decline, and in most of them the external migration balance moderates or even reverses the trend. However, in some municipalities the internal migration balance is also important, as in Carreño, which may benefit from deconcentration processes in Gijón, as a result of its location nearby.

These stagnating municipalities are located mainly inside or close to the central economic area. Both Gijón and Avilés, the main and the third major cities in Asturias, and most of the neighbouring municipalities (Carreño, Castrillón, Corvera de Asturias, and Gozón) are categorised under this group. Other smaller municipalities close to the central region are also categorised as stagnating. To the East, middle-sized municipalities which are close to the main regional centres are considered as stagnating as well (Parres, Ribadedeva, and Ribadesella). Two municipalities in the Nalón valley are also considered as stagnating, Laviana and Sobrescobio. They are close to the economic centres of the valley (Langreo and San Martín del Rey Aurelio), but are located in a much more attractive location, close to the Redes Natural Park and without the negative ambiental consequences derived from mining and heavy industry that are experienced in the neighbouring municipalities (Martínez and Mínguez, 2005). To the West, two municipalities can be categorised as stagnating: Navia and San Martín de Oscos. Navia is a municipality that encompasses one of the major towns in the West of Asturias, and a centre of regional services for the western region. San Martín de Oscos is one of the least populated municipalities in Asturias (484 inhabitants in 2012), and therefore its classification as a stagnating municipality could be a result of its population size.

Finally, those municipalities categorised under type five are those municipalities whose growth rate exceeds 5% of their initial population at the end of the period. Only seven municipalities are considered as growing. Amongst these we can find Oviedo, the capital, and its more immediate area of influence (Llanera, Noreña, and Siero), the major touristic and service centres on the East of Asturias (Cangas de Onís and Llanes), and Villaviciosa, in the area of influence of Gijón. Oviedo and its most immediate area of influence display the highest growth rates in Asturias. Again, the natural balance is negative in all municipalities, and population growth is due to migration. However, in Oviedo and the suburban municipalities around it, as well as in Villaviciosa, in a similar position in relation to Gijón, growth is derived from both an important internal and external migration balances. In contrast, growth in the major touristic towns in the East of Asturias is mainly caused by external migration.

4.2. Population change and associated social phenomena

The other objective of the study is to determine to what extent the relationship between population change and its associated social phenomena is important, particularly with ageing, human capital, economic resources, housing, local services, and tourism.

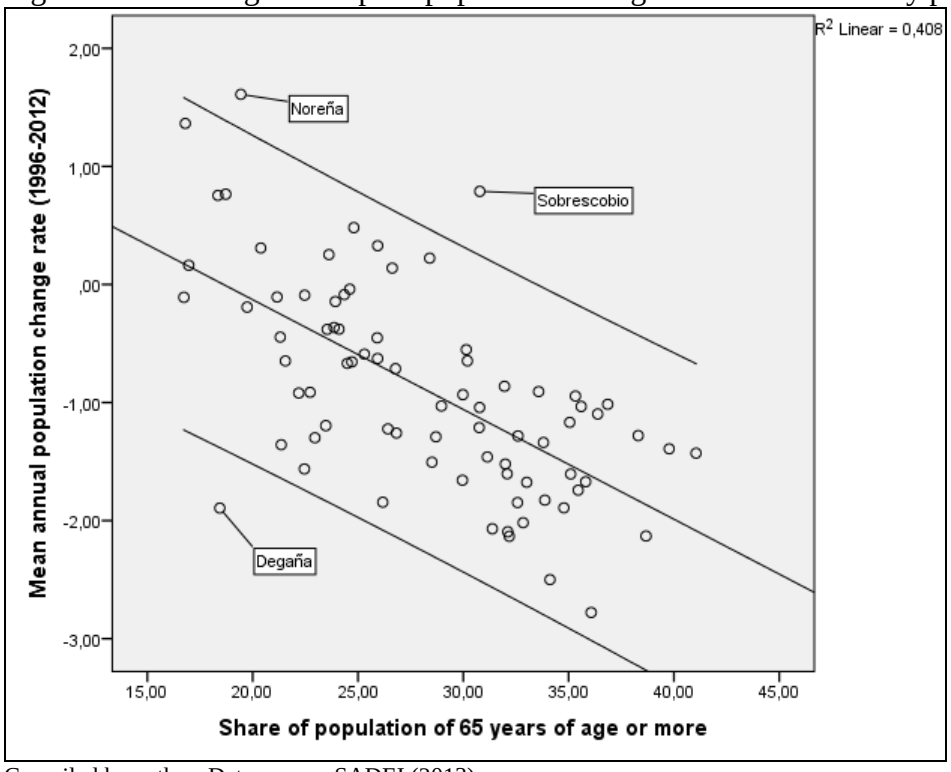
4.2.1. Population change and ageing

Linear regressions have been done to analyse the correlation between population change and ageing. In one of the analyses, the independent variable is the share of elderly people (above 64 years of age), in the other one, the independent variable is the grey pressure.

As we can see in table 3, the share of elderly people explains 40.8% of the variation of the population change. The regression coefficient is -0.093 and, as expected, is negative. Theory suggests that ageing is generally more evident in shrinking populations rather than in growing ones, although authors do not agree on the direction of causality (Van Dam et al., 2006, in: Verwest, 2011; Haartsen and Venhorst, 2010; Coleman and Rowthorn, 2011).

In the plot on figure 6 we can identify those municipalities whose pattern differs the most from the general trend. These are Degaña, Noreña, and Sobrescobio. As seen previously, Degaña is an exception, as it is a municipality with a low share of elderly people, but very remote, and its population decline is mainly caused by migration, with a minor effect on it of the natural balance. In this sense, Degaña displays a shrinking rate much higher than what we could expect under the Asturian context in relation to its share of elderly people. In contrast, both Noreña and Sobrescobio exhibit growth rates above what could be expected in the Asturian context given their share of elderly people. Noreña is a very small municipality consisting of several enclaves within the municipality of Siero, in the direct area of influence of Oviedo, the capital, and one of the main cities in Asturias, which largely benefits from internal migration. Sobrescobio is an atypical municipality too, situated on the upper Nalón valley. As stated before, it is close to both the main economic centres in the valley and to nature, which makes it an attractive municipality to live in. It is also noticeable that Sobrescobio is one of the municipalities with a higher growth rate in this period, while for the period 2002 to 2012 it has been categorised as a stagnating municipality. This is of course the result of the fluctuations of population change in a municipality that is very sparsely populated (872 inhabitants in 2012).

Figure 6. Linear regression plot: population change and share of elderly people.



Compiled by author. Data source: SADEI (2013).

Table 3. Linear regression: population change and share of elderly people.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.639	.408	.400	.687

Predictors: Share of population of 65 years of age or more
Dependent Variable: Population change 1996 to 2012

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.731	.370		4.677	.000
	65+	-.093	.013	-.639	-7.236	.000

Compiled by author. Data source: SADEI (2013).

If we consider the grey pressure as the independent variable, the model explains 31% of the variation of the population change in the region (table 4). This percentage is somewhat lower in relation to the previous one, but still reflects the theoretical linkage between population change and ageing. The regression coefficient, -0.03 (table 4), has also the expected sign. The fact that this coefficient is an order of magnitude lower than the one referring to the share of elderly people is compensated by the fact that the values for the grey pressure are one order of magnitude above those of the share of elderly people.

If we identify the municipalities whose result differs the most from the general trend, we can identify the same three municipalities we identified previously, plus an additional one, Llanera (figure 7). The situation of Llanera is very similar to that of Noreña, in the first area of influence of Oviedo. Indeed, both municipalities display the highest growth rates in Asturias during the period 1996 to 2012. Under the previous categorisation of municipalities in the period 2002 to 2012 this trend persists, unlike in the case of Sobrescobio. Larger municipal populations grant indeed some confidence against the chance that the categorisation of a municipality is affected by fluctuations of the population depending on the period considered.

Table 4. Linear regression: population change and grey pressure.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.557	.310	.301	.741

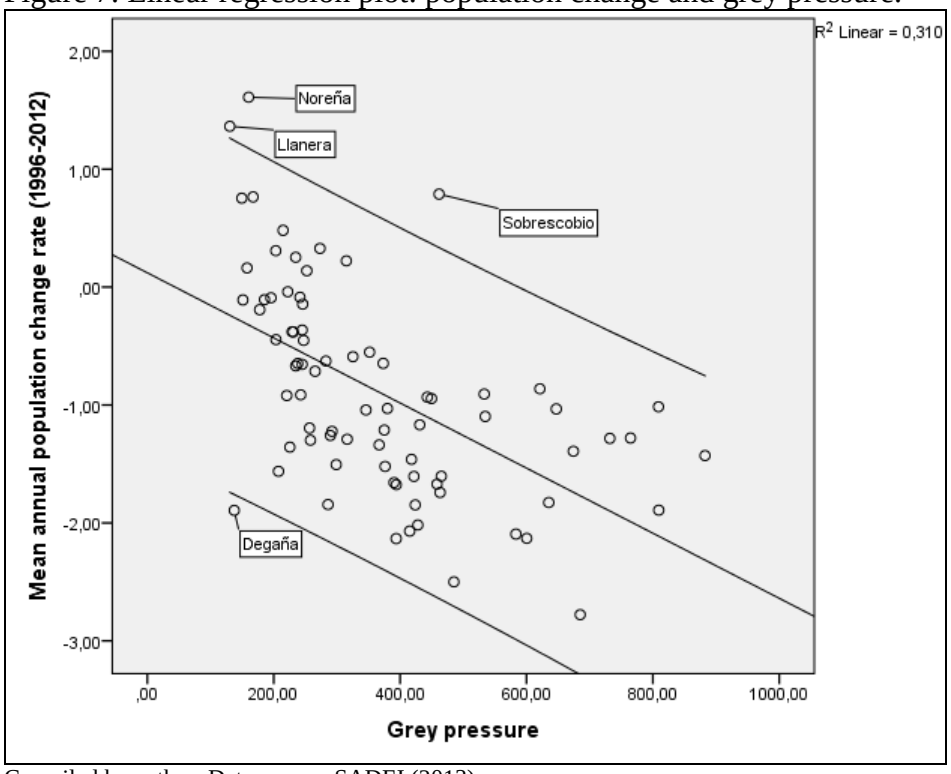
Predictors: Grey pressure
Dependent Variable: Population change 1996 to 2012

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.121	.192		.632	.529
	Grey press.	-.003	.000	-.557	-5.846	.000

Compiled by author. Data source: SADEI (2013).

Figure 7. Linear regression plot: population change and grey pressure.



Compiled by author. Data source: SADEI (2013).

As specified previously in the methods section, a different grade of association between population ageing and the type of declining municipality according to the components of decline is expected. According to theory, both ageing and population decline are stronger in those communities that face not only a negative natural balance, but also a negative migration balance.

To prove this fact it is possible to determine the share of people of 65 years of age or more in type one and type two municipalities and to compare them. As we can see in table 5, at the end of the study period, type one municipalities had a share of elderly people of 27.32%, which is slightly above the share of elderly people in type two municipalities, which was 26.74% at that time. However, if we consider the same shares at the beginning of the study period and analyse their evolution during the study period, type two municipalities have increased their share of elderly people in a further 2.48%. In the case of type one municipalities, this increase in the share of elderly people is much higher, of 4.90%. This evidence, together with the fact that decrease rates tend to be larger in type one municipalities (section 4.1.), prove the strong link between ageing and population decline, which is reinforced by out-migration, in addition to a negative natural balance caused by low birth rates. As type three category consists of only two municipalities that do not fit in any of the other categories, the analysis of their share of elderly people does not provide any relevant information.

Table 5. Share of elderly people according to the type of declining municipality.

	Share of elderly people	
Type of municipality	1996	2012
1	22.42	27.32
2	24.25	26.74
3	17.76	25.34

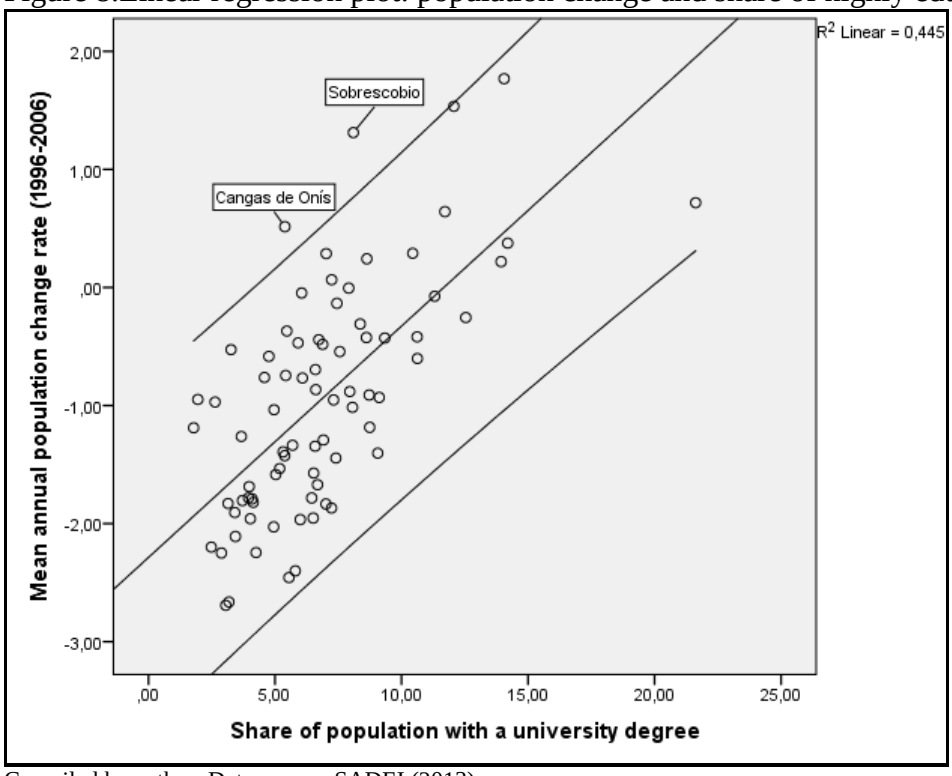
Compiled by author. Data source: SADEI (2013).

4.2.2. Population change and human capital

Linear regressions have been done to analyse the correlation between population change and human capital. In one of the analyses, the independent variable is the share of highly educated people, while in the other the independent variable is the share of people with no education at all.

As we can see in table 6, the share of highly educated people explains 44.5% of the variation of population change. The regression coefficient is 0.196 and, as expected, is positive. This is consistent with the theoretical view that young people leave the rural and old industrialized communities in recession in search of a better education, and that these people rarely come back as there are no attractive employment and career opportunities in those places (Stockdale, 2004). Although the current level of education is mainly the result of past migrations, these have also been responsible for a high share of elderly people in those areas. This has a clear effect on the share of population on their reproductive age, which may result in a more negative natural balance. Furthermore, emigration of youth may still continue in economically disfavoured areas.

Figure 8.Linear regression plot: population change and share of highly educated people.



Compiled by author. Data source: SADEI (2013).

In figure 8 we can identify those municipalities whose pattern differs the most from what could be expected as a result of their share of highly educated people in the Asturian context. Both Cangas de Onís and Sobrescobio have higher growth rates in relation to what could be expected in accordance to their share of highly educated people. Both of them are rural municipalities which may have suffered the effects of youth emigration in the past but that are now favoured towards a population growth. The case of Sobrescobio has already been discussed. Cangas de Onís is one of the two major touristic centres in the East of Asturias, the most touristic area of the region. This allows some economic development and enhances population growth.

Table 6. Linear regression: population change and share of highly educated people.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.667	.445	.438	.730

Predictors: Share of population with a university degree

Dependent Variable: Population change 1996 to 2006

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.286	.190		-12.044	.000
	Univers01	.196	.025	.667	7.804	.000

Compiled by author. Data source: SADEI (2013).

Highly educated people tend to concentrate in the leading economic areas, which are often also the areas that experience population growth. The association between population change and the share of people with no education is unclear. In the case of the share of people with no education at all, the proportion of variation explained by the model is much lower, 12.8% (table 7). Especially in the Spanish context, most of the elderly people, who were raised during the Spanish Civil War or during the first years of the Franco dictatorship era, have very little or no education, irrespective of whether they were born in an urban or a rural area. Furthermore, many of these elderly people currently living in Spanish cities in-migrated from rural areas, especially during the economic development from the sixties onwards. Nonetheless, considering such a complex phenomenon as population change, we could argue that a 10% explanation is somewhat relevant. The regression coefficient, -0.031, is also consistent with the theoretical framework. However, not only the proportion of variability explained in this model is lower, but also the regression coefficient itself. This suggests that the share of people with no education is much less associated with population change than the share of highly educated people.

Table 7. Linear regression: population change and share of non-educated people.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.358	.128	.117	.915

Predictors: Share of population with no education

Dependent Variable: Population change 1996 to 2006

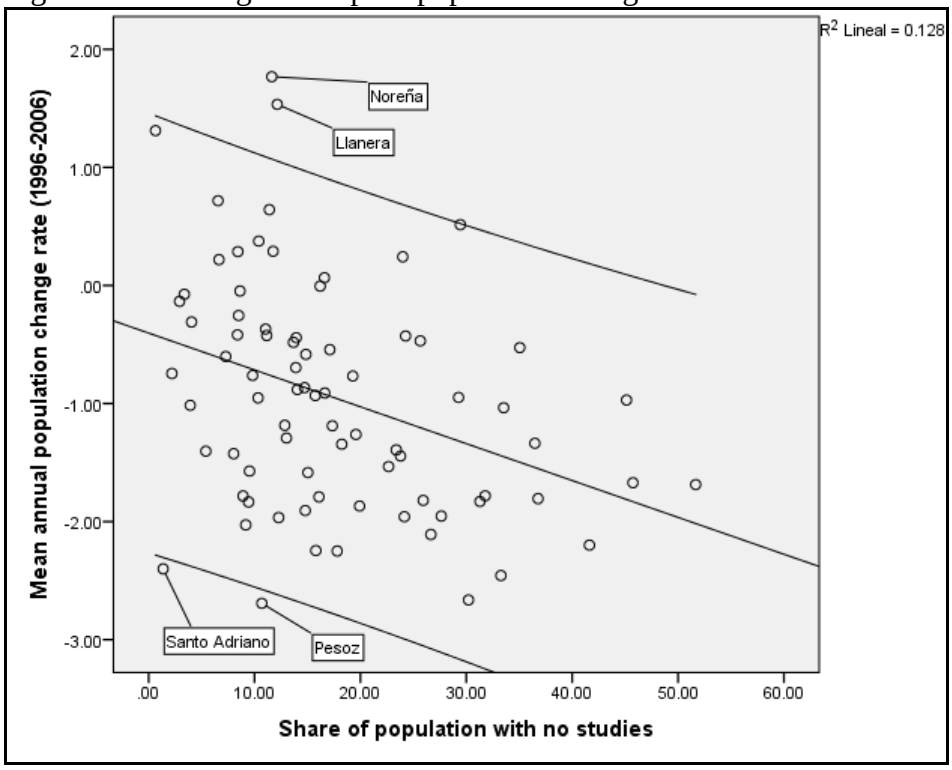
Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.403	.194		-2.074	.041
	Nostud01	-.031	.009	-.358	-3.341	.001

Compiled by author. Data source: SADEI (2013).

If we identify the municipalities that display a pattern which differs the most from the general trend in figure 9, four are identified. Llanera and Noreña exhibit growth patterns above what could be expected according to their share of poorly educated people. Their specific situation has already been described. Pesoz and Santo Adriano exhibit declining rates below what could be expected according to their share of people with no studies. Both of them figure amongst the least populous municipalities in the region (191 and 263 inhabitants in 2012, respectively) and those with the strongest rate of decline.

Figure 9.Linear regression plot: population change and share of non-educated people.



Compiled by author. Data source: SADEI (2013).

Table 8. Multivariate linear regression: population change and level of education.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.668	.447	.432	.734

Predictors: Share of population with a university degree, share of population with no education

Dependent Variable: Population change 1996 to 2006

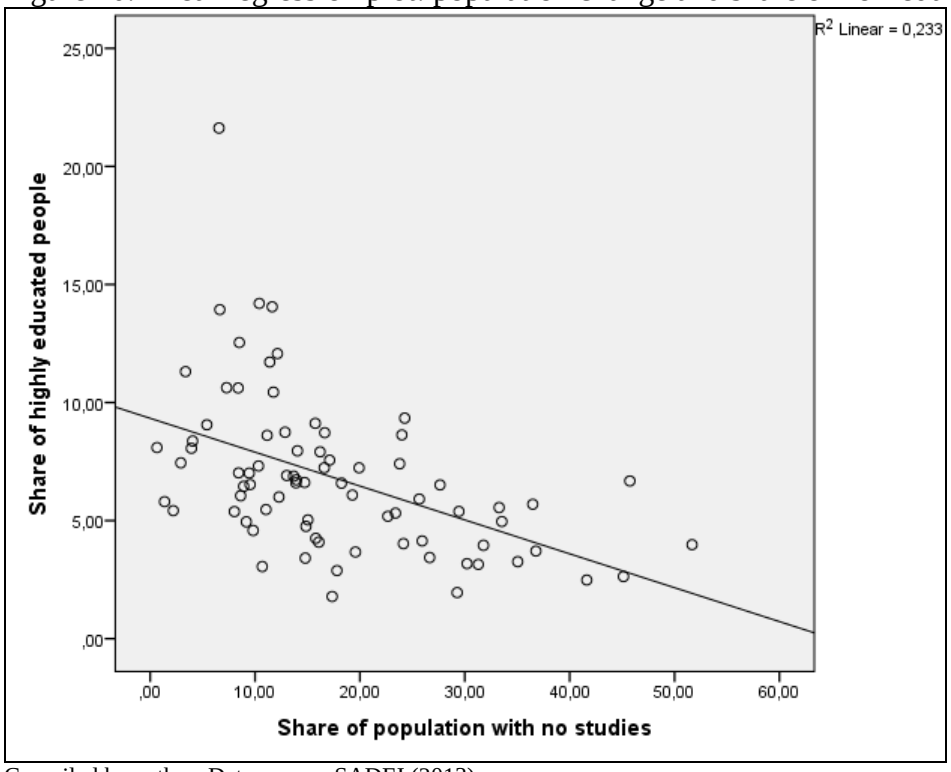
Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.170	.311		-6.981	.000
	Univers01	.189	.029	.645	6.570	.000
	Nostud01	-.004	.009	-.047	-.475	.637

Compiled by author. Data source: SADEI (2013).

In table 8, the results of a multivariate regression including both the share of highly educated people and the share of people without studies is presented. It is important to notice that both variables are not fully correlated, as the share of people with medium education levels is not considered. From the model, we can see how the proportion of variation explained does not improve much from that of the model considering the proportion of highly educated people only. In addition, the regression coefficient for the share of people without education is very low, ten times lower than the coefficient referring to the model considering the share of people with no studies only. These findings reinforce the previous finding that the share of people without education in Spain is not strongly associated to population change, while the share of highly educated people is indeed a good predictor of population change, as expected according to theory.

Figure 10.Linear regression plot: population change and share of non-educated people.



Compiled by author. Data source: SADEI (2013).

In figure 10 it is possible to check how the independent variables considered in the model are not strongly associated (R square 0.233). Furthermore, the variance inflation factor (VIF) also measures redundancy amongst explanatory variables in a multivariate regression model. In this case, the VIF value for both independent variables is 1.304, far below the redundancy level (7.5). Thus, the VIF value also reflects that the variables considered are not multicollinear, and that a regression coefficient close to zero indicates that the share of people with no education is not a good explanatory variable.

4.2.3. Population change and economic resources

A linear regression has been done to analyse the correlation between population change and economic resources. The independent variable considered is per capita income, which is expressed as a relative measure, as specified in section 3.2.3, so that the regression coefficient is large enough to be distinguished from zero (the regression output consists usually of only three decimals).

Table 9. Linear regression: population change and per capita income.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.530	.280	.271	.907

Predictors: Per capita income (relative)

Dependent Variable: Population change 1998 to 2010

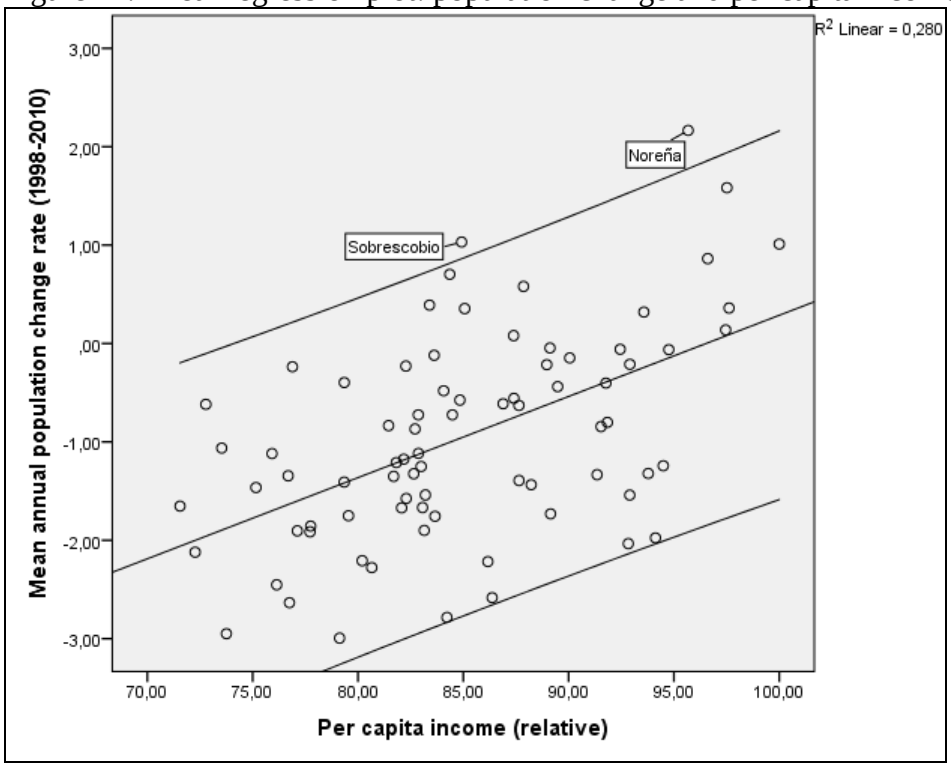
Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-7.963	1.294		-6.153	.000
	Income	.082	.015	.530	5.442	.000

Compiled by author. Data source: SADEI (2013).

As we can see in table 9, per capita income explains 28% of the variation in population change. The regression coefficient is 0.082 and, as expected, is positive. Indeed, income tends to be lower in rural and old industrialized areas in comparison to the leading economic urban areas (Stockdale, 2004; Verwest, 2011). As this is broadly the same schema for population decline or growth, we can expect that there is a positive relation between economic resources and population change.

Figure 11.Linear regression plot: population change and per capita income.



Compiled by author. Data source: SADEI (2013).

In figure 11 we can identify those municipalities whose pattern differs the most from what could be expected as a result of the economic resources their population has in the

Asturian context. Not surprisingly, Sobrescobio and Noreña appear to have higher growth rates than expected again.

4.2.4. Population change and housing

A linear regression has been done to analyse the correlation between population change and housing. The independent variable considered is construction licenses per 1,000 inhabitants.

As we can see in table 10, the number of licenses per 1,000 inhabitants explains 13% of the variation of population change. This percentage is certainly low. On the one hand, the number of construction licenses does not necessarily relate to the number of dwellings to be built, especially when comparing urban and rural municipalities, as urban municipalities generally have much taller buildings. On the other hand, residential moves are not necessarily linked to a change in the municipality of residence. These reasons are important enough to be aware of the results shown in this section, which should be interpreted with extreme care. The regression coefficient is 0.212 and, as expected, is positive. In theory, new houses tend to be built where there is demand for them, that is, in attractive and growing municipalities, while shrinking municipalities tend to present an oversupply of housing which prevents the possibility of new construction projects (Mulder, 2006; Haartsen and Venhorst, 2010; Van Dalen and Henkens, 2011).

Table 10. Linear regression: population change and construction licenses.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.360	.130	.117	.971

Predictors: Licenses per 1,000 inhabitants

Dependent Variable: Population change 2000 to 2012

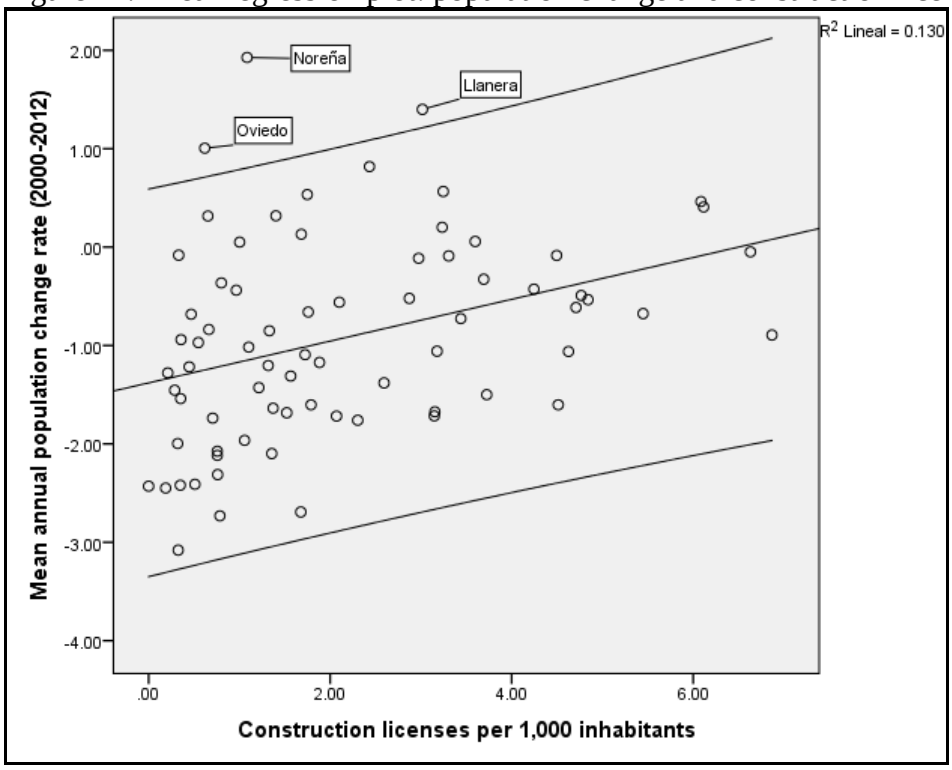
Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.380	.181		-7.632	.000
	Lic1000	.212	.065	.360	3.252	.002

Compiled by author. Data source: SADEI (2013).

In figure 12 we can identify those municipalities whose pattern differs the most from what could be expected as a result of the number of licenses per 1,000 inhabitants they possess. Again, Noreña and Sobrescobio display growing rates much higher than expected. However, this time also Oviedo, the capital, has a much larger growth rate than what the number of licenses per 1,000 inhabitants suggests. Together with the fact that this number of licenses per 1,000 inhabitants is very low in Oviedo, this evidence seems to underline that the variable considered leads to a biased model, as a single construction project usually intends to build numerous dwellings in an urban municipality, in comparison to a single house in a rural area. If we could use the number of new dwellings to be built instead of the number of licenses, the variation explained by the model would most likely improve.

Figure 12.Linear regression plot: population change and construction licenses.



Compiled by author. Data source: SADEI (2013).

4.2.5. Multivariate regression model

Up to this point, it has been concluded that no appropriate data on housing is available, and that the share of people with no education is not strongly correlated with population change in the case of Spain. However, a multivariate regression model could be possible with the share of highly educated people, income, and either the share of elderly people or the grey pressure. This multivariate regression model would determine the correlation between population change and three social phenomena: ageing, human capital, and economic resources.

However, we already argued that the time coverage of data is limited, especially in the case of education level, where data is available only for 2001. In contrast, there is only data available on income every two years from 2000 onwards. This difference in time coverage makes it difficult to arrange a regression model with these two variables. A regression model considering only the variation between 2000 and 2002 may be biased, as population change highly fluctuate, especially in small municipalities. If we already found evidence of it in a 10 year period, it would not be advisable to analyse trends in such a short period.

The only possibility to estimate a multivariate regression model with three different social phenomena included as independent variables is to consider a mid-estimation for the variable income in 2001 (average of the values for 2000 and 2002). Naturally, we would lose any possible information on the variation of the variable during the study period. In the bivariate regression models, the study period was simply adjusted to the period where data were available for the independent variable, as data on population are available yearly.

If we consider the share of elderly people, the resulting model is better than if we consider the grey pressure as the variable representing the ageing process (further discussed in section 4.2.6.). Unfortunately, when we run the regression model with the share of elderly people, the share of highly educated people, and income, the probability that the regression coefficient for income is zero is very high (0.75), and the coefficient itself is very low (-0.006). Furthermore, it has a negative sign, just the opposite of what was expected.

In a bivariate regression model, the impossibility to reject the null hypothesis that a regression coefficient is zero could be due to sampling errors (usually the lack of a big enough sample), or either to the fact that indeed there is no relation. Although we did not consider significance levels in the bivariate models as data do not come from samples, significance levels for the regression coefficients were always below 0.05. In a multivariate model, however, the possibility that a regression coefficient is zero could also be due to the fact that a variable is redundant, as it is a linear combination of the other independent variables considered. Indeed, if we run a regression model with income as the dependent variable, and the share of elderly people and the share of highly educated people as independent variables, 69.1% of the variation is explained by the model.

Table 11. Multivariate linear regression model.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.682	.465	.451	.721

Predictors: Share of population of 65 years of age or more , share of population with a university degree

Dependent Variable: Population change 1996 to 2006

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.234	.657		-1.879	.064
	65+	-.029	.017	-.186	-1.670	.099
	Univers01	.160	.033	.546	4.896	.000

Compiled by author. Data source: SADEI (2013).

If we run a multivariate regression model selecting the variables via backward elimination, the variable income is also left out. The results of this model can be seen in table 11. The significance level for the share of elderly people is just below the removal level (0.099). However, in this case the regression coefficient is further from zero, and it has the expected sign. The variation explained by the model (46.5%) is not much higher than that referring to the bivariate regression model with the share of highly educated people as the independent variable (44.5%). Other explanatory variables are missing to achieve a better model. The model could possibly improve if appropriate data were found for housing, which is highly correlated to population change according to theory, as the housing market would rapidly adapt to a change in the housing demand (Mulder, 2006; Haartsen and Venhorst, 2010; Van Dalen and Henkens, 2011).

4.2.6. Geographically weighted regression models: are these possible?

Geographically weighted regression (GWR) is a linear regression where regression coefficients are calculated using weights. These weights depend on the proximity of the data points to the point where the regression coefficient is calculated, as near things are usually more related than distant ones. Therefore, geographically weighted regression is adequate to model spatially heterogeneous processes. The differences in the regression coefficients along the space analysed reflect different areas, from those where the associated independent variable has no effect (coefficient value close to zero), to those where it is a good explanatory variable with a strong effect on the dependent variable (Charlton and Fotheringham, 2009). It can be interesting to try to identify the areas where each of the social phenomena considered are more correlated to population change, if possible.

In any case, according to Rosenshein et al. (2011), six aspects should be checked on the results of an ordinary least squares regression (OLS) before proceeding to a GWR.

-Regression coefficients should be statistically significant. In this study, data do not derive from samples, and therefore this point can be skipped in the bivariate regressions. However, in the multivariate regression, a regression coefficient could be zero due to redundancy.

-The relationships between the variables should be as expected, that is, have the expected sign. This point was met in all the regressions calculated.

-It is necessary to check for redundant explanatory variables. OLS results in ArcGIS provide an extra variance inflation factor (VIF). When this value is above 7.5 in any of the independent variables, we can conclude that that variable is redundant. In this study, a multivariate regression model was calculated, with both the share of elderly people and the share of highly educated people as independent variables. In this case, the VIF values for both variables are 1.740, far below the redundancy level.

-Residuals should be normally distributed. The Jarque-Bera test measures whether these residuals are indeed normally distributed (null-hypothesis). When the outcome of this test is statistically significant, the model is biased and we cannot trust the results. In most of the bivariate regressions calculated, the residuals seem to be normally distributed. This is not the case for the regression with the number of construction licenses per 1,000 inhabitants, where the Jarque-Bera test is statistically significant. However, we already determined that this variable was not appropriate to analyse the relationship between population change and housing. In the multivariate model considering the grey pressure as the variable for ageing, as well as the share of highly educated people and income, the Jarque-Bera test is also statistically significant. This is the reason why the share of elderly people was chosen as the variable representing ageing in the multivariate regression model considered (section 4.2.5.).

-The variation explained by the model should be high. In our case, we consider population change as a very complex phenomenon and are satisfied with r squared coefficients of 0.3 or higher.

-Residuals should be free of spatial autocorrelation, that is, overestimations or underestimations should not be clustered. We can check this in ArcGIS with the

Moran's I measure of spatial autocorrelation. If this condition is not satisfied, explanatory variables are missing in the model. Unfortunately, residuals were spatially autocorrelated in all the cases.

It is very important to find a good model before proceeding to GWR. If any of the checks fails, the model cannot be trusted, and its results could be biased (ESRI, 2010). In our case, the fact that residuals are not free of autocorrelation indicates that the results should be interpreted with care, as the rest of the results could be biased. In any case, we were aware of this situation since the beginning, as the r square values are not that high, even in the multivariate regression model considered. Possibly, if appropriate data had been available on housing and other social phenomena, the results of a multivariate regression model would have been better. In any case, as stated previously, regressions have been done as a sophisticated description, and the low r squared values have been considered as good to prove the association between several social phenomena and population change. Therefore, no explanation or prediction of population change is aimed in this study.

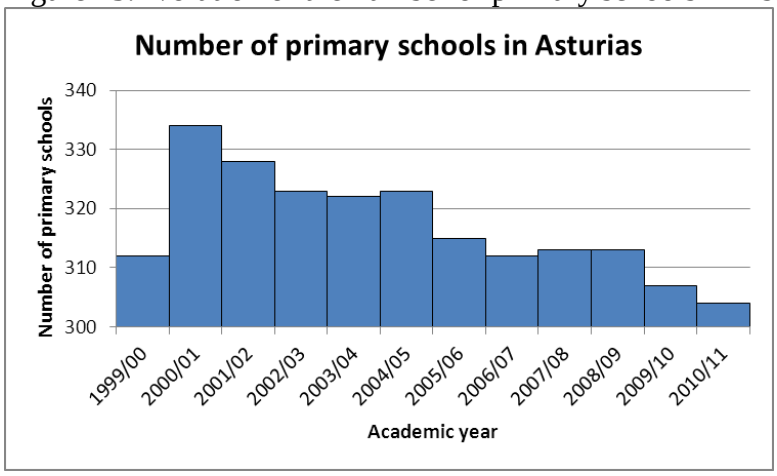
'The Koenker p-value reflects how likely it is that the relationships being modelled are consistent across the entire study area. If the Koenker p-value is small and statistically significant, the relationships do vary across the study area and are therefore nonstationary' (Rosenshein et al., 2011, p. 41). Therefore, when the Koenker test is statistically significant, it indicates that the model can be improved with a GWR. In all of the regressions calculated, the Koenker p-value is not significant. This means that the relationships between population change and the different independent variables considered do not vary across the study area, and that GWR is not applicable.

We grant the results of the Koenker tests as correct, despite knowing that these results could also be biased, as one of the checks in the different regression models always fails. Therefore, we state that GWR does not add relevant information to the study. Indeed, when performing these GWR, some of them demonstrate little spatial variation (concordant with the Koenker test), while others generate biased results (coefficients changing sign) or in spatial distributions of the regression coefficients that seem difficult to explain (clusters consisting of municipalities with very different characteristics). Due to these reasons, the results of the GWR analysis are not shown and discussed.

4.2.7. Population change and local services: education

If we look at the evolution of the number of primary schools in Asturias from the academic year 1999/00 to the academic year 2010/2011 in figure 13, we can see how during the first year there is a notable increase in the number of schools. Indeed, during the academic year 2000/01, there are 22 more primary schools throughout the region in relation to the number of schools during the previous academic year. However, we can see how afterwards the number of schools gradually diminished, as many of them were closed or merged due to a reduced number of pupils. In the end, during the academic year 2010/11 only 304 primary schools were left in Asturias, eight fewer than in the beginning of the study period.

Figure 13.Evolution of the number of primary schools in Asturias (1999/00-2010/11).

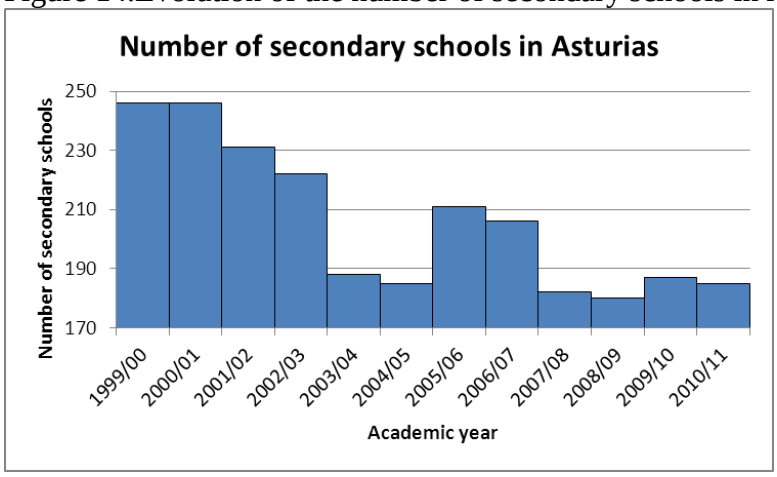


Compiled by author. Data source: SADEI (2013).

In the case of secondary schools, if we look at figure 14, we can see how the number of schools offering secondary education in Asturias has largely decreased from 246 at the beginning of the study period to 185 at the end of it. We can also identify the opening of new schools during the academic year 2005/06. However, most of them were closed only two years after that.

In both the trend in the number of primary and secondary schools we can see how there is some political support to education, as new schools were opened; but at the same time, many more schools had to close or merge due to a lack of students and the derived staffing and financial problems (Haartsen and Van Wissen, 2012).

Figure 14.Evolution of the number of secondary schools in Asturias (1999/00-2010/11).



Compiled by author. Data source: SADEI (2013).

Unfortunately, no further quantitative analysis is possible with data on the number of schools or pupils per municipality. As stated before, there seems to be an incongruence in the number of pupils in those municipalities with no school in the case of primary studies. While some municipalities without a primary school have a certain number of pupils, others have no pupils at all, according to the data. This incongruence raises the following question: is it possible that some schools attach their pupils to their municipality of residence and others attach them to the municipality where the school is located? Certainly, if this was the case, data would be inconsistent.

In order to answer the previous question, research has been done at the Asturian school directory available at EDUCASTUR, where a relation of all the education centres or organisations per municipality and their type is available. From the different types of education centres or organisations available, only those referring to primary or secondary education centres were selected. To simplify it, we only consider the compulsory secondary school (ESO), which is taught until 16 years of age, and we do not distinguish centres that offer secondary compulsory education only from those that offer secondary non-compulsory education too, which is a two-year preparation for university. These are public (primary) schools (CP), public secondary schools (IES, IESO), public schools offering both primary and secondary education (CPEB), private or state-subsidised schools (COL), and rural aggregated schools (CRA).

Especially interesting are the rural aggregated schools, which used to be rural schools with a small number of pupils and staffing problems that have been merged in a single school but maintain their teaching locations in the different towns. One by one, all municipalities with officially no school but a certain number of pupils were identified as having at least one old school that currently forms part of a rural aggregated school whose administrative centre is located in another municipality. In this sense, we can state that data on the number of pupils are not inconsistent, as pupils are attached to the place where they attend school. However, some of these places do not appear as schools because they are part of a larger merged school. Furthermore, we can find public schools which offer both primary and secondary education at the same time (CPEB), which is also the case of most of the private or state-subsidised schools (COL). It is unclear whether these schools are double counted as both primary and secondary schools.

Although data on the number of schools and pupils are consistent from a legal and administrative point of view, these data are not optimal for any statistical analysis. Therefore, literature review has been done to determine the current situation of education in Asturias.

The statute of autonomy of Asturias, which was approved by the organic law 7/1981, of December 30th, grants the Autonomous Community all education competencies on its article 18 (BOE, 1982). Furthermore, the organic law 8/1985, of July 3rd, grants the Asturian government the competency to create and close public education centres on its article 17 (BOE, 1985).

Due to the lack of students in many rural areas, and the derived staffing and financial problems, many schools have been forced to merge as aggregated rural schools. In these schools, the main centre is the official administrative centre of the school, but the old teaching locations are maintained and the teaching staff moves regularly amongst these teaching locations. However, any school or a teaching centre part of a merged school can be closed when the number of pupils attending it is four or less (BOPA, 2009).

In general, we can see how education is maintained quite well throughout the region, as a school in Asturias is only forced to close when it has four pupils or less. This is important in a region where orography makes transport difficult in many of its rural areas. Merger of schools proves to be an adequate solution to deal with the staffing and financial problems in schools with a reduced number of pupils. However, in some municipalities there is only one primary school, and the transport problem is solved

through residences (Escuela Hogar, EH) for those pupils who live in remote rural areas. These EH are also compiled in the Asturian school directory.

Currently, under the financial situation the Spanish government has, a project for a new national education law has been developed, the so-called project for an organic law to improve education quality. This project intends, amongst other things, to drastically raise the minimum number of pupils and unify this value throughout the state (LOMCE, 2013). This project of law has already received lots of criticism from political parties in the opposition and educational organisations. The effects on remote rural areas that this law might have once it is approved, not only in Asturias but also in other regions of Spain, are still unclear.

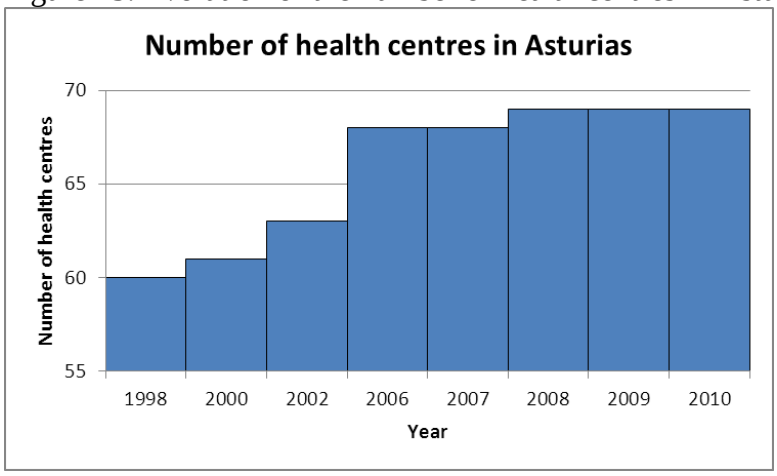
4.2.8. Population change and local services: health care

The Asturian health care is organised into eight health districts, each one having at least a hospital. These eight districts correspond to the geographical sub-regions or *comarcas*, although they take their names from the town or area where the hospital is located. Each of these districts is subdivided in the so-called basic health areas. In addition, minor health centres are found in rural or less populated areas. In the case of the most remote rural municipalities, special health areas are created, with their own health centre. These special health areas may also have minor health centres in other villages or rural areas (SESPA, 2011).

Possibly the location of the sub-regional hospitals has influenced to a certain extent the demographic trend in the municipalities where these are located. The hospital of Jarrio is located in the municipality of Navia, very close to its main town. As we saw in section 4.1., Navia is the only municipality in the West of Asturias that is classified as a stagnating municipality instead of a declining one. Certainly, the fact that it is a centre for provision of public services for the neighbouring municipalities (secondary education) and the Eo-Navia region (hospital), has had some influence on this demographic trend. Something similar can be applied to the municipality of Parres, in the East of Asturias, whose capital is Arriondas, where the hospital for the East of Asturias is located. Although larger municipalities and touristic centres as Llanes or Cangas de Onís exhibit higher growth rates, probably Arriondas is the location of the hospital due to its geographical location, in the middle of some of the main towns in the area (Cangas de Onís, Ribadesella, and Infiesto). Furthermore, Llanes is certainly closer to Parres than to Cangas de Onís. In the case of Cangas del Narcea, the third town having a hospital in a rural and declining region, the demographic trend is not reversed. In Langreo and Mieres, old industrialised cities in regression, the trend is not reversed either. In any case, both Langreo and Mieres are still the major urban centres and providers of services in their sub-regions.

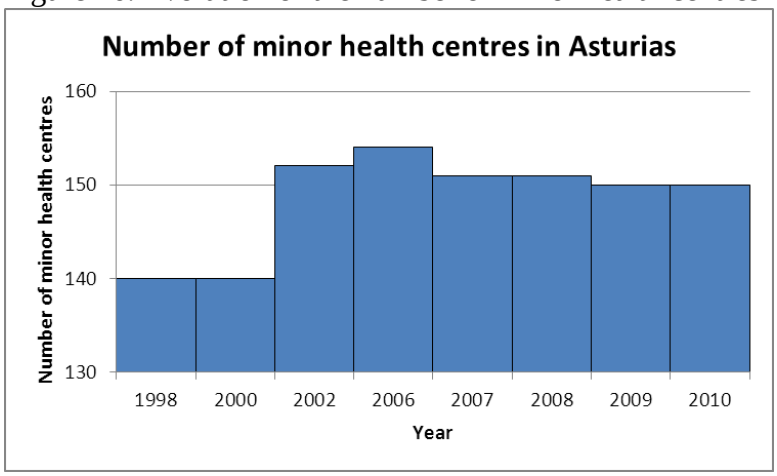
In the case of health centres, we can see the evolution of their number in Asturias from 1998 to 2010 in figure 15. The years presented do not display any regular pattern, but reflect instead the years for which data are available. The evolution of the number of minor health centres in Asturias during the same period can be seen in figure 16. In both figures we can see how health centres and minor health centres have increased during the study period, unlike the schools, which have decreased. This is of course the result of a shift in the demand of services caused by an ageing population (Verwest, 2011).

Figure 15. Evolution of the number of health centres in Asturias (1998-2010).



Compiled by author. Data source: SADEI (2013).

Figure 16. Evolution of the number of minor health centres in Asturias (1998-2010).



Compiled by author. Data source: SADEI (2013).

The annual report on the health situation of Asturias in 2011 made by SESPA has a chapter on satisfaction of the users of the health facilities, which is compiled from the health report on the health situation in 2010 made by the ministry of health, social services and equality. 54.29% of the people interviewed agree that the health system in Asturias is working quite well, while this percentage diminishes to only 23.86% at the national average. In contrast, all of the different categories suggesting that the health system should be changed (more or less radically), are agreed by a larger proportion of the interviewees at the national level, in comparison with Asturias (SESPA, 2011, p. 190). We can argue two possible explanations for this result. On the one hand, the opening of new health and minor health centres in Asturias during the last decade may have contributed to improve the health care in the region. On the other hand, the stagnating population trend in Asturias, in opposition to the rest of the Autonomous Communities, may be responsible for a better health service, which is not swamped by the health demand in a health system that is still highly similar in terms of infrastructure, personnel and expense to that of fifteen years ago, when massive immigration to Spain began.

4.2.9. Population change and tourism

It is known that tourism development can make a rural area more attractive and popular, and mitigate or even reverse population decline by attracting immigrants (García and Sánchez, 2005; Laguna, 2006).

Asturias is not an Autonomous Community especially known for tourism. Situated on the Atlantic coast in the North of Spain, its climate is completely different from that of the Mediterranean coasts that attract many tourists from all of Europe. However, the East of Asturias can be considered as a touristic region, at least in a national context, due to both historical and natural reasons. It is in this area where the Spanish *Reconquista* began, with the battle of Covadonga in the Asturian mountains. After this battle, the first Kingdom of Asturias was established, which would later be renamed as the Kingdom of León, and a part of it would split to become the Kingdom of Castille. Not surprisingly, the first capital of the Kingdom of Asturias was Cangas de Onís, one of the main touristic municipalities in Asturias at the moment. The first national park and protected space in Spain was also declared here, the *Picos de Europa* national park.

In table 12 we can see how 40% of the 72,098 touristic lodging spaces in Asturias are located in the Oriente, that is, in the East of Asturias. A total of 29,022 touristic lodging spaces are located in municipalities in the East of Asturias. There is also some touristic development in the sub-regions of Gijón and Oviedo, mainly located in these two cities. There are much fewer touristic lodging spaces in western and southern Asturias.

If we consider the number of touristic lodging spaces per 1,000 inhabitants, the East of Asturias is clearly the region with the highest development of tourism, with 54.30 touristic lodging spaces per 1,000 inhabitants, high above the Asturian average (6.65). The development of tourism has also some relative importance in the Eo-Navia sub-region (the western coast), although much less than in the East of Asturias.

Table 12. Touristic lodging spaces in the Asturian *comarcas*.

Asturias and *comarcas*	touristic lodging spaces		
	total	relative	per 1,000
Asturias	72,098	100.00	6.65
Oriente	29,022	40.25	54.30
Gijón	11,807	16.38	3.90
Oviedo	11,101	15.40	3.27
Eo-Navia	8,503	11.79	17.05
Avilés	7,524	10.44	4.77
Narcea	1,651	2.29	5.43
Caudal	1,336	1.85	1.94
Nalón	1,154	1.60	1.43

Compiled by author. Data source: SADEI (2013).

After these initial considerations, it is logical to state that tourism might have had an influence on population change only in the region where it is more developed, that is, in the East of Asturias. Table 13 shows the total number of touristic lodging spaces and the number of touristic lodging spaces per 1,000 people in each of the municipalities that form part of the East of Asturias.

Table 13. Touristic lodging spaces in the East sub-region of Asturias and its municipalities.

Oriente and its municipalities	touristic lodging spaces	
	total	per 1,000
Oriente	29022	54.30
Llanes	10851	77.78
Cangas de Onís	3981	58.93
Ribadesella	2752	43.68
Ribadedeva	2139	114.69
Cabrales	2078	92.23
Parres	1618	27.88
Colunga	1341	35.49
Piloña	1216	15.21
Caravia	1051	197.19
Onís	887	111.29
Peñamellera Baja	392	29.56
Peñamellera Alta	297	48.93
Ponga	248	36.58
Amieva	171	21.24

Compiled by author. Data source: SADEI (2013).

According to the classification of municipalities we made on section 4.1., Llanes and Cangas de Onís were categorized as growing municipalities. Parres, Ribadesella, and Ribadedeva were categorized as stagnating municipalities. The rest of the municipalities in the East of Asturias were categorized as declining municipalities. If we look at the touristic lodging capacity, we can see how the absolute data are associated much more strongly with population change than the relative data. Llanes, Cangas de Onís, Ribadesella, and Ribadedeva are indeed the four municipalities with the highest number of touristic lodging spaces. Parres is located in the sixth place, but certainly the fact that it is the municipality where the sub-regional hospital is located, has had some influence on its stagnating population as well.

In contrast, the relative data do not correspond with population change, as there are municipalities with a relatively high touristic specialization that are categorized as declining (Cabrales, Caravia, and Onís). This is most likely due to their smaller population size, with no major town, and therefore very few or no services. Not only do people in this municipalities depend on services located in neighbouring municipalities, but also complementary touristic activities might be concentrated in the larger towns, which are at the same time those towns where the majority (absolute value) of touristic lodging spaces are located.

5. Conclusions

The aim of this study was to determine the major components of population change in Asturias, as well as to find empirical evidence of several social phenomena that can be expected to be associated with population change from a theoretical point of view. According to this initial objective, a series of research questions and sub-questions were formulated:

Which are the major components of population change in the different Asturian municipalities?
- -To what extent is population change determined by the natural balance?
- -To what extent is population change determined by the migration balance?

How is the relation between population change and several social phenomena?
- -How is the relation between population change and ageing?
- -How is the relation between population change and human capital?
- -How is the relation between population change and economic resources?
- -How is the relation between population change and housing?
- -How is the relation between population change and local services?
- -How is the relation between population change and tourism?

Asturias was chosen amongst the Spanish regions because it has been the only region in Spain that has not experienced population growth during the last fifteen years, the period with the highest population growth in Spain since the mid-19th century, when the first modern census was taken and data on population are available since then. At the same time, Asturias is also one of the regions in Europe (NUTS2) with the lowest fertility rate, if not the lowest. In addition to declining rural areas, we can also find in Asturias old industrialised middle-sized cities in crisis since 1973 that are still declining. This latter situation is not so easily found in many of the other Spanish regions. Therefore, three have been the main reasons to choose Asturias amongst other Spanish regions to study population decline: a stagnating population trend in a generally growing Spanish context, an extremely low fertility rate, and a declining trend in most of the Asturian municipalities, that affects not only rural municipalities but also urban ones.

At this point, a review and reflection of how well these research questions could be answered is of main importance. As expected in a region with one of the lowest fertility rates in the world, natural balance is negative in every single municipality. Therefore, population change is influenced mainly by the magnitude and sign of the migration balance, especially the external migration balance. However, in the most dynamic municipalities, located in the corridor Oviedo-Gijón, the internal migration balance has played a very important role towards population growth as well.

It was possible to find empirical evidence of an inverse relationship between population change and ageing, with both of the variables used as indicators for ageing: the share of elderly people and the grey pressure. It has also been demonstrated that the ageing process is more advanced in those municipalities with the largest decline rate, which are at the same time those municipalities where decline is due to both a negative natural balance and a negative internal migration balance. This is concordant with theory, as ageing is caused by a low birth rate which has been extended over time. At the same time, ageing is reinforced by the out-migration of youth.

It was also possible to find empirical evidence of a direct relationship between population change and the share of highly educated people, and population change and income, as expected according to theory. In contrast, the expected inverse relationship between population change and the share of people with no education could not be proven. It is possible that in Spain this relation does not follow the expected theoretical path, as many elderly people, born during the war or the post-war, even those living in cities (whether they migrated to or were born in them), are illiterate or almost illiterate.

Unfortunately, no strong evidence of the relation between population change and housing has been found. The number of licenses per 1,000 inhabitants does not clearly reflect the total number of dwellings to be built, which would have probably been a much better indicator. The fact that Oviedo, the capital and one of the municipalities with the highest growth rate, has a low relative number of licenses reinforces this reflection.

A multivariate model with the share of elderly people and the share of highly educated people does not explain much more variation of the population change in comparison with the bivariate models. Income was a redundant variable and therefore was left out of the multivariate model. If appropriate data had been available on housing and other social phenomena, it is likely that the multivariate model would have been better.

As the Koenker tests were not significant in any of the bivariate OLS regressions calculated, as well as in the multivariate regression model, we can argue that the relationships between the variables analysed do not vary spatially, and that GWR techniques are not appropriate and would not add any relevant information to the study.

It was possible to find evidence of how ageing and the related shift in the demand of services has had an effect on the provision of public local services. At the same time, health centres were opened, while schools were merged or closed due to a lack of pupils. In any case, it is possible to state that the education system is somehow maintained, as a school is only forced to close when it has four pupils or less. Instead of closure, a system of aggregated schools makes it possible to offer an appropriate education service to the most remote and sparsely populated areas.

It has also been proven that tourism is a key variable in explaining the demographic trend of some attractive rural municipalities, creating jobs and attracting immigrants. Surprisingly, the development of tourism has an effect on population change based on the absolute magnitude of its development, and not relative to the municipal population. This is possibly due to the fact that complementary touristic activities tend to be clustered in the main touristic centres of a touristic region. In addition, in a rural area, local services for the population also tend to be located in the main villages.

Unfortunately, the study is not free of limitations. Data on population in Spain are overestimated in the population register, mainly due to the low deregistration rate amongst those foreigners who leave the country. The population register is checked for non-Schengen nationals, who should renew their residence permit every two years. Therefore, further co-operation is needed within the Schengen area. However, Asturias is one of the Autonomous Communities in Spain with the lowest share of foreigners, and its population has slightly decreased during the last 15 years, while in most of the other regions it has largely increased due to immigration. For this reason, we can argue

that the overestimation of the number of immigrants probably does not strongly affect the results in population change and its components in the case of Asturias.

The availability of data has also conditioned the variables chosen as indicators for the social phenomena associated with population decline. The number of construction licenses per 1,000 inhabitants is a clear example of how the availability of data can hamper the analysis, leading to a biased model. Therefore, the results obtained should always be interpreted carefully. These data available have also conditioned the analytic methods used in the study. In this sense, some of the variables were suitable for regression models (ageing, education level, income), while others were not (education and health services). In the case of tourism, its association to population change could not be generalised across the region, and therefore a regression model was not applicable either.

Not only the availability of data, but also its reference date, have influenced the study design and methods. As data referring to several phenomena pertain to different periods, the reference period for the dependent and independent variables has had to be adapted for each regression model.

The municipal definition and boundaries have also influenced the results. We have seen several cases of municipalities with very few inhabitants, whose demographic trend highly fluctuates and largely depends on the period considered. Certainly these characteristics are responsible for the fact that these types of municipalities are usually identified as outliers in the regression models.

In general, it has been possible to find empirical evidence of the theoretical associations between population change and several social phenomena, except in the case of housing due to a lack of appropriate data. Nevertheless, linear regressions have been performed as a sophisticated description and not under strict causality issues. For some social phenomena (education, health care, tourism), the methods used are much less powerful quantitatively, as data were not appropriate for the regression analysis or not possible to generalise.

Indeed, the direction of causality between population change and the social phenomena analysed is not clear from a theoretical point of view. Depending on the context, causality can be in one or the other way. Furthermore, in some cases, population change and some of the other social phenomena analysed may just share common causes, and neither be the cause of the other. In addition, even if causality could be identified under specific circumstances, so many other variables should be taken into consideration, and not only the social phenomena analysed in this study. In the end, it can be said without any doubt that population change, and especially population decline, is a very complex phenomenon.

In any case, most of the theories concerning these associations between population change and several social phenomena, without taking into account causality issues, have been validated in the Spanish context. Nevertheless, we are still very far from developing a general model trying to explain population decline and its relation to different social phenomena. Further research is needed to be able to comprehend population decline better.

Although many Spanish rural areas have experienced population decline in the past, Asturias has been the only region in Spain to decline in population recently. Within Asturias, decline takes place in rural and remote municipalities, but also in mining and industrial middle-sized cities in crisis. For these reasons, Asturias can be considered as a pioneer region experiencing population decline in Spain. This study permits a better understanding of population decline and how society adapts to it. The knowledge gained from this pioneer case study could be applied to develop adequate policies and planning, not only in Asturias, but also in other future declining regions.

The merging of schools is indeed an efficient way to deal with staffing and financial problems derived from a small number of pupils, and it permits to offer education services in remote and sparsely populated areas at a small cost. If we are able to offer education in remote areas at a small cost, it is also possible to offer better health services, as the demand for them increases. This is certainly an example of some of the key ideas that could be learnt on how to deal with unwanted side-effects of population decline. Tourism is also a good way to enhance economic development in rural areas, and moderate or even reverse population decline. Reconversion processes are needed in cities like Mieres and Langreo, still declining, as has happened with the main cities, to be able to generate employment and improve the spatial quality of their neighbourhoods. Investment to enhance career opportunities in rural areas is needed to allow a greater proportion of returnees after the completion of their studies.

The author strongly believes that this thesis provides some light on the importance of the study of the phenomenon of population decline, and how to deal with the unwanted side-effects related to it. Further decline is expected in Europe in the following decades, and the growth trend in Spain has ceased since the economic crisis in 2008. Indeed, the preliminary population figures for January 1st 2013 suggest that the Spanish population has declined for the first time since the modern population register was implemented in 1996. Furthermore, this recent population decline can be observed in all the Spanish Autonomous Communities. In a context of population decline right now in Spain, any study concerning population decline and its scientific and societal implications is of extreme importance.

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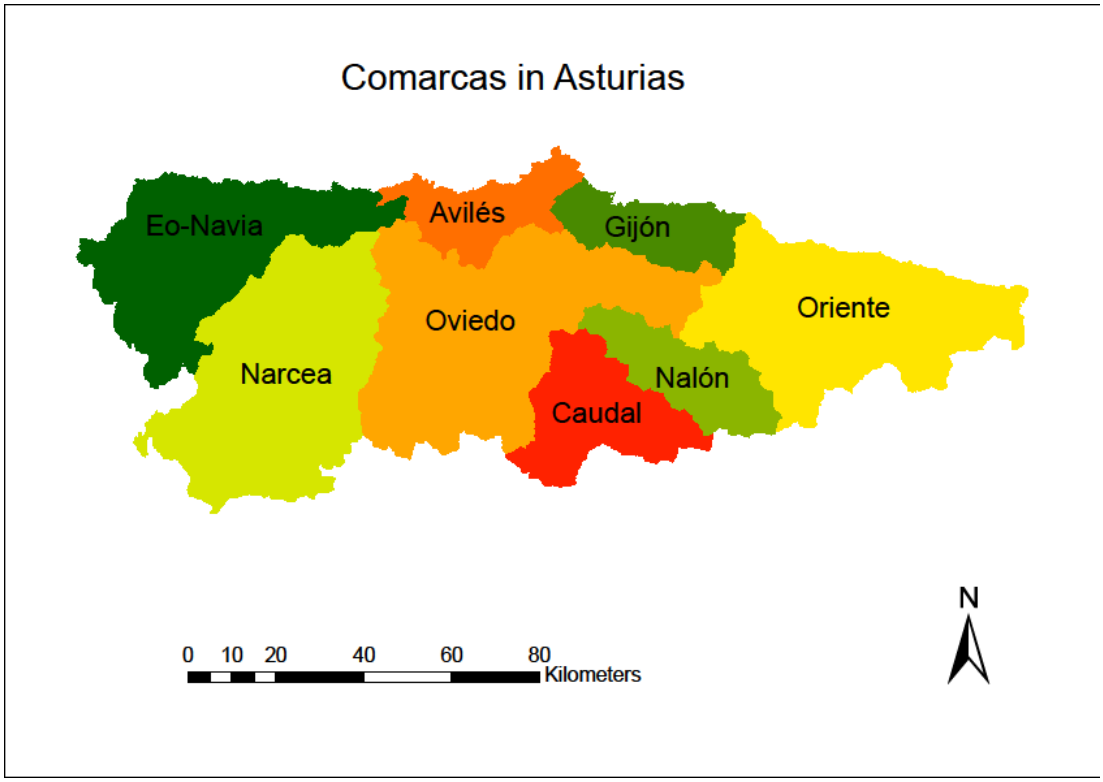
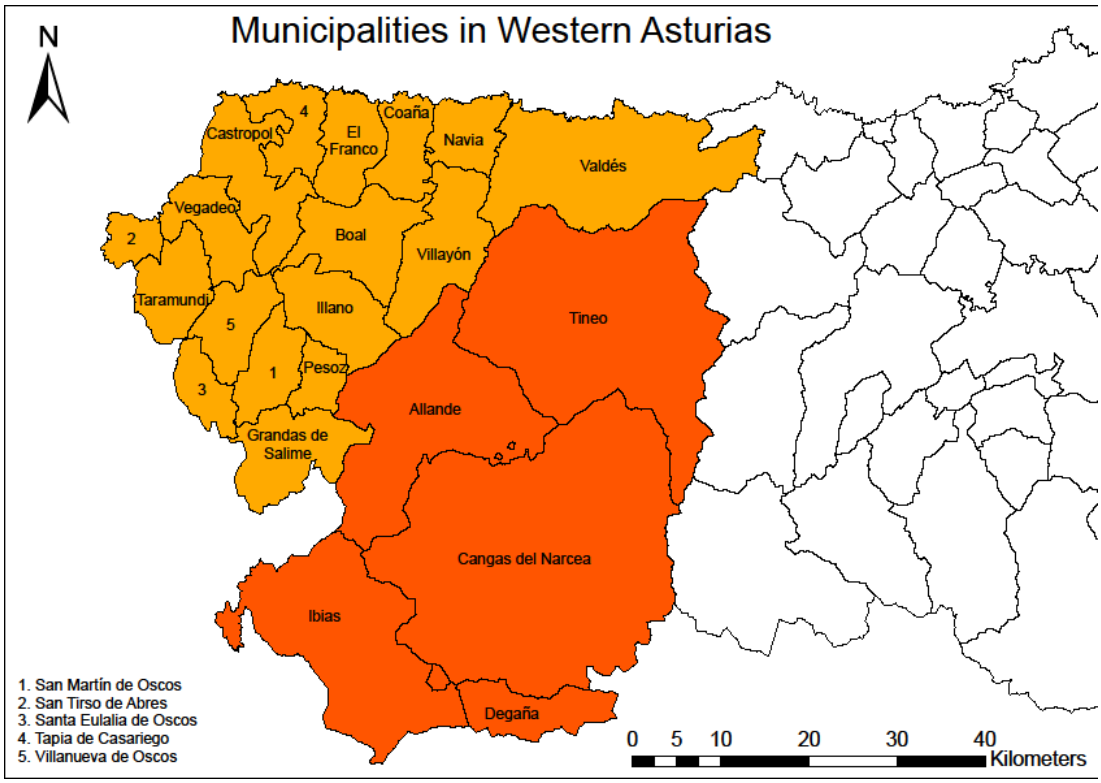
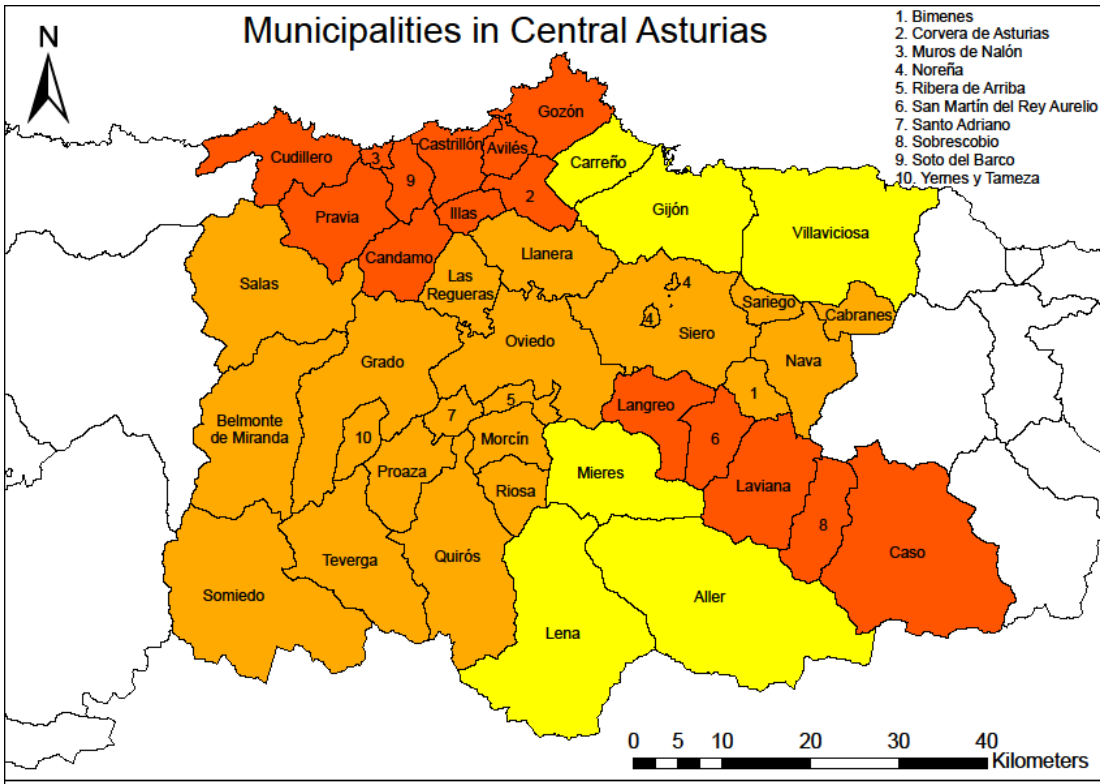
Appendix: maps with the location of the Asturian *comarcas* and municipalities.






Municipalities in Central Asturias
N
1. Bimenes
2. Corvera de Asturias
3. Muros de Nalón
4. Noreña
5. Ribera de Arriba
6. San Martín del Rey Aurelio
7. Santo Adriano
8. Sobrescobio
9. Soto del Barco
10. Yernes y Tameza
Gozón
Cudillero
Castrillón
Avilés
Carreño
Pravia
Illas
Gijón
Villaviciosa
Candamo
Llanera
Salas
Las Regueras
Sariego
Cabranes
Siero
Oviedo
Grado
Nava
Langreo
Belmonte de Miranda
Morcín
Mieres
Laviana
Proaza
Riosa
Caso
Teverga
Quirós
Somiedo
Aller
Lena
0 5 10 20 30 40
Kilometers


Municipalities in Eastern Asturias
N
Colunga
Caravia
Ribadesella
Llanes
Ribadedeva
Cangas de Onís
Piloña
Parres
Onís
Peñamellera Alta
Peñamellera Baja
Cabrales
Amieva
Ponga
0 4 8 16 24 32
Kilometers