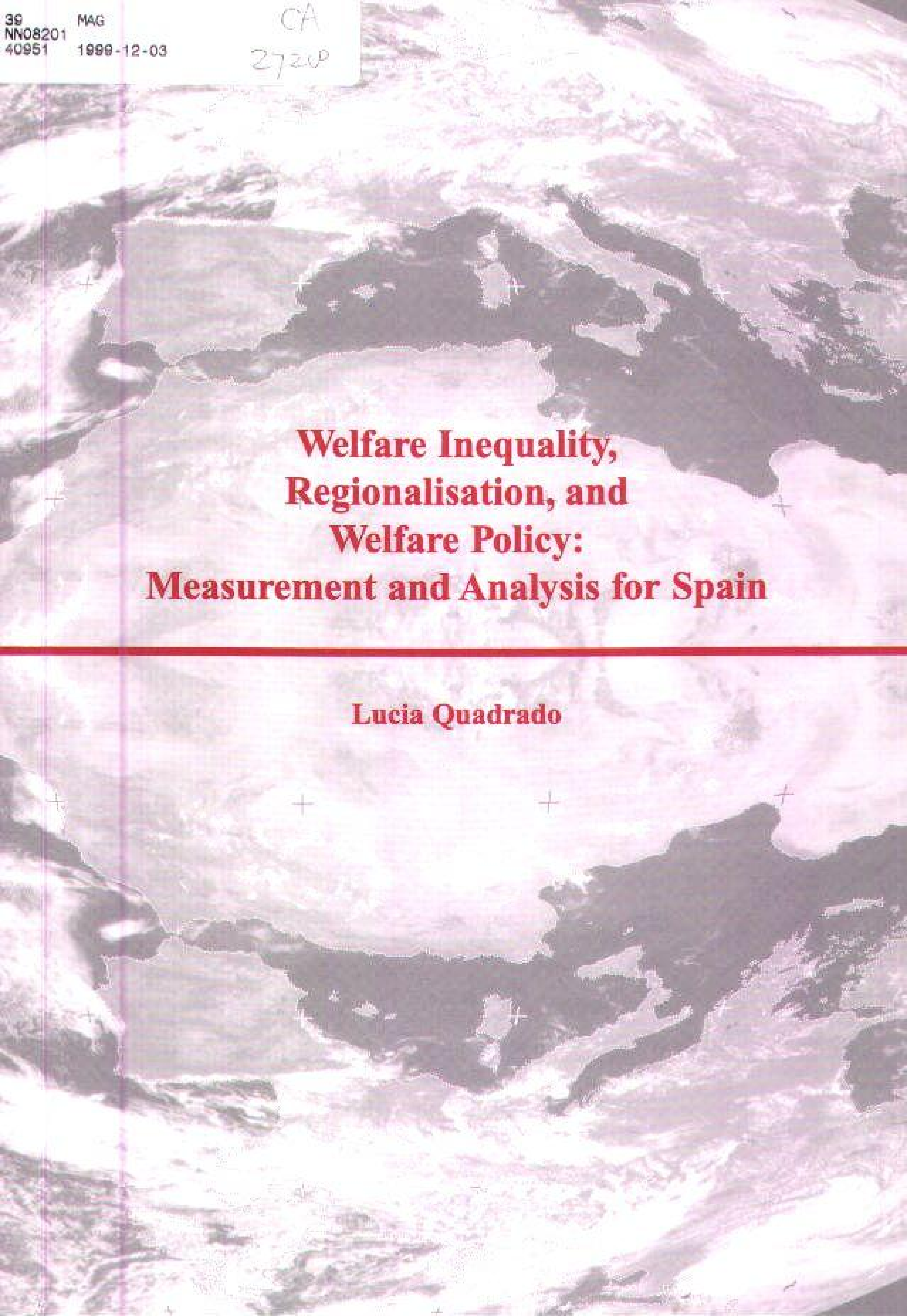

Welfare Inequality, Regionalisation, and Welfare Policy: Measurement and Analysis for Spain

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Welfare Inequality, Regionalisation, and Welfare Policy: Measurement and Analysis for Spain

Proefschrift

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Propositions

1. The setting up of the welfare state in Spain and the social policies have had important consequences for inequality.

2. The extent to which developments in the provision of health care result in improvements in inequality depends on the degree of decentralization of the health system.

3. Neglect of the spillovers with respect to health facilities of provinces or regions results in underestimation of inequality. When contiguity is considered a more accurate picture of inequality is obtained.

4. Too many people use *Principal Components* to study many variables, hoping that putting even more data into an existing algorithm will lead to valid scientific conclusions (Flury, 1995).

5. The measurement of welfare forms the foundation of public policy analysis (Slesnick, 1998). But a full consideration of health care reforms, transfer programs, social security system, education reform, subsidies and enviromental policies must ultimately address the question how these policies affect the well-being of individuals.

6. The excess supply of new Ph.D. economics in the labor market may be corrected by preventing potential candidates from seeing researchers in economics as *scientific heroes slaying great dragons in an exciting intellectual field* (Freeman, 1999).

7. Never later is better but better later than never.

8. If asked to name varieties of mental torture, most scientist would place writing at the top of the list.

9. An economist is someone who would ask a friend to go for lunch by saying: shall we study consumption behaviour and individuals decision making process?

10. Le succès de la plupart des choses dépend de l'appréciation exacte du temps qu'il faudra pour les réussir (Montesquie).

11. Dado que la investigación que he realizado sobre *la inmortalidad del cangrejo*, el *sexo de la gamba albina*, y la *convergencia entre el tomate catalán y el rábano canario* no ha podido ser incluida en esta tesis (por falta de espacio), utilizaré los resultados para publicar un artículo de gran interés científico.

Nunca te entregues
ni te apartes,
junto al camino.
Nunca digas:
No puedo más
y ahí me quedo.

José Agustín Goytisolo

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Over the last five years I have heard that a Ph.D. thesis is like walking in a dark tunnel, raising a child, or sailing a boat in the middle of the sea. I would prefer however defining a Ph.D in a more funny way as "***P.**ermanent **h.**ead **D.**amage*". To all people who have made in one way or another this "damage" less painful, I give my sincere thanks.

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Contents

PART II
RESEARCH METHODOLOGY

PART III
EMPIRICAL RESULTS AND CONCLUSIONS

PART I

WELFARE POLICY AND REGIONAL POLICY

Chapter 1

Introduction

The setting up of the welfare state system in Spain in the mid-seventies has had several consequences for regional disparities. First and foremost, the establishment of this welfare system has ensured uniform social protection to all regions. The government has formulated extensive social policy in order to provide welfare resources also to the lagging regions. Second, the development of the welfare state has involved the devolution of power to regions with respect to welfare issues, although the central government retains control over the remaining non-ceded expenditures and tax revenue power. The other side of the coin is, however, the fact that such a regionalisation process of the welfare state has not been symmetric among all the regions. The nineteen regional governments have now become entitled to legislate and execute welfare programs relating to basic infrastructures (ports, road networks, etc.), housing, environmental protection, and culture development, etc. But only seven out of the 19 regions have gained full autonomy for the two largest welfare expenditure items, education and health. This situation may have some implications for inequalities between regions. The policy approach of regional governments may be quite different from that of the central government. Regional authorities with newly transferred powers relating to welfare issues may be able to respond more quickly to deal with the instability of the welfare system than those regions still dependent on the central government (OECD, 1998). Unless all regions have the same opportunities to operate on the same welfare issues with complete devolution of power, it may be difficult to reduce the gap between the regions.

Policy makers have become more concerned about regional problems since regions play a major role in achieving national goals. So it is important to study more thoroughly what has happened to regional inequality in Spain over the last four decades. In contrast with the old dictatorship system, which did not ensure citizens rights, the welfare state is specifically intended to reduce inequality. Further, the devolution of power over welfare issues to regions may not automatically contribute to regional equality. An additional reason to pay attention to regional disparities is because of the significant role of regional authorities who are responsible for launching the reform of the welfare state in order to achieve the policy goals set by the European Union.

1.1 Changes in the Welfare System in Spain and in the EU.

Low economic growth in this decade has caused significant problems in financing the welfare system. The problem has become more complicated because of the demographic changes, such as the ageing of the population. Further, the new economic and social trends such as persistent unemployment, and the increasing participation of women in the labour force have altered the demand for welfare or the number of people entitled to be supported by the state. So the Spanish welfare system has needed to make some changes to face the severe structural problems caused by the increasing financial burden of the welfare system.

In response to these changes, various significant reforms have been enacted in Spain. These reforms are intended first, to restructure public pensions (the reforms included in the so called *Toledo Pact,* 1997), second, to modify the labour market on the basis of an agreement between trade unions and employer's representatives, and third, to introduce changes in the management of public owned services and the health system. At the regional level, several programmes have already been implemented by some of the regional governments which are taking advantage of the opportunity to launch reforms by themselves without depending on the state's action. For instance, the regions of Cataluña, Andalucía or País Vasco have already enacted reforms to improve the health care system. In the coming years, regions with high levels of autonomy in welfare issues are likely to contribute more to policy making because they will be responsible for modernising the structure of the welfare state.

The changes in the welfare state made by the Spanish government or the regional authorities can be better understood if we look at the changes in the welfare state in Europe. In general, most of the European governments have adopted a protectionist role with regard to the duties of the welfare state. The public bodies have become thus responsible for providing commodities of a redistributive nature (e.g., health or education) in order to achieve citizens equality (Sandmo, 1995). The developments over the last decades in the welfare system has led policy makers and the society in general to consider the welfare state as "*one of the most relevant triumphs of the policy making in the last century*". Today the future of the current welfare policy background is under discussion because the system appears to be very costly and sensitive to many exogenous factors. Public spending for social protection in the European Union[1] (which accounted for 28.5% of the GDP in 1995 (EC 1998a) has to be kept at reasonable levels to assure the continued effectiveness of the policy model. Also, the changing socio-economic context reinforces the risks of running an over-paternalist welfare system. There is a general consensus that there is a need to *renew* the welfare model by adapting the financial and operational structures to the new context.

The Spanish regions have benefited greatly from the regional policy of the European Union. Policy actions within the Union have focused on mitigating existing disparities in order to achieve economic and social cohesion among regions. An important proportion of the EU budget allocated to the structural funds for regional support is intended to help the less-favoured regions to catch-up with the prosperous regions. This fact reflects not only the profound interest in regional policy but also an awareness of the policy issues relating to the effectiveness of the decentralisation process in reducing inequality. Two documents of the EU reflect the foregoing argument. The report of March 1997 "*Modernising and Improving Social Protection in the European Union*" on the contribution

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[1] According to ESSPROS (the European System of Integrated Social Protection Statistics) expenditures on social protection include social transfers either in cash or in kind for welfare and health care purposes.

of social policy for achieving economic and social cohesion in the Member States can be linked to Article 130A of the EC Treaty that emphasises the cohesion goal in reducing regional disparities.

> *"The social policy is important for the social cohesion and for the income redistribution, helps to maintain the political stability and the economic progress in the lives of citizens in the Union. The social protection leads to positive effects in the labour market because the former turns a productive factor (i.e., necessary investment) to launch and sustain the economic growth and performance* " (EC, 1997f).

> *"Community has to strengthen its economic and social cohesion and reducing disparities between levels of development of various regions and the backwardness of the least favoured regions, including rural areas*" (EC, 1997f and Mellors and Copperthwaite, 1990).

1.2 Purpose of the Study.

The present research focuses on a dynamic analysis of inequality in regional welfare. A method for measuring inequality over extended periods of time is developed in the present study and is also applied to a study in the Spanish regions. The analysis is intended to examine the levels and trends in spatial inequality over time. A detailed analysis of regional inequality in Spain is particularly useful for policy purposes. It is of crucial interest from a policy point of view because it evaluates the effects of the social and regional policies before and after the establishment of the welfare system.

Leaving aside the more technical aspects, some remarks are still in order about the various problems that arise in dealing with these research objectives. The most important is perhaps to find an appropriate theoretical measure or index to compute the differences in regional welfare. A closely related problem lies in making welfare comparisons between regions on the basis of a notion of *regional welfare* that is today considered as a sublime mix of characteristics in most of the recent existing literature in this field. The comparison of regions with regard to welfare provision depends on how regional welfare is defined and which indicators are used to describe such a notion. Also, since the regions are not isolated geographical units, interactions between them may alter the inequality. For example, individuals seeking welfare services such as universities or hospitals are often willing to move to neighbouring areas. This situation might modify the availability of facilities of individuals in their own place of residence. In other words, the access to public or private services may improve as a result of the geographical proximity to areas well set up in facilities. Consequently, the distribution of available facilities is not uniform. Up until now, a method for incorporating the possible interaction (between and within regions) that results from individuals commuting (for services) has been only occasionally considered in the literature. This is therefore an issue of interest to study. Summing up, before carrying out any empirical application, we focus on three main methodological issues (which are tackled in the following chapters). First, there is the issue of the working definition of regional welfare used here. Second, on the basis of such a concept, a procedure to measure the regional disparities in welfare is developed. Third, a methodology is developed to take into account the interrelationship between and within regions. We assume that the level of available facilities is co-determined by the facilities of the own province and its adjacent provinces.

Although a more detailed explanation on inequality in regional welfare is provided in the following chapters, it should be noted in this introduction that there is quite a tradition in studying this topic on the basis of regional economic welfare (i.e. regional growth) and regional (un)employment. Hence, regional disparities from an economic perspective are often obtained by computing well-known theoretical indexes such as, Theil's measures, Atkinson's indexes, Gini's index, etc., using indicators of income per capita or unemployment levels for empirical purposes. There are some similarities between the procedure suggested in the present study and the foregoing indexes such as the use of a measure with a theoretical basis to measure inequality. But in contrast with classical indexes, Theil's measures applied here belong to the family of measures of multidimensional inequality. So comparisons are more meaningful since more than one indicator can be included. This is of crucial importance for our research because using only a single unique representative indicator to analyse disparities between regions in terms of welfare is restrictive and simplistic. More comprehensive findings may be obtained by considering various indicators for each welfare issue or the constituent components of regional welfare. A case in point is the demand made upon education services that could be analysed simply using as an indicator the total number of enrolled students in the educational system. Or alternatively, indicators for each educational level (e.g. primary, secondary and university) could be used to determine whether disparities are explained in the same way for all levels.

Previous studies (INE, 1981 and 1991; Pena 1977; Zarzosa Espina, 1996) have used rank orderings of the regions based on an indicator or a composite index of various indicators to draw conclusions about regional inequality. These studies have focused on the application of classical indexes and have used merely income or unemployment as an indicator for inequality measurement. However, this study adopts a different approach in comparison with other works on the measurement of spatial disparities in welfare. Our approach goes further because we develop a method to estimate a measure of multidimensional inequality which can be used for cross-sectional and longitudinal analyses. In particular we focus on the Theil's second measure because it has proven theoretical properties useful for achieving the purpose of this study. Also, the inclusion of the effects resulting from the geographical proximity (*spatial spillover*) is introduced as a possible factor influencing inequality.

Based on the definition of regional welfare, the empirical part of this research focuses on an in-depth analysis of various areas or components of welfare. Our study of regional inequality focuses on health care and health status, the institutional context of education as well as household consumption and housing conditions. This focus is partly because they are included in the definition of regional welfare. Also, the availability of reliable statistical information at the regional level for the period under study is another important reason for this focus. The areas of education and health are extensively studied in the present study. We also explore separately the changes in regional disparities relating to health status and enrollment in education and the provision and spatial organisation of facilities for health and education. This analysis distinguishes thus between indicators related to the demand for welfare services, which reflect individual's status, individual's behaviour according to their preferences and/or budget constraints, and the supply of welfare services, which depends mainly on policy and generally on public provision. This separation of the provision of welfare resources from its consumption is of interest from a policy point of view.

Our study pays particular attention to the statistical problems relating the empirical implementation of the suggested inequality measure. For each welfare area under consideration, we introduce various indicators which are combined into a single index to compute the inequality measure for multidimensional inequality. Although the literature dealing with multidimensional inequality is limited to few works, the main problem is not that of finding an appropriate statistical procedure to compose such an index but rather the actual application of the technique to carry out the dynamic analysis proposed here. This issue, introduced in the field of the Multivariate Analysis, is also investigated extensively.

Thus, the main purpose of the present research is to provide some guidelines about the changes in regional inequality in Spain. In the next chapters, we investigate not only methodological and technical issues but also policy implications which can be derived from an in-depth study of levels and trends in spatial inequality in Spain over the last few decades.

1.3 Organisation of the Study.

This study is organized in three parts. The first part includes Chapter 2 and 3, and deals with regional structure and policy to provide a foundation for the analysis. The second part focuses on the methodology developed in this study and the techniques used for that purpose (Chapter 4). The third part includes all the results of the analysis (Chapter 5, 6, and 7) and the conclusion chapter (Chapter 8).

We begin by discussing the importance of the policy background and the socio-economic context of the inequality changes in Chapter 2. The concept of the welfare state is explained, and its evolution and development in Europe are outlined. The development of the Spanish welfare state is discussed, the trends and pattern of public expenditures in Spain are examined and also it is compared with that in the rest of Europe. The focus is on the changes in the socio-economic and demographic context in Spain. An overview of the decentralisation and regionalisation process in the Spanish welfare state is presented. Finally, the reforms that have taken place in the European Union and in the Spanish welfare state are outlined.

In Chapter 3, we explore extensively the issue of regional policy. In particular attention is paid to the regional policy of the European Union, and Spanish regional policy is described in detail. The notion of region as well as issues related to this are reviewed. The focus is also on the state of regional policy pursued in Europe and in Spain and their relationship. The relevance of the European Union regional policy in mitigating existing disparities between regions is discussed. The rapid development of mechanisms for the regional support of (economically) weak regions has contributed to the reduction of inequality. The European Union's contribution to Spain's regional development is considered. Finally, the state of the regional policy in Spain is analysed in greater detail with respect to the two most important welfare items, health and education.

We develop a method to study inequality in regional welfare in longitudinal analyses in Chapter 4. For this purpose indicators of inequality for regional welfare are discussed. According to the indicators selected in this study, an appropriate inequality measure is selected and the Theil's second measure for multidimensional inequality in particular. A procedure is developed based on the estimation of the Theil's second measure in several periods (hereafter, longitudinal analysis). The discussion focuses on the most appropriate model to estimate the inequality measure from a statistical point of view.

In the empirical part of this study (Part III) we present the results on inequality with respect to several components of regional welfare. We analyse the main changes in inequality in the Spanish regions from the sixties to the nineties. Health facilities and health status are studied separately in Chapter 5. Special attention is paid on health facilities. The discussion is focused on the spatial effects (spillovers) resulting of the contiguity or geographical proximity between geographical units. Also a procedure is developed to incorporate facilities or services allocated in adjacent (neighbouring or contiguous) geographical areas (provinces). This is applied to health facilities in the empirical part of this chapter. Conclusions and policy implications are drawn with respect to the inequality results with respect to health facilities and health status.

The institutional context of education is investigated in Chapter 6. We explore inequality in educational facilities and education enrollment. In the study of education facilities, available facilities refer to services in the own area and those allocated in contiguous areas. The use of several order of contiguity is discussed in order to take into account the changes of the education system. The procedure to incorporate facilities in adjacent areas (developed in Chapter 5) is applied to education facilities. The results in inequality with respect to education facilities are analysed. The institutional context consisting of education enrollment is studied in this chapter. The analysis concentrates on the trends of inequality with respect to education enrollment as well as the relationship between distribution of education facilities and enrollment.

The welfare components most related to household income are studied in Chapter 7. Trends in inequality with respect to household consumption and housing conditions are analysed in this chapter.

In the final chapter the main issues raised in this study are summarised together with the conclusions which have been drawn from the empirical research. Finally, the main suggestions for further research into the measurement of inequality in regional welfare which can be derived from the present study are outlined.

Chapter 2

The Development of the Welfare State in Spain

2.1 The Concept of Welfare State.

The origins of the welfare state can be traced back to the 1930s in the Northern European countries when governments became highly active in the area of social protection and adopted the welfare system. Sandmo (1995) defines the welfare state as a policy making model which provides commodities with a redistributive nature (e.g. health or education) and moreover, gives high priority to equality and individual protection. Roughly speaking, the welfare system is built up on a generic conception of rights. Individuals in democratic societies such as the European ones, actually have *legal rights* to the law and land. But the welfare state also ensured the moral rights that persons should have or believe they are entitled to (Baunh, 1997). The often alluded-to principles of *solidarity, social justice* and *public supervision* reflect both the legal aspects and the moral basis of the welfare state. The *solidarity* principle means that "*nobody should drop below the essential level to achieve a decent existence in a free society*"; *social justice* is concerned with "*the distribution of the incomes and the scarce commodities derived from this system may not arise through arbitrary factors*" and, *public supervision* refers to "*the policy making for attaining maximum employment, low levels of unemployment, full time jobs, etc*".

The traditional version of the welfare state, also known as the Swedish model, involves: (i) an active manpower policy keeping unemployment at a low level (i.e. encouraging full-up employment), (ii) a social security system with an active labour force,

(iii) a large public service sector in the spheres of health, education and personal social services, (iv) significant public regulations and subsidies in particular areas of social interest (agriculture, housing) and, (v) a system of taxation for financing purposes (Olsson Hort, 1997). Since the end of World War II, governments in Western and Southern Europe have gradually adopted the traditional Swedish model as a prototype for social policy. The economic expansion during the post-war period together with policy changes in the sixties and seventies led to the dispersion of the welfare system across Europe.

In this chapter the importance of the policy background and the socio-economic context on the inequality changes is discussed. In Section 2.2, the evolution of the welfare state, and its expansion in Europe is outlined. The development of the Spanish welfare state is presented, and the trend and pattern of public expenditures in Spain are examined and compared them with those in the rest of Europe. In Section 2.3, the focus is on the changes in the socio-economic and demographic context in Spain. In Section 2.4, an overview of the decentralisation and regionalisation process in the Spanish welfare state is outlined. In Section 2.5, the reforms that have taken place in the European Union and in the Spanish welfare state system are presented. A summary of the chapter is provided in Section 2.6.

2.2 The Welfare State: Origins and Development.

2.2.1 Trends in Public Expenditures in Spain and the European Union.

The creation of the welfare state in Spain and other Southern European countries (Greece, Portugal) is more recent. The establishment of an extensive welfare system in Spain of public provision designed for social protection, followed as part of the democratisation process. The 1978 Spanish Constitution set out the legitimisation of the welfare state and ensured civil and moral rights for all citizens. Nevertheless, it is worth noting that although the dictatorship did not guarantee the same underlying principles that democratic systems do (Flora and Alber, 1981), various welfare programs had been launched even as early as in the seventies and were later incorporated into the welfare state system.

It is quite surprising that in just a few years, the structures of the authoritarian government had been replaced by a consolidated welfare state. Already in the eighties, public spending in Spain had expanded up to levels achieved by other countries in a longer period. Table 2.1 shows that total public expenditures in Spain accounted for 22% of the GDP in 1970, and the share increased to above 40% of the GDP in 1990. A catching-up process is observed although spending remains below the average share for the European Community countries (which was 48.7% of the GDP in 1990). The pattern of public spending is also similar, with social expenditures as one of the main items. Social expenditures in the Spanish system increased from 13% of the GDP in 1975 to record levels of about 22% of the GDP in 1990.

Table 2.1. Share of Public and Social Expenditures in the GDP in Spain and the European Community Countries (%).

	Spain				
	1970	**1975**	**1980**	**1985**	**1990**
Public Expenditures[1]	22.2	24.90	33.10	42.60	43.30
Social Expenditures[2]	9.44	12.46	18.38	21.04	21.75
Public Deficit	-	0.00	2.70	6.90	3.9
Public Debt	-	12.9	18.50	38.90	43.1
	European Community Countries				
Public Expenditures[1]	37.0	44.5	45.6	49.1	48.7

[1] *Public expenditures* include social expenditures, public goods, economic services and interest on public debt.

[2] Social Expenditures include old-age pensions, unemployment, sickness and disability, social services, health care, education and housing.

Sources: Pena Trapero (1996), Bandrés Moliné and Sánchez Sánchez (1996).

Spending on welfare programmes has declined between 1990 and 1995 since the expansion of the welfare programmes in the 1980s (Table 2.2). Expenditure on social protection in the EU increased by 4.6% in real terms between 1990-93, followed by a moderate rise of 1.6% between 1993 and 1995. Significant differences are also observed among the European countries. In general, the largest rise corresponds to some Western and Southern countries although there exists also important differences within these groups.

(Two interesting cases are Portugal, which experienced 12% of growth, in contrast with Italy where the level of expenditures increased by only 1.5%.) In Spain, expenditures increased moderately (6.4%) between 1990-93 followed by a slight decline.

Table 2.2 Growth of Expenditure on Social Protection

	Expenditure in Real Terms (adjusted by GDP deflactor) % Change per annum							
	Northern Countries		Western Countries		Southern Countries		Spain	EU13
	Min	Max	Min	Max	Min	Max		
1990-93	6	7	3	8	3	12	6.4	4.6
1993-95	-0.5	0.7	-0.5	7	-1.4	4	-1.4	1.6
1990-95	4.5	4.6	1.5	7	2	8	3.2	3.4

Northern Countries: *Denmark, Finland, and Sweden.*
Western Countries: *Austria, Belgium, Luxembourg, The Netherlands, West Germany, Germany, United Kingdom, and Ireland.*
Southern Countries: *Spain, Greece, France, Italy, and Portugal.*
E13: *All the European countries in the table except for Greece and Sweden.*

Source: EC (1998a).

The crisis of the welfare state began to be an important policy concern as a result of the growing and unmanageable fiscal deficit in the European countries since early in the nineties. Additional problems appeared with increasing unemployment, which caused significant erosion to the tax revenues. Finally, the demand on the public health system from various groups of the population increased. On the one hand, the expansion of medical know-how made costly forms of treatment and diagnosis available to an increasing number of patients. On the other hand, the ageing population phenomenon put much pressure on public health services. In sum, the size of the welfare model developed to unsustainable proportions.

The problem of financial constraints for the public sector involved uncertainty about the future sustainability of the Spanish welfare state as well. The growth of social expenditures caused high cumulative public deficits that accounted for 2.7% of the GDP in 1980 and 3.9% of the GDP in 1990. In addition, as shown in Table 2.1, public debt also expanded dramatically in the same period. The financial problems were reinforced by various exogenous factors (such as high unemployment and ageing population) which affected the welfare state as discussed in Section 2.3 (Bandrés Moliné and Sánchez Sánchez, 1996). These new demands therefore created a need for further reforms of the welfare state (discussed in Section 2.5).

2.2.2 Pattern of Social Expenditures in the European Union.

The most important items of social policy in Europe are similar for all the countries: unemployment benefits, health care and especially old-age pensions. In Table 2.3 we indicate the pattern of expenditures on social protection, with information by country given in Appendix 2.1. The various European countries have been clustered into groups as Northern, Southern and Western countries in order to figure our whether a common trend between the countries exists. In contrast with expectations, pensions and health care represent a major fraction of the expenditures rather than unemployment. The high proportion of expenditure on pensions reflects the impact of the population structure on the welfare system. The growing cost of the health care system and the increase in the number of protected people by the state as a result of demographic changes has contributed to the high proportion of expenditure on health care.

Table 2.3 Expenditures on Social Protection by Function at 1995

	% Total Expenditure							
	Northern Countries		**Western Countries**		**Southern Countries**		**Spain**	**EU14**
	Min	**Max**	**Min**	**Max**	**Min**	**Max**		
Sickness	3	5	320	7	1	5	5.5	4.6
Health	14	17	7	23	20	27	23.7	21.8
Disability	10	15	2	15	6	11	7.5	8.0
Pensions	30	37	5	47	40	63	44.1	42.4
Family and Children	11	12	7	13	2	9	1.8	7.3
Unemployment	11	14	3	17	2	14	13.9	8.1
Housing	1	3	0	7	0	3	0.4	1.9
Social Exclusion	2	4	1	2.5	0	2	0.4	1.6
Administration	1	3	2	4	2.5	5	2.5	3.4
Other	0	0	0	2	0	6	0.3	0.8

There is a small variation in the pattern of expenditures among the three groups (Northern, Western and Southern countries). Old-age pensions and health are the two largest spending items together with other welfare programs such as family and children, unemployment, and disability. There are more interesting differences between countries (Appendix 2.1). For example, in Italy, the share of old-age pensions in total expenditure is the highest (62.7%) compared to that in other European countries such as Ireland (24.9%), Finland (31.8%) or Sweden (36.6%). The lowest share of spending on health (13.8%) is in Denmark, whereas the share in Ireland is 28.3%. Transfers to unemployment are significantly high in Ireland (16.6%), Finland (13.9%) and Denmark (14.3%) and low in Italy (2.1%), Luxemburg (2.9%), Austria (5.4%) and Portugal (4.9%). Country differences within the European Union can be explained by two general arguments (EC, 1998a). First, social expenditure depends directly on economic growth so the capacity to support expenditures is higher for prosperous countries. But there is an additional explanation, and that is related to the social context. The highest levels of social expenditures on old-age pensions correspond to those countries with accelerated population ageing processes. The same argument also serves to explain the differences between the European countries in unemployment.

2.2.3 Pattern of Social Expenditures in Spain.

The public administration during the dictatorship in Spain developed various welfare programs on housing allowances, family subsidies and pensions. An extensive social welfare program was however initiated during the seventies in response to the political duties acquired in the 1978 Constitution. Expenditures in welfare programs in 1990 were higher than ever before accounting for 21.75% of the GDP in comparison with 9.44% in 1970 (Table 2.4). Table 2.4 reveals the expansion of social expenditures between 1970 and 1990.

Table 2.4 Changes in the Pattern of Social Expenditures by Transfer Program in relation to the gross domestic product (GDP). Spain between 1970 and 1990.

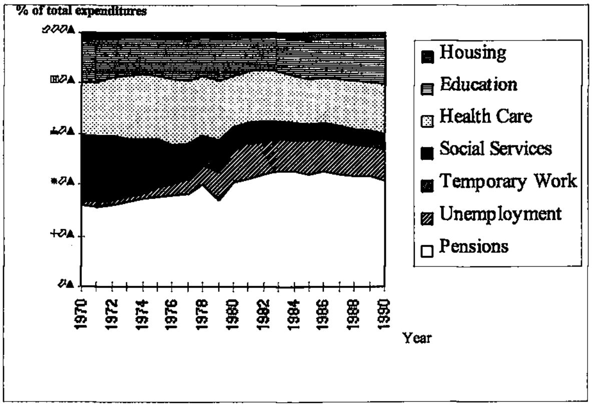
Transfer Programs	Share of GDP			Growth Rate*		
	1970	1980	1990	1970-76	1977-81	1982-90
Pensions	3.00	7.54	9.05	12.40	13.73	4.74
Unemployment Subsidities and Benefits	0.14	2.19	2.54	31.97	38.17	2.67
Temporary Work Injury Insurance and other Sickness Benefits	2.13	1.40	0.93	1.03	-4.00	-0.39
Medical and Health Care	1.99	3.77	4.29	14.53	3.58	4.65
Education	1.48	2.72	3.93	7.90	5.25	9.46
Social Assistance and Social Services	0.34	0.29	0.57	-0.77	2.62	13.09
Housing Allowances	0.36	0.46	0.45	0.44	5.62	4.80
Total	*9.44*	*18.38*	*21.75*	*10.49*	*9.82*	*4.87*

* Cumulative Annual Growth Rate of Social expenditures (constant 1986 prices).
Source: Bandrés Moline and Sánchez Sánchez (1996).

The welfare state policy following democratisation increased the number of people entitled for support in the areas of education, health care, pensions or unemployment. The effects of the changing socio-economic context (detailed in the next section) modified the financial standing of the state welfare (Bandrés Moliné and Sánchez Sánchez, 1997). The budget constraints are reflected in the slower rate of growth of total social expenditures on transfer programs in the period 1982 to 1990 (4.9%) compared to previous decades (10.5% during 1970-76 and 9.8% during 1977-81).

The pattern of social expenditures displayed in Table 2.4 shows the rise of all items between 1977-90 except for temporary work injury insurance which declined by 4% between 1977-81 and by 0.4% until 1990. The decline of this item is explained by a reorganisation of the welfare programs that excluded the parental benefits from temporary work injury insurance.

Figure 2.1 Distribution of the Social Expenditures by Transfer Programs between 1970-90.



Source: Bandrés Moliné and Sánchez Sánchez (1996).

Figure 2.1 shows that pensions, unemployment, health care and education are the most important items of the social expenditures. The remainder of this section focuses on the welfare expenditure items that are the subject of this research work. A discussion of the other welfare items is included in Appendix 2.3.

Education

Over the last few decades the educational system has been rapidly modified according to the underlying principles of the 1978 Constitution. The educational acts *Ley General de la Educación* (*LGE,* 1970), *Ley Orgánica reguladora al Derecho de la Educación* (*LODE*, 1985) and *Ley General de Ordenación del Sistema Educativo* (*LOGSE*, 1990)[2] built up an educational system based on universal compulsory (subsidised)

[2] The most important changes of the educational systems were introduced with the 1970 and 1990 acts. Before 1970, the free and compulsory enrolment at primary and secondary school levels (6 to 14 years old) was not ensured by public bodies. The new educational system however overcomes this problem and moreover, the vocational training was included as a part of secondary school. The 1990 act expanded

education at the primary level. Higher education that is non-compulsory has recently received more attention from the political sphere. First, the *University Reform Act* (*LRU,* 1983) has modified the organisation procedures of the universities[3] and second, the act known as *Decreto 2298/1983* (28th July) has facilitated grants for undergraduate students at lower socio-economic levels.

The effects of better education of the population have been reflected in the fall in illiteracy rates. Other signs of improvement are seen in the increasing primary and secondary school enrolment ratios and the increased numbers of students in university (Analística, 1995). Enrolment at all educational levels has been influenced by the demographic trends of the Spanish population. The impact of educational policies has been reinforced by the population explosion that occurred between the 1960s and the 1970s. As a result of the acquired responsibility of the state for education, public expenditures have been increasing over last decades. The largest increase took place between 1980 and 1990 when expenditures on education increased by 9.46% (Table 2.4). Thus public spending on education has provided financial support for people's education and improvement of human resources.

Health Care

The current health care system does not differ from other perhaps more protectionist ones such as the UK health care system (the British Health National Services). In general, governments in Europe are in charge of public heath care and it is finance by public spending. Around 70% of health care assistance is carried out by the state, in contrast with the US where the private sector carries out almost 50% of this social provision. In the Spanish system, the features of universality and equality are embedded in the system so that the whole population is somehow protected by the public entities. Also,

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compulsory education to children at the age of 6-15 (*Analística,* 1995).

[3] The main aim of the *Ley de Reforma Universitaria* was the organisation of the management of universities giving more power to these institutions to take decisions.

the system is very sensitive to population changes because this determines and modifies the needs of the population.[4] Social expenditure on health care increased by 14.53% between 1970-76, 3.58% between 1977-81 and 4.65% between 1981-90 (Table 2.4).

According to the principles and rights set out in the 1978 Constitution, the *Ley General de Sanidad* (*LGS,* 1986) was established in 1986 to ensure "*an equal access to health facilities and the decrease of inequalities in health*".[5] It is quite surprising that the public health system was not legally stated until the mid-eighties, but as many politicians and researchers point out this act was the final step of a lengthy process to regulate the public health systems.[6] The first system of health care was based on a limited system of public insurance called *Seguro Obligatorio de Enfermedad* (*SOE*, 1944).[7] In 1963 this was substituted by *Social Security* instituted by the *Ley de Bases de la Seguridad Social* (1963). Since then various entities dependent on the Ministry of Health and Consumer Affairs or the Ministry of Labour and Social Affairs administer and manage health and social services. Appendix 2.2 shows the organisation of the public institution or bodies which are responsible for social protection.

Social Assistance and Social Services

Social assistance and social services are intended to provide benefits to people who are too disabled to work, old people at lower economic levels and poor people. In contrast with the foregoing welfare programmes, transfers for social assistance are not an important fraction of the GDP, accounting for 0.57 of the GDP in 1990. Social assistance and social services increased by 13.09% between 1982-90 after a decline of 0.77% between 1970-76

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[4] The ageing of the population on is an example on how demographic changes can put pressure on health services.

[5] In addition to the Ley General de Sanidad, other acts have contributed to the provision of health care services across the country. For instance, the *Decreto sobre Estructuras básicas de la Salud* 137/1984 or the *Decreto sobre Reglamento de la Estructura, Organización y Funcionamiento de Hospitales* 521/1987.

[6] Freire (1993) argues that although the Ley General de Sanidad laid out the structures for health care, the establishment of a universal health care system began with the 1978 Constitution.

[7] The special features of the SOE involved a non-egalitarian situation because the social protection covered the poorest income workers, shutting out the system to the rest of the population.

(Table 2.4). Social assistance has mainly focused on the provision of housing to the people entitled. In addition, specific programmes have been developed for old people's entertainment (trips, day-care centres, etc). Finally, additional programmes have also focussed on specific groups of population such as *Plan Integral para la Infancia* for children, *Plan Gerontológico Integral* for old-age people, *Plan Concertado de Prestaciones Básicas de Servicios Sociales* for poor people and *Ley de Integración Social de Minusválidos* 13/1982 for disabled people.

Housing Allowances

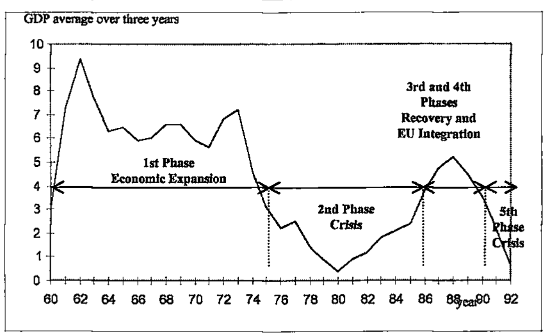
Housing programmes can be described not only as a way of improving citizens welfare but also as a mechanism to regulate the economic system. In the last few decades, changes in the housing market have reinforced the effects of policies to improve economic growth. It is likely that for this reason, the legislation concerning housing allowances is restricted to regulating the conditions of the housing market and to providing fiscal benefits or payments for purchasing houses to people at low-income levels. The acquision of council houses was recently established through the act *Real Decreto sobre Medidas de Financiación de Actuaciones Protegibles en Materia de Vivienda* (RD 1932/1991 20th December). Housing allowances expenditures have grown at 5.62% between 1977-81 and 4.80% between 1982-90 (Table 2.4).

2.3 Socio-Economic Changes in Spain.

2.3.1 Business Cycles in Spain.

The instability of Spain's economy as well as of the world economy and the demographic changes of the last few decades have resulted in the need for significant changes in the Spanish welfare system. In this section we describe briefly the economic and demographic changes that have influenced the welfare state. Figure 2.2 shows the evolution of the business cycle between 1960-92.[8] The first expansive phase dates from early in the sixties to 1975. Economic growth in this period was a result of the structural changes that occurred in 1959 known as *Plan* de *Estabilización Económica*. These reforms implied important progress in the Spanish economic liberalisation for the European markets. The previous economic mechanisms were replaced by liberal policies, thus creating a framework for an economic model based on an exchange market, foreign investments, imported technology, organised productive structure, etc. The second phase reflects the impact of the 1973 and 1979 oil crisis on the Spanish economic system. The effects of the former shock were not manifested until the mid-seventies while those caused by the 1979 crisis prolonged the recession until the eighties.[9] Between 1986-90 economic policy focused on containing the rise in prices and wages, and on improving the production system in order to start the recovery and expansion phases and also to participate in the globalisation process of the European countries.[10]

Figure 2.2 Evolution of the Business Cycle in Spain.



Source: Pena Trapero (1996).

[8] In this section we confine ourselves to describing the economic phenomena introducing those aspects that may influence in the welfare state. García Delgado (1997) provides a more detailed overview of the economic evolution of Spain since the fifties to the nineties.

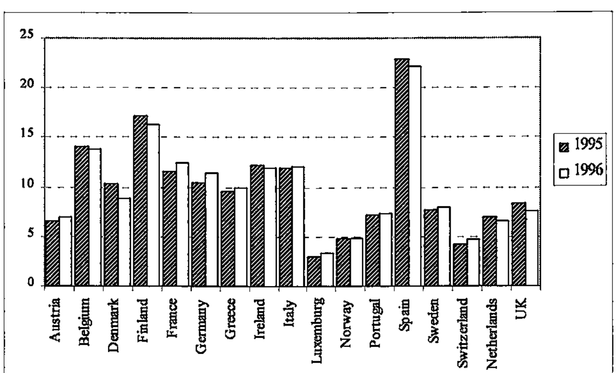
[9] The delay in the impact of the oil crisis was mainly caused by the dependency of the economy on energy products and technology imports from foreign countries (García Delgado, 1997).

[10] Spain joined the European Community in 1986.

The impact of the cyclic economic evolution is reflected in the unemployment rates, computed as the number of unemployed over total population potentially able to work. As shown in Figure 2.3, Spain is today the country with the highest unemployment in Europe. According to the International Labour Office, unemployment in 1995 and 1996 included 24% of the working population, in contrast with the unemployment rate in most of the European countries, which ranges between 5-13%.

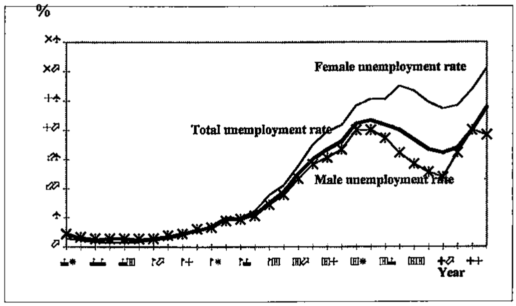
Unemployment is not equally distributed among population groups. A significant proportion of the current unemployed are young people, that is, between 20-29 years, which in 1994 accounted for 41.4% of the total active population (age group 16-64 years). Figure 2.4 shows that the trend of the unemployment between the 60s and the 80s has not varied significantly between the male and female labour force while the gap has widened during the last few decades. Between 1980 and 1993 the male unemployment rates increased from 12% to 20% of the labour force while female rates increased to 31% in 1993.

Figure 2.3 Unemployment in the European Countries in 1995-96.



Source: International Labour Office, 1994-1997.

Figure 2.4 Trends in Male and Female Unemployment in Spain.



Source: Blanes et al, 1996.

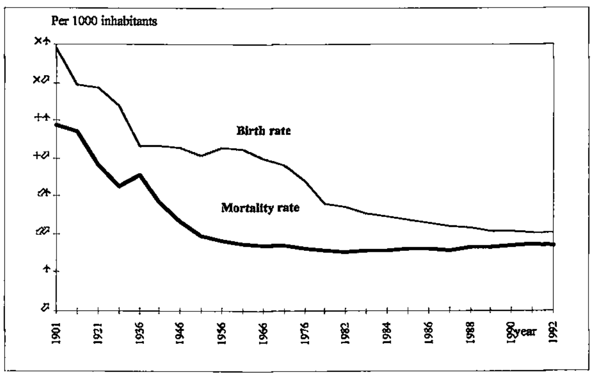
2.3.2 Demographic Changes.

The high levels of unemployment for the Spanish labour force are not only explained by the economic breakdowns but also by the demographic changes. The so-called *population surpluses* and the effects of migration within the country modified dramatically the participation of people in the work force. As Figure 2.5 shows the population in Spain varied as a result of the population explosion known as the *Spanish baby boom* which occurred in the sixties. The birth rate rose to 13 per 1000 inhabitants in 1964 and remained high until the mid-seventies. This development contrasts with the current tendency to ageing of the Spanish population caused by the gradual decrease of the mortality rates together with low population growth rates (1.5‰ in 1991). Several improvements in the citizens quality of life[11] have led to a striking increase in the life expectancy rates between 1900 and 1990, so that the rates rose from 34 to 73 years for men, and from 35 to 81 years

[11] Improvements in biological facilities (technical advances in vaccines and drugs) and socio-economic aspects of citizens (feeding conditions, health care policies, households, economic or educational status) are cited as the main causes of the increased life expectancy.

for women. This poses the question whether the welfare state has been affected by these demographic changes. As mentioned earlier, the evidence in Spain and other European countries has shown that changes in the structure of population alter the number of people entitled to be supported by the state, modify the demand for income transfers or public services, and affect the financial support of the welfare state, that is, the tax-payers.

Figure 2.5 Evolution of Birth and Mortality Rates (1901-1992).



Source: Blanes et al, 1996.

2.3.3 Changes in Employment Patterns.

The impact of the migration of workers from rural to prosperous areas which occurred between the 60s and 70s, is reflected in the changes in sectoral employment. The migrant flows were composed of young and economically active workers with diverse skills who moved to destination areas looking for employment opportunities in the growing industrial and service sectors. The increasing productivity in agriculture caused out-migration from rural to industrial areas. Table 2.5 reveals that the service sector increased from 40.5% to 61.3% in terms of the share of the labour force in contrast with the dramatic reduction of the workforce in the agricultural sector which accounted for 27% of the total labour force in 1970 and 9.5% in 1993.

Table 2.5 Distribution of Employment by Economic Sector. Spain 1970-1990

	Agriculture	Industry	Construction	Services
1970	27.0	24.3	8.2	40.5
1975	21.8	25.1	9.3	43.8
1980	19.2	24.9	8.6	47.3
1985	17.4	23.4	7.0	52.2
1990	11.4	22.8	9.3	56.6
1993	9.5	20.4	8.8	61.3

Source: Pena Trapero (1996).

Some changes in the economic structure have been caused by the increase in the numbers of women pursuing working careers. Total activity rates are defined as economically active people to the population potentially able to work, that is people at the age 16 to 64 years. Activity rates have declined gradually from 51% of the work force in 1964 to 47-48% in the seventies and stabilised to around 50 per cent of the work force in the nineties (Table 2.6).[12] It is interesting to look at the differences in the activity rates for males and females. During the Spanish economic expansion phase, female activity rates reached rates of around 30% of the total workforce while male rates varied little. By the mid-1990s male activity rates remained constant at over 60% of the labour force while female activity rates continued to grow to up to 36%. The female activity rate typically corresponds to employment in specific sectors. Women mainly joined the agricultural and textile sectors during the economic expansion because of their low technical skills and limited work histories. This pattern has already changed with the improvement of the educational levels of women which now makes it possible for women to hold more qualified jobs.

[12] The activity rates in the seventies were greatly influenced by the economic breakdowns and the drop of employment in the tourist trade. Since the sixties, the tourism sector has been of benefit to the Spanish economy. However the economic crisis had an important impact on employment. The revitalisation of international tourism occurred in 1986 and lead to striking improvements in this sector. For instance just the two regions Balearic Islands and Canary Islands accounted for 27% and 13.6% of the GDP respectively (Rodríguez-Pose, 1996).

Table 2.6 Activity Rates between 1964-1994. Spain.

	Total Activity Rate	Male Activity Rate	Female Activity Rate
1964	51.50	83.96	22.93
1969	51.02	81.97	23.16
1974	47.04	79.43	28.99
1979	48.59	71.81	27.25
1984	47.74	69.26	27.74
1989	49.24	66.79	32.92
1994	48.82	62.74	35.80

Source: Blanes et al (1996).

The entry of women into the labour force has had important effects on the changes in population. First, there is an important decline in the fertility rates from 2.8 children to 1.3 per woman (Table 2.7). Moreover the average age of a woman having her first child has increased from 25.1 to 27.2 years. The age of marriage has remained quite steady: it is 27-28 years for men and 25-26 years for women.

Table 2.7 Demographic Changes.

Year	Fertility Rate[1]	Average Age of Woman		Average Age at Marriage (years)	
		Having 1st Child	*Had All her Children*	*Men*	*Women*
1970	2.82	-	29.49	27.25	24.62
1975	2.78	25.10	28.67	26.13	23.97
1980	2.21	25.05	28.20	25.51	23.53
1985	1.63	25.78	28.45	27.00	24.53
1990	1.36	26.79	28.84	27.99	25.64
1991	1.34	27.18	29.07	27.90	25.57

[1] Number of children per woman
Source Blanes et al, 1996.

2.4 The Regionalisation Process in Spain.

Democratisation in Spain has marked an important institutional change for regions because the rights for the establishment of regional governments were stipulated in the

1978 Spanish Constitution. Indeed, such a regionalisation process was intended to create a favourable economic and social environment in the regions. The *Regional State* known as *Comunidades Autónomas* is a decentralised policy model composed of any of the nineteen *Autonomies* or administrative regions consisting of one or several provinces (from a total of fifty-two provinces).[13] The regions enjoy some sovereignty and have their own elected governments and are authorised to legislate and execute policies over various transferred powers. However, the central government still retains control over those matters that affect the whole country (e.g., defence, foreign affairs and justice) and over most of the taxing powers but has transferred some resources to the regions to cover ceded expenditures.

The model of regional autonomy is one of the decentralisation processes that can be found in Europe.[14] Other European countries such as, Germany, Austria or Switzerland have adopted the *federal state* that also involves the devolution of power to the mesolevels of government. The setting up of both regional models is accompanied by the establishment of regional governments and administrative services and the assumption of the so-called *subsidiary principle* among regions. According to this principle the higher level institution (the State or central government) only has power to act if an independent solution is not possible at the lower level (regional authorities). The main difference between regional states and federal systems is that the degree of autonomy in the former policy model is limited to certain issues while in the latter, regions achieve considerable or complete self-government.

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[13] According to Article 141 of the Spanish Constitution, a *province* is a local entity with its own legal personality determined by the collection of municipalities and territorial division for the fulfillment of the activities of the State. Bordering provinces with common historical regional unity may accede to self-government and constitute Regions or *Autonomous Communities* (Comunidades Autónomas) in accordance with Article 2 (Article 143 of the 1978 Constitution).

[14] The devolution of the political power to mesolevels of government in Spain is not an isolated case since this process has spread over most of the European countries. Germany (in 1949), Belgium (in 1970), and Italy (in 1970) have consolidated a full regional level after reinforcing the role of their regions so-called *landers, communities* and *regioni* respectively (EC, 1996a).[14]

2.4.1 The Regions' Share in the Public Budget.

Decentralisation has also involved the expansion of the budget capacity of the Spanish regions. Table 2.8 shows that the regional authorities have gained significant financial power over the total national budget. The regions' share in the public budget has jumped from 0% to 27% of the GDP in the last two decades. The new policy has not modified the situation of the local administrations (i.e. councils) which accounted for 11% of the GDP in 1978 and 17% in 1992. In contrast, the national administration has reduced its financial responsibility from 89% of the GDP in 1978 to 58% in 1992 as a result of the decentralisation process.

Table 2.8 The Allocation of the Public Budget in Spain

	1978	1984	1985	1986	1987	1988	1989	1990	1991	1992
National Administration	89	72.6	70.7	68.7	66.7	61.5	60.7	59.6	58.4	57
Autonomous Communities	0	14.4	15.8	17.2	18.7	22.7	23.1	23.9	25.4	26.6
Local Administrations	11	13	13.5	14.1	14.6	15.8	16.2	16.5	16.2	16.4

Source: Monasterio, 1998.

In recent years public debt in the regions has increased dramatically. During the eighties the economic expansion helped to finance the growing expenditure in the regions which increased from 5 per cent of the GDP in 1986 to 8 per cent in 1993. But the public debt for regions has risen by around 10.2% between 1996-97 while it has grown by 3.8% for the national bodies and decreased by 3.3% for the local administrations (Banco de España, 1997).

2.4.2 Transfer of Power to the Regions.

Regionalisation has contributed to increase the disparities mainly because the devolution of power to regions has not been uniform. Table 2.9 classifies the regions according to the level of access to regional autonomy. According to the 1978 Spanish Constitution the decentralisation process may be accomplished either quickly (Autonomy level = High in Table 2.9) or progressively, with gradual transfer of full autonomy (Autonomy level = Low in Table 2.9). The Constitution does not determine the level of autonomy of each region specifically. The level of autonomy has depended in practise on the interpretation of the strength of local identity (Rodríguez-Pose, 1996). The so-called *historical* regions (Cataluña, País Vasco and Galicia)[15] and the *fueros*[16] became thus entitled to gain full autonomy together with other regions such as Andalucía or Islas Canarias. The remaining regions accomplish the decentralisation process in the long run.[17]

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[15] The term *Comunidades Históricas* or *historical regions* refers to those regions which for reasons of history and language consider themselves to some extent separate from the rest of Spain. They were given a previous independence by the Second Republic (1931-36) that was revoked some years later by the dictatorship (1939). With the transition to democracy more political power were conferred to them.

[16] The *fueros* are economic charters which were granted to some Spanish Kingdoms in the Middle Ages and suppressed in the 18th century. At present, Navarra and País Vasco still keep the privileges conferred in those charters.

[17] The article 143.2 of the Spanish Constitution establishes that "the right to initiate the process towards self-government lies with all the provincial councils concerned or with the corresponding inter-island body and with two thirds of the municipalities whose populations represent at least the majority of the electorate of each province or island. This requirement must be met within six months from the initial agreement adopted to this effect by any of the local corporations concerned". The article 151 states "approval by three quarters of the municipalities of each province concerned, representing at least the majority of the electorate of each one, and ratification of the initiative in a referendum by the absolute majority of the electors in each province." (1978 Constitution, translation extracted from Rodríguez-Pose 1996).

Table 2.9 Access to Autonomy for the Spanish Regions

Type of Region	Autonomy Level	Regions[1]	Provinces
Fueros	High	Navarra	Navarra
		País Vasco	Álava, Guipúzcoa, Vizcaya
Article 151	High	Andalucía	Almería, Cádiz, Córdoba, Granada, Huelva, Jaén, Málaga, Sevilla
		Islas Canarias	Las Palmas, Sta. Cruz de Tenerife
		Cataluña	Barcelona, Gerona, Lérida, Tarragona
		Galicia	La Coruña, Lugo, Orense, Pontevedra
		Comunidad Valenciana	Alicante, Castellón, Valencia
Article 143	Low	Aragón	Huesca, Teruel, Zaragoza
		Asturias	Asturias
		Islas Baleares	Islas Baleares
		Cantabria	Cantabria
		Castilla-La Mancha	Albacete, Ciudad Real, Cuenca, Guadalajara, Toledo
		Castilla-León	Ávila, Burgos, León, Palencia, Salamanca, Segovia, Soria, Valladolid, Zamora.
		Extremadura	Cáceres, Badajoz
		Madrid	Madrid
		Murcia	Murcia
		La Rioja	La Rioja
		Ceuta-Melilla	Ceuta, Melilla

[1]Autonomous Community. *Source*: Rodríguez-Pose, 1996.

The regionalisation process has consisted mainly of giving more responsibilities to the regional authorities over welfare issues. All regions have been entitled to legislate with respect to the so-called *common powers*.[18] But only those regions that have gained full autonomy are empowered to legislate with respect to the items of education and health care. As can be seen from Table 2.10, the regions with low level of autonomy are only responsible for the common powers. But the common powers do not represent an important fraction of the public expenditures. In fact health care and education are the most important items because they account for 82% of total spending, in comparison with the common powers which account for only 18% of total spending.

[18] See Appendix 2.4 for a comprehensive description of State's retained powers.

Table 2.10 Distribution of Power among the Spanish Regions

<table>
<tr><th colspan="2">Type of Regions</th><th>Common Powers Transferred to Regions</th></tr>
<tr><td rowspan="3">151 Article regions

and

Fueros regions</td><td>143 Article regions</td><td>Management, financing, organisation and legislation with respect to:
• Agriculture, Cattle Raising and Fishing.
• Housing and Urban Development.
• Road Networks.
• Ports and Airports for non-commercial purposes.
• Basic Infrastructures for Irrigation, Water Supply, etc.
• Environmental Protection.
• Culture Development.
• Bodies for self-government.
• Tourist Trade and Sports Development.</td></tr>
<tr><td colspan="2">Specific Powers Transferred to Regions</td></tr>
<tr><td colspan="2">EDUCATION
• Management of educational systems (compulsory and non-compulsory education including university).
HEALTH CARE
• Provision of health care services.</td></tr>
</table>

Note. These powers are described in more detail in Appendix 2.4.
Source: Monasterio, 1998.

2.5 The Reforms of the Welfare State in the European Union and Spain.

The reforms of the welfare state are examined in this section. The reforms of the Spanish welfare state fall in line with the EU recommendations to ensure the sustainability of the welfare systems in the Member States. So we discuss first the reforms of the European Union, and then the reforms of the Spanish welfare state.

2.5.1 Reforms Adopted by the European Union.

Faced with the first signs of crisis, the EU governments have agreed to reform the old structures of the welfare system in order to continue providing *some* degree of welfare protection to their populations. It is sometimes difficult to determine to what extent the welfare responsibility devolves to the state or is up to individual citizens. But it is generally agreed that the government should provide at least some social protection for people who are not able to support themselves (by providing some basic minimum level of nourishment, housing, leisure, transport, clothing and education). It is also undeniably true that the state has to reduce somewhat its protectionist role if the welfare system is to be maintained in the long run. The evidence has shown that it is difficult to sustain the system merely supported by the taxpayer.[19] Keeping this in mind, the European governments have set up two policy goals and proposed some measures that are necessary to achieve them.

The first policy goal is to reduce the number of people dependent on the system, particularly people at pensionable age and the unemployed. By encouraging employment, income transfers to unemployed people can be reduced, while cutting back on the early retirement scheme for people between 50 and 64 years will reduce pension transfers, and the promotion of partial retirement will improve job opportunities for youth (EC 1998a). Roughly speaking, the measures to achieve the foregoing policy goals lie in modifying certain conditions of the labour market to create incentives for work. More specifically, the following list of measures has been suggested:

i. *Tightening eligibility for benefit.* It refers to the eligibility requirements such as the period of entitlement, the amount of contribution, etc.
ii. *Strengthening incentives to work.* The aim is to make work more attractive for unemployed people (in-work benefits, part-time jobs, etc).
iii. *Shifting towards more active policies.* Measures to increase employability by creating job-assistance, improving the access to training, providing re-training courses, etc.
iv. *Extending job creation schemes.* The state establishes subsidies to create jobs for certain groups of the unemployed (young people, long-term unemployed workers, etc.)
v. *Reducing dependency and social exclusion.* This refers to the social assistance or payments to people who are unable to work.

[19] Social transfers are subject to a tax or social charges so that the money paid out by the government is returned to tax-payers.

vi. *Helping people with disabilities*. These are programmes to make it easier for disabled people to find a job.

vii. *Reversing the trend towards early retirement*. The state encourages participation in the work force for people over 50 until they reach the official year of retirement.

viii. *Encouraging partial retirement with partial pensions*. People at the age close to retirement can move from full-time jobs to part-time receiving partial pensions.

The second policy goal is to improve the management of public services (schools, hospitals, etc.) and to reduce the costs associated with their provision. Public services play an important role with respect to equality because of their benefits to disadvantaged groups who may not have access to private services. Public services can consequently contribute to individual equality of opportunities. Public services serve also as a mechanism to create job opportunities in the administration and management or in the production of services. Note that the presence of public provision does not exclude private provision of services. The main difference between public and private provision of welfare services lies in the fact that the latter may pursue strategies which may not be consistent with the principles of solidarity and social justice (e.g., user charges, complete privatisation of the management, deregulation, contracting out of services, etc) and its actions are rather limited in comparison with public bodies (Rose, 1989). Up until now private providers and public bodies have operated complementarily within the market offering services.[20] Therefore, individuals have been able to choose freely by themselves between public and private services according to their preferences and budget constraints.

In recent years, as a result of the growth of public service costs, the European governments have made the modernisation and improvement of welfare services in the changing socio-economic context important policy goals. The new approach has involved the adoption of *market or pseudomarket mechanisms*, that is, via privatisation. The new

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[20] A case in point is that individuals will be able to choose their enrolment in private or public universities.

framework distinguishes clearly between the two agents in the market, that is, providers -supply- (i.e., hospitals, schools, etc) and consumers -demand- (i.e., private individuals). Market forces can operate more freely and may have positive effects on the efficiency of public services. Privatisation has however been a controversial issue. One of the main questions is whether the state will retain control over its managed services after privatisation. Greater privatisation for the purpose of increasing efficiency is likely to lead to erosion of the state's *monopolistic* position regarding welfare provision. An additional question, which may perhaps be more interesting, is whether governments are actually avoiding their responsibility regarding basic provision of welfare resources and social protection. Indeed privatisation implies that citizens become merely consumers rather than individuals who are entitled to determine their own public services. These reforms of the public services system have made more room for the private sector to take part in the provision of welfare services. [21] Nevertheless, commercial management does not mean that the welfare system is completely left in private hands or that the state's responsibility to support citizens and particularly disadvantaged groups of the population is removed.

2.5.2 Reforms of the Spanish Welfare State.

A number of major reforms have resulted from the social dialogue in Spain, namely, the pension reforms of the *Toledo Pact,*[22] the labour market reforms, and the new management model for the health care system. The main aim of the government with the reform of the labour market is to foster stable employment by reducing the large number of workers under fixed-term contract. The reforms are also intended to introduce more flexibility into the bargaining process by identifying the most appropriate level of negotiations for specific contract issues. It is expected that these two aims will be achieved

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[21] Just consider, by way of illustration, the recent privatisation of the administration of publicly owned hospitals in Spain where the finance and policy is still controlled by the public sector.

[22] Together with the Toledo Pact the Spanish government also enacted various measures for improving the management of the social protection. These are given in the Appendix 2.5.

after implementing the proposals summarised in Table 2.11.

The Spanish government intends to deal with the financial constraints of the system by enacting pension reform and at the same time trying to make the system more equitable. The measures implemented modify the pension base, the contribution ceilings and the pension rights which are reduced to discourage early retirement. Finally, central and regional governments are in charge of reforming the health care system, focusing mainly on the reduction of pharmacological costs and the privatisation of hospital management in order to improve both the effectiveness and the quality of health care provision.

Table 2.11 Labour Market Reform in Spain: Policy Objectives and Measures.

Proposal	Action
I. Reform employment security provision: a) Reduce the legal minimum severance payments for justified dismissals. b) Ensure that the decisions of the labour courts concerning severance payments conform to the spirit of existing legislation.	a) Creation of a new indefinite contract for targeted groups most exposed to unemployment with reduced severance payments for unjustified dismissals while restricting the use of fixed-term contracts. b) Some clarification in the conditions for fair dismissals.
II. Reform unemployment and related benefit systems: a) Review the eligibility conditions for unemployment assistance benefits. b) Maintain work incentives. c) Review the replacement rates and the maximum duration of unemployment benefits.	a) Reduce fraudulent use of temporary disability benefits.
III. Increase wage and labour cost flexibility: a) Increase the flexibility of working conditions and wages by reducing the range of provisions included in the *cláusulas normativas* and Ordenanzas laborales. b) Take more account of the enterprises' specific situation in collective agreements. c) Abandon automatic index taxation.	a) All *Ordenanzas laborales* have been revoked and contracts are now negotiated within the collective bargaining process. b) New voluntary framework for collective bargaining which proposes decentralisation of wage bargaining to firm or regional level.
IV. Expand and enhance active labour market policies: a) Consider active placement and job search assistance programs as well as workforce or employment subsidies for target groups.	a) Social contribution rates on the new indefinite contract were temporally reduced for targeted groups.
V. Improve labour force skills and competence: a) Enhance the educational attainment of youth cohorts. b) Ensure that vocational education is given appropriate emphasis.	a) Creation of a new contract with training certificate.
VI. Enhance product market competition: a) Restructure and privatise government owned enterprises. b) Lift region's restrictions on shopping hours. c) Reduce the prerogative of the "colegios profesionales".	a) Implementation of the June 1996 modernisation program for public enterprises. b) Two packages of measures liberalising inter alia, telecommunications, electricity and professional services.

Source: OECD, 1998.

2.6 Summary.

Although the Southern European countries were the last to set up a welfare system, there are no significant differences between the welfare systems among the various countries in Europe. The most important expenditure items in the welfare system are the same, and, in addition, the pattern of social expenditures has remained quite similar over the last four decades. Also, the expansion of the welfare system occurred in all the European countries from the eighties to early in the nineties. The consolidation of the welfare state in the Northern countries led these countries to experience earlier the consequences of the crisis of the welfare state. As paradoxical as it may seem, this fact did not serve as a warning to the remaining European countries which developed very costly public welfare systems. All the countries in Europe are now faced with a situation where the sustainability of the welfare state is uncertain. The problems of the welfare state are explained by economic constraints but are also caused by changes in the demographic structure. The European governments have agreed to carry out a common policy of welfare reform to deal with the crisis of the welfare state. Their first policy goal is to reduce the number of people dependent on the system, particularly people at pensionable age and the unemployed. The second policy goal is to improve the management of public services (schools, hospitals, etc.) and to reduce the costs associated with their provision. The reforms of the Spanish welfare state fall in line with these EU recommendations to ensure the sustainability of the welfare systems in the Member States.

Appendix 2.1

Social Protection in Europe.

Expenditures on Social Protection by Function at 1995

	B	DK	D	E	F	IRL	I	L	NL	A	P	FIN	S	UK	E14
							% total expenditure								
Sickness	4.6	3.5	6.9	5.5	3.0	5.6	0.9	2.9	7.1	3.9	2.9	4.0	4.9	3.7	4.6
Health	19.6	13.8	22.9	23.7	24.4	28.3	19.6	20.6	20.4	20.9	26.3	16.7	16.5	21.2	21.8
Disability	6.1	10.3	6.7	7.5	5.6	4.5	6.9	12.7	14.7	7.5	10.7	14.4	12.1	11.4	8.0
Old-age survivors	39.8	36.6	40.8	44.1	40.7	24.9	62.7	43.2	35.5	46.7	38.6	31.8	36.6	38.0	42.4
Family and Children	7.7	12.0	7.2	1.8	8.5	11.2	3.4	12.8	4.4	11.0	5.1	12.9	11.2	8.7	7.3
Unemployment	13.4	14.3	8.8	13.9	7.8	16.6	2.1	2.9	9.6	5.4	4.9	13.9	11.0	5.7	8.1
Housing	0.0	2.4	0.6	0.4	3.0	2.9	0.0	0.2	1.0	0.3	0.0	1.5	3.4	6.8	1.9
Social Exclusion	2.5	4.3	2.1	0.4	1.6	1.8	0.0	1.4	2.2	1.1	0.4	2.0	3.0	1.0	1.6
Administration	4.5	2.8	3.7	2.5	3.8	4.1	3.1	2.8	3.8	2.0	4.8	2.8	1.4	3.5	3.4
Other	1.8	0.0	0.2	0.3	1.5	0.1	1.5	0.6	1.3	1.3	6.3	0.0	0.0	0.0	0.8
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
							%GDP								
Sickness	1.4	1.2	2.0	1.2	0.9	1.1	0.2	0.7	2.2	1.2	0.6	1.3	1.7	1.0	1.3
Health	5.8	4.8	6.7	5.2	7.5	5.6	4.8	5.2	6.4	6.2	5.4	5.5	5.9	5.8	6.2
Disability	1.8	3.5	2.0	1.6	1.7	0.9	1.7	3.2	4.7	2.2	2.2	4.7	4.3	3.1	2.3
Old-age survivors	11.8	12.6	12.0	9.6	12.5	5.0	15.4	10.9	11.2	13.9	8.0	10.4	13.0	10.4	12.1
Family and Children	2.3	4.1	2.1	0.4	2.6	2.2	0.8	3.2	1.4	3.3	1.1	4.2	4.0	2.4	2.1
Unemployment	4.0	4.9	2.6	3.0	2.4	3.3	0.5	0.7	3.0	1.6	1.0	4.6	3.9	1.5	2.3
Housing	0.0	0.8	0.2	0.1	0.9	0.6	0.0	0.0	0.3	0.1	0.0	0.5	1.2	1.9	0.6
Social Exclusion	0.7	1.5	0.6	0.1	0.5	0.4	0.0	0.4	0.7	0.3	0.1	0.7	1.1	0.3	0.5
Administration	1.3	1.0	1.1	0.6	1.2	0.8	0.8	0.7	1.2	0.6	1.0	0.9	0.5	1.0	1.0
Other	0.5	0.0	0.1	0.1	0.5	0.0	0.4	0.1	0.4	0.4	1.3	0.0	0.0	0.0	0.2
Total	29.7	34.3	29.4	21.8	30.6	19.9	24.6	25.3	31.6	29.7	20.7	32.8	35.6	27.3	28.5

B: Belgium, DK: Denmark,D: Germany, E: Spain, F: France, IRL: Ireland, I: Italy, L: Luxemburg, NL: The Netherlands, A:Austria P: Portugal, FIN: Finland, S: Sweden, UK: United Kingdom, E14:All European countries considered in the table except for GR for which there is no breakdown by function. Source: EC, 1998a.

Growth on Expenditure on Social Protection (per cent per annum) at 1995

	B	DK	WG	D	GR	E	F	IRL	I	L	NL	A	P	FIN	S	UK	*E13*
Total Expenditure on Social Protection																	
Expenditure in real terms (ie adjusted by GDP deflactor)																	
1990-93	3.5	5.6	2.9	4.2	na	6.4	4.0	6.5	2.8	8.9	2.8	4.5	11.9	7.3	na	7.6	*4.6*
1993-95	3.5	0.5	2.8	2.9	3.4	-1.4	1.8	7.0	-0.2	4.2	-0.5	3.6	2.1	0.7	-0.5	2.0	*1.6*
1990-95	3.5	4.5	2.9	3.7	na	3.2	3.1	6.7	1.6	7.0	1.5	4.1	7.9	4.6	na	5.3	*3.4*
Change in relative prices (consumer prices relative to GDP deflactor)																	
1990-93	-0.8	0.1	-0.1	0.0	na	-0.6	-0.1	-0.2	-0.3	1.1	0.9	0.0	-0.7	1.3	na	-0.9	*-0.2*
1993-95	0.0	0.1	0.2	0.1	0.4	0.2	0.2	1.7	0.4	-1.1	0.4	0.2	-0.7	-0.8	-0.7	0.7	*0.2*
1990-95	-0.5	0.1	0.1	0.0	na	-0.3	0.0	0.6	0.0	0.2	0.7	0.1	-0.7	0.4	na	-0.3	*0.0*
Expenditure in purchasing power terms (ie adjusted by consumer prices)																	
1990-93	4.4	5.5	2.9	4.2	na	7.1	4.1	6.7	3.0	7.7	1.9	4.4	12.7	5.9	na	8.6	*4.8*
1993-95	3.6	0.5	2.6	2.8	3.0	-1.6	1.6	5.2	-0.5	5.3	-0.9	3.4	2.9	1.5	0.2	1.3	*1.4*
1990-95	4.1	4.5	2.8	3.7	na	3.5	3.1	6.1	1.6	6.8	0.8	4.0	8.7	4.2	na	5.6	*3.4*
Expenditure, excluding unemployment benefits																	
Expenditure in real terms (ie adjusted vy GDP deflactor)																	
1990-93	3.3	5.3	2.6	3.8	na	5.1	3.7	5.6	2.6	8.9	2.5	4.1	11.1	3.5	na	7.0	*4.1*
1993-95	3.7	2.4	3.0	3.7	na	1.3	2.3	6.7	-0.1	4.0	-0.9	3.6	1.9	1.7	-0.2	2.7	*2.3*
1990-95	3.5	4.7	2.8	3.7	na	3.6	3.1	6.0	1.5	6.9	1.1	3.9	7.3	2.8	na	5.3	*3.4*
Change in relative prices (consumer prices relative to GDP deflactor)																	
1990-93	-0.8	0.1	-0.1	0.0	na	-0.6	-0.1	-0.2	-0.3	1.1	0.9	0.0	-0.7	1.3	na	-0.9	*-0.2*
1993-95	0.0	0.1	0.2	0.1	na	0.2	0.2	1.7	0.4	-1.1	0.4	0.2	-0.7	-0.8	-0.7	0.7	*0.2*
1990-95	-0.5	0.1	0.1	0.0	na	-0.3	0.0	0.6	0.0	0.2	0.7	0.1	-0.7	0.4	na	-0.3	*0.0*
Expenditure in purchasing power terms (ie adjusted by consumer prices)																	
1990-93	4.2	5.2	2.7	3.8	na	5.7	3.7	5.7	2.8	7.7	1.6	4.1	11.9	2.2	na	8.0	*4.3*
1993-95	3.7	2.3	2.8	3.6	na	1.1	2.1	4.9	-0.5	5.2	-1.3	3.5	2.6	2.5	0.5	2.0	*2.0*
1990-95	4.0	4.6	2.7	3.7	na	3.8	3.1	5.4	1.5	6.7	0.4	3.8	8.1	2.3	na	5.6	*3.4*

B: Belgium, DK: Denmark, WG: West Germany, D:Germany, GR: Greece E: Spain, F: France, IRL: Ireland, I: Italy, L: Luxemburg, NL: The Netherlands, A:Austria P: Portugal, FIN: Finland, S: Sweden, UK: United Kingdom, E13: All the European countries in the table except for GR and S.

Source: EC, 1998a.

Appendix 2.2 Organisation of the Spanish Social Protection.

Ministry of Health and Consumer Affairs
Ministerio de Sanidad y Consumo

- Health Care

  - National Health Office (INSALUD)
  - Bodies of the Autonomous Regions with transferred powers

  Enterprises: voluntary cooperation in the management of health care

Ministry of Labour and Social Affairs
Ministerio de Trabajo y de Asuntos Sociales

- Unemployment
- Maternity
- Invalidity
- Old Age
- Death and Surviving Dependants
- Family Benefits

  - National Social Security Office (INSS)
  - Firms: volontary cooperation in dealing with temporary inability to work
  - Mutual benefit associations for employment injuries and occupational diseases

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- Employment Injuries
- Occupational Diseases

  - National Social Security Office (INSS)
  - Mutual benefit associations for employment injuries and occupational diseases

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- Unemployment

  - National Employment Office (INEM)

- Social Services
- Non-contributory Benefits

  - National Social Services Office (INSERSO)
  - Bodies of the Autonomous Regions with transferred powers

Autonomous Regions
Comunidades Autonomas

- Minimum wage for Integration

  - Bodies of the Autonomous Regions with transferred powers

- General Social Security Revenue Office= recovery of all contributions, control of affiliation

Source:EC, 1997a. Social Protection in the Members States of the European Union

The responsible bodies or public institutions for social protection are presented in this appendix. Education is not included because the programs are run by the Ministry of Education. The Na*tional Security Office* manages the financial benefits (ie. pensions, permanent and temporary sickness benefits, parental benefits and other allowances and benefits). The *National Health Office* grands benefits both to persons insured in the health insurance funds and to benefits. The *National Social Services Office* has transferred its competences to regions which are the first meso-level government below the State. The social services manage allowances and unemployment benefits not covered by other entities. The *Instituto Social de la Marina* is in charge of the social protection for employees of certain sectors of production such as merchant navy, fishermen and marine shiping. The *General Social Security Revenue Office* as the main source of finances administrates funds and collects the contributions (EC 1997a).

Appendix 2.3

Overview of the Evolution in Welfare Transfer Programmes over the last few Decades.

Pensions for Elderly

One of the most noticeable welfare program is on pensions for old-age. Pensions have become a crucial part of the current public budget accounting for 39.2% of the total social expenditures in 1990. Around 80% of pensions are subsidized by the current *Social Secury System* while remaining pensions for certain employees such as civil servants and war survivors are provided by the comunidades autónomas (Figure 1.6). Pensions support retirement for employees that contributed to the system before retirement. But also some benefits are provided to those people who do not accomplish all requirements. According to *Ley de Medidas Urgentes para la Revalorización de la Estructura y Acción Protectora de la Seguridad Social* (*Ley* 26/1985) pension benefits are transferred to people who have been contributing for at least 10 years to the social security system. As far as the figures on expenditures concerned, they have duplicated in the last twenty years (3% in 1970, 7.54% in 1980 and 9% in 1990 of the GDP). This rise reflects the presure put on the financial budget of the welfare state by the growth in population at pensionable age.

Unemployment Benefits

The unemployment benefits are constrained to elegible workers. A set of qualifiying conditions such as the period of entitlement to insurance benefit determines the eligibility for benefit. The former labour act dates back 1963 that ensured a minimum salary for workers (*Decreto 55* -17th *January*- 1993). But it was not until 1980 that the labour act known as *Estatuto de los Trabajadores* (*Ley 8/1980*) modified the principles of the labour market setting up collective negotiations, number of working days and flexible labour contracts. This act has been reformed in 1984 (*Ley 4/1983*, *Reforma 1984/08)* and in

1994 (*Ley 11/1994*). Workers rights for unemployment benefits and conditions for entitlement were set out in the 1980 act *Ley Básica del Desempleo (Ley 51/1980/10)* and reformed in *Ley de Protección del Desempleo (Ley 31/1984)*. According to the EU changes the recent Spanish policies intend to incentive employment rather than transferring incomes to unemployed (*Ley de Medidas Urgentes sobre Fomento del Empleo y Proteccioón por Desempleo (Ley 22/1992))*. As far as the social expenditures in unemployment benefits is concerned, these accounted for 0.14% of the GDP in 1970 while the rate in 1990 grew up to 2.54% of the GDP.

Temporary Work Injury Insurance, other Sickness and Parental Benefits

Income transfers and benefits for people who find themselves temporary unable to work (e.g., labour accidents or maternity) are supported by the social security system. The system establishes certain conditions for benefit such as the period of receiving support. Two cases in point are the payments for maternity which are constrained to 16 weeks and the transfers for labour disability that are limited to 18 months. Over last the Spanish governments have reduced the public spending on these welfare programs. In terms of GDP the figures for these social expenditures accounted 2.13% in 1970, 1.40% in 1980 and only 0.93% in 1990. One of the explaining reasons of these ongoing constraints is the changes in the policy that tend to act on workers absenteeism and specially workers fraud. Experience has showed that as long as income transfers are more attractive to workers in the sense of they are easier to get workers tend to remain unemployed. As a result the employability of unemployed becomes more difficult and workers are not encouraged to find a job.

Parental benefits is another welfare transfer usually included in this program. As was explained above, most of payments for such a benefit were removed after the establishment of the welfare state. Nevertheless parental benefits have been incorporated to other welfare programs and important improvements have been achieved with the 1985 act *Ley sobre Medidas Urgentes de Racionalización de la Estructura y Acción Protectora de la Seguridad Social* (*Ley* 26/1985 31th July) and the 1990 act known as *Ley de Prestaciones No Contributivas de la Seguridad Social* (Ley 26/1990 20th December).

Appendix 2.4

Breakdown of Powers according to Article 148 and 149 of the 1978 Spanish Constitution.

Article 148 of the 1978 Spanish Constitution. Region's Powers.

The Autonomous Communities may assume powers in the following:

1) organization of their institutions of self-government;

2) alterations of the municipal boundaries contained within its area, and in general the functions which belong to the State Administration concerning local corporations and whose transfer is authorized by the legislation on Local Governments;

3) regulation of the territory, urbanism, and housing;

4) public works of interest to the Autonomous Community in its own territory;

5) railways and highways whose itinerary runs completely in the territory of the Autonomous Community and within the same boundaries and transportation carried out by these means or by cable;

6) ports of refuge, recreational ports, airports, and generally those which do not carry out commercial activities;

7) agriculture and livestock raising in accord with the general regulations;

8) woodlands and forestry;

9) activities in matters of environmental protection;

10) water projects, canals, and irrigation systems of interest to the Autonomous Community and mineral and thermal waters;

11) fishing in inland waters, hunting, and river fishing;

12) interior fairs;

13) promotion of the economic development of the Autonomous Community within the objectives marked by the national economic polity;

14) handicrafts;

15) museums, libraries, and conservatories of interest to the Autonomous Community;

16) monuments of interest to the Autonomous Community;

17) promotion of culture, research, and, when applicable, the teaching of the language of the Autonomous Community;

18) promotion and regulation of tourism within its territorial area;

19) promotion of sports and adequate utilisation of leisure;

20) social assistance;

21) custody and protection of its buildings and installations, the coordination and other functions with respect to local police forces under the terms an organic.

Article 149. State's Powers.

The State holds exclusive competence over the following matters:

1) the regulation of the basic conditions which guarantee the equality of all Spaniards in the exercise of their rights and fulfillment of their constitutional duties;

2) nationality, immigration, emigration, alienage, and the right of asylum;

3) international relations;

4) defense and the Armed Forces;

5) administration of Justice;

6) mercantile, penal, and prison legislation, procedural legislation, without prejudice to the necessary specialties which in this order may derive from the particularities of the substantive law of the Autonomous Communities;

7) labor legislation, without prejudice to its execution by the organs of the Autonomous Communities;

8) civil legislation, without prejudice to the preservation, modification, and development by the Autonomous Communities of civil *fueros*, or special rights, where they may exist; in any case, the rules relative to the application and effectiveness of legal norms, civil-legal relations having to do with the form of marriage, regulation of registers and public instruments, the bases for contractual obligations, norms for resolving the conflicts of laws, and the determination of the sources of the law, in this last case, with respect to the norms of the *fueros* and special law;

9) legislation concerning intellectual and industrial property;

10) system of customs, tariffs, and foreign trade;

11) monetary system, foreign credits, exchange and convertibility; the general bases for the regulation of credit, banking, and insurance;

12) legislation on weights and measures, determination of the official time;

13) bases and coordination of general planning and economic activity;

14) general finance and debt of the state;

15) promotion and general coordination of scientific and technical research;

16) external health; bases and general coordination of health; legislation concerning pharmaceutical products;

17) basic legislation and economic system of social security, without prejudice to the execution of its services by the Autonomous Communities;

18) the bases of the legal system of the public administrations and the statutory system for its officials which shall in every case guarantee that the administered will receive a common treatment by them; a common administrative procedure, without prejudice to the specialties deriving from the particular organization of the Autonomous Communities; legislation on forcible expropriation; basic legislation on contracts and administrative concessions, and the system of responsibility of all public administration;

19) maritime fishing, without prejudice to the competences attributed to the Autonomous Communities in the regulation of the sector;

20) merchant marine and the ownership of ships; lighting of coasts and maritime signals; ports of general interest, airports of general interest, control of the air space, transit and transport, meteorological service and registration of aircraft;

21) railroads and land transport which crosses through the territory of more than one Autonomous Community; general communications system, traffic, and movement of motor vehicles; mail and telecommunications; aerial cables, submarine cables, and radio communication;

22) the legislation, regulation, and concession of water resources and projects when the waters run through more than one Autonomous Community and the authorization of electrical installations when their use affects another community or when the transport of energy goes beyond its territorial area;

23) basic legislation on environmental protection without prejudice to the faculties of the

Autonomous Communities to establish additional standards of protection; basic legislation on woodlands, forestry projects, and livestock trails;

24) public works of general interest or whose realization affects more than one Autonomous Community;

25) bases of the mining and energy system;

26) system of production, sale, possession, and use of arms and explosives;

27) basic norms of the system of press, radio, and television and, in general, of the other means of social communication, without prejudice to the faculties which in their development and execution belong to the Autonomous Communities;

28) protection of the cultural, artistic, and monument patrimony of Spain against exportation and exploitation; museums, libraries, and archives belonging to the State without prejudice to their management by the Autonomous Communities;

29) public security, without prejudice to the possibility of the creation of police by the Autonomous Communities in the manner which may be established in the respective statutes within the framework of the provisions of the organic law;

30) regulations of the conditions for obtaining, issuing, approving, and standardizing academic and professional degrees and basic norms for carrying out Article 27 in order to guarantee compliance with the obligations of the public powers in this matter;

31) statistics for State purposes; and

32) authorization for the convocation of popular consultations via referendum.

Appendix 2.5

List of Measures for the Management of Social Protection in Spain around Mid-Nineties.

Measures for the Management of Social Protection in Spain around Mid-Nineties.

Act	Description
Resolution of 17 January 1996 Royal Decree 94/96 of 26 January Royal Decree 148/96 of 5 February Royal Decree 397/1996	Implementation of new measures for improving the management of the social protection.
Royal Decree 208/96 of 9 February	Adjustment of administrative information services for citizens.
Royal Decree 396/96 of 1 March	Adjustment of the imposition of sanctions
Royal Decree 839/96 of 10 May	Reorganizing of governmental departments

Source: EC, 1997a.

Chapter 3

Regional Policy in the European Union and in Spain

3.1 Introduction.

As explained in the last chapter, in the last few decades Spain has experienced an important shift in the exercise of political power from the central government to the regions. This institutional change has implied that the regional authorities have gained significant power to initiate policies relating to a few economic issues and various social matters. Further, since policy makers in the regions are more concerned about the imbalances affecting the regions, regional policies have become more effective in achieving national or European goals than those pursued by the central government.

The present chapter explores extensively the issue of regional policy. In particular, attention is paid to the regional policy of the EU, and Spanish regional policy is described in detail. In Section 3.1 we review the notion of *region* and introduce the *regional profile* concept as the formal representation of regions. The specific notation of the regional profile is given in Appendix 3.1. In Section 3.2, the focus is on the concepts of *regional policy* and *policy instruments*. The remainder of this chapter is concerned with the state of regional policy pursued in Europe and Spain and their relation. Section 3.3 emphasises the relevance of the EU regional policy in mitigating existing regional inequalities. It is clear that the rapid development of mechanisms for the regional support of weak regions had contributed to the reduction of inequality. Specifically, the EU's contribution to Spain's regional development is discussed in Section 3.3.1, and an overview of the expected changes in current regional policy is presented in Section 3.3.2. Finally, the regional policy in Spain is given in Section 3.4. The two most important welfare items, health and education, are explained in greater detail in Sections 3.4.1 and 3.4.2. A summary of the discussion is presented in Section 3.5.

3.2 Theoretical Framework.

3.2.1 Regional Profile. The Working Definition in the Present Study.

For a long time there has been considerable debate about what is actually meant by a region. Many definitions have been suggested in the literature and various alternatives have been used for different purposes. At the simplest level, for instance, a region could be considered as a mere subdivision of a territory unit or State. Regions as subnational boundaries, could be identified according to their internal homogeneity and their heterogeneity relative to their adjacents with respect to certain characteristics that are demographic accounts (eg., total population, births, deaths, etc.) or language. Also, several regions could be drawn on a map by dividing arbitrarily the territory into several areas.[23] Regions can be classified on the basis of any criteria into groups, such as *lagging* or *motor* regions, which distinguishes between regions with low and high levels of GDP respectively.

The Committee of the Regions of the European Community established in 1994 has put an end to this debate with a now universally accepted definition. In Article 1.1 of the Committee the region is defined as a geopolitical or political-institutional or administrative-territorial sub-national unit with *shared features of a population*. This approach emphasizes regional features like language, culture, historical tradition and interests related to the

[23] Different shapes may be drawn such as rectangles, squares, etc.

economy as determinants that bestow identity to the region.[24] In other words, regions are complex systems rather than simply administrative bodies.

> *"Region shall be taken to mean a territory which constitutes, from a geographical point of view, a clear-cut entity or a similar grouping of territories where there is continuity and whose population possesses certain shared features and wishes to safeguard the resulting specific identity and to develop it with the object of stimulating cultural, social and economic progress".*(EC, 1996a)

In line with this definition, the *regional profile* is used as the theoretical for the notion of region and the measurement of regional inequality framework in the present study. The regional profile is a vector representation of a set of regional features which are combined into the so-called regional subsystem[25] (Hafkamp and Nijkamp, 1979; Folmer,1986; Nijkamp, 1994). Following Folmer and Oosterhaven (1979) we consider four regional subsystems: the demographic, socioeconomic, economic and environmental subsystems. The demographic subsystem encompasses the structure, distribution and evolution of the population. The socioeconomic subsystem is related to individuals welfare in a broad sense.[26]

The present research focuses on the regional sub-profile of the socioeconomic and economic subsystems. The socioeconomic subsystem is defined as *"the degree to which the group is able to realise its goals or identify its needs"* or, what amounts to the same *"the measure by which the group is able to satisfy its needs*" (Folmer and Oosterhaven, 1979). According to Norlen (1977), needs are related to certain areas as a framework for a set of level-of-living components.[27] The economic subsystem includes the factors that affect the

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[24] While there are some similar features among regions, there are also some differences between them. For instance, the regions of Cataluña, País Vasco or Galicia differ from the other Spanish regions in linguistic, cultural and historical peculiarities respects.

[25] At the same time, subsystems are multidimensional in the sense that they are composed of different elements. For instance, the economic subsystem embraces elements such as regional output, investments, unemployment, export and import.

[26] See Chapter 4 for a detailed explanation.

[27] In the empirical part of the present research the areas of health and medical care, schooling and education, living and housing conditions of families will be studied. Other areas suggested by Norlen are

economic activity of a region. Finally, the environmental subsystem comprises of the ecological characteristics.

The formal model suggested in Folmer and Oosterhaven (1979), and used by Nijkamp (1978) and Folmer (1986) to indicate the regional profile for a set of regions is presented in Appendix 3.1. Note that the description of the regional profile introduces two interesting aspects. First, regions in general and the autonomous development of the regional subsystems in particular depend on the interventions of regional authorities and the central government. As was earlier explained in the introductory chapter, the regionalisation process in Spain does not ensure complete devolution of power, with autonomy to legislate and execute limited to certain areas of policy concern. Further, as long as regions are not closed or isolated territorial units, geographical proximity is likely to cause interactions.

3.2.2 *Regional Policy* and *Policy Instruments* Concepts.

The term *Regional Policy* refers to those policy actions by national, regional or local governments pursued to influence the situation of one or more regions (Folmer, 1986). The analysis of the effectiveness of any regional policy, implies, first the determination of the elements or variables which such a policy aims to modify (Folmer and Nijkamp, 1984; Folmer, 1986). This study of the effects of a regional policy is defined as *impact analysis*. The second step is the process of *policy evaluation* in which a comparison is carried out between the impact of the regional policy and a target set in the policy making process.

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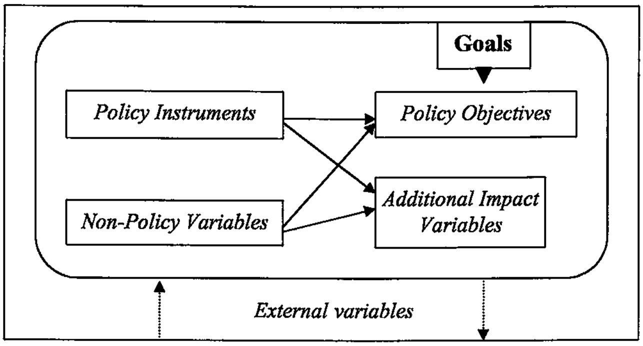
not analysed because of the unavailability of data (e.g., nutrition, leisure time and recreation, working conditions).

Figure 3.1 A Stimulus Response Model for Regional Impact Assessment.



The impact analysis is often represented in a conceptual model known as the *stimulus-response model* (Folmer, 1986). This model for regional policy is composed of a set of variables which are mutually interrelated (Figure 3.1). The *goals* are considered to be the most important variables. In contrast, the *objectives* are variables which reflect the specific and operational aims pursued with the development of a particular regional policy. These concepts can be closely seen in the regional policy developed in the European countries. Many governments pursue *equity* and *efficiency* as the main goals of policy making. *Equity* refers to the distribution of a certain item (e.g., resources, income or public services) so that all individuals in all regions would achieve an equal desired level of welfare.[28] The goal of *efficiency* involves the optimal allocation of resources to promote national welfare.[29] Although these two goals are compatible, they may come in conflict because the net effect of pursuing them at the same time is difficult to determine (Richardson 1979).[30] Such problems may arise with the goals of socioeconomic cohesion

[28] The interregional equity is often measured by means of inequality indexes on the basis of the average income per capita for empirical purposes.

[29] A criterion often used is the maximisation of regional growth represented by the GDP per capita.

[30] See Richardson (1979) for a comprehensive explanation about the equity-efficiency dilemma.

and inequality reduction in Europe. While cohesion is an equity goal,[31] it may affect efficiency because some regions may lose whereas others may benefit from such a policy (Molle and Boeckhout, 1995). In contrast, regional policy is intended to decrease disparities among regions but may alter national growth because of the benefits to the lagging regions.

The *policy instruments* are a set of acts designed by the government either to influence regional economies (e.g., allocation decisions of labour or capital) or to change certain aspects of regions (e.g., level of income or consumption). Policy instruments may be classified as *micro-policy* and *macro-policy* instruments (Armstrong, 1993). Micro-policy instruments act directly on regions. In the next section, the EU micro-policy instruments are explored in detail. Macro-policy instruments intend to expand national policy in order to influence regions, and include depreciation of the exchange rate which benefits exporting regions or regions with high levels of dependency on international trade. The *non-policy* variables influence the policy objectives but they are not regulated by the government. Similarly, *additional impact* variables are distinct variables that may be altered by regional policy although they can not be considered as policy objectives or policy instruments. Finally, although the *external variables* are constant for the policy problem in hand, they may influence other relevant variables and also other variables of the regional policy model may be affected by them. The national rate of interest is an example of an external variable.

3.3 Regional Policy of the European Union and Structural Funds. Implications for the Spanish Regions.

The admittance into the European Community of various Southern European countries, including Spain, with severe problems of regional underdevelopment increased the importance of the solidarity principle. According to Article 130a, the Community was

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[31] One of the reasons that support higher efficiency of national economies after cohesion is that the stability of the exchange rates is guaranteed so that the effects on investments within Europe caused by variations in the exchange rates on the foreign investment will be removed.

obliged to ensure the reduction of disparities and improve the position of the least developed regions. Over the last few decades the European Community (and later the European Union) have implemented the principle of mutual support and common responsibilities among countries by allocating funds to the lagging regions of the member countries. This political effort has helped to redress the regional imbalances within Europe and further has assured the positive effects of the integration.

Policy makers did not pay attention to regional matters until the Single European Act in 1985. (Appendix 3.2 shows the historical evolution of the European Union, which actually dates back much further). This concerted policy for integration of member countries set up the foundations for regional equilibrium: the *cohesion* and *convergence* goals. Socioeconomic *cohesion* is conceived as a goal with a geographical dimension which centers on the reduction of regional inequality. Homogeneity among regions implies reducing regional divergences to socially and politically acceptable levels with regard to income, gross domestic product or unemployment (Molle and Boeckhout, 1995). The *convergence* goal needed to achieve cohesion implies closing the gap between the regions in income per capita or national productivity.

There are large differences in per capita income among the European regions.[32] The gap between the poorest and richest regions remains very wide, because the 25 best-off regions have an income per head around 142% of the EU average whereas the 25 poorest have 55% (EC, 1997f). There also exist important differences in the unemployment rates, with the 25 regions with the highest rates accounting for 22.4% of the workforce in 1993 and the regions with the lowest rates accounting for 4.6%. The European Union has focussed mainly on these differences in per capita income and unemployment in formulating its policies with regard to regional inequality.

The policy instruments that the European Union uses to reduce the regional inequality are the *Structural Funds.* This consists of the *European Regional Development*

[32] The origins of the regional inequality were caused by the structural changes occurred in the fifties and sixties in the Western Europe. Further, the accession into the European Community of less-industrialised countries of the Southern Europe (i.e. Spain, Portugal and Greece) increase the imbalances between the richest and poorest countries. In sum, the gradual decline of the traditional industries of coal or steel and a poor agricultural development went together with the necessity of compensating to the Southern countries for their participation into the community.

Fund (ERDF), the *European Social Fund* (ESF) and the *Guidance Section of Agricultural Fund.* The structural funds focuses on three areas of policy concern: infrastructure (i.e. transport, telecommunication, energy, water supply, environmental protection), human resources (i.e. education, training) and productive investment (investment in R&D, industry). Regions are eligible to be assisted by the structural funds if they come under Objectives 1, 2, 3, 4, 5a, 5b and 6. The Structural Funds have targeted the following objective regions for assistance:

i. ***Objective 1.*** Economic adjustment of regions whose development is lagging behind.
ii. ***Objective 2.*** Social and economic conversion of declining industrial areas.
iii. ***Objective 3.*** Actions to combat at long term unemployment, facilitate the occupational integration of young people and persons exposed to exclusion from the labour market and promote equality of opportunity.
iv. ***Objective 4.*** Adaptation of workers to industrial change by means of measures to prevent unemployment.
v. ***Objective 5a.*** Adjustment of agricultural and fishery structures in the framework of the reform of the Common Agricultural Policy.
vi. ***Objective 5b.*** Economic diversification of vulnerable rural areas.
vii. ***Objective 6.*** Economic adjustment of regions with an extremely low population density.

3.3.1 Spain: One of the Leading Beneficiaries of the Structural Funds.

Since 1988 most of the EU's financial resources in the form of Structural Funds have been concentrated on the less-developed regions in order to achieve the goal of economic and social cohesion. The policy concern about developing policy instruments for funding these regions has greatly increased the aid for Objective 1 regions. Structural Funds aid for Objective 1 was doubled between 1988 and 1992 and almost 93,991 million ECU (at 1994 prices) is allocated for the period 1994-99 (EC, 1995). Eligibility was for the most part limited to regions with a GDP around 75% of the EU average, covering 21.7% of the

Community population. Nearly 70% of the allocations went to countries such as Greece, Spain, Ireland and Portugal.

Table 3.1 shows that the Spanish regions that come under Objective 1 are clearly considered as *priority areas* in comparison with the remaining European countries. Spain is one of the leading beneficiaries for the EU's regional support because of its special characteristics. In comparison with other member countries, it is the fifth in terms of population, and the second biggest in land area and ranks low in terms of per capita income.[33] Since regions qualify as Objective 1 according to their level of per capita income, an important fraction of financial assistance provided by the *European Regional Development Funds* (ERDF) and other European sources (eg *Cohesion Funds*) has gone to many Spanish lagging regions. The lagging regions in Spain include Andalucía, Asturias, Castilla-León, Castilla-La Mancha, Ceuta and Melilla, Valencia, Extremadura, Galicia, Canarias and Murcia. During the period 1994-99 Spain will benefit from the total structural funds to the extent of 27% of the total EU's budget.

Table 3.1 Structural Funds Appropriations for the EU Support Areas Covered under Objective 1 in the Period 1994-99. (Million ECU in 1994 prices)

Member Country	Allocation
Spain	26,300
Greece	13980
Ireland	5620
Portugal	13980
Belgium	730
Denmark	-
Germany	13640
France	2190
Italy	14860
Luxemburg	-
The Netherlands	150
United Kingdom	2360
Austria	162
Finland	-
Sweden	-
EUR15	93991

Source: Official Journal of the European Communities L 280/32. (EC, 1996a).

[33] Ireland, Greece, Portugal and Spain are the member countries with the lowest levels of income per capita.

The structural funds aid to Spain for Objective 1 represents 71% of all assistance to this country in the period 1994-99 and covers 77% of the country. The regional assistance has focused on problems such as deficiencies in education and training, poor productivity and low income per capita. So the aid has emphasized promotion of technical and vocational education and integrating job-seekers as well as human resources in RTD (*Research and Technological Development*), science and innovation and the environment.

Table 3.2 Breakdown of Assistance by Objective and Source of Funding in Spain, 1994-99. (ECU Millions at current prices and share in per cent)

	Total Structural Funds		ESF		ERDF	EAGGF	FIFG
	Allocation	Share	Allocation	Share	Allocations		
Objective 1	26300	82.5	6047	70.4	15944	3314	995
Objective 2	2615	8.2	612	7.1	2002	-	-
Objective 3	1474	4.6	1474	17.2	-	-	-
Objective 4	369	1.2	369	4.3	-	-	-
Objective 5a	446	1.4	-	-	-	326	120
Objective 5b	664	2.1	89	1	161	415	-
Objective 6	-	-	-	-	-	-	-
Total	31868	100	8591	100	18107	4055	1115
Community Initiatives	2660		747		1647	2423	23
General Total	*34528*		*9338*		*19754*	*6478*	*1138*

ESF. European Social Fund.
ERDF. European Regional Development Fund.
EAGGF. European Guidance Section of Agricultural Fund.
FIFG. Financial Instrument for Fisheries Guidance.

Source: EC, 1998b.

Additional aid has been allocated to the Spanish regions through other Objectives and the Community initiatives for employment promotion. Table 3.2 gives the breakdown of assistance allocated to Spain between 1994-99. In addition to Objective 1, Objective 3 has also provided substantial support accounting for 17% of the total ESF allocated to Spain. The regions that have received aid under this objective are: Aragón, Islas Baleares, Cataluña, Madrid, País Vasco and La Rioja. Nearly half of this allocation goes to programs for young people in order to facilitate and improve access to the labour market. Several programs also go to enhance technical and specific vocational training in new employment sectors. Regions under Objective 2 (Aragón, Cataluña, País Vasco, Madrid, Navarra, La Rioja and Islas Baleares) cover 20.3% of the population. These Objective 2 regions have specific problems relating to poor infrastructure, imbalances between the needs of enterprises and the qualifications of workforce, etc. Note that the allocations under Objective 5b (which account for 1% of the total ESF cover 13.5% of the Spanish territory) correspond to just 6% of the population. The rural regions benefited by this objective are rural regions with low population density (less than 20 persons per square kilometer).

3.3.2 Reorganisation of the European Regional Policy.

To conclude this section we mention some possibilities regarding the reorientation of European regional policy. First, it is not clear how the completion of the globalisation and integration of the European countries might alter the power of regions (Saether et al, 1996). The setting up of the *Committee of the Regions* (COR) in 1994 ensures a specific role for the regional governments in decision making. But up until now interventions of this body have been limited to policy recommendations over welfare issues (eg., health, education and vocational training). Second, due to the specific nature of the objectives, the structural policies have focused mainly on a general improvement of regions in economic terms (i.e., infrastructure and economic base). However, ongoing debate suggests that other dimensions should also perhaps considered in order to achieve socioeconomic cohesion. Policy makers also recognise the importance for cohesion of environmental conditions (such as pollution, congestion, land degradation) and natural capital (natural resources). The Community has begun to modify the regional support framework and regional policy on the basis of environmental criteria. This is reflected in the amended Regulation for the 1994-99 Structural Funds which empahasises the compliance of regional support with the Community's environmental policy.

> *"The amended Regulation keeps to the principle of compliance with other Community policies, with particular stress on environmental policy, competition policy, the regulations for the granting of public tenders, and the principle of equal opportunities for men and women".(Article 7)*

An increasing interest in incorporating environmental considerations into structural policy is found in the new regional plans for entitled areas for support in which the environmental situation must be assessed. It is suggested that although the assisted regions are poor or lagging in development from a strictly economic point of view, they may also contribute to cohesion by providing natural resources (EC, 1994; 1996b). So, the chances for alternative economic improvements for the weaker regions lie for instance in reducing the pressures of urban agglomerations, or further, in supplying natural resources to more industrialized regions. As will be explained in the next section, some Spanish regions are examples of regions with potential for development in natural resources.

3.4 The Spanish Regional Policy.

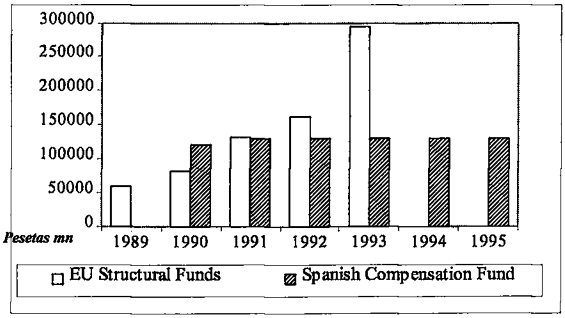
Since the decentralisation process was enacted in the 1978 Spanish Constitution, the public sector has been gradually transferred to the regions. The consolidation of the regional state has increased the power of territorial administrative units in policy making and in welfare issues in particular. It is expected that at the end of this institutional change, the regional authorities will have control over the *common powers* together with the items of education and health care. The process of devolution of power to the Spanish regions has also involved designing a system to finance the regional state which is often described as a complex system (Monasterio, 1998). Surprisingly, regions with similar degrees of autonomy are not financed with a common system whereas some regions with limited and some with full powers avail of the same financial system. Also, the system to finance health care is not unique over all regions and depends directly on the Social Security System instead of the Health Ministry.

Although decentralization devolves the responsibility in certain powers to regions, a sufficient level of resources for the provision of regional public services is ensured by the central government. Additionally, some transfers are intended to focus the regional policy for all regions to achieve a particular national goal while others go to regions to guarantee an optimal level of a transferred service. For the period 1997-2001, the Spanish government and regional authorities have agreed to implement a new regional financing plan which gives more autonomy to regions for tax revenue power and provides compensation to regions against possible revenue shortfalls as well. The regional governments may be able to retain a part of the personal income tax collected for financial their expenditure. (OECD, 1998).

In addition to the foregoing financing system, the Spanish regions also benefit from other specific sources meant to implement the solidarity principle. The 1978 Spanish Constitution (Article 2) guarantees the mutual support among all regions. In response to Articles 157 and 158.2 in the 1978 Spanish Constitution, the *Compensation Funds* (*Fondos de Compensación Interterritorial* or *FCI*) were established as a regional policy instrument for the reduction of per capita income inequalities among regions. Although the Compensation Funds primarily pursued the allocation of funds in the less-favored regions, until the nineties this policy instrument was considered to be a financing system rather than an inequality compensation method in line with the solidarity principle. For that reason a reform of the Compensation Funds was launched in 1990 with Act 29/1990 (December 26) which aimed to limit the transfers for redistributive purposes. This Act distinguished between regions benefiting from the Compensation Funds from those not-entitled for support.

An additional aim pursued by the reform of the Compensation Funds was linking the EU's and the Spanish policy instruments for the reduction of disparities. The reform was intended to join the Spanish regional policy to that of the European Union. As a result, contributions from the Compensation Funds have decreased in favor of the Structural Funds. Figure 3.2 reveals the shift in the financial sources, that is, the dramatic increase of the Structural Funds between 1991-93 and the stability of the Compensation Funds.

Figure 3.2 Evolution of the Structural Funds and Compensation Funds between 1989 and 1995 (Millions pesetas at current prices).



Data for the Structural Funds is available between 1990-93 and for the Compensation Funds between 1990-95.
Source: Monasterio, 1998.

Table 3.3 Distribution of the EU's Structural Funds and Spanish Compensation Funds among the Spanish Regions (%)

	Structural Funds				Compensation Funds			
	1990	**1991**	**1992**	**1993**	**1990**	**1991**	**1992**	**1993**
Andalucía	24.73	17.37	22.68	12.89	39.60	40.02	39.79	39.44
Aragón	2.74	2.86	3.88	2.60	-	-	-	-
Asturias	3.37	7.86	3.56	3.51	0.91	1.52	2.07	2.97
Baleares	0.29	0.79	0.60	0.85	-	-	-	-
Canarias	7.75	9.27	6.65	4.03	8.30	7.82	5.94	3.96
Cantabria	1.44	1.24	0.57	0.51	0.00	0.00	0.00	1.00
Castilla-La Mancha	6.62	7.97	8.07	18.21	9.60	9.55	9.60	8.63
Castilla y León	9.50	11.03	11.65	24.86	6.64	6.40	7.43	8.92
Cataluña	8.71	8.81	7.37	8.13	-	-	-	-
C. Valenciana	7.22	8.85	6.55	4.57	6.03	5.56	5.21	5.10
Extremadura	7.14	9.91	5.42	5.52	8.81	8.65	9.14	9.01
Galicia	11.74	6.62	17.73	9.99	16.20	16.52	17.23	18.24
La Rioja	0.55	0.64	0.63	0.35	-	-	-	-
Madrid	5.34	3.73	2.58	2.00	-	-	-	-
Murcia	2.88	3.06	2.06	2.00	3.90	3.96	3.60	2.73
Total	100	100	100	100	100	100	100	100

Source: Monasterio, 1998.

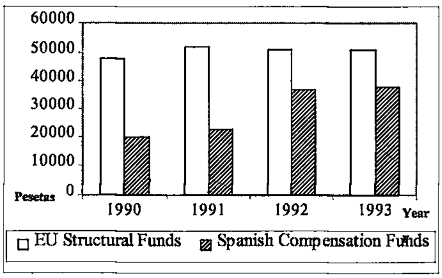
Table 3.3 shows the distribution of the EU's Structural Funds and the Spanish Compensation Funds among the regions which qualified for support. The regions of Galicia (which lies in the north-west of the Iberian Peninsula) and Andalucía (located in the south of Spain) are the two leading beneficiaries. Between 1990-93 around 40% of the total Compensation Funds was allocated to the region of Andalucía and 16-18% to the region of Galicia. The share of the total structural funds allocated to Andalucía and Galicia has fluctuated quite widely between 1990 and 1993.

Due to some common regional features, Galicia and Andalucía have been supported by the Spanish and the EU governments (EC, 1993). Galicia is a region with low-productivity in agriculture, and an industry that is concentrated on weak sectors (e.g., shipbuilding, metalworking and textiles). In addition, per capita income, per capita GDP and unemployment are lower than the national or EU average. Galicia is also considered to be a region with considerable potential for development because it has abundant natural resources, especially in energy and fishery reserves. On the other hand, Andalucía is the region with the largest population, and is one of the biggest regions in Spain. Economic activity is based on a declining agricultural sector, an underdeveloped industrial sector and a growing service sector. In terms of per capita GDP or income, Andalucía is rather below the Community average. An enormous potential of the region is its natural heritage consisting of a nature reserve which includes plains, mountains, forests and wetlands.

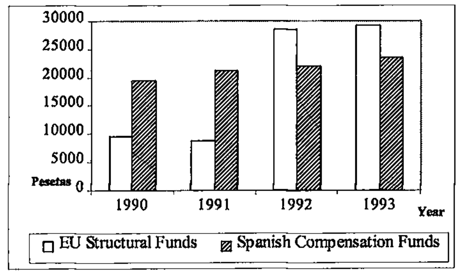
Figure 3.3 shows the trends in the Structural Funds and the Spanish Compensation Funds allocated for Galicia and Andalucía. It is evident in both provinces that there is an increase in the Structural Funds (particularly in Galicia) while there is little change in the Compensation Funds.

Figure 3.3 Evolution of the Structural and Compensation Funds in the most benefited Spanish Regions (million pesetas).

Andalucía



Galicia



Source: Monasterio, 1998.

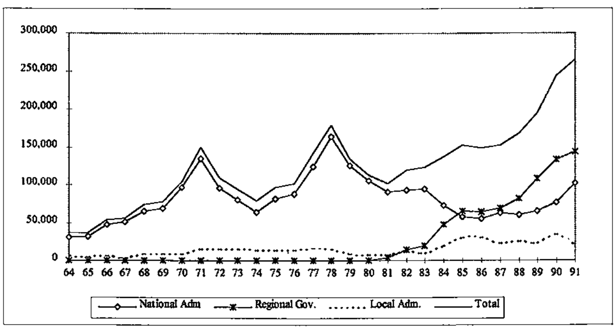
In the next sections we explore some aspects of regional policy relating to education and health care. We focus on these two items because of their importance as the main items in the regional policy (and also because there is not much information about other welfare items) as we indicated earlier.

3.4.1 Education.

Seven regions (Andalucía, Canarias, Cataluña, Galicia, Navarra, País Vasco and Comunidad Valenciana) out of the nineteen that comprise the Spanish regional state have gained power in education. Although this decentralisation has entitled regions to determine education expenditure, the regional authorities' policy actions have been constrained to the general guidelines set out by the Ministry of Education. As a result, the educational regional policy has been developed with differing criteria for the various regions, but with the same underlying norms.

Figure 3.4 shows that the public investment in educational infrastructures has increased primarily in the 80s and 90s. Also, it is clear that the descentralisation has reduced the role of the central government as the main investor, since the investments of the national administration have fallen in favor of an increase in the regional government's investments. The breakdown of public spending by region is shown in Figure 3.5. This figure reveals a tendency for all regions to increase spending on education, particularly between 1987 and 1991. Regions with relatively higher expenditures are Andalucía, Cataluña, and Comunidad Valenciana which are regions where power has been transferred. Madrid is a region with high expenditures, although it is a region where power has not been transferred. On the other hand, in Navarra where power has been transferred, expenditure is rather below that in other regions. The level of expenditures in Castilla-León (power has not been transferred) is similar to that in Galicia or País Vasco (with tranferred powers).

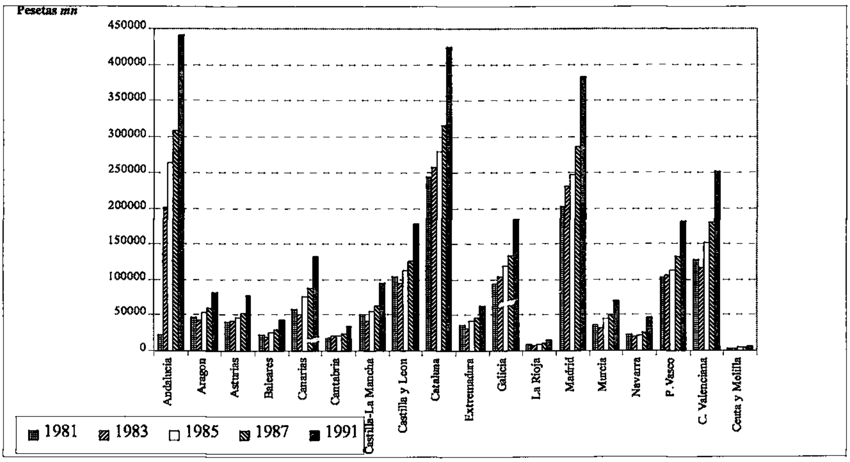
Figures 3.4 Evolution of Public Investment in Infrastructures for Education. (Millions of pesetas at 1990 prices)



Source: IVIE, 1997.

A distinct picture is observed when the regional differences in public spending are analysed with respect to level of spending per student. Thus, the regions of Navarra, Castilla León, Aragón, Cataluña, La Rioja, Galicia and País Vasco have had a level of expenditures above 74.805 pesetas per student in 1980 (current pesetas) (IVIE 1997). So regional differences in public education spending may be due to financial conditions of the education system in each region rather than their autonomy in education powers.

Figure 3.5. Breakdown of Spending in Education by Regions. (Millions of pesetas at 1990 prices)



Source: IVIE, 1997.

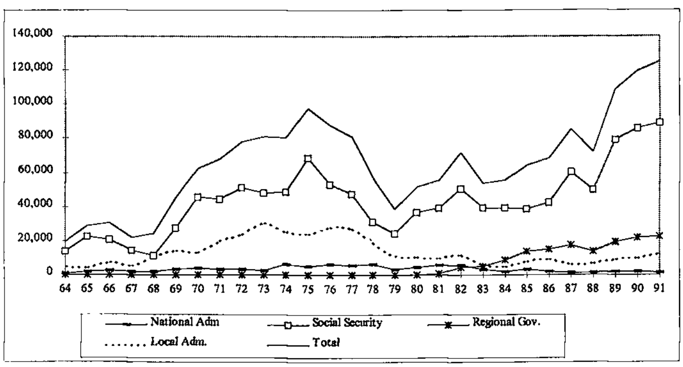
3.4.2 Health Care.

In the introductory chapter we mentioned that the reform of the health system has been initiated by various regional authorities which have accepted the responsibility for their public health care system. The pilot programs fall in line with the agreement between the regions and the Spanish government to reduce costs in management practices in health care centers and public hospitals during the period 1998-2001. In general it is intended to give more emphasis to primary health care, improve the hospital management system, and cut down the expenditure on pharmaceuticals. Cataluña has introduced productivity as a factor to take into account for the remuneration of staff, and further, has introduced considerable flexibility in hiring practices, job contracts and working hours. Andalucía, another region that has initiated reform programs, allows individuals to chose their own hospital, thus promoting competition. In the País Vasco, the health administration has incorporated a reference price system for pharmaceuticals.

If the health system is wholly transferred to the regions, a reform of the financing system will be necessary. However, the power to finance regional health care remains in hands of the Social Security System so that regions with transferred powers acquire only the management of health expenditures. Like education, health care is considered to be a public good dependent on the government's resources. But as OECD (1998) points out, the problem of reducing the cost of health care requires not only the joint efforts of the national and the regional governments, but perhaps also the reorganisation of the financing system.

Figure 3.6 shows the trends in health care investments by public bodies. Due to the characteristics of the financing system, the contribution of the regional governments is rather below that of the Social Security system. Nevertheless, the devolution of power can be seen in the small increments in the regional government's investments since the mid-eighties.

Figures 3.6 Evolution of Public Investment in Infrastructures for Health Care. (Millions of pesetas at 1990 prices)



Source: IVIE, 1997.

3.5 Summary.

Current EU policy and consequently Spanish policies center on mitigating the regional imbalances to achieve the European goal of socioeconomic cohesion. It is clear that the allocation of a significant fraction of the Structural Funds to Objective 1 and 3 regions contributes to economic and social cohesion within the member. Funds directed to Objective 1 regions are intended to narrow the gap in incomes between regions whereas funds to Objective 3 regions provide assistance to combat long-run unemployment. The measures adopted under Objective 3 are linked to social cohesion because unemployment has an impact on society through its wide-ranging effects on health, housing, education and environment. However, policies focusing on employment promotion and related issues tend to facilitate economic cohesion rather than social cohesion. Evidently, employment is a key factor influencing the social goal, but other perhaps more specific factors like housing conditions, education and training opportunities, health or discrimination and lack of integration play an essential role as well.

Appendix 3.1

Formal Model of the Regional Profile.

Let the vector $s_g(t)$ with elements $s_{gk}(t)$ (k=1,...,K) indicates the regional profile of a region g (g=1,...,G) at period t. In addition, the vector $v_i(t)$ with elements $v_{ij}(t)$ (j=1,...,J) contains the variables concerning policy actions. The regional profile is formally described as,

$$s_g(t) = f_1(s_g(t)) + f_2(v_g(t)) \forall t \in N \qquad 3.1$$

$s_g(t)$ is a multidimensional vector state that represents the regional subsystems in the region g,

$v_g(t)$ is a multidimensional vector that represents the policy variables in the region g,

f_1 is a function of the interaction between the elements of the regional profile,

f_2 is the function that represents the impact of policy actions on the elements of the regional profile,

N is a set of positive integers.

The lagged time dependences in both the autonomous developments and interventions are other influential factors on the state of the regional subsystems. The vector state for a regional system is rewritten as in (2.2) by including the time lags as well.

$$s_g(t) = f_1(s_g(t), s_g(t-1), \ldots, s_g(t-T), t) + f_2(v_g(t), v_g(t-1), \ldots, v_g(t-T^*), t) t \in N \qquad 3.2$$

where,

T and T^* are equal time lags.

Assuming that the relationship between functions f_1 and f_2 is linear, the foregoing equation becomes,

$$s_g(t) = A\begin{pmatrix} s_g(t) \\ s_g(t-1) \\ \vdots \\ s_g(t-T) \end{pmatrix} + B\begin{pmatrix} v_g(t) \\ v_g(t-1) \\ \vdots \\ v_g(t-T^*) \end{pmatrix} t \in N \qquad 3.3$$

where,

A ($K \times TK$) is a matrix of coefficients that represents the interrelationships between the elements of the regional profile in the region g

and,

B ($K \times T^{*}J$) is a matrix of coefficients with respect to policy actions.

Next, the spatial interaction among regions is introduced with W, the *matrix of spatial weights*. The equation (3.2) can be expressed as follows,

$$s_g(t) = f_1^{'}(s_g(t), Ws(t), s_g(t-1), Ws(t-1)\ldots, s_g(t-T), Ws(t-T), t)$$
$$+ f_2^{'}(v_g(t), W's(t), v_g(t-1), W's(t-1), \ldots, v_g(t-T^{*}), W's(t-T^{*}), t) t \in N \qquad 3.4$$

At period t,

$f_1^{'}$ is a function of the interaction between subprofiles and $f_2^{'}$ is a function that represents the impact of policy actions on the regional profiles with respect to the region under consideration,

W is a K×(I-1)K *matrix of spatial weights* between region g and other regions with respect to the profile elements. The elements of this matrix w_{gh} correspond to each pair of regions gh. The non-zero elements of this matrix reflect the spatial interaction between two regions. W' is a J×(I-1)J matrix of spatial weights with respect to the policy variables.

Since is assumed that $f_1^{'}$ and $f_2^{'}$ are linearly related, the equation (3.3) can be rewritten as follows,

$$s_g(t) = A^{'} \begin{pmatrix} s_g(t) \\ Ws(t) \\ \vdots \\ s_g(t-T) \\ Ws(t-T) \end{pmatrix} + B^{'} \begin{pmatrix} s_g(t) \\ W^{'}s(t) \\ \vdots \\ s_g(t-T^{*}) \\ W^{'}s(t-T^{*}) \end{pmatrix} t \in N \qquad 3.5$$

where,

A' and B' are $K \times T(I\text{-}1)$ and $J \times T^{*}(I\text{-}1)J$ matrices of interaction and impact coefficients respectively.

The state vectors for a set of regional systems at period t can be combined in the multidimensional matrix U. This is the formal representation of the *multiregional system* under consideration, that is, the set of G regions (g=1,...,G). Each column of the matrix U

contains the regional subsystems observed, whereas each row represents values of regions of each subsystem.[34] The matrix representation of U is,

$$U = \begin{array}{c} \\ 1 \\ \vdots \\ I \end{array} \begin{array}{c} \begin{array}{cccc} u_D & u_S & u_E & u_N \end{array} \\ \begin{pmatrix} u_{D1} & u_{S1} & u_{E1} & u_{N1} \\ \vdots & \vdots & \vdots & \vdots \\ u_{DG} & u_{SG} & u_{EG} & u_{NG} \end{pmatrix} \end{array} \tag{3.6}$$

where the matrix U at time t has been subdivided into the four subsystems under consideration. The regional profile depends on four regional subprofiles, that is,

u_{Dg}: regional sub-profile of the demographic subsystem for the region g,

u_{Sg}: regional sub-profile of the socioeconomic subsystem for the region g,

u_{Eg}: regional sub-profile of the economic subsystem for the region g,

u_{Ng}: regional sub-profile of the environment subsystem for the region g.

[34] A dynamic version of the matrix U can be also formalised if the multiregional system is considered over time.

Appendix 3.2 The Road to European Unity.

After the second World War the governments in Europe encouraged economic and policy revitalisation by undertaking initiatives to bolster the solidarity among countries but did not pay any specific attention to regions or to regional matters. The *Treaty of Paris* (established in 1951) and the *European Economic Community* (signed in Rome in 1957) pursued national growth by encouraging international cooperation between the European countries. The treaty of Paris stated as its main political goal, "the contribution to the expansion of the economy, the development of employment and the improvement of the standard of living in the participating countries" (Treaty of Paris, *article* 2).

On the other hand, the goal of the treaty of Rome was "the establishment of a Common market and a progressive approach of the policies of Member States, to promote throughout the Community a harmonious development of economic activities, a continuous and balanced expansion, an increased stability, an accelerated raising of the standard of livings and closer relations between its Member States" (Treaty of Rome, *article* 2). Indeed, the *Treaty of Rome* established the foundations for the liberalisation of trade: the elimination of barriers, tariffs and quotas within the member countries of the *Common Market*. Nevertheless, this first attempt to integrate the European economies failed because the policy focused on the strict protection of member countries and failed to take advantage of the elimination of obstacles between countries. According to the White Paper (1985) the common market failed due to the following reasons:

a) Customs delays and the administrative charges weighting on intra-Community trade.

b) Differences between plant-health and veterinary standards, necessitating checks at borders, the formalities carried out at borders for statistical purposes.

c) National differences in technical rules for standards for industrial purposes.

d) Lack of openness of public contracts to foreign suppliers.

e) Restrictions on the freedom to provide certain services, in particular financial services, and on freedom of establishment with regard to certain activities, differences between the rates of VAT and the excise duties, governed by the "rule of destination" and which had to be adjusted at the border of the member countries of destination.

f) Application of monetary compensatory amounts to inter-Community trade in certain agricultural products in accordance with the rules of the common agricultural policy.

g) Road transport licences and the checks on the conformity of vehicles with the various national regulations.

An internal market was finally consolidated in the *Single European Act* (Milan 1985) which came into force on July 1st of 1987. The so-called *Single European Market* (SEM) became a strong policy for the integration of the member countries.[35] More recently, the *Treaty of Maastrich* (1992) has established the creation and completion of the *Economic* and *Monetary Union* (EMU) in early 1999.[36] The EMU is characterized by the adoption of a single currency and the statement of a common monetary policy through the creation of a European Central Bank.

However, the idea of integrating the European countries can be traced back to a long time ago. In this Appendix we reproduce the "Road to the European Unity" extracted from The Wall Street Journal Europe (Monday January 4th of 1999).

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[35] The main objectives of the *Single European Act* are summarised as: the removal of physical and trade barriers, the liberalisation of capital flows, common transport and services markets, the harmonisation of the tax-systems, wide harmonisation of procurement standards and introduction of equal conditions of competition for European companies.

[36] The treaty of Maastrich (1992), that was ratified by all member countries of the European Union, established a set of requirements for the eligible countries in the EMU. The requirements to be satisfied are the following: convergence criteria for inflation, interest rates, exchange rate stability and public finance.

The Road to European Union

476
Fall of Roman Empire in western Europe.
800
Carlomagne crowned as Holy Emperor.
1517
Luther posts his 95 theses, starting the Reformation and dividing Europe along religious lines.
1531
Opening of Antwerp stock exchange, the world's first.
1618-1648
Thirty years War devastes central Europe.
1789
French Revolution sparks revolutionary sentiments across Europe.
1806-1812
Napoleon unites Europe into an economic zone called the Continental System. Britain excluded.
1848
Revolutions sweep Europe.
1870
Franco-Prussian War
1914-1918
World War I. Estimated 10 million dead.
1939-1945
World War II. Estimated 45 million dead world-wide.
1946
Winston Churchill calls for a United States of Europe.
1951
Treaty of Paris joins Belgium, France, the Federal Republic of Gernmany, Italy, Luxemburg and the Netherlands in the European Coal and Steel Community.
1957
Treaty of Rome creates the European Economic Community, or EC, establishing a common market among the same six countries.
1961
Charles de Gaulle blocks British entry into the European Community
1968
Workers guaranteed the right to work anywhere in the community
1972
An agreement known as the snake restricts currency fluctuations among member countries.
1973
Denmark, Ireland and the United Kigndom allowed to join the EC.
1979
European Monetary System goes into operation, aimed at closer monetary coordination. First direct elections for European Parliament.
1981
Greece joins EC.
1986
Spain and Portugal join.
1989
Berlin collapses, giving urgency to the creation of a common currency as a way of uniting Europe.
1990
Schengen Agreement eliminates border checks. Takes effect five years later.
1992
Maastrich Treaty paves way for monetary union, with Helmut Kohl and Francois Miterrand in the lead. European Economic Community takes the name European Union.
1995
Austria, Finland and Sweden join the EU.
1995
Euro is selected as name for the new currency.
Jan. 1, 1999
Euro launched for non-cash transaction.
Jan.1, 2002
Euro notes begin circulating.

PART II

RESEARCH METHODOLOGY

Chapter 4

The Measurement of Spatial Inequality in Regional Welfare

4.1 Introduction.

The theoretical framework used in the present study is based on the regional profile and we study regional welfare in particular (socioeconomic system). The general notion of welfare refers to individuals' welfare if it defines "*the degree to which the needs on constituent components of welfare are satisfied*"(Folmer and Oosterhaven, 1979). The concept is linked to a group (region or country) if welfare for that collective is *not* the aggregate of individual welfare. Collective welfare is thus defined as "*the degree to which the group is able to realise its goals or identify its needs*". An alternative definition is "*the measure by which the group is able to satisfy its needs on constituent components*". *Constituent components* are indirect indicators used to measure welfare such as health and medical care, schooling, employment and working conditions, economic resources, childhood and family conditions, housing conditions, nutrition, leisure time, and recreation (Norlen, 1977).

In the empirical part of the present study, an in-depth analysis of the various constituent components of collective welfare is carried out. In particular, the following components are examined:

- *Health and Medical Care.* This component encompasses the provision of health care in terms of utilization of health care services, resource allocation for primary and other health care, etc, as well as health status morbidity, mortality, etc.

- *Learning and Education.* This component refers to education facilities (staff, available resources) and education enrollment.
- *Household Consumption.* This component represents the basic consumption of households or basic needs (food, clothing, shelter, etc).
- *Housing Conditions.* This constituent component includes indoor amenities and access to outdoor amenities.

The empirical research presented in Chapters 5 to 7 consists of a study of inequality for the four welfare component described in this section. So inequality is measured using several indicators so as to capture the multidimensional nature of these components.[37] Inequality is investigated taking into account different views of both health and education welfare components. The notion of health refers to health status in the same sense of the effects on patients. Another approach to health is the organization of health services. Health facilities contribute to improve health after the onset of disease and through prevention. The notion of education can be viewed as a resource component, that is, it covers the organisation of the educational services. The other view of education is education enrollment or students registered in education institutions. The study of health status and education enrollment reveals differences in the decision-units (individuals) while the analysis of facilities in health or education shows the differences in the provision of resources.

This chapter is concerned with the method used to study inequality in regional welfare in longitudinal analysis, which is applied in the empirical part of this research. The remainder of this chapter is organized as follows. In Section 4.2, the indicators of inequality are discussed, in particular the use of economic measures such as per capita income. In Section 4.3, Theil's second measure for multidimensional inequality is presented. A description of this additively decomposable inequality measure is provided in Section 4.3.1. The reasons for selecting the Theil's second measure are enumerated in Section 4.3.2. Section 4.4 introduces methodological issues related to the procedure developed to estimate the composite index. This index is used to obtain the Theil's second inequality measure for the various welfare components. The estimation of the composite index is based on the

[37] For example, as explained in Chapter 5, the indicators used for health status are registered diseases records and mortality indexes.

weights associated with the indicators of the welfare component obtained using *Principal Common Principal Component* (PCPC) in longitudinal analysis whenever is appropriate or Principal Component Analysis (PCA) otherwise. PCPC is discussed in Section 4.4.1. The discussion focuses on the estimation using classical Principal Component Analysis (PCA) in Section 4.4.2. In the present study the latter is applied when PCPC is not appropriate. PCA has been applied for longitudinal analyses using Theil'second measure of multidimensional inequality (Maasoumi and Jeong, 1985; Maasoumi and Nickelsburg, 1988; Zandvakili, 1992, 1999). Section 4.4.3 describes the transformation used to consider the positive or negative sense of indicators. Section 4.5 describes in detail the procedure developed to obtain Theil's second measure in this study consisting mainly of the estimation of the composite index. Finally, the main aspects studied in the present chapter are outlined in Section 4.6.

Several appendices provide more comprehensive explanations on issues developed in this chapter. Appendix 4.1 describes the functional forms for a composite index developed by Maasoumi (1986) including the one used in the present study. In Appendix 4.2 the main theoretical aspects of PCA are outlined and those of Flury's approach are given in Appendix 4.3. Finally the estimation procedure of standard errors of common principal components is introduced in Appendix 4.4.

4.2 Indicators of Inequality: Choice of Variables.

Much of the theoretical and empirical studies of inequality have been restricted to using strictly economic indicators of inequality. But researchers have strongly criticized these approaches. An important conceptual problem arises when the economic variables used are measured in per capita terms (e.g., income per capita, personal income, etc) because inequality is constrained to the analysis of between-group differences (inter-regional inequalities), and within-group comparisons (intra-regional inequalities) are not taken into account. Also, it has been shown that the distribution of spatial inequality is highly dependent on the variables used for the analysis. For instance, Bradfield (1988) and Davezies (1992) show that different results are obtained by using income per capita or personal disposable income per household as the inequality measure.

An additional problem arises in the context of regional inequality. If regions are considered as complex systems affected by a number of features, a comprehensive analysis of spatial inequality must involve a comparison of regional profiles or subsystems. The main problem lies in measuring regional subsystems as theoretical concepts because of their non-observable and multidimensional character (Folmer and Oosterhaven, 1979). Regional subsystems could be represented by means of a single measurable indicator, which coincides for instance with an income measure for the economic subsystem. Alternatively an index could be constructed consisting of a combined set of indicators (such as income, investments in infrastructures, degree of urbanization for the economic subsystem).

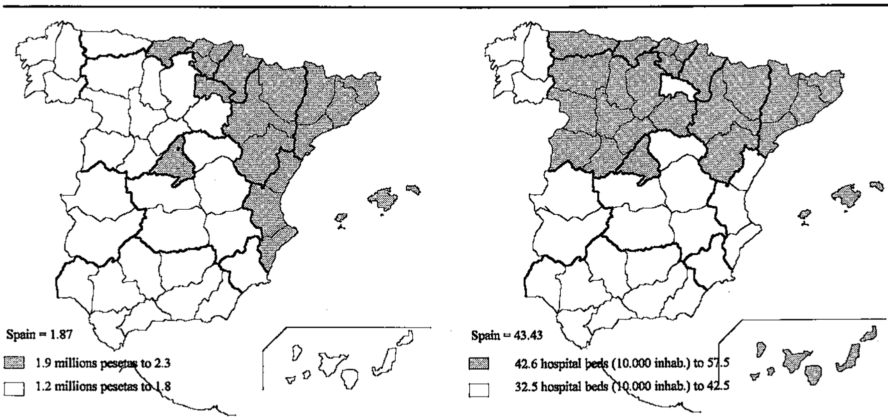
In the case of regional welfare, this problem becomes more severe for several reasons. First, the overall number of variables influencing welfare is not known. Researchers have assumed that welfare is linked to many aspects of individual's life. For instance, people's welfare is related to the environment in which they live in the sense that individuals may trade-off income for amenities in high-amenity environments (Hansen, 1995). It seems reasonable to assume a broad view of the concept of welfare, which may consist of monetary and non-monetary quantitative and qualitative elements. Note that some of these aspects cannot be adequately measured by a price system or in monetary terms (e.g., education or health). Second, many studies tackle the measurement of inequality in welfare using the income approach. It is assumed that monetary standards reflect accurately relative social value. However, this criterion does not match with particular goods related to welfare even if they are measured in monetary values (Richardson, 1979). For instance, the investment in a regional hospital may increase societal welfare much more than the same amount of expenditue allocated to industrial output. Another important constraint to the use of economic indicators as a proxy of welfare is that the distribution of economic measures over space may differ from the spatial pattern observed in non-economic measures such as social indicators (e.g., educational achievement indicators, health indices, welfare indicators such as, patients per doctor or students per teacher).[38] Figure 4.1 shows the rank order for the Spanish regions with respect to two indicators: per capita GDP in 1996 and hospital beds ratio in 1995. Part *a* of the figure reveals that the richest regions in terms of per capita

[38] According to Hafkamp and Nijkamp (1979), income per capita is a reasonable measure of welfare in the case of a perfect competitive system characterized by full information and fully operating price system.

GDP, that is the regions with the highest rank, are located in industrialized areas in the north-east, and includes Madrid which lies in the center of the Iberian Peninsula. The distribution of hospital beds ratio given in part *b* of the figure shows some similarity with the previous pattern because the lowest ranked regions cover a large territory in the South. But there is no clear concentration of highly ranked regions in the north-east. So the welfare facilities indicator shows more dispersal across the northern regions compared to the economic measure.

Figure 4.1 Rank Ordering of per capita GDP and Hospital Beds Ratios.

***a.* Per capita GDP at 1996** | ***b.* Hospital Beds per 10.000 inhabitants at 1995**



Source: INE, 1998.

Richardson (1979) points out that a welfare measure based on social indicator scores encompasses the whole population, whereas a welfare measure based on the average of per capita incomes may change even though only a single individuals' income has changed (Alonso, 1968)[39]. Consider, for example, high-income workers living in depressed and overpopulated regions who move to other regions. This leads to opposing effects. On the one hand, low-income workers in the origin regions improve their income levels

[39] According to Alonso (1968) income per capita is a weak measure because "it is perfectly possible for the per capita income of a depressed region to drop, but for all individuals in it to be better off. The conditions are that the depressed region be subjected to diminishing returns and that the higher-income members leave for other regions where their skills are better rewarded. Since the region is, in a sense, overpopulated (diminishing returns), the leaving of some raises the income of those who remain".

because the labor market is not pressured by the excess workforce. On the other hand, the average income per capita of the region drops. In sum, alternative methods have to be sought to deal with welfare inequality, rather than continuing with traditional approaches.

4.3 Measures for Multidimensional Inequality.

Measures for multidimensional inequality are used when several indicators are included in inequality measurement. These measures differ from those based on one single indicator[40] in that a composite index or an aggregator function of indicators represents the welfare component under study. While many well-known measures have been developed on one-dimensional inequality, the literature dealing with multidimensional inequality is limited to Maasoumi's contributions[41] and the theoretical works of Kolm (1977), Atkinson and Bourguignon (1982), Bradsburd and Ross (1988), Rietveld (1990), Dardanoni (1993), and Tsui (1995). In the present study we focus on the Theil's second inequality measure for multidimensional inequality as extended by Maasoumi (1986). This measure belongs to the family of *Generalised Entropy* (*GE*) inequality measures and possesses desirable and proven properties. In this chapter a procedure is developed to apply this measure for empirical purposes.[42] The empirical analysis (provided in Chapters 5 to 7) is focused on the Spanish regional state (Comunidades Autónomas) because there has been devolution of powers in welfare issues (in particular education and health) that may have influenced regional inequality over time. Note that although the Spanish regional state consists of nineteen regions, seventeen are investigated in the present study. The inclusion of Ceuta and Melilla is not possible due to the non-availability of statistical information.

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[40] For a comprehensive overview of inequality measures see, Cowell (1995).

[41] These include Maasoumi (1986), Maasoumi and Nickelsburg (1988), Maasoumi and Jeong (1985), Maasoumi and Zandvakily (1986 and 1990), Zandvakily (1992 and 1999).

[42] For a more comprehensive explanation on the theoretical aspects of multidimensional inequality, refer to the references given above.

4.3.1 Theil's Second Measure for Multidimensional Inequality: Definition.

Let us formalize Theil's second measure of overall inequality. $W_{\bullet}$ represents the regional state consisting of G-regions, and the subscript g denotes the seventeen regions under consideration (that is $g=(1,\ldots,G)$ with G=17). Each region consists of I_g provinces, with the number of provinces $I_g \geq 1$ while I denotes for the fifty provinces included in the regional state

$$I=\sum_{g=1}^{G} I_g \qquad I=50 \tag{4.1}$$

Theil's second measure of overall inequality is defined as follows:

$$T_{-1}(W_{\bullet})=T_{-1}(W_{\bullet})^{B}+T_{-1}(W_{\bullet})^{W} \tag{4.2}$$

The first term on the right hand of Equation (4.2) ($T_{-1}(W_{\bullet})^{B}$) denotes *between-regions inequality* while the second one ($T_{-1}(W_{\bullet})^{W}$) denotes *within-region inequality*. Between-region inequality is obtained (Maasoumi, 1986; Shorrocks, 1980):

$$T_{-1}(W_{\bullet})^{B}=\sum_{g=1}^{G} p_g \log(p_g / \mu_g^{*}) \tag{4.3}$$

Where $p_g = 1/G$ (with G=17) and μ_g^{*} is defined as:

$$\mu_g^{*}=\frac{\mu_g}{\sum_{g=1}^{G} \mu_g} \tag{4.4}$$

Where μ_g is obtained as

$$\mu_g=\frac{\sum_{i\in G} w_i}{I_g} \tag{4.5}$$

where w_i represents the welfare component for the ith province $(i \in G)$. This function is defined as

$$w_i = w(s_i) \tag{4.6}$$

where s_i refers to the determinants of welfare under consideration (for instance, health facilities and education enrollment). Since in the present study the multidimensional nature of welfare components is considered, welfare components consist of s_{ij} elements or indicators $(j=1,\ldots,p)$.

We first define a composite index (or an aggregator function) of indicators for welfare components, and then suggest a procedure to estimate this composite index for empirical purposes. We use the composite index suggested by Maasoumi (1986).[43] Maasoumi's aggregator function is used because it enables us to reproduce the maximum amount of information contained in the original data. In other words, the loss of relevant information is minimized after the composition of the indicators. The function is defined as

$$w_i = \sum_{j=1}^{p} \delta_j s_{ij} \tag{4.7}$$

where $\delta_j = \alpha_j / \sum_{j=1}^{p} \alpha_j$ are the weights associated with the s_{ij} indicators. When different weights are attached to the indicators for the welfare components, unequal valuation of indicators is possible.

The estimation of the composite index given in Equation 4.7 requires weights to be associated with the indicators. One way to obtain δ_j consists of assigning market prices to such elements. But the monetization is rather complicated for the type of indicators which represent welfare aspects (e.g., hospitals). Another procedure consist of analyst's evaluations (i.e., subjective assessments of the contribution the elements under consideration to welfare or, equal weights to all elements) but this is also not very satisfactory. We study in Section 4.4 an alternative based on the statistical properties of the data (indicators) used for the longitudinal analysis.

The second term on the right hand of Equation (4.2) denotes *within-region inequality*. This is independent of between-region inequality and is obtained as:

$$T_{-1}(W_{\bullet})^{W} = \sum_{g=1}^{G} p_g^{'} T_{-1}(w^g) \tag{4.8}$$

where,

$p_g^{'} = I_g / I$ with $I = 50$.

$T_{-1}(w^g)$ is Theil's second measure of inequality associated with w^g.

w^g indicates the vector of relative shares of regions.

For the gth region $T_{-1}(w^g)$ is computed

$$T_{-1}(w^g) = \sum_{g=1}^{G} p_g^{''} \log(p_g^{''} / w_{ig}^{*}) \tag{4.9}$$

[43] In Appendix 4.1 Maasoumi's aggregator function is described in detail.

where,

$$p_g^{''} = 1/I_g \qquad 4.10$$

and,

$$w_{ig}^{*} = \frac{w_i}{\sum_{i \in G} w_i} \qquad 4.11$$

The theoretical expression of a composite index given for w_i in Equation 4.7 can also be used to obtain w_i^* in Equation 4.11. A procedure to estimate w_i and w_i^* is developed in Section 4.4 for longitudinal analyses.

4.3.2 Reasons for Selecting Theil's Second Measure for Multidimensional Inequality.

The main reason to select Theil's second measure for multidimensional inequality in the present study is that it satisfies the property of additive decomposability. In other words, overall inequality can be decomposed (as done in Equation 4.2) to carry out intra-region and inter-region comparisons. This decomposition allows us to study the magnitudes and trends in inequality between regions as well as within regions.

When there are not many differences within regions the study of regional inequality can be restricted to investigating disparities among regions. For instance, we may consider regions (which are aggregated *homogenous* administrative (historical) subdivisions of territory), and regions consisting of one-single province or covering a small part of territory to be quite homogenous. Cases in point may be the region of Cantabria which consists of the province of Cantabria and occupies 5.289 km^2 of the territory, La Rioja which comprises also of a single province and covers an area of 5.000 km^2, or País Vasco which consists of the provinces of Alava, Guipúzcoa and Vizcaya and occupies 7.300 km^2.

But there may be a loss of relevant information especially when there are marked disparities within regions. Then the analysis based simply on differences between regions may present a very simplified picture regarding the sources of overall inequality (between-region and within-region inequality). There are significant regional differences between the Spanish regions with respect to regional characteristics such as language, culture, historical traditions, etc. Important differences within regions arise because of other socio-economic features (population, environment, etc) and also because of the land size of regions. Actually the territorial organization in Spain implies is such that some regions cover areas as extensive as some EU countries (Table 4.1). The land size of Extremadura (41.600 km^2) is similar to that of the Netherlands, the regions of Andalucia or Castilla-León with an area around 90.000 km^2 are comparable to Portugal, and the region of Castilla-La Mancha occupies the same area as the BENELUX (Belgium, the Netherlands and Luxemburg).

Table 4.1 Land size of the Spanish Regions.

Region	**Area (1000 km^2)**	**Region**	**Area (1000 km^2)**
Galicia	29.4	Castilla-León	94.2
Andalucía	87.3	Castilla-La Mancha	79.2
Asturias	10.6	Extremadura	41.6
Cantabria	5.3	Cataluña	31.9
País Vasco	7.3	Comunidad Valenciana	23.3
Navarra	10.4	Baleares	5.0
La Rioja	5.0	Murcia	11.3
Aragón	47.7	Canarias	7.2
Madrid	8.0	Ceuta y Melilla	0.032

Source: EC (1993) Portrait of the Regions EUROSTAT.

Summing up, the evaluation of the welfare status of one region relative to another that is simply based on the observed inequality for each region is likely to be inadequate when there are significant differences within the regions. Since wide variations in the Spanish regions (related to geographical or socio-economic features of regions) may cause significant within-region inequality, it is appropriate to study inequality with respect to a welfare component by considering both the intra- and inter-regional disparities. Therefore Theil's second measure for multidimensional inequality is applied to the territorial division of the regional state in Spain to achieve the following objectives:

i. To study the magnitude and direction of overall regional inequality.
ii. To analyze the intra-region and inter-region disparities. The magnitude of between-region inequality and also the magnitude of differences within regions is investigated.

iii. To analyze the geographical pattern of inequality using cluster analysis to study the similarities between one group of regions and the differences compared with another group of (similar) regions.

4.3.3 Other Empirical Estimates of Welfare Inequality.

There are no studies of welfare inequality in Spain which have considered the multidimensionality of each of the welfare components separately. There are also no studies that have done a longitudinal analysis of welfare inequality. Regional disparities in Spain over time with respect to health and/or education facilities have not been analyzed using an inequality measure. Thus it is not possible to compare inequality results from other literature sources with our results.

Studies such as (INE, 1981, 1991) or Zarzosa (1991) combine all kind of welfare indicators into a composite index, including facilities, health status, education enrollment, housing expenditures, housing conditions, etc. This is a common procedure in international cross-country comparisons of welfare (Hirschberg at al, 1991; Slottje et al, 1991) .

Analística (1995) and the National Institute of Statistics (*España en Cifras*) have done descriptive analyses of single indicators of health or education facilities (e.g. doctors per 1000 inhabitants). Sanz and Terán (1988) compute a statistical inequality measure such as standard deviation, coefficient of variation, or max-min range with respect to a single indicator in cross-sectional analysis.

Cutanda and Paricio (1992) carry out an analysis for Spanish infrastructure for health and education and consider the multidimensionality of these two components. But they use an inequality measure for unidimensional inequality (coefficient of variation and standard deviation with respect to the composite index). A composite index of indicators is computed using an arithmetic average, but different weights are not considered (as is done in our study). The data refers to 1980/1981, and no longitudinal analysis is done.

4.4 Estimation of a Composite Index for Theil's Second Measure of Multidimensional Inequality in Longitudinal Analyses.

4.4.1 Estimation using Partial Common Principal Component (PCPC).

In the present study we use the Partial Common Principal Component model (hereafter PCPC) whenever appropriate, to estimate the composite index for Theil's second measure of multidimensional inequality. The PCPC model (Appendix 4.3) is a generalization proposed by Flury (1988) of the well-known Principal Component Analysis (PCA) (Appendix 4.2). PCA has been applied for longitudinal analysis using Theil's second measure for multidimensional inequality (Maasoumi and Jeong, 1985;, Maasoumi and Nickelsburg, 1988; Zandvakili, 1992, 1999). The formal model of PCPC is a data reduction technique of large or multidimensional data sets with k ($t = 1,\ldots,k$) samples. So a number of variables p measured over several samples need to be reduced to a subset of q components ($q<p$) (or new variables) usually associated with the largest eigenvalues. The components then recover most of the variability in each of the samples simultaneously. As explained in the following sections, the basic assumption in PCPC is that the first component of all k samples (or a number of samples) is identical whereas the remaining components are specific to each sample. In other words, component coefficients of the first component are the same for all (or a number of samples). In this study q is equal to one. The selected component coincides with the one associated with the largest eigenvalue and the variance associated with that component may differ in the several samples.[44] When the PCPC model is applied for the four available samples (or a number of the samples) in the present study, the so-called *first partial common component* is obtained. Otherwise, PCA is applied and the individual component coefficients are the weights. The corresponding component coefficients are the weights (indicated in Equations 4.7). An overview of the

[44] Until the eighties principal component models of two or several samples had not received much attention in psychometrics or statistics. Models developed in both traditional researching fields of multivariate analysis present different statistical techniques to deal with the underlying problem which is the generalisation of classical principal components. In general, psychometricians adapt models used in the context of Factor Analysis to principal components (ten Berge, 1986; Meredith and Millsap, 1985; Millsap and Meredith, 1988; Kiers and ten Berge, 1989) whereas statisticians propose specific models for principal components (Krzanowski, 1979,1984,1990; Flury, 1987;1988). There seems to be a lack of agreement on which is the best approach.

procedure developed in this study is given in detail in Section 4.4 while the main statistical aspects of the models PCPC and PCA are outlined in Apendices 4.1 and 4.2.

The reasons for using the PCPC technique in the present study are summarized as follows. First, this technique is considered to be appropriate for longitudinal analysis. Since the available data used in this study refers to different points of time (periods), several samples are analyzed.[45] Although both multivariate models PCPC and PCA could be used for longitudinal analysis to estimate the composite index, the adequacy of PCPC is justified by the *principle of parsimony*. Flury (1988) in the introduction to his book "*Common Principal Components and related models*" notes that in multivariate methods such as multiple regression techniques, covariance fitting, or principal components, among others, "*the more parameters are estimated, the less stable the estimates are (in the sense of large standard errors)*".[46]

Another reason for using PCPC is that the resulting composite indexes include the maximum information contained in the original variables because the first component is considered. So the remaining or discarded components are then information lost after extracting one principal component.

Finally, PCPC can also be considered as an adequate technique to deal with the statistical problems caused by including a large number of variables or redundant information (multidimensionality or multicolinearity problems).

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[45] We may also use PCPC not only in the analysis of a number of variables at different points of time but also when there are two or more different sets of observations. The literature concerned with principal component generalisations has dealt with *longitudinal* or *multigroup* applications in the same way because both are viewed as replications of an unique set of observations (longitudinal) or several groups of individuals (multigroup). So, entities (observations or individuals) may change but the variables under study remain the same.

[46] In addition there is a trade off between the benefits and costs of reducing the parameters by imposing a certain structure on the covariance matrix or some elements. On this issue Flury refers to Dempster's (1972) argument, which reads as follows. "*... Parameter reduction involves a trade off between benefits and costs. If a substantial number of parameters can be set to null values, the amount of noise in a fitted model due to errors of estimation is substantially reduced. On the other hand, errors of mispecification are introduced because the null values are incorrect. Every decision to fit a model involves an implicit balance between these two kinds of errors, i.e., a decision is made not to complicate a model by adding more parameters. However, once parametric model is adopted, the question of whether or not to thin out the parametric structure is too often settled by default, specially when optimal estimates of the complete set of parameters are easily computed. Such optimality provides no protection against the costs of introducing unnecessary parameters ...*" *Dempster (1972)*

4.4.2 Estimation Using Principal Component Analysis (PCA).

Classical Principal Component Analysis (PCA) is used when PCPC can not be applied to the data in the present study.[47] This situation occurs when the component coefficients of k (or a number of samples) are *sample specific* so that the component coefficients reflect distinct underlying structures of samples. PCA is therefore considered as an appropriate technique for estimating the composite index in longitudinal analysis when it is not possible for using PCPC modelling to more than various samples (k=2).

PCA is a popular exploratory data-analytical technique developed as a one-group or one-sample technique (k=1) for large or multidimensional data sets. It involves the analysis of p correlated variables measured on n observations in one sample. In common practice, principal component is viewed in three different ways (Flury, 1988). The simplest application consists of a transformation of correlated variables into uncorrelated ones. In addition, it is a method to find linear combinations of variables with relatively large or small variance. Finally, principal component is also described as a data reduction technique. Combining the characteristics of the foregoing applications, that is orthogonal linear combinations with a certain variance, the dimensionality of a data set can be reduced. Formally speaking, this is equivalent to obtaining q ($q<p$) uncorrelated variables which are linear combinations of the original variables having maximum variance. The result is a simplification of the number of variables that capture most of the information and do not disturb the structure exhibited by the original data. In the present study PCA is used as a data reduction technique with q equal to one, and the component coefficients of the first component individually computed for samples are the weights in the composite index.

Researchers have raised doubts about PCA which could also relate to PCPC. And we shall take as an example the following argument:

> "... *From a theoretical point of view these methods* (*viz. Principal Components*) *are rather weak because they are only based on statistical properties of the original data set without any theoretical background. Furthermore, the interpretation of the components is*

---

[47] So the component coefficients of all or a number of components are not equal.

to a certain extent arbitrary and subjective ... " (Nijkamp, 1988).

We can not deny that the PCPC and PCPC models of multivariate statistics used in this study have an important mathematical setting. Actually the origin dates for both models dates back to Pearson (1901) who attempted to fit planes by orthogonal least squares and to Hotelling's (1933) method which focused on the analysis of covariance and correlation structures. However, these techniques have also been largely used in many research fields (social and natural sciences) in spite of the cited "lack of theoretical background".[48] We believe that the main problem lies in an inaccurate application of the method to many variables or perhaps rather unlinked variables in some theoretical sense. This is suggested by Flury:

> *"... The availability of efficient software has not always benefited science, because investigators are tempted to let the computer to do thinking. Too many people use principal component analysis to study too many variables hoping that putting even more data into an existing algorithm will lead to valid scientific conclusions ... "* (Flury, 1995)

So we can not expect a statistical procedure to give us rational answers in a strict economic sense. We conclude that the consistency of PCA or PCPC depends on how well the statistical technique fits the purposes of the research.

4.4.3 Transformation Using Covariance Matrices.

In the standard approach principal components are derived from covariance matrices. This approach assumes that all variables are comparable in terms of variance and units of measurement. However, if variables are in very divergent units of measurement or have substantial differences in their variances, a standardization procedure is suggested.[49] From the transformation of the variables, principal components are obtained from the

[48] PCA has become one of the most applied methods of multivariate statistics not only in the natural sciences and psychometrics but also in the social sciences and in economics in particular.

[49] Variables in the standardization are each taken separately and the transformation consists of substracting the variable's mean from each observation and dividing the result by the variable's standard deviation.

correlation matrices.[50] One of the problems associated with the principal components of correlation matrices is that their interpretation is not straightforward. Further, according to Anderson (1963), the asymptotic distribution of the eigenvectors and characteristic roots of the correlation matrices is difficult to obtain.[51] The method applied in the present study is based on the covariance matrix. We consider the variables used in this study to be highly comparable with respect to units of measurement. Nevertheless, for comparability, all indicators used for empirical purposes are re-scaled taking into account their positive or negative relation to welfare. So, high values of indicators like mortality rates have a negative association whereas school enrollment rates have a positive association. We let the highest value equal 1 for positive and 0 for negative indicators so that the resultant indicators range between 0 and 1.[52] According to Nijkamp (1978,1988) the transformation is as follows,

$$s_{ij}^{*} = \frac{s_{ij}}{s_j^{\max}} \quad \textit{if } j \textit{ is a positive indicator} \tag{4.12}$$

$$s_{ij}^{*} = 1 - \frac{s_{ij}}{s_j^{\max}} \quad \textit{if } j \textit{ is a negative indicator} \tag{4.13}$$

$$\text{with } s_j^{\max} = \max_i s_j$$

Where s_{ij} denotes elements of the regional welfare for j indicators ($j = 1,\ldots,p$) and i provinces $(i = 1,\ldots,50)$.

Although this transformation implies a change in the origin and scale of the original indicators, the relative order of the magnitude of the resultant indicators do not vary. Note that the resultant principal components may display some sensitivity to the re-scaling procedure[53].

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[50] Principal components of covariance matrices differ from the principal components of correlation matrices. Further, it is not possible to transform one of the principal components into the other (e.g. from the covariance matrix to the correlation). (Krzanowski, 1988).

[51] See Anderson (1963) for a more detailed description.

[52] A similar procedure is used in Ram (1982), Morris (1979), Maasoumi and Nickelsburg (1988).

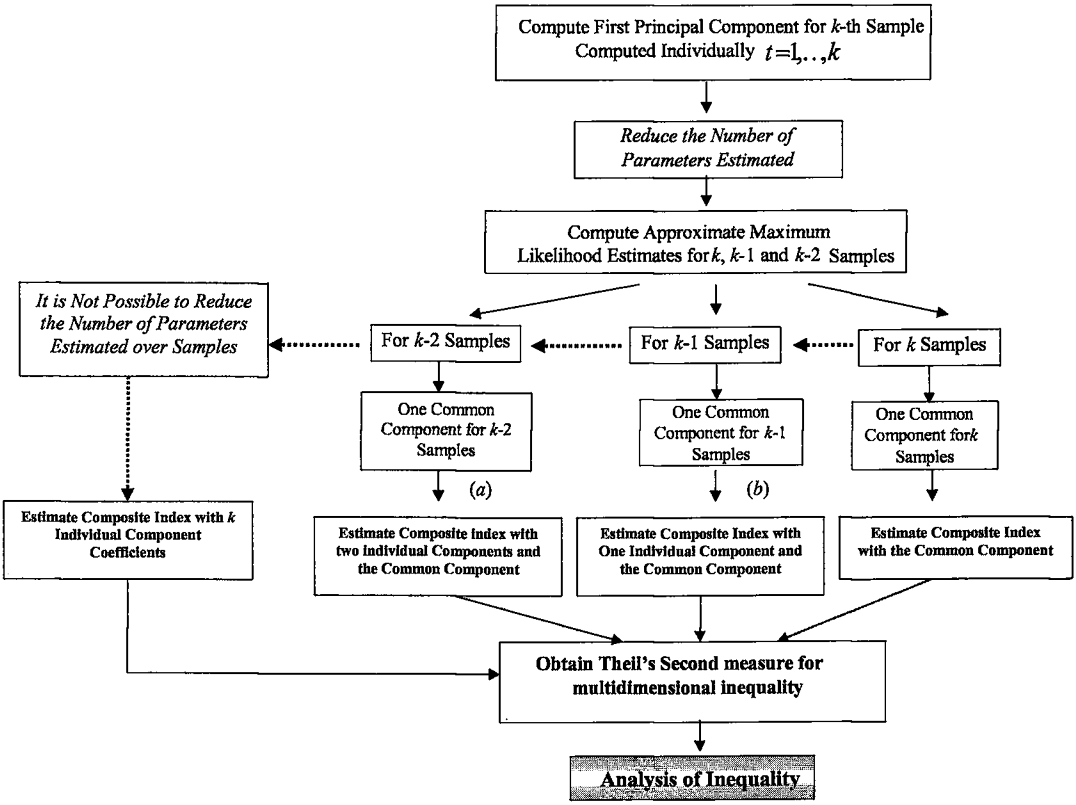
[53] The sensitivity of principal components itself to re-scaling should be small so long as such re-scaling is done primarily to transform the different variables in commensurable units.

4.5 Overview of the Estimation Procedure.

In this section the procedure that we develop to estimate the composite index used to obtain Theil's second measure of multidimensional inequality for longitudinal analyses is presented. Figure 4.2 shows an overview of the complete procedure while Figure 4.3 and Figure 4.4 describe in detail the steps of the estimation procedure. Let us outline first the procedure displayed in Figure 4.2. The procedure starts with the estimation of covariance matrices individually for all four samples or periods under consideration, as well as the estimation of the component coefficients obtained using PCA. The estimates of the covariance matrices and PCA component coefficients are the inputs used in the PCPC model. The analysis of results obtained using PCA gives an indication of the goodness of fit of the samples to the principal component model (PCPC or PCA). Note that the use of PCPC does not result in a major change to the goodness of fit obtained using PCA. In addition, the hypothesis of the PCPC model for k (k= 4, the number of samples used here) k-1, and k-2 is investigated by carrying out a visual comparison of results in PCA. In Appendix 4.2 the technical procedure involved with PCA is explained in detail. The next step consists of testing whether it is possible to reduce the number of parameters estimated for k, k-1 and k-2 periods or samples (with t=1,…,k and k=4). In other words the application of PCPC to the available data is studied. When all the four periods (k=4) share the same first component, the composite index is obtained from the component coefficients computed using a partial common principal component model (PCPC). Flury's approach for a PCPC is shown in Appendix 4.3 which also includes the Maximum Likelihood Estimation of PCPC. The composite indexes for different periods depend then on the values of variables rather than the weights attached to the variables (component coefficients). If the hypothesis of one common component is not rejected for a number of periods (three (k-1) or two periods (k-2)), the composite index is then constructed on the basis of the maximum likelihood estimates for these periods together with the individual component coefficients for the remaining periods. On the other hand, when it is not possible to reduce the number of parameters estimated, or stated in another way, a partial principal components model does not fit the data, the composite index is then based on individually computed component coefficients. So the weights used to obtain the composite index are the component coefficients in PCA. Finally, the overall inequality of the Theil's second measure is computed and decomposed using Equation (4.2) and the results are analyzed.

As shown in Figure 4.2, Theil's second measure for multidimensional inequality involves estimating a composite index of the indicators under consideration. The procedure developed in this study to build up such an index consists of various steps as shown in Figures 4.3 and 4.4 and summarized in Figure 4.2. The present section as well as Appendices 4.2, 4.3 and 4.4 have been developed based on Anderson (1984), Flury (1988), Muirhead (1982), and Mardia et al (1979).

Figure 4.2. Overview of the Procedure to Obtain Theil's Second Measure for Multidimensional Inequality in Longitudinal Analysis.



(a) Select the first principal component for the two samples when it is not possible to fit a partial common principal components model

(b) Select the first component for the sample when it is not possible to fit a partial common principal components model.

Figure 4.3. Previous Procedure to the Estimation of Partial Principal Component Model in Longitudinal Analysis. Estimation and Evaluation Procedure of Component Coefficients Obtained Using Principal Component Analysis (PCA).

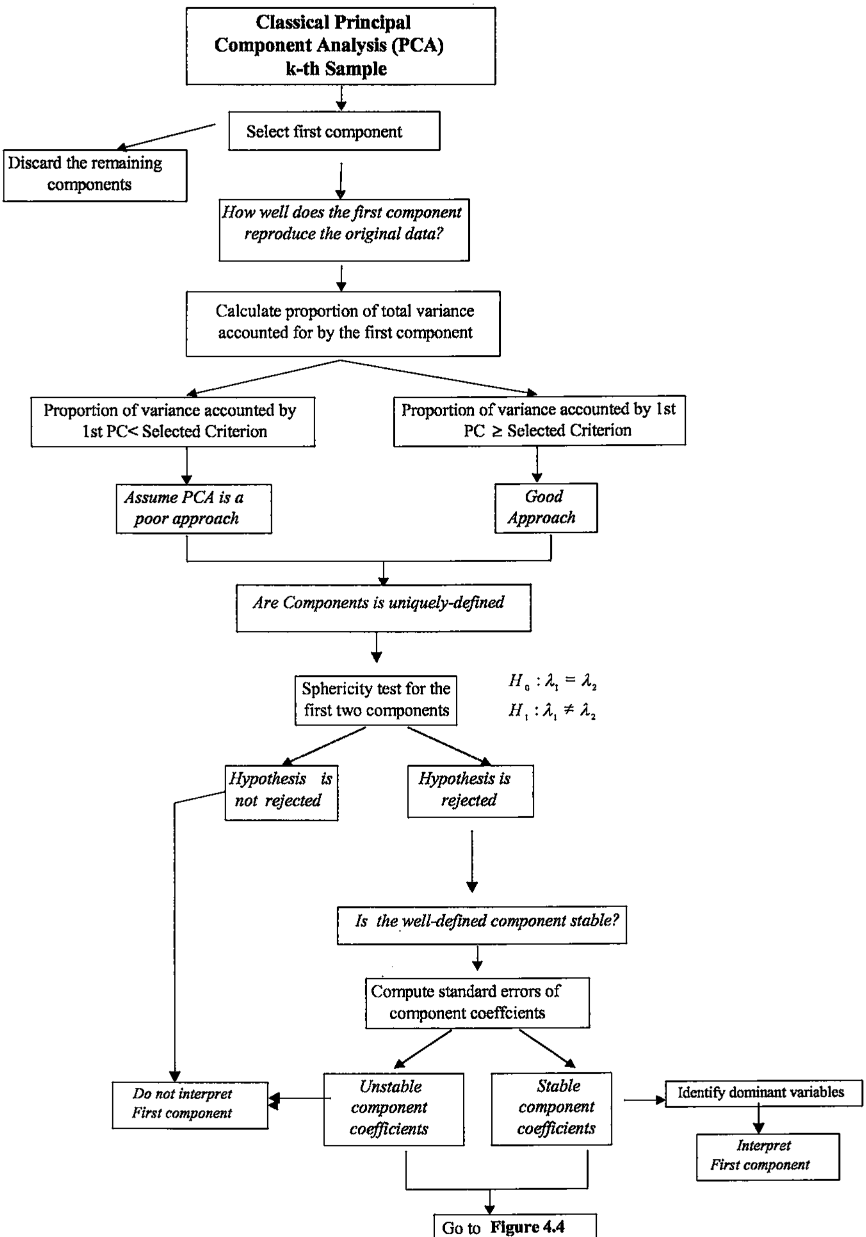
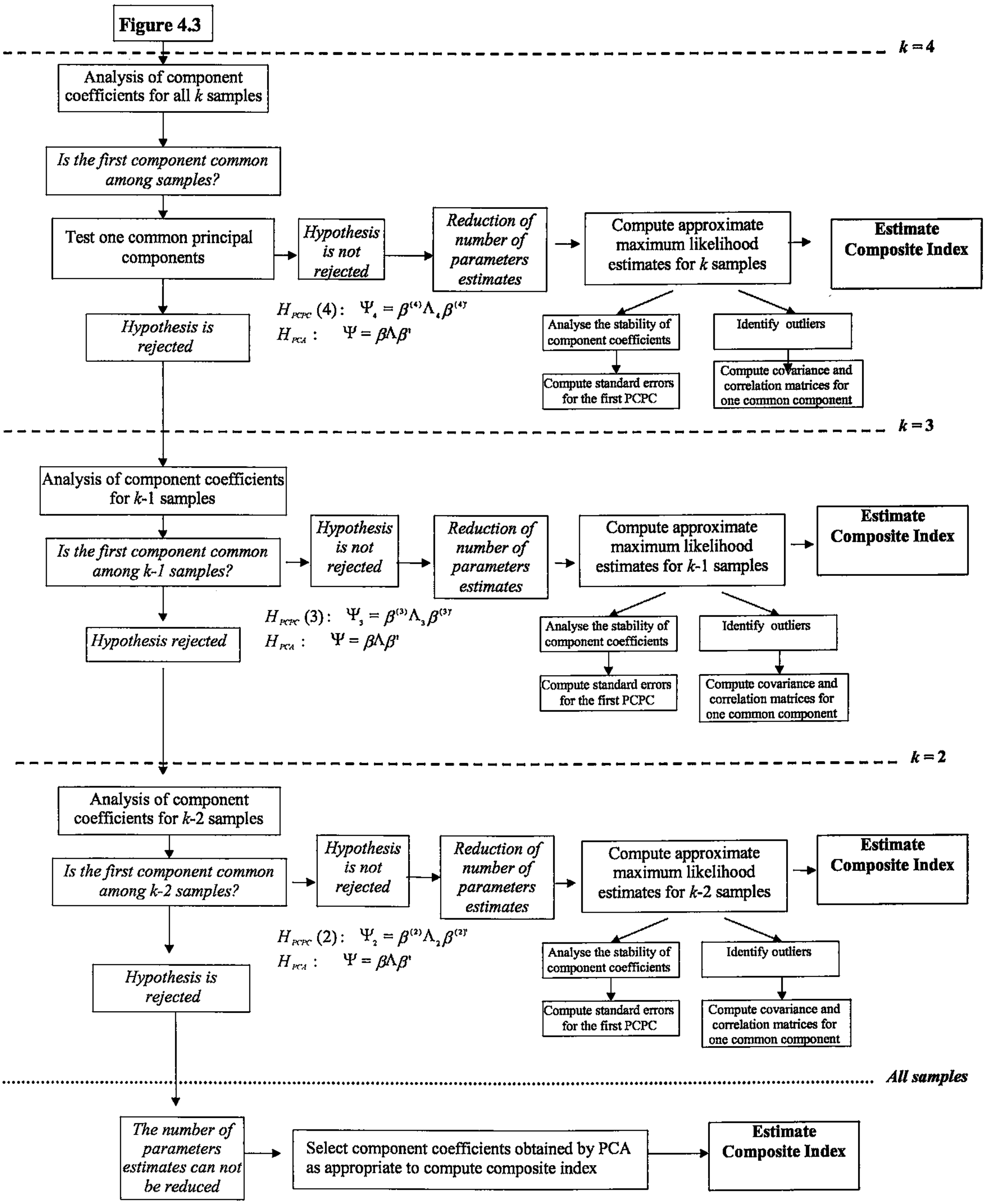


Figure 4.4. Selection of the Accurate Estimation Procedure in several samples. Application of Flury's Generalized Partial Common Principal Component model (PCPC).



The first step focuses on the separate or individual analysis of each period using the classical method of principal components (PCA) (Figure 4.3). For each sample,covariance as well as the first principal component are individually obtained. The remaining components are discarded. In the sample principal component it is assumed that S is the unbiased estimator of the positive definite covariance matrix of the X observable variables or Ψ (with $\Psi = \beta\Lambda\beta'$). The sample covariance matrix is a positive definite matrix,[54]

$$S = \frac{1}{N-1}\sum_{h=1}^{N}(X_H - \bar{X})(X_H - \bar{X})' \qquad 4.14$$

for X random vector with $N(\mu, \Psi)$ multivariate normal distribution, $X_1,\ldots X_N$ is a random sample of size N=n+1 and $\bar{X}$ denotes the mean. Then the maximum likelihood estimation of Ψ is

$$S^* = \frac{N-1}{N}S \qquad 4.15$$

The principal components of a sample are obtained from the spectral decomposition of S. This decomposition provides the pxp matrix of orthogonal eigenvectors (*characteristic vectors*) $B = (b_1,\ldots,b_p)$ and the L diagonal matrix with $l_1 > l_2 > \ldots > l_p$ eigenvalues (*characteristic roots*).

$$S = BLB' = \sum_{j=1}^{p} l_j b_j b_j' \qquad 4.16$$

$$\hat{U} = B'X \qquad 4.17$$

The first principal component is the eigenvector associated with the largest eigenvalue. This component and all the sample principal components in general ($\hat{U}_1,\ldots,\hat{U}_p$) are estimates of the population principal components

$$U = \beta' X = (U_1,\ldots,U_p)' \qquad 4.18$$

[54] The principal components do not change if the covariance matrix is replaced by the unbiased sample covariance.

where $\beta = (\beta_1,\ldots,\beta_p)'$ is a pxp orthogonal matrix of the eigenvectors of the Ψ covariance matrix that are associated with the corresponding eigenvalues of Λ the diagonal matrix of eigenvalues λ_j $(j = 1,\ldots p)$.

For the sample covariance, it is assumed that the spectral decomposition given in Equation 4.16 is unique if the corresponding eigenvalues of B are distinct. When all eigenvalues are the same, the variables are pairwise uncorrelated and the variances are equal so there is no point in computing the principal components. To test whether the eigenvalues are the same the overall sphericity criterion can be used. The null hypothesis is:

$$H_0 : \lambda_1 = \lambda_2 = \ldots = \lambda_p \tag{4.19}$$

and the alternative

$$H_1 : \lambda_1 \neq \lambda_2 \neq \ldots \neq \lambda_p$$

The statistic is:

$$X_r^2 = nr \log \frac{(1/r)\sum_{j=p-r-1}^{p} l_j}{(\prod_{j=p-r+1}^{p} l_j)^{1/r}} \tag{4.20}$$

Where l_j is the jth eigenvalue, n sample size, r the number of eigenvalues which is equal to the number of variables (so $r=p$). The statistic is asymptotically distributed with chi squared with $r(r+1)/2-1$ degrees of freedom. If the null hypothesis of overall sphericity is not rejected then the component coefficients are not well-defined[55]. So no purpose is served by performing the analysis of principal components.

The maximum likelihood estimates of β and Λ are the eigenvalues and eigenvectors of S^*, that is,

$$\hat{\beta} = B \tag{4.21}$$

$$\hat{\Lambda} = \frac{N-1}{N} L \tag{4.22}$$

Therefore, B and L are the consistent estimators of β and Λ from the general theory of maximum likelihood estimation.

---

[55] Overall sphericity means that all variables are pairwise uncorrelated and have the same variance so that all eigenvalues are equal.

Once the first principal components are obtained individually for all samples, the proportion of total variability of the first eigenvector is computed in order to obtain the goodness of fit of the principal component model (after reducing the number of indicators to one-single component).

$$\textit{Proportion of variabity } (1^{st}\ PC) = \frac{\sum_{j=1}^{r} l_j}{\sum_{j=1}^{p} l_j} \qquad 4.23$$

With r=1 (the number of eigenvalue associated with the extracted eigenvectors, which is one) and p is the number of variables. So this share tells us whether most of the information in our data is contained by the composite index or not. The first principal component reproduces the data well (*good approach*) when it exceeds the selected criterion. Otherwise we assume that the composite index reveals only partially the true information (*poor approach*) but the procedure is not stopped.

We test if the first and second eigenvalues are distinct to find out whether the first component is uniquely defined. That is, the sphericity of the first two adjacent pairs of principal components is tested. As in overall sphericity it is assumed that the two eigenvalues are identical in the null hypothesis, against, the alternative hypothesis of different eigenvalues. The statistic for two eigenvalues is

$$S(l_{h-1}, l_h) := 2n \log \frac{l_{h-1} + l_h}{2\sqrt{l_{h-1} l_h}} \qquad 4.24$$

This corresponds to a chi square distribution with two degrees of freedom. When the null hypothesis is not rejected, the component coefficients are mathematically not uniquely defined (the associated eigenvalues only differ by sampling error). So there is no point in computing the standard errors or interpreting components either. Spherical principal components should not be interpreted because the eigenvalues associated with such components only differ because of sampling errors. In sum, the results may be over-interpreted in case the components are spherical.

The composite index is interpreted using the variables that have been identified as the dominant ones (variables with the highest weights with respect to the first component), the composite index is interpreted. Now the standard errors of the component coefficients are computed (Equation 4.25) to study the instability of coefficients (p) (as reflected by large standard errors). We focus on the results for the first principal component to determine whether the interpretation of this component is robust. The asymptotic standard error of the component coefficient $(s(b_{mh}))$ of the component coefficient b_h which is defined as

$$s(b_{mh}) = \left[\frac{1}{n} l_h \sum_{\substack{j=1 \\ j \neq h}}^{p} \frac{l_j}{(l_j - l_h)^2} b_{mj}^2 \right]^{1/2} \tag{4.25}$$

where b_{mh} is mth element of b_h. and the sum in the equation (4.25) runs over the mth row of the consistent estimator (maximum likelihood) of the matrix of eigenvalues $B = (b_1, \ldots, b_p)$. Large standard errors mean that the component coefficients are unstable so that there is no point in interpreting principal components. According to Flury (1987, 1988) estimated standard errors larger than 0.1 indicate that the component coefficients are very unstable, in which case there is no point in interpreting unstable coefficients. Standard errors larger than 0.5 means that only the first digit of the component coefficients is robust for interpretation.

The component coefficients for all periods are used in the next step (Figure 4.4). The appropriateness of applying Flury's model of principal component is evaluated for the k-samples (periods) under consideration. The null hypothesis of one common principal components in the four periods is tested against the alternative of unrelated structures (there is no similarity between component coefficients or components obtained using PCA):

$$H_{PCPC}(q) : \Psi_t = \beta^{(t)} \Lambda_t \beta^{(t)\prime} \tag{4.26}$$

$$H_{PCA} : \Psi = \beta \Lambda \beta'$$

with

q number of components under consideration (p denotes the number of variable, $q<p$),

Ψ_t a positive symmetric matrix ($p \times p$) for the t-th sample. ($t=1,\ldots,k$)

$\Lambda_t = diag(\lambda_{t1}, \ldots, \lambda_{tp})$ with λ_t eigenvalues associated with the t-th sample.

and

$\beta^{(t)} = (\beta_c, \beta_s^{(t)})$ where β_c -with dimension $p \times q$- are the common eigenvectors for all groups and $\beta_s^{(t)}$ (with dimension $p \times (p-q)$) are the specific eigenvectors for each sample.

In this study we assume that all *four* samples (so t=4) share the *first* component (q=1) which is associated with the largest eigenvalue.

The exact maximum likelihood test for the null hypothesis $H_{PCPC}(q)$ versus the alternative of arbitrary covariance matrix (or components obtained using PCA) is given by:

$$X_c^2 = -2\log\frac{L(\hat{\Psi}_1,\ldots,\hat{\Psi}_k)}{L(S_1,\ldots,S_k)} = \sum_{t=1}^{k} n_t \log\frac{|\hat{\Psi}_t|}{|S_t|} \quad 4.27$$

If the foregoing hypothesis is not rejected, the approximate maximum likelihood estimates of the first common component are computed for all periods. According to the parsimony principle, the model of partial principal components model is more accurate than the classical one because the number of parameters estimated is reduced. As a result the component coefficients are more stable and interpretable. Therefore, the weights attached to the variables (component coefficients computed by maximum likelihood estimation) will be the same for all periods. If the hypothesis is rejected for all four samples, the procedure continues with the testing of the hypothesis of one common component with three samples. If the hypothesis is again rejected then it is tested with two samples. The component coefficients (weights attached to the variables) are the same for the samples which fit a model of partial principal components (for the four, three, or two samples). These component coefficients are interpreted and also the standard errors are computed (Appendix 4.4). When PCPC is not rejected for k, k-1, k-2, etc, the adequacy of the model can be corroborated by computing correlation matrices for the estimated components as

$$R_t = \hat{\Lambda}_t^{-1/2} F_t \hat{\Lambda}_t^{-1/2} \quad 4.28$$

where F_t is the covariance matrix of estimated components:

$$F_t = \hat{\beta}^{(t)'} S_t \hat{\beta}^{(t)} = \begin{bmatrix} \hat{\beta}_c' S_t \hat{\beta}_c & \hat{\beta}_c' S_t \hat{\beta}_s^{(t)} \\ \hat{\beta}_s^{(t)'} S_t \hat{\beta}_c & \hat{\beta}_s^{(t)'} S_t \hat{\beta}_s^{(t)} \end{bmatrix} = \begin{bmatrix} F_{11}^{(t)} & F_{12}^{(t)} \\ F_{21}^{(t)} & F_{22}^{(t)} \end{bmatrix} \quad 4.29$$

with $\hat{\Lambda}_t = diag\ F_t$. So the correlation matrices in Equation 4.28 can be re-written as:

$$R_t = \hat{\Lambda}_t^{-1/2} F_t \hat{\Lambda}_t^{-1/2} = \begin{bmatrix} R_{11}^{(t)} & R_{12}^{(t)} \\ R_{21}^{(t)} & I_{p-q} \end{bmatrix} \quad 4.30$$

Finally we conclude that it is not possible to reduce the number of parameters estimated when any two periods do not have the first component common. So, the most accurate model is the classical principal components and the weights attached to the variables are different in each period.

4.6 Summary.

In this chapter the notion of spatial inequality has been studied within the context of regional welfare and the theoretical problems related to this have been described. We find that the components of regional welfare such as health or education are better represented by several indicators rather than a single indicator. So the choice of an adequate measure to study the spatial inequality is necessary for us to take into account the multidimensional nature of welfare components. Attention has been paid to the additively decomposable Theil's second measure for multidimensional inequality. The property of decomposability of Theil's second measure enables the decomposition of overall inequality in *between-* and *within-groups inequality*. The group in this study is a region which is divided into provinces. The use of Theil's second measure for empirical purposes implies the aggregation of the indicators used to represent the welfare components into a composite index. In this chapter an estimation procedure is developed to obtain this index for longitudinal analysis using PCPC (whenever appropriate) or PCA.

Appendix 4.1

Maasoumi's Aggregator Function Composite Index

Any composite index should reproduce the maximum amount of information contained in the original data. So the loss of relevant information has to be minimized after combining of the indicators under study into an index. This criterion is used by Maasoumi (1986) to develop the aggregator function given in equation (4.31):

$$w_i = w \propto \left[\sum_{j=1}^{p} \delta_j s_{ij}^{-\beta}\right]^{-1/\beta} if\, \beta \neq 0,-1 \qquad 4.31$$

where $\delta_j = \alpha_j / \sum_{j=1}^{p} \alpha_j$ are the weights attached to each of the indicators and β denotes the level of aggregation (substitution) of indicators (β=-2, -1, -1/2, 0). These weights allow the unequal valuation of the different variables so they are comparable to prices for index numbers. When β is -1 or 0, equation 4.31 is:

$$w_i = \sum_{j=1}^{p} \delta_j s_{ij} \quad if\ \beta = -1 \qquad 4.32$$

$$w_i = \prod_{j=1}^{p} s_{ij}^{\delta_j}\, if\, \beta = 0$$

Where w_i represents the composite index for the ith province and s_i refers to the welfare component under consideration (for instance, health facilities and education enrollment).

If $\sum_{j=1}^{p} \alpha_j = 1$ then $\delta_j = \alpha_j$ equation (4.31) and (4.32) can be re-written as follows,

$$w_i = w \propto \left[\sum_{j=1}^{p} \alpha_j s_{ij}^{-\beta}\right]^{-1/\beta} if\, \beta \neq 0,-1 \qquad 4.33$$

$$w_i = \left[\sum_{j=1}^{p} \alpha_j s_{ij}\right] \quad if\ \beta = -1$$

$$w_i = \prod_{j=1}^{p} s_{ij}^{\alpha_j} \quad if \quad \beta = 0$$

Where α_k are the weights associated with the s_{ij} indicators.

Equation (4.33) can be viewed not only as the counterpart of a statistical measure like harmonic mean but also as a classical utility function when $\beta \neq 0,-1$. If $-\beta = 1-(1/\sigma)$ and σ indicates the constant elasticity of substitution, such an equation corresponds to a CES utility function. In a similar way, equation (4.33) can represent a linear function (weighted arithmetic mean) or a Leontief utility function $\beta = -1$. Finally, equation (4.33) indicates a geometric mean or a Cobb-Douglas utility function when $\beta = 0$. In sum, the resulting functional forms coincide with well-known index numbers or linear functions and also utility functions.

Appendix 4.2

Principal Component Analysis (PCA)

In this appendix the main statistical aspects of principal component analysis are outlined. This appendix is based on Muirhead (1982), Anderson (1984), Mardia et al (1979) and Flury (1988) which can be referred to for more details. In the first part of this appendix, population principal components are presented and the principal components of a sample are described in the second part.

Population Principal Components.

Principal components are based on the second moments for random vector X, $X = (X_1,\dots,X_p)'$. μ and Ψ denote the mean and the covariance matrix. It is assumed that the covariance matrix is symmetric and positive definite so that the spectral decomposition of Ψ is:[56]

$$\Psi = \sum_{j=1}^{p} \lambda_j \beta_j \beta_j' = \beta \Lambda \beta' \qquad 4.34$$

where $\beta = (\beta_1,\dots,\beta_p)'$ is a pxp orthogonal matrix of the eigenvectors of the Ψ covariance matrix which are associated with the corresponding eigenvalues of Λ the diagonal matrix of eigenvalues λ_j $(j = 1,\dots p)$. It is assumed that the eigenvalues (also called characteristic or latent roots) are in decreasing order so that $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda_p$. With $U = \beta' X = (U_1,\dots,U_p)'$ the *principal components* of X, the covariance of U is equal to Λ. This implies that $U_1,\dots,U_p$ are uncorrelated with variance λ_j $(j = 1,\dots p)$.

According to the general criterion adopted in (4.34), the first principal component is $U_1 = \beta_1' X$. It corresponds to the normalized linear combination with maximum variance equal to λ_1, since var($\beta_1' X$) = $\beta_1' \Psi \beta_1 = \lambda_1$. The second principal component, denoted by $U_2 = \beta_2' X$, is also a normalized linear combination with the largest possible variance but

[56] The spectral decomposition procedure is explained in Flury (1988).

$U_2 = \beta_2' X$, is also a normalized linear combination with the largest possible variance but uncorrelated with the preceding U_1 principal component. The corresponding variance of U_2 is equal to λ_2. This procedure can be followed to derive the jth ($j = 1, \ldots p$) principal component, $U_j = \beta_j' X$ which is uncorrelated with the preceding principal components and has a variance equal to λ_j.

In general, the principal components of a matrix X are defined as p-variate random vector:

$$U = \begin{bmatrix} U_1 \\ \vdots \\ U_p \end{bmatrix} = \beta' X \qquad 4.35$$

where β denotes the set of normalized eigenvalues of Ψ. The covariance of U is

$$Cov(U) = E[UU'] = \beta' \Psi \beta = \Lambda \qquad 4.36$$

which means that the principal components are pairwise uncorrelated. In addition, U_j has the maximum variance among the normalized linear combinations which are uncorrelated with U_1 to U_{j-1}.

The classical notions of multivariate dispersion, that is, *total variance* and *generalized variance* are invariant under the principal component transformation. Let σ^2_{total} denote the total variance and σ^2_{gen}. Invariance with principal component is proved in equation (4.37) and (4.38).

$$\sigma^2_{total} = \sum_{j=1}^{p} \mathrm{var}[X_j] = tr\Psi \qquad 4.37$$

$$\sigma^2_{gen} = \det \Psi \qquad 4.38$$

tr and *det* are the trace and the determinant for random vector X.

$$\sigma^2_{total} = tr(\beta\Lambda\beta') = tr(\Lambda\beta'\beta) = tr\Lambda = \sum_{j=1}^{p} \lambda_j = \sum_{j=1}^{p} \mathrm{var}[U_j] \qquad 4.39$$

$$\sigma^2_{gen} = \det(\beta\Lambda\beta') = \det(\beta)\det(\Lambda)\det(\beta') = \det(\Lambda)\det(\beta'\beta) = \det(\Lambda) \qquad 4.40$$

Other properties attached to the principal components are defined when the dimensionality is reduced using the principal component technique (Flury, 1988; McCabe, 1984). Hence, principal component q ($q<p$) is an uncorrelated linear combination of the p-variate random vector X with maximum variance. With Ψ as the covariance matrix of X, the expression (4.35) is rewritten as follows:

$$Y = A'X \qquad 4.41$$

where A is a $p\times q$ matrix, q the largest eigenvectors of the covariance matrix and, $A'A=I_q$. The corresponding spectral decomposition for the covariance matrix of Y is

$$\Psi_Y = A'\Psi A \qquad 4.42$$

where $\lambda_1 \geq \lambda_2 \geq \ldots \geq \lambda_p \geq 0$ are the eigenvalues of the Ψ covariance matrix ranked in descending order.

The q principal components account for the total and general variance which are maximised as follows:

$$\max tr(\Psi_Y) = \sum_{j=1}^{q} \lambda_j \qquad 4.43$$

$$\max \det(\Psi_Y) = \prod_{j=1}^{q} \lambda_j \qquad 4.44$$

Now, assume that X_1 and X_2 are p-dimensional random vectors with the same distribution as X. Equation (5.8) is then rewritten as $Y_h = A'X_h \quad (h=1,2)$ so that the total and generalised variance are expressed as follows,

$$\max E[(Y_1 - Y_2)'(Y_1 - Y_2)] = 2\sum_{j=1}^{q} \lambda_j \qquad 4.45$$

$$\max \det\{E[(Y_1 - Y_2)(Y_1 - Y_2)']\} = 2\prod_{j=1}^{q} \lambda_j \qquad 4.46$$

Sample Principal Components

In many situations the covariance matrix is unknown, so that an unbiased statistic $\hat{\Psi}$ is required to analyzc the eigenstructure of the covariance and to estimate the principal components. Let S be the covariance of the observable variables or the sample covariance for the unbiased estimator of $\hat{\Psi}$. This sample covariance matrix is a positive definite matrix,[57]

$$S = \frac{1}{N-1}\sum_{h=1}^{N}(X_H - \overline{X})(X_H - \overline{X})' \qquad 4.47$$

for X random vector with $N(\mu, \Psi)$ multivariate normal distribution, $X_1,\ldots X_N$ is a random sample of size $N=n+1$, $\overline{X}$ denotes the mean, and the covariance matrix $\Psi = \beta\Lambda\beta'$ is positive definite. Then the maximum likelihood estimation of Ψ is

$$S^* = \frac{N-1}{N}S \qquad 4.48$$

The spectral decomposition of S provides the $p\times p$ matrix of orthogonal eigenvectors $B=(b_1,\ldots,b_p)$ and the L diagonal matrix with $l_1 > l_2 >\ldots> l_p$ eigenvalues. The sample principal components $\hat{U}_1,\ldots,\hat{U}_p$ in (4.50) are estimates of the population principal components given in equation (4.35).

$$S = BLB' = \sum_{j=1}^{p} l_j b_j b_j' \qquad 4.49$$

$$\hat{U} = B'X \qquad 4.50$$

Since the first element in each column of β is non-negative, the spectral decomposition of $\Psi = \beta\Lambda\beta'$ is unique if the eigenvalues $\lambda_1,\ldots,\lambda_p$ are distinct. For the sample covariance, the same condition is assumed for the first elements of B. With probability one, the decomposition of S, given by (4.49), is unique as well. The maximum likelihood estimates of β and Λ are the eigenvalues and eigenvectors of S^*, that is,

$$\hat{\beta} = B \qquad 4.51$$

$$\hat{\Lambda} = \frac{N-1}{N}L \qquad 4.52$$

Therefore, B and L are consistent estimators of β and Λ according to the general theory of maximum likelihood estimation.

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[57] Principal components do not change if the covariance matrix is replaced by the unbiased sample covariance.

In the remainder of this section we quote Flury's (1988) application of the large sample theory of maximum likelihood estimation for the inference on eigenvalues and eigenvectors.

Inference for eigenvalues

First, the j-th eigenvalue l_j is approximately distributed for large sample n,

$$l_j \sim N(\lambda_j, 2\lambda_j^2 / n) \tag{4.53}$$

The consistent estimate of the standard error of l_j is

$$s(l_j) = \sqrt{2/n}\, l_j \tag{4.54}$$

On the other hand, the use of the principal components as data reduction technique implies that a number of p-q components are discarded. In order to assess the goodness of fit of the model, it is necessary to determine the contribution of p-q components to the trace of the covariance matrix. In principal components p-q are often discarded when the fraction

$$f = \frac{\lambda_{q+1} + \ldots + \lambda_p}{\lambda_1 + \ldots + \lambda_p} \tag{4.55}$$

is smaller than a fixed value f_0.

A form to test the hypothesis that $f \le f_0$ for a fixed $f_0 \in (0,1)$ versus the alternative $f > f_0$ is based on

$$\hat{f} = \frac{\sum_{j=q+1}^{p} l_j}{trS} \tag{4.56}$$

Which is the consistent estimator of the fraction of variance accounted for by the last p-q components in Equation (4.55). The hypothesis is accepted if $\hat{f} \le f_0$.

The one-sided confidence interval for f with probability 1-α may be obtained as

$$0 < f \le \hat{f} + z_\alpha \sqrt{\frac{2}{n}} \frac{\left[(\sum_{j=1}^{q} l_j)^2 \sum_{j=q+1}^{p} l_j^2 + (\sum_{j=q+1}^{p} l_j)^2 \sum_{j=1}^{q} l_j^2 \right]^{1/2}}{(trS)^2} \tag{4.57}$$

Inference for eigenvectors

When the eigenvalues for several components are distinct,

$$\lambda_{h-1} > \lambda_h > \lambda_{h+1} \tag{4.58}$$

λ_h is the eigenvalue associated with eigenvector $b_h = (b_{1h}, \ldots, b_{ph})'$. The sampling variability of the principal components coefficients (i.e, standard errors of coefficients) is estimated before interpreting the components obtained. The asymptotic standard error of the component coefficient b_h is defined as,

$$s(b_{mh}) = \left[\frac{1}{n} l_h \sum_{\substack{j=1 \\ j \neq h}}^{p} \frac{l_j}{(l_j - l_h)^2} b_{mj}^2 \right]^{1/2} \tag{4.59}$$

where b_{mh} is the mth element of b_h. Large standard errors means that the component coefficients are unstable so there is no point in interpreting principal components.

The interpretation of a principal component is subjected to distinct eigenvalues of the covariance matrix Ψ. Then testing is done for two eigenvalues by means of the sphericity criterion. The null hypothesis is

$$H_0: \quad \lambda_{h-1} = \lambda_h \text{ and } \lambda_h = \lambda_{h+1} \tag{4.60}$$

and the alternative

$$H_1: \lambda_{h-1} \neq \lambda_h \text{ and } \lambda_h \neq \lambda_{h+1}$$

The statistic for two eigenvalues is,

$$S(l_{h-1}, l_h) := 2n \log \frac{l_{h-1} + l_h}{2\sqrt{l_{h-1} l_h}} \tag{4.61}$$

This corresponds to a chi square distribution with two degrees of freedom. When the null hypothesis is not rejected, the component coefficients are mathematically not uniquely defined. The associated eigenvalues only differ by sampling error). So there is no point in computing the standard errors or interpreting components either.

For the hypothesis of sphericity with more than two eigenvalues (that is for r distinct eigenvalues), the statistic becomes

$$X_r^2 = nr \log \frac{(1/r)\sum_{j=p-r-1}^{p} l_j}{(\prod_{j=p-r+1}^{p} l_j)^{1/r}} \tag{4.62}$$

This is also asymptotically distributed with chi squared with $r(r+1)/2-1$ degrees of freedom. When the number of eigenvalues is equal to the number of variables the criterion is known as overall sphericity criterion. If the null hypothesis is rejected for all eigenvalues then the principal components is not an adequate technique.

Appendix 4.3

Flury's Approach for a Partial Common Principal Component Model (PCPC)

Some introductory notions about PCPC are presented in this appendix. This is based on Flury (1987, 1988), which provides a more comprehensive explanation.

Overview of the Model. Introductory Notions.

The statistical model of PCPC assumes that a number of components, say q, is shared by several samples or groups, say, k. Technically speaking, PCPC is a particular case of the generalisation of PCA to several groups known as the *Common Principal Component model* (Flury 1988). The basic assumption is that the covariance matrices of k populations are simultaneously diagonalizable, or stated in another way, all components (i.e., $p=q$) are common in k samples. Covariance matrices of several samples could share one, various, or all components and further could be equal, proportional, or unrelated to each other. A complete hierarchy of relationships among covariance matrices is provided as follows. The most and least restrictive models correspond to equal and unrelated covariance matrices respectively (Phillips 1997).[58]

i. *Equality of all k covariance matrices.* Covariance matrices are identical.
ii. *Proportionality of all k covariance matrices.* Covariance matrices have exactly the same eigenvectors but their eigenvalues differ by a proportional constant. So each element of the covariance matrix is multiplied by a single constant.

[58] The various models can be defined by the formal hypotheses of equal covariances, proportional covariances, or common principal components,

H_0: $\Psi_2 = \Psi_1$ (equality)

H_0: $\Psi_2 = \rho\Psi_1$ $\rho > 0$ (proportionality) with ρ as a single constant.

and H_0: $\Psi_t = \beta\Lambda_t\beta'$ $t = 1,\dots,k$ where β is an orthogonal $p \times p$ matrix and $\Lambda_t = diag(\lambda_{t1},\dots,\lambda_{tp})$.

iii. *Common Principal Components model (CPC).* Covariance matrices share common principal components but their eigenvalues are different.

iv. *Partial Common Principal components model (PCPC).* Covariance matrices share q components ($q<p$) and the remaining eigenvectors are specific in each sample.

v. *Unrelated or arbitrary covariance matrices.* There is no relationship between covariance matrices.

The formal hypothesis of PCPC is as follows:

$$H_{PCPC}(q): \Psi_t = \beta^{(t)} \Lambda_t \beta^{(t)'} \tag{4.63}$$

with

q number of components under consideration (p denotes the number of variable, $q<p$),

Ψ_t a positive symmetric matrix ($p\times p$) for the t-th sample. ($t=1,...,k$)

and

$\Lambda_t = diag(\lambda_{t1},...,\lambda_{tp})$ with λ_t eigenvalues associated with the t-th sample.

and $\beta^{(t)} = (\beta_c, \beta_s^{(t)})$ where β_c -with dimension $p\times q$- are the common eigenvectors for all groups and $\beta_s^{(t)}$ (with dimension $p\times(p-q)$) are the specific eigenvectors for each sample. $\beta^{(t)}$ can be re-written as

$$\beta^{(t)} = (\beta_1, \ldots, \beta_q, \beta_{q+1}^{(t)}, \ldots, \beta_p^{(t)}) \tag{4.64}$$

Since β_c and $\beta_s^{(t)}$ are orthogonal, the number of common components in the partial model is restricted to the range $(1 \le q \le p-2)$ so that the number of variables p is at least 3.

The model given in (4.63) can be written in spectral decomposition form

$$\Psi_t = \sum_{j=1}^{q} \lambda_{tj} \beta_j \beta_j' + \sum_{j=q+1}^{p} \lambda_{tj} \beta_j^{(t)} \beta_j^{(t)'} \tag{4.65}$$

where β_j $(j = 1,\ldots,q)$ are the common eigenvectors of the k covariance matrices while $\beta_j^{(t)}$ $(j = q+1,\ldots,p)$ are the specific eigenvectors of these covariances.

In the present study we fit a partial CPC model with one common component (so q=1) which is associated with the largest eigenvalue. This component recovers then most of the variability in all k samples simultaneously, and further the composite index constructed on this basis explains the maximum information contained in the raw data. For that reason the hypothesis of one common component is therefore restricted to the eigenvector that retains the highest proportion of variance. For empirical purposes we assume a canonical rank order of the eigenvalues of all samples (Flury 1987).[59]

$$\lambda_{t1} \geq, \ldots, \geq \lambda_{tp} \tag{4.66}$$

where $(t = 1, \ldots, k)$ samples or groups and λ_t is the eigenvalue associated with the t-th sample.

Maximum Likelihood Estimation of Partial Common Components

The estimation of the partial common principal components is based on the independent sample covariance matrices S_t $(S_1,\ldots,S_k)$ with a Wishart distribution with n_t degrees of freedom and parameter matrix Ψ_t / n_t. The common likelihood function for $\Psi_1,..,\Psi_k$ given $S_1,\ldots,S_k$ is as follows (Flury, 1988):

$$L(\Psi_1,\ldots,\Psi_k) = C \times \prod_{t=1}^{k} etr(-1/2n_t \Psi_t^{-1} S_t)|\Psi|^{-1/2n_t} \tag{4.67}$$

where C is a constant which does not depend on the covariance matrix, n_t is the sample size for the t-th group and etr denotes the exponential function of tr trace.

Maximizing the likelihood is equivalent to minimizing the function:

$$g(\Psi_1,\ldots,\Psi_k) = -2\log L(\Psi_1,\ldots,\Psi_k) + 2\log C = \sum_{t=1}^{k} n_t (\log|\Psi_t| + tr\Psi_t^{-1} S_t) \tag{4.68}$$

Assuming that the null hypothesis on common components holds for a fixed number of components q, Flury (1988) obtains the function,

$$g = \sum_{t=1}^{k} n_t \left(\sum_{j=1}^{p} \log \lambda_{tj} + \sum_{j=1}^{q} \beta_j' S_t \beta_j / \lambda_{tj} + \sum_{j=q+1}^{p} \beta_j^{(t)'} S_t \beta_j^{(t)} / \lambda_{tj} \right) \tag{4.69}$$

This function is to be minimized under the restriction of orthogonality of all (common and specific) eigenvectors of the k covariance matrices. Flury (1987) formalises the orthogonality as follows:

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[59] This assumption is also used in classical PCA to classify components as first, second, etc., according to the share of variance explained by each component.

$$\beta_h'\beta_j = \begin{cases} 0 & (h \neq j) \\ 1 & (h = j) \end{cases} \quad (1 \leq h, j \leq q)$$

$$\beta_h^{(t)'}\beta_j^{(t)} = \begin{cases} 0 & (h \neq j) \\ 1 & (h = j) \end{cases} \quad (q < h, j \leq p; t = 1, \ldots, k) \tag{4.70}$$

$$\beta_h'\beta_j^{(t)} = 0 \quad (t = 1, \ldots, k;\ 1 \leq h \leq q < j \leq p)$$

The maximum likelihood equations obtained by Flury (1988) are:

$$\lambda_{tj} = \begin{cases} \beta_j' S_t \beta_j & (j = 1, \ldots, q), \\ \beta_j^{(t)'} S_t \beta_j^{(t)} & (j = q+1, \ldots, p) \end{cases} \quad (t = 1, \ldots, k) \tag{4.71}$$

$$\beta_h^{(t)'} S_t \beta_j^{(t)} = 0 \quad (j \neq h) \tag{4.72}$$

$$\beta_l'\left(\sum_{t=1}^{k} \frac{\lambda_{tl} - \lambda_{th}}{\lambda_{tl}\lambda_{th}} n_t S_t\right)\beta_h = 0 \quad (1 \leq l, h \leq q, l \neq h), \tag{4.73}$$

$$\left(\frac{1}{\lambda_{mj}} - \frac{1}{\lambda_{ml}}\right) n_m \beta_l' S_m \beta_j^{(m)} = \beta_j^{(m)'}\left\{\sum_{t=l\neq m}^{k}\left(n_t S_t \beta_l / \lambda_{tl} - \sum_{h=q+1}^{p} \delta_{lh}^{(t)} \beta_h^{(t)}\right)\right\}$$
$$(m = 1, \ldots, k; 1 \leq l \leq q < h \leq p) \tag{4.74}$$

where

$$\delta_{lh}^{(t)} = n_t \beta_l' S_t \beta_h^{(t)} / \lambda_{th} \qquad (t = 1, \ldots, k; 1 \leq l \leq q < h \leq p)$$

are the $kq(p\text{-}q)$ Lagrange multipliers introduced for the restrictions. Equation (4.72) indicates that the specific eigenvectors $\beta_h^{(t)}$ satisfy the same type of restrictions as if the principal components were estimated in each sample by means of classical PCA. Equation system (4.73) is exactly the same as the one occurring in ordinary common principal components but here it is only valid for the common components under consideration (that is l). The equation (4.74) links the common and specific component[60].

Denoting the exact maximum likelihood estimates by $\hat{\beta}^{(t)}, \hat{\Lambda}_t$ and $\hat{\Psi}_t$, respectively, Flury (1988) constructs an exact and approximate log likelihood ratio statistic for the null hypothesis $H_{PCPC}(q)$ versus the alternative of arbitrary covariance matrix:

[60] The method to solve the likelihood equations and the solution is given in Flury (1988). In addition a simple procedure to obtain approximate maximum likelihood estimates for large samples and S_t sample covariance matrices is also provided.

$$X_c^2 = -2\log\frac{L(\hat{\Psi}_1,\ldots,\hat{\Psi}_k)}{L(S_1,\ldots,S_k)} = \sum_{t=1}^{k} n_t \log\frac{|\hat{\Psi}_t|}{|S_t|} \qquad 4.75$$

$$X_{c,APP}^2 = -2\log\frac{L(\tilde{\Psi}_1,\ldots,\tilde{\Psi}_k)}{L(S_1,\ldots,S_k)} = \sum_{t=1}^{k} n_t \log\frac{|\tilde{\Psi}_t|}{|S_t|} \qquad 4.76$$

The number of parameters estimated under the alternative hypothesis is $\frac{1}{2}kp(p+1)$. Under the null hypothesis the number of parameters estimated is as follows: kp parameters for eigenvalues, $\frac{1}{2}p(p-1)$ parameters for one of the orthogonal matrices, say β^1, and $\frac{1}{2}(k-1)(p-q)(p-q-1)$ parameters for the specific eigenvectors of the other k-1 covariance matrices. Assuming that the number of common components q is $(1 \le q \le p-2)$ for a partial model of principal components, the number of parameters estimated in such a model is:[61]

$$\frac{1}{2}p(p-1) + \frac{1}{2}(k-1)(p-q)(p-q-1) + kp \qquad 4.77$$

By the general theory of likelihood ratio tests, the null distribution of the exact log likelihood ratio statistic is asymptotically chi-squared with:

$$\tfrac{1}{2}(k-1)\{p(p-1)-(p-q)(p-q-1)\} \qquad 4.78$$

degrees of freedom.

The covariance matrices between the estimated principal components are

$$F_t = \hat{\beta}^{(t)'} S_t \hat{\beta}^{(t)} = \begin{bmatrix} \hat{\beta}_c' S_t \hat{\beta}_c & \hat{\beta}_c' S_t \hat{\beta}_s^{(t)} \\ \hat{\beta}_s^{(t)'} S_t \hat{\beta}_c & \hat{\beta}_s^{(t)'} S_t \hat{\beta}_s^{(t)} \end{bmatrix} = \begin{bmatrix} F_{11}^{(t)} & F_{12}^{(t)} \\ F_{21}^{(t)} & F_{22}^{(t)} \end{bmatrix} \qquad 4.79$$

with $\hat{\Lambda}_t = diag\ F_t$. Similarly the correlation matrices can be re-written as:

$$R_t = \hat{\Lambda}_t^{-1/2} F_t \hat{\Lambda}_t^{-1/2} = \begin{bmatrix} R_{11}^{(t)} & R_{12}^{(t)} \\ R_{21}^{(t)} & I_{p-q} \end{bmatrix} \qquad 4.80$$

The standard errors of the first principal component coefficients estimated under the PCPC model computed in the empirical part of the present study are the standard errors for the first component under Common Principal Components (Appendix 4.1). As Flury (1988)

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[61] With arbitrary covariance matrices the number of parameters estimated is:

$$k\left[\frac{1}{2}[p(p-1)+p]\right]$$

suggests, the latter are valid approximations given that there is no an appropriate theory available at present for obtaining the standard errors estimated under PCPC.

Appendix 4.4

Estimation of Standard Errors under the Common Principal Component Model

According to Flury (1988) it is reasonable to assume that the standard errors computed under the common principal component model[62] for the first eigenvector are good approximations of standard errors under Partial Common Principal Component with one common component. Using consistent estimates,

$$\hat{\theta}_{jh}^{(t)} = r_t^{-1} \frac{\hat{\lambda}_{tj}\hat{\lambda}_{th}}{(\hat{\lambda}_{tj} - \hat{\lambda}_{th})^2} \tag{4.81}$$

with $r_t = n_t / n$ where n stands for k samples or groups $n = n_1 + \ldots + n_k$. In addition,

$$\hat{\theta}_{jh} = \left(\sum_{t=1}^{k} \hat{\theta}_{jh}^{(t)^{-1}}\right)^{-1} \tag{4.82}$$

a large sample estimate of the standard error of $\hat{\beta}_{mh}$ is defined as,

$$s(\hat{\beta}_{mh}) = \left(\frac{1}{n}\sum_{\substack{j=1 \\ j\neq h}}^{p} \hat{\theta}_{jh}\hat{\beta}_{mj}^2\right)^{1/2} \tag{4.83}$$

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[62] The formal hypothesis of this model is given in Footnote 3 in Appendix 4.2.

PART III

EMPIRICAL RESULTS

Chapter 5

Analysis of Inequality in Health Facilities and Health Status

5.1 Introduction.

In this century, Europe has made excellent improvement with regard to health. According to the EC reports, today's population is healthier than ever before (EC, 1996c; EC, 1997b). Signs of this improvement are found in the changes in vital statistics such as the steady rise in life expectancy, the decline of the infant mortality rate, and the increasing height of the population. Highly specialized health care systems, increasing governmental expenditures on public health and living conditions (improved housing, water and sanitation, better hygiene and improved nutrition) are often mentioned as the main contributory factors to the current state of population' health. However, these successes should not overshadow the current financial problems of public health services.[63] The developments in the modes of therapy, and the new technologies for prevention, diagnosis and treatment have involved notorious and costly medical advances. In addition, health care is more expensive since the number of patients being treated has increased.

The notion of health itself is a conceptual matter. The *World Health Organisation* (hereafter WHO) describes health as "*a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*" (WHO, 1981). But such a wide-

[63] As noted in Chapter 2, the European countries have responded to the uncertain financial sustainability with a policy strategy that combines the control of the health expenditures and the efficient provision of health systems. Solutions for the long term are however an ongoing political debate.

ranging definition has raised many criticisms. Emphasis is put on a subjective notion of well-being but this involves measurement problems: the relationship among the physical, mental and social elements of health is not specified (Horn, 1993). So it is not surprising to find many difficulties in describing an overall notion of health. For a comprehensive picture, the concept is explained in various ways (Horn, 1993; EC, 1996b). Health is viewed as the individuals' health perception, the status of population health or the provision of health systems.

The *health perception* concept defines individuals' self-evaluations based on the own perceptions of their health. Surveys of the general population provide statistical information on health perception. Respondents answer questions about various situations and attitudes regarding their recent illness. Measurements of health perception are ascertained grading the level of individuals' satisfaction on scales (for example, 0-4 signifies dissatisfaction whereas 6-10 indicates rather satisfied) or according to various categories (for example, *very good, good, poor* and *very poor* health). Although health perception gives some idea of an individual's health, this is a limited notion. Surveys appear to be highly dependent on the type of questions, age and the socioeconomic status of respondents.

Based on the definition, health perception indicates a positive meaning. In other words, health is referred to as the absence of illness. In contrast to this view, the *health status* gives evidence of the illness of patients. In many countries illness episodes registers (i.e., noticeable diseases) are classified according to the digit codes proposed by the WHO (1977, 1986, etc.). As Horn (1993) points out death is the antithesis of life and mortality rates reveal the outcome of the health status. On the basis of international coding systems, causes of deaths are also registered. In both type of records (morbidity and mortality), statistical information is usually available for several diseases and locations (hospitals, countries, regions, etc.).

Another approach is concerned with the *organization of health services*. Although there is a relationship between the state of public health and available health facilities, the definitions are not connected. The EC proposals states that "*health services contribute to improve health after the onset of disease and through prevention*" (EC 1997b). The provision of health care is described by the distribution of doctors across regions, the number of available hospitals, or public expenditures on health.

In the present chapter we investigate inequality in the organisation of health facilities and health status. Other views of health can not be considered because there are important gaps in the statistical information available at the geographical level of provinces. Since there are no surveys on health perception, health is studied without taking this subjective notion into consideration. In addition, we do not go into details about the provision for the aged and disabled, or the longer-term effects of ill health. The promotion of prevention policies and the quality (i.e., effectiveness) of health care are not included either. Although these aspects merit much more attention, its assessment is rather complicated and the process of data collecting involves many difficulties.

The remainder of this chapter is organized in two parts. The first part (Section 5.2) focuses on health facilities. Indicators used for the empirical analysis are described in Section 5.2.1. The effects of contiguity between geographical units (provinces) on the level of health services are discussed in Section 5.2.2. A procedure to include facilities located in contiguous units (neighboring provinces) is suggested in Section 5.2.3. The main aspects of the estimation procedure of Theil's second measure are enumerated in Section 5.2.4. The results of the estimation of the composite index when contiguity is considered are given in Section 5.2.5. The goodness of fit of the statistical procedure used is determined here. Inequality with respect to health facilities is analyzed in Section 5.2.6. In Section 5.2.7 the implications of the inclusion of contiguity are investigated. The second part (Section 5.3) centers on health status and it is arranged in a similar way to Section 5.2. Section 5.3.1 introduces indicators used for the analysis. The results of the estimation of the composite index are explored in Section 5.3.2. Finally, the analysis of inequality in health status is provided in Section 5.3.3. A summary and the main conclusions of this chapter are presented in Section 5.4.

5.2 Provision and Spatial Organization of Health Services.

5.2.1 Indicators for Health Facilities.

In this section we study inequality in health facilities using indicators that refer to general practitioners, health specialists, chemists and hospital beds per 10.000 inhabitants. Data relates to the fifty Spanish provinces for the years 1964, 1974, 1981 and 1991. The source for the statistical information is the *Spanish Institute of Statistics* (INE). All facilities have been considered as positive indicators in constructing the composite index.

5.2.2 Effects of Contiguity between Geographical Units. Spatial Spillovers in Welfare Facilities.

Since the public sector is the predominant supplier of health facilities in Spain[64], the government's role lies in an efficient and equitable distribution of such resources among individuals and regions.[65] Actually, the Spanish health act (LGS 1986) sets out that policy actions have to be equity-oriented and targeted towards the reduction of inequality. In terms of citizens' rights, this statement implies equal access to public resources for all individuals. But equal provision of public resources across the provinces (or even regions) would be very costly. Actually when needs are the same for all individuals, (economical) rationale tells us that the most appropriate geographical location of resources is, for instance, in urban and populated areas. The trade-off between the efficiency and equity leads to a certain level of spatial inequality. We address here the question of whether differences in

[64] As was explained in Chapter 2, Spain has a national health service in which the provision and financing is mainly within the public sector. This pattern of health services differs from more pluralist systems based on private (non-profit) and public provision. The health care in countries such as Belgium, France, Germany, Luxembourg and the Netherlands is financed by compulsory health insurance.

[65] For a more comprehensive explanation on the trade-off between efficiency and equity as policy goals, we refer to Chapter 3.

geographical access to health facilities (and in general, to any service) located in contiguous areas modify the available level of own services and consequently spatial inequality.

The answer to this question involves assuming interaction among geographical units and mobility of individuals. We explained earlier that regions are not isolated geographical units so that they interact to each other. Also, this argument could be extended to provinces. Considering the territorial division of regions in Spain it is possible that individuals commute to the nearest area with available resources which might be a province in an contiguous region or simply another province in the same region.[66] So available services for individuals in a geographical unit comprise not only the own but also the neighboring facilities.

In addition, we assume that:

i. Everyone who is seeking facilities has access to transportation.[67]

ii. Individuals are willing to move to contiguous or neighboring provinces or regions.

iii. Geographical differences in terms of travel distance or travel time have a negative impact on the level of health services. So, long journeys make the access to the services in contiguous provinces difficult.

iv. The use of neighboring services is legitimate; there are no legal barriers.

v. Neighboring or contiguous provinces are defined according to the notion of *order of connectedness* or *contiguity* in space (Hordijk, 1974; Folmer 1986).[68] Different orders can be defined. The *first order of contiguity* describes two spatial or geographical units (eg., regions, provinces or cities) that have a

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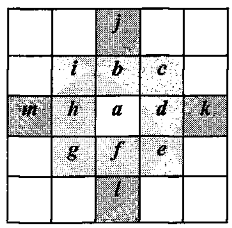
[66] Commuting for different purposes (e.g., work, education, etc.) has increased with the recent improvements in road networks and transport.

[67] Economic and social changes have led to the use of cars as the main means of transport in Spain in the last decades. Oil prices and car costs have decreased considerably. The Spanish society views cars as a sign of individual's wealth. The share of households with a car was 13% for 1964 and 34% in 1974 (*Sources*: Encuesta de Condiciones de Vida y la Vivienda INE 1964, INE 1974) whereas it increased up to 52% for 1981 and 64% for 1991 (*Sources*: Encuesta de Presupuestos Familiares INE 1981, INE 1991).

[68] The matrix of first order of contiguity is provided in Appendix 6.1.

common boundary of non-zero length (known as *rook criterion*), common vertex (i.e., *bishop criterion*) or both (i.e., *queen criterion*). A *second order of contiguity* is defined between two contiguous spatial units, one of them being first-order contiguous. For a spatial structure like the regular lattice displayed in Figure 5.1, the province labeled *a* is first-order contiguous to *b, c, d, e, f, g, h* and *i*. Also, *j, k, l* and *m* are first-order contiguous to *b, h, d* and *f* and second-order to *a*.

Figure 5.1. Contiguity on a Square Grid.



In general the concept of order of contiguity can be defined as follows. Assume that an area (say A), is partitioned into provinces A_r where $r = 1,2,\ldots,R$ such that

$$\bigcup_{r=1}^{R} A_r = A$$

$$A_r \cap A_{r'} = \varnothing$$

where $\forall r, r' \quad r \neq r'$

Then any two regions of A are first-order contiguous if they have common boundary of non-zero lengh. A region *r* of *A* is contiguous of *k*-th order (*k*>1) to a region *r*' of *G* ($r \neq r'$) if region r is first-order contiguous to one of the regions of A, which is contiguous of order *k*-1 to *r*' and is not already contiguous of an order less than *k*. Region is defined as non-contiguous with itself.

We consider only the first order contiguous provinces for health. Let us illustrate the possible effects of contiguity (i.e., access to facilities in neighboring areas) for the level of health services. We investigate three cases (Guadalajara, Toledo and Badajoz) that differ in two characteristics: the available services in the own region and the possibility of access to services in neighboring provinces.[69] For this illustration, the number of doctors per 1000 population represents the local facilities. The figure for the national average is 3.8 doctors per 1000 population and the maximum value corresponds to Zaragoza (5.5) and the minimum value corresponds to Ciudad Real (2.1). We evaluate the possibility of access to services in contiguous provinces using travel inputs such as *travel distance* (measured in kilometers) and *travel time* (measured in hours).

Table 5.1 reveals that people in Guadalajara or Toledo can easily reach the services located in Madrid. (Figure 5.2 displays the return journey by road which is used to obtain optimal distance and travel inputs). The estimated travel time between the provincial capital of both provinces and Madrid is shorter than one hour. Guadalajara and Toledo may then be at an advantage due to their proximity to Madrid. Access to health services may be improved for Guadalajara has a level of services similar to Madrid and also for Toledo which has a level of services below the national average (Table 5.1). So it is possible that there are spillover effects between the region of Madrid and the region of Castilla la Mancha (Toledo and Guadalajara are situated in Castilla la Mancha). However contiguity does not change the availability of facilities when provinces with below average facilities are far from the provinces with better level of facilities. Badajoz serves as example of this case. (Figure 5.3 displays the return journeys to the contiguous provinces). The shortest travel time (Table 5.1) is 90 minutes (98 km) between Badajoz and Cáceres (both provinces are situated in the region of Extremadura). The largest is 297 minutes (363 km) between Badajoz (Extremadura) and Toledo (Castilla la Mancha). In addition, the rate of doctors is below the national average in the closest province within the region (Cáceres), while provincial capitals of other provinces have a level of services similar low to Badajoz (Huelva), or have more facilities but are situated rather far away (Sevilla, Córdoba). So the travel inputs for Badajoz reveal that the facilities located in neighboring provinces within the region or in other regions do not improve the access to services for Badajoz. In this case it is difficult to find spill over effects between the region of Extremadura and adjacent regions.

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[69] Data is reported annually by the Spanish Institute of Statistics (INE).

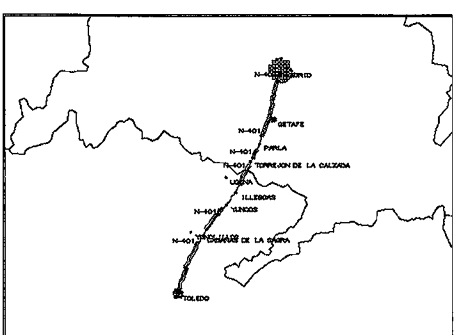
Table 5.1 Distance Factors and Available Health Services in Guadalajara, Toledo and Badajoz.

Province	Own Services[1]	Neighboring Province(s)[2]	Adjacent Services[1]	Travel Distance[3]	Travel Time[4]
Guadalajara	5.1	Madrid (Madrid)	5.0	58	37
Toledo	2.8	Madrid (Madrid)	5.0	74	53
Badajoz	3.0	Cáceres (Extremadura)	2.8	98	90
		Ciudad Real (C.Mancha)	2.4	323	260
		Cordoba (Andalucía)	3.4	275	213
		Huelva (Andalucía)	2.8	240	194
		Sevilla (Andalucía)	4.1	224	157
		Toledo (C.Mancha)	2.8	363	297

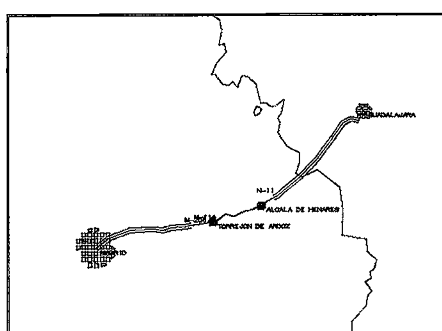
[1] Doctors per 1000 population in 1991
[2] First-order contiguous provinces. Name of the corresponding region to the province in brackets.
[3] Units in kilometers. Travel distance computed between provincial capitals.
[4] Units in minutes. Travel time computed between provincial capitals.
Source: Dirección General de Tráfico and INE.

So contiguity may change the level of health services when the geographical proximity to other provinces contributes to an increase in available facilities in the own province as a result of spill over effects. This applies also for education facilities. In the present chapter (and Chapter 6) we investigate whether this situation may affect the changes in overall inequality as well as the extent of intra-region and inter-region disparities.

Figure 5.2 Optimal way between Madrid and the Neighboring Provinces of Toledo and Guadalajara.

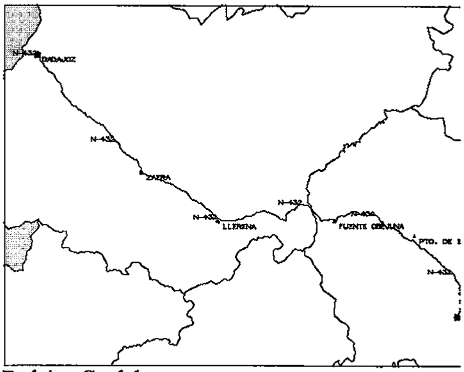


Return Journey to reach Toledo.

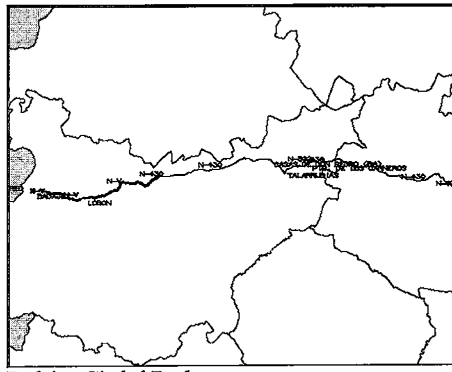


Return Journey to reach Guadalajara.

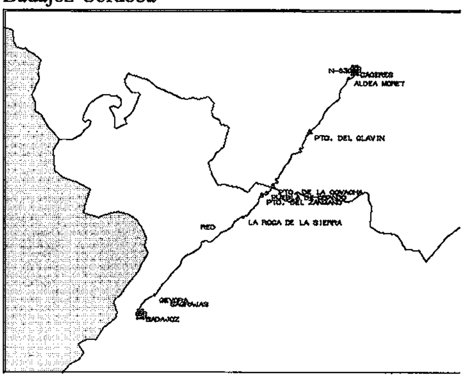
Figure 5.3 Optimal Way between Badajoz and its Neighbours (First Order of Contiguity).



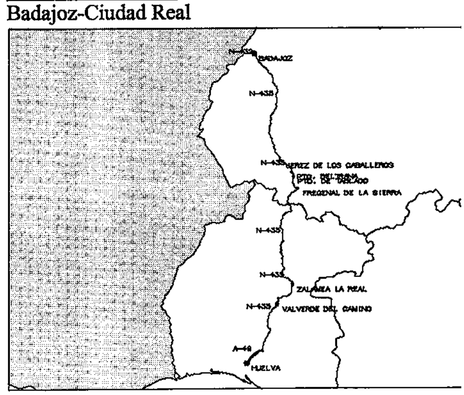
Badajoz-Cordoba



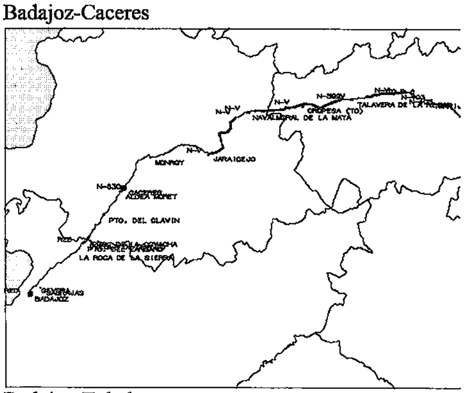
Badajoz-Ciudad Real



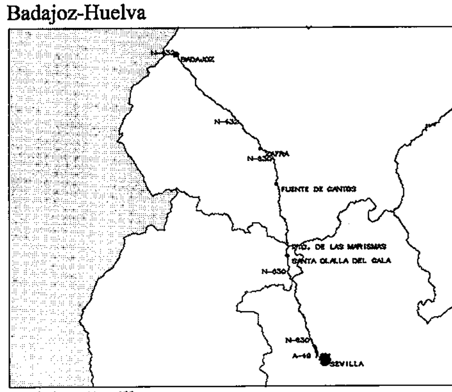
Badajoz-Caceres



Badajoz-Huelva



Badajoz-Toledo



Badajoz-Sevilla

5.2.3 Procedure for Incorporating Contiguity with respect to Health Facilities.

In this section we suggest a procedure for introducing contiguity into the analysis of public and private services. The proposed procedure is applied in this chapter (and also in Chapter 6 for education facilities). In order to determine whether there are spillovers, we compare the findings obtained when contiguity (hereafter *contiguity case*) is incorporated in the analysis and when it is not (*non-contiguity case*). This comparison also helps us to identify the most important geographical effects which may affect inequality. The geographical units considered here are provinces because these are needed to compute decomposition of Theil's second measure in between region and within region inequality (Section 4.3).

According to Nijkamp (1978), the level of available resources is co-determined by the facilities of the own province and its adjancent provinces. Data on services is then transformed to introduce information on facilities in contiguous provinces. For a province, say i, the level of available resources (A_i) is composed of the available services (denoted by A_i^L) and the services located in neighbouring provinces (A_i^N), that is,

$$A_i = A_i^L + A_i^N \tag{5.1}$$

Facilities in contiguous provinces are weighted as follows:

$$A_i^N = \sum_{\substack{j=1 \\ i\neq j}}^{J} w_{j_i} A_{j_i} \tag{5.2}$$

where $j = 1,\ldots,J$ are j-th contiguous provinces to i, (for health facilities only first order of contiguity is considered)

the j_i subscript refers to all j provinces contiguous to i,

A_{j_i} is the level of services in the *jth* first order contiguous provinces,

and w_{j_i} denotes the *spatial weights* where the j_i index corresponds to each province pair. Spatial weights reflect the proximity or "connectedness" between two provinces.

By substituting 5.2. into 5.1 we have:

$$A_i = A_i^L + \sum_{\substack{j=1 \\ i\neq j}}^{J} w_{j_i} A_{j_i}^N \tag{5.3}$$

Literature on spatial statistics has suggested expressions for the spatial weights based on a function of inverse distance known as *simple inverse distance* or *any integer power of the inverse distance* (Anselin, 1988).[70] So the distance between two provinces (provincial capitals) measured by travel inputs (i.e., travel time or travel distance) is raised to 1 or other integer powers:

$$w_{ji} = \frac{1}{d^{p}_{ji_i}} \quad 5.4$$

Where, d_{ji_i} denotes the distance between the i-th and j-th province and p indicates the integer power. In the present study p is 1.

In most applications the spatial weights are based on distance such as the estimated distance by road between provincial capitals, or the distance from the border. But weights may alternatively also be a combination of distance measures and the relative length of the common border between two spatial units, that is, the share in the total border length that is occupied by the other unit under consideration (Anselin, 1988). Let s_{ji} be the proportion of the interior boundary of province i which is in contact with province i. A possible spatial weight is:

$$w_{ji} = \frac{s_{ji}}{d^{p}_{ij_i}} \quad 5.5$$

In the present chapter and (Chapter 6) spatial weights are computed as the simple inverse distance (Equation 5.4 with p=1) because information on the boundary is not available.

The first order of contiguity (Appendix 5.1) is considered for health facilities because we assume that patients seek a first contact with doctors or specialized treatment and diagnosis at the *nearest* place to their home province.[71] Patients are treated in health

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[70] Measures based on the inverse distance are known as *Measures of Potential Interaction* between two observations.

[71] A suggestion for further research consists of introducing higher order of contiguity and in particular for specialized care. Another suggestion for further research consists of taking into account *central places* (for instance Madrid) These are provinces with highly specialized facilities and accessible from everywhere. So these provinces may provide facilities to individuals from different regions.

facilities in the own region due to the proximity to individual's place of residence. But there is some evidence that patients from neighboring provinces are attracted by the availability of services in certain provinces. As Cais et al (1993) report, patients admitted to hospitals in some provinces may move from their home province to central places which may be located in neighbouring provinces because health services for secondary care are not well set up in the origin province.

The spatial weight is computed as the inverse distance of the optimal distance between the provincial capital of the province under consideration and the provincial capitals of its contiguous provinces.[72] The optimal distance is assumed constant for the periods under consideration (due to non-availability of information), and it refers to the shortest way by road and it is constant over time due to unavailability of information. Recent information on roads and estimates of travel inputs are provided by the Ministry of Interior in Spain (*Dirección General de Tráfico*) so as the data on travel time used here refers to 1998.[73] We assume geographical centralization of the resources in the provincial capitals although the data refers to for the total supply within the province. The hypothesis that facilities are centralized in provincial capitals is justified as follows for the case of health facilities. The variables related to health resources consist of facilities for primary (first aid) and secondary care (specialized care). Secondary care facilities (specialists or specialized general hospital or private) are mostly located in the provincial capitals in Spain. It is reasonable to assume that individuals can commute to the provincial capitals when they need specialized treatment or diagnosis of their health problem.

5.2.4 Summary of the Main Aspects of the Estimation Procedure of Theil's Second Measure.

Before presenting the results with respect to health facilities, we first summarize the

[72] Alternative travel inputs such as distance between the border to the capital of neighboring province can not be obtained.

[73] Travel inputs in first order of contiguity are provided in Appendix 5.1.

main aspects of the estimation procedure of Theil's second measure for multidimensional inequality (described in detail in Chapter 4). In the empirical chapters (Chapters 5 to 7) we follow this sequence of steps to obtain the results. The notation used in Chapter 4 is also used here. So k stands for the number of samples, q denotes the number of components, and p indicates the number of variables.

Step 1. Sample covariance matrices that represent the welfare components under consideration are estimated for all four periods (samples). These matrices are used to obtain the eigenvalues and component coefficients (eigenvectors) of the first individual component using PCA.

Step 2. To determine if the composite index recovers most of the information contained in each sample separately, we calculate the proportion of total variance accounted for the first component. We assume that the proportion of variance is sufficiently large when it exceeds the criterion for selection (*good approach*) which is that the proportion of variance of the first component accounts for around 70% of the total variance. Otherwise we assume that the composite index obtained from the coefficients of the first component reveals partially the true information (*poor approach*). Also we compute the upper end of the 95% confidence region. This gives us the proportion of variance lost after extracting the first principal component.

Step 3. We interpret the first component on the basis of the component coefficients. The interpretation depends on the dominant variables (variables with the highest component coefficients of the first component). The robustness of this interpretation is tested in the following step.

Step 4. To test if the component coefficients of the first component are uniquely defined (so to evaluate the robustness of the interpretation given above) we use the sphericity test for the first two components. The null hypothesis is $H_0 : \lambda_1 = \lambda_2$ where λ_1 *and* λ_2 are the eigenvalues associated with the first two eigenvectors. The alternative is that the eigenvalues associated with the first and second eigenvectors are actually different ($H_1 : \lambda_1 \neq \lambda_2$). The statistic used is

$$S(l_1, l_2) := 2n \log \frac{l_1 + l_2}{2\sqrt{l_1 l_2}}$$

where l_1 is the eigenvalue associated with the first eigenvector of the sample covariance matrix, l_2 is the eigenvalue associated with the second eigenvector, and n is the sample size. The statistic is asymptotically distributed with chi squared 2 degrees of freedom. The critical value at the 5% level of significance with 2 degrees of freedom is X^2=5.99.

Step 5. If the hypothesis stated in Step 4 is not rejected, the interpretation of the first component is not robust, otherwise the procedure continues as in Step 6. Improvements in the robustness of interpretations of the component coefficients can be achieved in steps 9, 11 or 12.

Step 6. If the hypothesis stated in Step 4 is rejected, we test the stability of the component coefficients (p). We focus on the results for the first principal component to determine whether the interpretation of this component is robust. The asymptotic standard error of the component coefficient $(s(b_{mh}))$ of the component coefficient b_h which is defined as

$$s(b_{mh}) = \left[\frac{1}{n} l_h \sum_{\substack{j=1 \\ j \neq h}}^{p} \frac{l_j}{(l_j - l_h)^2} b_{mj}^2 \right]^{1/2}$$

where b_{mh} is the mth element of b_h and the sum in the equation above runs over the mth row of the consistent estimator (maximum likelihood) of the matrix of eigenvalues $B = (b_1, \dots, b_p)$ .n is the sample size and l_j and l_h are the eigenvalues associated with the jth and lth eigenvectors. According to Flury (1988, page 48) estimated standard component coefficients smaller than 0.1 indicate that the component coefficients are stable. So the interpretation of the first principal component is then considered robust at this stage. If not the PCPC is a useful tool to improve the stability of component coefficients of several samples. This model estimates a lesser number of parameters than PCA. So whenever this model is appropriate, the stability can be improved by using PCPC.

Step 7. To test if it is possible to reduce the number of parameters estimated for all samples, we use PCPC. The null hypothesis is $H_{PCPC}(q)$: $\Psi_t = \beta^{(t)} \Lambda_t \beta^{(t)'}$

where q is 1, Ψ_t (for t=1,...,4) are the covariance matrices computed for all samples individually (step 1) and $\Lambda_t = diag(\lambda_{t1},...,\lambda_{tp})$ with λ_t eigenvalues associated with the t-th sample. The eigenvector $\beta^{(t)} = (\beta_c, \beta_s^{(t)})$ consists of β_c (with dimension $p\times1$) which is the common eigenvector for all groups associated with the first component, and $\beta_s^{(t)}$ (with dimension $p\times(p-1)$) which is the specific eigenvector for each sample. So we test here if all four samples share the same first principal component. The alternative hypothesis is H_{PCA}: $\Psi = \beta\Lambda\beta'$ where $\beta = (\beta_1,...,\beta_p)$ is a $p\times p$ orthogonal matrix of eigenvectors of the Ψ covariance matrix which are associated with the corresponding eigenvalues of the Λ diagonal matrix of eigenvalues λ_j. Hence the alternative hypothesis is that four samples do not have the first component in common (component coefficients obtained by PCA).

Step 8. The exact maximum likelihood test for the null hypothesis $H_{PCPC}(q)$ versus the alternative H_{PCA} (arbitrary covariance matrix with component coefficients obtained using PCA) is

$$X_c^2 = -2\log\frac{L(\hat{\Psi}_1,\dots,\hat{\Psi}_k)}{L(S_1,\dots,S_k)} = \sum_{t=1}^{k} n_t \log\frac{|\hat{\Psi}_t|}{|S_t|}$$

Where S_t is the tth sample covariance matrix. Under the null hypothesis the distribution of X_c^2 is asymptotically chi squared with $\frac{1}{2}(t-1)\{p(p-1)-(p-q)(p-q-1)\}$ where p is the number of variables, q is 1 (only the first component is considered) and k is the number of samples.

Step 9. When the hypothesis stated in Step 7 is not rejected: first, we corroborate the goodness of fit of the PCPC model, second, the improvement of the stability of component coefficients is analyzed, and finally the first partial common component is interpreted. If not the procedure then continues as in Step 10. To study the goodness of fit, we compute the correlation matrices of the estimated components which are the first partial common component for all samples and the remaining individual components obtained by using PCPC. These correlation matrices are obtained as $R_t = \hat{\Lambda}_t^{-1/2} F_t \hat{\Lambda}_t^{-1/2}$ where F_t is the covariance matrix of estimated components, and $\hat{\Lambda}_t = diagF_t$. Under the null hypothesis of PCPC, correlations are expected to be close to a unit matrix of dimension p×1 (Flury, 1988). Standard errors of the first common component are computed as in Appendix 4.3. We use the standard errors to show the improvement in the stability of component coefficients after applying PCPC. The standard errors obtained using PCA are compared with those obtained using PCPC. Finally on the basis of the maximum likelihood estimates of the first partial common component for all four samples we interpret the first partial common component and compute the composite index.

Step 10. If the hypothesis stated in Step 7 is rejected for all four samples we test if it is possible to reduce the number of parameters for three samples (so t=1,...,3). To select these samples we look for similarity in the component coefficients (obtained using PCA) by carrying out a visual comparison. So we apply PCPC to the three samples that have the most similar component coefficients of the first *individual* component.

Step 11. If the hypothesis stated in Step 10 is not rejected on the basis of the exact maximum likelihood test (Step 8) applied to three samples we corroborate the goodness of fit of the model (if not the procedure continues as in Step 12). In addition, correlation matrices of the estimated components for the three samples are obtained. Finally, we use the maximum likelihood estimates of the first partial common component for the three samples to compute the composite index. The component coefficients for the remaining sample are those obtained using PCA. So the weights used are the same weights for the three samples under consideration in Step 10 and different weights for the remaining sample.

Step 12. If the hypothesis for three samples in Step 10 is rejected then it is tested with two samples (so t=1,2). The selection of the two samples is also based on a visual inspection of the individual component coefficients (PCA). If the hypothesis is not rejected for two samples we use the maximum likelihood estimates of the first partial common component (so same weights for two samples) to compute the composite index together with the different component coefficients for the remaining samples. The latter are those obtained using PCA. In case the hypothesis stated in the present step is rejected, the procedure continues as in Step 13.

Step 13. We conclude that it is not possible to reduce the number of parameters estimated when any two periods do not share the same component. In this case the composite indexes are computed using the component coefficients obtained using PCA as in Step 1. So different weights are used for all samples.

Step 14. On the basis of the composite indexes obtained in Steps 9, 11 and 12, we finally estimate Theil's second measure.

The statistical package used to estimate the Partial Principal Component model (PCPC) is CPC-Common Principal Component Analysis Program developed by Patrick Phillips (University of Texas at Arlington). This software has been adapted from FORTRAM versions written by Bernhard Flury. The statistical package used to estimate the Principal Component Model (PCA) is SAS.

5.2.5 Results of the Estimation of the Composite Index with respect to Health Facilities. The Contiguity Case.

We focus now on the empirical results of the estimation of the composite index with respect to health services in the case of contiguity. Positive indicators with respect to health facilities are: the number of general practitioners, specialists, chemists, and hospitals beds per 1000 population. In order to introduce contiguity we consider the level of available resources to be co-determined by the facilities in the own province and contiguous provinces (Equation 5.3). As explained, the first-order of contiguity between provinces is considered. The spatial weights are calculated on the basis of the simple inverse distance function (Equation 5.4) where the integer power is 1. We consider travel time in minutes from the provincial capital to neighboring provincial capitals as travel inputs (Appendix 5.1)[74].

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[74] The results of the estimation of composite index with respect to the non-contiguity case of health

The results obtained after following Steps 1 to 4 with respect to the welfare component of health services are given in Tables 5.2 and 5.3. Table 5.2 displays the information concerning the eigenvalues obtained in separate analysis of the four samples. The first principal component recovers 60-70% of total variability. The upper end at a significance level of 5% indicates that the lost variance after discarding the three remaining components is between 40 and 60% of total variability.

Table 5.2 Analysis of the First Eigenvalues (Principal Components Variances) with respect to Health Services.

	1964	1974	1981	1991
Eigenvalues	0.083	0.060	0.075	0.058
Standard Errors	0.017	0.012	0.015	0.012
Standard Deviation	0.288	0.246	0.274	0.240
Proportion of Total Variance	0.71	0.62	0.72	0.68
Upper end of 95% confidence region	0.452	0.584	0.518	0.426

Table 5.3 reveals that the variables related to health staff (*specialist* and general practitioners in particular) and hospital beds are more dominant than the remaining in the first principal component (PCA). But the component coefficients for all samples are positive for all variables and have values ranging between 0.3 and 0.6 (Table 5.3). So we interpret the first component as an overall measure of health facilities (Step 3). This interpretation is robust from a statistical point of view because the hypothesis of sphericity between the first and second eigenvalues (Step 4) is rejected at any level of significance for all samples (Table 5.3). For all samples, chi-square is larger than the critical value at the 5% level of significance with 2 degrees of freedom (X^2 is 5.99). In Table 5.3 asymptotic standard coefficients of the first component are displayed (Step 6). Since the component coefficients are stable we conclude that the first component has been reasonably interpreted.

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facilities are provided in Appendix 5.2.

Table 5.3 Coefficients of the First Principal Component with respect to Health Services. Standard Errors in Brackets. Sphericity Test for the First and Second Eigenvalues.

Group	1964		1974		1981		1991	
Practitioners	0.4442	(0.0462)	0.6113	(0.0528)	0.5005	(0.0345)	0.4981	(0.0326)
Chemists	0.3444	(0.0501)	0.3411	(0.0660)	0.2690	(0.0572)	0.3619	(0.0687)
Specialists	0.6265	(0.0556)	0.5798	(0.0686)	0.6247	(0.0529)	0.5686	(0.0644)
Hospital Beds	0.5400	(0.0629)	0.4169	(0.0941)	0.5356	(0.0592)	0.5456	(0.0655)
Sphericity Test for the First and Second Eigenvalues								
Chi Square (2 Df)	31.34		18.95		33.17		26.75	

We apply the partial common principal component model to test the hypothesis that all samples share the same component, or the alternative being that they do not (Step 7). The restricted model with one component fits well since the chi square is 7.739 with 9 degrees of freedom (p-value 0.5607) (Table 5.4). The covariance and correlation matrices between the estimated principal components (Step 9) are given in Table 5.6 in a combined form (the variances and covariances are on and above diagonal, while correlations are below the diagonal). The correlation between the first common component (1st PCPC) and the remaining three components computed individually (2nd PCA, 3rd PCA and 4th PC) under PCPC is not very high from a practical point of view (the highest correlation is 0.33 between the 1st PCPC and the 4th PC). This corroborates the goodness of fit of PCPC.

The results on the approximate maximum likelihood estimates of the first common component are displayed in Table 5.5 along with the standard errors (Step 9). The coefficients of this characteristic vector and the corresponding characteristic roots vary very little with regard to those given in Tables 5.2 and 5.3. So we interpret this component as an overall measure of health facilities. Looking at the standard error of the first common component (Step 9) we may conclude that the foregoing interpretation makes sense from a statistical point of view because the coefficients are stable as found in the PCA.

Table 5.4 Test for Partial Common Principal Components for the 1964, 1974, 1981 and 1991 samples with respect to Health Services.

Test for One Common Principal Component

	PCPC(1)
Number of Estimated Parameters in the Model	31
Likelihood Ratio Test Chi Square	7.739
Degrees of Freedom	9
p-Value	0.5607

Table 5.5 Approximate Maximum Likelihood Estimates for the 1964, 1974, 1981 and 1991 Samples with respect to Health Services. Standard Errors of the First Common Component in Brackets.

a. Coefficients of the First Common Principal Component. Standard Errors in Brackets.

Practitioners	0.5160	(0.0197)
Chemists	0.3156	(0.0312)
Specialists	0.6024	(0.0292)
Hospital Beds	0.5209	(0.0339)

b. Characteristic Roots for the First Common Principal Component.

	1964	1974	1981	1991
Characteristic Roots	0.082	0.059	0.075	0.058
Proportion of Total Variance	0.70	0.61	0.72	0.68

Table 5.6 Covariance (F) and Correlation (R) Matrices of Estimated Components for the 1964, 1974, 1981 and 1991 Samples with respect to Health Services.†

a. Matrices for the 1964 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.07888	-0.00044	0.00806	0.00685
$R_{64}\backslash F_{64}$	=	-0.01384	0.01284	0	0
		0.23309	0	0.01515	0
		0.33402	0	0	0.00534

b. Matrices for the 1974 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.05351	0.00328	-0.00264	-0.00076
$R_{74}\backslash F_{74}$	=	0.10898	0.01692	0	0
		-0.09638	0	0.01407	0
		-0.04223	0	0	0.00611

c. Matrices for the 1981 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.05697	-0.0034	-0.00244	-0.0025
$R_{81}\backslash F_{81}$	=	-0.11238	0.0161	0	0
		-0.09419	0	0.01175	0
		-0.15055	0	0	0.00485

d. Matrices for the 1991 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.04601	-0.00178	-0.00076	-0.0007
$R_{91}\backslash F_{91}$	=	-0.07029	0.01388	0	0
		-0.03372	0	0.01102	0
		-0.04989	0	0	0.00429

† On and above diagonal variances and covariances of the first common component. Below diagonal correlations.
1st PCPC: First common principal component. This is obtained using PCPC.
2nd, 3rd and 4th PC: Second, third and fourth principal component computed individually using PCPC.

5.2.6 Analysis of the Spatial Inequality with respect to Health Facilities. The Contiguity Case.

As explained in Section 5.2.3 the analysis focuses now on the results of inequality taking into account the contiguity between first-order contiguous provinces. Total inequality declines between 1964-1974 and 1981-1991 (Table 5.7) implying that the distribution of health facilities has become more uniform in Spain over these periods. Overall inequality increases between 1974 and 1981. Inequality declines particularly sharply between 1964 and 1974. This drop in Theil's second measure may be due to data problems. We suspect that the results may be influenced by the accuracy of data in 1964. The statistical source used for data collection of 1964 is *Censo de Establecimientos Sanitarios* (INE), while the source for the remaining samples is *Estadística de Establecimientos Sanitarios en Régimen de Internado* (INE). The results for the 1974, 1981 and 1991 samples are therefore more comparable and reliable for longitudinal analysis of inequality than the 1964 sample. Note that the change in inequality between 1964 and 1974 periods have not been affected by the use of different weights because the same partial principal component model is used for the four samples. Composite indexes for the four samples have thus been calculated with the same component coefficients of the first partial common component. Therefore since the 1964 sample seems not very comparable in relation to the remaining samples, the analysis is limited to results for 1974, 1981 and 1991.

Table 5.7 Theil's Second Measure with respect to Health Facilities. The Contiguity Case.

	1964		1974		1981		1991	
	$T_{-1}(W_{\bullet})$	%	$T_{-1}(W_{\bullet})$	%	$T_{-1}(W_{\bullet})$	%	$T_{-1}(W_{\bullet})$	%
Between-Region	0.0173	77.2	0.0088	59.6	0.0092	55.2	0.0057	44.9
Within-Region	0.0051	22.8	0.0059	40.4	0.0074	44.8	0.007	55.1
	$T_{-1}(W_{\bullet})$		$T_{-1}(W_{\bullet})$		$T_{-1}(W_{\bullet})$		$T_{-1}(W_{\bullet})$	
Total Inequality	***0.0224***		***0.0147***		***0.0166***		***0.0127***	

Overall inequality increases between 1974-81 while there is a sharp drop in the inequality between 1981-91. This occurs in the period of changes in the health system prior to the establishment of the national health service system (in 1986). Between 1974 and 1981, there was little change in health service coverage which was just over 80% of the population. In 1978, the INSALUD (National Institute of Health) was created under the central government in order to streamline the provision of health services. These changes reflect the process of modernisation taking place in the health system that culminated with the Health Act of 1986.

There is a substantial decline in inequality between 1981 and 1991 which may be due to the 1986 health act (*Ley General de Sanidad*). This act was enacted to regulate the public health system resulting in improvements in health care. The Health act of 1986 estblished the principle of universal right to publicly founded health care with 99.5% coverage of the population. This is likely to have resulted in the reduction of inequality with respect to health facilities.

The decomposition of overall inequality is given in Table 5.7. The percentage of between-region inequality in overall inequality has decreased from 55.2% of the overall inequality in 1981 to 44.9% in 1991. This drop coincides with the devolution of power in health issues to certain regions. Moreover there is an important change in the main source of overall inequality. This is between-region inequality in 1974 and 1981 while within-region is the main source of inequality in 1991. So our results suggest that during the eighties the increase of autonomy in health issues may have caused changes in the pattern of regional inequality.

The regions with the highest values in the region's share of within-region inequality are the same in 1981 and 1991 (Appendix 5.5). In 1991 Castilla León's share of within-region inequality is 21.9%, Castilla la Mancha's share is 57.9% and Andalucía's share is 12%. All these regions are bound by similar regional features, such as, limited industrial development, abundant potential in natural resources, predominance of agriculture and they are situated in the Centre and South of Peninsula. In addition they occupy 53% of the Spanish territory (total land size). So within-region inequality may have affected by the characteristics of these regions. The region's contribution to within-region inequality has changed especially in regions with powers in health. Within-region inequality in Cataluña, Comunidad Valenciana, País Vasco, and Galicia has reduced between 1981 and 1991 while the share remains constant in Canarias.[75] These results suggest that regional policies may have contributed to distribute facilities within regions when regional authorities have powers in health issues. Another region with autonomy in health care is Andalucía but the region's share of within region inequality increases between 1981 and 1991. It is possible that regional policies in health may have not caused much impact on the geographical distribution of facilities of Andalucía due to the socio-economic conditions there.

We investigate how the classification of regions has changed over time using cluster analysis[76]. We classify the Spanish regions into two groups, the most-favoured and the least-favoured in health facilities with respect to the composite index for regions. The map given in Figure 5.4 represents cluster analysis carried out with the composite index for 1991. It is observed that regions geographically situated in the North of the Iberian Peninsula have better health facilities in comparison with the group consisting of the Southern regions (Andalucía, Extremadura, Murcia and Comunidad Valenciana), Galicia (that lies in the Western tip of Spain) and the archipelago of Canarias. This indicates that the regional distribution of health facilities in 1991 describes a geographical pattern of clustered regions. The regions of Andalucía, Galicia and Extremadura included in the least-favoured group are less densely populated areas and are traditional agricultural economies with levels of GDP below the EU average. So we suggest that there is a relationship between the location of health facilities and the socio-economic conditions of regions.

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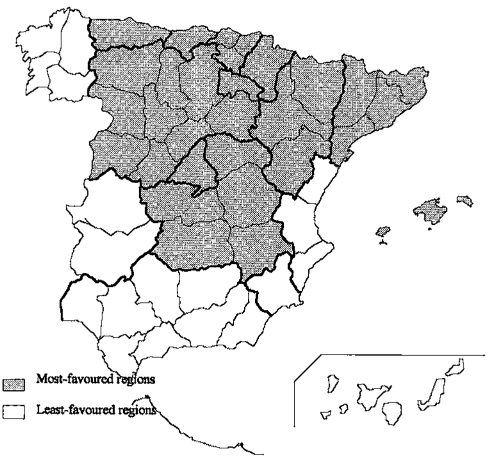
[75] See Appendix 5.5. Cataluña's share of within-region inequality is 2.4% in 1981 and 1.1% in 1991; Comunidad Valenciana's share is 3% in 1981 and 1.2% in 1991; País Vasco is 1.8% in 1981 and 1.4% in 1991, Canarias's share is 0.7 in 1981 and 1991, and Galicia's share is 3.9% in 1981 and 0.8% in 1991. Andalucía's share is 8.3% in 1981 and 12% in 1991. Note that there are no results for within-region inequality in Navarra. The lowest territorial division considered in the present research is provinces so that it is not possible to obtain values for within-region inequality in regions consisting of one province like Navarra.

[76] The cluster analysis identifies the two distinct groups (*most-favoured and least-favoured regions*) which are more similar with respect to the composite index within the group and dissimilar to the other group. For this statistical analysis we use the composite index of regions (when cluster analysis identifies two groups of regions) or the composite index of provinces (when cluster analysis identifies two groups consisting of provinces of a region). A brief description of this statistical technique is provided in Appendix 5.3. For a more comprehensive explanation we refer to the literature also given in this appendix.

Figure 5.4 Clusters of Most-Favoured and Least-Favoured Regions with respect to Health Facilities in 1991. The Contiguity Case[77].



Least-Favoured regions:

Andalucía, Canarias, Comunidad Valenciana, Extremadura, Galicia, Murcia.

Most-Favoured regions:
Aragón, Cataluña, Asturias, Cantabria, Castilla León, Castilla La Mancha, Madrid, Navarra, País Vasco, La Rioja, Baleares.

The geographical patterns over time have not changed very much compared to what is shown in Figure 5.4. Maps of clusters for the remaining periods (not provided here) are very similar to the previous figure, and the main difference is that the group of most-favoured regions in 1981 includes of Comunidad Valenciana as well as the Northern regions.

5.2.7 Implications of Including Spillover Effects. Comparison of the Contiguity Case and the Non-Contiguity Case.

Now we compare the results of the contiguity case with the non-contiguity case. Table 5.8 shows the trends of overall inequality as well as inequality decomposition in the case of non-contiguity. In line with the reasoning given for the contiguity case we suspect

[77] In the contiguity case with respect to health facilities for 1991, the most-favoured regions with respect to composite index range from 0.54 (La Rioja) to 0.55 (Cantabria) while the composite index for the least-favoured regions ranges from 0.48 (Canarias) to 0.46 (Andalucía).

that the results may be influenced by the lack of accuracy of the data in 1964. So the comparative analysis is limited to the results for 1974, 1981 and 1991.[78]

Table 5.8 Theil's Second Measure with respect to Health Facilities. The Non-contiguity Case.

	1964		1974		1981		1991	
	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%
Between-Region	0.0158	75.6	0.0088	66.4	0.0085	65.5	0.0057	58.2
Within-Region	0.0051	24.4	0.0045	33.6	0.0045	34.5	0.0041	41.8
	$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$	
Total Inequality	***0.0209***		***0.0133***		***0.0130***		***0.0097***	

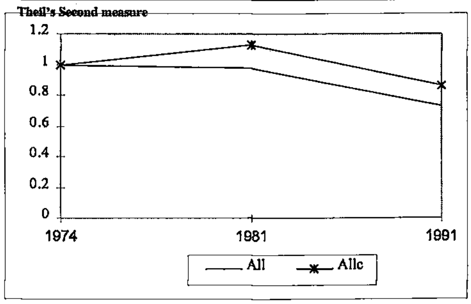
Inequality is larger in the contiguity case than in the non-contiguity case. In the contiguity case we assume that the individual's access to available services are higher than in the non-contiguity case. The inclusion of geographical proximity implies that individuals have access to facilities in the home area and further other areas near by. So individuals are considered to have access to similar opportunities in their place of residence or else in surrounding areas. Since our results reveal that inequality is larger in the contiguity case, it is possible that regions have not been favoured equally by spatial spillovers. So the availability of health facilities in certain regions of Spain may not have improved (even including services in contiguous areas) resulting in an increase in overall inequality.

Figure 5.5 shows that overall inequality increases between 1974-81 in the contiguity case while the trend in inequality does not change much for the non-contiguity case over this period. The comparison reveals that inequality is particularly affected by the location of facilities in adjacent provinces. When the non-contiguity case is considered, it is

[78] In the case of non-contiguity changes in inequality in 1964 may be also due to the use of different component coefficients. Component coefficients used for 1964 are obtained using PCA while the coefficients for the remaining samples are obtained using PCPC. The use of different coefficients may have modified the inequality index because of the changes in the dominant variables. These variables in the composite index (constructed with the first separate principal component or PCA) are specialists and hospital beds ratio for the 1964 sample. The composite index for the 1974, 1981 and 1991 samples (based on the approximate maximum likelihood estimates of the PCPC model) depends on specialists and general practitioners. But we suspect that the sharp drop in Theil's second inequality is because the data is not very accurate.

not possible to determine the impact of health policies on the trend in inequality between 1974 and 1981. The trend in inequality between 1981 and 1991 is the same in the contiguity and non-contiguity case. Therefore we conclude that the most important improvements in terms of inequality may have arisen from the 1986 health act.

Figure 5.5. Trends of Theil's Second measure in Overall Inequality with respect to Health Facilities (The Contiguity and Non-contiguity Cases). 1974 Base Year.

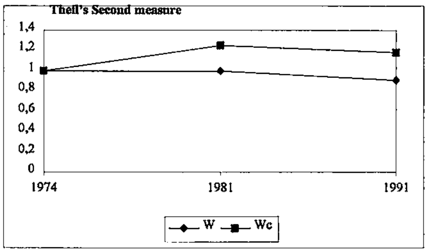


All: Spatial or overall inequality. Allc: Spatial or overall inequality considering contiguity.
Year 1974 =1

The inclusion of contiguity has resulted in an important change in inequality in within-region inequality and between-region inequality. Figure 5.6 shows that although the between-region inequality does not change much between 1981 and 1991, within-region inequality is much larger in the contiguity case. This may be because commuting is more likely within regions in Spain in the case of health facilities. Although there are no legal barriers to the use of facilities in neighbouring regions, individuals are mostly treated in the health systèm of their home region. In addition there are important spillover effects in the North of Spain which may contribute to increase the disparities between the Northern and Southern regions. So the nature of the health system may affect to distribution of facilities.

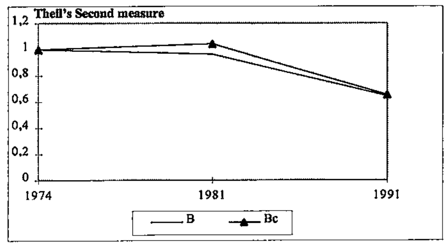
Figure 5.6 Trends of Theil's Second Measure in Between-Region and Within-Region Inequality with respect to Health Facilities (The Contiguity and Non-contiguity Cases). 1974 Base Year

Within-Region Inequality



W: Within-regions inequality. Wc: Within-regions inequality considering contiguity.
Year 1974 =1

Between-Region Inequality

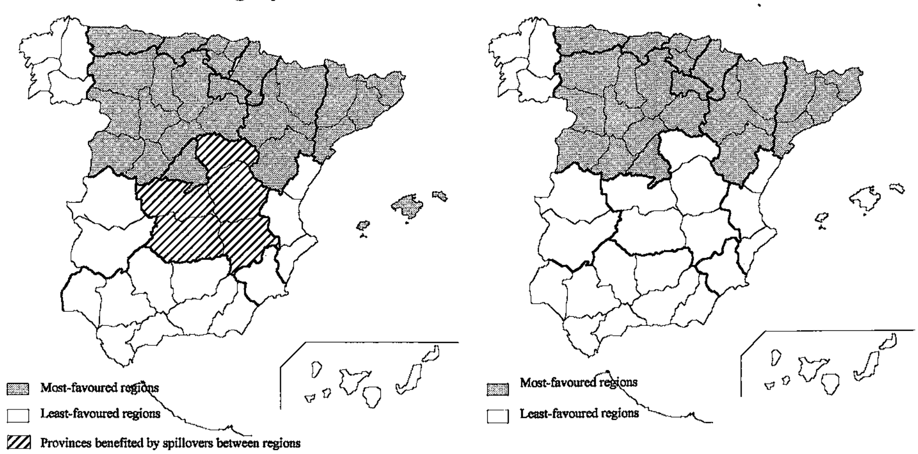


B: Between-regions inequality. Bc: Between-regions inequality considering contiguity.
Year 1974 =1

The map given in Figure 5.7 presents the results of cluster analysis carried out with the composite index for 1991 in the contiguity and non-contiguity cases. These geographical patterns reveal that Castilla la Mancha is not included in the most-favoured group of regions in health facilities in the non-contiguity case but it is in the contiguity case. So the comparison suggests that the most important spillovers effects between regions in health facilities are observed in the centre of Spain. Castilla la Mancha is geographically placed at the centre of the Iberian Peninsula so geographical spillovers are due to the proximity (first-order contiguous) of the provinces of Toledo and Cuenca to a central place like Madrid (Appendix 5.1). The availability of services in these provinces changes when facilities in Madrid are considered and consequently, there is an improvement of facilities in the region. As seen from the ranking of the fifty Spanish provinces with respect to health facilities, Toledo and Cuenca change their positions in the contiguity case (Appendix 5.4). Thus Toledo ranks in the 37th position when adjacent facilities are not included, while the province's position in the ranking is 34th in the contiguity case. The availability of facilities improves more dramatically in Cuenca because this province's position changes from the 45th to 23rd. So there are important spillovers between the region of Castilla la Mancha and the central place of Madrid.

Figure 5.7 Clusters of Most-Favoured and Least-Favoured Regions with respect to Health Facilities at 1991. Comparison between the Contiguity and Non-Contiguity Cases.

The Contiguity Case[79] **The Non-Contiguity Case**[80]



The Contiguity Case

Least-Favoured regions:
Andalucía, Canarias, Comunidad Valenciana, Extremadura, Galicia, Murcia.
Most-Favoured regions:
Aragón, Cataluña, Asturias, Cantabria, Castilla León, Castilla La Mancha, Madrid, Navarra, País Vasco, La Rioja, Baleares.

The Non-Contiguity Case

Least-favoured regions:
Andalucía, Canarias, Comunidad Valenciana, Extremadura, Galicia, Murcia, Baleares, Castilla La Mancha.
Most-favoured regions:
Aragón, Cataluña, Asturias, Cantabria, Castilla León, Madrid, Navarra, País Vasco, La Rioja.

Spillover effects within regions may also improve the level of available facilities in the province of the region of Castilla la Mancha. We carry out a cluster analysis using the values of the composite index of health facilities for the 5 provinces of Castilla la Mancha. The results show that the group of most-favoured provinces consists of Guadalajara in the contiguity and non-contiguity case. So although Guadalajara is a central place in Castilla la Mancha which may be providing services to neighbouring provinces, the inclusion of geographical proximity does not modify the group of most-favoured provinces within the region. Note that since the analysis is limited to first order contiguous provinces, only

[79] In the contiguity case of health facilities for 1991, the most-favoured regions with respect to composite index range from 0.54 (La Rioja) to 0.55 (Cantabria) while the composite index for the least-favoured regions ranges from 0.48 (Canarias) to 0.46 (Andalucía).

[80] In the non-contiguity case with respect to health facilities for 1991, the most-favoured regions with respect to composite index range from 0.81 (Madrid) to 0.63 (Castilla León) while the composite index for the least-favoured regions ranges from 0.6 (Galicia) to 0.46 (Canarias).

Cuenca may be benefited by facilities in Guadalajara. So we conclude that the improvement in the availability of services in Cuenca may be due to geographical spillovers within the region and between regions. But it is likely that Toledo is only favoured by facilities provided in Madrid.

We also analyse within-region spillovers for other regions with high intra-regional disparities such as Andalucía and Castilla León (Appendix 5.5). The results for Andalucía show that the group of most-favoured provinces within the region do not change much when contiguity is considered. In the case of contiguity, the cluster consists of Sevilla, Málaga, Granada and Córdoba. The inclusion of Córdoba in the group of favoured provinces is a consequence of its geographical situation. Thus, the first-order contiguous provinces of Córdoba are Sevilla, Málaga and Granada (favoured regions). So there are clear spillover effects between Córdoba and its neighbours. On the other hand, Cádiz is not favoured by its geographical situation. This province, which is situated in the most Southern part of Andalucía, is not included in the most-favoured group when contiguity is considered. In addition, the province's rank decreases dramatically from the 29th (non-contiguity) to the 46th (contiguity) position with respect to health facilities for the 50 Spanish provinces.

Finally, we investigate spillover effects within the region of Castilla León (Appendix 5.5). We have found that the cluster of most-favoured provinces consists of Palencia, Segovia, Soria and Avila. The comparison of cluster analysis in the contiguity and non-contiguity cases shows improvements in the availability of health services in Avila. This province is benefited by first-order contiguous provinces with levels of health facilities higher than the own facilities. The availability of facilities in Avila may be affected by its proximity to Segovia or Salamanca.[81] So Avila's position in the ranking with respect to the 50 Spanish provinces changes from the 26th in the non-contiguity case to the 3rd in the contiguity case.

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[81] In the ranking of provinces with respect to health facilities given in Appendix 5.4 it appears that the provinces neighbouring Avila: Madrid, Segovia and Salamanca, rank higher than Avila.

5.3 Health Status.

5.3.1 Indicators for Health Status.

In this section health is viewed as a medical phenomenon. We will to compare the results with respect to population' health status and the provision of health facilities in order to see if there is a relationship between the two. The analysis with respect of health status is carried out using data on morbidity and mortality.[82] To identify diseases which cause high morbidity or are likely high mortality rates, the European Community suggests the following criterion (Table 5.9). In terms of scourge, the major *Health Threats* or *Health Problems* describe those diseases which cause significant premature death, ill health or serious disabilities (EC, 1996b). From an economic point of view, the impact of diseases on the cost of health services has to be taken into account. This is because many health problems require expensive treatment and diagnosis. The impact of the age structure on diseases may also be a relevant factor because particular age groups are affected by certain diseases and rarely the whole population. For instance cancer or circulatory diseases are commonly diagnosed in adults and older people. And the motor vehicle accidents cause high mortality to the age group 25-34 years. So there is a relationship between certain diseases and the age-structure.

[82] Other alternative measures to study health status are hospital use ratios or patient admissions to hospitals. But they are not available at different levels of spatial detail for the periods under consideration. This is in the case the Spanish provinces because the registers on patient admittance are available only up to the mid-seventies.

Table 5.9 Diseases Producing High Mortality and/or Morbidity in the European Community, 1991

Disease Health Problem	Costs for Health Services	Major Scourge	Age Group	Age Profile Years
Cancer	Medium	High	Adults Older People	35-64 65 +
Diseases of the Circulatory System	High	High	Adults Older People	35-64 65 +
Mental Disorders (Including suicides)	High	Medium	Young People Adults	15-34 35-64
Accidents (motor vehicle)	High	High	Young People	25-34
Drug and Alcohol Abuse	Medium	High	Adults	35-64
Musculo Skeletal Problems	High	Medium	Adults Old People	35-64 65 +
Respiratory Diseases	Medium	Medium	Adults Older People	35-64 65 +
Congenital Abnormalies	Medium	None	Babies	0-1
Perinatal Conditions	Medium	None	Babies	0-1
Visual Problems	Low	None	-	-
Auditory Problems	None	None	-	-
Communicable Diseases[1]†	Medium	Medium	Adults	35-64
Childhood Infections[2]†	Low	None	Children	0-14
Rare Diseases[3]	None	Low	-	-
Food Borne diseases	Low	Medium	-	-

[1] AIDS is not included.[2] e.g., measles or rubella.[3] e.g., thalassaemia.[4] e.g., salmonella poisoning
[5] Distribution of total deaths by cause, age group and sex.
† Incidence or morbidity rates
- Non-specified or non-available information

Sources: EC (1996b).

The following six health problems are selected: respiratory diseases, childhood infections, cancer, circulatory system, traffic accidents, and infant mortality[83] on the basis of the assessments on cost or scourge given Table 5.9. Hence diseases or mortality causes considered here are those with high/medium impact on cost and/or incidence. This subset of diseases are then the most important problems from a medical and/or economic point of view. The Swedish Environmental Protection Agency (1993) considers respiratory diseases and allergic diseases (included both in the variable respiratory diseases), congenital anomalies (included in the variable childhood infections), reproduction related diseases

[83] The infant mortality data includes the number of death caused by congenital abnormalies as well as perinatal conditions.

(infertility, miscarriage, infant mortality, etc) as environmental-related diseases. The environment (consisting of housing and transport conditions; quality of noise, air or water; level of waste, sewage, radiation, and bio-diversity) may particularly affect the health of some groups of the population, such as children, or people with existing illnesses (EC, 1996c)

The data for the indicators relate to the fifty Spanish provinces for the years 1964, 1974, 1981 and 1991. The statistical source for the morbidity data is the *Encuesta de Morbilidad Hospitalaria* survey which is provided by the Spanish Institute of Statistics (INE). This statistical information includes the registered diseases records in private and public hospitals.[84] The source for deaths that are certified by doctors is the survey known as *Defunciones por Causa de Muerte* (INE).[85] In order to include the age-structure of the diseases,[86] the actual numbers of death records and disease incidences are divided by the corresponding age profile given in Table 5.9 (age group in which diseases dominate).[87] The resulting morbidity and mortality rates are treated as indicators with a negative impact on regional welfare (Chapter 4).

Communicable diseases such as AIDS (with medium impact on cost and scourge) are not included because the records date back only to the mid-eighties for the Spanish regions. So the available information does not encompass all the years under consideration in the present study. The death records for suicides are not included either. The comparison of the two data sets on suicide rates (Table 5.10), that is *Anuarios* (INE) and *Estadisticas por Causa de Muerte* (INE) reveals a lack of accuracy in the available statistical information. The change between 1964 and 1991 in both databases is very dissimilar. In view of this suicide is omitted as a health problem in the present study.

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[84] In the *Encuesta de Morbilidad Hospitalaria* (INE), the term *Hospital* describes those health centres that provide medical and surgical care to patients while *Patients* are the people admitted to hospitals for treatment or diagnosis.

[85] Mortality records are classified according to the disease or cause of death. The survey covers the overall population who died during the period of data collection (usually, one year).

[86] According to Rennie and Rusting (1996) the health status data has to be adjusted to correct for the rising longevity of the population.

[87] For instance, the number of records for cancer diseases is divided by the proportion of the population above 35 years of age.

Table 5.10 Comparison of Suicides Rates between two Available Data sets.

	Dataset 1			Dataset 2		
	1964	1991	% Change 1964-91	1964	1991	% Change 1964-91
Asturias	5.62	49.13	774.20	7.94	51.65	550.50
Barcelona	26.97	8.84	-67.22	18.86	22.58	33.93
Madrid	14.44	13.78	-4.57	9.27	8.63	-6.90
Soria	13.37	100.78	653.78	26.73	54.26	102.99
Sta. Cruz de Tenerife	21.40	20.46	-4.39	23.19	7.22	-68.87
Segovia	11.44	45.25	295.54	11.44	37.88	231.12
Spain	19.49	21.45	10.06	16.21	24.06	48.43

Sources. Data set 1 refers to *Anuarios* INE (1964, 1991) while *Data set 2* refers to *Estadísticas por Causa de Muerte* (1964, 1991).

Finally note that we found a deviation in the changes in death rates for Spain related from the European pattern. Table 5.11 shows that the death rates associated with some of the "*greatest killers*" (e.g., ischaemic heart diseases, circulatory system or traffic accidents) have dropped dramatically by 30-40% between the 70s and the 90s in the European Community countries. However, a close look at the data for Spain reveals that except for the diseases of the circulatory system and infant mortality, rates did not come down in 1990. Further, the percentage of change reveals an increase in the most common causes of death between 1970-1990. This raises the question whether the reasons for the different pattern are environmental, or social determinants of health, or related to the health services.[88] We should perhaps ask whether this is due to (perhaps more fundamental) data problems.

[88] In Section 7.3 the household conditions are studied as social determinants of health while health services are investigated in the next section.

Table 5.11 Deaths Rates, Several Diseases. European Community and Spain.

Country	Spain			European Community		
Historical/Latest Year	1970	1990[1]	% Change	1970	1991	% Change
Diseases of Circulatory System	93.3	51.3	*-45.1*	102.5	62.4	*-39.1*
Ischaemic Heart Diseases	17.5	20.4	*16.4*	46.0	32.6	*-29.2*
Malignant Neoplasm Breast	10.2	16.5	*61.4*	18.3	20.0	*9.4*
Other Cancers	9.4	16.6	*76.2*	17.1	19.6	*14.6*
Suicides	4.7	7.1	*50.1*	11.8	11.7	*-0.6*
Traffic Accidents	14.4	19.3	*34.3*	22.5	14.1	*-37.5*
Infant Mortality	20.8	7.6	*-63.4*	22.3	7.5	*-66.4*

[1] In the EC (1996) report, the latest available information for Spain dates from 1990.

Source: EC, 1996b.

5.3.2 Results of the Estimation of the Composite Index with respect to Health Status.

In this section we study the results of the individual analysis of each period for health status looking at the estimates for the principal component (PCA). These have been obtained by applying Steps 1 to 6 (Tables from 5.12 to 5.16). In Step 2 we compute the proportion of variance accounted for by the first component. This component accounts for the highest percentage of total variability in 1974 (49% of the trace) while the lowest percentage is 38% in 1991. A single dimension represents the samples under consideration poorly and the first component is not sufficient for recovering a reasonable proportion of the trace (Table 5.12). At least two components would be required to be able to account for 60% of the total variability. So the model based on the first component is a poor approach because it does not fit the data very well.

One of the factors explaining both the low proportion of variability accounted for by the first components is a data problem relating to changes in the data collecting procedure. Also the morbidity records may have been improperly collected and the medical personnel may not have registered all the incidences which they treated, or if they did, it was not accurately recorded. Statistical theory establishes that if there are errors of measurement in the data then the variances are inflated and the correlations turn weak (Flury 1988). Furthermore, the use of the principal component technique with unrelated data structures (in the sense of low correlations among variables used in the analysis) results in components which account for low proportions of the variability. In other words, more than one component would be necessary to recover most of the total variance.

Component coefficients computed for the four samples are provided in Table 5.13 (Step 1). We look at the dominant variables in order to interpret the first components (Step 3). Variables with the highest coefficients (dominant variables) on the first component are respiratory diseases, childhood infections and traffic accidents for the 1964, 1974 and 1991. We interpret the first component for these samples as an overall measure of diseases related to environment and other external causes (traffic accidents). We interpret the first component for the 1981 sample as an overall measure of diseases related to environment for the 1981 sample because the coefficients for childhood infections and respiratory diseases are high while the component coefficient for the variable related to traffic accidents is very low.

We test now if the previous interpretations of the first components are robust (Step 4 and 6) (Table 5.13). The statistic of sphericity for the two first eigenvalues (Step 4) yields a chi square of 6.68 (in 1964) and 7.96 (in 1974) with two degrees of freedom. The foregoing chi-square values are larger than the critical value (X^2=5.99) of a chi-square distribution with two degrees of freedom at the 5% level of significance. So we reject the hypothesis that the first and second eigenvalues are close (Table 5.13). This implies that the interpretations for 1964 and 1974 are robust. At the same level of significance the sphericity test can not be rejected for the 1981 and 1991 samples. So the interpretations for the 1981 sample and 1991 sample are not robust. The standard errors of the first principal component (Step 6) reveal that the component coefficients of the first eigenvector are unstable for the 1964 and 1974 samples (Table 5.13). The standard errors are larger than 0.1 for two variables in the 1981 and 1991 samples. Summing up, the interpretations for the 1964 and 1974 samples are not robust because they depend on unstable coefficients while the interpretations for the 1981 and 1991 samples can not be accepted either because of the sphericity between the first and second components.

Table 5.12 Analysis of the Two First Eigenvalues (Principal Components Variances) with respect to Health Status.

	1964		1974		1981		1991	
	1st PCA	2nd PCA	1st PCA	2nd PCA	1st PCA	2nd PCA	1st PCA	2nd PCA
Eigenvalues	0.085	0.041	0.079	0.035	0.061	0.039	0.057	0.037
Standard Errors	0.017	0.008	0.016	0.007	0.012	0.008	0.011	0.007
Standard Deviation	0.292	0.202	0.281	0.188	0.247	0.197	0.239	0.193
Proportion of total Variance	0.46	0.22	0.49	0.22	0.40	0.21	0.38	0.25
Accumulated Proportion of the Total Variance Accounted by the two First Components	0.68		0.71		0.61		0.63	

Table 5.13 Coefficients of the First Principal Component with respect to Health Status. Standard Errors in Brackets. Sphericity Test for the First and Second Eigenvalues.

Group	1964		1974		1981		1991	
Respiratory Diseases	0.6473	(0.0871)	0.5018	(0.0773)	0.7371	(0.0658)	0.6882	(0.0812)
Childhood Infections	0.5228	(0.0969)	0.6914	(0.0560)	0.6632	(0.0536)	0.6035	(0.1627)
Cancer	0.0987	(0.0498)	0.0085	(0.0496)	0.0681	(0.0496)	-0.1230	(0.0469)
Circulatory System	0.0128	(0.0684)	0.0055	(0.0572)	0.0133	(0.1321)	-0.0758	(0.1076)
Traffic Accidents	0.5006	(0.1562)	0.5069	(0.1191)	-0.0950	(0.2854)	-0.3643	(0.2077)
Infant Mortality	0.2172	(0.1025)	-0.1144	(0.1435)	-0.0555	(0.1542)	-0.0926	(0.2449)
Sphericity Test for the First and Second Eigenvalues								
Chi Square (2 Df)	6.68		7.96		2.51		2.31	

[1] Incidence or morbidity rates.
[2] Mortality rates

We test the hypothesis that all samples have one common component, or the alternative being that they do not (Step 7). The results are provided in Tables from 5.14 to 5.16. The proportion of variability accounted by the eigenvector associated to the largest eigenvalue varies a little in comparison to the results obtained by separate analysis. The statistic computed to test the goodness of fit of the restricted model (Step 8) confirms the adequacy of the partial common principal components (Table 5.14). That is, the hypothesis that the four periods share the same component is not rejected at the 5% level of significance. The chi square statistic of the PCPC model (X^2= 22.47) is smaller than to the 95th percentile of a chi squared distribution with 15 degrees of freedom (X^2= 25.00). In addition, correlations of the estimated components displayed in Table 5.16 below the diagonal are not very high, being smaller than -0.30.[89] Therefore the results on the composite index are not sample-specific resulting of using the same weights attached to variables (partial common component coefficients).

The partial common principal component model yields better results than the classical technique. The results provided in Table 5.15 reveal that the standard errors of the first partial common principal component are stable in the new model. The interpretation of of the component coefficients resulting from the first partial common component (PCPC) is more robust than the one from the individual model (PCA). We interpret the first common component on the basis of the approximate maximum likelihood estimates for all periods (Table 5.15) as a measure of diseases related to the environment and other external causes. The variables that dominate the first common component are environment-related diseases, that is respiratory diseases, childhood infections and the infant mortality. The traffic accident mortality is considered as an external cause.

Table 5.14 Test for Partial Common Principal Component for the 1964, 1974, 1981 and 1991 Samples with respect to Health Status.

Test for One Common Principal Component	PCPC(1)
Number of Estimated Parameters in the Model	69
Likelihood Ratio Test Chi-Square	22.466
Degrees of Freedom	15
p-Value	0.0962

[89] A negative correlation is found in the matrix for 1974 between the 1st PCPC and 3rd PC components.

Table 5.15 Approximate Maximum Likelihood Estimates for the 1964, 1974, 1981 and 1991 Samples with respect to Health Status. Standard Errors of the First Common Principal Component in Brackets.

a. Coefficients and Standard Errors of the First Common Principal Component.

Respiratory Diseases	0.6540 (0.0445)
Childhood Infections	0.6865 (0.0414)
Cancer	0.0194 (0.0256)
Circulatory System and Heart Diseases	-0.0110 (0.0365)
Traffic Accidents (Motor Vehicle)	0.2544 (0.0855)
Infant Mortality	0.1891 (0.0805)

b. Characteristic Roots for the First Common Principal Component

	1964	1974	1981	1991
Eigenvalues	0.081	0.072	0.056	0.047
Proportion of the Total Variance Accounted by the 1st Common Component	0.44	0.44	0.37	0.31

Recapitulating briefly, the main conclusions from this section are as follows:

i. The application of PCA to compute the composite index raises some concerns about the first component, which does not fit the data very well. In general, our results in the separate and partial common principal component analysis are not very satisfactory in terms of the proportion of the variability accounted for by the first component (individual or partial common). These findings may be due to the fact that the techniques of principal component (both PCA and PCPC) are very sensitive to data problems[90].

ii. The standard errors are crucial in the determination of the stability of the coefficients of the eigenvectors. Our results for the first partial common component display stable coefficients while the components obtained separately using PCA are clearly unstable. This reveals the improvement achieved using the PCPC model.

iii. The partial common principal component model may be considered a better

[90] In Section 5.3.3 the changes in data collection procedures are described. The study of other techniques related to the principal components such as the Principal Points (Flury and Puri 1988) is a suggestion for further research.

alternative to the classical principal components. Our results reveal a good fit for the restricted model, and as stated before, the coefficients of the first common component are stable.

iv. On the basis of the maximum likelihood estimates for the first partial common principal component, we interpret the first common component (and composite index) as an overall measure of environment-related diseases and external causes. Our results show that the variables with respect to cancer and circulatory systems mortality do not dominate the first common component. So it is not possible to interpret the first partial common principal component (or stated in another way the composite index) is not a measure of all diseases suggested for representing health status in Section 5.3.1 rather than a measure of diseases related to environment and other external causes.

Table 5.16 Covariance (F) and Correlation (R) Matrices of the Estimated Components for the 1964, 1974, 1981 and 1991 Samples with respect to Health Status.†

a. Matrices for the 1964 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC
		0.0806	0.0119	0.0073	0.0017	0.0031	0.0025
		0.2	0.0438	0	0	0	0
$R_{64}\backslash F_{64}$	=	0.1521	0	0.0284	0	0	0
		0.0482	0	0	0.0157	0	0
		0.1101	0	0	0	0.0095	0
		0.1064	0	0	0	0	0.0070

b. Matrices for the 1974 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC
		0.0715	0.0004	-0.0165	0.0004	-0.0041	0.0017
		0.0101	0.0259	0	0	0	0
$R_{74}\backslash F_{74}$	=	-0.2984	0	0.0426	0	0	0
		0.0181	0	0	0.007	0	0
		-0.1728	0	0	0	0.0078	0
		0.081	0	0	0	0	0.006

c. Matrices for the 1981 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC
		0.0559	-0.0082	-0.0062	0.0027	0.0035	0.0019
		-0.1680	0.0421	0	0	0	0
$R_{81}\backslash F_{81}$	=	-0.1745	0	0.0226	0	0	0
		0.1312	0	0	0.0075	0	0
		0.1039	0	0	0	0.02	0
		0.1230	0	0	0	0	0.0042

d. Matrices for the 1991 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC
		0.0471	-0.0102	0.003	-0.0066	-0.0004	-0.0016
		-0.2289	0.0422	0	0	0	0
$R_{91}\backslash F_{91}$	=	0.1081	0	0.0158	0	0	0
		-0.2894	0	0	0.011	0	0
		-0.0203	0	0	0	0.0092	0
		-0.1243	0	0	0	0	0.0036

† On and above diagonal variances and covariances of the first common component. Below diagonal correlations.
1st PCPC: First common principal component. This is obtained using PCPC.
2nd, 3rd and 4th, 5th and 6th PC: Second, third, etc principal component computed individually using PCPC.

5.3.3 Analysis of Spatial Inequality with respect to Health Status.

Table 5.17 displays the results for the Theil's second measure with respect to health status. Two patterns are clearly observable. Overall inequality declines from 1964 to 1981 while there is an increase in inequality in 1991. The decline in inequality observed between 1964-81 means a reduction of disparities in the levels of health status over Spain. This is consistent with the improvements which occurred between the 60s and the 90s in Spain in the environment (food, sanitary conditions, hygiene and living conditions), working conditions and in general the socio-economic conditions of individuals. Also, the improvements in health promotion such as preventive measures (vaccination programs) and the availability of effective treatments and diagnosis may have also contributed to reduce inequality.

The foregoing factors do not explain the upturn in inequality observed in 1991. It is possible that the results have been affected by changes in data collection methods. Over the last few decades the criteria used for registering incidences have been changed. The 1976 reform of the morbidity survey (enacted in *Real Decreto 1360/1976*) consisted of modifying the registration procedure for incidences and the survey became obligatory not only for public hospitals but also private. So the comparison of inequality in the pairs of samples consisting of the 1964 and 1974 samples and the 1981 and 1991 samples is more reliable than the study of the trend between 1964-91. For this reason the analysis focuses on the 1964-74 period and 1981-91 period. Finally note that the results may also reflect the sensitiveness of the technique of principal components in general (including PCA and PCPC) to changes in data[91].

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[91] A suggestion for further research is therefore to compare our results with that using alternative data sets.

Table 5.17 Theil's Second Measure with respect to Health Status.

	1964		1974		1981		1991	
	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%
Between-Region	0.0268	80.9	0.0097	40.6	0.0043	29.6	0.0087	52.1
Within-Region	0.0063	19.1	0.0142	59.4	0.01	70.4	0.0080	47.9
	$T_{-1}(W_\cdot)$		$T_{-1}(W_\cdot)$		$T_{-1}(W_\cdot)$		$T_{-1}(W_\cdot)$	
Total Inequality	***0.0331***		***0.0239***		***0.0142***		***0.0167***	

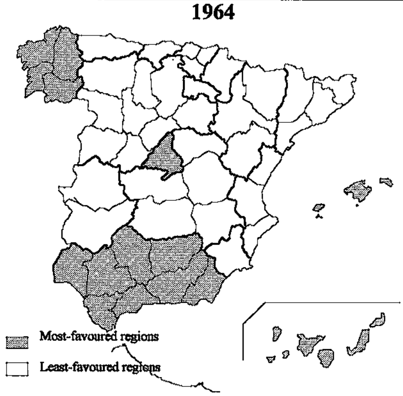
The decomposition of overall inequality (Table 5.17) reveals that the main source of inequality in 1964 and 1991 is between region inequality, while the main source is within-region inequality in 1974 and 1981. The percentage of overall inequality computed for the two components of inequality (Table 5.17) shows that between-region inequality explains a sizeable fraction of overall inequality in 1964 (80.9% of the overall inequality) but this share declines dramatically in 1974 (40.6% in 1974). Between 1981-91 there is a drop in overall inequality resulting in more or less similar contributions of between- (52.1%) and within-region (47.95) inequality in 1991.

Figure 5.8 displays the cluster analysis for health status (1964, 1974, 1981, and 1991). The cluster analysis separated the regions into two groups based on the composite index of health status. This composite index is obtained from a set of indicators which have been transformed as negative indicators (explained in Section 4.4.3). The group of most favoured regions with respect to health status consists of regions with the highest values of the composite index. So high values of the composite index correspond to low rates of mortality and/or morbidity[92]. Figure 5.8 shows that there is no stable geographical pattern between 1964-74. Again we suspect that this may be due to inaccuracies of the data used in this study. But some similarities are observed in 1981-91 in the regions of Canarias, Baleares, Cataluña, and Galicia since these are classified into the most-favoured group of regions for both years.

[92] So a high value for a composite index (in the present study) reflects a good best position for a region or province.

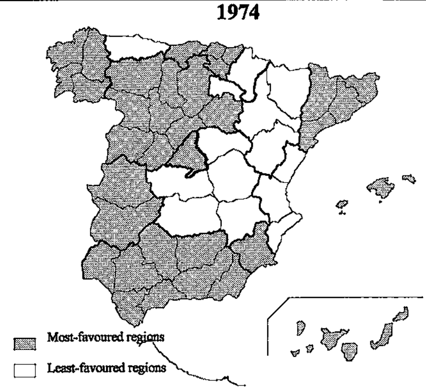
Figure 5.8 Clusters of Most-Favoured and Least-Favoured Regions with respect to Health Status.[93]

1964



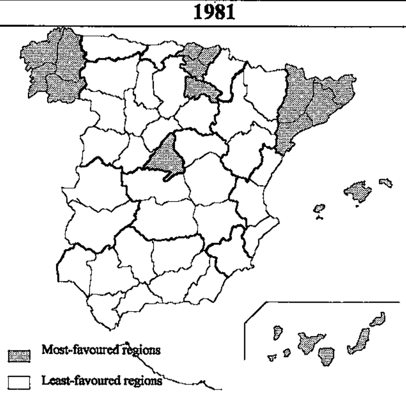
Least-favored regions: Castilla León, Castilla La Mancha, Aragón, Asturias, Cantabria, País Vasco, La Rioja, Navarra, Extremadura, Comunidad Valenciana.
Most-favored regions: Canarias, Baleares, Andalucía, Murcia, Galicia, Madrid.

1974



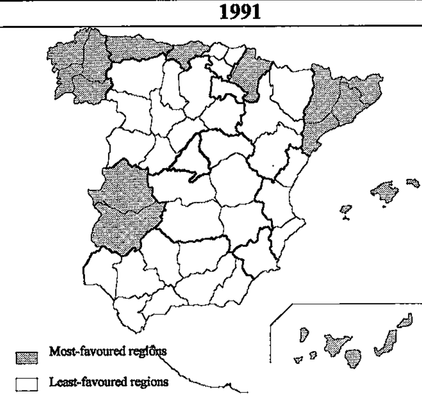
Least-favored regions: Castilla La Mancha, Aragón, Navarra, La Rioja, Asturias.
Most-favored regions: Andalucía, Baleares, Canarias, Extremadura, Madrid, Castilla León, Galicia, Cantabria, País Vasco, Cataluña, Murcia.

1981



Least-favored regions: Andalucía, Extremadura, Castilla León, Castilla La Mancha, Navarra, Aragón, Asturias, Cantabria.
Most-favored regions: Canarias, Baleares, Cataluña, La Rioja, País Vasco, Galicia, Madrid.

1991



Least-favored regions: Andalucía, Madrid, Castilla León, Castilla La Mancha, País Vasco, Aragón, La Rioja, Comunidad Valenciana, Murcia.
Most-favored regions: Extremadura, Baleares, Canarias, Cataluña, Navarra, Galicia, Asturias, Cantabria.

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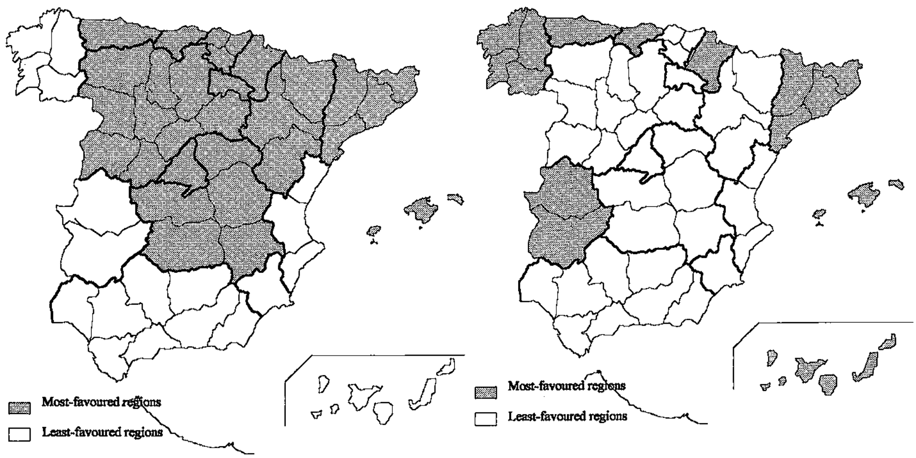
[93] In the case of health status for 1964, the most-favoured regions with respect to the composite index range from 0.81 (Canarias) to 0.67 (Baleares) while the composite index for the least-favoured regions ranges from 0.66 (Murcia) to 0.13 (La Rioja). For 1974, the most-favoured regions with respect to the composite index range from 0.83 (Murcia) to 0.66 (Extremadura) while the composite index for the least-favoured regions ranges from 0.63 (Cantabria) to 0.37 (Asturias). For 1981, the most-favoured regions with respect to composite index range from 0.85 (Baleares) to 0.71 (País Vasco) while the composite index for the least-favoured regions ranges from 0.68 (Cantabria) to 0.48 (Navarra). For 1991, the most-favoured regions with respect to composite index range from 0.74 (Cantabria) to 0.56 (Asturias) while the composite index for the least-favoured regions ranges from 0.51 (País Vasco) to 0.35 (Madrid).

In addition to improvements in the socio-economic conditions among the Spanish regions, it is likely that the availability of health facilities may also have had an impact on regional inequality. There is some kind of relationship (possibly causal) between health services and improvements in health status. Improvements in health facilities may be the result of an increase in the number of patients with health problems, or a result of new advances in techniques for treatment and diagnosis. But services may also change as a result of preventive policies. In the present study we assume that the healthiest populations would be found in the most-favoured regions/provinces with respect to health facilities. To study the relationship between facilities and health status we have used the results of the cluster analysis. We compare the clusters obtained in health status and health facilities with respect to the contiguity case. Figure 5.9 reveals that the geographical pattern described by health facilities is quite different from the one for health status. Actually it is quite difficult to link the geographical distribution of health status with the one observed for health facilities. Some of the regions which are classified in the group of least-favoured in health facilities belong to the group of most-favoured regions in health status, for instance, Galicia, Extremadura, or Canarias. Also, favoured-regions for health facilities such as Madrid, La Rioja or País Vasco are surprisingly least-favoured in health status. Only a few regions such as Cataluña, Navarra, Asturias or Cantabria are favoured regions in both health status and health facilities.

Figure 5.9 Comparison of Cluster Analyses between Health Status and Health Facilities in 1991.

Clusters of Most-Favored and Least-Favored Regions with respect to Health Facilities[94] (The Contiguity Case)

Clusters of Most-Favored and Least-Favored Regions with respect to Health Status[95]



Least-Favoured regions:
Andalucía, Canarias, Comunidad Valenciana, Extremadura, Galicia, Murcia.
Most-Favoured regions:
Aragón, Cataluña, Asturias, Cantabria, Castilla León, Castilla La Mancha, Madrid, Navarra, País Vasco, La Rioja, Baleares.

Least-favored regions: Andalucía, Madrid, Castilla León, Castilla La Mancha, País Vasco, Aragón, La Rioja, Comunidad Valenciana, Murcia.
Most-favored regions: Extremadura, Baleares, Canarias, Cataluña, Navarra, Galicia, Asturias, Cantabria.

So our results do not show that a clear relationship between health status and health facilities. We suspect that our results may have been influenced by the quality of data used. So a suggestion for further research is therefore to compare our results with that using alternative data sets for health status.

[94] In the contiguity case with respect to health facilities for 1991, the most-favoured regions with respect to the composite index range from 0.54 (La Rioja) to 0.55 (Cantabria) while the composite index for the least-favoured regions ranges from 0.48 (Canarias) to 0.46 (Andalucía).

[95] In the case of health status for 1991, the most-favoured regions with respect to the composite index range from 0.74 (Cantabria) to 0.56 (Asturias) while the composite index for the least-favoured regions ranges from 0.51 (País Vasco) to 0.35 (Madrid).

5.4 Summary and Main Conclusions.

The evidence has shown that the development of specialised health care systems, the increase in governmental expenditures on health care, and especially changes in housing conditions, individual's nutrition or hygiene aspects have resulted in an improvement in health in Europe over the last century. The present chapter is focused on health since this welfare component is today one of the most important policy concerns. Since new technologies for treatment and diagnosis are very costly, it is more difficult to sustain the current public health system. Two views of the notion of health are studied. *Health status* refers to the absence of illness while *health facilities* consist of services relating to improvement after the onset of disease and also prevention services.

The organisation of services, in health or education, implies a trade-off between efficiency and equity. According to the Spanish 1978 Constitution individuals are entitled to have equal access to facilities, but there is no point in an equal distribution of resources across space. Nevertheless there are interactions between geographical units since individuals may commute from their own area to adjacent or neighbouring areas when facilities are not available in the home area. In this chapter, the inclusion of services in contiguous areas is investigated. Available facilities are considered to consist of facilities in the own area and adjacent areas. A procedure is suggested to include contiguity in the analysis of health facilities and the implications in terms of inequality are investigated.

This procedure is applied to health facilities. So the inequality results are obtained under the assumption that available facilities include also contiguous services. The results are analysed and a comparison between the contiguity and non-contiguity cases (with and without incorporating geographical proximity between geographical units) is made. There is an increase in inequality between 1974 and 1981 which may be due to the limited impact of the health measures undertaken over this period. But improvements in inequality with respect to health facilities are observed between 1981 and 1991. The sharp drop in inequality coincides with the enactment of the *1986 Health act* (LGS).

There is also an important change in the components of overall inequality between 1981 and 1991. The percentage of between-region inequality decreases from 55.2% of overall inequality in 1981 to 44.9% in 1991. The change in between-region inequality coincides with the devolution of power in health issues. So regional policies may have caused changes in the pattern of regional inequality.

The regionalisation process of the health system may also have had important implications for regions with transferred powers in health issues. In these regions the results reveal that within-region inequality decreases between 1981 and 1991. So it is possible that the regional policies have resulted in a uniform distribution of health facilities within certain regions. The geographical distribution of facilities obtained using cluster analysis reveals a North-South pattern so that facilities are mostly located in the North of Spain. The group of most-favoured regions consists of regions with transferred powers together with other regions like Madrid (which is a central place) or with certain socio-economic characteristics. We suggest, therefore, that the geographical distribution may be affected by socio-economic conditions of regions.

The comparison of the contiguity and non-contiguity cases reveals that there are important spatial effects, especially between the regions situated in the North and the Centre of the Iberian as neighbours Peninsula. Geographical proximity benefits certain regions resulting in a dramatic increase in inequality in the contiguity case. When contiguity is not taken into account, the results for inequality show a very different impact for health policies. This situation is found in the trends in inequality between 1974 and 1981 since inequality in the contiguity case increases, while it does not change much in the non-contiguity case.

The most interesting spillovers between regions are found between Castilla la Mancha and its neighbours. It is possible that the improvement in the availability of facilities is due to the proximity of the various provinces of Castilla la Mancha to Madrid. So Madrid may be supplying health services to these regions. There are also spillovers within this region, between the provinces of Guadalajara and Toledo, which may affect within-region inequality.

Inequality with respect to health status is investigated and the results are compared with those for health facilities (contiguity case) in order to establish a relationship between the population's health and available services. There is a decline in inequality between 1964 and 1974 which may be due to improvements in the general environment (living conditions, food, etc) and developments in health care. But it is not possible that changes in these factors caused the increase in inequality between 1981 and 1991. The geographical distribution of most-favoured regions and least-favoured regions with respect to health facilities and health status shows no clear relationship between services and health status. So we may conclude that inequality results with respect to health status may have been affected by inaccuracies in the data in the present research.

Summing up, the distribution of health facilities in Spain may have affected by regional characteristics, that is, the geographical situation and socio-economic conditions and improvements in health. In addition, the extent of autonomy in health issues and the establishment of the public health system may also have influenced inequality.

Appendix 5.1

Travel Inputs in First-Order Contiguous Provinces in Spain. Distance Factors between Provincial Capitals

In this appendix travel inputs are presented with respect to first-order contiguous provinces. Travel time (measured in km) and travel distance (measured in hours) have been computed between the provincial capitals of two first-order contiguous provinces. *Km* refers to the travel distance between two adjacent provincial capitals. *T* denotes travel time measured in hours from the origin provincial capital to the adjacent provincial capitals.

Province	Adjacent	Km	T	Province	Adjacent	Km	T
Alava	Burgos	116	1.2	**Caceres**	Avila	245	2.9
	Guipúzcoa	107	1.3		Badajoz	98	1.5
	Navarra	100	1.2		Salamanca	221	2.6
	Rioja	66	1.0		Toledo	265	3.4
	Vizcaya	68	0.8	**Cádiz**	Huelva	211	3.2
Albacete	Alicante	172	2.6		Málaga	216	3.3
	C. Real	212	2.6		Sevilla	122	1.1
	Cuenca	151	1.7	**Cantabria**	Asturias	193	2.4
	Granada	328	4.4		Burgos	160	1.9
	Jaén	255	3.3		León	234	3.0
	Murcia	166	2.4		Palencia	212	2.4
	Valencia	175	2.0		Vizcaya	95	0.9
Alicante	Albacete	172	2.6	**Castellón**	Tarragona	192	2.0
	Murcia	82	1.0		Teruel	127	1.7
	Valencia	158	2.1		Valencia	70	0.8
Almería	Granada	159	2.1	**C. Real**	Albacete	212	2.6
	Murcia	214	2.5		Badajoz	323	4.3
Asturias	Cantabria	193	2.4		Córdoba	194	2.2
	León	111	1.6		Cuenca	239	3.7
	Lugo	214	3.1		Jaén	182	2.5
Avila	Caceres	245	2.9		Toledo	123	1.5
	Madrid	108	1.4	**Córdoba**	Badajoz	275	3.6
	Salamanca	105	1.3		Ciudad Real	194	2.2
	Segovia	67	0.9		Granada	167	2.8
	Toledo	136	1.8		Jaén	107	1.7
	Valladolid	125	1.5		Málaga	165	2.8
					Sevilla	139	1.3

Province	Adjacent	Km	T	Province	Adjacent	Km	T
Badajoz	Caceres	98	1.5	**L Coruña**	Lugo	97	1.1
	C. Real	323	4.3		Pontevedra	127	1.7
	Córdoba	275	3.6	**Cuenca**	Albacete	151	1.7
	Huelva	240	3.2		C. Real	239	3.7
	Sevilla	224	2.6		Guadalajara	145	1.7
	Toledo	363	5.0		Madrid	167	1.8
Barcelona	Gerona	97	1.7		Teruel	140	2.5
	Lérida	158	1.9		Toledo	188	2.2
	Tarragona	96	1.5		Valencia	213	2.9
Burgos	Alava	116	1.2	**Gerona**	Barcelona	97	1.7
	Cantabria	160	1.9		Lérida	231	3.4
	Palencia	93	1.0	**Granada**	Albacete	328	4.4
	Rioja (La)	121	1.5		Almería	159	2.1
	Segovia	203	2.1		Córdoba	167	2.8
	Soria	152	2.2		Jaén	93	1.4
	Valladolid	131	1.3		Málaga	129	1.3
	Vizcaya	156	2.3		Murcia	282	3.5

Province$_i$	Adjacent	Km	T	Province$_i$	Adjacent	Km	T
Guadalajara	Cuenca	145	1.7	**Murcia**	Albàcete	166	2.4
	Madrid	58	0.6		Alicante	82	1.0
	Segovia	134	1.8		Almería	214	2.5
	Soria	171	2.2		Granada	282	3.5
	Teruel	251	4.1	**Navarra**	Alava	100	1.2
	Zaragoza	256	2.6		Guipúzcoa	82	0.7
Guipúzcoa	Alava	107	1.3		Huesca	165	2.1
	Navarra	82	0.7		Rioja (La)	94	1.1
	Vizcaya	95	1.3		Zaragoza	185	2.0
Huelva	Badajoz	240	3.2	**Orense**	León	245	3.5
	Cádiz	211	3.2		Lugo	98	1.2
	Sevilla	95	1.0		Pontevedra	93	1.1
Huesca	Lérida	132	1.8		Zamora	263	3.2
	Navarra	165	2.1	**Palencia**	Burgos	93	1.0
	Zaragoza	77	1.0		Cantabria	212	2.4
Jaén	Albacete	255	3.3		León	131	1.8
	C. Real	182	2.5		Valladolid	52	0.5
	Córdoba	107	1.7	**Pontevedra**	Coruna L	127	1.7
	Granada	93	1.4		Lugo	145	2.0
León	Asturias	111	1.6		Orense	93	1.1
	Cantabria	234	3.0	**Rioja La**	Alava	66	1.0
	Lugo	217	3.0		Burgos	121	1.5
	Orense	245	3.5		Navarra	94	1.1
	Palencia	131	1.8		Soria	118	1.4
	Valladolid	150	1.8		Zaragoza	181	1.8
	Zamora	139	1.6	**Salamanca**	Avila	105	1.3
Lérida	Barcelona	158	1.9		Caceres	221	2.6
	Gerona	231	3.4		Valladolid	123	1.4
	Huesca	132	1.8		Zamora	67	0.8
	Tarragona	97	1.3	**Segovia**	Avila	67	0.9
	Zaragoza	146	1.4		Burgos	203	2.1
Lugo	Asturias	214	3.1		Guadalajara	134	1.8
	Coruna (La)	97	1.1		Madrid	90	1.1
	León	217	3.0		Soria	204	2.5
	Orense	98	1.2		Valladolid	109	1.7
	Pontevedra	145	2.0				

Province	Adjacent	Km	T	Province	Adjacent	Km	T
Madrid	Avila	108	1.4	**Sevilla**	Badajoz	224	2.6
	Cuenca	167	1.8		Cádiz	122	1.1
	Guadalajara	58	0.6		Córdoba	139	1.3
	Segovia	67	0.9		Huelva	95	1.0
	Toledo	74	0.9		Málaga	201	2.7
Málaga	Cádiz	216	3.3	**Soria**	Burgos	152	2.2
	Córdoba	165	2.8		Guadalajara	171	2.2
	Granada	129	1.3		Rioja	118	1.4
	Sevilla	201	2.7		Segovia	204	2.5
					Zaragoza	163	2.2
Tarragona	Barcelona	96	1.5	**Valladolid**	Avila	125	1.5
	Castellón	192	2.0		Burgos	131	1.3
	Lérida	97	1.3		León	150	1.8
	Teruel	298	4.0		Palencia	52	0.5
	Zaragoza	236	2.5		Salamanca	123	1.4
Teruel	Castellón	127	1.7		Segovia	109	1.7
	Cuenca	140	2.5		Zamora	103	1.1
	Guadalajara	251	4.1	**Vizcaya**	Alava	68	0.8
	Tarragona	298	4.0		Burgos	156	2.3
	Valencia	147	1.9		Cantabria	95	0.9
	Zaragoza	193	2.2		Guipúzcoa	95	1.3
Toledo	Avila	136	1.8	**Zamora**	León	139	1.6
	Badajoz	363	5.0		Orense	263	3.2
	Caceres	265	3.4		Salamanca	67	0.8
	C. Real	123	1.5		Valladolid	103	1.1
	Cuenca	188	2.2	**Zaragoza**	Guadalajara	256	2.6
	Madrid	0.3	0.2		Huesca	77	1.0
Valencia	Albacete	175	2.0		Lérida	146	1.4
	Alicante	158	2.1		Navarra	185	2.0
	Castellón	70	0.8		Rioja	181	1.8
	Cuenca	213	2.9		Soria	163	2.2
	Teruel	144	1.9		Tarragona	236	2.5
					Teruel	193	2.2

Appendix 5.2

Results of the Estimation of the Composite Index with respect to Health Facilities. The Non-contiguity Case.

In this appendix the results of the estimation of the composite index with respect to health facilities are provided for the case of non-contiguity. Positive indicators of health facilities are the same as the ones used in the case of contiguity. They include general practitioners, chemists, specialists and hospital beds per 1000 population. Available facilities consist of resources in the own province. So we assume that there is no mobility between or within regions. The results have been obtained following the same procedure used in the contiguity case, and they are summarised below.

i. (Step 1) Using PCA eigenvalues and eigenvectors for the four samples under consideration are computed with respect to health facilities for the non-contiguity case (Table 5.18 and 5.19).

ii. (Step 2) The percentage of variability for most of samples reveals that PCA is a poor approach. The highest proportion of variance accounted for by the first principal component is 69 % with respect to the 1964 sample (Table 5.18).

iii. (Step 3) The individual components obtained using PCA are interpreted as an overall measure of health facilities. (Step 4) From a statistical point of view this interpretation is robust for all samples because we reject the sphericity hypothesis at the 5% level of significance. Chi square values are larger than the critical value of chi square at the 5% level of significance and with 2 degrees of freedom (critical value is 5.99) (Table 5.19).

iv. (Step 6) Component coefficients of the hospital beds variable are unstable in the 1974 and 1991 samples (Table 5.19). The interpretation of the first component is robust from a statistical point of view for the 1964 and 1981 samples.

v. (Step 7) The application of PCPC shows that the hypothesis that all four samples share the same component is rejected at the 5% level of significance (the chi square with 9 Df is 24.589 and p-value is 0.0035). (Step 10) Following the procedure described in Chapter 5, we select the 1974, 1981 and 1991 samples because they have the most similar component coefficients. The PCPC model is applied to these samples. Now the hypothesis is not rejected, chi square is 3.624 with 6 degrees of freedom (p-value is 0.7275) (Table 5.20). The goodness of fit of the PCPC model is corroborated in Table 6.22. The highest correlation is 0.19 between the first common component and the 4[th] PCA for the 1974 sample.

vi. (Step 9) Finally we interpret the first common component as a measure of health facilities (Table 5.21). The component coefficients are stable. After the application of PCPC only the interpretation of the first component for the 1974 sample remains non-robust from a statistical point of view. The stability of the coefficients associated with the common component for the 1991 sample leads to a robust interpretation of the component.

Table 5.18 Analysis of the First Eigenvalues (Principal Components Variances) with respect to the Health Facilities. The Non-Contiguity Case.

	1964	1974	1981	1991
Eigenvalues	0.079	0.051	0.057	0.043
Standard Errors	0.016	0.010	0.011	0.009
Standard Deviation	0.281	0.226	0.239	0.208
Proportion of Total Variance	0.69	0.59	0.62	0.53
Upper end of 95% confidence region	0.482	0.65	0.591	0.724

Table 5.19 Coefficients of the First Principal Component in Health Services. Standard Errors in Brackets. The Non-Contiguity Case.

	1964		1974		1981		1991	
Practitioners	0.3891	(0.0443)	0.6104	(0.059)	0.5988	(0.0557)	0.5980	(0.057)
Chemists	0.3354	(0.0538)	0.2988	(0.0696)	0.1315	(0.073)	0.1539	(0.1252)
Specialists	0.6562	(0.0541)	0.6682	(0.0652)	0.6208	(0.0734)	0.6283	(0.0993)
Hospital Beds	0.5527	(0.0762)	0.3017	(0.1279)	0.4886	(0.0844)	0.4732	(0.1153)
Sphericity Test between the First and Second Eigenvalues								
Chi Square (2 Df)	23.04		11.95		17.96		10.27	

Critical value of the chi square at 5% of significance with 2 Df = 5.99

Table 5.20 Test for Partial Common Principal Components of the 1974, 1981 and 1991 Samples. The Non-Contiguity Case.

Test for One Common Principal Component

	PCPC(1)
Number of Estimated Parameters in the Model	24
Likelihood Ratio Test Chi-Square	3.624
Degrees of Freedom	6
p-Value	0.7275

Table 5.21 Approximate Maximum Likelihood Estimates in the Health Services of the 1974, 1981 and 1991 samples. Standard Errors of the First Common Component in Brackets. The Non-Contiguity Case.

a. Coefficients of the First Common Principal Component. Standard Errors in Brackets.

Practitioners	0.6144	(0.0327)
Chemists	0.1887	(0.0508)
Specialists	0.6370	(0.0426)
Hospital Beds	0.4255	(0.0618)

b. Characteristic Roots for the First Common Principal Component

	1974	1981	1991
Characteristic Roots	0.050	0.057	0.043
Proportion of Total Variance	0.57	0.62	0.53

Table 5.22. Covariance (F) and Correlation (R) Matrices of the Estimated Components for the 1974, 1981 and 1991 Samples with respect to Health Facilities.† The Non-Contiguity Case.

a. Matrices for the 1974 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.05008	-0.0049	0.0003	0.0033
$R_{74}\backslash F_{74}$	=	-0.1556	0.0196	0	0
		0.0134	0	0.0115	0
		0.1899	0	0	0.0059

b. Matrices for the 1981 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.0566	0.0033	-0.0013	-0.0003
$R_{81}\backslash F_{81}$	=	0.1073	0.01682	0	0
		-0.0506	0	0.0126	0
		-0.0199	0	0	0.0052

b. Matrices for the 1991 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.043	0.0017	0.0001	0.002
$R_{91}\backslash F_{91}$	=	0.0703	0.0138	0	0
		0.0057	0	0.01320	0
		0.0141	0	0	0.0047

1st PCPC: First common principal component. This is obtained using PCPC.

2nd, 3rd and 4th PC: Second and third principal component computed individually using PCPC.

† On and above diagonal variances and covariances of the first common component. Below diagonal correlations.

Appendix 5.3

Brief Description of the Cluster Analysis Method

Cluster analysis is a multivariate procedure for indentifying groups in the data. This is used in Chapters 5 to 7. In the present study the objects in these groups are regions when cluster analysis is used to describe the geographical patterns of welfare components. When cluster analysis is used to find out the geographical effects within regions, the objects are provinces.

This descriptive technique consists of classifying a set of objects into groups or categories, but neither the number nor the members of the group are known. That is, the group membership is unknown and often it is not possible to know how many clusters there are. In the present study we use the method consisting of *Hierarchical Cluster Analysis* for forming groups. In this method, clustering begins by finding the closest pair of objects according to a distance measure and combines them to form a cluster. The algorithm continues one step at a time, joining pairs of objects, pairs of clusters, or an object with a cluster, until all the data are in two clusters. The method is hierarchical because once two objects or clusters are joined, they remain together until the final step. So a cluster former in a later stage contains clusters from an earlier stage which contain clusters from still earlier stage.

We use *square Euclidean distance* as a similarity measure for defining how different or alike two objects are. When two cases are very similar, the value of this distance measure is small and the value of a similarity measure is large. The square Euclidean distance is the sum of the squared distance over all variables.

The method used for combining or linking clusters is *Ward's method* (Ward 1963) At each step of the algorithm, two objects are joined, two clusters are joined or an object and a cluster are joined. In Ward's method, the error sum of squares across all geographical units (provinces or regions) is the distance to be minimised in order to establish the membership in a cluster. The distance between two clusters, say L and K, is defined as:

$$D_{LK} = \frac{\|\bar{x}_L - \bar{x}_K\|}{(1/N_L + 1/N_K)}$$

where,

$\bar{x}_L$ and $\bar{x}_K$ are vectors of arithmetic means of the geographical units included in clusters L and K.

N_K and N_L are the number of geographical units in each cluster.

$\|\bar{x}_L - \bar{x}_K\|$ is the Euclidean norm defined as

$$\|\bar{x}_L - \bar{x}_K\| = \sum(\bar{x}_L - \bar{y}_K)^2$$

The method consists of first calculating the means of each composite index within each cluster. Then, for each unit, the squared Euclidean distance to the cluster means is computed. These distances are summed for all units. At each level of clustering, two clusters are merged in order to determine the smallest increase in the overall sum of the squared within-cluster distance.

On the basis of the results provided in the statistical package SPSS (icicle plot, dendogram and agglomeration schedule) we select two clusters or groups. The group of regions (provinces) with similar high values with respect to the composite index is referred to as the *most-favoured regions (provinces).* And the group of *least-favoured regions (provinces)* consists of regions with similar low values of the composite index which are dissimilar to the other group. For a further description of this method and cluster analysis, refer to SPSS Base 8.0 (Application Guide) or multivariate statistics handbooks such as Cuadras (1991), Krzanowski (1988), Anderberg (1973), and Ward (1963).

Appendix 5.4

Ranking of the Spanish Provinces with respect to Health Facilities

In the present Appendix provinces have been ranked in descending order with respect to the 1981 and 1991 composite index for health facilities in the cases of the non-contiguity and contiguity. So provinces ranked in low positions are better than those which rank in high positions with respect to health facilities.

Values of the Composite Index for the 1981 and 1991 Samples with respect to the Health Facilities in the 50 Spanish Provinces. Rank of Provinces in Brackets. The Contiguity Case and the Non-Contiguity.

	Contiguity				Non-Contiguity					Contiguity				Non-Contiguity			
	1981		1991		1981		1991			1981		1991		1981		1991	
ALAVA	0,62	(8)	0,61	(7)	0,67	(15)	0,71	(12)	LEÓN	0,44	(30)	0,41	(37)	0,50	(37)	0,50	(43)
ALBACETE	0,36	(43)	0,37	(42)	0,39	(47)	0,43	(49)	LÉRIDA	0,46	(29)	0,46	(26)	0,50	(35)	0,54	(33)
ALICANTE	0,41	(35)	0,37	(44)	0,56	(26)	0,54	(32)	LUGO	0,39	(38)	0,43	(31)	0,45	(41)	0,53	(38)
ALMERÍA	0,32	(49)	0,35	(47)	0,52	(31)	0,59	(25)	MADRID	0,73	(3)	0,65	(4)	0,84	(2)	0,81	(2)
ASTURIAS	0,52	(19)	0,53	(14)	0,68	(12)	0,75	(6)	MÁLAGA	0,42	(34)	0,49	(21)	0,51	(34)	0,64	(19)
AVILA	0,66	(7)	0,66	(3)	0,58	(24)	0,59	(26)	MURCIA	0,40	(37)	0,37	(45)	0,51	(33)	0,52	(39)
BADAJOZ	0,33	(47)	0,37	(43)	0,38	(48)	0,46	(47)	NAVARRA	0,60	(10)	0,63	(6)	0,71	(9)	0,79	(4)
BALEARES	0,55	(17)	0,50	(18)	0,55	(27)	0,55	(30)	ORENSE	0,33	(48)	0,41	(36)	0,42	(45)	0,54	(34)
BARCELONA	0,54	(18)	0,51	(16)	0,71	(10)	0,72	(10)	PALENCIA	0,68	(6)	0,63	(5)	0,76	(6)	0,74	(7)
BURGOS	0,50	(21)	0,52	(15)	0,54	(30)	0,58	(27)	PALMAS(LAS)	0,38	(41)	0,40	(39)	0,38	(49)	0,43	(48)
CACERES	0,35	(45)	0,38	(41)	0,44	(42)	0,51	(40	PONTEVEDRA	0,36	(42)	0,42	(32)	0,48	(39)	0,60	(24)
CÁDIZ	0,38	(40)	0,36	(46)	0,55	(28)	0,57	(29)	RIOJA (LA)	0,69	(4)	0,55	(12)	0,77	(4)	0,67	(15)
CANTABRIA	0,51	(20)	0,49	(20)	0,62	(23)	0,65	(18)	SALAMANCA	0,58	(11)	0,55	(11)	0,70	(11)	0,70	(13)
CASTELLÓN	0,46	(28)	0,42	(35)	0,68	(13)	0,64	(20)	SANTA CRUZ DE TENERIFE	0,44	(31)	0,46	(27)	0,44	(43)	0,49	(44)
CIUDAD REAL	0,34	(46)	0,30	(50)	0,38	(50)	0,38	(50)	SEGOVIA	0,84	(2)	0,75	(2)	0,73	(8)	0,67	(17)
CÓRDOBA	0,40	(36)	0,39	(40)	0,46	(40)	0,50	(42)	SEVILLA	0,43	(33)	0,42	(33)	0,52	(32)	0,55	(31)
CORUÑA (LA)	0,46	(27)	0,48	(25)	0,63	(21)	0,72	(11)	SORIA	0,55	(16)	0,59	(8)	0,64	(20)	0,72	(9)
CUENCA	0,43	(32)	0,48	(23)	0,41	(46)	0,47	(45)	TARRAGONA	0,58	(12)	0,53	(13)	0,64	(19)	0,63	(21)
GERONA	0,46	(26)	0,45	(28)	0,76	(5)	0,79	(3)	TERUEL	0,62	(9)	0,48	(24)	0,65	(18)	0,54	(35)
GRANADA	0,47	(24)	0,48	(22)	0,54	(29)	0,60	(23)	TOLEDO	0,48	(23)	0,42	(34)	0,57	(25)	0,53	(37)
GUADALAJARA	1,00	(1)	1,00	(1)	0,84	(1)	0,89	(1)	VALENCIA	0,56	(15)	0,45	(29)	0,65	(16)	0,57	(28)
GUIPÚZCOA	0,56	(14)	0,56	(10)	0,73	(7)	0,79	(5)	VALLADOLID	0,57	(13)	0,51	(17)	0,65	(17)	0,61	(22)
HUELVA	0,35	(44)	0,32	(49)	0,50	(36)	0,50	(41)	VIZCAYA	0,48	(22)	0,49	(19)	0,63	(22)	0,69	(14)
HUESCA	0,47	(25)	0,44	(30)	0,68	(14)	0,67	(16)	ZAMORA	0,38	(39)	0,40	(38)	0,49	(38)	0,54	(36)
JAÉN	0.32	(50)	0.33	(48)	0,42	(44)	0,47	(46)	ZARAGOZA	0,68	(5)	0,59	(9)	0,78	(3)	0,72	(8)

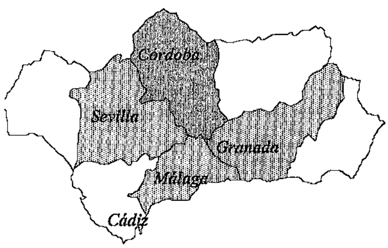
Appendix 5.5

Within-Region Inequality in the Spanish Regions

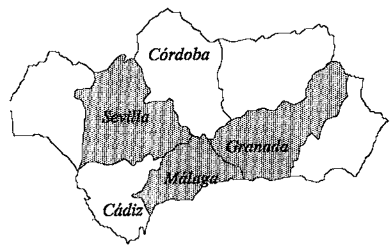
Cluster of within region inequality with respect to Health Facilities: Provinces benefitting spatial spillovers.

Andalucía

The Contiguity Case



The Non-contiguity case

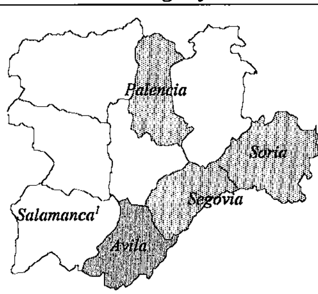


Favoured provinces within Andalucía

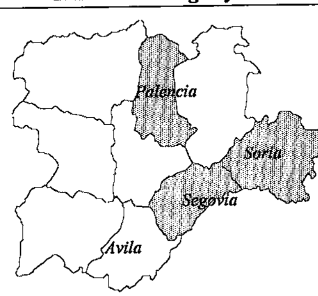
Favoured provinces by within region spillovers

Castilla León

The Contiguity Case



The Non-Contiguity Case



Favoured provinces within Castilla León

Favoured provinces by within region spillovers

[1] In the ranking of provinces with respect to health facilities, the province of Salamanca ranks higher than Avila.

Share of Within-Region Inequality. Health Facilities at 1991 (%)

	Health Facilities	
	Non-contiguity	Contiguity
Regions without Transferred Powers		
ARAGON	5.2	2.9
ASTURIAS	0	0
BALEARES	0	0
CANTABRIA	0	0
CASTILLA LEON	15.7	21.9
CASTILLA MANCHA	51.5	57.9
EXTREMADURA	0.7	0
MADRID	0	0
MURCIA	0	0
RIOJA LA	0	0
Regions with Transferred Powers		
ANDALUCIA	8.9	12
CANARIAS	0.9	0.7
CATALUNA	8.2	1.1
COMUNIDAD VALENCIANA	1.5	1.2
GALICIA	6.3	0.8
NAVARRA	0	0
PAIS VASCO	1.1	1.4
Total	100	100

Share of Within-Region Inequality. Health Facilities at 1981 (%)

	Health Facilities	
	Non-contiguity	Contiguity
Regions without Transferred Powers		
ARAGON	1.8	4.2
ASTURIAS	0	0
BALEARES	0	0
CANTABRIA	0	0
CASTILLA LEON	20	25.6
CASTILLA MANCHA	48.9	50.1
EXTREMADURA	1	0.1
MADRID	0	0
MURCIA	0	0
RIOJA LA	0	0
Regions with Transferred Powers		
ANDALUCIA	5.3	8.3
CANARIAS	1	0.7
CATALUNA	9	2.4
COMUNIDAD VALENCIANA	2.1	3
GALICIA	9.7	3.9
NAVARRA	0	0
PAIS VASCO	1.1	1.8
Total	100	100

Chapter 6

Analysis of Inequality in Education Facilities and Enrollment

6.1 Introduction.

Over the last few decades, the Spanish government has pursued a specific policy strategy for the purpose of improving the education level of the population. The acquisition of better knowledge, the improvement of individuals skills and personal capabilities have been achieved by an education policy which has extended the duration of compulsory schooling and promoted higher education. The policy focus on education is a result of the new growth theories which emphasize the impact of human capital investment on economic welfare of countries and regions. Human capital (education, individuals skills) is considered as a prerequisite for countries (regions) to absorb the necessary knowledge and to increase their growth rates (Barro, 1991). Countries (regions) can grow faster if they have a high stock of human capital (Nelson and Phelps, 1966; Romer, 1990; Becker, Murphy and Tamura, 1990).

Education can be viewed also as a resource component as well as a consumption component of welfare (Blohm and Ohlsson, 1973). Thus individuals may realise their social and economic potential in terms of employment possibilities, income generation and quality of life. But this criterion also implies that the main goal of a community (regional authorities or central government) consists of providing equal education opportunities to citizens. This underlies the importance of the *institutional context* which covers the organization of the educational resources, and also the education enrollment registered in education institutions (Horn, 1993).

In Spain the provision of education facilities in particular is mostly in hands of the central government and regional authorities. Seventy-six per cent of the primary schools in

1991 (which corresponds to 72% pupils enrolled in the primary educational level) is controlled by both the *Ministry of Education* or the *Education Departments* or *Boards* in those regions with transferred powers for education. In addition, the State body and the regional governments not only finance the public-sector schools and higher institutions but also provide funds to the *grant-aided* private schools. Another characteristic of the Spanish educational system is that education is compulsory for the age group 6-13 years (since 1970), and also for pupils aged 14-15 years since 1990. The extension in the age limit for compulsory level up to 13 years old results from the educational acts (1970 *Ley General de Educación* and 1990 *Ley de Ordenación del Sistema Educativo*). Assuming *normal ages,*[96] pupils enter primary school at the age of 6 years while the end of the compulsory education coincides with lower secondary education[97]. Upper secondary education is optional and non-funded, and prepares students for higher education, or trains students for vocational or technical fields. The pre-primary school for children up to the age of 5 is concerned, it is included as a part of the educational system but is not compulsory.

Since the 60s the impact of education policy on enrollment in Spain has been reinforced by demographic developments. In particular the population explosion of the 60s and mid-70s has modified the age structure of the population, influencing the number of students attending compulsory and non-compulsory education. Figure 6.1 represents the changes in the numbers of young people listed in the 1960, 1970, 1981 and 1991 censuses. The index for each year is obtained by computing the ratio of the number of young people registered in each year to the base year (1960). There has been significant increase in the age groups from 10 to 19 years and from 20 to 29 years, a decline for the youngest group (0 to 9 years) in the last twenty years and a steady decline in the group of young people between 1981 and 1991.[98] So the data suggests that the enrollment in non-compulsory education (secondary and higher education) may have changed not only due to education

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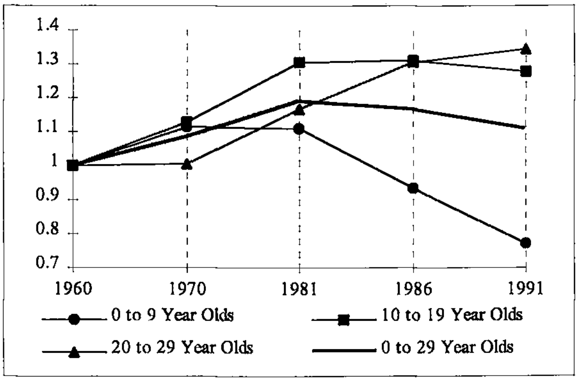
[96] The notion of normal ages refers to the ages of admission to courses and duration. Neither early or late starts nor extended duration resulting from pupils having to repeat years are then taken into account (EC 1997e).

[97] This corresponds to the first cycle of the general secondary education for the last three decades under consideration in the present study.

[98] These changes are mostly explained by the population growth that occurred in the sixties and mid-seventies and the decline in birth rates from the eighties (Chapter 2).

policies but also due to changes in population the population group of 10 to 29 years old over the last few decades.

Figure 6.1 Trends in the Age Distribution in Spain, 1960 to 1991 (Population Index with 1960=1).



Source: 1960, 1970, 1981 and 1991 Census.

Inequality in the institutional context of education is examined in this chapter. Facilities in education are studied in Section 6.2 while education enrollment is explored in Section 6.3. In detail, indicators that represent education facilities are described in Section 6.2.1. The inclusion of facilities located in adjacent areas (contiguity) is discussed for education in Section 6.2.2. The results of the estimation of the composite index with respect to education facilities are given in Section 6.2.3. Inequality is analyzed in Section 6.2.4. The implications of including spatial effects are investigated comparing results in the contiguity and non-contiguity cases in Section 6.2.5. The indicators used for the analysis of education enrollment are presented in Section 6.3.1, the results of the estimation of composite index are given in Section 6.3.2. The analysis of inequality in enrollment is provided in Section 6.3.3 and finally Section 6.3.4 focuses on the comparison of geographical patterns between education facilities and education enrollment.

6.2 Provision and Spatial Organization of Education Facilities.

6.2.1 Indicators for Education Facilities.

The number of teachers and institutions per 1000 inhabitants for secondary and higher education in the fifty Spanish provinces is used as the indicators for education facilities. Primary education is not considered because education is compulsory at this level and so the provision of facilities is publicly guaranteed. The statistical source used is *Estadísticas de la Enseñanza en España* (Ministry of Education) for the four time periods under consideration. Because of the changes in the educational system,[99] the institutions included under secondary and university education are different for the four years considered. The data on the secondary education in 1964 refers to teachers and institutions in higher secondary school (*Bachillerato*), vocational training (*Formación Profesional*), business and infirmary studies (*Comercio* and *ATS*) and agricultural and technical studies (*Bachillerato laboral* and *Escuelas técnicas*). Since the 1970 education act however study of business, infirmary and agricultural and technical studies are included at the university education. Secondary education in 1981 consists of vocational training, secondary school, and other type of studies not considered as higher technical studies (arts). In 1991, secondary education consists only of vocational training and higher secondary school.

University education included university faculties and higher technical schools in 1964, and a number of studies were dropped from the definition of secondary education in the rest of the periods (infirmary study, bussiness study, etc).

6.2.2 The inclusion of Spatial Spillover Effects in Education.

As in Chapter 5, contiguity between provinces is considered in the analysis of inequality in education facilities. The procedure developed in Section 5.2.3 is used for

[99] Appendix 6.1 shows that the definitions of the three education levels have varied following changes in the educational acts.

empirical purposes. Available facilities for non-compulsory education in a province consist of the facilities in the own province and those in its neighbours. This section focuses on the spatial weights required due to the inclusion of contiguity.

In the case of facilities for secondary education, we compute spatial weights based on inverse distance (travel time) between the provincial capitals of two adjacent provinces. As explained in Chapter 5, the geographical centralization of services in provincial capitals is assumed[100]. The level of contiguity considered here is the first-order because we assume that individuals seek education in the nearest area to their place of residence.

Spatial weights in university education are also computed assuming the centralisation of facilities at a geographical point (provincial capital). With some examples we investigate whether there is a centralization of higher education in the provincial capitals. So we first try to find some evidence of the centralization of resources for university education in the provincial capitals. If these institutions are dispersed within the provinces, then we have to find alternative ways to estimate spatial weights.

The spatial distribution within the province is investigated with respect to the campuses of three universities located in industrialized the provinces of Madrid, Barcelona and Valencia. These universities also have high levels of enrollment. Table 6.1 provides the main locations of campuses for each university together with the travel inputs computed between the provincial capital and the location of the campus (within the province or outside of the province). The capacity of the campus or the maximum number of students admitted in 1998 is also provided in Table 6.1. The campuses are located in the provincial capital or in areas very close in distance or travel time terms. For instance, most of the campuses of the Universidad Autónoma de Barcelona are located in Cerdanyola which is 13 km from the provincial capital of Barcelona. Similarly campuses of the other universities are located in the provincial capital or in adjacent areas. So it appears that universities are centralized within provinces (e.g., Valencia) or located in adjacent areas (e.g., Alcalá de Henares).

[100] Provincial capitals are considered representative points of provinces.

Table 6.1 Location of Universities in Barcelona, Valencia, and Madrid Provinces.

Name of the University	Province	Location[a]	Capacity of Campus[b]		Travel Inputs[c]	
			Total	Share	km	min
Autónoma de Barcelona	Barcelona	*Barcelona*	378	4.2	-----	-----
	Barcelona	Mollet del Vallés	95	1.0	18	14
	Barcelona	Sabadell	560	6.2	20	15
	Barcelona	Terrassa	422	4.6	28	21
	Barcelona	Manresa	253	2.8	57	50
	Barcelona	CERDANYOLA	6976	76.6	13	12
	Barcelona	Sant Cugat Vallés	418	4.6	18	14
Valencia (Estudi Gral)	Valencia	*VALENCIA*	8960	73.0	-----	-----
	Valencia	BURJASOT	2062	16.8	5	4
	Valencia	Cheste	86	0.7	31	21
	Valencia	Catarroja	750	6.1	8	8
	Valencia	Montcada	368	3.0	9	8
	Castellón	Castellón	54	0.4	70	49
Alcalá de Henares	Madrid	*Madrid*	542	10.3	-----	-----
	Guadalajara	Guadalajara	675	12.8	58	37
	Madrid	ALCALÁ de HENARES	4041	76.9	32	21

[a] Main locations of the universities in capital letters and provincial capitals in italic font style.
[b] Capacity of the center, that is, maximum number of students who are admitted. Share denotes the percentage of students admitted in the campus over the total number of students admitted in the university.
[c] Travel time (in minutes) and travel distance (in kilometers).
Sources: Ministry of Education of Spain (MEC) and Ministry of Interior (Dirección General de Tráfico).

In order to determine the most appropriate level of contiguity, the changes in the distribution of university facilities in Spain have to be considered. During the sixties and the early seventies many universities were established in regions and in highly industrialized provinces in particular. So universities tended to be concentrated in specific areas. It is quite likely that this spatial organization is the result of a previous policy seeking allocative efficiency within the country. But since the seventies the strategy pursued has involved the improvement of university education and further a decentralization of universities.[101] The forty-five new universities founded between 1964 and 1998 show that educational policies have led to geographical dispersion among the

[101] The dispersion of the universities in most of the European countries has shown that higher education has positive impacts in the *home* region (i.e. region in which the university is established). Universities contribute to improve the regional economy and evidently the human capital in the home regions. Florax (1992) provides a comprehensive explanation of the economic and non-economic effects of the universities on regions.

Spanish provinces.[102] In other words, the expansion of higher education has gone hand in hand with the regional spread of the universities.

Available facilities at the university level consist of the services located in the own province and in contiguous provinces (Equation 5.3). Contiguous provinces in the analysis for 1964 and 1974 consist of facilities located in the first and second order of contiguity together with facilities in Madrid and Barcelona. The spatial weight is given by the sum of inverse distance from the origin provincial capital to the first order contiguous provinces plus the inverse distance to the second order contiguous provinces plus the inverse distance to the central places. So for 1964 and 1974 we take into account the fact that there has been a centralization of universities in Madrid and Barcelona during the 60s and the 70s. In other words Madrid and Barcelona are considered as central places which provide services to individuals. In 1981 and 1991 the level of available facilities for university is determined by the sum of own facilities and those located in first and second contiguous provinces. So we assume that it is possible for individuals to use facilities of university education located near their places of residence because of the dispersal of facilities.

The statistical information on travel inputs used in this chapter (first, second levels of contiguity and travel inputs with respect to Madrid and Barcelona) are given in Appendices 5.1, 6.2 and 6.3, respectively.

6.2.3 Results of the Estimation of the Composite Index with respect to Education Facilities. The Contiguity Case.

In the present section we discuss the results for the contiguity case while the results for the non-contiguity case are given in Appendix 6.5. In both cases the empirical findings reported have been obtained following the steps of the estimation procedure summarized in Chapter 5. Tables 6.2 and 6.3 give the results obtained after following Steps 1 to 6. The proportion of variance computed from the eigenvalues (Step 2) reveals that the first component retains around 60-70% of the total variability (Table 6.2). The 1974 sample has

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[102] The number of universities is 14 in 1964 while this is 60 in 1998 (Appendix 6.4).

the highest fraction of trace which accounts for 71% of total variance. The upper end of 95% confidence region also indicates poor results because of the loss of 50-70% of variability after removing the remaining components.

Table 6.2 Analysis of the First Eigenvalues (Principal Components Variances) with respect to Education Facilities. The Contiguity Case.

	1964	1974	1981	1991
Eigenvalues	0.101	0.087	0.071	0.076
Standard Errors	0.020	0.017	0.014	*0.015*
Standard Deviation	0.318	0.295	0.266	0.276
Proportion of Total Variance	0.60	0.71	0.62	0.67
Upper end of 95% confidence region	0.616	0.491	0.657	0.547

The coefficients of the first component (Step 1) are given in Table 6.3. Although the first component is dominated by the university teachers variable in the 1964, 1974 and 1991 samples, the other variables have high coefficients as well (component coefficients range between 0.3 and 0.6). So we interpret these components as a measure of facilities for non-compulsory education (Step 3). University teachers and university institutions clearly dominate the first component in the 1981 sample. Component coefficients are 0.72 for the university teachers variable and 0.65 for university institutions. The interpretation of the first component of the 1981 sample is therefore a measure of facilities for university education.

Now we investigate the robustness of the foregoing interpretations using the sphericity test between the first and second eigenvalues (Step 4) and the results are given in Table 6.3. The values of the statistic chi square show that the null hypothesis (whether the first and second eigenvalues are equal) is rejected at the 5% level of significance for the 1974 and 1964 samples. The critical value of a chi-squared distribution with two degrees of freedom is 5.99 at the 5% of significance). The hypothesis is also rejected at the 10% level of significance for the 1964. The critical value of chi square with two degrees of freedom is 4.61 at 10% of significance. But we can not reject the hypothesis of identical first and second eigenvalues for the 1981 sample because the chi square is 4.20. So we conclude that the interpretations are robust for all samples except for the 1981 sample. The analysis of the stability of the component coefficients using the asymptotic standard error (Step 6) reveals that component coefficients for the 1964 and 1991 samples are quite unstable while the ones for the 1974 sample are stable being smaller than 0.1 (Table 6.3). In sum, we can consider only the 1974 sample to have been reasonably interpreted as an overall measure of non-compulsory education from a statistical point of view.

Table 6.3 Coefficients of the First Principal Component with respect to Education Facilities. Standard Errors in Brackets. The Contiguity Case. Sphericity Test between the First and Second Eigenvalues.

Group	1964		1974		1981		1991	
Secondary Education Teachers	0.4064	(0.1268)	0.3461	(0.0682)	0.1746	(0.14)	0.3155	(0.0738)
Secondary Education Institutions	0.5402	(0.1045)	0.3123	(0.0876)	0.1958	(0.1832)	0.3709	(0.103)
University Teachers	0.6027	(0.0975)	0.6745	(0.0530)	0.7151	(0.0349)	0.7290	(0.0502)
University Institutions	0.4241	(0.1152)	0.5727	(0.0395)	0.6479	(0.0625)	0.4818	(0.058)
Sphericity Test between the First and Second Eigenvalues								
Chi Square (2 Df)	5.16		14.15		4.20		11.46	

In the next two steps (Step 7 and 8) we test if it is possible to reduce the number of parameters. We apply the PCPC model assuming the null hypothesis that the four samples have one common component against the alternative that the component coefficients of these samples are not equal. At the 5% level of significance this hypothesis is rejected (chi square is 19.212 with 9 degrees of freedom while the p-value is 0.0235) (the critical value is 16.92). In the following step of the procedure (Step 10) we select the 1974, 1981, and 1991 samples to determine whether a reduction of the number of parameters is possible for these three samples. The choice of these samples is based on the similarity of their component coefficients displayed in Table 6.3. The dominant variables are mostly related to university education level. The PCPC model is applied to these samples and yields a chi-square 13.253 with 6 degrees of freedom (p-value is 0.0392). So the null hypothesis that the 1974, 1981 and 1991 samples share the first component is rejected at the 5% level of significance. Again the model is applied to the most similar pairs of samples (Step 12), first for the 1964 and 1974 samples, and then for the 1981 and 1991 samples. The null hypothesis can not be rejected so it is possible that the 1964 and 1974 samples share the same component coefficients. The exact maximum likelihood test for the 1964 and 1974 samples yields a chi square 6.534 with 3 degrees of freedom (p-value is 0.0883) (Table 6.4). The first component is also common for the 1981 and 1991 samples. The chi square is 7.325 with 3 degrees of freedom (p-value is 0.0622) for the 1981 and 1991 samples (Table 6.4).

The covariance and correlation matrices (Step 9) between the first common component (1st PCPC) and the remaining three individual components (2nd, 3rd and 4th PC) obtained under PCPC for the 1964 and 1974 samples are given in Table 6.6. The matrices for the 1981 and 1991 samples are provided in Table 6.7. Looking at the correlations (displayed below the diagonal) we corroborate that the first component is common for these three samples. The highest correlation in the 1964 sample is equal to 0.27 between the 1st PCPC and the 4th PC, while the negative correlation of 0.22 between the same components is also the highest correlation for the 1991 sample.

Finally, the results (Step 12) for the approximate maximum likelihood estimates of the first common component for the 1964/1974 samples and 1981/1991 samples are given in Table 6.5 together with the standard errors of the first common components. Based on the coefficients of the common component, this component is interpreted in both cases (that is for the 1964/1974 samples and for 1981/1991) as a measure of the facilities for non-compulsory education. The standard coefficients of common components are stable so the interpretations can be considered robust. So there is a clear improvement in the results in terms of the stability of component coefficients and in particular with respect to those used to estimate the composite index.

Table 6.4 Test for Partial Common Principal Components for the 1964 and 1974 Samples, and 1981 and 1991 samples with respect to Education Facilities. The Contiguity Case.

Test for One Common Principal Component

	PCPC(1) 1964 and 1974 Samples	PCPC(1) 1981 and 1991 Samples
Number of Estimated Parameters	17	17
Likelihood Ratio Test Chi Square	6.534	7.325
Degrees of Freedom	3	3
p-Value	0.0883	0.0622

Table 6.5 Approximate Maximum Likelihood Estimates with respect to Education Facilities. Results for the PCPC model for the 1964 and 1974 samples, and the PCPC model for the 1981 and 1991 Samples. Standard Errors of the First Common Components in Brackets. The Contiguity Case.

a. Coefficients of the First Common Principal Component. Standard Errors in Brackets.

	1964 and 1974 Samples		*1981 and 1991 Samples*	
	Coefficients	Standard Errors	Coefficients	Standard Errors
Secondary Education Teachers	0.3842	(0.0611)	0.2951	(0.0674)
Secondary Education Institutions	0.4016	(0.0722)	0.3653	(0.0897)
University Teachers	0.6371	(0.0421)	0.6970	(0.0360)
University Institutions	0.5340	(0.0457)	0.5420	(0.0487)

b. Characteristic Roots for the First Common Principal Component

	1964 Sample	*1974 Sample*	*1981 Sample*	*1991 Sample*
Characteristic Roots	0.099	0.086	0.069	0.076
Proportion of Total Variance	0.59	0.71	0.61	0.67

Table 6.6 Covariance (F) and Correlation (R) Matrices of Estimated Components for the 1964 and 1974 Samples with respect to Education Facilities. The Contiguity Case.†

a. Matrices for the 1964 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.099	-0.007	0.002	-0.009
$R_{64}\backslash F_{64}$	=	-0.099	0.054	0	0
		0.072	0	0.005	0
		0.266	0	0	0.011

b. Matrices for the 1974 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.086	0.006	0.001	0.002
$R_{74}\backslash F_{74}$	=	0.122	0.030	0	0
		0.043	0	0.004	0
		0.187	0	0	0.001

† On and above diagonal variances and covariances of the first common component. Below diagonal correlations.

1st PCPC: First common principal component. This is obtained using PCPC.

2nd, 3rd and 4th PC: Second, third and forth principal component computed individually using PCPC.

Table 6.7 Covariance (F) and Correlation (R) Matrices of Estimated Components for the 1981 and 1991 Samples with respect to Education Facilities. The Contiguity Case.†

a. Matrices for the 1981 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.069	0.007	0.002	0.002
$R_{81}\backslash F_{81}$	=	0.131	0.041	0	0
		0.168	0	0.003	0
		0.178	0	0	0.001

b. Matrices for the 1991 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.076	-0.001	-0.003	-0.003
$R_{91}\backslash F_{91}$	=	-0.027	0.029	0	0
		-0.179	0	0.005	0
		-0.222	0	0	0.003

† On and above diagonal variances and covariances of the first common component. Below diagonal correlations.

1st PCPC: First common principal component. This is obtained using PCPC.

2nd, 3rd and 4th PC: Second, third and forth principal component computed individually using PCPC.

6.2.4 Analysis of Spatial Inequality with respect to Education Facilities in the Contiguity Case.

This section focuses on the analysis of results with respect to the contiguity case for the non-compulsory education (secondary and university education. With the inclusion of the education services located in adjacent provinces, inequality declines in the periods 1964-1974 and 1981-1991 with a small increase between 1974-1981. We suspect that results for 1974-1981 may have been affected by differences in the weights used to compute the composite indices. Different models of PCPC have been applied to the 1964 and 1974 samples and to the 1981 and 1991 samples. So the 1974 and 1974 samples share a partial common component. Another common component is used for the 1981 and 1991 samples. Although the dominant variables are the same in both cases, component coefficients are slightly different especially with regard to university teachers and institutions (Table 6.6 for all samples). Since inequality does not change much between 1974-1981, the decline in inequality from the seventies to the nineties may have occurred because education policy focused on the promotion of non-compulsory education. This decline in inequality may be the result of the geographical spread of university and secondary education institutions in Spain.

Table 6.8 Theil's Second Measure with respect to Educational Facilities. The Contiguity Case.

	1964		1974		1981		1991	
	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%
Between-Region	0.0523	55.4	0.0125	39.2	0.0109	28	0.0115	41
Within-Region	0.042	44.6	0.0193	60.8	0.0280	72	0.0166	59
	$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$	
Total Inequality	***0.0943***		***0.0318***		***0.0389***		***0.0281***	

The results for the two components of overall inequality are displayed in Table 6.8. Inequality decomposition shows that the main source of inequality over time is within-region inequality (except for 1964). The change observed between 1964 and 1974 coincides with the establishment of an educational system which guarantees compulsory education and pays attention to the enhancement of the non-compulsory education. Within-region inequality accounts for 60.8% of the overall inequality in 1974, 72% in 1981 and 59% in 1991. Over the period 1981-91 between-region inequality increases from 28% of overall inequality (in 1981) to 41% (in 1991). This change may be because education powers have been transferred to regional authorities in the mid-eighties, and autonomy may have had an impact on between-region inequality.

A more in-depth analysis of within-region inequality over the whole period shows that Andalucía, Castilla León and Castilla la Mancha are the regions with the highest region's share of within-region in 1991 (Appendix 6.7). As explained in Chapter 5 these regions have similar socio-economic regional features and are all located in the Center or South of Spain. But they differ in the level of autonomy in education powers. There is a significant increase of within region inequality in Andalucía and Castilla León between 1981 and 1991. Andalucía's percentage of within region inequality increases from 29.6% of within region inequality in 1981 to 32.9% in 1991, while Castilla León's percentage changes from 22.6% of within-region inequality (1981) to 27.6% (1991). The percentage of within-region inequality does not change much in Castilla la Mancha over this period. So the results for inequality in the regions with important intra-regional disparities suggest that regional socio-economic characteristics may have had more influence on inequality than the devolution of powers in education.

Among the other regions with powers in education issues, the results show that the contribution of País Vasco, Cataluña, and Comunidad Valenciana to within-region inequality has increased between 1981 and 1991, while the region's percentage of within-region inequality in Galicia and Canarias has declined (Appendix 6.7).[103] The results for within-region inequality in these regions suggest that regional policies may have been affected by the region's features. Galicia and Canarias are very different with respect to several features. Galicia has abundant natural energy resources striking contrast to Canarias. The main economic sector in Galicia is agriculture while in Canarias it is services (tourist industry). Galicia and Canarias have also different geographical characteristics

[103] See Appendix 6.7. Cataluña's share of within-region inequality is 2.7% of within region inequality (1981) and 5.9% (1991); Comunidad Valenciana's share is 3.1% (1981) and 6.2% (1991); País Vasco's percentage is 0.01% (1981) and 0.1% (1991). On the other hand Galicia's percentage of within-region inequality declines from 10.3% (1981) to 4.8% (1991) and Canarias' percentage decreases from 4.6% (1981) to 0.2% (1991).

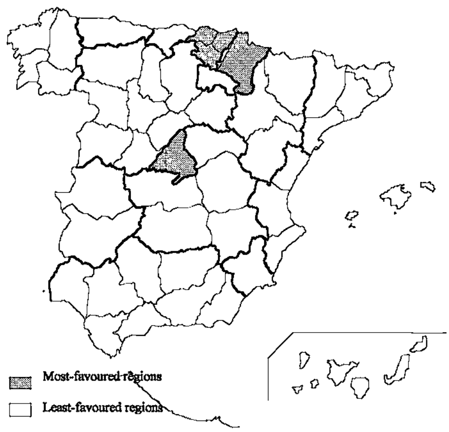
because the former is situated in the North of the Iberian Peninsula and the latter are the islands situated close to western coast of Africa. But both regions have various characteristics in common. Firstly, they are the poorest regions with powers in education and secondly, there are marked contrasts within these regions. The main intra-regional disparities are found between the Atlantic coast and inland areas in Galicia, and within the islands in Canarias. These differences are caused by economic development, degree of urbanisation and population.

We consider now the changes in the geographical distribution of facilities using cluster analysis. The classification of the Spanish regions in two groups is displayed in Figure 6.2[104] for 1964 and 1991. The map for 1964 depicts a geographical location of education facilities in País Vasco and Navarra (situated in the North of Spain) and Madrid situated in the centre of Iberian Peninsula). However the most-favoured regions are situated in the centre of the Peninsula in 1991. So the maps show that there are important differences between 1964 and 1991. The changes in the geographical pattern may be the result of the education policies which focused on the decentralisation of non-compulsory education. The regions of Castilla León, Navarra and Aragón have been particularly benefited by the new measures.

[104] In the contiguity case of education facilities for 1964, the most-favoured regions with respect to composite index range from 0.63 (Madrid) to 0.47 (Navarra) while the composite index for the least-favoured regions ranges from 0.33 (Asturias) to 0.09 (Extremadura). For 1991, the most-favoured regions with respect to composite index range from 0.54 (Navarra) to 0.45 (Aragón) while the composite index for the least-favoured regions ranges from 0.37 (Cantabria) to 0.24 (in Comunidad Valenciana).

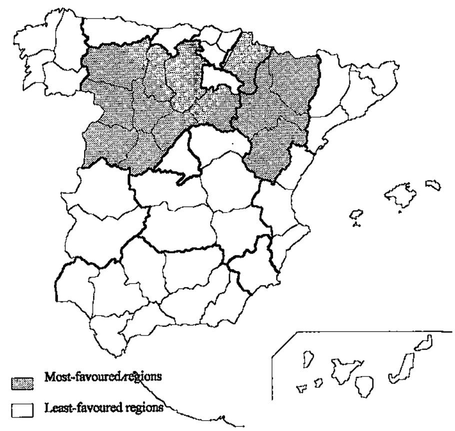
Figure 6.2 Clusters of Most-favoured and Least-favoured regions with respect to Education Facilities the Contiguity Case.

1964



Most-favoured regions: Madrid, Navarra País Vasco.
Least-favoured regions: Andalucía, Canarias, La Rioja,Comunidad Valenciana, Extremadura, Castilla León, Castilla la Mancha, Galicia, Murcia, Extremadura, Asturias, Cantabria, Aragón, Cataluña, Baleares.

1991



Most-favoured regions: Castilla León, Navarra, Aragón.
Least-favoured regions: Andalucía, Canarias, Comunidad Valenciana, Extremadura, Castilla la Mancha, Galicia, Murcia, Extremadura, Madrid, Asturias, Cantabria, País Vasco, Cataluña, Baleares, La Rioja.

6.2.5 Implications of Including Spillover Effects. Comparison of the Contiguity Case and the Non-Contiguity Case.

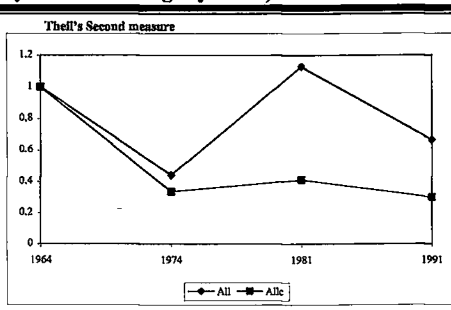
A comparison of the results from the contiguity and non-contiguity cases is presented in this section. The current practice in the literature is to ignore the differences in geographical access to education facilities. From 1974 to 1991 inequality is smaller in the contiguity than in the non-contiguity case (Table 6.9). As explained in Chapter 5, the difference may be due to the inclusion of contiguity. So the smaller inequality in the contiguity case compared to the non-contiguity case may be due to spillover effects which improve the availability of facilities in all regions. So we may conclude that since the seventies individual's opportunities for non-compulsory education have improved.

Table 6.9 Theil's Second Measure with respect to Educational Facilities. The Non-contiguity Case.

	1964		1974		1981		1991	
	$T_{-1}(W_{\bullet})$	%	$T_{-1}(W_{\bullet})$	%	$T_{-1}(W_{\bullet})$	%	$T_{-1}(W_{\bullet})$	%
Between-Region	0.0507	69.3	0.0132	40.9	0.0232	28.1	0.018	37.1
Within-Region	0.0225	30.7	0.0191	59.1	0.0593	71.9	0.0305	62.9
	$T_{-1}(W_{\bullet})$		$T_{-1}(W_{\bullet})$		$T_{-1}(W_{\bullet})$		$T_{-1}(W_{\bullet})$	
Total Inequality	***0.0731***		***0.0323***		***0.0825***		***0.0485***	

Figure 6.3 reveals a picture of the trend in overall inequality in the contiguity case and non-contiguity case. The change in inequality between 1974 and 1981 is more dramatic in the non-contiguity case. Overall inequality in the contiguity case does not change much over this period. But overall inequality declines quite sharply when contiguous facilities are not included in the analysis. We believe that the contiguity case gives us a better overview of inequality. In this case the results are in line with the education measures which have focused on promoting non-compulsory education since the seventies. So we may conclude that the impact on inequality of education policies seems clear in the contiguity case[105].

Figure 6.3 Trends of Theil's Second measure in Overall Inequality with respect to Education Facilities (The Contiguity and Non-contiguity Cases). 1964 Base Year.



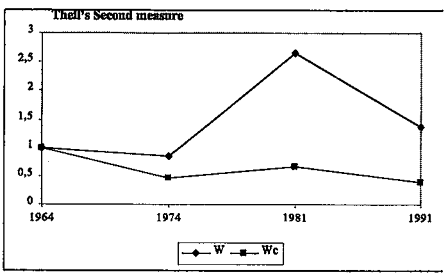
All: Spatial or overall inequality. Allc: Spatial or overall inequality considering contiguity.
Year 1964 =1

[105] A similar conclusion is drawn in Chapter 5 with respect to health facilities.

Figure 6.4 shows that inequality is larger for both between-region inequality and within-region inequality in the non-contiguity case. In addition the trends are rather different in the non-contiguity case compared to the contiguity case. So it is possible that the geographical effects or spillover have affected overall inequality and the components in the inequality decomposition.

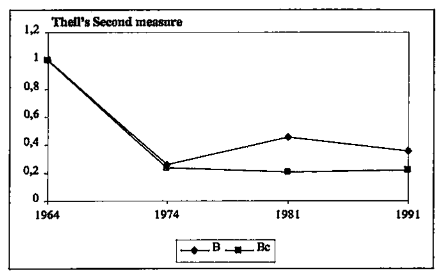
Figure 6.4 Trends of Theil's Second Measure in Between-Region and Within-Region Inequality with respect to Education Facilities (The Contiguity and Non-contiguity Cases). 1964 Base Year

Within-Region Inequality



W: Within-regions inequality. Wc: Within-regions inequality considering contiguity.
Year 1964 =1

Between-Region Inequality



B: Between-regions inequality. Bc: Between-regions inequality considering contiguity.
Year 1964 =1

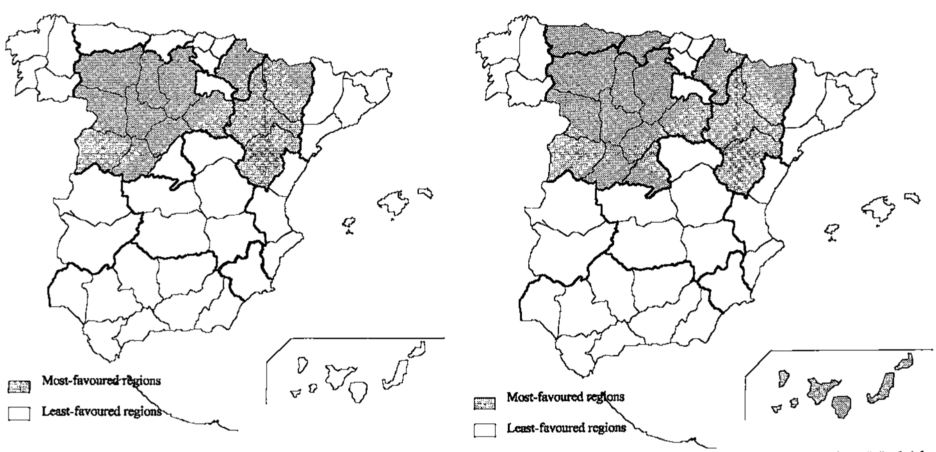
The maps displayed in Figure 6.5 show that there are not many noticeable changes in the distribution of facilities in the contiguity and non-contiguity cases. The comparison of the geographical distribution of facilities in 1991 suggests that the regions that have been mostly benefited by spillovers are Aragón, Navarra and Castilla León. These regions fall into the group of most-favored regions in the contiguity case, while Madrid, Cantabria and Asturias are not included. The provinces of Huesca and Teruel situated in Aragón may be favoured by the proximity (first or second order) to the provinces of Madrid, Barcelona and Navarra[106]. This is observed in the change in the position of Huesca and Teruel with respect to the ranking of the 50 Spanish provinces in education facilities (Appendix 6.6). Huesca ranks at the 13th position in the non-contiguity case and at the 10th position in the contiguity. The position of Teruel changes from the 27th (non-contiguity) to the 9th (contiguity). So

[106] All these provinces have high levels of available facilities even in the non-contiguity case (Appendix 6.6).

there are spillovers between the region of Aragón and the regions of Madrid, Cataluña and Navarra. The spillovers between Castilla León and its neighbours may be due to the geographical proximity of the provinces of Avila, Segovia, and Soria to Madrid, and the contiguity of provinces of Castilla León (first or second order) to Navarra. Navarra ranks at the 2nd position in the non-contiguity case and the 1st position in the contiguity case so it is a favoured region in both cases.

Figure 6.5 Clusters of Most-Favoured and Least-Favoured Regions with respect to Education Facilities at 1991.

The Contiguity Case | **The Non-Contiguity Case**



Most-favoured regions: Castilla León, Navarra, Aragón.
Least-favoured regions: Andalucía, Canarias, Comunidad Valenciana, Extremadura, Castilla la Mancha, Galicia, Murcia, Extremadura, Madrid, Asturias, Cantabria, País Vasco, Cataluña, Baleares, La Rioja.

Most-favoured regions: Castilla León, Canarias, Madrid, Navarra, Aragón, Asturias, Cantabria.
Least-favoured regions: Andalucía, Comunidad Valenciana, Extremadura, Castilla la Mancha, Murcia, La Rioja, Baleares, Cataluña, Galicia, País Vasco.

We investigate spillover effects in the regions with the highest within region inequality using cluster analysis (Andalucía, Castilla León, and Castilla la Mancha) (Appendix 6.7). The cluster analysis is based on the provinces' composite index values with respect to education facilities in each region. The results are compared for the contiguity and non-contiguity cases. From the comparison it appears that there are no important spatial effects within Andalucía and Castilla la Mancha. The cluster of most-favoured provinces within the region of Andalucía (i.e Granada) with respect to education facilities does not change in the contiguity case compared to the non-contiguity. The most-favoured provinces within Castilla la Mancha are Albacete, Ciudad Real, Cuenca, and Guadalajara in the non-contiguity case, while Guadalajara is the only province included in this cluster in the contiguity case. This change may be because Guadalajara is particularly favoured by its proximity to other regions (like Madrid). In other words, the availability of education facilities in this province improves because of between-region spillovers. Finally, the inclusion of geographical proximity reveals spatial spillovers within the region of Castilla León. The group of most-favoured provinces with respect to the provinces' composite index consists of Salamanca and Segovia in the contiguity case, while only Salamanca is included in the non-contiguity case. Segovia's position in relation to the 50 Spanish provinces is 6^{th} in the non-contiguity case and 3^{rd} in the contiguity case (Appendix 6.6).

6.3 Enrollment in the Private and Public Education Services.

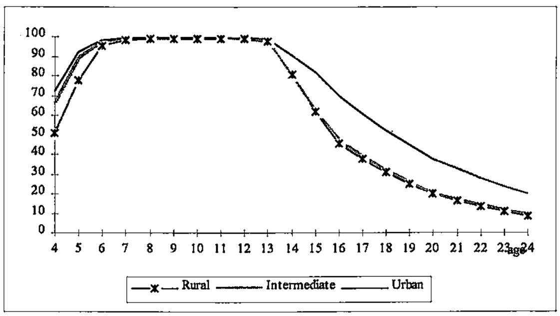
6.3.1 Indicators for Enrollment.

Looking for a definition of demand for education one finds several related meanings. The notion may refer to *potential demand* which corresponds to individuals with compulsory education in the age group from 6 to 13 years. However, the majority of researchers consider the *recorded demand* as the number of students enrolled in a certain educational system. For compulsory education, the recorded demand corresponds to the number of pupils found in the primary schools. Both views of the notion of demand for education to calculate *enrollment ratios* for a community, say region *g*. Recorded demand in the gth region is then bounded to the potential demand of the geographical area under consideration.

The analysis of inequality carried out in this section is based on the enrollment ratios. The statistical source of recorded demand is *Estadísticas de la Enseñanza en España* (Ministry of Education, 1964,1974,1981,1991) and the *Censuses* (INE, 1960, 1970, 1981, 1991) for the potential demand. The age groups 15-19 and 20-29 years denote the potential demand in the secondary (including vocational training and secondary school) and higher educational systems. The enrollment ratios are considered as elements with a positive impact on welfare.

Indicators of enrollment in primary education have not been considered. The inclusion of primary education makes no sense since education is compulsory and publicly provided at this educational level. In addition, on the basis of 1981 census data, Torres (1991) shows that there are not many differences in enrollment in primary education with respect to the place of residence. The enrollment rates in compulsory education for people living in rural (less than 2000 inhabitants), intermediate (from 2000 to 10000 inhabitants) and urban areas (above 10000 inhabitants) are equal. The percentage enrollment for the age group 6-13 years (compulsory education) is above 90% for three areas (Figure 6.6). But differences between enrollment rates in urban and rural/intermediate areas become significant for the age group 14-24 years. There is a significant decline in the enrollment in scarcely populated areas for the age group 14 to 24 years. Pupils in rural areas leave school before they finish compulsory education. Apart from socio-economic factors,[107] this drop may be caused by difficulty in access to the secondary schools and universities. So the fall in enrollment in certain areas may not only be due to people's attitude but also by the distribution of resources in non-compulsory education level.

Figure 6.6 Percentage of Enrollment in Spain for the Age Group 4-24 Years.



Source: Torres (1991) from census data.

The use of the available statistical information on higher education has led to several problems. First, potential demand has to refer to the age group 20-29 years instead of 18-29 because censuses only provide provincial information for five-year age groups.[108] We are aware that the omission of this group may influence our results, but there is no available statistical information for the age group 18-29.

The second problem relates to information provided by universities for 1991. Although many universities have established institutions in different provinces, the statistical information refers to the total number of students in the university[109] as a whole so the exact number of enrollments in each provincial institution is not available. We have computed weights to distribute the recorded demand of each university among its provincial institutions. The weight used consists of the percentage of students admitted in

[107] Being non-obligatory at this level individuals are free to enter into the labour force. Especially, the young in rural areas leave the school to work on the land.

[108] Census data is organised by five years groups, that is, 0-4, 5-9, 10-14, etc.

[109] For instance, the *Universidad del País Vasco* provides information on the overall number of students in the institutions located in the provinces of Vizcaya, Guipúzcoa and Alava.

the provincial institutions over the total number of students in the university. The statistical source is the *Secretaría General del Consejo de Universidades* (Ministry of Education) for 1997-98. Appendix 6.4 presents the weights used according to the geographical location of the institutions in the private and public Spanish universities.

Finally note that enrollment at the university level consists of students from own region and also, students from adjacent provinces or other distant provinces.[110] It is possible to find this situation in provinces with high level of facilities. For instance the potential demand for university education in the provinces of Madrid and Barcelona is 20% of this population age group in 1964 and 25% in 1991 (1960, 1991 Census).[111] But, the figures for recorded demand are 57 per cent in 1964 and 40 per cent in 1991 of the total number of students enrolled in higher education.[112] This may be because to most of the universities located in these provinces have a larger capacity than universities in other provinces (in terms of maximum number of students who are admitted).

6.3.2 Results of the Estimation of the Composite Index with respect to Education Enrollment.

Tables 6.10 and 6.11 summarize the main findings obtained after following Steps 1 to 4 with respect to education enrollment. The results for the eigenvalues of the individual analysis of principal component (Step 2) reveal that the first principal component recovers 60-70% of the total variability (Table 6.10). The share of total variance is 0.71 in the 1964 sample, 0.64 in the 1974 sample, 0.66 in the 1981 sample and 0.72 in the 1991 sample. The upper end at a significance level of 5% indicates that the lost variance after discarding the

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[110] This assumption is consistent with the many arguments about commuting for education and higher education in particular.

[111] Potential demand for higher school has been computed using the population age group 20-29 years. The Spanish provinces of Madrid and Barcelona are considered because most of the universities have been established in these two provinces.

[112] Enrollment has been computed by counting the number of students admitted into public and private universities.

three remaining components is around 50-60%.

Table 6.11 shows the dominant variables of the four samples. Component coefficients for university education are high specially for the 1974, 1981 and 1991 samples while coefficients for secondary education are higher in the 1964 samples. These component coefficients are interpreted as follows (Step 3). Since the university education variable clearly dominates in the first component of the 1974, 1981 and 1991 samples (with values around 0.95), these components are interpreted as a measure of enrollment in university education. But for the 1964 sample the variable related to vocational training (included in secondary level education) is dominant although the remaining (secondary school and university level) also have high values. So it is interpreted as a measure of enrollment in non-compulsory education.

Table 6.10 Analysis of the First Eigenvalues (Principal Components Variances) with respect to Education Enrollment.

	1964	1974	1981	1991
Eigenvalues	0.096	0.085	0.072	0.064
Standard Errors	0.019	0.017	0.014	0.013
Standard Deviation	0.310	0.292	0.268	0.253
Proportion of Total Variance	0.71	0.64	0.66	0.72
Upper end of 95% confidence region	0.47	0.57	0.57	0.50

The interpretations given above are robust because the hypothesis of sphericity between the first and second eigenvalues is rejected for all samples (Step 4) (Table 6.11). Values of the chi square with two degrees of freedom are above the critical values at the 5% level of significance (the critical value of chi square is 5.99 with two degrees of freedom) (Table 6.11). But the standard errors of the first principal component given in Table 6.11 are not very stable with respect to all samples. We conclude that the interpretations are not robust from a statistical point of view (Step 6).

Table 6.11 Coefficients of the First Principal Component with respect to Education Enrollment. Standard Errors in Brackets. Sphericity Test between the First and Second Eigenvalues.

Group	1964		1974		1981		1991	
Secondary School	0.5108	(0.0417)	0.3329	(0.0749)	0.2730	(0.0681)	0.2816	(0.0591)
Vocational Training	0.7293	(0.0574)	0.3420	(0.1291)	0.2343	(0.1347)	-0.0263	(0.1036)
University Education	0.4553	(0.1013)	0.8788	(0.0675)	0.9331	(0.0472)	0.9592	(0.0161)
Sphericity Test between the First and Second Eigenvalues								
Chi Square (2 Df)	16.05		10.05		10.36		17.40	

The hypothesis that the first component is common is tested following Steps 7 to 11. For the four samples this is rejected at the 5% level of significance because the chi square is 21.883 with 6 degrees of freedom (p-value is 0.0013) (Steps 7 and 8). The visual inspection of component coefficients in Table 6.11 reveals that the 1974, 1981 and 1991 samples are similar (Step 10). We apply a partial common principal component model for these samples (Step 11). Now, this model fits the data for the 1974, 1981 and 1991 samples because the chi square is 5.942 with 4 degrees of freedom (p-value 0.2035) (Table 6.12). Table 6.14 gives the covariance (on and above the diagonal) and correlation matrices (below diagonal) between the estimated principal components in a combined form. The highest correlation is –0.20 between the first common component (1st PCPC) and second individual component (2nd PC) obtained under PCPC for the 1991 sample. So the goodness of fit of the one common component model is corroborated with the correlations of estimated components as well.

Table 6.13 displays the approximate maximum likelihood estimates of the first common component. The dominant variable refers to higher education with a component coefficient equal to 0.95. From a statistical point of view, the component coefficients are stable (lower than 0.1) so the interpretation is robust. There is therefore an improvement in stability after applying the PCPC model. We interpret the first common component as a measure of enrollment in higher education.

Table 6.12 Test for Partial Common Principal Components for the 1974, 1981 and 1991 Samples with respect to Education Enrollment.

Test for One Common Principal Component	
	PCPC(1)
Number of Estimated Parameters in the Model	14
Likelihood Ratio Test Chi Square	5.942
Degrees of Freedom	4
p-Value	0.2035

Table 6.13 Approximate Maximum Likelihood Estimates for the 1974, 1981 and 1991 samples with respect to Education Enrollment. Standard Errors of the First Common Component in Brackets.

a. Coefficients of the First Common Principal Component. Standard Errors in Brackets.

Secondary School	0.2780	(0.0395)
Vocational Training	0.1462	(0.0758)
University Education	0.9494	(0.0204)

b. Characteristic Roots for the First Common Principal Component.

	1974	**1981**	**1991**
Characteristic Roots	0.083	0.072	0.063
Proportion of Total Variance	0.62	0.65	0.70

Table 6.14 Covariance (F) and Correlation (R) Matrices of the Estimated Components for the 1974, 1981 and 1991 Samples with respect to Education Enrollment.†

		1st PCPC	2nd PC	3rd PC
a. Matrices for 1974				
		0.0827	0.0106	-0.0013
$R_{74}\backslash F_{74}$	=	0.1930	0.0365	0
		-0.0401	0	0.0133
b. Matrices for 1981				
		1st PCPC	**2nd PC**	**3rd PC**
		0.0717	0.0036	-0.0021
$R_{81}\backslash F_{81}$	=	0.0796	0.0288	0
		-0.0806	0	0.0091
b. Matrices for 1991				
		1st PCPC	**2nd PC**	**3rd PC**
		0.0624	-0.0072	0.0033
$R_{91}\backslash F_{91}$	=	-0.2033	0.0201	0
		0.1646	0	0.0066

† On and above diagonal variances and covariances of the first common component. Below diagonal correlations.

1st PCPC: First common principal component. This is obtained using PCPC.

2nd and 3rd PC: Second and third principal component computed individually using PCPC.

6.3.3 Analysis of Spatial Inequality with respect to Education Enrollment.

Overall inequality has been computed from the composite index for education enrollment in the non-compulsory level of the Spanish educational system. Table 6.15 shows that inequality declines between 1964 and 1991. Inequality here may have been affected by the use of different component coefficients. These have been obtained using PCA for the 1964 sample and a PCPC model for the remaining samples. The composite index for the 1964 sample depends on secondary and higher education while higher education is the dominant variable for the 1974, 1981 and 1991 samples.

Although the results might have been influenced by the coefficients used, the trends in inequality are in line with the education policy pursued between 1964 and 1991. Education measures undertaken over this period focused on promoting non-compulsory education. This may have resulted in a decline in inequality. In particular, the establishment of new universities in many Spanish provinces may have helped to increase education enrollment and modify its distribution (Appendix 6.4). In addition, changes in the trend in overall inequality may be due to population developments which occurred over the last few decades. Thus, the 60's baby boom and the migration from rural areas to industrialized areas may have altered the geographical pattern of enrollment for secondary and higher education.

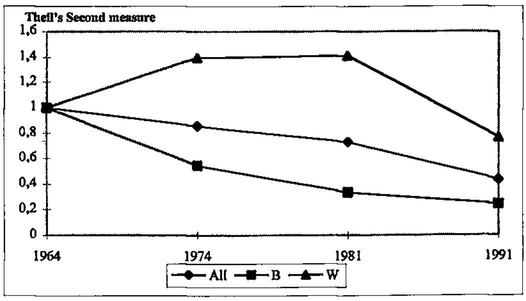
Table 6.15. Theil's Second Measure with respect to Education Enrollment.

	1964		1974		1981		1991	
	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%
Between-Region	0.0590	63.3	0.0321	40.2	0.0198	29.1	0.0143	35.3
Within-Region	0.0342	36.7	0.0477	59.8	0.0482	70.9	0.0262	64.7
	$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$	
Total Inequality	***0.0931***		***0.0797***		***0.0680***		***0.0405***	

Table 6.15 shows that the main source of inequality is between-region inequality in 1964 while within-region inequality is the main source in the other years. The percentage of overall inequality accounted for by between-region inequality is 63.3% in 1964 and it

declines from 40.2% (in 1974) to 29.1% (in 1981). Decomposition of inequality and the trends shown in Figure 6.7 reveal that between-region inequality has increased between 1981 and 1991. This result suggests that the regional policies following the devolution of power to regions in education has had an impact on regional disparities with respect to education enrollment.

Figure 6.7. Trends of Theil's Second Measure of the Components and Overall Inequality with respect to Education Enrollment.



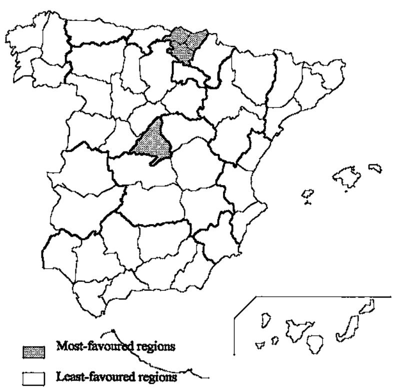
All: Spatial or overall inequality. B: Between-regions inequality. W: Within-regions inequality.
Year 1964 =1

6.3.4 Comparison of the Geographical Patterns between Education Enrollment and Education Facilities.

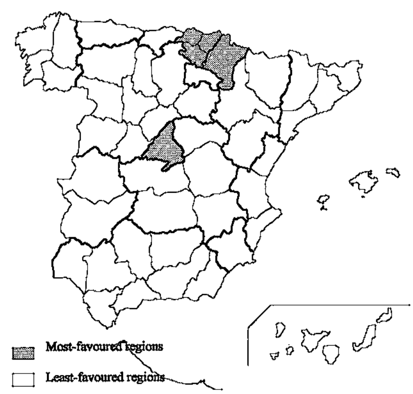
Enrollment may be related to the availability of education facilities as well. The dispersion of facilities for non-compulsory education across regions and within regions may have resulted in changes in the distribution of enrollment. To study this relationship, we assume that the highest enrollment is recorded in the most-favoured regions/provinces with respect to education facilities and we compare the geographical patterns described by clusters of the most and the least-favoured regions with respect to education facilities (contiguity case).

Figure 6.8. Comparison of Clusters of the Most-favoured and Least-Favoured Regions between Education Enrollment and Education Facilities (The Contiguity Case).

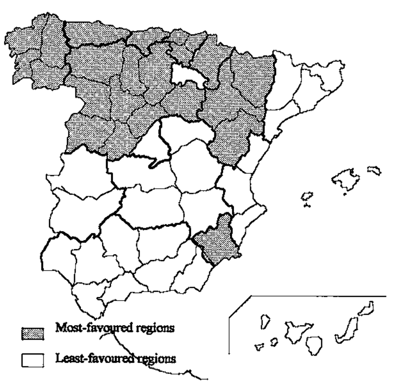
Education Enrollment[113] (1964)



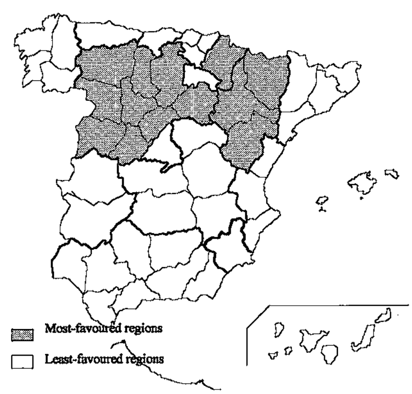
Education Facilities (Contiguity Case)[114] (1964)



Education Enrollment[115] (1991)



Education Facilities (Contiguity Case)[116] (1991)



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[113] In the case of education enrollment for 1964, the most-favoured regions with respect to composite index range from 0.81 (Madrid) to 0.65 (País Vasco) while the composite index for the least-favoured regions ranges from 0.39 (La Rioja) to 0.10 (Extremadura).

[114] In the contiguity case of education facilities for 1964, the most-favoured regions with respect to composite index range from 0.63 (Madrid) to 0.47 (Navarra) while the composite index for the least-favoured regions ranges from 0.33 (Asturias) to 0.09 (Extremadura).

[115] In the case of education enrollment for 1991, the most-favoured regions with respect to composite index range from 0.67 (Madrid) to 0.44 (Murcia) while the composite index for the least-favoured regions ranges from 0.40 (Canarias) to 0.26 (La Rioja).

[116] In the contiguity case of education facilities for 1991, the most-favoured regions with respect to composite index range from 0.54 (Navarra) to 0.45 (Aragón) while the composite index for the least-favoured regions ranges from 0.37 (Cantabria) to 0.24 (in Comunidad Valenciana).

The cluster analysis identifies the group of most-favoured regions (similar high values of the composite index) and least-favoured regions (similar low values of the composite index) with respect to educational enrollment and education facilities (Figure 6.8). The comparison between enrollment and facilities in the case of contiguity shows that there is a relationship between the two. Some of the regions included in the most-favoured group with respect to enrollment are also favored in terms of facilities. The maps reveal that enrollment relates to the availability of services in Madrid and País Vasco in 1964. In 1991 there is a relationship between the location of facilities in the North of Spain and the geographical distribution of enrollment rates. So it is possible that changes in inequality with respect to education enrollment reflect the geographical distribution of educational facilities.

As explained in previous sections, Andalucía and Castilla León are here the regions with the highest contribution to within-region inequality in 1991 (*Andalucía:* 37% of within-region inequality; *Castilla León:* 24.5%) (Appendix 6.7). The cluster analysis of provinces within Andalucía in 1991 indicates that the most-favoured group of provinces within region with respect to educational enrollment is Granada, and Palencia, Salamanca, Segovia and Valladolid in the region of Castilla León. Granada, Salamanca and Segovia are also found in the corresponding cluster of most-favored with respect to educational facilities. So it is likely that there is a relationship between the availability of services and enrollment in education. Finally, it is interesting to notice that the region's share of within-region inequality for Cataluña and Galicia is quite high although these regions are smaller than Andalucía or Castilla León in terms of land size (Appendix 6.7). In 1991 Cataluña's share is 12.8% of within-region inequality while Galicia's share is 10.2%. So we suspect that inequality within these regions are due to intra-regional disparities in available facilities. The provinces of Tarragona and Gerona rank around 40th with respect to education facilities (contiguity) while Barcelona and Lérida rank around 20th (contiguity) (Appendix 6.6).

6.4 Summary and Main Conclusions.

Improvements in personal skills and personal capabilities show that educational policies have had an important impact on the Spanish population. These measures undertaken over the past several decades have focused on the extension of the duration of compulsory schooling and the promotion of university education. Investments in human capital have been an important factor that drives rapid growth. Although human capital is of crucial interest from an economic point of view, this chapter deals with the institutional context of education. Since the sixties there have been important changes in both education enrollment and the organisation of education facilities which may have had implications for regional inequality. Both aspects of the institutional context are explored with respect to non-compulsory education. Primary education is not investigated because it is publicly guaranteed.

Contiguity is included in the study of facilities because education is one of the most likely reasons of individuals' to commute. The procedure developed in the previous chapter is also used here so that available facilities in a geographical unit consist of own services and facilities in adjacent areas. In secondary education we consider first-order contiguous areas (provinces) defined as neighbouring provinces. In the case of university education, we consider first and second-order contiguous provinces are the contiguous areas. It is assumed that individuals seek education near their places of residence. In addition, facilities located in Madrid and Barcelona are included as available facilities in university education for 1964 and 1974. These provinces are considered as central places that provide facilities to other provinces within region or in other regions.

The results for inequality with respect to education facilities show that inequality has declined between 1974 and 1991. This may be due to the promotion of non-compulsory education. Over the last several decades the Spanish government has pursued a policy intended to distribute more evenly university education and vocational training. Decomposition of overall inequality has revealed that one of the most important changes in inequality is observed between 1964-1974. From 1974 onwards within-region inequality is the main source of inequality, which coincides with the new education measures. Another interesting change in the decomposition of inequality is observed between 1981 and 1991.

The contribution to inequality of between-region inequality increases which may be due to the impact of the regional policies.

Intra-regional disparities are more important in Castilla León, Castilla la Mancha, and Andalucía. All these regions are bound by similar regional characteristics such as limited industry, abundant potential in natural resources, predominance of agriculture and their geographical situation in the Centre and South of the Iberian Peninsula. Regional authorities in Andalucía are responsible for education powers, while there has been no devolution of power in Castilla León and Castilla la Mancha. So the socio-economic characteristics seem to have more effect on inequality in these regions than autonomy.

Regionalisation may have affected the other regions with autonomy in education powers in a different way. Between 1981 and 1991 within-region inequality has increased in the richest regions with transferred powers (Comunidad Valenciana, Cataluña, and País Vasco), while it has declined in the poorest regions (Galicia and Canarias). The impact of regional policies may have be more important in Galicia and Canarias where there are clear intra-regional disparities in population, level of urbanisation, economic development, etc.

The geographical distribution of facilities has changed dramatically between the sixties and the nineties. This shows that changes in education policies have influenced inequality. In addition our results reveal that there is a major concentration of resources in the North of Spain.

Spillover effects have not been considered in the literature on inequality in education. However, spillover effects have affected the availability of facilities in the Spanish regions resulting in smaller values of overall inequality in the contiguity case compared to non-contiguity. Trends in inequality in the contiguity case are more in line with changes in the education policy which resulted in dispersion of facilities. So we find that inequality tends to decline. In contrast in the non-contiguity case, there is an increase in inequality between 1974 and 1981. These trends are simply not consistent with policy changes, and thereafter sharp drop in inequality between 1981-1991. The inclusion of spillovers gives us a better picture of the impact of policies on inequality and that shows clearly that the education policies have been effective.

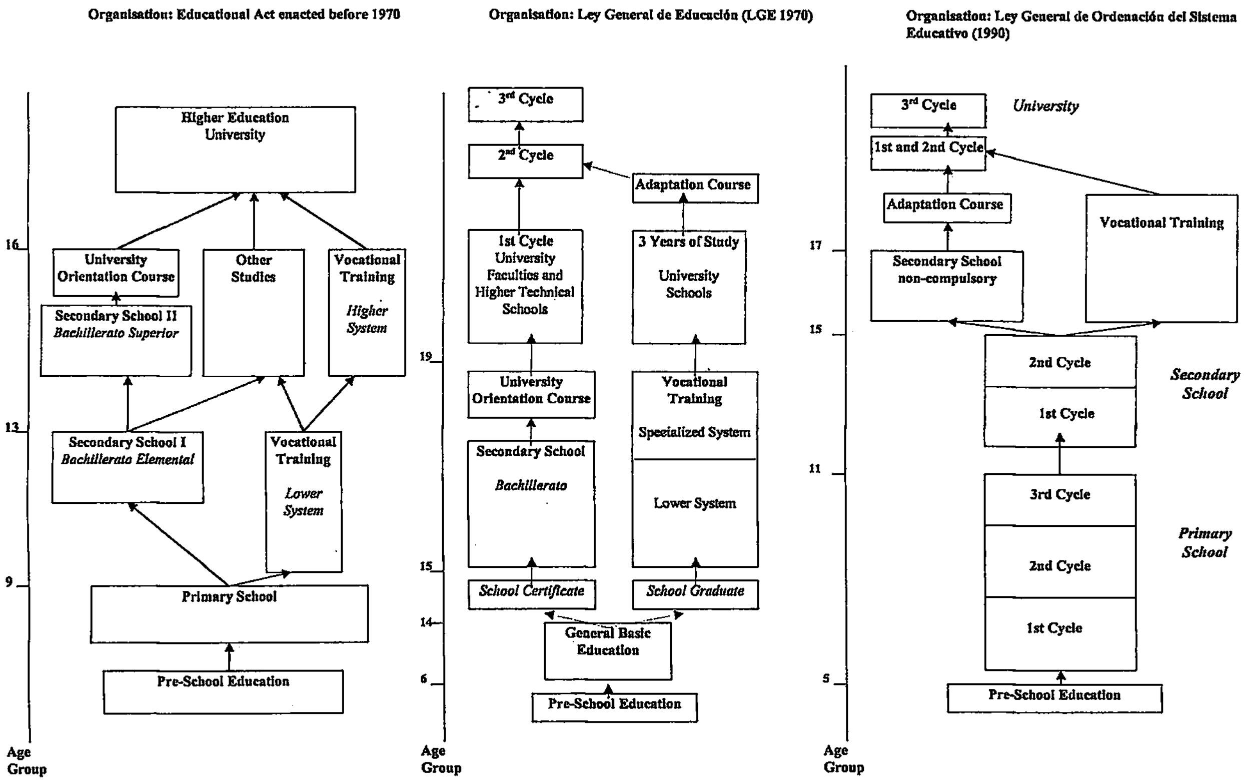
Spatial spillovers are observed in the Centre of Spain in 1991 between the region of Aragón and its first or second order neighbours (Madrid, Cataluña and Navarra). It is however more difficult to find spillovers within regions with high levels of within-region inequality (Castilla León, Castilla la Mancha and Andalucía).

Education enrollment in non-compulsory education is investigated in the second part of the present chapter. As explained in the case of education facilities, enrollment in primary education is compulsory so that the meaningful differences are expected only for non-compulsory education. The results of overall inequality and its decomposition with respect to enrollment are very similar to those for education facilities. Enrollment declines between 1964 and 1991. Within-region inequality is the main source of inequality. The most relevant change observed in the components of overall inequality is between 1981-1991. So education enrollment and education facilities have been influenced by education policies and the regionalisation process.

The geographical pattern of education enrollment does not change much compared to that for education facilities. The comparison between enrollment and education facilities in the contiguity case makes more sense than the non-contiguity case. The enrollment rate used in this study consists of the number of students registered in the universities. So such indicators and includes students of the own province as well as those who commute from neighbouring provinces. Thus the data incorporates by its nature the contiguity aspect. The study of inequality in education enrollment and facilities clearly shows the validity of including contiguity in the analysis.

Appendix 6.1

Structure of the Education System in Spain from 1960 to 1990



Appendix 6.2

Travel Inputs in Second-Order Contiguous Provinces in Spain. Distance Factors between Provincial Capitals

In this appendix travel inputs are presented with respect to second-order contiguous provinces. Travel time (which is measured in km) and travel distance (which is measured in hours) have been computed between the provincial capital of a province with respect to the provincial capitals of its adjacent provinces (2nd order).

Origin	Destination	km	Hours	Origin	Destination	km	Hours
ALAVA	CANTABRIA	170	1.6	**BADAJOZ**	ALBACETE	539	6.5
	PALENCIA	213	2.0		AVILA	407	4.2
	SEGOVIA	322	3.1		CÁDIZ	346	3.7
	SORIA	192	2.1		CUENCA	601	6.0
	VALLADOLID	252	2.3		JAÉN	393	4.6
	ZARAGOZA	268	2.4		MADRID	431	4.2
ALBACETE	BADAJOZ	539	6.5		MÁLAGA	436	4.5
	CASTELLON	247	2.6		SALAMANCA	320	4.1
	CÓRDOBA	355	3.9	**BARCELONA**	CASTELLON	300	2.8
	GUADALAJARA	284	2.8		HUESCA	296	3.2
	MADRID	261	2.4		TERUEL	426	4.4
	MÁLAGA	450	5.2		ZARAGOZA	311	2.9
	TERUEL	224	2.7	**BURGOS**	ASTURIAS	333	3.6
	TOLEDO	278	2.8		AVILA	279	2.7
ALICANTE	ALMERÍA	303	2.8		GUADALAJARA	244	2.5
	CASTELLON	252	2.4		GUIPUZCOA	228	2.3
	CIUDAD REAL	399	4.2		LEÓN	210	2.5
	CUENCA	347	3.3		MADRID	247	2.3
	GRANADA	369	3.6		NAVARRA	221	2.2
	JAÉN	432	4.5		ZAMORA	233	2.3
	TERUEL	324	3.3		ZARAGOZA	315	2.9

Origin	Destination	km	Hours	Origin	Destination	km	Hours
ALMERÍA	ALBACETE	383	4.1	**CÁCERES**	CIUDAD REAL	282	3.7
	ALICANTE	303	2.8		CÓRDOBA	334	3.9
	CÓRDOBA	327	3.9		CUENCA	483	4.9
	JAÉN	227	2.8		HUELVA	321	3.7
	MÁLAGA	228	2.6		MADRID	313	3.1
ASTURIAS	BURGOS	333	3.6		SEGOVIA	313	3.7
	CORUÑA	312	3.7		SEVILLA	276	3.2
	ORENSE	321	3.9		VALLADOLID	345	4.0
	PALENCIA	263	2.8		ZAMORA	289	3.4
	PONTEVEDRA	374	4.2	**CÁDIZ**	BADAJOZ	346	3.7
	VALLADOLID	273	2.9		CÓRDOBA	262	2.4
	VIZCAYA	302	3.2		GRANADA	342	3.3
	ZAMORA	253	2.7	**CANTABRIA**	ALAVA	170	1.6
AVILA	BADAJOZ	407	4.2		GUIPUZCOA	100	0.9
	BURGOS	279	2.7		LUGO	421	5.0
	CIUDAD REAL	261	3.1		ORENSE	507	6.1
	CUENCA	283	2.9		RIOJA	241	2.3
	GUADALAJARA	170	1.6		SEGOVIA	365	3.9
	LEÓN	279	2.8		SORIA	343	3.5
	PALENCIA	197	1.9		VALLADOLID	273	2.9
	SORIA	275	3.3		ZAMORA	362	4.0
	ZAMORA	188	2.0				
CASTELLON	ALBACETE	247	2.6	**GRANADA**	ALICANTE	369	3.6
	ALICANTE	252	2.4		BADAJOZ	477	4.9
	BARCELONA	300	2.8		CÁDIZ	342	3.3
	CUENCA	272	3.4		CIUDAD REAL	295	3.2
	GUADALAJARA	381	4.4		CUENCA	481	5.1
	LERIDA	261	2.6		SEVILLA	254	2.3
	ZARAGOZA	278	3.4		VALENCIA	515	5.2

Origin	Destination	km	Hours	Origin	Destination	km	Hours
CIUDAD REAL	ALICANTE	399	4.2	**GUADALAJARA**	ALBACETE	284	2.8
	AVILA	261	3.1		AVILA	170	1.6
	CÁCERES	282	3.7		BURGOS	244	2.5
	GRANADA	295	3.2		CASTELLON	381	4.4
	GUADALAJARA	264	2.6		CIUDAD REAL	264	2.6
	HUELVA	430	4.3		HUESCA	336	3.2
	MADRID	210	2.1		NAVARRA	396	3.8
	MÁLAGA	371	4.1		RIOJA	298	3.3
	MURCIA	435	4.6		TARRAGONA	499	4.7
	SEVILLA	334	3.4		TOLEDO	132	1.2
	TERUEL	386	4.5		VALENCIA	384	4.1
	VALENCIA	370	4.3		VALLADOLID	250	2.5
CÓRDOBA	ALBACETE	355	3.9	**GUIPUZCOA**	BURGOS	228	2.3
	ALMERÍA	327	3.9		CANTABRIA	100	0.9
	CÁCERES	334	3.9		RIOJA	174	1.8
	CÁDIZ	262	2.4		ZARAGOZA	270	2.5
	CUENCA	450	4.6	**HUELVA**	CÁCERES	321	3.7
	HUELVA	235	2.1		CIUDAD REAL	430	4.3
	MURCIA	459	4.8		CÓRDOBA	235	2.1
	TOLEDO	361	3.6		MÁLAGA	307	2.8
CORUÑA	ASTURIAS	312	3.7		TOLEDO	595	5.7
	LEÓN	329	3.9	**HUESCA**	ALAVA	266	3.2
	ORENSE	105	1.2		BARCELONA	296	3.2
CUENCA	ALICANTE	347	3.3		GERONA	379	3.9
	AVILA	283	2.9		GUADALAJARA	336	3.2
	BADAJOZ	601	6.0		GUIPUZCOA	248	2.8
	CÁCERES	483	4.9		RIOJA	258	2.5
	CASTELLON	272	3.4		SORIA	240	2.7
	CÓRDOBA	450	4.6		TARRAGONA	242	2.7
	GRANADA	481	5.1		TERUEL	272	3.1
	JAÉN	389	4.0				
	MURCIA	383	3.8				
	SEGOVIA	262	2.7				
	SORIA	283	3.2				
	TARRAGONA	477	4.9				
	ZARAGOZA	283	3.5				

Origin	Destination	km	Hours	Origin	Destination	km	Hours
GERONA	HUESCA	379	3.9	**JAÉN**	ALICANTE	432	4.5
	TARRAGONA	190	1.8		ALMERÍA	227	2.8
	ZARAGOZA	393	3.6		BADAJOZ	393	4.6
LEÓN	AVILA	279	2.8		CUENCA	389	4.0
	BURGOS	210	2.5		MÁLAGA	215	2.3
	CORUÑA	329	3.9		MURCIA	359	3.8
	PONTEVEDRA	259	4.2		SEVILLA	251	2.6
	SALAMANCA	207	2.4		TOLEDO	299	3.0
	SEGOVIA	288	3.1		VALENCIA	436	5.1
	VIZCAYA	341	3.8	**ORENSE**	ASTURIAS	321	3.9
LERIDA	CASTELLON	261	2.6		CANTABRIA	507	6.1
	GUADALAJARA	409	3.8		CORUÑA	105	1.2
	NAVARRA	332	3.1		PALENCIA	351	4.1
	RIOJA	331	3.1		SALAMANCA	332	3.9
	SORIA	312	3.2		VALLADOLID	359	3.9
	TERUEL	277	3.3	**PALENCIA**	ALAVA	213	2.0
LUGO	CANTABRIA	421	5.0		ASTURIAS	263	2.8
	PALENCIA	338	4.1		AVILA	197	1.9
	VALLADOLID	362	3.9		LUGO	338	4.1
	ZAMORA	308	3.6		ORENSE	351	4.1
MADRID	ALBACETE	261	2.4		RIOJA	230	2.2
	BURGOS	247	2.3		SALAMANCA	172	1.8
	CÁCERES	313	3.1		SEGOVIA	166	2.0
	CIUDAD REAL	210	2.1		SORIA	243	2.7
	SALAMANCA	211	2.3		VIZCAYA	263	2.5
	SORIA	239	2.4		ZAMORA	151	1.6
	TERUEL	312	3.3	**PONTEVEDRA**	ASTURIAS	374	4.2
	VALENCIA	361	3.7		LEÓN	359	4.2
	VALLADOLID	192	2.0		ZAMORA	356	4.2
	ZARAGOZA	319	2.9				
MÁLAGA	ALBACETE	450	5.2				
	ALMERÍA	228	2.6				
	BADAJOZ	436	4.5				
	CIUDAD REAL	371	4.1				
	HUELVA	307	2.8				
	JAÉN	215	2.3				
	MURCIA	425	4.2				

Origin	Destination	km	Hours	Origin	Destination	km	Hours
MURCIA	CIUDAD REAL	435	4.6	**RIOJA**	CANTABRIA	241	2.3
	CÓRDOBA	459	4.8		GUADALAJARA	298	3.3
	CUENCA	383	3.8		GUIPUZCOA	174	1.8
	JAÉN	359	3.8		HUESCA	258	2.5
	MÁLAGA	425	4.2		PALENCIA	230	2.2
	VALENCIA	228	2.3		SEGOVIA	339	3.3
NAVARRA	BURGOS	221	2.2		TERUEL	363	3.9
	GUADALAJARA	396	3.8		VALLADOLID	269	2.5
	LERIDA	332	3.1		VIZCAYA	141	1.4
	SORIA	185	2.0	**SALAMANCA**	BADAJOZ	320	4.1
	TARRAGONA	422	4.0		BURGOS	254	2.6
	TERUEL	363	3.9		LEÓN	207	2.4
	VIZCAYA	166	1.8		MADRID	211	2.3
SEVILLA	CÁCERES	276	3.2		PALENCIA	172	1.8
	CIUDAD REAL	334	3.4		SEGOVIA	167	2.0
	GRANADA	254	2.3		TOLEDO	243	2.9
	JAÉN	251	2.6	**SEGOVIA**	ALAVA	322	3.1
	TOLEDO	500	4.9		CÁCERES	313	3.7
SORIA	ALAVA	192	2.1		CANTABRIA	365	3.9
	AVILA	275	3.3		CUENCA	262	2.7
	CANTABRIA	343	3.5		LEÓN	288	3.1
	CUENCA	283	3.2		PALENCIA	166	2.0
	HUESCA	240	2.7		RIOJA	339	3.3
	LERIDA	312	3.2		SALAMANCA	167	2.0
	MADRID	239	2.4		TERUEL	404	4.2
	NAVARRA	185	2.0		TOLEDO	165	1.6
	PALENCIA	243	2.7		VIZCAYA	372	3.6
	TARRAGONA	403	4.1		ZAMORA	196	2.2
	TERUEL	247	2.9		ZARAGOZA	410	3.8
	VALLADOLID	225	2.6	**VALENCIA**	CIUDAD REAL	370	4.3
	VIZCAYA	242	2.6		GRANADA	515	5.2
					GUADALAJARA	384	4.1
					JAÉN	436	5.1
					MADRID	361	3.7
					MURCIA	228	2.3
					TARRAGONA	269	2.5
					TOLEDO	378	4.1
					ZARAGOZA	342	3.9

Origin	Destination	km	Hours	Origin	Destination	km	Hours
TARRAGONA	CUENCA	477	4.9	**VALLADOLID**	ALAVA	252	2.3
	GERONA	190	1.8		ASTURIAS	273	2.9
	GUADALAJARA	499	4.7		CÁCERES	345	4.0
	HUESCA	242	2.7		CANTABRIA	273	2.9
	NAVARRA	422	4.0		GUADALAJARA	250	2.5
	SORIA	403	4.1		LUGO	362	3.9
	VALENCIA	269	2.5		MADRID	192	2.0
TERUEL	ALBACETE	224	2.7		ORENSE	359	3.9
	ALICANTE	324	3.3		RIOJA	269	2.5
	BARCELONA	426	4.4		SORIA	225	2.6
	CIUDAD REAL	386	4.5		TOLEDO	266	2.6
	HUESCA	272	3.1		VIZCAYA	302	2.8
	LERIDA	277	3.3	**VIZCAYA**	ASTURIAS	302	3.2
	MADRID	312	3.3		LEÓN	341	3.8
	NAVARRA	363	3.9		NAVARRA	166	1.8
	RIOJA	363	3.9		PALENCIA	263	2.5
	SORIA	247	2.9		RIOJA	141	1.4
	TOLEDO	332	3.9		SEGOVIA	372	3.6
TOLEDO	ALBACETE	278	2.8		SORIA	242	2.6
	CÓRDOBA	361	3.6		VALLADOLID	302	2.8
	GUADALAJARA	132	1.2	**ZAMORA**	ASTURIAS	253	2.7
	HUELVA	595	5.7		AVILA	188	2.0
	JAÉN	299	3.0		BURGOS	233	2.3
	SALAMANCA	243	2.9		CÁCERES	289	3.4
	SEGOVIA	165	1.6		CANTABRIA	362	4.0
	SEVILLA	500	4.9		LUGO	308	3.6
	TERUEL	332	3.9		PALENCIA	151	1.6
	VALENCIA	378	4.1		PONTEVEDRA	356	4.2
	VALLADOLID	266	2.6		SEGOVIA	196	2.2
ZARAGOZA	ALAVA	268	2.4				
	BARCELONA	311	2.9	**ZARAGOZA**	VALENCIA	342	3.9
	BURGOS	315	2.9		SEGOVIA	410	3.8
	CASTELLON	278	3.4				
	CUENCA	283	3.5				
	GERONA	393	3.6				
	GUIPUZCOA	270	2.5				
	MADRID	319	2.9				

Appendix 6.3

Travel Inputs between Madrid and Barcelona as Origin Provinces and Provincial Capitals of the Spanish Provinces

In this appendix travel inputs are presented with respect to Madrid and Barcelona as origin provinces. Travel time (measured in km) and travel distance (measured in hours) have been computed between the provincial capital of the Spanish provinces and the provincial capitals of Madrid and Barcelona.

Destination Province	Origin Province (Madrid)		Origin Province (Barcelona)	
	Distance (km)	Distance (hours)	Distance (km)	Distance (hours)
ALAVA	364	3.3	576	5.3
ALBACETE	261	2.4	542	5.3
ALICANTE	443	4.0	548	5.1
ALMERÍA	573	6.0	822	7.8
ASTURIAS	465	4.4	932	9.0
AVILA	113	1.1	726	6.7
BADAJOZ	431	4.2	1062	9.9
BARCELONA	613	5.6	----	---
BURGOS	247	2.3	623	5.8
CÁCERES	313	3.1	944	8.9
CÁDIZ	674	6.1	1120	12.4
CANTABRIA	407	4.2	690	8.2
CASTELLON	430	4.3	300	2.8
CIUDAD REAL	210	2.1	735	7.7
CÓRDOBA	412	3.8	913	9.1
CORUÑA (LA)	620	6.6	1158	12.0
CUENCA	170	1.8	581	5.9
GERONA	713	6.5	97	1.7
GRANADA	443	4.2	888	8.6
GUADALAJARA	58	0.6	555	5.1
GUIPUZCOA	472	4.6	578	5.3
HUELVA	647	5.9	1147	11.3

Destination Province	Origin Province (Madrid)		Origin Province (Barcelona)	
	Distance (km)	Distance (hours)	Distance (km)	Distance (hours)
JAÉN	351	3.2	801	8.5
LEÓN	351	3.4	833	8.2
LERIDA	467	4.3	158	1.9
LUGO	520	5.4	1053	10.7
MADRID	—	—	613	5.6
MÁLAGA	561	5.4	1017	9.8
MURCIA	478	4.5	601	5.8
NAVARRA	454	4.4	496	4.6
ORENSE	517	5.3	1066	10.8
PALENCIA	244	2.4	715	6.7
PONTEVEDRA	608	6.4	1158	11.9
RIOJA (LA)	495	4.5	495	4.5
SALAMANCA	211	2.3	843	8.1
SEGOVIA	67	0.9	705	6.5
SEVILLA	552	5.0	1052	10.4
SORIA	239	2.4	476	4.7
TARRAGONA	557	5.2	96	1.5
TERUEL	312	3.3	426	4.4
TOLEDO	74	0.9	705	6.4
VALENCIA	361	3.7	372	3.4
VALLADOLID	192	2.0	754	7.0
VIZCAYA	415	3.9	626	5.8
ZAMORA	259	2.6	853	8.1
ZARAGOZA	319	2.9	311	2.9

Appendix 6.4

Distribution of Universities and Campuses in the Spanish Provinces.

In this appendix the 1998 distribution of university institutions in the Spanish provinces is presented. The name of the university, information about whether the university was established in 1964, 1974, 1981 and 1991, the location of university's campuses are provided. In addition the weights used to distribute the recorded demand of each university are also displayed.

University (year 1998)	**Establishment of University**				**Province**	**Weight**	**Location of the Institutions (1998 year)**
	1991	**1981**	**1974**	**1964**			
Universidad de Alcalá de Henares	YES	YES	NO	NO	Madrid Guadalajara	0.86 0.14	Madrid Alcalá de Henares Guadalajara
Universidad de Alicante	YES	YES	NO	NO	Alicante	1	Alicante Elche San Vicente Raspeig
Universitat Autónoma de Barcelona	YES	YES	YES	NO	Barcelona	1	Barcelona Manresa Sabadell Terrasa Sant Cugat Mollet del Vallés Cerdanyola del Vallés
Universidad Autónoma de Madrid	YES	YES	YES	NO	Madrid	1	Madrid Aravaca Leganés
Universitat de Barcelona	YES	YES	YES	YES	Barcelona	1	Barcelona
Universidad de Cádiz	YES	YES	NO	NO	Cádiz	1	Cádiz Jerez de la Frontera Algeciras Puerto Real Línea de la Concepcion
Universidad de Cantabria	YES	YES	YES	YES	Cantabria	1	Santander Torrelavega

University (year 1998)	Establishment of University 1991	1981	1974	1964	Province	Weight	Location of the Institutions (1998 year)
Universidad Castilla-Mancha	YES	NO	NO	NO	Cuenca Ciudad Real Albacete Toledo	0.16 0.39 0.25 0.20	Cuenca Ciudad Real Albacete Toledo Talavera de la Reina Almadena
Universidad Complutense de Madrid	YES	YES	YES	YES	Madrid Segovia	0.96 0.04	Madrid Segovia Pozuelo de Alarcon S.Lorenzo del Escorial
Universidad de Córdoba	YES	YES	YES	NO	Córdoba	1	Córdoba Belmez
Universidad de Extremadura	YES	YES	YES	NO	Cáceres Badajoz	0.45 0.35	Cáceres Badajoz Mérida Plasecia Almendralejo
Universidad de Granada	YES	YES	YES	YES	Granada	1	Granada
Universidad de La Coruña	YES	YES	NO	NO	La Coruña	1	La Coruña El Ferrol
Universidad de La Rioja	YES	YES	NO	NO	La Rioja	1	Logroño
Universidad de León	YES	YES	YES	NO	León	1	León
Universidad de Murcia	YES	YES	YES	YES	Murcia	1	Espinardo Cartagena
Universidad de Oviedo	YES	YES	YES	YES	Oviedo	1	Oviedo Gijon Mieres
Universidad del País Vasco	YES	YES	NO	NO	Alava Guipuzcoa Vizcaya	0.10 0.35 0.55	San Sebastian Bilbao Vitoria Leioa Eibar Barakaldo Portugalete
Universidad Politécnica de Cataluña	YES	YES	YES	YES	Barcelona	1	Barcelona Sant Cugat Terrassa Canet de Mar Vilanova i la Geltrú Mataró Manresa Igualada Sant Just Desvern

University (year 1998)	Establishment of University				Province	Weight	Location of the Institutions (1998 year)
	1991	1981	1974	1964			
Universidad Politécnica de Madrid	YES	YES	YES	YES	Madrid	1	Madrid Boadilla del Monte
Universidad Politécnica de Valencia	YES	YES	YES	YES	Valencia	1	Valencia Grao Montcada Almusafes
Universidad Pública de Navarra	YES	YES	YES	YES	Navarra	1	Pamplona
Universidad de Salamanca	YES	YES	YES	YES	Salamanca Zamora Avila	0.83 0.10 0.07	Salamanca Zamora Avila Bejar
Universidad de Santiago de Compostela	YES	YES	YES	YES	La Coruña	1	La Coruña
Universidad de Sevilla	YES	YES	YES	YES	Sevilla	1	Sevilla
Universidad de Valencia (Estudi Gral.)	YES	YES	YES	YES	Valencia	1	Valencia Burjasot Catarroja Cheste Montcada Godella
Universidad de Valladolid	YES	YES	YES	YES	Valladolid Segovia Palencia	0.82 0.03 0.15	Valladolid Segovia Palencia
Universidad de Vigo	YES	NO	NO	NO	Orense Pontevedra	0.35 0.65	Orense Pontevedra
Universidad de Zaragoza	YES	YES	YES	YES	Zaragoza Huesca Teruel	0.81 0.13 0.06	Zaragoza Huesca Teruel Almunia de Dona Godina
Universidad de Navarra	YES	YES	YES	YES	Navarra	1	Pamplona
Universidad DEUSTO	YES	YES	YES	YES	Vizcaya	1	Bilbao
Universidad Pontificia de Salamanca	YES	YES	YES	YES	Salamanca	1	Salamanca
Universidad Comillas	YES	YES	NO	NO	Madrid	1	Madrid

Source: Ministry of Education of Spain (MEC)

List of Universities Established between 1991 and 1998 in Spain.

University	Province	Locations
Universidad de Almería	Almería	Almería
Universidad de Burgos	Burgos	Burgos
Universidad Carlos III	Madrid	Madrid Getafe Leganés
Universidad de Gerona	Gerona	Gerona
Universidad de Huelva	Huelva	Huelva
Universidad de Jaén	Jaén	Jaén Linares Ubeda
Universidad Jaume I de Castellón	Castellón	Castellón
Universidad de Lleida	Lleida	Lleida La Seu d'Urgell Manresa
Universidad de Málaga	Málaga	Málaga Ronda Antequera
Universidad Miguel Hdez. de Elche	Alicante	Elche Altea San Juan Orihuela
Universidad Pompeu Fabra	Barcelona	Barcelona Mataró Manresa Calella
Universidad Rey Juan Carlos	Madrid	Madrid Alcorcón Móstoles
Universidad Internacional de Cataluña	Barcelona	Barcelona
Universidad de Ramon Llull	Barcelona	Barcelona
Universidad de Vic	Barcelona	Vic
Mondragón Unibertsitatea	Guipuzcoa	Mondragón
Universidad Alfonso X El Sabio	Madrid	Madrid Villanueva de la Canada
Universidad Antonio de Nebrija	Madrid	Hoyo de Manzanares
Universidad Europea de Madrid	Madrid	Villaviciosa de Odon
Universidad San Pablo	Madrid	Madrid
SEK	Segovia	Segovia

Source: Ministry of Education of Spain (MEC)

Appendix 6.5

Analysis of Inequality in Education Facilities in the Non-Contiguity Case

In this appendix the results of the estimation of the composite index with respect to education facilities are provided for the case study of the non-contiguity. Positive indicators of education facilities are the ones used in the case study of contiguity and given in Section 5.2.4 (teachers and institutions per 1000 population for secondary education including secondary school as well as vocational training, and university level). Available facilities is considered to be consisting of resources in the own province under the assumption that there is not individuals mobility between or within regions.

Results have been obtained following the same procedure used in the contiguity case, and they are summarised but not discussed in detail.

i. (Step 1) Using PCA eigenvalues and eigenvectors for the four samples under consideration are computed with respect to education facilities for the non-contiguity case (Table 6.16 and Table 6.17).
ii. (Step 2) The percentage of variability for most of samples reveals that PCA is a poor approach. The highest proportion of variance accounted by the first principal component is 64 % with respect to the 1981 sample while the lowest is 58% with respect to the 1964 sample (Table 6.16).
iii. (Step 3) The individual components obtained using PCA can be interpreted as a measure of facilities for non-compulsory education with respect to 1964 and 1974 samples while we interpret this component as a measure of facilities for university education with respect to the 1981 and 1991 samples. From a statistical point of view this interpretation is robust for all samples because we reject the sphericity hypothesis at 5% of significance with two degrees of freedom (Table 6.17).

iv. (Step 6) Component coefficients are unstable for all samples (Table 6.17). So we conclude that the interpretation of the first component is not robust from a statistical point of view.

v. (Step 7) The application of PCPC shows that the hypothesis that the four samples share the same component is rejected at 5% of significance (the chi square with 23.556 with 9 Df and p-value is 0.0051). Following the procedure (Step 10) we choice the 1971, 1981 and 1991 samples because of their component coefficients are similar. We apply PCPC model but the null hypothesis is rejected at 5% of significance (p-value is 0.0429, chi-square 13.011 with 6 Df). Again, we apply PCPC and the null hypothesis can not be rejected at 5% of significance (Step 11). Table 6.18 reveals that p-value is 0.0646, while chi square is 7.239 with 3 degrees of freedom. The goodness of fit of the PCPC is corroborated in Table 6.20. The highest correlation is -0.26 between the first partial common component and the fourth component obtained using PCA.

vi. Finally we interpret the first partial common component for the 1981 and 1991 samples as a measure of education facilities for university education. The stability of the component coefficients have improved with respect to the results obtained using PCA. Only the secondary education institution variable remains unstable (Table 6.19).

Table 6.16 Analysis of the First Eigenvalues (Principal Components Variances) in Education Facilities. The Non-contiguity Case.

	1964	1974	1981	1991
Eigenvalues	0.084	0.084	0.086	0.066
Standard Errors	0.017	0.017	0.017	0.013
Standard Deviation	0.290	0.290	0.293	0.257
Proportion of Total Variance	0.58	0.63	0.64	0.62
Upper end of 95% confidence region	0.629	0.607	0.597	0.618

Table 6.17 Coefficients of the First Principal Component in Education Facilities. Standard Errors in Brackets.† The Non-Contiguity Case. Sphericity Test between the First and Second Eigenvalues.

Group	1964		1974		1981		1991	
Secondary Education Teachers	0.5628	(0.0806)	0.4056	(0.1126)	0.1031	(0.1197)	0.1970	(0.1088)
Secondary Education Institutions	0.6868	(0.0447)	0.2864	(0.1310)	0.0429	(0.1557)	0.1364	(0.1326)
University Teachers	0.3336	(0.0835)	0.6787	(0.0871)	0.7265	(0.0198)	0.7802	(0.0389)
University Institutions	0.3168	(0.1478)	0.5411	(0.0556)	0.6781	(0.0210)	0.5778	(0.0340)
Sphericity Test between the First and Second Eigenvalues								
Chi Square (2 Df)	8.23		6.13		6.16		52.68	

Critical value of the chi square at 5% of significance with 2 Df = 5.99

Table 6.18 Test for Partial Common Principal Components for the 1981 and 1991 Samples with respect to Education. The Non-Contiguity Case.

Test for One Common Principal Component

	PCPC(1)
Number of Estimated Parameters in the Model	17
Likelihood Ratio Test Chi Square	7.239
Degrees of Freedom	3
p-Value	0.0646

Table 6.19 Approximate Maximum Likelihood Estimates in Education Facilities of the 1981 and 1991 Samples. Standard Errors of the First Common Component in Brackets. The Non-Contiguity Case.

a. Coefficients of the First Common Principal Component. Standard Errors in Brackets.

Secondary Education Teachers	0.1854	(0.0791)
Secondary Education Institutions	0.1514	(0.1019)
University Teachers	0.7370	(0.0208)
University Institutions	0.6321	(0.0207)

b. Characteristic Roots for the First Common Principal Component

	1981	1991
Characteristic Roots	0.085	0.066
Proportion of Total Variance	0.64	0.62

Table 6.20 Covariance (F) and Correlation (R) Matrices of of the Estimated Components for the 1981 and 1991 Samples with respect to Education Facilities. The Non-Contiguity Case.†

a. Matrices for the 1981 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.0848	-0.0060	-0.0012	0.0031
		-0.0990	0.0430	0	0
$R_{81} \backslash F_{81}$	=	-0.0704	0	0.0035	0
		0.2459	0	0	0.0019

b. Matrices for the 1991 Sample

		1st PCPC	2nd PC	3rd PC	4th PC
		0.0658	-0.0003	0.0015	-0.0041
		-0.0061	0.0288	0	0
$R_{91} \backslash F_{91}$	=	0.0665	0	0.0081	0
		-0.2693	0	0	0.0036

1st PCPC: First common principal component. This is obtained using PCPC.
2nd, 3rd and 4th PC: Second and third principal component computed individually using PCPC.
†On and above diagonal variances and covariances of the first common component. Below diagonal correlations.

Appendix 6.6

Ranking of the Spanish Provinces with respect to Education Facilities

In the present Appendix provinces have been ranked in descending order with respect to the 1991 provinces' composite index for education facilities. The results presented here are those obtained in the case of the contiguity (*C* denotes contiguity in the table) and non-contiguity (*NC* denotes non-contiguity). Provinces ranked in low positions are better than those which rank in high positions with respect to education facilities.

PROVINCE	Value of the Composite Index		Rank		PROVINCE	Value of the Composite Index		Rank	
	NC	C	NC	C		NC	C	NC	C
ALAVA	0,294	0,364	24	21	LEÓN	0,364	0,379	15	15
ALBACETE	0,206	0,266	40	38	LERIDA	0,245	0,356	31	24
ALICANTE	0,187	0,199	41	46	LUGO	0,346	0,380	20	14
ALMERÍA	0,101	0,146	49	50	MADRID	0,391	0,364	10	22
ASTURIAS	0,389	0,374	11	17	MÁLAGA	0,232	0,236	36	43
AVILA	0,232	0,448	35	11	MURCIA	0,268	0,268	29	37
BADAJOZ	0,241	0,255	34	40	NAVARRA	0,585	0,544	2	6
BALEARES	0,280	0,282	26	34	ORENSE	0,283	0,331	25	28
BARCELONA	0,386	0,362	12	23	PALENCIA	0,407	0,511	7	8
BURGOS	0,157	0,269	44	35	PALMAS (LAS)	0,340	0,332	21	27
CÁCERES	0,301	0,323	23	30	PONTEVEDRA	0,209	0,222	39	44
CÁDIZ	0,242	0,249	33	42	RIOJA (LA)	0,186	0,288	42	32
CANTABRIA	0,357	0,375	16	16	SALAMANCA	0,958	0,862	1	1
CASTELLON	0,099	0,184	50	47	SANTA CRUZ DE TENERIFE	0,399	0,372	9	18
CIUDAD REAL	0,230	0,268	37	36	SEGOVIA	0,434	0,693	6	3
CÓRDOBA	0,278	0,287	28	33	SEVILLA	0,315	0,300	22	31
CORUÑA (LA)	0,403	0,385	8	13	SORIA	0,357	0,584	17	4
CUENCA	0,222	0,367	38	20	TARRAGONA	0,168	0,254	43	41
GERONA	0,134	0,204	46	45	TERUEL	0,280	0,470	27	9
GRANADA	0,577	0,514	3	7	TOLEDO	0,156	0,258	45	39
GUADALAJARA	0,263	0,702	30	2	VALENCIA	0,368	0,341	14	26
GUIPUZCOA	0,349	0,370	19	19	VALLADOLID	0,576	0,547	4	5
HUELVA	0,117	0,173	47	48	VIZCAYA	0,354	0,347	18	25
HUESCA	0,385	0,460	13	10	ZAMORA	0,243	0,330	32	29
JAÉN	0,107	0,161	48	49	ZARAGOZA	0,449	0,439	5	12

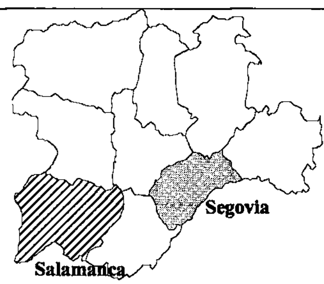
Appendix 6.7

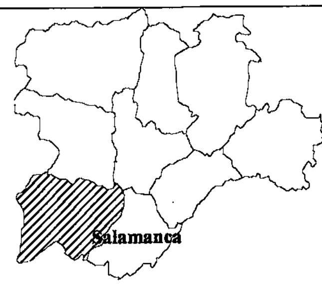
Within-Region Inequality in the Spanish Regions

Cluster of Within-Region Inequality with respect to Education Facilities: Provinces benefitting from Spillovers.

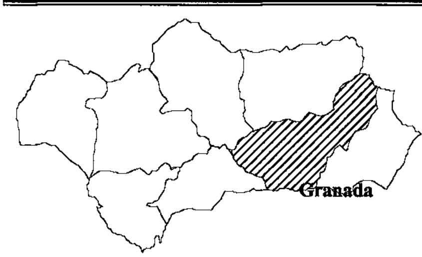
Castilla León

The Contiguity Case	**The Non-Contiguity Case**

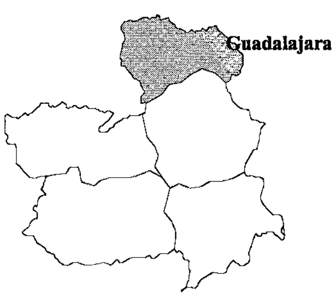


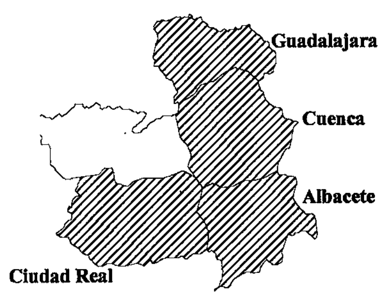


Andalucía



Castilla La Mancha





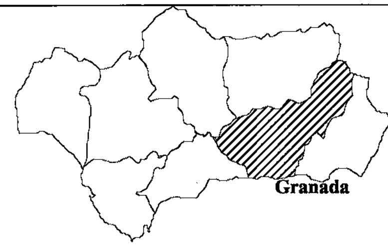
Favored provinces within the region

Provinces benefitting from spillovers

Cluster of Within-Region Inequality with respect to Enrollment.

Castilla León

Andalucía



Favored provinces within the region

Share of Within-Region Inequality. Education Facilities and Education Enrollment at 1991 (%)

	Education Facilities		Enrollment
	Non-contiguity	Contiguity	
Regions without Transferred Powers			
ARAGON	1.6	0.1	3
ASTURIAS	0	0	0
BALEARES	0	0	0
CANTABRIA	0	0	0
CASTILLA LEON	33.1	27.6	24.5
CASTILLA MANCHA	2.1	21.5	2
EXTREMADURA	0.3	0.7	0.2
MADRID	0	0	0
MURCIA	0	0	0
RIOJA LA	0	0	0
Regions with Transferred Powers			
ANDALUCIA	37.7	32.9	37
CANARIAS	0.2	0.2	0.1
CATALUNA	9.4	5.9	12.8
COMUNIDAD VALENCIANA	12	6.2	9.5
GALICIA	3.3	4.8	10.2
NAVARRA	0	0	0
PAIS VASCO	0.3	0.1	0.8
Total	100	100	100

Share of Within-Region Inequality. Education Facilities and Education Enrollment at 1981 (%)

	Education Facilities		Enrollment
	Non-contiguity	Contiguity	
Regions without Transferred Powers			
ARAGON	10.5	4.5	11.8
ASTURIAS	0	0	0
BALEARES	0	0	0
CANTABRIA	0	0	0
CASTILLA LEON	39.2	22.6	33.8
CASTILLA MANCHA	2.1	22.4	1.9
EXTREMADURA	0.1	0.2	0
MADRID	0	0	0
MURCIA	0	0	0
RIOJA LA	0	0	0
Regions with Transferred Powers			
ANDALUCIA	25.4	29.6	24.2
CANARIAS	2.7	4.6	3.2
CATALUNA	4.6	2.7	7
COMUNIDAD VALENCIANA	4.4	3.1	5.7
GALICIA	10.7	10.3	12.1
NAVARRA	0	0	0
PAIS VASCO	0.3	0.01	0.3
Total	100	100	100

Chapter 7

Analysis of Household Consumption and Housing Conditions

7.1 Introduction.

In this chapter inequality relating to household consumption and housing conditions is studied. The Spanish Institute of Statistics (INE, 1991) defines a household as the people who share dwelling, food and services, charging household expenditures on a common budget. Inequality in household consumption (expenditures) is investigated in Section 7.2. Indicators to represent the economic welfare of households are discussed in Section 7.2.1, while Section 7.2.2 provides the statistical findings of the estimation of the composite index for household consumption. On the basis of the Theil's Second measure, the results regarding inequality are analyzed in Section 7.2.3. Section 7.3 describes the characteristics of the external environment and housing conditions in particular. The indicators used and the empirical results are detailed in Section 7.3.1 and 7.3.2 respectively. Finally the analysis of inequality is reported in Section 7.3.3.

7.2 Household Consumption.

7.2.1 Indicators with respect to Household Consumption.

The evaluation of inequality among households has been traditionally performed in terms of household incomes. However, the appropriateness of such an analysis has recently become a debatable issue (INE, 1996). First, it is pointed out that a more meaningful economic measure for household welfare, and therefore for inequality measurement, should incorporate information on the capital resources of the household members.[117] In addition, household income is a phenomenon that changes according to the business cycle. Finally, the accuracy and reliability of the data on household incomes is an important drawback to using this variable. A significant bias is encountered in the estimation of household income as a consequence of problems related to data collection. In the statistical information obtained from surveys, income receivers usually underestimate their own income (Cannari and d'Alessio, 1993; INE 1996).

An alternative to using incomes for inequality comparisons is to use household expenditures. This variable reflects the payments on goods and services, as well as other payments related to those goods and services received by the household for their self-consumption, rent, etc (Analística, 1995). Just like household incomes, household expenditures are also not free from errors. Expenditures can be influenced by the behavior of the members of the household (for instance, by the differences in consumption habits or household needs), the environment (i.e., expenditures in rural areas are not the same as in urban areas) or mis-estimations of their real value (for instance, in specific goods such as alcoholic drinks or tobacco).

For these reasons, researchers do not agree about what is the most satisfactory variable for the measurement of inequality among households. Actually, it is often suggested that the results derived from the different variables should be compared. In this study, the analysis of the inequality is limited to household expenditures because statistical information on incomes is not available for the periods under consideration. The sources employed are the household budget surveys of the Spanish Institute of Statistics (INE), known as *Encuesta de Presupuestos Familiares (EPF),* for the years 1963-64, 1973-74, 1980-81 and 1990-91.[118] In order to analyze spatial inequality in household consumption

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[117] Household incomes may increase when the capital resources are sold.

[118] Reliable information on consumption is available for individuals, households and provinces which is analysed for different purposes. First, a price index for measuring the cost of living (known as *IPC*) is

component of welfare, we use data on household expenditures per capita in the Spanish provinces.[119]

Household expenditures have been arranged according to the following classification system:

a. *Food, (alcoholic and non-alcoholic) Drinks and Tobacco.*

These expenditures refer to those goods consumed within the household. So consumption in restaurants and cafes is excluded from this group.

b. *Clothing and Footwear.*

The acquisition or repair of clothing and footwear are included in this group of expenditures.

c. *Housing and Household Equipment.*

In this group, payments for rent, heating, furniture, and household goods as well as furnishings and fittings are included.

d. *Medical Services.*

Expenditures included in this group comprise the consumption of products for health care (e.g., drugs and pharmaceutical goods) and payments for medical care, hospital attendance and medical insurance.

e. *Transports and Communication.*

The purchase of vehicles (e.g., cars, motorcycles or bicycles) comes under this group. Other expenditures such as those derived from the use of private vehicles (car insurance, vehicle taxes, fines, etc) and public means of transport are also taken into account. Expenditure on communication refers to payments on telephone calls and post.

f. *Leisure, Education and Culture.*

Payments on goods and services for leisure, education and culture are registered as expenditures in this group.

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estimated. Second, estimations of macroeconomic indicators such as private consumption are also computed. Finally, the microeconomic data is analysed to determine household demand.

[119] The expenditures are in per capita terms. The use of the household as the unit would require that the household size also be taken into account.

g. *Other expenditures.*

This group of expenditures contains payments which are not classified under the foregoing groups. The group is composed of expenditures on restaurants, cafes and hotels (i.e., consumption outside the household), amounts spent on trips and expenditures on personal care.

Payments on taxes have been removed in the classification given above because data is not available for the 1963-64 and 1973-74 surveys. Also, the goods and services included in the expenditure groups may have changed over time for example between 1980-1 and 1990-1.

7.2.2 Results of the Estimation of the Composite Index with respect to Household Consumption.

In this section we discuss the results concerning the estimation of the composite index. The procedure detailed in Chapter 5 has been followed. Table 7.1 displays the main findings for the analysis of the first principal component computed separately for the four years (Step 1). The results for Step 1 (eigenvalues or characteristic roots), Step 2 (percentage of variability accounted by the first principal component and the upper end of the 95% confidence region for the relative contribution of the last six components) are reported here.

Table 7.1 Analysis of the First Characteristic Root (Principal Components Variances) with respect to Household Expenditures.

	1963-64	1973-74	1980-81	1990-91
Characteristic Root	0.185	0.127	0.124	0.094
Standard Deviation	0.430	0.356	0.352	0.307
Standard Error	0.037	0.025	0.025	0.019
Proportion of total Variance Accounted by the First Characteristic Root	0.68	0.76	0.75	0.75
Upper end of 95% confidence region	0.426	0.343	0.362	0.362

Table 7.1 reveals that the principal components computed individually fit the data quite well. The proportion of the variance accounted for by the first principal component recovers 75% of the trace in all cases, except for the first principal component for the data of the 1963-64 survey which accounts for 68% of the total variability. In addition, most of the variation is in the first principal component for all periods. The standard deviation of the characteristic roots varies a little.[120] The upper end at a significance level of 10% indicates that no more than 30-40% of the total variance will be lost by removing the six remaining components. The results for the remaining six components (not provided here), that is the components which were discarded, show that they are poorly defined. The amount of variability accounted for by the second principal components in all periods is no greater than 9-10%. So, the information contained in the remaining six components is reasonably ignored (the total number of variables is seven). Summing up, all these results show that the reduction to one single dimension of household expenditures, that is the composite index, is a good approach.

The characteristic vectors for the first component (Step 1) are displayed in Table 7.2. The interpretation of these component coefficients is based on the dominant variables (Step 3). The expenditure categories of housing and household equipment, leisure, education and culture, and other expenditures dominate in the year 1963-4, while the variable with respect to housing and household equipment also dominates in 1973-4. In 1980-81 and 1990-1, medical services, leisure, education and culture, and transports and communications dominate. In all samples the coefficients associated with the groups relating to basic need consumption (Food, drinks, tobacco and Clothing and footwear) are low (around 0.2 for 1963-4/1973-4 and around 0.1 for 1980-1/1990-1) and further they tend to decrease between 1974 and 1991. We interpret then the first component as a measure of the non-basic consumption of households.

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[120] These values differ from the standard deviations in the second principal component which are 0.167 for 1963-64, 0.129 for 1973-74, 0.125 for 1980-81 and 0.108 for 1990-91.

Table 7.2 Coefficients of the First Principal Component with respect to Household Expenditures. Standard Errors in Brackets. Sphericity Test for the First and Second Eigenvalues.

Group	1963-64		1973-74		1980-81		1990-91	
Food, Drinks and Tobacco	0.250	(0.0250)	0.237	(0.0266)	0.163	(0.0282)	0.194	(0.0226)
Clothing and Footwear	0.324	(0.0571)	0.390	(0.0359)	0.287	(0.0373)	0.281	(0.0458)
Housing and Household Equipment	0.463	(0.0222)	0.407	(0.0224)	0.375	(0.0333)	0.386	(0.0285)
Medical Services	0.259	(0.0500)	0.319	(0.0527)	0.414	(0.0435)	0.459	(0.0393)
Transports and Communications	0.380	(0.0434)	0.426	(0.0316)	0.465	(0.0312)	0.405	(0.0315)
Leisure, Education and Culture	0.420	(0.0326)	0.449	(0.0244)	0.467	(0.0272)	0.472	(0.0290)
Other Expenditures	0.481	(0.0449)	0.376	(0.0248)	0.380	(0.0356)	0.370	(0.0313)

Sphericity Test for the First and Second Eigenvalues

	1963-64	1973-74	1980-81	1990-91
Chi Square (2 Df)	39.10	44.68	45.80	46.98

The application of the sphericity criterion to the first and second characteristic roots (Step 4) confirms that the interpretation of this component as set above is robust (Table 7.2). The hypothesis that the eigenvalues associated with the two first components are equal is rejected. The corresponding chi square on two degrees of freedom is above the critical value (X^2=5.99) at the 5% level of significance. The stability of all components is studied from the results given in Table 7.2 (Step 5). The standard errors for the first principal component coefficients are below 0.1. This suggests that the first component for all samples is stable so that the first principal component is well-interpreted for all periods from a statistical point of view.

We test if it is possible to reduce the number of parameters (Step 7) over the four samples. Then we check the hypothesis that the first component is common in the four periods and the results of the test (Step 8) are given in Table 7.3. We find that the chi square lies between the 90th and 99th quantile with 18 degrees of freedom, indicating that the PCPC model fits our data at the 10% level of significance (i.e., the p-value is equal to 0.0587). The covariances and correlation matrices of the estimated components are given in Table 7.5 in combined form (Step 9). The correlation (values below diagonal) results between the first partial common component and the remaining components obtained individually for each sample indicate that the model selected is appropriate since the values for the correlations are not very high. The highest correlation is found between the first partial common component (1st PCPC) and the second individual component (2nd PC) obtained under PCPC in the matrices for the 1963-64 sample.

Table 7.3 Test for Partial Common Principal Components for the 1963-4, 1973-4, 1980-1 and 1990-1 Samples with respect to Household Expenditures.

Test for One Common Principal Component	*PCPC*
Number of Estimated Parameters in CPC(1)	94
Likelihood Ratio Test Chi-Square	28.225
Degrees of Freedom	18
p-Value	0.0587

Table 7.4 Approximate Maximum Likelihood Estimates for the 1963-4, 1973-4, 1980-1 and 1990-1 Samples with respect to Household Expenditures.

a. First Common Principal Component. Characteristic Vectors	
Food, Drinks and Tobacco	0.2032
Clothing and Footwear	0.3437
Housing and Household Equipment	0.4208
Medical Services	0.3775
Transports and Communications	0.4314
Leisure, Education and Culture	0.4409
Other Expenditures	0.3750

b. Characteristic Roots for the First Common Principal Component

	1963-64	1973-74	1980-81	1990-91
Characteristic Roots	0.180	0.127	0.123	0.093
Proportion of total variance accounted by the first characteristic root	0.66	0.76	0.74	0.74

Since the hypothesis that all samples share one component is not rejected (or stated in another way the PCPC model is not rejected), the same weights are associated with the expenditure categories. These weights are the maximum likelihood estimates of the first partial common component (Step 7) for the 1964, 1974, 1981 and 1991 samples. What does this imply for the construction of the composite index? First, the number of parameters estimated by the PCPC model is smaller than for PCA. So the component coefficients used are more stable than the ones in PCA although the latter are already stable. There exists stationarity in the main sources of the variability which results from the use of constant coefficients. So the weights used to construct composite index are not sample-specific.

The maximum likelihood estimates of the eigenvectors of the partial common principal component model are displayed in Table 7.4. These coefficients do not change much in relation to the ones computed separately. Again we interpret the first component as a measure of non-basic consumption of households because the component coefficients for the basic consumption variables remain low.

Table 7.5 Covariance (F) and Correlation Matrices (R) Matrices of the Estimated Components for the 1963-4, 1973-4, 1980-1 and 1990-1 Samples with respect to Household Expenditures.

a. Matrices for the 1963-64 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC	7th PC
		0.1796	-0.0265	0.0060	0.0030	0.0089	0.0041	0.0058
		-0.3935	0.0252	0	0	0	0	0
		0.0846	0	0.0282	0	0	0	0
$R_{64}\backslash F_{64}$	=	0.0525	0	0	0.0187	0	0	0
		0.1940	0	0	0	0.0116	0	0
		0.1611	0	0	0	0	0.0035	0
		0.1967	0	0	0	0		0.0049

b. Matrices for the 1973-74 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC	7th PC
		0.1265	-0.0073	-0.0022	0.0019	0.0029	-0.0027	0.0042
		-0.1557	0.0171	0	0	0	0	0
		-0.0671	0	0.0088	0	0	0	0
$R_{74}\backslash F_{74}$	=	0.0730	0	0	0.0051	0	0	0
		0.1247	0	0	0	0.0043	0	0
		-0.1501	0	0	0	0	0.0025	0
		0.2115	0	0	0	0	0	0.0031

c. Matrices for the 1980-81 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC	7th PC
		0.1227	0.0095	0.0047	-0.0019	-0.0016	0.0008	0.0007
		0.2114	0.0165	0	0	0	0	0
		0.1333	0	0.0102	0	0	0	0
$R_{81}\backslash F_{81}$	=	-0.0632	0	0	0.0076	0	0	0
		-0.0668	0	0	0	0.0046	0	0
		0.0432	0	0	0	0	0.0029	0
		0.0533	0	0	0	0	0	0.0015

d. Matrices for the 1990-91 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC	7th PC
		0.0932	0.0089	-0.0033	0.0016	0.0005	-0.0006	0.0001
		0.2884	0.0103	0	0	0	0	0
		-0.1550	0	0.0047	0	0	0	0
$R_{91}\backslash F_{91}$	=	0.0964	0	0	0.0030	0	0	0
		0.0538	0	0	0	0.0009	0	0
		-0.0703	0	0	0	0	0.0008	0
		0.0058	0	0	0	0	0	0.0015

†On and above diagonal variances and covariances of the first common component. Below diagonal correlations.

1st PCPC: First common principal component. This is obtained using PCPC(1). **2nd, 3rd and 4th, 5th, 6th and 7th PC:** Second, third, etc., principal component computed individually using PCPC.

7.2.3 Analysis of Spatial Inequality in Household Consumption.

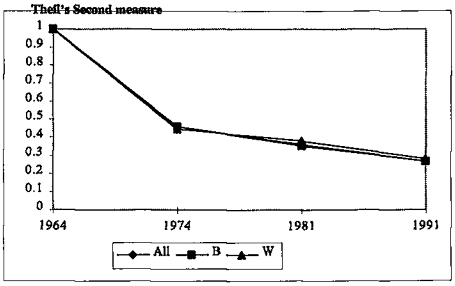
The results for inequality with respect to household consumption are shown in Table 7.7. Inequality has narrowed significantly over the last four decades. In other words, household consumption has tended to be more similar in Spain. Since consumption is related to household incomes, the reduction of inequality is largely due to the poor regions catching up with the rich (in terms of income). Inequality has declined more sharply between 1964-74 and 1981-91. These changes in inequality coincide with the Spanish economic expansion and liberalisation arising from the 1959 *Plan de Estabilización Económica* and the development of the economy after the oil crisis. So the reduction of inequality is likely to have been caused by the changes in household income disparities.

Table 7.6 Theil's Second Measure with respect to Household Consumption.

	1964		1974		1981		1991	
	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%
Between-Regions Inequality	0.0221	74.6	0.0102	75.4	0.0078	73.2	0.0059	73.7
Within-Regions Inequality	0.0075	25.4	0.0033	24.6	0.0029	26.8	0.0021	26.3
	$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$	
Total Inequality	***0.0296***		***0.0136***		***0.0106***		***0.0079***	

Overall inequality is divided into intra- and inter-region components (Table 7.6). Decomposition of inequality reveals that the disparities between the regions are the main source of the overall inequality. In terms of the percentage of overall inequality, the component of between-region inequality has remained largely unchanged over time accounting for around 75% of overall inequality while the percentage of within-region has ranged around 25%. This stability in the pattern of inequality is also shown in Figure 7.1 which reveals a similar trend of between, within-region and overall inequality. This may be due to there is a relationship between the economic structure of regions and the household consumption (private consumption).

Figure 7.1. Trends of Theil's Second Measure in Overall, Between-Region and Within-Region Inequality with respect to Household Consumption. 1964 Base Year.



All: Spatial or overall inequality. B: Between-regions inequality. W: Within-regions inequality.
Year 1964 =1

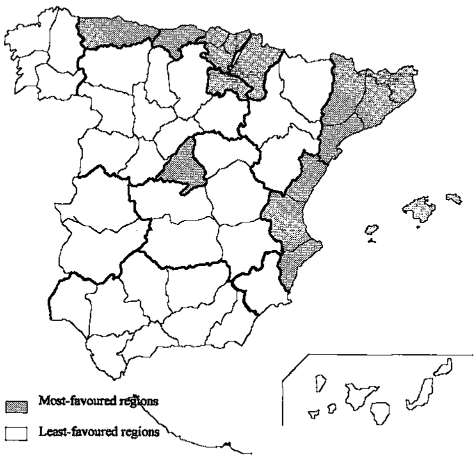
The results for cluster analysis show that the distribution of housing expenditures has not changed much between 1964 and 1991.[121] Regions such as Madrid, Navarra, País Vasco, La Rioja, Cataluña and Baleares are included in the group of most-favoured regions with respect to household consumption consistently over time.[122] This pattern is very similar to that for household incomes (except for Aragón). So it is likely that the inequality in household consumption changes according to the economic conditions of regions as reflected by changes in household income.

[121] Maps for the remaining periods (not provided here) reveal a similar geographical pattern to Figure 7.2.

[122] In the case of household consumption for 1964, the most-favoured regions with respect to composite index range from 0.74 (in Madrid) to 0.56 (Comunidad Valenciana) while the composite index for the least-favoured regions ranges from 0.49 (Canarias) to 0.27 (Galicia). For 1991, the most-favoured regions with respect to composite index range from 0.89 (Cataluña) to 0.52 (Extremadura) while the composite index for the least-favoured regions ranges from 0.76 (Asturias) to 0.52 (Extremadura).

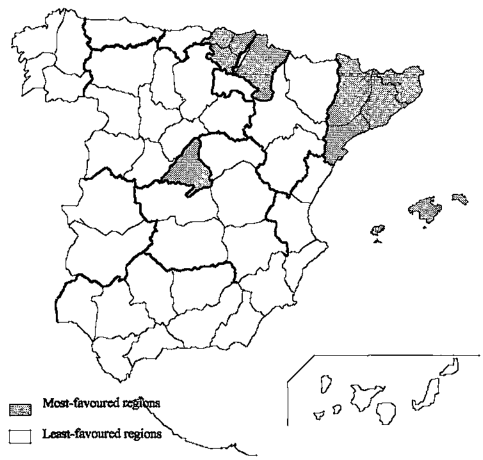
Figure 7.2. Clusters of Most-Favoured and Least-Favoured regions with respect to Household Consumption.

1964



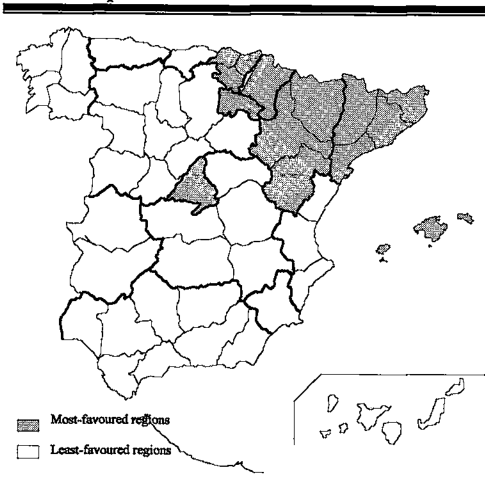
Least-favoured regions: Andalucía, Castilla León, Castilla la Mancha, Extremadura, Galicia, Murcia, Aragón, Canarias.
Most-favoured regions: Cataluña, Asturias, Cantabria, Madrid, Navarra, País Vasco, La Rioja, Baleares, Comunidad Valenciana.

1991



Least-favoured regions: Andalucía, Castilla León, Castilla la Mancha, Extremadura, Galicia, Murcia, Aragón, Canarias, Cataluña, Asturias, Cantabria, Comunidad Valenciana.
Most-favoured regions: Madrid, Navarra, País Vasco, La Rioja, Baleares.

Figure 7.3. Clusters of Most-favoured and Least-favoured regions with respect to per Capita Household Income. Spain at 1991.



Least-favoured regions: Andalucía, Asturias, Cantabria, Castilla León, Castilla la Mancha, Extremadura, Galicia, Murcia, Canarias, Comunidad Valenciana.
(Household income ranges between 1.039.800 –Comunidad Valenciana- current psetas at 1991 and 776.670 ptas - Extremadura-).
Most-favoured regions: Cataluña, Madrid, Navarra, País Vasco, La Rioja, Baleares, Aragón.
(Household income ranges between 1.402.171 –Baleares- current pesetas at 1991 and 1.091.800ptas -Aragón-).

Source: BBV (1998)

7.3 External Environment: Housing Conditions.

7.3.1 Indicators with respect to Housing Conditions.

Although the *external environment* is associated with housing, transportation (e.g., volume of transport network, conditions of transport networks) and ecological characteristics (e.g., air, noise, water, waste, etc), the study of inequality with respect to the external environment focuses only on housing conditions. While households may have achieved minimum standards in basic facilities,[123] residential living conditions describe only part of the full impact of the external environment. More comprehensive analysis must also incorporate ecological characteristics as important elements in the person's life. The increasing number of incidences and fatalities associated with existing environment-related diseases (eg., skin and lung cancer, respiratory diseases, allergic diseases, etc) have shown the effects of man's exposure to his surroundings and his or her vulnerability to environmental damage (pollution, congestion, etc) in particular (EC, 1996b).

Because of the non-availability of data, the present analysis is restricted to housing conditions. Housing conditions and household consumption are treated separatelly because there has been important improvements in housing conditions over the last few decades. Reliable census data for housing is provided by INE with the *Censos de Edificios* and *Censos de Población y Vivienda* and additional information has been collected from the household survey known as the *Encuesta de Presupuestos Familiares (INE)*. Inequality in housing conditions is explored by using six indicators relating to household facilities. Three indicators with a negative sense represent the lack of facilities and they are: sanitary, heating, and running water supplies. The remaining indicators have a positive sense and are: the availability of a fridge, of a washing machine, and of a telephone set.

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[123] The minimum component or standard of *good housing* refers to basic sanitary facilities (i.e., inside lavatory, bath or shower) in the EC report (1996b).

7.3.2 Results of the Estimation of the Composite Index with respect to Housing Conditions.

The results obtained from the separate principal component analysis (Steps 1 and 2) are given in Table 7.7. These reveal a good fit of the first component to our data since this axis accounts for over 70 per cent of the total variability of the samples (although in the 1991 sample it accounts for 0.68 per cent). The upper end of 95% of the confidence region indicates that 40% of the variance in the 1964 sample, around 30% in the 1981 sample, and 50% in the 1991 sample is lost after discarding the five remaining components.

Table 7.7 Analysis of the First Characteristic Root (Principal Components Variances) with respect to Housing Conditions.

	1964	1974	1981	1991
Characteristic Root	0.219	0.210	0.166	0.070
Standard Deviation	0.468	0.458	0.408	0.265
Standard Error	0.044	0.042	0.033	0.014
Proportion of total Variance Accounted by the First Characteristic Root	0.71	0.77	0.82	0.68
Upper end of 95% confidence region	0.39	0.32	0.27	0.50

Interesting conclusions follow from Table 7.8 which reproduces the main findings of the component coefficients of the first component. The interpretation of these coefficients (Step 3) is carried out looking at the dominant variables. The low coefficients for all samples reveal that there is no clear dominance of a particular variable in the 1964, 1974 and 1981 samples. Except for the sanitary facilities variable which dominates in these three samples, component coefficients attached to all variables are quite similar (and low) for all samples. In contrast, the variability for the 1991 sample is clearly explained by the variable *Household Lacking Sanitary Facilities* because the component coefficient yields 0.76. In other words, the dominant variable is different in the 1964, 1974 and 1981 samples compared to the 1991 sample. So we interpret the first component for the 1964, 1974 and 1981 as an overall measure of housing conditions while for 1991 the first component is a measure of *good housing* in the sense of minimum standards for households.

From a statistical point of view the foregoing interpretations can be considered as robust because the test of the sphericity between the first and second eigenvalues (Step 4) reveals that the eigenvalues are not close or equal (Table 7.8). At any reasonable level of significance the hypothesis is rejected because the chi square is larger than the critical values.

Table 7.8 First Principal Component Coefficients (Standard Errors in brackets) with respect to Housing Conditions.

Group	1964		1974		1981		1991	
Households Lacking Sanitary Facilities	0.5029	(0.0423)	0.5242	(0.0336)	0.5605	(0.0330)	0.7603	(0.0554)
Households Lacking Running-Water Supplies	0.2911	(0.0323)	0.3812	(0.0376)	0.5253	(0.0328)	0.4202	(0.0796)
Households Existing Fridge	0.4376	(0.0493)	0.3791	(0.0295)	0.1884	(0.0185)	0.0576	(0.0105)
Households Existing Washing Machine	0.4533	(0.0348)	0.3828	(0.0368)	0.3815	(0.0239)	0.1805	(0.0164)
Households Existing Telephone Set	0.2932	(0.0294)	0.3111	(0.0292)	0.3861	(0.0330)	0.3462	(0.0474)
Households Lacking Heating Facilities	0.4236	(0.0583)	0.4393	(0.0386)	0.2823	(0.0320)	0.2995	(0.0468)

Sphericity Test for the First Two Principal Components

	1964	1974	1981	1991
Chi Square (2 Df)	31.69	54.04	55.24	21.93

The hypothesis that the four samples share the same first common component is tested following Steps 7 to 11. For the four samples this is rejected at the 5 % or any other level of significance (chi square is 171.128 with 15 Df; *the critical value at* the *5%* level *of significance is 25.00*). A visual inspection of the component coefficients of all samples (Table 7.8) exhibits a strong similarity between the 1964, 1974 and 1981 samples (Step 10). So we apply a PCPC for these samples (Step 11). This model is also rejected because chi square (Step 8 applied to three samples) is 79.307 with 10 Df (*critical value at* the *5%* level *of significance: 18.31*). In the following step (Step 12) we test the hypothesis for the pairs of samples 1964 and 1974, 1974 and 1981, and finally 1981 and 1991. Except for the first pair of samples 1964-1974, the hypothesis is rejected in the others. The pair consisting of the 1974-1981 samples yields a chi square is 34.257 while for the pair 1981-1991 samples the chi square is 62.515 (*critical value at* the *5%* level *of significance* with 5 Df*: 11.07*).

The results for the partial common principal component model for the 1964 and

1974 samples are given in Table 7.9. Chi square is 6.185 with 5 degrees of freedom (p-value is 0.2889). The correlation matrices given below the diagonal in Table 7.11 are low so the fit of the model is corroborated. The highest correlation (0.25) is found between the first partial common component (1st PCPC) and the sixth individual component obtained under PCPC (6th PC).

Table 7.9 Test for Partial Common Principal Components for the 1964 and 1974 Samples with respect to Housing Conditions.

Test for One Common Principal Component	PCPC(1)
Number of Estimated Parameters in CPC(1)	37
Likelihood Ratio Test Chi Square	6.185
Degrees of Freedom	5
p-Value	0.2889

The approximate maximum likelihood estimates for the first common component are displayed in Table 7.10. We interpret this component as an overall measure of housing conditions. Although in the separate analysis component coefficients are already stable, we compute standard errors of the first common component (Appendix 4.3). Results show that the common component coefficients are stable, being lower than 0.1 (Table 7.11).

Table 7.10 Approximate Maximum Likelihood Estimates for Housing Conditions for the 1964 and 1974 Samples. Standard Errors in Brackets.

a. First Partial Common Principal Component. Characteristic Vectors		
Households Lacking Sanitary Facilities	0.5212	(0.0256)
Households Running-Water Supplies	0.3330	(0.0226)
Households Fridge Availability	0.4162	(0.0252)
Households Washing Machine Availability	0.4201	(0.0258)
Households Telephone Set Availability	0.2818	(0.0206)
Households Lacking Heating Facilities	0.4340	(0.0326)

b. Characteristic Roots for the First Common Principal Component

	1964	1974
Characteristic Roots	0.218	0.209
Proportion of total Variance Accounted by the First Characteristic Root	0.71	0.76

Table 7.11 Covariance (F) and Correlation (R) Matrices of the Estimated Components for the 1964 and 1974 Samples with respect to Housing Conditions†.

a. Matrices for the 1964 Sample

		1st PCPC	2nd PCA	3rd PCA	4th PCA	5th PCA	6th PCA
		0.21819	-0.00577	0.00659	0.00129	-0.00397	0.00789
		-0.06088	0.0411	0	0	0	0
$R_{64}\backslash F_{64}$	=	0.09746	0	0.02093	0	0	0
		0.02194	0	0	0.01576	0	0
		-0.09784	0	0	0	0.00753	0
		0.25401	0	0	0	0	0.00443

b. Matrices for the 1974 Sample

		1st PCPC	2nd PC	3rd PC	4th PC	5th PC	6th PC
		0.2089	0.01173	-0.00097	-6.7E-05	0.00897	-0.00032
		0.17156	0.02239	0	0	0	0
$R_{74}\backslash F_{74}$	=	-0.01631	0	0.01684	0	0	0
		-0.00164	0	0	0.00795	0	0
		0.16951	0	0	0	0.01341	0
		-0.01056	0	0	0	0	0.00431

† On and above diagonal variances and covariances of the first common component. Below diagonal correlations.

1st PCPC: First common principal component. This is obtained using PCPC.

2nd, 3rd and 4th, 5th, 6th and 7th PC: Second, third, etc principal component computed individually using PCPC.

7.3.3 Analysis of Spatial Inequality in Housing Conditions.

From 1964 to 1991 inequality in housing conditions has declined dramatically (Table 7.12). The results do not seem to be affected either by the use of different component coefficients for the 1964 and 1974 samples (PCPC) and the 1981 and 1991 samples, nor by the difference in statistical data sources. The Theil's second measure declines more sharply between 1964-74 and between 1981-91. This reduction in inequality is consistent with the changes in socio-economic conditions in Spain and the changes in household income in particular. So it is possible that the main factor influencing inequality in household conditions is household incomes.

Table 7.12. Theil's Second Measure with respect to Housing Conditions.

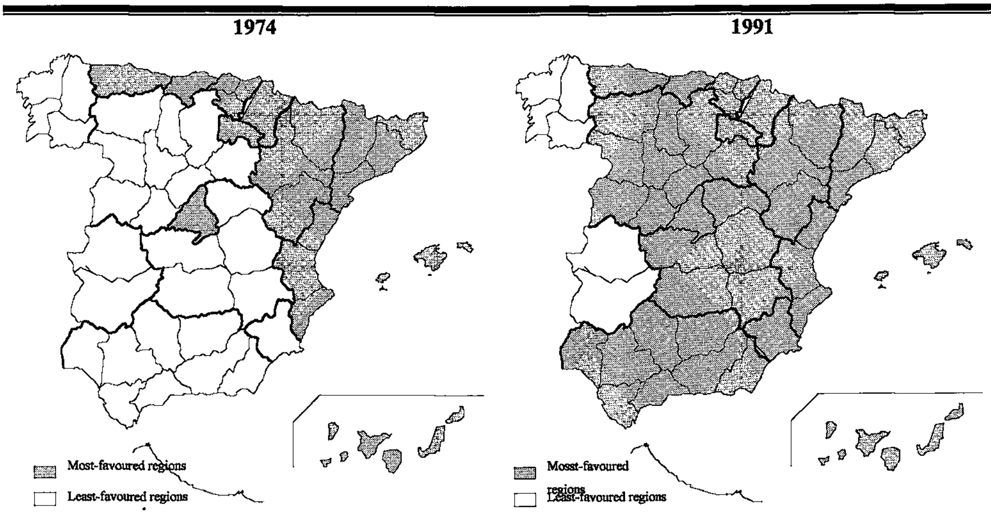
	1964		1974		1981		1991	
	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%	$T_{-1}(W_\bullet)$	%
Between-Regions Inequality	0.0482	72.7	0.0242	75.2	0.0133	65.9	0.0043	62.2
Within-Regions Inequality	0.0181	27.3	0.008	24.8	0.0069	34.1	0.0026	37.8
	$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$		$T_{-1}(W_\bullet)$	
Total Inequality	***0.0662***		***0.0322***		***0.0202***		***0.007***	

Table 7.12 shows that the main source of inequality is between-region inequality. The trend for between-region inequality is very similar to the one for overall inequality in housing conditions and household consumption. The contribution of between region inequality to total inequality is around 75% of overall inequality between 1964-74 in household expenditures and housing conditions. But the percentage of between region inequality is smaller in housing conditions between 1981-91 than in household expenditures. Between 1964 and 1981 the regions with the highest region's share of within-region inequality remain the same (Andalucía, Castilla León, Castilla la Mancha, Aragón, Galicia). Land size appears to be an important factor in within-region inequality but also regional characteristics such as intra-regional economic development seem to have some influence. This is suggested by the cluster analysis of provinces' composite index in the regions of Aragón and Galicia. In both cases the least industrialised region (Lugo in Galicia

and Teruel in Aragón) appears in the cluster of least-favoured provinces with respects to housing conditions.

The decline in inequality is shown in Figure 7.4 which displays the maps obtained for 1974 and 1991 using the cluster analysis of regions composite index. The maps show the most- and least-favoured regions with respect to housing conditions for 1974 and 1991. In 1974 the group of most favoured-regions consists of regions situated in the North-Eastern part of the peninsula including Canarias and Baleares. The pattern is quite different in 1991 when it shows much more uniformity reflecting the decline in inequality.

Figure 7.4. Clusters of Most-favoured and Least-favoured Regions with respect to Housing Conditions.



Least-favoured regions: Andalucía, Castilla León, Castilla la Mancha, Extremadura, Galicia, Murcia.
Most-favoured regions: Aragón, Cataluña, Asturias, Cantabria, Madrid, Navarra, País Vasco, La Rioja, Baleares, Canarias, Comunidad Valenciana.

Least-favoured regions: Galicia, Extremadura.
Most-favoured regions: Andalucía, Castilla León, Castilla la Mancha, Murcia, Aragón, Canarias, Cataluña, Asturias, Cantabria, Madrid, Navarra, País Vasco, La Rioja, Baleares, Comunidad Valenciana.

7.4 Summary and Main Conclusions.

This chapter has focused on the analysis of inequality with respect to household consumption and housing conditions. The appropriateness of several indicators (incomes or expenditures) to measure inequality relating to households has been discussed. Our results suggest that the magnitudes and trends in inequality which might be expected with respect to household incomes are similar to those that we have obtained with respect to household expenditures. Inequality in household consumption and housing conditions has narrowed significantly over the last four decades. This is consistent with the changes in the economic situation which occurred during this period.

Chapter 8

Summary and Conclusions

8.1 Introduction.

This study has focused on the changes in regional inequality in Spain over the last four decades, with emphasis on regional welfare. Attention has been paid to the levels and trends in inter and intra-regional disparities in the welfare components of health, education and housing. Various methodological issues have been explored in the context of measuring inequality at different points of time. Methodological issues relating to welfare inequality between regions have been studied and a specific procedure for analysing inequality has been developed. This chapter summarises the main findings of the present research. The organization of this chapter is as follows. In Section 8.2 the approach used to study of regional welfare inequality is justified. In Section 8.3 the context of this study is explained. We describe the methodology that we develop and its limitations in Section 8.4. In Section 8.5 the empirical results are presented and some policy implications are indicated. Finally, suggestions for further research are given in Section 8.6.

8.2 Justification for the Present Study.

In this century, most of the industrialized European societies have created a welfare system which guarantees individuals equality in civil and moral rights. This system is also responsible for the redistribution of income and wealth among individuals. The welfare programs provide payments to people who are disabled, unemployed, elderly or incapacitated. Finally, the rights of each individual to an equal level of opportunities are also ensured by this welfare system. With the collective provision of certain goods and services such as public education, health care and housing, equality is intended in opportunities rather than outcomes. In other words, the government's duties relate to individuals rights in achieving a necessary (minimum standard) of publicly provided goods and services such as health care and education services.

The welfare system goes beyond that of minimizing income disparities or reducing inequalities in income. Income merely reflects the quantity of goods and services that individuals can obtain according to their preferences given their budget constraints. The welfare system is also a matter of providing a level playing field so that all individuals have the same chances with respect to some basic opportunities such as education, health, etc. So a study of differences in income is somewhat limited since the major concern in welfare is not merely income. This study investigates inequality from a different perspective, focussing not on regional disparities in income but differences in health care and health facilities, enrollment and education facilities, household consumption and housing conditions. So we have selected health, education and housing as the main focus in the present study.

8.3 Policy Changes in Spain and Regional Inequality in Welfare.

A substantial part of the policy changes relating to the welfare system in Spain have resulted from the redefinition of the government's duties following the 1978 Constitution. Additional changes in welfare programs have taken place to accommodate the economic and social changes of the last four decades. Within the changing context of the welfare state, compulsory education has been expanded, a public health system has been created, subsidies for housing have been provided, and finally, a social service system has been set up to assist the elderly, unemployed, and sick. In sum, the Spanish welfare system has pursued equality of opportunities in a broad sense.

Challenges in education and health have been of major interest in this study because there has also been devolution of power to some regional authorities during this period. Education and health are the largest expenditure items in the welfare system. In addition, a significant expansion in public investment has occurred. Finally, the fact that only seven out of the nineteen regions have gained full autonomy for education and health powers may also have some implications for inequality.

8.4 Methodology and Limitations of the Study.

The present study has focused on the estimation of the Theil's second measure of multidimensional inequality in Spain for 1964, 1974, 1981 and 1991. This additive decomposable inequality measure has enabled us to study intra and interregional disparities in health facilities, health status, education facilities, enrollment in education, household consumption and housing conditions. The use of several indicators to represent each of the welfare components under consideration involves defining a composite index of indicators. The underlying multidimensionality of the welfare components is thus taken into account. In the present study, Maasoumi's (1986) aggregator function is used to aggregate the indicators. This function enables us to reproduce the maximum amount of information contained in the original indicators. There are no studies of welfare inequality in Spain which have considered the multidimensionality of each of the welfare components separately. There are also no studies that have done a longitudinal analysis of welfare inequality. Regional disparities in Spain over time with respect to health and/or education facilities have not been analyzed using an inequality measure. Thus it is not possible to compare inequality results from other literature sources with our results.

For empirical purposes the use of Maasoumi's function requires weights associated with indicators. Different weights are used for different indicators. We have developed a method to estimate the Theil's second inequality measure for longitudinal analysis. The estimation procedure consists of computing the weights (or component coefficients) associated with the selected indicators using Partial Common Principal Component model (PCPC) whenever appropriate or Principal Component Analysis (PCA) otherwise. PCA has been applied for longitudinal analysis using Theil's second measure for multidimensional inequality (Maasoumi and Jeong, 1985;, Maasoumi and Nickelsburg, 1988; Zandvakili, 1992, 1999).

When all periods share the same first component, the composite index is obtained on the basis of the component coefficients computed using a partial common principal component model. So component coefficients are not sample-specific because they are the same in all periods. In other words, the composite indexes for these periods depend on the values of the variables rather than the weights attached to variables. If the hypothesis of one partial common component is not rejected for a number of periods (say three or two periods), the composite index is then constructed on the basis of the maximum likelihood estimates for these periods together with the individual component coefficients for the remaining periods. When it is not possible to reduce the number of parameters estimated, or stated in another way, a partial principal components model does not fit the data, the composite index is based on individually computed component coefficients. Finally, the overall inequality of the Theil's second measure is computed and decomposed for analysis.

The Theil's second measure has been applied in the present study to achieve various objectives. First, the magnitude and direction of overall inequality, between-region inequality, and within-region inequality have been computed. The wide variations in the socio-economic structure of the Spanish regions justify an in-depth analysis of inequality focusing on intra- and inter-region disparities. Moreover the estimates of the composite indexes for the geographical units (regions) have been used for a statistical cluster analysis which identifies the similarities between one group of regions in contrast with another group of (similar) regions. In this study the cluster analysis identifies two groups of high similar values (most-favored regions) and low similar values (least-favored regions). So a picture of the geographical distribution of welfare components is obtained and changes over time can be compared. The inequality results and the results from the cluster analysis form the main findings of our study.

In addition to the estimation procedure summarized above, we have also developed a method for incorporating contiguity with respect to health and education facilities. Interactions between geographical units (provinces) are inevitable since individuals can commute from their own province to contiguous provinces when facilities are not available in the home province. The level of resources (facilities) available in a certain province is therefore considered to consist of the facilities in the own province plus the facilities located in *contiguous provinces* weighted by *spatial weights*. *Spatial weights* used here correspond to the simple inverse distance (optimal distance by road) between the provincial capital of the Spanish provinces and their contiguous provinces. In this study the term of *contiguous provinces* refers to those provinces connected at a certain level of contiguity. For health facilities, we consider the first order of contiguity. The first order of contiguity describes two provinces that have a common boundary, common vertex or both. It is assumed that patients seek a first contact with doctors or specialized treatment and diagnosis at the nearest place to their home province. For education facilities in secondary education also, we consider the first order of contiguity. The fact that universities have been rather centralised in certain provinces (which are central points) until the eighties is taken into account to compute the facilities in 1964 and 1974. The facilities in university education for 1964 and 1974 consist of facilities located in neibouring provinces at the first and second order of contiguity in addition to facilities in Madrid and Barcelona. Here a second order of contiguity is defined between two contiguous provinces, one of them being first-order of contiguity (facilities in provinces adjacent to the neighbouring province). The facilities in university education for 1981 and 1991 consist of facilities located in first and second order contiguous provinces.

Most of the limitations which arise from this study relate to the multivariate model used (PCPC or PCA) in this study. In the procedure developed to estimate the Theil's second measure, the use of such a technique implies that the composite indexes are computed on the basis of statistical techniques and not on the basis of a theoretical model. Also, the results based on principal components may be sensitive to outlying observations (Devlin et al 1981), to the accuracy of the data, or to changes in the scales of raw data due to the transformation used to consider the positive or negative sense of indicators to welfare. Finally, the estimation of principal components using a partial common principal component model (or any other generalization of statistical techniques of multivariate analysis) limits the analysis to the same variables and number in all the samples. So the methodology restricts the variables in the composite index to a fixed number of indicators for all time periods even though this may actually be changing over time.

8.5 Empirical Results of the Study and Policy Implications.

The first conclusion of this study is that the setting up of the welfare system and the social policies undertaken in education or health have had significant consequences for inequality in Spain. The government's guarantee of equality in these basic opportunities appears to have helped reduce overall inequality over the last four decades. In addition, changes in the economic context, especially during the economic expansion of the sixties and the nineties together with policies focused on reducing inequality in income may also have influenced the decline in disparities in the socio-economic conditions of households (household consumption and housing conditions).

In the analysis of inequality with respect to health and education facilities, it is necessary to take the contiguity into account. The inclusion of spillovers gives a better overview of inequality as well as the impact of welfare policies on inequality. Our results show that overall inequality tends to change as a result of incorporating the facilities located in neighbouring areas. So spillover effects within or between regions may lead to improvements in the availability of services in provinces (and consequently in the regions as well). The inclusion of contiguity in the cases of health and education facilities also reveals a distinct picture of the trends in inequality in comparison with that of the non-contiguity. The results for inequality with respect to education and health fall in line with policy measures. With respect to health facilities, inequality declines more sharply between 1981 and 1991. This change is consistent with the enactment of the 1986 Health Act, and the regionalisation process. Trends in inequality with respect to education facilities in the contiguity case reveal that inequality declines from the seventies onwards. This may be due to the education measures which initiated in the seventies focused on the promotion of the non-compulsory education. But is difficult to find evidence of the dramatic changes in inequality for the non-contiguity case.

In the welfare components of health and education, the decomposition of inequality shows that there is an important change in the contribution of between-region inequality between 1981 and 1991. This coincides with the devolution of power to regions. But the impact of the regionalisation seems to be quite different for the two largest expenditure items of the welfare system. The share of between-region inequality in overall inequality increases for education (education facilities and enrollment) while this percentage decreases for health (health facilities). It is possible that this difference is because of the policy background of the welfare component. Thus, the promotion of non-compulsory education dates back from early in the seventies while a public health system was not formally established till 1986. The regionalisation process may involve an improvement first at the national level (overall inequality) and then at the regional level (between-region inequality).

The impact of regional policies seems also to be different for education and health facilities in the regions with autonomy. The contribution of Cataluña, Comunidad Valenciana, País Vasco, Canarias, and Galicia to within-region inequality decreases (or varies a little) between 1981 and 1991 with respect to health facilities. With respect to education facilities, the contribution of Cataluña, Comunidad Valenciana, País Vasco, (which are the richest regions in income terms with autonomy) to within-region inequality increases while it declines in the poorest regions (Canarias and Galicia). Once again this difference between health and education may be due to the policy context of the welfare component.

The substantial contribution of Castilla León, Castilla La Mancha, and Andalucía to within region inequality may be reasonable because of the socio-economic structure of these regions. All these regions have similar regional features: limited industrial development, abundant potential in natural resources, predominance of agriculture and geographical location in the Center and South of the Iberian Peninsula.

Facilities in health and education tend to be located in the Centre and North of Spain. This geographical pattern suggests that there is a relationship between location of services and the economic structure of regions. The distribution of facilities also seems to be affected by spillovers which are mostly observed between the regions situated in the Center and North of the Iberian Peninsula. So regions in the South of Spain are not benefited by their geographical position.

The beneficiaries of structural policies resulting of solidarity principle and regional funds should be the Southern regions that are least-favored with respect to most of the welfare components analyzed in this study. These Southern regions also have problems relating to their socio-economic conditions. Policy makers should take this into account if they want to improve the imbalances in welfare among the regions in Spain.

8.6 Suggestions for Further Research.

In this study, due to the unavailability of data we have assumed that individuals commute from the own provincial capital to the provincial capital in contiguous provinces. So the assumption is that facilities are centralised in the provincial capitals. So the travel inputs are estimates of the travel time (by optimal road) between two provincial capitals.

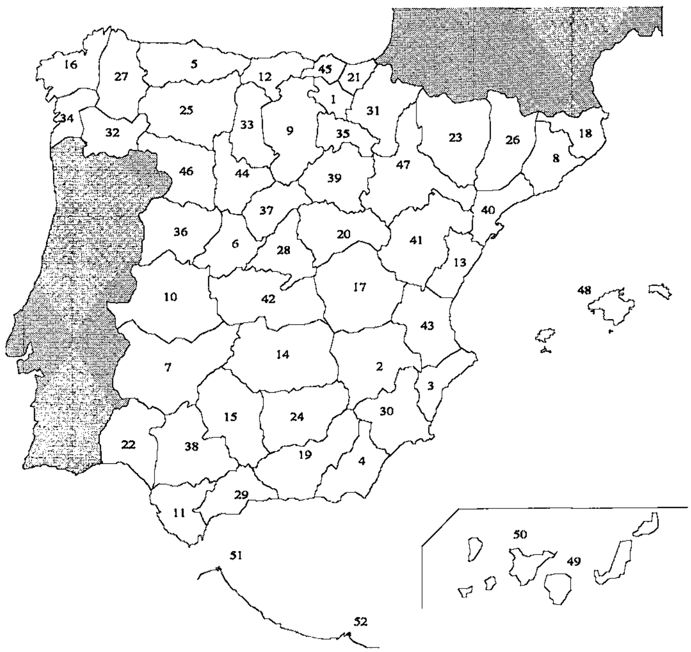
One possibility for further research is to carry out a sensitivity analysis to determine the robustness of our results to changes in travel inputs. This is however beyond the scope of the present study.

Also more data could be collected in order to study a greater number of periods so that more robust results could be obtained from the longitudinal analysis. It would be interesting to determine if changes in inequality after 1991 are affected by the consolidation of the Comunidades Autónomas (regionalisation process) and the increasing role of the regional authorities as responsible bodies in welfare powers during the last decade.

We have examined in this study several components of regional welfare. But an overall measure consisting of all welfare components has not been analyzed. First, the methodology suggested here may be applied to this case but researchers should keep in mind that inequality results depend on the underlying correlations between the indicators used. In our separate analysis of welfare components we suppose that indicators within each welfare component are correlated. But this assumption might be not so consistent when aggregating many indicators of different welfare components. Another possibility is to investigate the nature of the relationship between the demand and provision for health and for education. A suggestion for further research is to apply the procedure developed here using all welfare components (health, education, and housing) together. It may also be possible to statistically test the causal relationship between welfare policy changes and actual changes in welfare inequality over time.

Appendix I

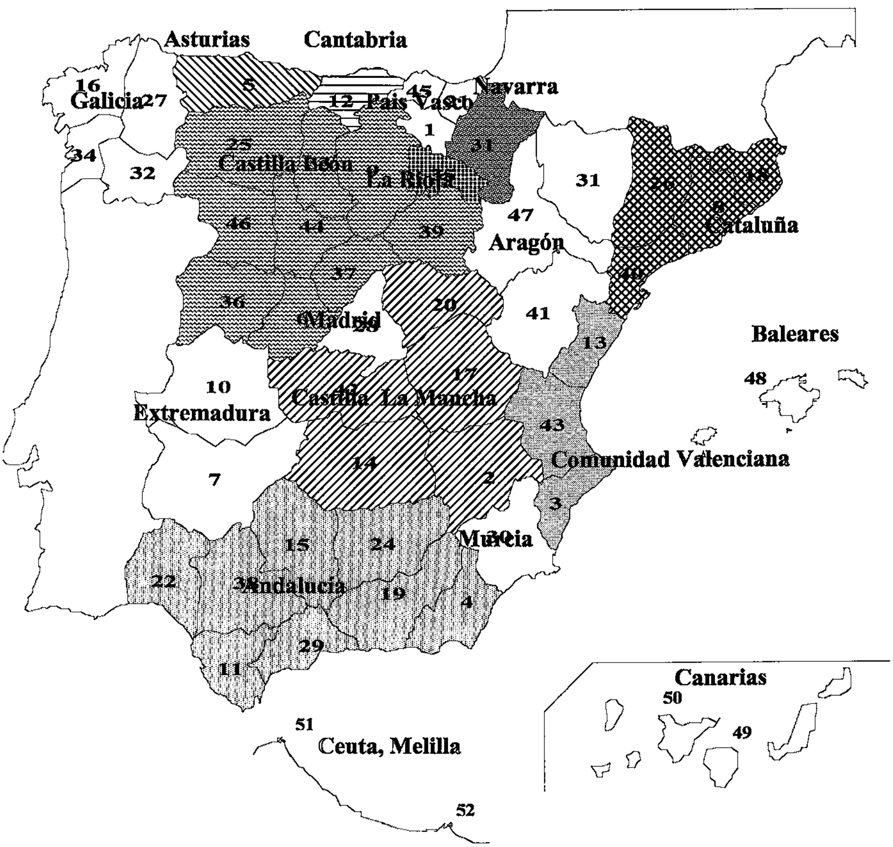
The Spanish Provinces



1	Alava	14	Ciudad Real	27	Lugo	40	Tarragona
2	Albacete	15	Córdoba	28	Madrid	41	Teruel
3	Alicante	16	La Coruña	29	Málaga	42	Toledo
4	Almería	17	Cuenca	30	Murcia	43	Valencia
5	Asturias	18	Gerona	31	Navarra	44	Valladolid
6	Avila	19	Granada	32	Orense	45	Vizcaya
7	Badajoz	20	Guadalajara	33	Palencia	46	Zamora
8	Barcelona	21	Guipúzcoa	34	Pontevedra	47	Zaragoza
9	Burgos	22	Huelva	35	La Rioja	48	Baleares
10	Cáceres	23	Huesca	36	Salamanca	49	Las Palmas
11	Cádiz	24	Jaén	37	Segovia	50	Tenerife
12	Cantabria	25	León	38	Sevilla	51	Ceuta
13	Castellón	26	Lérida	39	Soria	52	Melilla

Appendix II

The Spanish Regions



Appendix III

Contiguity Matrices

The Spanish Provinces		Adjacent or Neibouring Provinces	
		Levels of Contiguity	
Label	*Name*	*Simple Contiguity*	*Second-Order*
		Province Labels	*Province Labels*
1	Alava	9 21 31 35 45	12 33 37 39 44 47
2	Albacete	3 14 17 19·24 30 43	7 13 15 20 28 29 41 42
3	Alicante	2 30 43	4 13 14 17 19 24 41
4	Almería	19 30	2 3 15 24 29 9 16
5	Asturias	12 25 27	9 16 32 33 34 44 45 46
6	Avila	10 28 36 37 42 44	7 9 14 17 20 25 33 39 46
7	Badajoz	10 14 15 22 38 42	2 6 11 17 24 28 29 36
8	Barcelona	18 26 40	13 23 41 47
9	Burgos	1 12 33 35 37 39 44 45	5 6 20 21 25 28 31 46 47
10	Cáceres	6 7 36 42	14 15 17 22 28 37 38 44 46
11	Cádiz	22 29 38	7 15 19
12	Cantabria	5 9 25 33 45	1 21 27 32 35 37 39 44 46
13	Castellón	40 41 43	2 3 8 17 20 26 47
14	Ciudad Real	2 7 15 17 24 42	3 6 10 19 20 22 28 29 30 38 41 43
15	Córdoba	7 14 19 24 29 38	2 4 10 11 17 22 30 42
16	Coruña, La	27 34	5 25 32
17	Cuenca	2 14 20 28 41 42 43	3 6 7 10 13 15 19 24 30 37 39 40 47
18	Gerona	8 26	23 40 47
19	Granada	2 4 15 24 29 30	3 7 11 14 17 38 43
20	Guadalajara	17 28 37 39 41 47	2 6 9 13 14 23 31 35 40 42 43 44
21	Guipúzcoa	1 31 45	9 12 35 47
22	Huelva	7 11 38	10 14 15 29 42
23	Huesca	26 31 47	1 8 18 20 21 35 39 40 41
24	Jaén	2 14 15 19	3 4 7 17 29 30 38 42 43
25	León	5 12 27 32 33 44 46	6 9 16 34 36 37 45
26	Lérida	8 18 23 40 47	13 20 31 35 39 41
27	Lugo	5 16 25 32 34	12 33 44 46
28	Madrid	6 17 20 37 42	2 9 10 14 36 39 41 43 44 47
29	Málaga	11 15 19 38	2 4 7 14 22 24 30
30	Murcia	2 3 4 19	14 15 17 24 29 43
31	Navarra	1 21 23 35 47	9 20 26 39 40 41 45
32	Orense	25 27 34 46	5 12 16 33 36 44
33	Palencia	9 12 25 44	1 5 6 27 32 35 36 37 39 45 46
34	Pontevedra	16 27 32	5 25 46
35	Rioja, La	1 9 31 39 47	12 20 21 23 33 37 41 44 45
36	Salamanca	6 10 44 46	7 9 25 28 33 37 42
37	Segovia	6 9 20 28 39 44	1 10 12 17 25 33 35 36 41 42 45 46 47
38	Sevilla	7 11 15 22 29	10 14 19 24 42
39	Soria	9 20 35 37 47	1 6 12 17 23 26 28 31 33 40 41 44 45
40	Tarragona	8 13 26 41 47	17 18 20 23 31 39 43
41	Teruel	13 17 20 40 43 47	2 3 8 14 23 26 28 31 35 39 42
42	Toledo	6 7 10 14 17 28	2 15 20 22 24 36 37 38 41 43 44
43	Valencia	2 3 13 17 41	14 19 20 24 28 30 40 42 47
44	Valladolid	6 9 25 33 36 37 46	1 5 10 12 20 27 28 32 35 39 42 45
45	Vizcaya	1 9 12 21	5 25 31 33 35 37 39 44
46	Zamora		

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Summary

This study is focused on the changes in regional inequality in Spain over the last four decades, with emphasis on regional welfare. The two most important items of welfare in Spain are, health and education, and so these are the main focus of this study. Attention is paid to the levels and trends in inter and intra-regional disparities in the welfare components of health, education and housing. The extent to which changes in inequality with respect to welfare relate to changes in regional welfare policy is evaluated. Various methodological issues are explored in the context of measuring welfare inequality between regions. A specific procedure to measure inequality in longitudinal analyses is developed. The study is organised in three parts. The first part includes Chapter 2 and 3, and deals with regional structure and policy to provide a foundation for the analysis. The second part focuses on the methodology developed in this study and the techniques used for that purpose (Chapter 4). The third part includes all the results of the analysis (Chapter 5, 6, and 7) and the conclusion chapter (Chapter 8).

Chapter 2 focuses on the development of the Spanish welfare state and its socio-economic context. A substantial part of the policy changes relating to the welfare system in Spain have resulted from the redefinition of the government's duties following the 1978 Constitution. Since the sixties the Spanish economy has been unstable and there have been important developments such as, the population explosion, and the ageing of the population. This situation has resulted in the need for significant changes in the welfare state as seen in a variety of policy changes.

The devolution of power to the regions and the *regionalisation process* of the welfare state in particular are of major interest in the present study. The regional state in Spain, known as Co*munidades Autónomas,* is a decentralised policy model composed of any of the nineteen Autonomies or admisnistrative regions consisting of one or several provinces (from a total of fifty two). The development of the welfare state in Spain has involved increased autonomy for the regions in welfare issues. The nineteen regions are

responsible for welfare programs relating to basic infrastructure (ports, road networks, etc). But only seven out of the nineteen Spanish regions have gained full autonomy in education and health (the largest expenditure items of the welfare state). So the regionalisation process has not been symmetric among all regions. This situation may have some implications for the inequality between regions. The impact on inequality of the regionalisation of the welfare state is therefore one of the important issue investigated in the present study. In the coming years, regions with high levels of autonomy are likely to contribute greatly to policy making since they will be responsible for modelling the structure of the welfare state.

In Chapter 3, the regional policy of the European Union, and the Spanish regional policy is described in detail. Spain is today one of the leading beneficiaries of the EU's financial assistance for regional development known as the *Structural Funds*. The relevance of the European Union (EU) regional policy in mitigating existing disparities between regions is discussed. The rapid development of mechanisms for the regional support of (economically) weak regions has contributed to a reduction of inequality. The *Compensation Funds* which started in 1978 have played an important role in the regions although the Structural Funds remain more important.

In Part II we discuss the selection of a measure of inequality for our study. The *Theil's Second measure for multidimensional inequality* is selected (Chapter 4). A specific procedure is developed to estimate this measure for longitudinal analyses. We use several indicators to represent each of the welfare components under consideration. This involves defining a composite index of indicators. Inequality in regional welfare is investigated focusing on the following welfare components: health facilities and health status, education facilities and education enrollment and finally, household expenditures and housing conditions. The underlying multidimensionality of the welfare components is thus taken into account. In the present study, Maasoumi's (1986) aggregator function is used to aggregate the indicators. This function enables us to reproduce the maximum amount of information contained in the original indicators. The data used relates to the following years (or periods): 1964, 1974, 1981, and 1991. There are also no studies that have done a longitudinal analysis of welfare inequality. Regional disparities in Spain over time with respect to health and/or education facilities have not been analyzed using an inequality measure. Thus it is not possible to compare inequality results from other literature sources with our results.

For empirical purposes the use of Maasoumi's function requires weights associated with the indicators. Different weights are used for the different indicators. The estimation procedure for these weights developed in the present study is based on the *Partial Common Principal Component model* (PCPC) whenever appropriate or *Principal Component Analysis* (PCA) otherwise. The weights attached to the indicators are the component coefficients of the first component obtained using PCPC (or PCA). PCA has been applied for longitudinal analysis using Theil's second measure for multidimensional inequality (Maasoumi and Jeong, 1985;, Maasoumi and Nickelsburg, 1988; Zandvakili, 1992, 1999). When the periods under consideration share the same first component, the composite index is obtained on the basis of the component coefficients computed using a partial common principal component model. So the component coefficients are not sample-specific because they are the same in all the periods. In other words, the composite indexes for these periods depend on the values of the variables rather than the weights attached to variables. If the hypothesis of one partial common component is not rejected for a number of periods (for first three, and then two periods in this study), the composite index is then constructed on the basis of the maximum likelihood estimates for these periods together with the individual component coefficients for the remaining periods. When a partial principal component model does not fit the data, the composite index is based on individually computed component coefficients. Finally, the overall inequality of the Theil's second measure is computed.

The Theil's second measure is applied in the present study to achieve the following objectives. First, the magnitude and direction of *overall inequality*, *between-region inequality*, and *within-region inequality* is computed with respect to each of the welfare components under study. The wide variations in the geographic and socio-economic structure of the Spanish regions require an in-depth analysis of inequality focusing on intra- and inter-region disparities. In addition, the estimates of the composite indexes for the geographical units (regions) have been used for a *statistical cluster analysis* which identifies the similarities between one group of regions in contrast with another group of (similar) regions. The cluster analysis identifies two groups of high similar values (*most-favored regions*) and low similar values (*least-favored regions*). A picture of the geographical distribution of welfare components is obtained, and changes over time are compared. The inequality results and the results from the cluster analysis form the main findings of our study.

The empirical results with respect to the welfare components are presented in Part III. *Health facilities* and *health status* are studied separately (Chapter 5). A substantial part of Chapter 5 is focused on health facilities. The inclusion of geographical effects (*spatial spillovers*) resulting from the *contiguity* (or geographical proximity) between geographical units forms the major contribution of this study. Spatial spillovers across geographical areas are inevitable since individuals can commute from their own area to contiguous areas when health facilities are not available in the home area. A procedure is developed to incorporate contiguity into the analysis. The geographical units considered for contiguity are provinces which are the smaller territorial divisions of regions.

In the method developed for incorporating contiguity, the level of facilities available in a certain province is considered to consist of the facilities in the own province plus the facilities located in *contiguous provinces* weighted by *spatial weights*. *Spatial weights* used here correspond to the simple inverse distance (optimal distance by road) between the provincial capital of the Spanish provinces and the provincial capital in contiguous provinces. For health facilities and health status the notion of *contiguous provinces* refers to first-order contiguous provinces connected at *the first order of contiguity*. The first order of contiguity describes two provinces that have a common boundary, common vertex or both. The use of this order of contiguity is justified as patients seek a first contact with doctors or specialized treatment and diagnosis at the nearest place to their home province.

The results show improvements in inequality with respect to health facilities are between 1981 and 1991. The sharp drop in inequality coincides with the enactment of the *1986 Health act* (LGS). In addition there is also an important decline in the components of between-region inequality between 1981 and 1991. It is possible that regional policies and the devolution of power in health issues in the mid-eighties may have caused changes in the pattern of regional inequality.

The regionalisation process of the health system may also have had important implications for regions with transferred powers in health issues. In these regions the results reveal that within-region inequality decreases between 1981 and 1991. So it is possible that the regional policies have resulted in a more uniform distribution of health facilities within certain regions. The geographical distribution of facilities obtained using cluster analysis reveals a North-South pattern with facilities located mostly in the North of Spain. The group of most-favoured regions consists of regions with transferred powers, regions which are *central places* like Madrid, and regions with certain socio-economic characteristics. It is suggested, therefore, that the geographical distribution of facilities may be affected by the socio-economic conditions of regions.

The comparison of the contiguity and non-contiguity cases reveals that there are important spatial effects, especially among the regions situated in the North and the Centre of the Iberian Peninsula. Geographical proximity benefits only a few number of regions resulting in a dramatic increase in inequality in the contiguity case. When contiguity is not taken into account, the results for inequality show a very different impact for health policies. Inequality with respect to health status is investigated, but the results obtained are not very satisfactory possibly because of inaccuracies in the data used.

Education facilities and *education enrollment* are studied in Chapter 6. With respect to education facilities, spatial spillovers are also incorporated since education is one of the most common causes of individuals commuting. But contiguity is not often taken into account in the literature on education. For computing available facilities in secondary education, the first order of contiguity is considered. The available facilities for university education consist of facilities located in contiguous provinces at the first order of contiguity plus the *second order of contiguity*, (plus the facilities in Madrid and Barcelona for 1964 and 1974). Here a second order of contiguity is defined as between two contiguous provinces, one of them being first-order contiguous (facilities in provinces adjacent to the neighbouring province).

The results for inequality with respect to education facilities show that inequality has declined between 1974 and 1991. This may be due to the promotion of non-compulsory education. Over the last few decades the Spanish government has pursued a policy intended to distribute university and vocational training facilities more evenly. The increase in the contribution to inequality of between-region inequality between 1981 and 1991 may be due to the impact of regional policies.

Intra-regional disparities are more important in Castilla León, Castilla la Mancha, and Andalucía. All these regions are bound by similar regional characteristics such as limited industry, abundant potential in natural resources, predominance of agriculture and their geographical situation in the Centre and South of the Iberian Peninsula. In addition, these three regions cover 53% of the Iberian Peninsula and 52% of the total land size. Regional authorities in Andalucía are responsible for education powers while there has been no devolution of power in Castilla León and Castilla la Mancha. The socio-economic characteristics of these regions appear to be more influential with respect to inequality than autonomy. The geographical distribution of facilities with respect to education has changed dramatically between the 60s and the 90s. This result from cluster analysis shows that changes in education policies have affected inequality.

Spillover effects have improved the education facilities in the Spanish regions resulting in smaller values of overall inequality in the contiguity case compared to the non-contiguity. Spatial spillovers are observed in the Centre of Spain in 1991 between the region of Aragón and its first or second order neighbours (Madrid, Cataluña and Navarra). Further, the trends in inequality in the contiguity case are more in line with the policy measures than results in the non-contiguity case. So the inclusion of spillovers in the contiguity case seems to be a good approach for the study of inequality.

Education enrollment in the non-compulsory education is also investigated in Chapter 6. The results for overall inequality and the inequality decomposition with respect to enrollment are very similar to those for education facilities. The results suggest that education facilities and education enrollment have been influenced by policy measures and the regionalisation process.

Trends in inequality with respect to household consumption and housing conditions are analysed in Chapter 7. The results suggest that the magnitudes, and the trends for inequality that might be expected with respect to household incomes are similar to those obtained with respect to household expenditures. Inequality in household consumption and housing conditions has narrowed significantly over the last four decades. This is consistent with the changes in the economic situation which occurred during this period.

Finally, Chapter 8 summarises and discusses the main conclusions based on the findings in this study. One of the main conclusions is that the procedure that we develop for the longitudinal analysis of multidimensional inequality in the welfare components is successful and performs satisfactory. In addition, spatial spillovers must be taken into account by using the procedure developed for incorporating contiguity. When contiguity is considered a more accurate picture of inequality is obtained. With respect to the empirical findings in this study, we conclude that firstly, the setting up of the welfare system and the social policies undertaken over the last few decades in education and health have had important consequences for inequality. Secondly, the impact of the regionalisation process on inequality with respect to education and health also appears to be important. New insights with respect to the relationship between welfare policies and the actual changes in welfare inequality may be provided by extending the present analysis.

Samenvatting

Het onderwerp van deze studie is de verandering in regionale ongelijkheid in Spanje gedurende de laatste veertig jaar, waarbij de nadruk op de regionale welvaart ligt. De twee belangrijkste onderdelen van welvaart in Spanje zijn gezondheid en opleiding. Daarop is deze studie dan ook primair gericht. Ingegaan wordt op de niveaus en de trends in de inter- en intra-regionale ongelijkheid in gezondheid, scholing en huisvesting. De mate waarin veranderingen in de welvaartsongelijkheid in verband staan met het regionaal gevoerde beleid wordt geanalyseerd. Verschillende methodologische thema's komen aan bod bij de meting van welvaartsongelijkheid tussen de regio's. Er wordt een specifieke procedure ontwikkeld om welvaartsongelijkheid in een longitudinale analyse te meten. De studie bestaat uit drie delen. Het eerste deel bestaat uit de hoofdstukken 2 en 3 en gaat in op de regionale structuur en het beleid. Het is bedoeld als basis voor de verdere analyse. In het tweede deel staan de ontwikkelde methodologie en de gebruikte technieken centraal (Hoofdstuk 4). Het derde deel bevat alle resultaten van de uitgevoerde analyse (Hoofdstukken 5, 6 en 7) en de conclusie (Hoofdstuk 8).

Hoofdstuk 2 gaat over de ontwikkeling van de Spaanse welvaartsstaat en de sociaal-economische context. Een groot deel van de beleidsveranderingen met betrekking tot de welvaartsstaat vloeien voort uit de herdefiniering van de overheidstaak als gevolg van de Constitutie van 1978. Sinds de zestiger jaren is de Spaanse economie in beweging en zijn er belangrijke ontwikkelingen geweest, zoals een explosie van de bevolkingsgroei en de vergrijzing van de bevolking. Deze ontwikkelingen vragen om duidelijke aanpassingen in de welvaartsstaat, zoals deze ook tot uitdrukking komen in een scala van beleidsveranderingen. De verschuiving van de macht naar de regio's en in het bijzonder de regionalisering van de welvaartsstaat zijn de belangrijkste aandachtspunten in deze studie. De regionale staatsstructuur in Spanje staat bekend onder de naam *Communidades Autonomas*. Het is een gedecentraliseerde beleidsstructuur die bestaat uit negentien *Autonomies* ofwel zelfstandige administratieve regio's. Ze bestaan elk uit een of meerdere provincies (waarvan er 52 zijn). De ontwikkeling van de welvaartsstaat heeft tot een sterke autonomie voor de regio's geleid als het gaat om de vormgeving van de welvaartsstaat. De negentien regio's zijn verantwoordelijk voor voorzieningen zoals de basisinfrastructuur (havens, wegen, enzv.) Slechts zeven van de negentien 'provincies' hebben volledige autonomie op het terrein van het onderwijs en de gezondheidszorg (de terreinen met het grootste aandeel in de totale uitgaven voor de welvaartsstaat). Het regionalisatieproces verloopt dus niet symmetrisch over de regio's. Dit kan gevolgen hebben voor de regionale ongelijkheid. Het effect van ongelijkheid op de regionalisering van de welvaartsstaat is daarom een van de belangrijke zaken die in deze studie zijn onderzocht. In de komende jaren mag worden verwacht dat de regio's met relatief veel autonomie een sterke bijdrage aan het beleidsproces zullen geven. Ze zijn immers verantwoordelijk voor de vormgeving van de structuur van de welvaartsstaat.

Hoofdstuk 3 geeft een gedetailleerde beschrijving van het regionale beleid, zowel van dat van de Europese Unie (EU) als van Spanje zelf. Spanje is op dit moment een van de landen die het meeste profiteert van het regionale beleid van de EU, zoals dat vorm krijgt door middel van de zogenaamde structuurfondsen. Het belang van het Europse regionale beleid om de regionale dispariteiten terug te dringen wordt besproken. De snelle ontwikkeling van regionale steun voor de (economsich) zwakke regio's heeft bijgedragen aan vermindering van de ongelijkheid. De Compensatiefondsen die in 1978 zijn ingesteld spelen een belangrijke rol in de regio's, hoewel de Structuurfondsen nog steeds dominant zijn.

In deel II wordt de keuze voorde ongelijkheidsmaatstaf die in deze studie wordt gebruikt gemotiveerd. Uiteindelijk wordt Theils *Second measure of multidimensional inequality* gekozen (Hoofdstuk 4). Er wordt een speciale procedure ontworpen om deze maatstaf te schatten voor een longitudinale analyse. We gebruiken verschillende indicatoren om de onderscheiden welvaartsaspecten te meten. Dit impliceert dat uiteindelijk een samengestelde index van indicatoren nodig is. Regionale ongelijkheid wordt onderzocht op de volgende punten: gezondheidszorg, gezondheidsstatus, opleidingsfaciliteiten en consumentenbestedingen en huisvestingsvoorzieningen. Er wordt rekening gehouden met de onderliggende multi-dimensionaliteit van de welvaartscomponenten. In deze studie wordt Maasoumi's (1986) aggregator functie gebruikt om de indicatoren op een noemer te brengen. Deze functie maakt het mogelijk om de maximale hoeveelheid informatie uit de afzonderlijke indicatoren tot uitdrukking te brengen. De gebruikte gegevens hebben betrekking op de jaren 1964, 1974, 1981 en 1991. Er zijn geen andere studies waarin een dergelijke longitudinale analyse van de welvaartsongelijkheid is uitgevoerd. De regionale verschillen met betrekking tot gezondsheidszorg en opleidingsfaciliteiten zijn nog nooit geanalyseerd met behulp van een ongelijkheidsmaatstaf. Het is daarom niet mogelijk om de gevonden resultaten met andere studies te vergelijken.

Voor een empirische toepassing is het nodig dat er gewichten voor de verschillende indicatoren in Maasoumi's functie worden gespecificeerd. Er worden verschillende gewichten voor verschillende indicatoren gebruikt. De schattingsprocedure voor deze gewichten is, voorzover deze geschikt was, gebaseerd op het Partial Common Principal Components model (PCPC). In het andere geval is de Principal Components analyse (PCA) gebruikt. De gewichten die aan de indicatoren worden toegekend zijn de componentcoefficiënten voor de eerste hoofdcomponent die met de PCPC (of PCA) is verkregen. PCA is eerder op een longitudinale data-analyse toegepast (Maasouni en Jeoung, 1985; Maasoumi en Nickelsburg, 1987 en Zandvakili, 1992, 1999). Als de geanalyseerde perioden dezelfde eerste component hadden, is de samengestelde index gebaseerd op de berekende component-coefficiënten door een PCPC model te gebruiken. De component-coefficiënten zijn dus niet jaar-specifiek omdat ze hetzelfde zijn voor alle perioden. Met andere woorden, de uitkomsten van de samengestelde index hangen primair af van de waarden van de variabelen en niet van de gewichten die aan deze variabelen worden toegekend. Als voor een aantal perioden de hypothese van een principale component niet wordt verworpen wordt de samengestelde index geconstrueerd op basis van de maximum likelihood schattingen voor een beperkter aantal perioden (waarvoor de hypothese wel op gaat) en met de individuele component-coefficiënten voor de overige perioden. Als het PCPC model niet spoort met de data, wordt de samengestelde index gebaseerd op de individueel berekende component-coefficiënten. Uiteindelijk wordt de algehele ongelijkheid berekend met behulp van Theils second measure.

De maatstaf van Theil wordt in deze studie toegepast met de volgende oogmerken: Allereerst wordt de grote en de richting van de algehele ongelijkheid, zowel tussen regio's alsook binnen regio's, berekend voor elk van de onderscheiden componenten. De grote variatie in de geografische en sociaal-economische structuur van de Spaanse regio's vereist een diepteanalyse van de ongelijkheid op basis van intra- en interregionale dispariteiten. Daarnaast zijn de geschatte samengestelde indexen voorde geografische eenheden (regio's) gebruikt voor een statistische clusteranalyse. Met de clusteranalyse kunnen de overeenkomsten van een groep regio's ten opzichte van een andere groep regio's worden onderscheiden. De clusteranalyse onderscheidde twee groepen van regio's, die met overeenkomstige hoge waarden (*most favoured* regio's) en die met overeenkomstig lage waarden (*least favoured* regio's). Er is een kaart gemaakt met de geografische verdeling van de welvaartscomponenten en ook de ontwikkeling in de tijd is geanalyseerd. De gemeten ongelijkheid en de clusteranalyse vormen de belangrijkste resultaten van deze studie.

De empirische resultaten met betrekking tot de welvaartscomponenten worden gepresenteerd in deel III. Gezondheidszorg en gezondheidsstatus worden afzonderlijk geanalyseerd (Hoofdstuk 5) Een groot deel van Hoofdstuk 5 gaat in op de faciliteiten van de gezondheidszorg. Een van de belangrijkste bijdragen van deze studie is dat geografische effecten (ruimtelijke spillovers), voortvloeiend uit de contiguiteit (geografische nabijheid) van regio's in de analyse wordt meegenomen. Ruimtelijke spillovers zijn onvermijdelijk omdat als bepaalde medische voorzieningen niet in de eigen regio aanwezig zijn, individuen zich bewegen van hun eigen gebied naar een naburige regio. Er is een methode ontwikkeld om contiguiteit in de analyse mee te nemen. De geografische eenheden voor contiguiteit zijn de provincies, die de kleinere territoriale eenheden binnen de regio's vormen.

In de ontwikkelde methode om rekening te houden met contiguiteit wordt het niveau van de voorzieningen in een bepaalde regio beschouwd als zijnde de voorzieningen in de eigen regio plus de voorzieningen in aangrenzende provincies. De laatste worden gewogen met ruimtelijke gewichten. De ruimtelijke gewichten komen overeen met de reciproke van de afstand (optimale afstand over de weg) tussen de hoofdstad van de provincie en die van de naburige provincies. Het concept van contiguiteit voor de gezondheidszorgfaciliteiten en de gezondheidsstatus verwijst naar de eerste orde contigue provincies. De eerste orde contiguiteit beschrijft twee provincies die een gemeenschappelijke grens hebben of elkaar op een punt raken. Uitgaan van eerste orde contiguiteit is in dit geval gerechtvaardigd omdat patienten allereerst contact zullen zoeken met artsen of specialistische behandeling in de dichtsbijzinde plaats (gezien vanuit de eigen provincie).

De resultaten laten zien dat er in de periode tussen 1981 en 1991 een afname in de ongelijkheid met betrekking tot faciliteiten voor de gezondheidszorg heeft plaatsgevonden. Deze sterke afname valt samen met het van kracht worden van de Gezondheidswet uit 1986

(LGS). Daarnaast is er ook een sterke daling van de ongelijkheid in de componenten van de interregionale ongelijkheid tussen 1981 en 1991. Het is mogelijk dat het regionale beleid en de decentralisatie van de beslissingsbevoegdheid met betrekking tot gezondheidsissues de veranderingen in het patroon van regionale ongelijkheid hebben veroorzaakt.

Het regionalisatieproces van de gezondheidszorg kan ook belangrijke implicaties hebben gehad voor de regio's die een sterke mate van autonomie op het terrein van de gezondheidszorg hebben. De resultaten wijzen uit dat in deze regio's in de periode 1981-1991 de ongelijkheid binnen regio's is afgenomen. Het is daarom goed mogelijk dat het regionale beleid aan een uniformere verdeling van gezondheidszorgfaciliteiten binnen bepaalde regio's heeft bijgedragen. Uit de cluster analyse blijkt dat de geografische verdeling van faciliteiten een Noord-Zuid patroon laat zien, waarbij de faciliteiten overwegend in Noord-Spanje liggen. De groep van *most favoured* regio's bestaat uit regio's waaraan beslissingsbevoegdheid is overgedragen, waaronder regio's met centrale lokaties zoals Madrid en regio's met bepaalde sociaal-economische karakteristieken. Dit laatste suggereert dat de geografische verdeling van faciliteiten kan zijn beinvloed door de sociaal-economsiche condities van de regio's.

Vergelijking van contigue met niet-contigue gevallen laat zien dat er sprake is van belangrijke ruimtelijke effecten. Dit geldt in het bijzonder voor het noorden, het centrum en het Iberisch schiereiland. Geografische nabijheid blijkt slechts voor een beperkt aantal regio's gunstig. Als rekening wordt gehouden met contiguiteit blijkt er sprake van een dramatische toename in de ongelijkheid. Als geen rekening met contiguiteit wordt gehouden, laten de resultaten een heel ander effect van het beleid met betrekking tot de gezondheidszorg zien. Ook de ongelijkheid met betrekking tot de status van de gezondheid is onderzocht. De verkregen resultaten op dat punt zijn niet erg bevredigend, wat samenhangt met de slechte kwaliteit van de gebruikte data die de gezondheidstoestand moesten representeren.

Scholingsfaciliteiten en scholingsparticipatie worden geanalyseerd in Hoofdstuk 6. Ook met betrekking tot de scholingsfaciliteiten zijn de ruimtelijke spillover effecten meegenomen in de analyse. Scholing is immers een van de meest voorkomende oorzaken voor het pendelen tussen regio's. Met contiguiteit wordt echter in de literatuur over onderwijs niet vaak rekening gehouden. Bij de analyse van de beschikbaarheid van de beschikbare faciliteiten voor het voortgezet onderwijs wordt rekening gehouden met eerste orde contiguiteit. De beschikbare accademische opleidingsmogelijkheden worden bepaald door de faciliteiten in de eerste en de tweede orde contigue regio's te sommeren (en voor 1964 de faciliteiten in Madrid en Barcelona). Contiguiteit van de tweede orde wordt hier gedefinieerd als contiguiteit tussen twee provincies, waarvan een contigue van de eerste orde is met de betrokken provincie.

De resultaten met betrekking tot de ongelijkheid in opleidingsfaciliteiten laten zien dat de ongelijkheid over de periode 1974 en 1991 is afgenomen. Dit kan mede een gevolg zijn van de stimulering van niet-verplichte scholing. Over de laatste twintig a dertig jaar heeft de Spaanse overheid een beleid gevoerd om de universiteiten en beroepsopleidingen meer gelijkmatig over de regio's te verdelen. Het toenemend gewicht van regionale ongelijkheid als verklarende factor achter de ongelijkheid tussen 1981 en 1991 kan het gevolg zijn van regionaal beleid.

Intra-regionale verschillen blijken belangrijk in Castilla León, Castilla la Mancha en Andalusie. Deze regio's hebben dezelfde karakteristieken, zoals beperkte omvang van industriële activiteit, overvloedig potentieel in natuurlijke bronnen, belangrijk agrarisch karakter en overeenkomstige geografische ligging in het centrum en het zuiden van het Iberisch schiereiland. Deze drie regio's beslaan 53% van het Iberisch schiereiland en 52% van het totale land. In Andalusie is de regionale overheid verantwoordelijk voor de vormgeving van het onderwijs, terwijl er geen sprake is van decentralisatie op het terrein van het onderwijs voor Castilla León en Castilla Mancha. De sociaal-economische karakteristieken van deze regio's blijken belangrijker te zijn dan de mate van beleidsautonomie. De geografische spreiding van opleidingsfaciliteiten heeft zich dramatisch gewijzigd in de periode van de zestiger tot en met de negentiger jaren. De resultaten uit de clusteranalyse laten zien dat veranderingen in het onderwijsbeleid de ongelijkheid hebben beinvloed.

Wanneer we de case waarin wel rekening wordt gehouden met contiguiteit vergelijken met de case waarin daar geen rekening mee wordt gehouden, valt op dat spillover effecten de beschikbaarheid van opleidingsfaciliteiten in de Spaanse regio's hebben versterkt en zo bijdragen aan lagere waarden voor algehele ongelijkheid. Ruimtelijk spillover effecten spelen een rol in het centrum van Spanje tussen de regio Aragón en de eerste of tweede orde contigue regio's (Madrid, Cataluña en Navarra).

Trends in de ongelijkheid met betrekking tot de bestedingen van huishoudens en de huisvestingsvoorzieningen worden geanalyseerd in Hoofdstuk 7. De resultaten suggereren dat de omvang en de trends die mogen worden verwacht met betrekking tot de inkomens van de huishoudens overeenkomen met de bestedingen van de huishoudens. De ongelijkheid in de consumptieve bestedingen van huishoudens en de huisvestingsvoorzieningen is significant afgenomen over de laatste veertig jaar. Dit spoort met de veranderingen in de economische situatie die in deze periode plaatsvonden.

In Hoofdstuk 8 worden tenslotte de resultaten besproken en samengevat. Een van de belangrijkste conclusies is dat de procedure die we hebben ontwikkeld voor de longitudinale analyse van meerdimensionale ongelijkheid in welvaartscomponenten succesvol blijkt en goed blijkt te werken. Daarnaast is het van belang om ruimtelijke spillover effecten in de analyse mee te nemen door rekening te houden met contiguiteit. Het in beschouwing nemen van de contiguiteit geeft een beter beeld van de ongelijkheid. Wat de empirische resultaten betreft concluderen we in de eerste plaats dat het ontwikkelen van de verzorgingsstaat en het gevoerde sociale beleid belangrijke gevolgen hebben gehad voor de mate van ongelijkheid. In de tweede plaats blijkt ook het regionalisatieproces met betrekking tot gezondheid en opleiding een belangrijke impact op de ongelijkheid te hebben. Verder onderzoek kan helpen om nieuwe inzichten in de relatie tussen welvaartsbeleid en werkelijke veranderingen in welvaartsongelijkheid aan het licht te brengen.

Curriculum Vitae

Lucia Quadrado Mercadal was born in Maó (Menorca), Spain in 1970. In 1993 she obtained a university degree in Economics and Business at the University of Barcelona (Spain). In 1994 she joined the department of Statistics, Econometrics and Spanish Economy at the University of Barcelona. As a researcher, she participated in several research projects. In 1995 she initiated her Ph.D studies at the University of Barcelona focusing on issues such as regional economics, statistics and econometrics. In 1997 she got a position as a teacher assistant at the University of Barcelona. Since 1998 she developed her research in the department of General Economics at the Wageningen University in the Netherlands.