Socioeconomic Determinants of Health

PhD Thesis

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A la meva família

A mon amour

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

The aim of this thesis is to contribute to the understanding of the effect of socioeconomic variables on individual's health, in order to help policy makers to design proper health enhancing policies. Although this topic has been already analysed, this thesis focuses on important aspects that still need to be solved. On one hand, it studies the association between health and one of its most controversial socioeconomic determinants, which is income distribution. And on the other hand, it proposes new methodological and econometric approaches to improve health modeling.

First, **Chapter 2** summarises the initial hypotheses and the main mechanisms connecting income distribution and health. Although it has been proved that income has a protective effect, there is still controversy regarding the association between income disparities and health. Initial theoretical models claim that individuals living in more unequal societies might have worse health. However, previous empirical evidence has not been able to confirm this hypothesis. This fact rises some unsolved questions:

1. Are traditional income inequality measures appropriate to proxy the mechanisms connecting income distribution and health?

2. Which is the relevant reference group to measure income disparities?

3. Do income disparities have a direct impact on health? Or only an indirect effect through omitted variables?, etc...

Chapter 3 and Chapter 4 aim at answering these questions to disentangle whether (and how) income distribution affects health.

Thus, **Chapter 3** explores the relationship between *"Polarisation and Health"*. I argue that income polarisation captures much better the social tension and conflict that underlie some of the pathways linking income distribution and individual health, and which have been traditionally proxied by inequality. Thus, the main contribution of this chapter is to show the empirical relevance of polarisation in explaining individual health status measured by means of self-assessed health.

This premise is tested with panel data using the Spanish component of the European Community Household Panel survey (ECHP) for the period 1994-2001. As for the econometric strategy, I use a method due to Ferrer-i-Carbonell and Frijters (2004), which allows taking full advantage of the time-varying and time-invariant information available in a longitudinal study when modeling an ordinal outcome.

Furthermore, besides defining polarisation between regions, the study introduces polarisation between reference groups. That is, the relevant comparison group may not be the region but individuals with similar characteristics. In this case polarisation is only relevant between reference groups and not between regions. Thus, these results challenge what has been traditionally assumed in the literature, i.e. that it is regions that matters.

Chapter 4 revises the relationship between *"Relative Income and Health"*. Relative concerns have been found to be important for individual health. However, the literature has so far looked solely at upward income comparisons, disregarding the effects of comparisons with worse-off individuals. In this chapter, I use a broad definition of relative income to test simultaneously for the effect of "upward" and "downward" income comparisons on health. Relative deprivation and relative satisfaction indexes are used to capture the complexity of income comparisons, summarising upward and downward comparisons.

In this case the dataset used is the German Socio-Economic Panel data (SOEP) for the period 1994-2010. One of the main advantage of this survey is that includes *quasi-objective health measures*. Although self-assessed health has been proved to be a valid measure of health, I reestimate the model using the quasi-objective health measures to test the robustness of the results, focusing on the mental and physical dimension of health.

Regarding the econometric strategy, panel data models are considered to correct for income endogeneity bias due to omitted variables.

Chapter 5 is titled *"State Dependence in Self-assessed Health"* and contributes to health modeling when studying its socioeconomic determinants. This chapter analyses the importance of the contribution of state dependence to the explanation of self-assessed health dynamics in Spain. At the measurement level, accounting for state dependence will correct the possible overestimation of the socioeconomic factors. With this objective in mind, a series of econometric models are estimated including a new proposal for a Heckman selection model with an initial conditions equation run as an ordered probit. Again, the dataset used is the Spanish component of the European Community Household Panel (ECHP) for the period 1994-2001.

Finally, **Chapter 6** concludes with a brief summary of the last three chapters main findings, some final remarks and future extensions of my research agenda.

Chapter 2

Background: Income, Income distribution and Health

2.1 Introduction

The aim of this chapter is to point out the relevance of the study of the relationship between income disparities and health. With this objective in mind, the second section describes briefly the background of this association, focusing on the mechanisms and the initial hypotheses relating both variables. The third section summarizes previous empirical evidence highlighting the discrepancies in the results between studies. And finally, the conclusion posits the main unsolved questions which will be analysed in the following chapters.

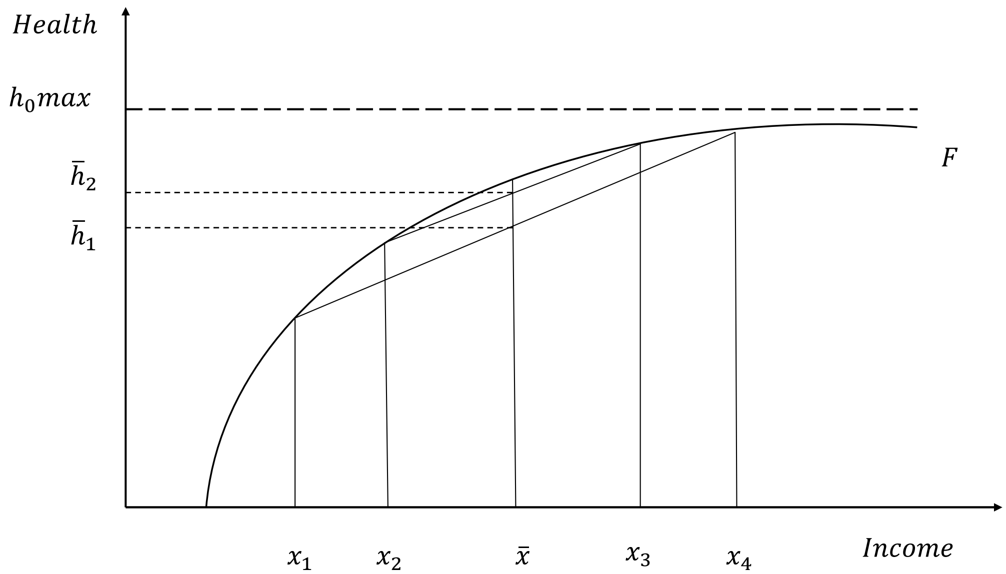
2.2 Income, Income disparities and Health

One of the first socioeconomic factors to catch the attention of economist was income. An increase in income is expected to have a positive effect on health, this is known as the *Absolute Income Hypothesis*.

Preston (1975) and Rodgers (1979) document such positive relationship by analysing life expectancy and per capita income for several countries. They note that this association flattens out when income rises, so that life expectancy stops rising in response to higher levels of national income. As a matter of fact, an increase in income per head raises life expectancy in developing countries, being this increase very low or absent among the richest ones. In front of this evidence, they suggest that income might not be the only determinant of health, and income distribution within countries may be also relevant. Rodgers (1979) uses Figure 2.1 to illustrate that income disparities affects individuals' health independently of their absolute level of income.

F is the function showing the non-linear relationship between income and health — measured by means of life expectancy. $h_0 max$ is the individual's maximum health level

Figure 2.1: Non-linear relationship between income and health



Source: Rodgers 1979

which can not be improved by income. This figure plots two different countries with the same mean income, $\overline{x}$, but with different income distribution. The first country has two individuals with income values, x_1 and x_4. Concurrently, the second country has two individuals with incomes x_2 and x_3. Figure 2.1 shows how average health is higher in the country with lower income disparities, $\overline{h}_2 \succ \overline{h}_1$, independently of having the same average income.

In the literature different mechanisms are proposed to describe how income disparities might operate on individual health (Wilkinson, 1996; Subramanian and Kawachi). Hildebrand and Van Kerm (2009) summarize them in three possible pathways: First, *structural pathways* which relate poorer health to spatial concentration and residential segregation due to income disparities. Second, *policy pathways* state that income inequality affects health via an influence on the implementation of particular social and health related policies (Osberg, Smeeding, and Schwabish, 2006). And finally, the *social cohesion and collective social pathways* posit that inequality affects health by weakening social cohesion and holding back the formation of social capital beneficial to health (Kawachi, Kennedy, and Lochner, 1997). This is usually labeled the *Income Inequality Hypothesis* (IIH) (Wagstaff and Van Doorslaer, 2000). This hypothesis considers that income inequality captures the mechanisms described above, and it may show a negative effect on health.

More on detail, all these channels might contribute to the inequality of opportunities to access health enhancing goods such as health services, environmental controls, availability of food, and quality housing, and obviously health will be negatively affected.

At the same time they might generate *psychosocial stress*. It has been already proved by psychosomatic medicine that stress derived of psychosocial causes attack the immunological system. A psychosomatic disease is defined as a physical illness believed to be caused by psychosocial factors, such as recent or early life events, personality, psychological well-being and chronic or daily stress. This medical discipline claims that psychosocial well-being helps to the immunological, endocrine and cardiovascular systems. For example, it plays an important role in coping with stress in transplant treatments. Moreover, it has a favorable impact on a disease course, implying a longer survival time (Sapolsky, 1994; Fava and Sonino, 2000).

Psychosocial stress might also be related to more health compromising behaviour. Individuals suffering from stress might eat and drink alcohol in excess, smoke more or even sleep less. Again, this might threaten individuals' health (Eibner and Evans, 2005).

Finally, other authors argue that an individual's health might also be affected by other's income, rather than by absolute income. This is known as the *Relative Income Hypothesis* (RIH) (Wagstaff and Van Doorslaer, 2000).

Deaton (2003) suggests that social status is important in determining how much control individuals have over their own life and over their level of participation in society. In this case the difficulty to access to health enhancing goods and the *psychosocial stress* might be due to relative income (Wilkinson, 2000; Deaton, 2003;Marmot, 2004; Theodossiou and Zangelidis, 2009; Subramanyam, Kawachi, Berkman, and Subramanian, 2009).

All the arguments above have direct public policy implications. If income disparities have a detrimental effect on health, income redistribution might be an individual health enhancing policy. For example, focusing again on Figure 2.1, if the first country enforces a redistribution policy redistributing income from individual 4 to individual 1, resulting in the same income distribution as in the second country, then population health will increase from $\overline{h}_1$ to $\overline{h}_2$.

There have been many attempts to test empirically the hypotheses above. In the next section, I review the most relevant empirical evidence regarding the association between income, income distribution and health.

2.3 Empirical Evidence

Initially, the previous hypotheses were analysed using aggregate measures (Waldmann, 1992; Wilkinson, 1992; Judge, 1995; Cantarero and Pascual, 2005). However, one of the most important criticisms to these initial studies was concerned with the use of aggregate data to analyse individual variables such as health. Therefore in order to avoid what it has been called the *Ecological Fallacy*, individual data studies became the principal focus (Judge, 1995; Gravelle, 1998).[1].

The empirical evidence supports the hypothesis that income has a protective effect on health. This result is quite robust across countries and using different econometric specifications (Ettner, 1996; Jones and Wildman, 2008). However, previous findings suggest that the *Absolute Income Hypothesis* might not be sufficient to explain the relationship between income inequality and health (Karlsson, Nilsson, Hampus, and Leeson, 2010).

The *Income Inequality Hypothesis* has traditionally been tested by including the Gini coefficient, or some other measures of income inequality. Nevertheless, the evidence from such research based on individual-level data is mixed, and there is no consensus in the literature regarding the validity of this hypothesis (Wilkinson and Pickett, 2006; Karlsson, Nilsson, Hampus, and Leeson, 2010). On the one hand, some studies report evidence of a negative effect of income inequality on a variety of health indicators: Fiscella and Franks (2000) and Subramanian and Kawachi (2004) using United States data, Osler, Prescott, Grø nbæk, Christensen, Due, and Engholm (2002) for Denmark and Li and Zhu (2006) for China. On the other hand, there are also many studies which contradict the *Income Inequality Hypothesis*: Mellor and Milyo (2001) for United States, Feng and Myles (2005) for Canada and Gerdtham and Johannesson (2004), Craig (2005) and Lorgelly and Lindley (2008) for European Countries.

The effect of relative income on health is also controversial. While some studies find a negative effect of relative income, in others it is not significant, or even positive (Eibner

[1]However, Wilkinson and Pickett (2006) claim that many studies failed to capture the effect of income inequality on health because they measured inequality in areas too small to reflect the scale of social class differences in a society. Therefore, they suggest that this relationship might be analysed using population data.

and Evans, 2005; Miller and Paxson, 2006; Theodossiou and Zangelidis, 2009).

Finally, there have been also attempts to disentangle between the three hypotheses. Hildebrand and Van Kerm (2009) using data from the European Household Panel find evidence of the positive effect of income and the negative effect of income inequality on health. However, in many cases the impact of income inequality disappears after controlling for relative income (Deaton, 2001; Gravelle and Sutton, 2009). Again, there are not conclusive results regarding which of the three hypotheses is more relevant for health.

2.4 Concluding Remarks

After summarizing previous studies the main conclusion is that empirical studies have not been able to confirm the initial hypotheses regarding the relationship between income, income distribution and health.

The ambiguity in previous results might be due to the heterogeneity in the methods used to test empirically these initial hypotheses such as different units of aggregation, different health measures, different econometric strategies and so on. However, I believe that results disparities might be also a consequence of the misunderstanding of the real pathways linking income inequality and relative income with health. Therefore, in the next chapters I suggest new approaches to revise the Income Inequality and the Relative Income hypotheses to disentangle the association between income, income distribution and health.

Chapter 3

Polarisation and Health

3.1 Introduction

In this chapter I examine,[1] for first time, the relationship between income polarisation and individual health. As it was summarized in the previous chapter, some social factors which are known to determine health operate through the social tension and conflict that they generate. Two are especially relevant: the psychosocial stress which results from strategies of dominance and conflict that govern many social structures in modern industrialised societies, and the lower provision of public goods and redistributive policies due to the tension and disagreement between groups with conflictive interests. Since polarisation is the concept that is most closely related to social tension and conflict (Esteban and Ray, 1994), I want to test empirically whether polarisation has a negative effect on individuals' health.

The novelty of the study, then, is introducing polarisation in the extensive literature that relates distributive issues with health, and showing its empirical relevance to understand how income disparities might affect health.

The empirical strategy uses panel data from Spain and employs a recently developed econometric method due to Ferrer-i-Carbonell and Frijters (2004), which allows taking full advantage of the time-varying an time-invariant information available in a longitudinal study when modeling an ordinal outcome.

The findings provide empirical support to the main hypothesis: that is, income polarisation affects individual health in a negative way. Polarisation takes places between groups, and I also find that the way the relevant population subgroups are defined is important: polarisation is only significant if measured between education-age groups for each region, but is not significant between regions. This result is important and rather new, since the

[1] This chapter is joined work with Xavi Ramos and it is published in the Review of Income and Wealth (2010).

empirical literature has mostly focused on income disparities between regions, and has neglected other population subgroups that I find relevant. The results are obtained conditional on a comprehensive set of controls, including absolute and relative income, and subjective poverty.

The chapter is structured as follows. Section 3.2 puts forth the theoretical grounds that explain a negative relationship between income polarisation and individual health, and clarifies the differences between polarisation and inequality. Section 3.3 describes the data and defines the key variables, while Section 3.4 presents the empirical model and outlines the estimation procedure. Section 3.5 presents the main empirical findings and Section 3.6 shows that results are robust to changes in the polarisation measure and to the inclusion of subjective poverty in the analysis. Finally, Section 3.7 provides some concluding remarks.

3.2 Polarisation and Health

3.2.1 Why income polarisation?

I argue that income polarisation affects individual health in at least two ways. First, psychosocial stress, related to strategies of dominance, conflict and submission, and prevalent in most industrialised societies, have adverse consequences on health (Wilkinson, 1996, Wilkinson, 1997; Wilkinson, 1998). My premise is that income polarisation captures the conflict that underlies psychosocial stress, and thus shows a negative relation with individual health.

The second pathway is related to the long standing argument in the political economy literature that income disparities increase disagreement and tension between groups with conflictive interests on the provision of public goods, such as health, education or police. Such conflict of interests is likely to reduce the provision of public goods and redistributive policies –see Osberg, Smeeding, and Schwabish (2006) for a review of the literature.[2] Income disparities may also discourage political participation of poorer individuals relative to better-off citizens, which undermines the political voice of worse-off individuals, and endangers the responsiveness of government to the popular majority and not the elite minority. There is some evidence that supports this view. For instance, Garand and Nguyen (2007) find that in US counties with larger income disparities, "vote turnout tends to be lower in general and especially for disadvantaged people, relative to high-income citizens" (p. 4), while Jacobs and Skocpol (2005) argue that "our governing institutions are much more responsive to the privileged and well-organized narrow interests than to other Americans" (p. 9).

Hence, I hypothesise that greater polarisation leads to lower provision of public goods. This premise is in line with recent findings on the (negative) relation between (ethnic) polarisation and the share of public spending on public goods (Alesina, Baqir, and Easterly, 1999). In so far as these public goods contribute to individual health, polarisation may be seen as a health hazard. However, there is some evidence that indicates that access to medical services does not have large effects on health, especially in adulthood (Adler, Boyce, Chesney, Cohen, Folkman, and Leonard Syme, 1994; House and Williams, 1995). If this was the case, I would expect no effect of polarisation on individual health, at least through this channel.

Traditionally, the two mechanisms outlined above, despite being related to conflict, have never been linked to the notion of polarisation, but to the concept of inequality. As it has been explained in chapter two, the relationship between inequality and health has attracted

[2]However, if increased income disparities imply a poorer median voter, the outcome might be the opposite, since she will favour more social (and especially redistributive) spending (Meltzer and Richard, 1981; Meltzer and Richard, 1983).

much attention from different disciplines -see Kawachi, Kennedy, and Wilkinson (1999) for a nice collection of papers on the topic.

Deaton (2003), who argues that there is no direct link between inequality and health, recognises that psychosocial stress is one of the plausible ways through which inequality may relate to health. Indeed Wilkinson (2000) relates inequality to the "stressful strategies of dominance and conflict", which may result in psychosocial stress and deteriorate individual health. Inequality, but also segregation, has been traditionally deemed relevant for the provision of public goods (Meltzer and Richard, 1981; Meltzer and Richard, 1983), although the evidence is mixed: while Lindert (1996) and Moene and Wallerstein (2002) find that inequality across countries is associated with lower public spending, Milanovic (2000) finds the opposite.

In this chapter I argue that it is inequality between relevant population subgroups, i.e. alienation, and not simply overall population inequality, which sharpens the differences in collective preferences and leads to disagreement and conflict on the provision of public goods. Of course, the more homogeneous the groups the sharper the differences in preference. I argue that it is polarisation, a notion which is conceptually close to segregation, and not inequality, which should correlate with health. In sum, what is indeed novel in my approach is the focus on conflict, which is brought about by a polarised situation, rather than by a simply unequal one.

Since inequality has been extensively used in the literature to approximate different pathways, it will also be included in the empirical work. One of the major channels through which inequality might still be relevant for individual health is social capital. Income inequality is a determinant of social capital (Milanovic, 1997; Kawachi, Kennedy, and Lochner, 1997; Alesina and La Ferrara, 2000), which in turn is supposed to have a positive effect on individual health (Mellor and Milyo, 2005). Social capital -defined as the features of social organization, such as civic participation, norms of reciprocity and trust in others- facilitate cooperation for mutual benefit (Putnam, 1993; Glaeser, Laibson, and Sacerdote, 2002), and generate both psychological (trust and emotional support) and tangible benefits (better access to information, increased civic and community participation or more taste for redistributive and collective goods). In so far as inequality is a good proxy for social capital, it is likely to have a negative effect on health. In the empirical analysis, I use club membership and whether speaking often with neighbours as control variables. Nonetheless, since these are rather crude and incomplete indicators of social capital -albeit widely used-, inequality may still exert a significant effect on individual health.

3.2.2 Income polarisation

Polarisation is best understood as the result of two features: alienation and identification (Esteban and Ray, 1994). In societies where groups or communities are far apart from each other, they are likely to have different collective preferences and pursue different goals and interests. Such distance will give rise to a feeling of alienation, which may lead to the lack of understanding of and tolerance for other population groups. Such alienation brings about tension and social and political conflict. Additionally, as groups are internally more homogeneous, because the relevant characteristics of their members are more similar, their members identify more closely with the group, and thus are likely to have a larger feeling of belonging to their group or community, which in turn may also increase the social and political conflict. In sum, the larger the inter-group heterogeneity -alienation- and the intra-group homogeneity -identification-, the larger the polarisation.

Polarisation is fundamentally different from inequality. The early contributors to this literature thoroughly and persuasively explain the distributive differences between polarisation and inequality.[3] Knack and Keefer (1994) shows how polarisation, but not inequality, captures the disappearance of the middle class, and Esteban and Ray (1994) devote large part of their paper to illustrate the distributive features that clearly distinguish polarisation from inequality. Perhaps the most important of those is that polarisation may not be consistent with the principle of transfers, which is a fundamental property in inequality measurement. Suppose a two-group society with intra-group disparities. Rich to poor transfers, consistent with the principle of transfers, will certainly reduce measured inequality but will increase polarisation, as they increase identification. A second distinctive feature of polarisation is that it is "global" in nature, in a way that inequality measures are not" (p. 826). That is, to make polarisation comparisons one has to consider the whole distribution. However, inequality measurement may be "local", and the principle of transfers is a good example since it only looks at two incomes to make inequality comparisons. Nonetheless, the most relevant difference between polarisation and inequality is that polarisation, and not inequality, may bring about social tension and social and political conflict.

3.3 Data and variables description

I employ Spanish data from the European Community Household Panel survey (ECHP), a standardized multi-purpose annual longitudinal survey providing comparable micro-data about living conditions in the European Union Member States. I consider the eight waves (1994-2001) of the Spanish sample of the ECHP. As suggested by Cowell and Victoria-

[3]Notwithstanding this, recent and influential contributions still confound the two concepts or proxy polarisation with some inequality measure. Knack and Keefer (1997), for instance, purport to measure polarisation with an inequality index, and Alesina, Baqir, and Easterly (1999) study the relationship between ethnic polarisation and the provision of public goods, and argue that if polarisation of preferences is a function of income -rather than ethnic- polarisation, then income inequality might explain the provision of public goods.

Feser (2002), to avoid noise and bias in the estimation of the inequality and polarisation indexes due to outliers and extreme incomes, I have trimmed 1% of the upper and lower tails of the income distribution -see also Gravelle and Sutton (2009) and Weich, Lewis, and Jenkins (2002). The final sample contains 95748 individual-observations that correspond to 15692 individuals. The average length of time in the panel is 6.1 years.

Individual health is measured by a self-assessed measure (SAH), which is taken from the individual answer to the following question: "how is your health in general?" Individuals can report five different answers ordered from "very poor" (value 1) to "very good health" (value 5). The use of subjective measures to evaluate not only health but also other aspects of life has increased in recent years, as empirical evidence on its validity has been accumulating (Clark, Frijters, and Shields, 2008). In particular, individual health subjective evaluations of health have been found to be good predictors of morbidity and mortality (Deaton, 2003), even conditional on a physician's examination (see Idler and Benyamini, 1997).

Since the measure of polarisation ought to capture the conflict between exogenously defined population subgroups, and not only the clustering along the income distribution for the overall population, my index of polarisation (P) will be the ratio of between to within inequality components (Zhang and Kanbur, 2001). Consider, for instance, the Generalised Entropy family of inequality indices, which depends on sensitivity parameter α:

$$I(\alpha) = I_W + I_B = \sum_{g}^{K} w_g I_g + I(\mu_1 e_1, ..., \mu_K e_K) \tag{3.1}$$

where I_W is the within inequality component and I_B is the between inequality component. The within component is a weighted sum of inequalities, I_g, occurring within each (exogenously given) subgroup $g = 1, \ldots, K$, where the weights w_g are a function of overall and subgroup mean income, μ and μ_g, and overall and subgroup population shares, n and n_g:

$$w_g = \left(\frac{n_g}{n}\right)^{1-\alpha} \left(\frac{\mu_g}{\mu}\right)^{\alpha} \tag{3.2}$$

The between component measures the inequality in a counterfactual distribution where individuals are assigned the mean income of their group, μ_g (hence e_g is a vector of ones of length n_g). Then Zhang and Kanbur's index of polarisation, P, may be expressed as

$$P = \frac{I_B}{I_W} = \frac{I(\mu_1 e_1, ..., \mu_K e_K)}{\sum_g^K w_g I_g} \tag{3.3}$$

Zhang and Kanbur (2001) index is especially suitable to measure polarisation between exogenously defined groups, as opposed to the axiomatically derived measures of income polarisation (e.g. Esteban and Ray, 1994; Wang and Tsui, 2000; see Zhang and Kanbur (2001) for a complete survey of existing polarisation indexes).

Besides measuring polarisation between regions, as it is usual in the literature, the empirical analysis adds a new feature by arguing that the relevant population subgroups are not regions but individual's reference groups. Then, the obvious question is how to define the reference group to which individuals compare to. Here reference group are defined as individuals who live in the same region, and have about the same age and education level, a practice common in the literature of income and happiness (Ferrer-i-Carbonell, 2005).[4] Thus, polarisation is a time time-varying variable, which differs across reference groups.

I use the Theil index to measure inequality, which is especially suitable for my pur-

[4] I consider the three education categories provided by the data and bunch individuals into 4 age groups (younger than 25, 25-44, 45-65, older than 65). Since I consider 7 regions (defined as NUTS1), there are 84 reference groups per year. The 7 regions are sufficiently large, the smallest having 1.7 million and the largest over 9.4 million inhabitants, according to the 2001 census.

poses since it decomposes additively into within and between inequality, the two elements required to compute polarisation. As a robustness check I also use the Mean Log Deviation (MLD) -see Section 3.6. These two inequality indexes are the only two that provide and exact additive decomposition, and that use only population- (MLD) and only income-related (for the Theil) weights to aggregate subgroup inequalities to obtain the within component (Cowell, 1980; Shorrocks, 1980).

Besides polarisation and inequality, the covariates include variables that have been shown to have an influence on individual health. The specifications include income-related variables (family income and average income of the reference group), personal characteristics (age, education, and labour market status), a proxy of social capital (whether talking often with neighbours), and environmental factors (crime or vandalism problems and pollution problems in the area of residence). Health hazardous behaviour variables such as smoking, and the body mass index were also tried but showed systematically insignificant.[5] Descriptive statistics are shown in Appendix Table A.1.

3.4 Empirical model and estimation procedure

The principal aim of the paper is to test whether income polarisation has any effect on self-assessed individual health, which is an ordinal variable that can take 5 discrete ordered values. The empirical analysis assumes that individuals' answers are comparable among them, which means that an individual reporting a 4 enjoys a better health than one reporting a 2. Nevertheless, and given that health is measured in discrete numbers, the empirical analysis uses a categorical ordered model so as to avoid assuming cardinality. Following

[5] Recent empirical work for selected European countries obtains similar results (e.g. Theodossiou and Zangelidis, 2009).

the usual notation for ordered categorical models, the equation to be estimated is

$$h_{it}^{*} = X_{it}\beta + f_i + \epsilon_{it} \tag{3.4}$$

$$h_{it} = k \Leftrightarrow h_{it}^{*} \in [\lambda_k, \lambda_{k+1}\} \tag{3.5}$$

where h_{it}^{*} is the latent health status of individual i at time t, h_{it}^{*} is the observed one, λ_k is the kth cut-off point for the 5 different k categories, X_{it} is a vector of covariates, f_i are the individual time-invariant unobserved characteristics, and ϵ_{it} is the usual time-varying error term. The inclusion of fixed effects in an ordered categorical model is not straightforward. In this paper I use an extension derived in Ferrer-i-Carbonell and Frijters (2004) of the widely used fixed-effect binary logit model by Chamberlain (1980) in which the original variable is collapsed into a binary variable by using an individual-specific threshold.[6] Instead of the most common practice of collapsing the original categorical ordinal variable into a binary variable according to an arbitrary threshold that is common for all individuals,[7] the Ferrer-i-Carbonell and Frijters (2004) model recodes the original variable by means of an individual-specific threshold via the free parameter k_i. The first option wastes a lot of the sample information, as all individuals for whom the binary health status variable does not change over the sample period will not contribute to estimation, even if their reported health status ordinal indicator does change. The second option instead allows us to include all individuals whose health status score changes over the sample period, which is the case for 87% of all observations, while studies using the first option usually loose over 50% of the sample observations (e.g. Clark, 2003).

[6] I will employ the individual mean score of reported health status over the sample period.

[7] For instance, I could recode the five scale ordinal health status variable such that the lower three categories are assigned a value of 0 and the upper two are assigned a value of 1.

The conditional estimator for β maximises the following likelihood of observing which of the T health status of the same individual are above k_i, given that there are c out of T health status above k_i:

$$L\left[I(h_{i1} > k_i), ..., I(h_{iT} > k_i)\left|\sum_{t=1}^{T} I(h_{it} > k_i) = c\right.\right] = \frac{\exp\left\{\sum_{t=1}^{T} I(h_{it} > k_i)X_{it}\beta\right\}}{\sum_{h\in S(k_i,c)} \exp\left\{\sum_{t=1}^{T} I(h_{it} > k_i)X_{it}\beta\right\}}$$

(3.6)

Here, $S(k_i, c)$ denotes the set of all possible combinations of $\{h_{i1}, ..., h_{iT}\}$ such that $\sum_{t=1}^{T} I(h_{it} > k_i) = c$. For details on the estimation procedure I refer to Ferrer-i-Carbonell and Frijters (2004).

3.5 Empirical Results

Table 3.1 reports the estimates of basic specifications for the fixed-effects ordered logit models. All specifications include the basic controls but differ in the way the inequality and polarisation variables are introduced. The first two specifications include polarisation between regions and reference groups. The last two introduce, next to polarisation, inequality between regions and reference groups.

Before discussing the main variables of interest, I briefly discuss some of the most interesting explanatory variables. The estimates of the covariates are robust across specifications and have the expected sign, with the exception of unemployment, which shows a positive sign. As usual in the literature, income has a positive effect on health, as it buys goods and services that are health enhancing (Deaton, 2003). Such positive relationship has also

Table 3.1: Individual health and polarisation (estimated with Theil index). Fixed-Effects Ordered Logit model, ECHP 1994-2001

Covariates	*Specif.1*	*Specif.2*	*Specif.3*	*Specif.4*
Ln(family income)	0.053**	0.056**	0.05**	0.052***
Ln(average income reference group)	0.31***	0.356***	0.277***	0.305***
Age	-0.107***	-0.109***	-0.114***	-0.108***
Age squared	0.0004***	0.0004***	0.0004***	0.0004***
Secondary education	0.082*	0.093**	0.077	0.09*
Tertiary education	0.141**	0.163**	0.128*	0.146**
Unemployed	0.083**	0.084**	0.083**	0.083**
Inactive	-0.075**	-0.073**	-0.076**	-0.076**
Separated	-0.037	-0.039	-0.038	-0.037
Divorced	0.188	0.192	0.187	0.19
Widowed	-0.022	-0.016	-0.022	-0.022
Single	0.067	0.067	0.068	0.068
Do not talk often to neighbours	-0.231***	-0.233***	-0.231***	-0.231***
No crime problems in area	0.138***	0.139***	0.138***	0.138***
No pollution problems in area	0.139***	0.139***	0.139***	0.139***
Polarisation (between reference groups)[1]	-0.933***		-0.819***	-0.947***
Polarisation (between regions)		0.382		
Inequality (between reference groups)[1]				-0.527
Inequality (between regions)			-2.354	
Log likelihood	-39602	-39612	-39599	-39602
No. Observations	95748	95748	95748	95748

Note: [1]Reference groups defined over education and age for each region and year.
Significance: *** 99% confidence level, ** 95% and * 90%.

proven to be causal -see Frijters, Haisken-DeNew, and Schields (2005) for recent evidence. As customary, the income variable refers to the equivalent net household income.[8] As it has been shown in the previous chapter, besides absolute income, a recent body of the literature has argued and tested that relative income has also a bearing on individual health. In this study I use the average income as a measure of relative income. That is, holding own income level fix, the average income in a reference group also affects individual's health

[8]The OECD scale is used to equivalise income. This deflator gives a weight of 1 to the first adult of the household, 0.7 to the rest of the adults, and 0.5 to the children younger than 14 (see Hagenaars, de Vos, and Zaidi, 1994).

status (see next chapter for a discussion on the relative income hypothesis). The traditional model posits that relative income harms health by increasing relative deprivation and thus psychosocial stress (Wilkinson, 1996; Wilkinson,1997; Wilkinson, 1998). Recent evidence, however, suggests a positive relationship between relative income and health, which could be explained by a positive externality brought about by the larger expenditure on health-promoting goods and services in wealthier communities -regardless of own income level (Miller and Paxson, 2006). Here, the relative income is defined as the (log of the) average income of a reference group, defined in the same way as the reference groups of income polarisation. If reference groups are defined only as individuals in the same region, the effect is insignificant. Relative income has a positive and statistically significant sign, which suggests that the level of income of the community is consistent with a positive externality effect, rather than a relative deprivation argument.

As outlined above, social capital was originally approximated by two standard indicators: club membership and whether speaking often with neighbours. However, only the latter is significant and it is finally included in the regression. Recall from my discussion above that, when included, inequality may also capture the effects of social capital on health. Finally, I also control for environmental factors which have been found to affect health (Sassi and Hurst, 2008), and which include having problems of crime, vandalism and pollution in the area of residence. I find these environmental problems to have a negative correlation with individual health.

The first two specifications show that while polarisation between reference groups is negatively correlated with health, regional polarisation does not have a statistical significant effect on health. This evidence supports my predictions on the negative effect of polarisation on individual health, but also warns that the way population subgroups are defined is important. My results suggest that tension and conflict occur among groups of people who share basic individual characteristics such as education and age and live in the same region, and not among those individuals who simply reside in different regions, regardless of their personal attributes. As Table 3.2 shows, polarisation is larger among education-age groups than among regions, and this is because both alienation and identification are larger for the former than for the latter.[9]

Table 3.2: Polarisation and its components by wave, using Theil index

	Polarisation		Alienation		Identification	
Year	Groups	Regions	Groups	Regions	Groups	Regions
1994	0.204	0.082	0.025	0.012	0.123	0.145
1995	0.198	0.108	0.024	0.015	0.12	0.141
1996	0.193	0.098	0.022	0.013	0.115	0.136
1997	0.211	0.128	0.025	0.018	0.12	0.143
1998	0.191	0.122	0.023	0.017	0.118	0.138
1999	0.184	0.139	0.02	0.018	0.109	0.128
2000	0.188	0.116	0.02	0.014	0.105	0.122
2001	0.191	0.15	0.019	0.017	0.101	0.116
All years	0.196	0.116	0.022	0.015	0.115	0.135

Note: Between and within inequality components computed using the Theil index. Groups are defined by age and education for each region and wave. Alienation is the between inequality component, and for age-education groups it is the average of between inequalities for all regions. Identification is the within inequality component.

The last two specifications introduce inequality between regions and between age/education groups, respectively, to check whether inequality still has some explanatory power beyond polarisation. I find that only income inequality between regions matters for health, but that inequality between age-education groups has no significant effect.[10] If, as suggested above,

[9] Bear in mind that larger identification means lower within group inequality.

[10] This finding is at odds with previous evidence for Spain (see Regidor, Calle, Navarro, and Dominguez (1997) and Regidor, Calle, Navarro, and Dominguez (2003)), which finds no significant effect of regional inequality on individual health. As argued in Wilkinson and Pickett (2006), this discrepancy may be explained by the size of the regions used in the two studies. I use larger regions defined in accordance to NUTS 1, while Regidor, Calle, Navarro, and Dominguez (1997) and Regidor, Calle, Navarro, and Dominguez (2003) use much smaller (NUTS 2) regions.

inequality is a proxy for social capital, my results indicate that it is inequality among individuals of a region that matters, and not only among those individuals with similar basic characteristics. Note that the negative effect of regional inequality obtains in spite of controlling for another social capital variable (i.e. how often talking to neighbours), and that the sign and size of the latter does not change with the inclusion of regional inequality.

3.6 Robustness checks

This section shows that the main result -i.e. the negative effect of polarisation between reference groups on health- is robust to using a different polarisation measure and to including (subjective) poverty in the analysis. I measure polarisation using an alternative index of inequality that also decomposes additively, and obtain similar results. Table 3.3 shows the estimates of the same four basic specifications presented in Table 3.1 where polarisation and inequality have been computed using the MLD -instead of the Theil index. Polarisation continues to have a detrimental effect on health only when computed between age-education groups. However, inequality now shows a negative and significant effect both between reference groups and between regions (specifications 3 and 4).

Relative poverty has been adduced to have a deleterious effect on health (Deaton, 2003; Wagstaff and Van Doorslaer, 2000; Wilkinson, 1996). Certain kind of socioeconomic problems (e.g. unemployment, debts, housing and marital problems) have negative psychological effects on individuals. This stress may affect health directly, for example, by weakening the immunological system and favouring the appearance of other illnesses, or it may affect health indirectly, by inducing an increase in alcohol or drugs consumption (McIsaac and Wilkinson, 1995). I capture this stress, and the related psychological effects, by a subjective account of financial difficulties. In particular, individuals report whether they are

Table 3.3: Individual health and polarisation estimated using MLD. Fixed-Effects Ordered Logit model, ECHP 1994-2001

Covariates	*Specif. 1*	*Specif.2*	*Specif.3*	*Specif. 4*
Ln(family income)	0.053**	0.056**	0.049**	0.052**
Ln(average income reference group)	0.329***	0.369***	0.255**	0.326***
Age	-0.106***	-0.112***	-0.119***	-0.109***
Age squared	0.0004***	0.0004***	0.0004***	0.0004***
Secondary education	0.086*	0.095**	0.075	0.098**
Tertiary education	0.149**	0.167**	0.121*	0.158**
Unemployed	0.083**	0.084**	0.083**	0.083**
Inactive	-0.075**	-0.073**	-0.076**	-0.076**
Separated	-0.037	-0.038	-0.039	-0.037
Divorced	0.189	0.192	0.185	0.191
Widowed	-0.02	-0.016	-0.021	-0.02
Single	0.067	0.067	0.07	0.068
Do not talk often to neighbours	-0.232***	-0.233***	-0.231***	-0.232***
No crime problems in area	0.139***	0.139***	0.138***	0.139***
No pollution problems in area	0.139***	0.139***	0.138***	0.139***
Polarisation (reference groups)[1]	-0.824***		-0.683***	-0.859***
Polarisation (regions)		0.737		
Inequality (reference groups)[1]				-0.78**
Inequality (regions)			-4.39***	
Log likelihood	-39607	-39612	-39593	-39604
No. Observations	95748	95748	95748	95748

Note: [1] Reference groups defined over education and age for each region and year.
Significance: *** 99% confidence level, ** 95% and * 90%.

able to make ends meet.[11] Table 3.4 shows the estimates of the four base models when this subjective poverty measure is included. As expected, (subjective) poverty has a deleterious effect on individual health. Additionally, the income level becomes insignificant. Most importantly for me, polarisation is robust both in size and precision to the inclusion of subjective poverty. This suggests that the negative psychological effects caused by the perception of being poor do not confound the negative polarisation effects on health.

[11] I have recoded the original ordinal answers on a 6 point scale, running from “with great difficulty” to “very easily” to a dummy variable that takes a value of 1 if individuals report being able to make ends meet “with great difficulty”, “with difficulty” or “with some difficulty”, and zero for the other 3 categories: “fairly easily”, “easily” or “very easily”.

Table 3.4: Adding subjective poverty to the base models of Table 3.1[1]. Fixed-Effects Ordered Logit model, ECHP 1994-2001

Covariates	*Specif. 1*	*Specif.2*	*Specif.3*	*Specif. 4*
Difficulties to make ends meet	-0.195***	-0.195***	-0.196***	-0.195***
Ln(family income)	0.031	0.034	0.029	0.03
Ln(average income reference group)	0.307***	0.353***	0.273***	0.302***
Age	-0.111***	-0.113***	-0.119***	-0.112***
Age squared	0***	0***	0***	0***
Secondary education	0.086*	0.097**	0.08*	0.093*
Tertiary education	0.145**	0.167**	0.132*	0.151**
Unemployed	0.095***	0.096***	0.094***	0.095***
Inactive	-0.069**	-0.067**	-0.07**	-0.069**
Separated	-0.025	-0.027	-0.026	-0.025
Divorced	0.206	0.209	0.204	0.207
Widowed	-0.016	-0.011	-0.016	-0.016
Single	0.087	0.086	0.088	0.087
Do not talk often to neighbours	-0.229***	-0.231***	-0.229***	-0.23***
No crime problems in area	0.13***	0.131***	0.13***	0.13***
No pollution problems in area	0.131***	0.131***	0.131***	0.131***
Polarisation (reference groups)[2]	-0.927***		-0.809***	-0.941***
Polarisation (regions)		0.386		
Inequality (reference groups)[2]				-0.537
Inequality (regions)			-2.43***	
Log likelihood	-39554	-39563	-39550	-39553
No. Observations	95748	95748	95748	95748

Notes: [1]Polarisation and inequality computed using the Theil index.
[2]Reference groups defined over education and age for each region and year.
Significance: *** 99% confidence level, ** 95% and * 90%.

3.7 Concluding Remarks

I argue that income polarisation has a negative impact on individual's health and provide empirical evidence that supports my theoretical arguments. Income polarisation increases social tension and conflict, which in turn may create psychosocial stress and reduce the provision of certain public goods, both of which affect health. These two pathways are empirically tested using longitudinal data. Individual health is proxied by a self-reported measure of own health. The empirical analysis uses a recent econometric development due to Ferrer-i-Carbonell and Frijters (2004), which estimates an ordinal categorical model with fixed effects. By using this model, one imposes interpersonal comparability of self-assessed health only at the ordinal level.

Besides defining polarisation between regions, the paper introduces polarisation between reference groups. That is, I postulate that the relevant comparison group may not be the region but individuals with similar characteristics. I find that polarization is only relevant between reference groups and not between regions. Thus, my results challenge what has been traditionally assumed in the literature, i.e. that it is regions that matters. Clearly then, more research needs to be done to understand which are the relevant comparison groups that affect not only individual health but perhaps also other economically relevant outcomes, such as subjective perceptions of welfare and poverty.

Chapter 4

Relative Income and Health

4.1 Introduction

In this chapter I focus on the relationship between relative income and health. I propose a new approach when analysing the *Relative Income Hypothesis* to explain the ambiguous results of the effect of relative income on health in previous literature. I argue that the relative income measures used so far fail to capture the complexity of income comparisons on health. Previous empirical evidence focuses mostly on income distances with the better-off individuals in the reference group, what is known as "upward" income comparisons. However, individuals might also compare with the worse-off. Therefore, my main contribution is to estimate the relationship between relative income and health based on a relative income measure, which allows to distinguish between the effect of "upward" and "downward" income comparisons on health.

To my knowledge, this is the first study to analyse this relationship tacking into account the panel-dimension of the data to control for unobserved heterogeneity. This is important in order to correct for income endogeneity due to omitted variables. This seems to be the case, since the size and significance of the estimated coefficients in this study are reduced once unobserved heterogeneity is included.

The analysis is based on the German Socio-Economic Panel (SOEP), which includes longitudinal income and health data for the period 1994-2010. Additionally, SOEP reports "quasi objective" health measures, which allow to test the models using more objective health indicators, distinguishing between the mental and physical dimensions of health.

Finally, different reference groups are considered to find out which is the relevant reference group for Germans. New evidence suggests that Germans compare themselves with people in the same profession (Mayraz, Wagner, and Schupp, 2009). However, more traditional reference group definitions are used as a robustness check.

The results show that both upward and downward comparisons are statistically significant even after controlling for unobserved heterogeneity. Upward comparisons within the reference group generates a positive effect on health while downward comparisons affect health negatively. In the case of Germany psychosocial stress might not be derived from relative deprivation, but from relative satisfaction. These results might contradict the initial hypothesis and might explain some of the discrepancies found in the literature.

This paper is structured as follows. Section 4.2 summarizes previous empirical evidence regarding the relative income hypothesis. Section 4.3 presents the theoretical background. The employed data and the econometric specifications used in this paper are described in Section 4.4. Section 4.5 shows the empirical findings. And finally, Section 4.6 concludes.

4.2 Relative Income and Health in the literature

Relative income is measured in the health literature by means of the distance between individual's income and a reference income. Depending on the reference income considered a different measure of relative income is obtained. As it is highlighted in chapter 2, relative income is expected to have a deleterious effect on health through psychosocial stress.

Three are the measures of relative income mainly used in previous studies (Wagstaff and Van Doorslaer, 2000). The first one is the average income of the reference group, which proxies the distance between individual income and the mean income of the reference group. This hypothesis —which is known as *relative income hypothesis* per se— suggests that the higher the distance, the more psychosocial stress might be experimented by individuals, and their health status would worsen. However, there are situations where average income of the reference group might vary without changing the distance between individuals' income, in other words, without changing relative income (Deaton, 2003). In this case, a negative effect of average income of the reference group on health might only reflect a negative effect of belonging to a poorer reference group, but not relative income. Thus, average income of the reference group would not a be a good indicator of relative income, although it has been extensively used in the analysis of relative income and health.

Secondly, the *deprivation hypothesis* is based on a deprivation index. In this case, the distance between individual income and an income threshold –usually the poverty threshold— might be determinant for health. Again a higher distance would mean that it is more difficult for the individual to reach the desired consumption level. And finally, the *relative-position hypothesis* from which it can be drawn that it is the relative position in the income distribution that matters, which is measured by the rank of the individual in the income distribution (Deaton, 2003).

Although all these three measures have been vastly tested in the literature, there is still controversy about the effect of relative income on health. For example, Gerdtham and Johannesson (2004) do not find evidence of the effect of relative income measured by means of community average income for the Swedish population, but a protective effect at the county level. Following the same analysis, Hildebrand and Van Kerm (2009) find only weak evidence of the negative effect of relative income using ECHP data for 11 European countries. In this case, their relative income measure is also the mean income of the regional reference group. On the contrary, Feng and Myles (2005) after analysing US data state that living in richer neighbourhoods enhances health of the worse-off. They find a positive effect on health of the median neighbourhood income, showing that individuals might benefit from living with richer peers. Wealthier neighbourhoods might spend more on health-related public goods, and it may operate as a positive externality for the poor living there (Miller and Paxson, 2006). However, Pham-Kanter (2009) when analysing the effect of living with richer neighbours in the US using National Social Life, Health, and Aging Project (NSHAP) data finds that relative income is detrimental for health of those at the bottom and the top of the income distribution. In any case, the positive effect might contradict the initial hypothesis regarding the effect of relative income on health.

Similarly, the same disparity of results is found when using deprivation as a relative income measure. Eibner and Evans (2005) analyse data from the National Health Interview Survey for Multiple Causes of death for the USA, considering reference group based on individual characteristics. The relative deprivation indexes show a negative effect of relative income on health. But again, another study of Jones and Wildman (2008) with BHPS data from 1991 to 2002 and relative deprivation measures finds no effect of relative income on self-assessed health when allowing parametric and semiparametric models to asses the relationship between income and health. More recently, a clearer example of how difficult it is to determine the effect of relative income on health is the paper of Gravelle and Sutton (2009). They consider health records for Britain for the period 1979-2000, showing that the effect of relative income is sensitive to the reference group and to the relative income measures used. Finally, rank measures do not achieve either to shed light on this relationship, because there are also discrepancies in the empirical evidence (Subramanyam, Kawachi, Berkman, and Subramanian, 2009; Eibner and Evans, 2005).

These disparities in the results might be explained by some methodological caveats which have not been solved yet. First, the validity of the reference group. Again, there is no consensus in the literature about which is the relevant reference group. This might differ depending on the country or the population group considered (Karlsson, Nilsson, Hampus, and Leeson, 2010).

Second, the validity of the health measures. It is difficult to find datasets which include both a wide range of socioeconomic variables and health measures, particularly objective health. Therefore, most of the studies are based on self-assessed health. Although self-assessed health is a valid measure, it might present reporting bias, especially in cross-country analysis (Sadana, Mathers, Lopez, Murray, and Moesgaard, 2002).

Last, the validity of the relative income measure. I argue that the three measures presented above fail to capture the complexity of the effect of income comparisons on health. Therefore, I suggest to reconsider the relative income hypothesis

4.3 Theoretical considerations

4.3.1 Income comparisons and Well-being

Since Easterlin (1979) found a low correlation between income and well-being in richer countries, and suggested that a higher income does not make people happier once it rises above a "subsistence level",[1] a great bulk of studies have focused on the implications of income comparisons on individual well-being. Especifically, empirical evidence shows that well-being is affected by the income gap between individual's income and her reference income (Easterlin, 1974; Ferrer-i-Carbonell, 2005; Clark and Senik, 2010).

This idea stems from the assumption that the utility function of an individual i is determined by the interdependence of preferences and social status (Ferrer-i-Carbonell, 2005 and Wunder and Schwarze, 2009). Accordingly, consumption and individuals' behaviour are influenced by other individuals' decisions and consumption.[2] Thus, individuals would feel deprived when they cannot reach others' consumption level, that is to say, that social comparisons are relevant for well-being. In this case, individual well-being might be af-

[1] This has been dubbed the Easterlin Paradox.

[2] Ferrer-i-Carbonell (2005) suggests that if everybody were to drive a Rolls Royce, one would feel unhappy with a cheaper car.

fected not only by individual income y_i,[3] but also by individual relative income —denoted by y_j— within his reference group, as it is shown in the following equation:

$$U_i = (y_i, y_j, X) \tag{4.1}$$

where U_i stands for the utility or well-being level of individual i, and X includes a set of individual and household characteristics, which are also relevant for individual well-being.

Additionally, income comparisons also provide individuals with information about their self-value and individual esteem within the reference group. In this sense, relative income would be a measure of the contentment derived from social status and would help individuals to assess their own success or failure (Dakin and Arrowood, 1981; Wunder and Schwarze, 2009).

Fehr and Schmidt (1999) propose the following utility function to capture the effects of individual income and income comparisons on well-being:

$$U_i = y_i - \frac{\alpha}{n-1}\sum_{y_j > y_i}(y_j - y_i) - \frac{\beta}{n-1}\sum_{y_j < y_i}(y_i - y_j) \tag{4.2}$$

They assume that $\alpha \geq \beta$ and $1 > \beta \geq 0$. Thus, individual's welfare might depend positively on his own income and upward and downward comparisons might have a negative effect. This effect might be higher for upward comparisons.

However, there is still controversy in the direction and the sign of income comparisons. For example, Duesenberry in 1949 pointed out that individuals compare themselves with

[3]Note if this is the case absolute income might have a positive effect on health as it is claimed by the absolute income hypothesis.

richer individuals, namely, he suggested that in most cases social comparisons are upwards. Being worse-off might lower individual well-being, because individuals might feel deprived and would consider it as a signal for social failure. As a matter of fact, Duesenberry (1949) called it "envy" effect. Ferrer-i-Carbonell (2005) using SOEP data also finds evidence of upward comparisons.

On the contrary, Hirschman and Rothschild (1973) were concerned about the existence of an "information effect" or "tunnel effect" as it is pointed out in the previous section. In the social comparisons context, Hirschman and Rothschild (1973) claimed that individuals might use the information of individuals in comparable circumstances to predict their own future income situation. Following this line of thought, an increase in the average income of the reference group would be seen as an individual's own future income improvement, and individual well-being would be higher.[4] This is what D'Ambrosio and Frick (2012) find in Germany, when they analyse the effect of relative income on welfare.

Alternatively, income comparisons might also be downwards, and individuals would pay attention to the worse-off (Falk and Knell, 2004). Again, the effect of social comparisons might be positive or negative. Being richer might be interpreted as a "prestige or status effect", because it might be informative of individual social success (Frank, 1985). On the contrary, some individuals might feel "regret" for being richer, that is to say, individuals might have aversion to advantageous inequality (Hopkins, 2008). For example, Wunder and Schwarze (2009) using reference groups based on occupation and region in Germany find evidence of both downward and upward comparisons. However, they claim that the latter dominate in the absolute impact on well-being.

[4]Note that a self-deception problem might arise in the long run once individuals experiment an income increase, and the average difference with the reference group disappears, in other words, the hope of further improvement vanishes and also the effect on well-being.

To sum up, relative income might generate satisfaction and discontent depending on which of these effects, informative, prestige, envy or regret are generated by income comparisons on individuals.

4.3.2 A new approach for the Relative Income Hypothesis

In front of the results disparities presented in section 4.2 one might think that "relatives income hypotheses" fail to capture the psychosocial stress caused by social status, or even that social status might not be significant for health. In my opinion, the main problem is that relative income measures used so far are unable to proxy the real mechanisms through which relative income might determine health, because they only focus on part of the story. Actually, the new evidence regarding well-being presented in the previous section suggests that the relationship between relative income and well-being is very complex, and posits that being at the bottom of the social ladder does not always have a deleterious effect on psychosocial well-being. Following this vision, individuals might not only compare themselves with the better-off, as the average income of the reference group and the deprivation measures state, but also with the worse-off. In other words, income comparisons might be upwards and downwards and their effect on psychosocial well-being, might be positive or negative depending on individual‘s beliefs.

Thus, when income comparisons increase psychosocial well-being, as in the cases of a "tunnel effect" or "prestige", individual health status might improve, because positive psychosocial well-being helps to cope with daily stress. Alternatively, if what is relevant is the "envy" or the "regret" effect, individual psychosocial well-being would decrease, and individual health is expected to worsen off through the psychosocial stress mechanism.

As far as I know, this is the first attempt to disaggregate the effect of income comparisons on health using panel data, when analysing relative income. At the beginning of this section I describe different studies which analyse social status using relative income, but all of them consider only upward comparisons. The study of Theodossiou and Zangelidis (2009) goes one step further, and analyses the effect of subjective social status, which shows the social position of the individual within a reference group. In the SOCIOLD dataset individuals are asked to compare their present income to that of other individuals of similar professional standing, with the same characteristics in terms of age, gender and educational level, in other words, using professional status as a reference group. Results for 2004 show that the ones who answer "much more than others" present a better health status compared to those who believe that their economic situations is "much less than others" within the reference group. Although this measure helps to evaluate the gradient between social status and income, it only considers that individuals compare mainly either with richer or with poorer, but not with both at the same time. Therefore, it does not allow us to understand all the effects of income comparisons on health explained previously, as the measure of relative income presented in this paper does. Specifically, the relative income measure used in this study differentiates between upward and downward comparisons and allows to test their effect on health.

Gravelle and Sutton (2009) use a "relative affluence measure" to consider that individuals care about being richer than the others. They find a positive effect of this measure on health only when they use a regional reference group. However, they do not considered unobserved heterogeneity, given than they based their analysis on cross-sectional data.

In front of the previous evidence in well-being, upward and downward comparisons are expected to be significant for Germany. It is not clear whether the effect will be positive or negative for individual health, because there is no previous evidence analysing this relationship.

4.3.3 Reference Group

Income comparisons take place within a reference group, which contains the subjects with whom an individual compares himself to (Runciman, 1966; Yitzhaki, 1979). Ferrer-i-Carbonell (2005) suggests that the relevant group might be a set of people with similar observable characteristics such as age, occupation, education or location. However, this group might share other characteristics and might be diverse, such as family, friends, co-workers and it might even diverge between countries or individuals. The literature is not conclusive about which is the relevant reference group. Knight, Song, and Gunatilaka (2008) when analysing rural immigrants in China find that individuals compare with individuals in the same village. However, for post-transition European countries, Senik (2009) finds that people compare with individuals who they knew before the transitions started. The cross country differences are also highlighted in the paper of Karlsson, Nilsson, Hampus, and Leeson (2010), based on data for 21 countries in 2006, showing that the level of development in the country is relevant to establish the reference group. While individuals in middle/low income countries might compare with individuals living in the same community, the age reference group is significant for individuals in richer countries.

More recently, Clark and Senik (2010) analyse the third wave of the European Social Survey (ESS) covering 24 different countries and they find that different population groups have different reference groups. For instance, married people compare more with family and friends, as self-employed. And employees take colleagues as a reference group. They also note that there is divergence depending on the country. Thus, in central Europe individuals compare more with colleagues —which will be the case of Germany—, while the

Spanish, Irish, Polish and Finnish compare more with family. And finally, those in Eastern Europe compare less with family than the others do.

Regarding the German case, a work by Mayraz, Wagner, and Schupp (2009) using a pretest module of the SOEP for 2008, shows that the more important income comparisons are work-related, for instance with other people in the same profession, and less with family and almost unimportant with neighbours. These results are similar to the conclusions found in Clark and Senik (2010).

4.4 Data and Methods

The data used in this study is the German Socio-Economic Panel (SOEP). SOEP is a representative longitudinal study of private households in the Federal Republic of Germany which started in 1984. It includes data on 11,000 households with more than 20,000 individuals per year, covering a wide range of socioeconomic variables (see Wagner, Frick, and Schupp, 2007 for a detailed description of SOEP dataset).[5]

The final sample covers the period from 1994 to 2010 due to data availability. I focus on individuals aged 18 to 65, considering also two representative subsamples for females and males, with around 83,000 and 71,000 individuals observations respectively. The sample is split by gender to capture gender differences. Females usually report worst health than males. Moreover, Mayraz, Wagner, and Schupp (2009) suggest that the effect of income comparisons might differ by gender, since they find a significant effect of relative income

[5]The data used in this study were extracted using the Add-On package PanelWhiz v3.0 (Nov 2010) for Stata. PanelWhiz was written by Dr. John P. Haisken-DeNew (john@panelwhiz.eu). The following authors supplied PanelWhiz SOEP Plugins used to ensure longitudinal consistency, Markus Hahn and John P. Haisken-DeNew. The PanelWhiz generated DO file to retrieve the SOEP data used here and any Panelwhiz Plugins are available upon request. Any data or computational errors in this study are my own. Haisken-DeNew and Hahn, (2010) describe PanelWhiz in detail.

on life satisfaction for men, but not for women.

The dependent variable is a self-assessed health measure (SAH) constructed by means of the answers to the question "How would you describe your current health?". The reporting answers are five different categories ordered from very bad (value one) to very good (value five). Since true health perceptions may differ among individuals and also across countries, this subjective health measure might present reporting bias (Sadana, Mathers, Lopez, Murray, and Moesgaard, 2002). However, as it has been pointed out in the previous chapter, SAH has been found to be a good predictor of mortality and other health outcomes such as physicians' services and retirement in different countries. (Idler and Benyamini, 1997; Miilunpalo, Vuori, Oja, Pasanen, and Urponen, 1997; Dwyer and Mitchell, 1999; Deaton, 2003). This is also the case for Germany, as it is shown in the study by Schwarze, Andersen, and Anger (2000) using SOEP data.

Objective health measures have been also considered to test the main hypotheses of this study and to check the robustness of the results. SOEP does not contain objective data for the period 1994-2001. However, since 2002 SOEP respondents report information on "quasi-objective" health measures, based on the 12 health-related questions of the SF12 index. This SF12 index is a generic health measure, which was developed to accurately measure the objective health status of individuals, focusing on two dimensions, mental health, called *mcs*, and physical health, referred as *pcs* —more details on how the SF12 index is calculated can be found in Andersen, Mühlbacher, Nübling, Schupp, and Wagner, 2007. Unfortunately, these measures are only reported every two years. Therefore, the final sample with objective health includes only 5 waves, from 2002 to 2010. Additionally, since weight has been proved to be a good predictor of health, individual body mass index, *bmi*, is also considered.[6]

The values of the three variables, *pcs*, *mcs* and *bmi* are normalized to a 0-1 interval. A higher *pcs* or *mcs* index indicates better health. The *bmi* variable is included in the analysis as one minus the body mass index. Thus, a higher value of the *bmi* variable represents less body mass index.

Table 4.1 presents the correlation between health variables, showing that the correlation between SAH and *pcs* is much higher than with the other two variables. One possible explanation might be that individuals are more conscious about their physical, rather than their mental health when they report their level of health.

Table 4.1: Correlation between SAH and the "quasi-objective" health measures, 2002-2010

	pcs	mcs	bmi
SAH	0.7296***	0.2644***	0.1906****
pcs	–	-0.0553***	0.2401****
mcs	–	–	-0.0472****

Note: Significance: *** 99% confidence level

Finally, a set of covariates such as age, age square, gender, individual's number of years of education, nationality, marital status, labour status, household composition and income are included to control for personal characteristics —see Table B.1 in the B Appendix for a description of the variables. Namely, the income variable refers to the equivalised household post-government income which represents the combined income after taxes and government transfers in the previous year of all individuals in the household.[7] SOEP dataset imputes any missing income information due to item-nonresponse according to the lon-

[6]SOEP also considers grip measures as an objective health indicator but data is only available since 2006.

[7]The equivalence scaled used is the modified OECD scaled which sets a single adult to be 1.0, each additional adult to be 0.5, and each child to be 0.3 (Hagenaars, de Vos, and Zaidi,1994).

gitudinal and cross-sectional imputation procedures described in Frick and Grabka, 2005 (see also Grabka, 2009 for a detailed description of the SOEP income variables). The income variable has been deflated to 2006 prices. As suggested by Cowell and Victoria-Feser (2002), to avoid noise and bias in the estimation of the relative income indexes due to outliers and extreme incomes, income distribution has been trimmed 1% of the upper and lower tails of the income distribution. Equivalised household post-government income is included in logarithm. The income variable has also been used to calculate the average income of the reference group and the relative income measures.

4.4.1 The Relative Income measure

In this study relative income is measured by means of a relative deprivation and a relative satisfaction index.

First, the relative deprivation measure follows the deprivation index, $d_i(x)$, suggested by Yitzhaki (1979). This index is based on the idea that a person's feeling of relative deprivation in a society comes from the comparison of his situation with those of the better off individuals (Chakravarty, 1997). Thus, upward income comparisons are defined as the deprivation felt by a person with income x_i with respect to a person with income x_j.

$$d_i(x) = (x_j - x_i)\ if\ x_i < x_j,$$
$$= 0\ else$$

(4.3)

Thus, the deprivation function of the person with income x_i is:

$$Deprivation_i(x) = \frac{\sum_{j \varepsilon B_i(x)}(x_j - x_i)}{n}, \tag{4.4}$$

Chakravarty (1997) proposes to look at a relative concept of deprivation felt by a person with income x_i with respect to a person with income x_j, namely, their income share differential $\frac{d_i(x)}{\lambda(x)}$. Now, the total relative deprivation function of the person with income x_i is:

$$Rel.Deprivation_i(x) = \frac{\sum_{j \varepsilon B_i(x)}(x_j - x_i)}{n\lambda(x)}, \tag{4.5}$$

where $\lambda(x)$ is the mean income of the reference group. B_i refers to the set of individuals that have a higher income than individual i in the reference group.

If incomes are equally distributed, individuals might not feel deprived and the Rel. Deprivation index is equal to 0 for all i. Alternatively, the maximum deprivation arises when the richest individual owns the entire income. In this case, the Rel. Deprivation index is equal to 1 for the richest individual, and 0 for the rest of the individuals.

Since individual i is not deprived if he compares his own income, x_i, with the income of poorer individuals, he may be satisfied (Chakravarty, 1997). D'Ambrosio and Frick (2012) suggest a relative satisfaction index to measure downward income comparisons. The relative satisfaction index of the person with income x_i is:

$$Rel.Satisfaction_i(x) = \frac{\sum_{j \varepsilon W_i(x)}(x_i - x_j)}{n\lambda(x)}, \tag{4.6}$$

W_i refers to the set of individuals that have a lower income than individual i in the reference group.

This Rel. Satisfaction index is equal to 0 for the poorer individual in the income distribution, and 1 for the richest.

In this case, I assume that income comparisons take place within the reference group. Therefore, deprivation and satisfaction indexes are calculated for each individual within each reference group.

4.4.2 The relevant Reference Group

In front the empirical evidence presented in section 4.3.3, I define the reference group by means of individual's profession, using the ISCO-88 occupation codes available in SOEP, aggregated into 22 different categories as suggested in Pischke (2010) —refoccup.

Since the SOEP occupation variable is very wide, the geographical criteria is also included to allow for some proximity with people in the same profession. In this case it is considered that individuals might compare to individuals in the same occupation and living in the same area. Three different regional aggregation are used. First the traditional division between East and West —refoccup2—, the four region division —refoccup4: East-North-Central-South— and finally the 16 "Bundeslands" —refoccup16.

Reference groups only based on regional criteria are also considered to test for the positive externalities of living with richer individuals —region2, region4 and region16.

Finally, to test the robustness of the reference group, relative income is measured by means of a more traditional reference group definition: by age, educational level and geographical area —including the different geographical divisions mentioned above: refgrup2, refgrup4 and refgrup16. Table 4.2 shows the number of groups in each reference group.

Table 4.2: Number of reference groups by definition

Name	Definition	# of groups
region2	living in west or east Germany	2
region4	living in the 4 big areas in Germany: East-North-Central-South	4
region16	living in the 16 federal regions of Germany	16
refoccup	by occupation	22
refoccup2	by occupation and region2	44
refoccup4	by occupation and region4	88
refoccup16	by occupation and region16	330
refgrup2	by age, education and region2	18
refgrup4	by age, education and region4	36
refgrup16	by age, education and region16	135

4.4.3 The estimation procedure

A health production model is used in order to estimate the effect of relative income on self-assessed health:

$$h_{it}^{*} = X_{it}\beta + y_{it} + Rel.Deprivation_{it} + Rel.Satisfaction_{it} + e_{it} \tag{4.7}$$

$$h_{it} = k \Leftrightarrow h_{it} \in [\lambda_k, \lambda_{k+1}\} \tag{4.8}$$

Where h_{it}^{*} is the latent health status of the individual i at time t. h_{it} is the individual observed health measured by means of the self-assessed health and λ_k i the kth cut-off point for the five different k categories. On the right-hand side, X_{it} is a set of control variables, y_{it} stays for the income variable and $Rel.Deprivation_{it}$ and $Rel.Satisfaction_{it}$ are the relative income measures —relative deprivation and relative satisfaction respectively.

Given the ordinal nature of self-assessed health, it is difficult to apply traditional econometric techniques to estimate the model. For this reason, SAH is transformed to a “pseudo” continuous variable following the "Probit OLS Method" (POLS), proposed by Van Praag and Ferrer-i-Carbonell (2004/2008).

Following this econometric strategy, I assume that the observed health variable, h_i, is related to the "true" unobserved and "continuous" individual level of health, h^* (Van Praag and Ferrer-i-Carbonell, 2004; Van Praag and Ferrer-i-Carbonell, 2006):

$$h_i = j\ if\ \mu_{j-1} < h_i^* < \mu_j\ for\ j = 1, 2, ..., k \tag{4.9}$$

The latent health variable, h^*, is divided in k intervals. The jth answer is observed if h_i^* lies between μ_{j-1} and μ_j. It is also assumed that h^* has a standard normal distribution in the population. Given this distributional assumption, the μ_{js} can be estimated using the frequency for each category of the observed ordinal variable. Assuming that $\mu_0 = -\infty$ and $\mu_k = +\infty$, $p_1, ..., pk$ are defined as:

$$p_j = N(\mu_j) - (N\mu_{j-1}),\ for\ j = 1, ..., k-1 \tag{4.10}$$

where N is the cumulative standard normal distribution.

Although the true values of the latent health variable can not be directly observed, I can estimate the conditional expectation of each observation by means of the normal distribution, as suggested by Maddala (1983):

$$\overline{h}_i = E(h*_i \diagup \mu_{j-1} < h*_i < \mu_j) = \frac{n(\mu_{j-1}) - n(\mu_j)}{N(\mu_j) - N(\mu_{j-1})} = \frac{n(\mu_{j-1}) - n(\mu_j)}{p_j}) \tag{4.11}$$

where $\overline{h}_i$ is the discrete random version of the underlying continuous variable. N is again the cumulative standard normal distribution and n is the standard normal density function.

The use of POLS implies some loss of information due to discretization. If it is the case, the residual variance is underestimated and the corresponding t-statistics are overestimated. However, Origo and Pagani (2009) claim that ordered probit may present the same problem. The main difference between POLS and ordered probit is that the former assumes that the variables of the model are approximately normally distributed, while ordered probit makes no assumption on the distribution of the variables. Van Praag and Ferrer-i-Carbonell (2004/2008) show that POLS and ordered probit estimated coefficients, t-ratios and standard deviations differ only for a multiplication factor. However, the advantage of POLS is that equation 4.7 can be estimated using traditional econometric strategies —for instance, fixed-effects can not be included in ordered probit—, allowing to interpret estimated coefficients as marginal effects, and directly to compare the results obtained with different models (Origo and Pagani, 2009; Van Praag, Romanov, and Ferrer-i-Carbonell, 2010). — B.1 Appendix shows the alternative models used to test the coherency of the POLS with the ordered probit estimation.

Moreover, taking advantage of the panel structure of the data I also control for time-invariant unobserved individual effects, to correct for the existence of omitted variables:

$$h_{it} = X_{it}\beta + y_{it}\gamma_1 + Rel.Deprivation_{it}\gamma_2 + Rel.Satisfaction_{it}\gamma_3 + u_i + \epsilon_{it} \quad (4.12)$$

where u_i is the time-invariant individual-level effect, and ϵ_{it} is the disturbance term.

In order to estimate equation 4.12, an assumption has to be made regarding the correlation between u_i and the regressors. When this correlation is zero, u_i is considered "an individual random effect", and parameters can be consistently estimated by OLS with robust variance matrix, what is named Pooled OLS, which do not require full strict exogeneity.

However, u_i is a nuisance parameter and cannot be estimated. Given that Pooled OLS might be inefficient, the model could also be estimated by modeling the within-panel correlation to get more efficient estimates. This option is called Random Effects estimation (RE).

On the other hand, if the unobserved effect is suspected to be correlated with the X_{it}'s, "fixed-effects" (FE) is the most appropriate strategy to estimate the coefficients consistently (Wooldridge, 2010). Genetics or ability are individual time invariant unobserved variables, which obviously affect health, but also could be correlated with other explanatory variables such as income or education. In this case the use of FE might solve part of the income endogeneity.[8]

Both techniques can be easily applied using traditional statistical packages. Nonetheless, one drawback of the FE approach is that it removes panel-level averages — $\overline{h}_i$, $\overline{y}_i$,$\overline{Rel.Deprivation}_i$ and $\overline{Rel.Satisfaction}_{it}$— from each side of equation 4.12 to get rid off the fixed effect u_i from the model.

$$h_{it} - \overline{h}_i = (X_{it} - \overline{X}_{it})\beta + (Z_i - Z_i)\delta + (y_{it} - \overline{y}_i)\gamma_1(RD_{it} - \overline{Rel.Deprivation}_i)\gamma_2 +$$

$$+(Rel.Satisfaction_{it} - \overline{Rel.Satisfaction}_{it})\gamma_3 + u_i - u_i + \epsilon_{it} - \overline{\epsilon}_i \tag{4.13}$$

obtaining:

$$\widetilde{h_{it}} = \widetilde{X_{it}}\beta + \widetilde{y_{it}}\gamma_1 + Rel.\widetilde{Deprivation}_{it}\gamma_2 + Rel.\widetilde{Satisfaction}_{it}\gamma_3 + \widetilde{\epsilon_{it}} \tag{4.14}$$

[8] Nevertheless, if omitted variables are not time-invariant or if there is reverse causality between income and health, income will be still endogenous.

Then, OLS can be applied to equation 4.14, and it will produce consistent estimates. However, note that Z_i variables from equation 4.13 are time-invariant covariates. This approach implies that any characteristic that does not vary over time cannot be estimated, because it disappears after the differences transformation, for instance individual's gender or origin. In order to avoid this, Mundlak (1978) recommends to include panel-level means of the time-varying regressors to capture its correlation with u_i. Moreover, estimated coefficients on time-varying variables might be numerically identical to within estimates, in other words, to FE estimation. Thus, Mundlak's approach allows to estimate coefficients on time-invariant variables, and also to test the appropriateness of RE, conducting a Wald test on panel-level means coefficients. If the null hypothesis of "all panel-level means are 0" is rejected, it means that unobserved heterogeneity is correlated with the regressors. In that case, orthogonality assumption is violated, inconsistent RE estimates will significantly differ from their FE counterparts, and the latter model will be more appropriate. This can also be tested using a Hausman test, which considers the null hypothesis that extra orthogonality conditions imposed by the RE estimator are valid. Again if this null hypothesis is rejected, FE estimation is more appropriate (Baum, 2006).

Therefore, I estimate equation 4.12 by FE and using the Mundlak's approach.

4.5 Empirical Results

This section presents the results obtained for the estimation of the effect of relative deprivation and relative satisfaction on SAH using the econometric techniques described in the previous section.

4.5.1 Relative Deprivation, Relative Satisfaction and SAH

Table 4.3 summarizes Pooled OLS estimations using the whole sample (TOTAL), and the two sub-samples for MALE and FEMALE. All the specifications include the control variables. The relative income measures are based on the reference group defined only by individual's occupation —Table B.2 in the B Appendix shows the estimated coefficients for all the variables included in the models.

Table 4.3: Pooled OLS estimations of relative income on SAH using occupation as reference group, 1994-2010

	TOTAL		MALE		FEMALE	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
income	0.0914***	0.2031***	0.0764***	0.2031***	0.0965***	0.2033***
mean income	0.1275***		0.1437***		0.1193**	
Rel.Deprivation		0.2383***		0.2378***		0.2685***
Rel.Satisfaction		-0.0285		-0.0534**		0.0008
R-squared	0.0816	0.0815	0.0936	0.0932	0.0701	0.0703
Obs.	153,729	153,729	82,679	82,679	71,050	71,050

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%. Mean income, Rel. Deprivation and Rel. Satisfaction are refered to Refoccup.

For the three samples income presents a positive and significant effect on SAH. In this case, the evidence suggests that the level of income might be relevant for health, as it is claimed by the *Absolute Income Hypothesis*.

When relative income is measured by means of the average income of the reference group, it has a positive sign (model 1). In other words, individuals who belong to a richer reference group report better health. According to the relative income hypothesis, when average income of the reference group increases, individuals might feel more deprived and health may worsen. Nevertheless, as it has been pointed out in section 4.3, a variation in average income does not always represent a relative income change. Therefore, I believe that average income might capture the effect of income differences between reference groups, rather than within.

In model 2 relative income is measured by means of upward and downward income comparisons. In this specification, $Rel.Deprivation$ presents a positive sign and is significant for the three samples. However, the $Rel.Satisfaction$ coefficient is negative.

These results would suggest that there is no evidence of psychosocial stress when individuals compare to richer individuals, on the contrary, it would be the tunnel effect suggested by Hirschman and Rothschild (1973). Since reference group in Table 4.3 is occupation, $Rel.Deprivation$ gives positive expectations to individuals about their future income, and therefore it might not be negative for health. This is also the case when the reference group is defined by occupation and region, as shown in Table 4.4. One possible explanation of this result is that individuals living in societies with high social and upward mobility might not consider to be "currently" relative deprived as a handicap to obtain a higher future income. As a result, relative deprivation does not generate psychosocial stress and the initial relative income hypothesis might not hold. Although in the literature of well-being it is mostly found that the effect of $Rel.Deprivation$ is negative for life satisfaction, new empirical evidence suggests that it is not always the case. D'Ambrosio and Frick (2012) claim in their study of dynamic relative income on well-being for Germany, that the tunnel effect explains individual well-being in stable societies, as it is the case in Germany.

On the other hand, $Rel.Satisfaction$ is negative and significant for males and also for the TOTAL sample when *refoccup4* and *refoccup16* are considered. It means that a higher distance with the worse-off individuals in the reference group might worsen health. Thus, both relative income indexes are significant, showing that upward and downward income comparisons are relevant for health. Nevertheless, $Rel.Satisfaction$ is not significant for females. This might confirm that there are gender differences on the effect of relative income comparisons in Germany as suggested in Mayraz, Wagner, and Schupp (2009).[9]

These findings are consistent with the study of Wunder and Schwarze (2009) with SOEP data, in which they find a positive effect of their measure of relative deprivation on well-being when using occupation to define reference group. They also find that the impact of upward comparisons is stronger than the effect of downwards ones. The same is shown in the results of this study, where the positive impact of $Rel.Deprivation$ is much stronger than the one of $Rel.Satisfaction$ —as it is suggested in the Fehr and Schmidt's utility function.

Thus, in the case of Germany it seems that the negative impact of $Rel.Satisfaction$ might be compensated by the positive effect of $Rel.Deprivation$. This might be one explanation for the results' disparities in those studies using average income and not controlling for another measure of relative income. Depending on which of the two relative income indexes is stronger, average income might have a positive or a negative sign.[10]

Regarding the covariates, results are quite robust in all the specifications —covariates estimations for the four reference groups related to occupation and region are shown in the Table B.2 in the B Appendix.[11]

As expected age has a deleterious effect on health due to human capital depreciation

[9]Results regarding female and male samples are based on the assumption that females and males compare with both at the same time. I have conducted alternative estimations for the male and female samples considering that they compare only with individuals of the same gender. Results obtained under the latter assumption are similar to the ones presented in this study and they are available upon request.

[10]In this analysis it is not possible to control for both, average income and Rel. Deprivation and Rel. Satisfaction indexes, in the model, because the Rel. Deprivation and Rel. Satisfaction are relative indexes. It means that they are corrected for the size of the reference group, dividing the indexes by the average income of the reference group.

[11]Covariates estimations with the rest of the reference groups present similar results. The tables are available upon request.

—especially for MALE—, which increases with age as shown by the positive effect of age squared. In the TOTAL sample estimation females report worse SAH than males, being positive and significant the effect of household size and education. All these results coincide with the ones found in the previous literature.

Regarding civil status, being married but separated has a protective effect on health (with respect to married people), but only for females. The same happens for the case of widowed and divorced individuals for the TOTAL sample. Being single has no effect on SAH in the MALE and FEMALE samples. Europeans and non-Europeans report better SAH than Germans, but these variables are not significant for the case of females. However, stateless is positive and negative for males and females respectively. Finally, employment shows disparities in the results. Only being on training and sheltered working are negative and significant with respect to full-time employed for the three samples. Being part-time or marginal part-time working are negative and significant only for males. Finally, being not employed is negative for males, but not significant. In the case of females it is positive, but only significant for the specifications of *refoccup4* and *refoccup16* in the occupation reference group. Actually, unemployment is believed to affect health negatively. However, in this case the not employed variable includes different status, for instance females on maternity leave, or females that usually have a secure job but they are not currently working, maybe because they have freely decided not to work. This might be an explanation why not working would not be negative for females' health, because the negative effect of unemployed females might be offset by these "positive situations". Therefore, I have also estimated the model defining labour status as being unemployed or not. The findings confirm that being unemployed has a negative and significant effect on health with respect to non unemployed for the three samples as it was expected (see table B.3 in the B Appendix).

4.5.2 Panel effects with unobserved heterogeneity

This section presents the results when unobserved heterogeneity is considered. I focus on two possible scenarios. Firstly, when the time-invariant unobserved effect is assumed not to be correlated with the regressors and that model is estimated using RE. And secondly, when X are allowed to be correlated with u_i. In this case, the model is estimated using FE and the Mundlak's approach. Results obtained with FE and Mundlak's approach are quite similar. However, Mundlak's approach allows us to estimate the effect of time invariant variables and to analyze the correlation between the omitted variables and the regressors through the panel-level means estimation —this correspondence is shown in Table B.6.

Table 4.5 shows the effect of relative income on health, now estimated by RE and FE. Regarding income and the relative income variables, the results follow the same pattern as in the Pooled OLS estimations. Income is positive and significant. $Rel.Deprivation$ shows a positive effect on health for the three samples. And $Rel.Satisfaction$ has a deleterious effect but is not significant for females. However, the estimated coefficients for those three variables are lowered after correcting for unobserved heterogeneity, especially in the FE specification. While $Rel.Deprivation$ increases health in 0.2383 in the Pooled OLS for refoccup, its coefficient reduces to 0.1916 in the RE model, and even more when the unobserved heterogeneity is correlated with the regressors, to 0.0865. However, the negative effect of $Rel.Satisfaction$ presents a slightly decrease, from -0.0285 to -0.0233.

Thus, the Pooled OLS estimation might overestimate the effect of income and relative income on SAH. This result is reinforced by the significance of the panel-level means of income and $Rel.Deprivation$ when using the Mundlak's approach, showing that part of the effect of income on health is due to the correlation of income with omitted variables — panel-level means are shown in Table B.5 in the B Appendix. Alternatively, the significance of the panel-level means might also suggest that individuals' history might be relevant for health. If it is the case, not only *current* absolute and relative income might be important for health, but also permanent income or to be deprived recurrently. Nevertheless, in this analysis is not possible to disentangle which is the real interpretation of the panel-level means variables.

What is clear is that unobserved heterogeneity still explains almost half of the variability of SAH, as the rho coefficient shows in all the specifications. More research is needed to find how much of this unobserved heterogeneity is due to socioeconomic variables.

Table 4.4: Pooled OLS estimations of the effect relative income on SAH using occupation and region as a reference group, 1994-2010

	TOTAL	MALE	FEMALE
Refoccup2			
income	0.1911***	0.1942***	0.1872***
Rel.Deprivation	0.2204***	0.2298***	0.2419***
Rel.Satisfaction	-0.0285	-0.0539**	0.0011
R-squared	0.0817	0.0937	0.0703
Refoccup4			
income	0.1968***	0.2023***	0.1885***
Rel.Deprivation	0.2297***	0.2481***	0.2376***
Rel.Satisfaction	-0.0337**	-0.0585***	-0.0040
R-squared	0.0818	0.0939	0.0703
Refoccup16			
income	0.1681***	0.1788***	0.1512***
Rel.Deprivation	0.1548***	0.1868***	0.1393***
Rel.Satisfaction	-0.0311**	-0.0570***	0.0000
R-squared	0.0814	0.0935	0.0698
Obs.	153,729	82,679	71,050

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%.

Table 4.5: RE and FE estimations using occupation and regional reference groups, 1994-2010

	Refoccup		Refoccup2		Refoccup4		Refoccup16	
SAH	RE	FE	RE	FE	RE	FE	RE	FE
TOTAL								
income	0.1455***	0.0693***	0.1507***	0.0732***	0.1505***	0.0744***	0.1270***	0.0654***
Rel.Deprivation	0.1916***	0.0865**	0.2069***	0.0987***	0.2052***	0.1019***	0.1540***	0.0836***
Rel.Satisfaction	-0.0278**	-0.0233*	-0.0298***	-0.0217	-0.0314***	-0.0220*	-0.0260**	-0.0201
Obs.	153,729	153,729	153,729	153,729	153,729	153,729	153,729	153,729
rho	0.470	0.565	0.470	0.565	0.470	0.565	0.470	0.565
MALE								
income	0.1608***	0.0838***	0.1603***	0.0827***	0.1687***	0.0973***	0.1462***	0.0878***
Rel.Deprivation	0.1960***	0.0784*	0.2004***	0.0809*	0.2226***	0.1168***	0.1790***	0.1051***
Rel.Satisfaction	-0.0514***	-0.0412**	-0.0510***	-0.0377**	-0.0523***	-0.0389**	-0.0439***	-0.0321**
Obs.	82,679	82,679	82,679	82,679	82,679	82,679	82,679	82,679
rho	0.483	0.574	0.483	0.574	0.483	0.574	0.483	0.574
FEMALE								
income	0.1331***	0.0635**	0.1441***	0.0707**	0.1319***	0.0532**	0.1075***	0.0460**
Rel.Deprivation	0.1936***	0.1046*	0.2206***	0.1226**	0.1880***	0.0823*	0.1282***	0.0597
Rel.Satisfaction	-0.0029	-0.0069	-0.0080	-0.0071	-0.0085	-0.0045	-0.0068	-0.0093
Obs.	71,050	71,050	71,050	71,050	71,050	71,050	71,050	71,050
rho	0.460	0.555	0.460	0.555	0.460	0.555	0.460	0.555

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%.

The sign and statistical significance of the covariates under RE specification are similar to the Pooled OLS estimation. However, some of them such as $hsize$ and $educ$ lose their statistical significance when using FE and Mundlak's approach (see Table B.4 in the B Appendix). One possible explanation might be that panel variation of both variables is low. Nevertheless, their panel-level means are significant, showing that the effect of these variables on health might be through omitted variables. Thus, once unobserved heterogeneity is taken into account their effect on health vanishes. At the same time, estimated coefficients are lower comparing to Pooled OLS estimations, especially in the Mundlak's approach. Again, panel-level means might capture part of their effect due to its correlation with unobserved heterogeneity.

Finally, after conducting a Wald test on panel-level means of the time variant variables for the three specifications, the null hypothesis is rejected. This result confirms that u_i is related with the regressors, and the FE specification is more convenient. Finally, a Hausman test also confirms this result —tests are shown in Table B.9 in the B.2 Appendix.

4.5.3 The relevant Reference Group

In order to check the validity of the reference groups defined by occupation, more traditional definitions of reference group have also been considered in the analysis. First, reference groups defined by age, educational level and the three different regional levels described in section 4.2. Second, reference groups defined only using the regional criteria.

The Pooled OLS estimations using the two sets of reference groups are shown in Table 4.6. In the case of the first set of reference groups, the statistical significance and the size of the coefficients of income and relative income indexes are similar to the ones defined by occupation. However, once unobserved heterogeneity is included in the analysis, the significance of the relative income measures vanishes in most of the specifications for males and females —Table 4.7 summarizes the results when FE are used. As it is shown in the previous section, this is not the case for $Rel.Deprivation$ and $Rel.Satisfaction$ measured using occupational reference groups.

Table 4.6: Pooled OLS estimations of the effect of relative income on SAH using traditional reference group definitions, 1994-2010

Refgrup	TOTAL	MALE	FEMALE	Refgrup	TOTAL	MALE	FEMALE
Refgrup2				Region2			
income	0.1480***	0.1335***	0.1597***	income	0.1594**	0.1857**	0.1355*
Rel.Deprivation	0.1585***	0.1206**	0.2182***	Rel. Deprivation	0.1721	0.2308	0.1424
Rel.Satisfaction	-0.0205	-0.0379*	0.0003	Rel. Satisfaction	0.0023	-0.0257	0.0290*
R-squared	0.0810	0.0926	0.0698	R-squared	0.0811	0.0928	0.0698
Refgrup4				Region4			
income	0.1690***	0.1552***	0.1796***	income	0.2043**	0.2309**	0.1805*
Rel.Deprivation	0.1174***	0.0790*	0.1786**	Rel. Deprivation	0.2611*	0.3227**	0.2295
Rel.Satisfaction	-0.0091	-0.0256*	0.0111	Rel. Satisfaction	-0.0199	-0.0465	0.0048
R-squared	0.0811	0.0927	0.0700	R-squared	0.0812	0.0930	0.0699
Refgrup16				Region16			
income	0.1549***	0.1494***	0.1557***	income	0.1532*	0.1857**	0.1193
Rel.Deprivation	0.1311**	0.1154	0.1648**	Rel. Deprivation	0.1521	0.2290	0.0955
Rel.Satisfaction	-0.0144	-0.0330	0.0083	Rel. Satisfaction	0.0010	-0.0277	0.0294
R-squared	0.0811	0.0927	0.0698	R-squared	0.0810	0.0929	0.0697
Obs.	153,729	82,679	71,050	Obs.	153,729	82,679	71,050

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%.

When only region is used to define the reference group, income is positive and significant for the three resultant reference groups (see Table 4.6). $Rel.Deprivation$ is only significant in the case of the 4 big regions, and $Rel.Satisfaction$ is never significant. The lost of significance is more pronounced when unobserved heterogeneity is considered, particularly, when it is allowed to be correlated with the regressors as is shown in Table 4.7. $Rel.Deprivation$ and $Rel.Satisfaction$ are not significant in almost any of the three regional reference groups. This might suggest that relative income measured by regional criteria might capture the effect of omitted variables. Moreover, depending on the regional level considered the effect of $Rel.Deprivation$ and $Rel.Satisfaction$ changes the sign. Again, these results might explain the disparities found in previous studies when regional reference groups were used and unobserved heterogeneity is not considered.

Table 4.7: FE estimations of the effect relative income on SAH using traditional reference group definitions, 1994-2010

Refgrup	TOTAL	MALE	FEMALE	Refgrup	TOTAL	MALE	FEMALE
Refgrup2				Region2			
income	0.0707***	0.0806***	0.0572*	income	0.0764	0.1043**	0.0838
Rel.Deprivation	0.0830**	0.0661	0.0856	Rel. Deprivation	0.0613	0.1072	0.1467
Rel.Satisfaction	-0.0283**	-0.0418**	-0.0116	Rel. Satisfaction	-0.0365	-0.0454*	-0.0171
rho	0.5652	0.5731	0.5555	rho	0.5656	.5743	0.5557
Refgrup4				Region4			
income	0.0849***	0.0697**	0.0970**	income	-0.0874	0.0401	0.1223
Rel.Deprivation	0.1160**	0.0493	0.1705**	Rel. Deprivation	-0.2514	-0.0192	0.2284
Rel.Satisfaction	-0.0301*	-0.0334	-0.0238	Rel. Satisfaction	0.0379	-0.0169	-0.0302
rho	0.5652	0.5731	0.5555	rho	0.5651	.5743	0.5557
Refgrup16				Region16			
income	0.0711***	0.0559*	0.0827**	income	-0.0952	0.0373	0.0788
Rel.Deprivation	0.0870*	0.0171	0.1437**	Rel. Deprivation	-0.2722*	-0.0290	0.1418
Rel.Satisfaction	-0.0257*	-0.0311	-0.0169	Rel. Satisfaction	0.0382	-0.0189	-0.0120
rho	0.5652	0.5731	0.5555	rho	0.5649	.5743	0.5557
Obs.	153,729	82,679	71,050	Obs.	153,729	82,679	71,050

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%.

These findings support the idea that Germans compare themselves with people in the same profession as it is shown in Mayraz, Wagner, and Schupp (2009), and these comparisons might be relevant for health.

Since individuals' reference group might differ between countries, the cross-country analysis of the impact of relative income on health will be difficult until data sets do include information to determine the relevant reference group.

4.5.4 Quasi-objective Health measures

A set of alternative health measures are used to check the robustness of the results obtained with *SAH*.

In Table 4.8 are shown the results of the Pooled OLS estimations for the objective measures mentioned in the data section, referring to the physical dimension of health, *pcs*, the body mass index, *bmi*, and the mental dimension, *mcs*. The sign and significance of the estimated coefficients for income, $Rel.Deprivation$ and $Rel.Satisfaction$ are similar to the SAH results in Tables 4.3 and 4.4 for *pcs* and *bmi*. However, the size of income and $Rel.Deprivation$ coefficients is much lower.

In the case of *mcs*, the effect of income is positive but it is not significant in most of the cases. The same happens with the relative income indexes, which change the sign of the effect depending on the reference group considered.

Thus, the physical health measures confirm the results obtained for SAH with Pooled OLS, but not mental health. One explanation might be that correlation between SAH and *pcs* is much higher, than with *mcs*, as it was shown in the data section. These findings point out that relative income might affect health through physical health.

Table 4.8: Pooled OLS estimations using "quasi-objective" measures of health and reference group defined by occupation, 2002-2010

	Refoccup			Refoccup2			Refoccup4			Refoccup16		
	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE
PCS												
income	0.0357***	0.0367***	0.0319***	0.0334***	0.0353***	0.0284***	0.0340***	0.0360***	0.0290***	0.0298***	0.0332***	0.0233***
Rel.Deprivation	0.0568***	0.0590***	0.0527***	0.0531***	0.0572***	0.0471***	0.0549***	0.0599***	0.0477***	0.0441***	0.0525***	0.0336***
Rel.Satisfaction	-0.0031	-0.0053**	0.0005	-0.0031	-0.0059**	0.0013	-0.0034	-0.0056**	0.0006	-0.0030	-0.0059**	0.0018
R-squared	0.1288	0.1465	0.1131	0.1290	0.1471	0.1131	0.1293	0.1475	0.1131	0.1286	0.1470	0.1124
MCS												
income	0.0030	0.0019	0.0037	0.0122***	0.0086	0.0169**	0.0108**	0.0086	0.0135**	0.0119***	0.0087*	0.0156***
Rel.Deprivation	-0.0186**	-0.0131	-0.0222	0.0007	0.0007	0.0057	-0.0026	0.0003	-0.0018	-0.0036	-0.0012	-0.0024
Rel.Satisfaction	0.0091**	0.0091*	0.0095	0.0049	0.0058	0.0037	0.0056*	0.0057	0.0054	0.0030	0.0047	0.0009
R-squared	0.0309	0.0177	0.0262	0.0306	0.0174	0.0258	0.0306	0.0174	0.0258	0.0305	0.0174	0.0257
BMI												
income	0.0136***	0.0072*	0.0232***	0.0120***	0.0059**	0.0201***	0.0116***	0.0058**	0.0193***	0.0107***	0.0054***	0.0171***
Rel.Deprivation	0.0208**	0.0164**	0.0331***	0.0183***	0.0141**	0.0279***	0.0172***	0.0135**	0.0259***	0.0143***	0.0118***	0.0201***
Rel.Satisfaction	-0.0009	-0.0035*	0.0012	-0.0003	-0.0032**	0.0023	-0.0002	-0.0034**	0.0027	-0.0006	-0.0040**	0.0028
R-squared	0.1315	0.0924	0.1004	0.1315	0.0923	0.1001	0.1313	0.0923	0.0999	0.1312	0.0923	0.0995
Obs.	49,198	25,939	23,259	49,198	25,939	23,259	49,198	25,939	23,259	49,198	25,939	23,259

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%.

Table 4.9: RE and Mundlak estimations using "quasi-objective" measures of health and reference group defined by occupation, 2002-2010

	TOTAL		MALE		FEMALE	
	RE	Mundlak	RE	Mundlak	RE	Mundlak
PCS						
income	0.0260***	0.0017	0.0303***	0.0183***	0.0198***	0.0041
Rel.Deprivation	0.0451***	0.0107	0.0461***	0.0260***	0.0412***	0.0253**
Rel.Satisfaction	-0.0014	0.0024	-0.0053*	-0.0075**	0.0034	0.0046
rho	0.493	0.493	0.487	0.487	0.491	0.491
MCS						
income	0.0040	-0.0009	0.0017	-0.0078	0.0069	0.0039
Rel.Deprivation	-0.0124*	-0.0134	-0.0051	-0.0109	-0.0176	-0.0200
Rel.Satisfaction	0.0047*	-0.0011	0.0071**	0.0053	0.0018	-0.0075
rho	0.469	0.469	0.478	0.478	0.457	0.457
BMI						
income	0.0025***	-0.0014	0.0009	-0.0008	0.0050***	0.0005
Rel.Deprivation	0.0047**	-0.0012	0.0014	-0.0020	0.0095***	0.0033
Rel.Satisfaction	0.0005	0.0010	-0.0001	0.0004	0.0008	0.0005
rho	0.881	0.881	0.871	0.871	0.888	0.888
Obs.	49,198	49,198	25,939	25,939	23,259	23,259

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%. Rel. Deprivation and Rel. Satisfaction are refered to Refoccup.

When the model is estimated using RE and Mundlak's approach, the impact and significance of $Rel.Deprivation$ and $Rel.Satisfaction$ on *pcs* are similar to the POOLED OLS estimations, showing that $Rel.Deprivation$ and $Rel.Satisfaction$ are relevant for health in the case of males. For females only $Rel.Deprivation$ is significant —see Table 4.9. In the case of *mcs*, $Rel.Deprivation$ is negative, and $Rel.Satisfaction$ is positive for males and negatives for females, but in both cases are not significant. Finally, the coefficients of $Rel.Deprivation$ and $Rel.Satisfaction$ are not precisely estimated for *bmi* in most of the specifications. Around 90% of the variability on *bmi* is due to unobserved heterogeneity. It indicates that *bmi* might be explained by variables not included in this analysis.

In sum, $Rel.Deprivation$ and $Rel.Satisfaction$ might be only relevant for *pcs*, but not for the mental dimension of health and *bmi*. It might be important to use more accurate objective measures of health to disentangle how relative income operates on physical and mental health.

4.6 Concluding Remarks

The aim of this study is to shed light on the relationship between relative income and health. Previous research only takes into account upward income comparisons. Nevertheless, the findings of this study show that both upward and downward comparisons might be relevant for health.

Relative income is measured by means of a relative deprivation and a relative satisfaction index in this study. Both are significant for the TOTAL and MALE samples —for females only upward comparisons are precisely estimated. As a matter of fact, Rel. Deprivation might have a positive effect on health through an "informative or tunnel effect". In the case of Germany, being deprived might not generate psychosocial stress as the relative income hypothesis states. Alternatively, Rel. Satisfaction presents a negative impact on health. However, the effect of Rel. Deprivation is much stronger.

These findings might be an explanation for the results' disparities found in the literature when relative income is measured by the average income of the reference group. Depending on which of the two dimensions of relative income dominates, average income might take a positive or a negative sign. Moreover, the effect of relative deprivation and relative satisfaction might be positive or negative depending on individuals' beliefs. It means that they might be different depending on the country considered. Again, this might explain the ambiguous results when analysing different countries. Therefore, it is important to understand how individuals' beliefs are created and how they differ between countries.

Once unobserved heterogeneity is considered, the relative income indexes coefficients are lowered, especially with FE, but they are still significant. This would suggest that there are omitted variables correlated with relative income, which might explain the remaining variability of the proposed model. As the value of rho indicates it is almost 50%. Thus, future research might focus on finding which are these omitted variables.

All these finding should be taken into account for health policy design, because they point out that redistribution might not be always a health enhancing policy. Therefore, more research is needed to disentangle how relative concerns might affect health (and also well-being).

Although final estimations are not affected by omitted variables endogeneity, reverse causality between income and health has not been considered in this study.

It has been also confirmed that reference groups are based on occupation for Germany. Rel. Deprivation and Rel. Satisfaction indexes lose their significance when more traditional definitions of reference group are used to measure relative income.

Finally, the findings of this study point out that Rel. Deprivation and Rel. Satisfaction are relevant for physical health, but not for mental health. Estimations using the physical dimension of the SF12 index, *pcs*, support the results obtained with SAH, but not *mcs* and *bmi*. Thus, more research is needed to understand how relative income operates in health using more accurate objective health measures.

Chapter 5

State dependence in Self-assessed Health in Spain

76

5.1 Introduction

This last chapter is concerned with health modeling when studying its socioeconomic determinants.[1] As it has been pointed out in previous chapters, the relationship between socioeconomic status and health is well documented in the literature (Wilkinson, 2000; Deaton, 2003). Empirical evidence shows that low endowments of human capital or low income worsen the individual level of health. To the extent that this individual socioeconomic heterogeneity persists over time, the probability of persistence in health outcomes increases (Gravelle and Sutton, 2009). On the other hand, the literature, especially in the field of labour market economics, has shown the importance of accounting for *scarring effects* when explaining inherently dynamic processes (Arulampalam, Booth, and Taylor, 2000; Stewart, 2007; Biewen, 2009). The effect of a past value influencing *by itself* the future values of the same process is known as *genuine state dependence*.

In this chapter, I aim to measure, for the first time, the degree of genuine state dependence in self-assessed health status in Spain, that is, how much *current* health is explained by *past* health experiences while controlling for observed and unobserved characteristics.[2] At the measurement level, accounting for state dependence will correct the possible overestimation of the socioeconomic factors — such as income or education. As for policy design, if the results show that the degree of state dependence is positive and significant, this will imply that policy interventions that improve health will have long-lasting consequences over time. As a result, health policies should give special emphasis to prevention.

As a matter of fact, one of the objectives of the Spanish public health agenda is to reduce health inequalities by working on the social determinants of health, as was proposed and

[1] This chapter is joined work with Sara Ayllón and it is published in Hacienda Pública (2012).

[2] For the remainder of the paper, I refer to genuine state dependence when describing state dependence.

approved during the Spanish Presidency of the European Union in 2010.[3] For this reason, Spain established a Health Commission as early as 2008 to study and monitor health determinants. Despite the preliminary results obtained, it has been suggested that more empirical evidence is required to understand the mechanisms through which social determinants affect health.[4] This paper is in line with this objective as it studies the importance of state dependence on health and its relationship with other health determinants.

Few existing studies have taken into account the importance of state dependence and unobserved heterogeneity when explaining health outcomes. Contoyannis, Jones, and Rice (2004a) and (2004b), my main reference for this study, support the existence of a certain degree of self-assessed health state dependence in the United Kingdom. They show that the impact of individual heterogeneity on their model decreases when controlling for state dependence and that unobserved heterogeneity accounts for 30% of the unexplained variation in health. Halliday (2008) finds that the degree of health state dependence in the United States is modest for half of the population while very high for those suffering bad health. He concludes that many health problems should be traced back to early adulthood or childhood. Concerning more objective health measures, Karlsson, Mayhew, and Rickayzen (2009) analyse the interdependences of survival probabilities, cohabitation and employment over time, concluding that health status has a strong impact on subsequent survival probabilities.

[3]See *Council conclusions on Equity and Health in All Policies: Solidarity in health*, Council of the European Union, Brussels, 2010: "http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/lsa/114994.pdf".

[4]*Análisis de situación para la elaboración de una propuesta de políticas e intervenciones para reducir las desigualdades sociales en salud en España*, Comisión para Reducir las Desigualdades Sociales en Salud en España, Ministerio de Sanidad y Política Social, Madrid, 2010: "http://www.mspsi.gob.es/profesionales/saludPublica/prevPromocion/promocion/\desigualdadSalud/docs/Analisis{_{-}}\protect\unhbox\voidb@x\hbox{reducir}{_{-}}\protect\unhbox\voidb@x\hbox{desigualdes.pdf}"

Moreover, Hernández-Quevedo, Jones, and Rice (2008) compare state dependence and unobserved heterogeneity for binary measures of health limitations for a selection of European countries, including Spain. They show that people hampered by any physical or mental problem suffer from a major degree of state dependence. However, a comparative perspective leads them to conclude that a lower degree of state dependence is associated with a greater importance of unobserved heterogeneity — as found in Spain.

To the best of my knowledge, no other evidence based on the Spanish case exists in the literature. That is, the main contribution of this paper is to measure state dependence for self-assessed health (SAH) in Spain. I seek to disentangle the causes of the persistence of health outcomes by focusing on its three main sources: socioeconomic heterogeneity, state dependence and unobserved heterogeneity. With this objective in mind, I base my results on a series of econometric strategies that take these sources into account and also control for the initial conditions problem and a possible correlation between random effects and time-varying explanatory variables. In addition to previous models already used in the literature, a new feature of my analysis is the inclusion of a new econometric strategy based on a Heckman model with an initial conditions equation run as an ordinal probit. Hence, all models follow an ordinal approach to therefore maximise the use of information available in the data set.

The main results indicate that state dependence and unobserved heterogeneity are the most important explanatory factors for a given health status. As a matter of fact, most of the explanatory power of the observed variables vanishes when introducing individual-specific effects and lags of the dependent variable. However, while the direction of my results is clear in the sense that past health status determines *by itself* future levels of health, its degree of influence diminishes as the structure of the model error terms is improved.

The structure of the paper is as follows. Section 5.2 describes the data set and the final sample used in my analysis. In section 5.3, I focus on health dynamics in Spain and on the descriptive of SAH persistence. Section 5.4 presents the econometric techniques used in the empirical analysis and outlines the estimation procedures, while Section 5.5 shows the main results. Finally, Section 5.6 provides some concluding remarks.

5.2 Data set, sample and definitions

The data set is the Spanish component of the European Community Household Panel (ECHP) which is a harmonised cross-national longitudinal survey collected across all members of the former European Union-15 between 1994 and 2001 — except for Austria and Finland who joined the project in 1995 and 1996, respectively.[5]

The greatest advantage of the ECHP is that an standardised questionnaire is answered each year by a representative sample of individuals and households which allows longitudinal analysis. Moreover, it collects information related to income, education, employment, health, household composition, housing, social relations and individual satisfaction. On the negative side, only the population living in private households is represented in the ECHP, so this study does not cover individuals living in community housing (old people's homes, hospitals, etc.).

My working sample is composed of the adult population with individuals older than 18 being allowed to enter the panel at any time. After excluding missing values due to attrition and item non-response, I am left with a working sample of 14,657 individuals and 78,156 individual-wave observations in my final regressions.

[5] I am aware that eight waves introduce some limitations to my analysis as it is not a long period of time for the study of health. However, for Spain, there is no other longitudinal data set available that would contain all the variables needed.

As in previous chapters, individual health is measured by a self-assessed health indicator which reflects individual perception of health in different dimensions: physical, psychological and socioeconomic. SAH is taken from the individual answer to the question: "How is your health in general?". Individuals can report five different answers ordered from 'very poor' (value 1) to 'very good' health (value 5).[6]

As for the main covariates used in the analysis, and following Contoyannis, Jones, and Rice (2004a) I include age as a fourth-order polynomial, marital status, educational qualifications, being an immigrant, deflated equivalent household income, household demographic composition and labour market status.[7] Note that household income has been equivalised using the modified OECD equivalent scale, deflated to 2000 prices and transformed to logarithms to allow concavity between health and income.[8] Table C.1 in the Appendix contains labels, definitions and descriptives of all variables.

[6]This subjective health measure has been found to be a good predictor of morbidity and mortality (Idler and Benyamini, 1997; Deaton, 2003) therefore, it is commonly used in the analysis of health. Literature has shown that self-assessed measures might suffer from a reporting heterogeneity bias — also called "state dependent reporting bias" or "scale of reference bias". Some population groups may systematically rate their health status differently to another due to cultural or socioeconomic differences. Therefore, this phenomenon of differential reporting also exists within countries when samples are stratified by education, age, gender or income (Ziebarth, 2010; Bago d'Uva, O'Donnel, and van Doorslaer, 2008; and Etilé and Milcent, 2006). In order to correct the reporting heterogeneity bias vignettes or other objective health measures might be used to mirror SAH. Unfortunately, the ECHP does not contain vignettes and it is difficult to find an objective health measure which might help us to correct the reporting bias.

[7]Note I cannot control for certain characteristics such as body mass index (BMI) or behaviour (e.g. smoking) even though it is known that being a non-smoker and having a lower BMI are both health enhancing. However, these variables are not available for the whole time span of my study, 1994-2001.

[8]Income is collected retrospectively in the ECHP. So, for instance, interviews that took place during the first wave of the panel in 1994 asked about the income obtained in 1993. I am aware of this time bias in relation to the remaining variables but I preferred to be able to model health dynamics with the eight waves available in the panel. Furthermore, by accepting the time bias in the household income variable I do not need to deal with the number of missing values that arise when one of the household members attrit or does not inform about his/her income.

5.3 Self-assessed Health in Spain: a description

In this section, I analyse SAH evolution in Spain for the aforementioned sample. First, I look at those descriptives that may show some evidence of health persistence. And, second, I focus my attention on the relationship between health and the set of socioeconomic variables that are used in my model to control for observed heterogeneity.

As shown in Figure 5.1, on average, around 11.88% of the adult population report a poor or a very poor health in Spain during the analysed period. Nearly half of the sample reports that they are in good health and around 17.42% say that they enjoy very good health. Moreover, the mean SAH in Spain has undergone a slight increase with 85.32% of individuals reporting a healthy status (fair, good or very good) in 1994 while 90.07% did so in 2001.[9]

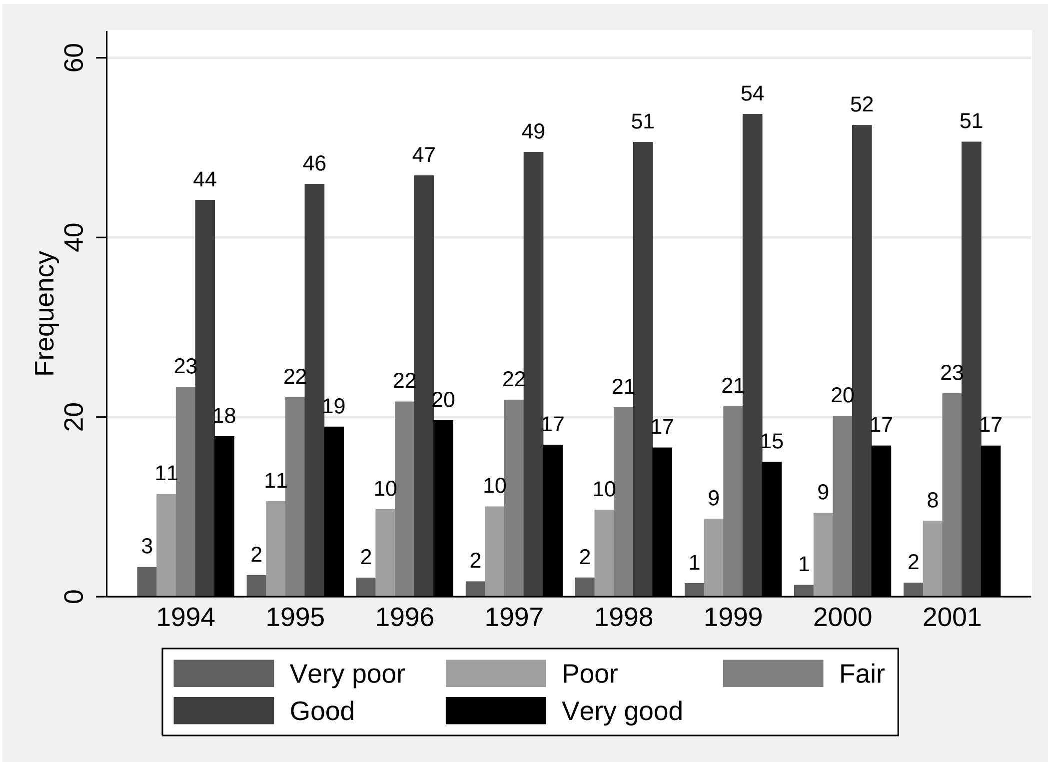
Additionally, Table 5.1 shows self-assessed health transitions between $t-1$ and t highlighting a certain degree of persistence in health outcomes as shown by the values in its diagonal. For example, 44.67% of individuals with poor health at $t-1$ reported the same outcome in the next wave, being around 63.87% in the case of good health. At the same time, transitions between extreme outcomes are rare: individuals tend to remain close to their initial state throughout the whole period. This suggests that health is affected by a certain degree of state dependence with a higher probability of having poor health if a poor health status has been reported in the previous year.

Next, I turn my attention to the relationship between SAH and certain socioeconomic characteristics: education, labour market activity and income.[10] The first graph in Figure

[9]Despite the use of weights, these results may be partly explained by the fact that individuals with the poorest health tend to be more likely to leave the panel because of their difficulties with answering the questionnaire or death.

[10]See Cantarero and Pascual (2005), Pascual and Cantarero (2007) or Hildebrand and Van Kerm (2009) for detailed analyses of the socioeconomic determinants of self-assessed health in Spain using the same data set.

Figure 5.1: Percentage of individuals per self-assessed health category by year in Spain, 1994-2001



Note: Weighted results.

5.2 displays the relationship between the maximum level of education and self-assessed health. Clearly, there is a gradient between education and health, meaning that individuals with a higher level of education report higher health outcomes. Education might facilitate access to health enhancing goods or to better information which has a positive impact on health.

Similarly, labour market status has been considered a determinant of health. In Figure 5.2, I observe that employed individuals present higher rates of good or very good health status. This observation has been traditionally supported by the idea that labour generates

Table 5.1: Self-assessed health transitions between $t-1$ and t in Spain, 1994-2001 (percentages)

		SAH at t					
		Very Poor	Poor	Fair	Good	Very Good	Total
	Very Poor	23.36	48.15	20.95	6.10	1.45*	100.00
SAH	Poor	8.69	44.67	34.21	10.60	1.83	100.00
at	Fair	1.97	14.75	44.59	33.82	4.87	100.00
$t-1$	Good	0.21	2.35	15.00	63.87	18.57	100.00
	Very Good	0.11*	0.72	6.77	55.01	37.39	100.00
	Total	1.81	9.62	21.86	49.64	17.07	100.00

Note: Weighted results. *less than 50 observations in the cell.

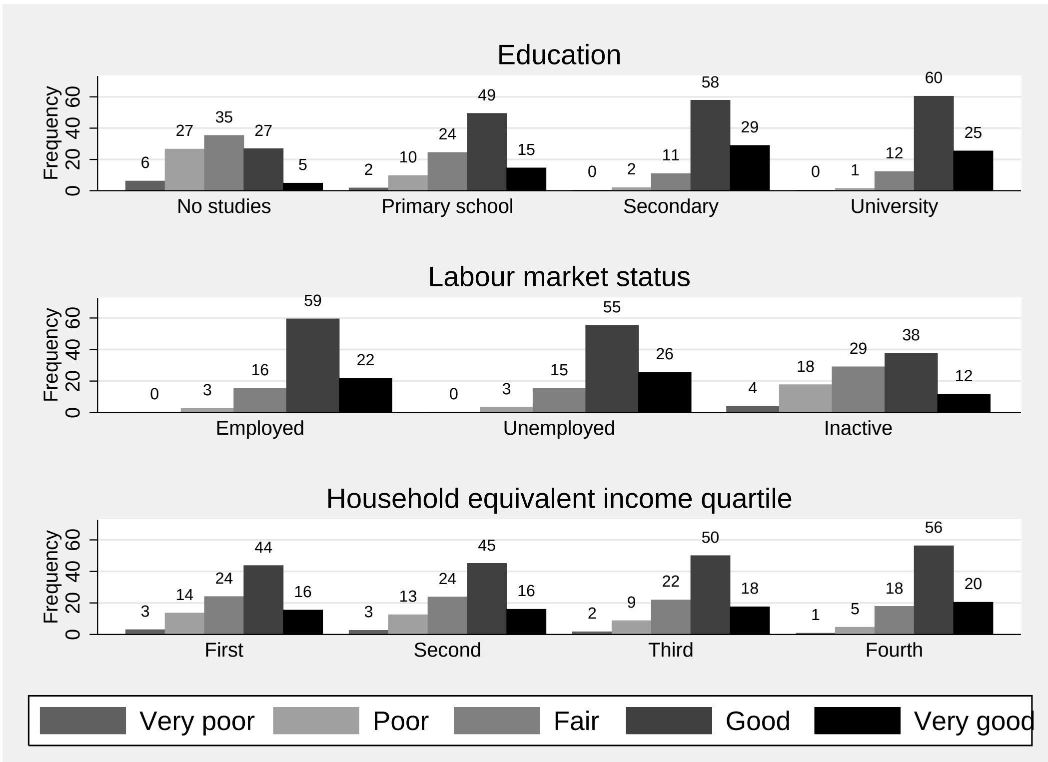
positive psychological effects — for instance, through self-esteem — which might favour better health. In addition, being part of the workforce might allow individuals to enjoy better economic conditions (Gravelle and Sutton, 2009). Therefore, I expect a positive effect of being employed on health.

The last graph in Figure 5.2 describes the percentage of individuals reporting a given health outcome by household equivalent income quartile. Individuals with poor or very poor health are mainly placed in the first income quartile while those in better health conditions have higher incomes. Overall, data descriptives indicate a certain gradient between socioeconomic variables and health — its degree of importance is assessed in the following sections.

5.4 Models and estimation methods

In this section, the different econometric strategies are presented. I build my models step-by-step, from the simplest possible to more complex structures. First, I introduce a pooled ordered probit (Model 1) and a dynamic pooled ordered probit (Model 2), followed by a

Figure 5.2: Self-assessed health by level of education, labour market status and household equivalent income quartile in Spain, 1994-2001



Note: Weighted results.

random-effects ordered probit which adopts Wooldridge's solution in the treatment of initial conditions and unobserved heterogeneity (Model 3) (see below). In order to control for a possible correlation between the random effects and the time-variant explanatory variables, Model 4 adds to Model 3, the average of all these variables (see Mundlak, 1978). Finally, Model 5 follows Heckman's solution in the treatment of initial conditions.

5.4.1 Static and dynamic pooled ordered probit

In the first place, and as a baseline against which to compare the results, I estimate a pooled ordered probit (Model 1) and a dynamic pooled ordered probit (Model 2). Formally, the dynamic specification can be written as follows,

$$h^*_{it} = \beta' X_{it} + \gamma' h_{it-1} + v_{it} \qquad (5.1)$$

where $i = 1, 2, ..., N$ refers to adult individuals and $t = 1, ...T$ are the number of periods under study. X_{it} are the observed explanatory variables; h_{it-1} is an indicator of the individual health status in the previous wave and γ is the state dependence parameter to be estimated. v_{it} is the serially independent error term assumed to follow a standard normal distribution with zero mean and unit variance.

Furthermore, the latent outcome, h^*_{it}, is not observed, although, I do know of an indicator of the category in which the latent variable falls, h_{it}. As similarly expressed in Contoyannis, Jones, and Rice (2004a):

$$h_{it} = j \quad \text{if} \quad \mu_{j-1} < h^*_{it} \leq \mu_{j+1}, \qquad j = 1, ..., m \qquad (5.2)$$

where $\mu_0 = -\infty, \mu_j \leq \mu_{j+1}, \mu_m = \infty$.[11] In my case, self-assessed health status has five categories (j), as explained in the descriptive section of this paper.

While, neither the static nor the dynamic strategy take into account unobserved heterogeneity or the initial conditions problem, it has been shown that the Maximum Likelihood estimator for β is consistent whether the error structure is correctly specified or not (see Contoyannis, Jones, and Rice, 2004a; Biewen, 2009).

5.4.2 A dynamic random-effects model: Wooldridge's solution

In order to take into account unobserved heterogeneity, I next propose the estimation of a dynamic random-effects ordered probit model following Wooldridge in the treatment of

[11] As explained by Contoyannis, Jones, and Rice (2004a), it would be impossible to separately identify an intercept (β_0) and the cut points (μ) thus, note that all models have adopted the normalisation $\beta_0 = 0$.

initial conditions (Model 3). That is, I define the equation to have the following structure:

$$h_{it}^* = \beta' X_{it} + \gamma' h_{it-1} + c_i + u_{it} \tag{5.3}$$

where c_i is the individual-specific effect and u_{it} the idiosyncratic error term assumed to follow a standard normal distribution with zero mean and unit variance and to be serially independent. As a result, the probability of observing a particular category of self-assessed health for an individual i in a period t is given by:

$$\begin{aligned} P_{itj} = P(h_{it} = j) = \Phi(\mu_j - \beta' X_{it} - \gamma' h_{it-1} - c_i) - \\ - \Phi(\mu_{j-1} - \beta' X_{it} - \gamma' h_{it-1} - c_i) \end{aligned} \tag{5.4}$$

where $\Phi(\cdot)$ is the standard normal distribution function.

As shown in the literature (see, for instance, Biewen, 2009; Weber, 2002), it is important to take into account unobserved heterogeneity because ignoring it does overestimate the degree of state dependence. On the other hand, the presence of the individual-specific effects results in an initial conditions (IC) problem which arises because the start of the observation window may not be the same as the start of the outcome experience. Therefore, it is reasonable to believe that initial conditions are correlated with the individual specific effect (c_i). Ignoring the IC problem yields inconsistent estimates.[12] [13]

Following Wooldridge (2005) in the treatment of initial conditions, I find the density

[12] See Hsiao (1986), Wooldridge (2005) and Chay and Hyslop (2000) for a review of the different strategies that have dealt with the initial conditions problem.

[13] Carro and Traferri (2011) avoid the IC problem by assessing the degree of state dependence in SAH for the British case with a dynamic fixed-effects ordered probit with one fixed-effect in the linear index equation (that is meant to account, for example, for genetic traits) and another one in the cut points which enables the control for unobserved heterogeneity and reporting behaviour.

of the dependent variables from $t = 2, ..., T$ conditional on the initial conditions and the explanatory variables — instead of finding the density for the whole period $t = 1, 2, ..., T$ given the explanatory variables. This implies the need to specify the density of the unobserved specific effects conditional on the dependent variables at $t = 1$.

Finally, while following the same structure as Model 3, in Model 4 I assume a certain correlation between X_{it} and c_i and therefore time-averages of all time-varying explanatory variables are included in the specification, $\overline{X_i}$ (see Stewart, 2007; Chamberlain, 1984; Alessie, Hochguertel, and Van Soest, 2004 or Mundlak, 1978).[14]

Thus, c_i can be specified as follows:

$$c_i = \alpha + \delta h_{i1} + \eta' \overline{X_i} + \kappa_i \tag{5.5}$$

by which, unobserved heterogeneity is estimated conditional to the initial conditions and the average of the time-varying explanatory variables. In order to get consistent estimates, κ_i is integrated out using Gauss-Hermite quadrature with 12 points while assuming it follows a normal distribution with zero mean and $\sigma^2_{\kappa_i}$ variance. Estimates of the model parameters are obtained by Conditional Maximum Likelihood (CML).

5.4.3 A dynamic random-effects model: Heckman's solution

An alternative to Wooldridge's treatment of initial conditions is the one proposed by Heckman (1981). According to the author, the initial conditions problem can be dealt with by specifying a linearised approximation to the reduced form equation for the initial value of

[14] In my analysis, it includes the fourth age polynomials, marital status, household size, number of children, number of adults, labour market status and income.

the latent variable which is jointly estimated with the main equation (Model 5). That is,

$$h^*_{it} = \beta' X_{it} + \gamma' h_{it-1} + c_i + u_{it} \tag{5.6}$$

is estimated together with,

$$h^*_{i1} = \Pi' Z_{i1} + a_i \tag{5.7}$$

for $i = 1, ..., N$ and $t = 2, ..., T$ and where Z_{i1} is a vector of explanatory variables including X_{i1} — those of the main equation. It is important to note that, in my case, the equation for the initial conditions is estimated by means of an ordered probit.[15] That is, the latent outcome, h^*_{i1}, is not observed but I do know of an indicator of the category in which the latent variable falls, h_{i1}. So,

$$h_{i1} = j \quad \text{if} \quad \mu_{j-1} < h^*_{i1} \leq \mu_{j+1}, \qquad j = 1, ..., m \tag{5.8}$$

where $\mu_0 = -\infty, \mu_j \leq \mu_{j+1}, \mu_m = \infty$.

Furthermore, a_i is assumed to be correlated with c_i — otherwise, I would need to accept that individual health status in the first period is unrelated with the individual specific effect c_i which is unrealistic in the given context. However, a_i is uncorrelated with u_{it} for $t \geq 2$. Finally, a_i can be written as follows:

$$a_i = \theta c_i + u_{i1} \tag{5.9}$$

where ($\theta > 0$) and c_i and u_{i1} are independent of each other. And, the initial conditions equation is specified as:

$$h^*_{i1} = \Pi' Z_{i1} + \theta c_i + u_{i1} \tag{5.10}$$

[15] I am not aware of a similar application in the literature of a Heckman model with an initial conditions equation run as an ordered probit.

The integral is approximated numerically by Gauss-Hermite quadrature with 12 integration points.[16]

5.5 Empirical results

In this section, I present my empirical findings by comparing first the results of the different model specifications and choosing the model with the best fit. I also explicitly describe observed heterogeneity and present Average Partial Effects (APE) which show, in absolute terms, the impact of a change in an explanatory variable on the likelihood of a very good health status.[17] For example,

$$\widehat{APE}(P(h_{it} = 5) = [1 - \Phi(\widehat{\mu_4} - \widehat{\beta}' X_{it} - \widehat{\gamma}' h_{it-1} \cdot 1 - c_i)] - \\ -[1 - \Phi(\widehat{\mu_4} - \widehat{\beta}' X_{it} - \widehat{\gamma}' h_{it-1} \cdot 0 - c_i)] \quad (5.11)$$

where all the parameters estimated have been multiplied by $(1 + \widehat{\sigma_{\kappa_i}}^2)^{-1/2}$.[18]

5.5.1 Model specification and state dependence

Let's first turn my attention to the results for state dependence. As shown in Table 5.2, all the coefficients that account for the lagged value of SAH in Spain are clearly significant at 1%.[19] That is, health shocks are not immediately adjusted and *current* health clearly depends on *past* health experiences, as shown in Models 2 to 5. However, Model 4 not only controls for unobserved heterogeneity and initial conditions but also allows for a correlation

[16] I verified that the results were very similar when using a smaller or greater number of integration points.

[17] Note that I have only computed APE for underlying coefficients that are statistically significant at least at 95% confidence level.

[18] Multiplying by this constant does make the results comparable with other econometric strategies such as pooled probit (see Arulampalam, 1999).

[19] All model parameters and standard errors can be found in Table C.2 of the Appendix.

between the time-varying covariates and the random effect, which is the specification where state dependence proves to be less important.

Table 5.2: Model specifications for self-assessed health in Spain, 1994-2001 (selected parameters)

	Model 1		Model 2		Model 3		Model 4		Model 5			
											IC	
$h_{t-1}(1)$			-2.0769	***	-0.7414	***	-0.7348	***	-0.8605	***		
$h_{t-1}(2)$			-1.5766	***	-0.6118	***	-0.6070	***	-0.7089	***		
$h_{t-1}(3)$			-0.7858	***	-0.2938	***	-0.2910	***	-0.3237	***		
$h_{t-1}(5)$			0.4009	***	0.0747	***	0.0745	***	0.0364	***		
$h_0(1)$					-1.7155	***	-1.6955	***				
$h_0(2)$					-1.2731	***	-1.2566	***				
$h_0(3)$					-0.618	***	-0.6097	***				
$h_0(5)$					0.3318	***	0.3316	***				
cut 1	-3.6550	***	-4.2742	***	-5.1966	***	-4.9414	***	-5.0023	***	-4.7578	***
cut 2	-2.5901	***	-2.9837	***	-3.6922	***	-3.4354	***	-3.5170	***	-3.4208	***
cut 3	-1.6023	***	-1.7814	***	-2.2781	***	-2.0197	***	-2.1184	***	-2.0908	***
cut 4	0.0659		0.0512		-0.1856		0.0739		-0.0225		-0.1822	
σ_{κ_i}					0.5664	***	0.5662	***	0.6999	***		
θ									1.1932	***		
ln-L	-88513.25		-80104.07		-77338.14		-77281.94		-95004.95			

Note:Significance: *** 99% confidence level, ** 95% and * 90%.
Model 1: Ordered probit
Model 2: Dynamic ordered probit.
Model 3: Random effects dynamic ordered probit.
Model 4: Random effects dynamic ordered probit with time-varying variables mean.
Model 5: Dynamic ordered Heckman probit with time-varying variables mean.

Furthermore, the results clearly show the need to control for unobserved heterogeneity when analysing self-assessed health. Note how in models 3 to 5, the standard deviation of the random effect is significant at 1%, ranging from 0.56 in the case of Model 3 to 0.70 in Model 5. This means that between 24% and 32% of the variance is due to the panel-level variance component.

The coefficients associated with the initial conditions are significant at 1% indicating the need to control for self-assessed health at the beginning of the observation window. Moreover, note how in the Heckman specification, the load factor $theta$ is clearly positive which rejects the hypothesis of exogenous initial conditions.

Following Hernández-Quevedo, Jones, and Rice (2008), I assess the statistical fit of the different models using Akaike and Bayesian Information Criteria (AIC and BIC, respectively) for model selection. Formally,

$$AIC = -2lnL + 2q \tag{5.12}$$

$$BIC = -2lnL + (lnM)q \tag{5.13}$$

where q represents the number of parameters in each specification and M the number of individual-wave observations. In order to compare Models 4 and 5, I have combined the Wooldridge estimator based on $t \geq 2$ with a simple probit model for $t = 1$ (see Stewart, 2007).

As Table 5.3 shows, Model 4 is the specification with the best fit as it reports the lowest AIC and BIC values indicating that self-assessed health needs to be studied by controlling for state dependence, unobserved heterogeneity and initial conditions while allowing for a correlation between time-varying explanatory variables and random effects. Wooldridge and Heckman's solutions yield similar results but the former performs slightly better.[20]

Table 5.3: AIC and BIC for the different model specifications

	Model 1	Model 2	Model 3	Model 4	Model 5
AIC	177086.5	157200.3	158772.5	154671.8	-
BIC	177364.4	157552.5	159096.8	155172.2	-
AIC	-	-	-	189641.3	190159.9
BIC	-	-	-	190377.5	190854.8

Note:
Model 1: Ordered probit
Model 2: Dynamic ordered probit
Model 3: Random effects dynamic ordered probit
Model 4: Random effects dynamic ordered probit with time-varying variables mean
Model 5: Dynamic ordered Heckman probit with time-varying variables mean

Therefore, and following the specification of Model 4, APE indicate that the probability of enjoying very good health reduces by 9.3% when reporting a very poor health status in the previous year, 8.2% if suffering poor health and 4.6% if health was fair. In turn, the chances of a very good health status increase by 1.3% for those adults that declared that they were in very good health in the previous wave. Results are clear as for the direction of the state dependence impact, but the size of the effects is limited.

5.5.2 Observed heterogeneity

In this section, I focus on the results concerning the set of covariates that were included in the five models to control for observed heterogeneity. As shown in Table C.2, nearly all covariates are significant at 99% confidence level in my base model, Model 1, and have the expected sign. Thus, as is traditionally indicated in the literature, highly educated young men that are married, have children and receive higher income would be more likely to

[20] Additionally, the solution proposed by Wooldridge can be more easily estimated using standard software (e.g. Stata) while the Heckman model requires the use of aML, a multi-level multi-process programme.

report a better health status. Only two variables, unemployment status and household size, are not precisely estimated in this first specification. However, when adding a control for past health status, thus moving from Model 1 to 2, some of the variables lose explanatory power and others are no longer statistically significant.

More importantly, when controlling for state dependence and unobserved heterogeneity and correcting for the initial conditions problem (Models 3 to 5), the significance of most of the observed explanatory variables vanishes. These results suggest that the effect of observed heterogeneity on self-assessed health is generally overestimated given that it captures the impact that should be attributed to previous health status or other variables not present in the most commonly used data sets. My findings contrast to the widespread belief that *current* income and other socioeconomic variables are the major determinants of health status (Wilkinson, 2000; Van Ourti, Van Doorslaer, and Koolman, 2009).[21]

In particular, regarding the estimation of my preferred model (Model 4), I observe that only gender, education and being inactive or unemployed are statistically significant. At the same time, education has the largest effect on health with respect to the gender and employment status of the individual. In this case, having a university degree increases the chances of reporting very good health by 6.0% as opposed to individuals that never completed primary education. Women are less likely to report a very good health status yet the APE of the underlying coefficient is only -0.5%. Unemployment exerts a positive effect on health (of about 0,8%), a result that contrasts with the idea that unemployment generates negative psychological effects that reduce the level of health (Wilkinson, 1996). However, other authors suggest that being unemployed for a short period of time gives the opportunity to enjoy free time and therefore a better quality of life (Knabe, Rätzel, Schöb,

[21] Note that I have not taken into account the inverse relationship between income and health in my analysis. I leave for a future study the analysis of the feedback effects of *past* income on *current* health and reversely.

and Weimann, 2010). Finally, note that due to the inclusion of the time-average variables in Model 4, some of the *current* values are not precisely estimated while the means are. For example, the logarithm for household equivalent income is not statistically significant although its average value is at 1%. In this case, the fact that the time-average variable is significant suggests that a proxy for permanent income is more relevant for individual health than current income — even after controlling for state dependence. I observe the same effect in the case of the age variables indicating that belonging to a certain age group is more relevant than current age.

5.6 Concluding Remarks

This paper studies, for the first time, the importance of state dependence, socioeconomic heterogeneity and unobserved heterogeneity when explaining self-assessed health in Spain. With this objective in mind, I propose different econometric solutions in order to compare and assess the influence of each source when studying health dynamics.

Using the Spanish component of the ECHP for 1994-2001, I find evidence of state dependence considering a five category SAH measure, namely, past health status influences *by itself* the probability of current health. That is, individuals who enter in a spiral of bad health have greater difficulties to leave it behind (or recover from health shocks). In this sense, improving my knowledge on the persistence of self-assessed health (as measured by state dependence) can be used for a better understanding of mortality and medical care use (see, for example, Van Doorslaer and Gerdtham, 2003 and Erdogan-Ciftci, Van Doorslaer, Bago d'Uva, and Van Lenthe, 2010). For instance, given socioeconomic inequalities in survival risk, state dependence in SAH will predict inequalities to persist. This is an argument in favour of short-run policy interventions to improve health which will have longer term implications. Nevertheless, my results suggest that the impact of state dependence on health is relatively small as I improve the structure of the models' error terms.[22]

In the analysis of health, observed heterogeneity measured by socioeconomic variables has so far played an important role in explaining individual health status and its dynamics. However, this paper suggests that state dependence and unobserved heterogeneity account for much of the probability of reporting a specific health status. As similarly found by Contoyannis, Jones, and Rice (2004a) and (2004b), most of the explanatory power of observed heterogeneity vanishes when correcting for state dependence and unobserved heterogeneity, and only gender, education and labour status seem to be relevant in explaining health status. Alternatively, the main determinants of health might be captured by unobserved heterogeneity which in my preferred model accounts for 24% of the panel-level variance.

My results for state dependence have also been shown to be robust with the new econometric strategy that I have proposed in this paper based on a Heckman model with an initial conditions equation run as an ordered probit. Nevertheless, I recommend the use of Wooldridge's solution for this type of analysis given that is slightly more efficient and, at the same time, is more user-friendly in terms of standard software programming and requires less computation time.

Given my results, I propose that future research should focus on new variables that are not generally taken into account in the analysis of health dynamics, such as individual childhood characteristics or childhood environment as health determinants which may account for part of the unobserved heterogeneity.[23] Finally, despite the fact that the effect of socioe-

[22]Hernández-Quevedo, Jones, and Rice (2008) find also a small impact of state dependence in health limitations for Spain.

[23]See Ahlburg (1998) for a discussion on self-assessed health being partly explained by genetics. Case, Fertig, and Paxson (2005) and Case, Lubotsky, and Paxson (2002) show how childhood health and socioeconomic circumstances have lasting effects on adult health, employment and socioeconomic status — especially as the individual ages. See also Trannoy, Tubeuf, Jusot, and Devaux (2010) for an analysis of the influence of

conomic variables on health almost vanishes when accounting for state dependence and unobserved heterogeneity, these results might be contrasted with an analysis of the effect of *past* socioeconomic characteristics, given that only *current* socioeconomic values have been included in my models. For example, present income is not significant in my *best fit* model but past income or even permanent income might be relevant for health. These results are important in order to design health enhancing policies by improving those socioeconomic factors that truly determine health — as intended by the Spanish public health agenda.

parents'longevity and occupation on the health status of descendants in adulthood.

Chapter 6

Conclusions

The aim of this thesis is to contribute to the literature on the socioeconomic determinants of health by answering some unsolved questions in previous studies, and focusing mainly on the controversial relationship between health and income distribution.

Chapter 2 summarizes previous evidence regarding this association. **Chapter 3** and **Chapter 4** examine two of the main hypotheses linking health and income disparities. On the one hand, chapter 3 explores for the first time the effect of income polarisation on health showing that polarisation is relevant for health. On the other hand, chapter 4 reviews the association between relative income and health by proposing a new methodological approach to capture the complexity of the effect of income comparisons on health. Finally, **Chapter 5** contributes to health modeling by focusing on the degree of genuine state dependence in self-assessed health status, when studying the socioeconomic determinants of health.

As it has been highlighted in **chapter 2** the underlying mechanisms connecting health with income and income distribution have been tested in the literature by means of the Absolute Income Hypothesis, the Income Inequality Hypothesis and the Relative Income Hypothesis. Previous empirical evidence is ambiguous regarding the validity of these hypotheses. However, the main results of this thesis explain some of these disparities in previous results.

Chapter 3 shows that polarisation might be a better proxy than income inequality for some of the pathways linking income disparities and health. Income polarisation increases social tension and conflict, which in turn may create psychosocial stress and reduce the provision of certain public goods, both of which affect health. Polarisation measured by means of the Zhang and Kanbur's index presents a negative effect on self-assessed health, even after controlling for income inequality and relative income.

Moreover, the negative effect of polarisation is robust to using an alternative index of inequality to measure the Zhang and Kanbur's polarisation index, and to the inclusion of (subjective) poverty.

Thus, all these findings suggest that income polarisation should be taken into account when explaining the effects of income on health, and not only income inequality.

Finally, the results challenge what has been traditionally assumed in the literature regarding the definition of reference groups. In the case of self-assessed health in Spain the relevant comparison group to measure polarisation may be individuals with similar characteristics. Nevertheless, as it has been shown in chapter 4, more research needs to be done to understand which is the relevant comparison group, because they might differ between countries and between population groups. The importance of determining the reference group in the analysis of socioeconomic determinants of health should motivate socioeconomic datasets designers to include relevant questions to help researchers to overcome this limitation in our studies.

Chapter 4 aims at explaining results' disparities of previous empirical evidence regarding the Relative Income Hypothesis. The main results point out that the traditional relative income measures fail to capture the complexity of the effect of income comparisons on health. In this case, I use a relative deprivation and relative satisfaction index to measure upward and downward income comparisons, showing that both are relevant to explain self-assessed health, at least for the total and the male samples. My findings suggest that females might not only report worst self-assessed health than males, but also they might differ in the way they compare to others.

Interestingly, in Germany being deprived might not generate psychosocial stress as the relative income hypothesis states. Alternatively, relative satisfaction presents a negative impact on health, but the effect of relative deprivation is much stronger, as Fehr and Schmidt

(1999) propose for utility. Thus, depending on which of the two dimensions of relative income dominates, average income might take a positive or a negative sign. These findings might be an explanation for the results' disparities found in the literature when relative income is measured by the average income of the reference group. Moreover, these results may come as a surprise for scholars who consider redistribution as a health enhancing policy. Although I do not dare to recommend the opposite, I believe that this is a warning that more research is needed to disentangle how relative concerns might affect health (and also well-being). The effect of income comparisons on health might be sensitive to the country used for the analysis and to the reference group used to establish income comparisons. Occupation has been found to be relevant for income comparisons in Germany.

These results are robust to the introduction of unobserved heterogeneity in the model. However, the size of the coefficients relative income indexes is smaller, especially for the estimations with FE, but they are still significant. This would suggest that relative income indexes are correlated with omitted variables, as it is shown by the significance of the panel level means estimations in the Mundalk's approach. Thus, relative income might have a direct and an indirect effect on health. Moreover, the remaining unexplained variability is almost 50%. Therefore, future research might focus on finding whether other socioeconomic factors might explain it.

Finally, the use of SOEP allows to test the robustness of the previous findings focusing on more objective health measures. Estimations based on the physical dimension of the SF12 index, support the results obtained with SAH. Nevertheless, the relative income indexes are not precisely estimated when health is measured by means of the mental dimension of the SF12 index and the *bmi*. Although self-assessed health has been proved to be a valid indicator of health status, my results points out the necessity of considering objective health indicators to understand the links between health status and income and income distribution.

The main objective of **Chapter 5** is to assess the effect of state dependence, when studying socioeconomic determinants of self-assessed health in Spain. The results show that most of the explanatory power of observed heterogeneity, which are mainly socioeconomic factors, vanish after correcting for state dependence and unobserved heterogeneity, and only gender, education and labour status seem to be relevant in explaining health status. On the contrary, income is not significant after taking into account state dependence and unobserved heterogeneity. Although the findings of this study seem to contradict the Absolute Income Hypothesis —and the results regarding this hypothesis in chapter 3 and 4, another interpretation might be that "current" income is not relevant for health, but "past" income or even "permanent" income are. Therefore prevention and improving socioeconomic conditions in early life might be a "current" health enhancing policy.

Moreover, some general conclusions can be drawn from this thesis. First, that the effect of socioeconomic determinants on health might be different between countries. It has been shown that there are discrepancies not only in the effect of income comparisons on health, but also in other socioeconomic factors such as unemployment. Chapters 3 and 5 show how the effect of unemployment on SAH is positive in Spain but negative in Germany (chapter 4). More research is needed to understand why there are such differences, but in any case policy makers should take them into account when designing health enhancing policies.

Second, although most of the literature focused on the *current* effect of socioeconomic determinants of health, results suggest that *past states* might have an effect on current health. Future research might focus on individuals' history to understand how past socioeconomic status affect current health.

Finally, there are still some limitations in this analysis. As it has been pointed out in chapter 2, one of the pathways linking psychosocial stress and health is health compromising behaviour. In order not to overestimate the effect of income variables I should control for health related behaviour such as whether individuals smoke, practice exercise or have an unhealthy diet. However, none of the two datasets used in this thesis have this kind of information.

Furthermore, it would be interesting to disentangle which of the four hypothesis: the Absolute Income Hypothesis, the Income Inequality Hypothesis, the Relative Income Hypothesis or the one proposed in this thesis, the Polarisation Hypothesis, is more relevant for health. Nevertheless, since income inequality, relative income and income polarisation are based on the same income variable, it is difficult to test all this hypothesis together due to possible collinearity problems.

Finally, the reverse causality between income and health has not been considered in this thesis. I focus on the effect of income on health, but health might also affect income. If it is the case, the effect of the income variables might be overestimated.

Therefore, in my future research I would like to focus on some of the questions that arise from previous chapters. First, I would like to conduct a cross-country analysis to test the sensitivity of my results, especially the effects of income comparisons and the relevant reference group. SOEP allows me to do that because it is one of the dataset included in the Cross-National Equivalent File (CNEF), which contains equivalently defined socioeconomic variables and health indicators for the British Household Panel Study (BHPS), the Household Income and Labour Dynamics in Australia (HILDA), the Korea Labor and Income Panel Study (KLIPS), the Panel Study of Income Dynamics (PSID), the Russia Longitudinal Monitoring Survey (RLMS-HSE), the Swiss Household Panel (SHP), and the

Canadian Survey of Labour and Income Dynamics (SLID).

Second, I want to study the effect of "past" income and also "past" income disparities on health. At the same time, panel data might be suitable to consider the effect of "past states" duration on health. If individual's history is important to determine current health status, variables affecting this "history" such as social and income mobility might also be relevant for health.

Third, in the models studied in this thesis unexplained heterogeneity of self-assessed health is really high both in Germany and in Spain. Moreover, in chapter 4 I have shown that income and relative income are correlated with unobserved heterogeneity. Therefore, it is important to find out which are the omitted variables in this analysis. One possible candidate might be personality traits. This variable might be related with both, health and income. More and more socioeconomic datasets include questions to assess the personality traits of individuals which might make possible to study this relationship.

Finally, as it has been mentioned before I have not considered in this thesis the reverse causality between income and health. There have been few attempts in the literature to overcome this limitation, principally because it is difficult to find good instruments or natural experiments to control for this reverse relationship. Recent econometric advances might facilitate to control at least for "feedback" effects between both, considering the dynamic dimension of the two variables.

I hope to be able to take up some of these extensions in the near future.

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Appendices

A Appendix: Polarisation and Health

Table A.1: Summary Statistics

Covariates	*Mean*	*St. Dev.*	*Min.*	*Max.*
Self-assessed health	0.46	0.5	0	1
Difficulties to make ends meet	0.63	0.48	0	1
Ln(family income)	8.9	0.57	6.55	10.32
Ln(average income reference group)	9.02	0.26	8.54	9.98
Age	46.32	19.38	16	92
Secondary education	0.17	0.38	0	1
Tertiary education	0.14	0.36	0	1
Unemployed	0.09	0.28	0	1
Inactive	0.52	0.5	0	1
Separated	0.01	0.12	0	1
Divorced	0.01	0.09	0	1
Widowed	0.09	0.29	0	1
Single	0.29	0.45	0	1
Do not talk often to neighbours	0.05	0.21	0	1
No crime problems in area	0.82	0.38	0	1
No pollution problems in area	0.87	0.34	0	1
Polarisation Theil (reference groups)1	0.2	0.05	0.1	0.43
Polarisation MLD (reference groups)[1]	0.17	0.05	0.09	0.37
Polarisation Theil (regions)	0.12	0.02	0.08	0.15
Polarisation MLD (regions)	0.11	0.02	0.08	0.13
Inequality Theil (reference groups)[1]	0.11	0.02	0.01	0.37
Inequality MLD (reference groups)[1]	0.12	0.03	0.01	0.47
Inequality Theil (regions)	0.14	0.02	0.1	0.19
Inequality MLD (regions)	0.14	0.02	0.11	0.18

Note: [1]Reference groups defined over education and age for each region and year.

B Appendix: Relative Income and Health

Table B.1: Variable labels and descriptives for the TOTAL sample

Variables	Definition	Mean
Health measures		
SAH	Self-Assessed Health	3.587135
mcs	Mental health	0.4992533
pcs	Physical health	0.5238817
bmi	Body mass index	0.7449622
age	Age in years of the individual	41.05497
agesq	Age squared	1814.168
sex	1 if male, 2 if female	.4622456
	(reference group of sex is male)	
Civil status		
married_sep	1 if married but separated, 0 otherwise	0.0197489
single	1 if single, 0 otherwise	0.2625919
divorced	1 if divorced, 0 otherwise	0.0764466
widow	1 if widow, 0 otherwise	0.0137496
	(reference group of civil status is married)	
Labour status		
part-time	1 if part-time employed, 0 otherwise	0.1703239
training	1 if vocational training, 0 otherwise	0.0417355
mg_working	1 if marginal or irregular part-time, 0 otherwise	0.0547058
not_working	1 if not employed, 0 otherwise	0.0037187
sheltered_working	1 if sheltered workshop, 0 otherwise	0.0013476
	(reference group of labour status is full-time employed)	
unemployed	1 if unemployed, 0 otherwise	.0104051
	(reference group of unemployed is not unemployed)	
Origin		
European	1 if European, 0 otherwise	0.0531073
non-European	1 if Non-European 0 otherwise	0.0314888
state-less	1 if state-less, 0 otherwise	0.0000715
	(reference group of origin is German)	
hsize	Number of members of the household	2.943862
educ	Number of years of education	12.42869
income	Log of equivalised total net household income	9.904644
mean income	Log of average income of the reference group	9.973518
Rel.Deprivation	Relative Deprivation	.2051115
Rel.SatisfactionS	Relative Satisfaction	.2074072

Source: Own calculation on the SOEP, 1994-2010. Mean income, Rel.Deprivation and Rel.Satisfaction are referred to Refoccup.

Table B.2: POOLED OLS estimations with occupation and occupation-regional reference groups, 1994-2010

	Refoccup			Refoccup2			Refoccup4			Refoccup16		
	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE	TOTAL	MALE	FEMALE
age	-0.0273***	-0.0347***	-0.0230***	-0.0273***	-0.0347***	-0.0229***	-0.0273***	-0.0347***	-0.0229***	-0.0274***	-0.0348***	-0.0229***
	(0.0027)	(0.0022)	(0.0039)	(0.0025)	(0.0023)	(0.0035)	(0.0020)	(0.0022)	(0.0027)	(0.0020)	(0.0025)	(0.0027)
agesq	0.0002***	0.0002***	0.0001**	0.0002***	0.0002***	0.0001***	0.0002***	0.0002***	0.0001***	0.0002***	0.0002***	0.0001***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
female	-0.0440***			-0.0416***			-0.0421***			-0.0411***		
	(0.0050)			(0.0047)			(0.0052)			(0.0067)		
married_sep	0.0395***	0.0247	0.0518*	0.0381**	0.0246	0.0487*	0.0388***	0.0256	0.0497*	0.0399***	0.0256	0.0524**
	(0.0122)	(0.0202)	(0.0257)	(0.0149)	(0.0235)	(0.0264)	(0.0132)	(0.0182)	(0.0252)	(0.0132)	(0.0179)	(0.0223)
single	0.0165*	0.0168	0.0166	0.0159*	0.0169	0.0144	0.0161*	0.0172	0.0149	0.0162*	0.0169	0.0161
	(0.0092)	(0.0112)	(0.0149)	(0.0086)	(0.0108)	(0.0122)	(0.0083)	(0.0117)	(0.0115)	(0.0086)	(0.0120)	(0.0117)
divorced	0.0300***	0.0278*	0.0301*	0.0292***	0.0282*	0.0278	0.0295***	0.0283*	0.0287*	0.0301***	0.0284*	0.0304**
	(0.0073)	(0.0147)	(0.0153)	(0.0103)	(0.0143)	(0.0179)	(0.0095)	(0.0150)	(0.0164)	(0.0091)	(0.0162)	(0.0131)
widow	0.0642**	0.0347	0.0676**	0.0639**	0.0363	0.0666**	0.0640***	0.0366	0.0666***	0.0642***	0.0366	0.0668***
	(0.0245)	(0.0477)	(0.0278)	(0.0260)	(0.0533)	(0.0253)	(0.0207)	(0.0497)	(0.0220)	(0.0234)	(0.0456)	(0.0250)
euro	0.0535***	0.0834***	0.0193	0.0478***	0.0776***	0.0129	0.0481***	0.0776***	0.0134	0.0481***	0.0777***	0.0133
	(0.0135)	(0.0195)	(0.0176)	(0.0137)	(0.0199)	(0.0179)	(0.0150)	(0.0197)	(0.0212)	(0.0127)	(0.0184)	(0.0183)
non-euro	0.0410**	0.0686***	0.0094	0.0352**	0.0628***	0.0027	0.0362***	0.0641***	0.0034	0.0355**	0.0635***	0.0025
	(0.0168)	(0.0148)	(0.0238)	(0.0146)	(0.0154)	(0.0202)	(0.0133)	(0.0155)	(0.0209)	(0.0150)	(0.0179)	(0.0207)
stateless	0.0106	0.1330***	-0.3053***	0.0033	0.1243***	-0.3181***	0.0073	0.1239	-0.2964***	0.0064	0.1249	-0.3059***
	(0.0772)	(0.0112)	(0.0175)	(0.0774)	(0.0163)	(0.0221)	(0.1139)	(0.1206)	(0.0218)	(0.1123)	(0.1159)	(0.0185)
part-time	0.0058	-0.0780***	0.0049	0.0029	-0.0801***	0.0008	0.0034	-0.0791***	0.0015	0.0040	-0.0782***	0.0027
	(0.0072)	(0.0181)	(0.0074)	(0.0075)	(0.0179)	(0.0077)	(0.0079)	(0.0194)	(0.0087)	(0.0075)	(0.0192)	(0.0092)
training	-0.0570***	-0.0660***	-0.0681***	-0.0553***	-0.0637***	-0.0672***	-0.0551***	-0.0636***	-0.0667***	-0.0542***	-0.0633***	-0.0647***
	(0.0110)	(0.0125)	(0.0112)	(0.0170)	(0.0203)	(0.0175)	(0.0146)	(0.0160)	(0.0175)	(0.0132)	(0.0175)	(0.0170)
mg_working	-0.0092	-0.0630***	-0.0046	-0.0134*	-0.0647***	-0.0109	-0.0125	-0.0640***	-0.0096	-0.0129	-0.0641***	-0.0097
	(0.0068)	(0.0162)	(0.0092)	(0.0070)	(0.0181)	(0.0092)	(0.0091)	(0.0191)	(0.0095)	(0.0093)	(0.0180)	(0.0104)
not_working	0.0332	-0.0180	0.0731	0.0321	-0.0193	0.0715	0.0319	-0.0202	0.0717*	0.0329	-0.0189	0.0728*
	(0.0283)	(0.0408)	(0.0433)	(0.0256)	(0.0369)	(0.0444)	(0.0273)	(0.0391)	(0.0361)	(0.0307)	(0.0449)	(0.0421)
sheltered_working	-0.5228***	-0.4833***	-0.5839***	-0.5244***	-0.4843***	-0.5874***	-0.5240***	-0.4841***	-0.5870**	-0.5240***	-0.4835***	-0.5891***
	(0.0990)	(0.0666)	(0.1347)	(0.0888)	(0.0723)	(0.1591)	(0.1021)	(0.1248)	(0.2329)	(0.0810)	(0.1234)	(0.1735)
hsize	0.0200***	0.0136***	0.0270***	0.0200***	0.0132***	0.0275***	0.0198***	0.0130***	0.0272***	0.0200***	0.0133***	0.0271***
	(0.0018)	(0.0021)	(0.0032)	(0.0018)	(0.0025)	(0.0030)	(0.0024)	(0.0027)	(0.0037)	(0.0025)	(0.0032)	(0.0039)
educ	0.0122***	0.0138***	0.0119***	0.0130***	0.0145***	0.0128***	0.0129***	0.0143***	0.0128***	0.0139***	0.0153***	0.0139***
	(0.0015)	(0.0016)	(0.0026)	(0.0013)	(0.0014)	(0.0023)	(0.0014)	(0.0019)	(0.0022)	(0.0013)	(0.0016)	(0.0019)
income	0.2031***	0.2031***	0.2033***	0.1911***	0.1942***	0.1872***	0.1968***	0.2023***	0.1885***	0.1681***	0.1788***	0.1512***
	(0.0340)	(0.0305)	(0.0430)	(0.0260)	(0.0234)	(0.0344)	(0.0215)	(0.0252)	(0.0269)	(0.0218)	(0.0267)	(0.0247)
Rel.Deprivation	0.2383***	0.2378***	0.2685***	0.2204***	0.2298***	0.2419***	0.2297***	0.2481***	0.2376***	0.1548***	0.1868***	0.1393***
	(0.0705)	(0.0671)	(0.0878)	(0.0459)	(0.0434)	(0.0654)	(0.0393)	(0.0448)	(0.0528)	(0.0408)	(0.0541)	(0.0458)
Rel.Satisfaction	-0.0285	-0.0534**	0.0008	-0.0285	-0.0539**	0.0011	-0.0337**	-0.0585***	-0.0040	-0.0311**	-0.0570***	0.0000
	(0.0225)	(0.0253)	(0.0262)	(0.0175)	(0.0209)	(0.0238)	(0.0139)	(0.0198)	(0.0185)	(0.0156)	(0.0199)	(0.0201)
Rsquared	0.0815	0.0934	0.0703	0.0817	0.0937	0.0703	0.0818	0.0939	0.0703	0.0814	0.0935	0.0698
Obs.	153,729	82,679	71,050	153,729	82,679	71,050	153,729	82,679	71,050	153,729	82,679	71,050

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%. Standard Errors in brackets.

Table B.3: POOLED OLS estimations of the covariates with occupation reference groups using labour status defined by unemployed/not unemployed, 1994-2010

SAH	TOTAL	MALE	FEMALE
age	-0.0247***	-0.0303***	-0.0204***
	(0.0028)	(0.0022)	(0.0042)
agesq	0.0001***	0.0002***	0.0001*
	(0.0000)	(0.0000)	(0.0000)
female	-0.0425***		
	(0.0055)		
married	0.0378***	0.0219	0.0505*
	(0.0117)	(0.0200)	(0.0251)
single	0.0106	0.0103	0.0072
	(0.0105)	(0.0109)	(0.0195)
divorced	0.0288***	0.0251	0.0290*
	(0.0069)	(0.0149)	(0.0146)
widow	0.0658**	0.0344	0.0691**
	(0.0238)	(0.0469)	(0.0270)
euro	0.0547***	0.0844***	0.0213
	(0.0136)	(0.0196)	(0.0173)
non-euro	0.0381**	0.0653***	0.0070
	(0.0170)	(0.0150)	(0.0239)
stateless	0.0431	0.1393***	-0.3400***
	(0.0924)	(0.0180)	(0.0133)
unemployed	**-0.0841*** **	**-0.0842*** **	**-0.0853*** **
	(0.0097)	(0.0282)	(0.0174)
hsize	0.0182***	0.0125***	0.0245***
	(0.0019)	(0.0022)	(0.0036)
educ	0.0129***	0.0138***	0.0128***
Obs.	153,729	82,679	71,050

Note: year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%. Standard Errors in brackets.

Table B.4: RE and Mundalk estimations using occupation and occupation-regional reference groups, 1994-2010

	Refoccup		Refoccup2		Refoccup4		Refoccup16	
	RE	Mundlak	RE	Mundlak	RE	Mundlak	RE	Mundlak
age	-0.0201***	-0.0219***	-0.0201***	-0.0220***	-0.0201***	-0.0219***	-0.0201***	-0.0221***
	(0.0017)	(0.0025)	(0.0017)	(0.0025)	(0.0017)	(0.0025)	(0.0017)	(0.0025)
agesq	0.0001***	-0.0000	0.0001***	-0.0000	0.0001***	-0.0000	0.0001***	-0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
female	-0.0524***	-0.0382***	-0.0517***	-0.0362***	-0.0519***	-0.0368***	-0.0509***	-0.0357***
	(0.0062)	(0.0070)	(0.0062)	(0.0069)	(0.0062)	(0.0069)	(0.0062)	(0.0069)
married_sep	0.0543***	0.0599***	0.0541***	0.0599***	0.0543***	0.0599***	0.0545***	0.0599***
	(0.0122)	(0.0136)	(0.0122)	(0.0136)	(0.0122)	(0.0136)	(0.0122)	(0.0136)
single	0.0107	0.0126	0.0105	0.0123	0.0106	0.0123	0.0107	0.0124
	(0.0078)	(0.0106)	(0.0078)	(0.0106)	(0.0078)	(0.0106)	(0.0078)	(0.0106)
divorced	0.0245***	0.0395***	0.0245***	0.0396***	0.0245***	0.0394***	0.0247***	0.0395***
	(0.0092)	(0.0121)	(0.0092)	(0.0121)	(0.0092)	(0.0121)	(0.0092)	(0.0121)
widow	0.0346	-0.0088	0.0346	-0.0090	0.0346	-0.0090	0.0346	-0.0089
	(0.0215)	(0.0297)	(0.0215)	(0.0297)	(0.0215)	(0.0297)	(0.0215)	(0.0297)
euro	0.0459***	0.0583***	0.0412***	0.0529***	0.0416***	0.0534***	0.0413***	0.0532***
	(0.0131)	(0.0130)	(0.0131)	(0.0130)	(0.0131)	(0.0130)	(0.0131)	(0.0130)
non-euro	0.0512***	0.0659***	0.0470***	0.0601***	0.0479***	0.0612***	0.0471***	0.0611***
	(0.0154)	(0.0154)	(0.0153)	(0.0154)	(0.0153)	(0.0154)	(0.0153)	(0.0154)
stateless	-0.0097	0.0769	-0.0155	0.0668	-0.0105	0.0736	-0.0156	0.0707
	(0.1463)	(0.1451)	(0.1467)	(0.1452)	(0.1428)	(0.1409)	(0.1448)	(0.1410)
part-time	0.0121**	0.0133**	0.0112*	0.0131*	0.0114**	0.0131*	0.0114**	0.0131*
	(0.0058)	(0.0067)	(0.0058)	(0.0067)	(0.0058)	(0.0067)	(0.0058)	(0.0067)
training	-0.0086	-0.0022	-0.0081	-0.0020	-0.0081	-0.0020	-0.0072	-0.0015
	(0.0103)	(0.0115)	(0.0102)	(0.0115)	(0.0103)	(0.0115)	(0.0102)	(0.0115)
mg_working	0.0073	0.0107	0.0062	0.0104	0.0066	0.0106	0.0057	0.0102
	(0.0082)	(0.0093)	(0.0082)	(0.0093)	(0.0082)	(0.0093)	(0.0082)	(0.0093)
not_working	0.0561**	0.0666***	0.0555**	0.0666***	0.0555**	0.0665***	0.0557**	0.0666***
	(0.0233)	(0.0233)	(0.0232)	(0.0233)	(0.0232)	(0.0233)	(0.0232)	(0.0233)
sheltered_working	-0.4715***	-0.1265	-0.4714***	-0.1265	-0.4717***	-0.1273	-0.4724***	-0.1254
	(0.0969)	(0.1652)	(0.0968)	(0.1652)	(0.0969)	(0.1653)	(0.0972)	(0.1654)
hsize	0.0083***	0.0003	0.0084***	0.0005	0.0083***	0.0005	0.0084***	0.0004
	(0.0020)	(0.0026)	(0.0020)	(0.0026)	(0.0020)	(0.0026)	(0.0020)	(0.0026)
educ	0.0154***	0.0029	0.0154***	0.0029	0.0154***	0.0029	0.0162***	0.0031
	(0.0012)	(0.0029)	(0.0012)	(0.0029)	(0.0012)	(0.0029)	(0.0012)	(0.0029)
income	0.1455***	0.0717***	0.1507***	0.0730***	0.1505***	0.0750***	0.1270***	0.0631***
	(0.0150)	(0.0175)	(0.0135)	(0.0169)	(0.0131)	(0.0161)	(0.0116)	(0.0141)
Rel.Deprivation	0.1916***	0.0894***	0.2069***	0.0967***	0.2052***	0.1013***	0.1540***	0.0785***
	(0.0295)	(0.0337)	(0.0269)	(0.0325)	(0.0261)	(0.0308)	(0.0228)	(0.0264)
Rel.Satisfaction	-0.0278**	-0.0251*	-0.0298***	-0.0228*	-0.0314***	-0.0234*	-0.0260**	-0.0203*
	(0.0114)	(0.0130)	(0.0111)	(0.0129)	(0.0110)	(0.0128)	(0.0107)	(0.0122)

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Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%. Standard Errors in brackets.

Table B.5: RE and Mundalk estimations using occupation and occupation-regional reference groups, 1994-2010 (continued from previous page)

	Refoccup		Refoccup2		Refoccup4		Refoccup16	
	RE	Mundlak	RE	Mundlak	RE	Mundlak	RE	Mundlak
		-0.0123***		-0.0122***		-0.0122***		-0.0123***
age_m		(0.0034)		(0.0034)		(0.0034)		(0.0034)
		0.0003***		0.0003***		0.0003***		0.0003***
agesq_m		(0.0000)		(0.0000)		(0.0000)		(0.0000)
		0.0253***		0.0250***		0.0248***		0.0251***
hsize_m		(0.0039)		(0.0039)		(0.0039)		(0.0039)
		0.0107***		0.0116***		0.0115***		0.0122***
educ_m		(0.0032)		(0.0032)		(0.0032)		(0.0032)
		-0.0591*		-0.0609*		-0.0599*		-0.0580
married_sep_m		(0.0359)		(0.0360)		(0.0360)		(0.0360)
		0.0087		0.0085		0.0089		0.0090
single_m		(0.0154)		(0.0154)		(0.0154)		(0.0154)
		-0.0241		-0.0249		-0.0242		-0.0237
divorced_m		(0.0186)		(0.0186)		(0.0186)		(0.0186)
		0.1083***		0.1084***		0.1085***		0.1087***
widow_m		(0.0394)		(0.0394)		(0.0394)		(0.0394)
		-0.0065		-0.0093		-0.0085		-0.0079
part-time_m		(0.0140)		(0.0140)		(0.0140)		(0.0140)
		-0.1304***		-0.1283***		-0.1278***		-0.1285***
training_m		(0.0277)		(0.0277)		(0.0277)		(0.0277)
		0.0006		-0.0053		-0.0037		-0.0027
mg_working_m		(0.0259)		(0.0259)		(0.0259)		(0.0259)
		-0.1874***		-0.1880***		-0.1869***		-0.1881***
not_working_m		(0.0155)		(0.0155)		(0.0155)		(0.0155)
		-0.5769**		-0.5785***		-0.5767**		-0.5783***
$\text{sheltered\_working}_m$		(0.2244)		(0.2243)		(0.2244)		(0.2244)
		0.1230***		0.1074***		0.1113***		0.0981***
income_m		(0.0242)		(0.0222)		(0.0219)		(0.0206)
		0.1757***		0.1487***		0.1497***		0.1007**
Rel.Deprivation_m		(0.0513)		(0.0479)		(0.0476)		(0.0441)
		0.0382		0.0400		0.0326		0.0302
$\text{Rel.Satisfaction}_m$		(0.0245)		(0.0246)		(0.0245)		(0.0244)
Rho	0.470	0.470	0.470	0.470	0.470	0.470	0.470	0.470
Obs.	153,729	153,729	153,729	153,729	153,729	153,729	153,729	153,729

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%. Standard Errors in brackets.

Table B.6: FE and Mundalk estimations using occupation and occupation-regional reference groups, 1994-2010

	Refoccup		Refoccup2		Refoccup4		Refoccup16	
	FE	Mundlak	FE	Mundlak	FE	Mundlak	FE	Mundlak
TOTAL								
income	0.0693***	0.0717***	0.0732***	0.0730***	0.0744***	0.0750***	0.0654***	0.0631***
	(0.0191)	(0.0175)	(0.0185)	(0.0169)	(0.0175)	(0.0161)	(0.0150)	(0.0141)
Rel.Deprivation	0.0865**	0.0894***	0.0987***	0.0967***	0.1019***	0.1013***	0.0836***	0.0785***
	(0.0359)	(0.0337)	(0.0347)	(0.0325)	(0.0326)	(0.0308)	(0.0274)	(0.0264)
Rel.Satisfaction	-0.0233*	-0.0251*	-0.0217	-0.0228*	-0.0220*	-0.0234*	-0.0201	-0.0203*
	(0.0134)	(0.0130)	(0.0134)	(0.0129)	(0.0131)	(0.0128)	(0.0125)	(0.0122)
Obs.	153,729	153,729	153,729	153,729	153,729	153,729	153,729	153,729
Num. of persnr	24,348	24,348	24,348	24,348	24,348	24,348	24,348	24,348
rho	0.565	0.470	0.565	0.470	0.565	0.470	0.565	0.470
MALE								
income	0.0838***	0.0844***	0.0827***	0.0833***	0.0973***	0.0977***	0.0878***	0.0879***
	(0.0248)	(0.0247)	(0.0246)	(0.0245)	(0.0231)	(0.0231)	(0.0205)	(0.0205)
Rel.Deprivation	0.0784*	0.0803*	0.0809*	0.0827*	0.1168***	0.1182***	0.1051***	0.1055***
	(0.0468)	(0.0466)	(0.0459)	(0.0457)	(0.0433)	(0.0432)	(0.0374)	(0.0374)
Rel.Satisfaction	-0.0412**	-0.0410**	-0.0377**	-0.0376**	-0.0389**	-0.0388**	-0.0321**	-0.0320**
	(0.0175)	(0.0174)	(0.0174)	(0.0173)	(0.0171)	(0.0170)	(0.0162)	(0.0162)
Obs.	82,679	82,679	82,679	82,679	82,679	82,679	82,679	82,679
Num. of persnr	12,710	12,710	12,710	12,710	12,710	12,710	12,710	12,710
rho	0.574	0.483	0.574	0.483	0.574	0.483	0.574	0.483
FEMALE								
income	0.0635**	0.0550*	0.0707**	0.0634**	0.0532**	0.0465*	0.0460**	0.0408*
	(0.0300)	(0.0297)	(0.0284)	(0.0282)	(0.0268)	(0.0266)	(0.0219)	(0.0218)
Rel.Deprivation	0.1046*	0.0903	0.1226**	0.1103**	0.0823*	0.0710	0.0597	0.0513
	(0.0563)	(0.0559)	(0.0531)	(0.0528)	(0.0497)	(0.0494)	(0.0402)	(0.0400)
Rel.Satisfaction	-0.0069	-0.0030	-0.0071	-0.0040	-0.0045	-0.0017	-0.0093	-0.0072
	(0.0210)	(0.0209)	(0.0209)	(0.0208)	(0.0205)	(0.0205)	(0.0194)	(0.0194)
Obs.	71,050	71,050	71,050	71,050	71,050	71,050	71,050	71,050
Num. of persnr	11,638	11,638	11,638	11,638	11,638	11,638	11,638	11,638
rho	0.555	0.460	0.555	0.460	0.555	0.460	0.555	0.460

Note: Control variables and year dummies are included in all the specifications. Significance: *** 99% confidence level, ** 95% and * 90%. Standard Errors in brackets.

B.1 Appendix: POLS transformation validity

In order to test the robustness of the findings obtained in section 4.5 and the validity of the POLS transformation for SAH, equation 4.7 is estimated considering the ordinal nature of self-assessed health using an ordered probit model. Table B.7 of this appendix shows the results for Table 4.3 now estimated using an ordered probit model.

In an ordered probit model the estimated coefficients cannot be directly interpreted, but the sign is informative about whether the effect is positive or negative. In the case of the ordered probit model, coefficients for absolute and relative income measures present the same sign as the ones estimated by Pooled OLS.[1]

In this case the POLS and ordered probit (OP) estimations differ in a multiplication factor of around 0.5 ($\widehat{\beta}_{POLS}/\widetilde{\beta}_{OP} = 0.5$).

[1]Results are also similar when using reference groups defined by occupation and region, tables are available upon request.

Table B.7: Ordered probit estimations using reference group defined by occupation, 1994-2010

	TOTAL		MALE		FEMALE	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
income	0.1786***	0.3878***	0.1510***	0.3880***	0.1866***	0.3877***
	(0.0165)	(0.0659)	(0.0215)	(0.0601)	(0.0230)	(0.0808)
mean income	0.2382***		0.2691***		0.2234**	
	(0.0780)		(0.0756)		(0.0918)	
Rel.Deprivation		0.4435***		0.4427***		0.5002***
		(0.1387)		(0.1364)		(0.1662)
Rel.Satisfaction		-0.0550		-0.1011**		-0.0023
		(0.0435)		(0.0496)		(0.0490)
cut1	0.6068	0.3945	0.2672	0.0138	0.9001	0.7762
	(0.6419)	(0.6247)	(0.6372)	(0.6172)	(0.8348)	(0.7923)
cut2	1.6249**	1.4126**	1.2654**	1.0119*	1.9407**	1.8169**
	(0.6416)	(0.6238)	(0.6289)	(0.6080)	(0.8396)	(0.7969)
cut3	2.7276***	2.5153***	2.3942***	2.1406***	3.0182***	2.8945***
	(0.6472)	(0.6294)	(0.6366)	(0.6161)	(0.8407)	(0.7977)
cut4	4.2845***	4.0720***	3.9781***	3.7244***	4.5475***	4.4239***
	(0.6475)	(0.6297)	(0.6374)	(0.6167)	(0.8414)	(0.7979)
Obs.	153,729	153,729	82,679	82,679	71,050	71,050

Note: Control variables and year dummies are included in all specifications Significance: *** 99% confidence level, ** 95% and * 90%. Mean income, Rel.Deprivation and Rel.Satisfaction are refered to Refoccup.

Again, the sign and significance of income, $Rel.Deprivation$ and $Rel.Satisfaction$ is the same to the results obtained with RE and Mundlak after the POLS transformation in Table B.4 –see Table B.8.

These findings might support the use of POLS transformation for SAH.

Table B.8: Reoprobit estimations using reference group defined by occupation, 1994-2010

	TOTAL		MALE		FEMALE	
	RE	Mundlak	RE	Mundlak	RE	Mundlak
income	0.3990***	0.1844***	0.4681***	0.2417***	0.3376***	0.1154*
	(0.0352)	(0.0403)	(0.0465)	(0.0540)	(0.0545)	(0.0672)
Rel.Deprivation	0.5047***	0.2153***	0.5690***	0.2268**	0.4607***	0.1745
	(0.0698)	(0.0786)	(0.0918)	(0.1043)	(0.1080)	(0.1295)
Rel.Satisfaction	-0.0813***	-0.0736**	-0.1465***	-0.1320***	-0.0090	-0.0038
	(0.0268)	(0.0300)	(0.0358)	(0.0406)	(0.0408)	(0.0465)
cut1	-0.6615*	0.4022	-0.4541	0.0403	-0.7198	1.2617
	(0.3484)	(0.5400)	(0.4573)	(0.7487)	(0.5427)	(0.9428)
cut2	0.7780**	1.8452***	0.9755**	1.4751**	0.7300	2.7142***
	(0.3483)	(0.5400)	(0.4572)	(0.7486)	(0.5426)	(0.9428)
cut3	2.3618***	3.4318***	2.6150***	3.1182***	2.2576***	4.2446***
	(0.3484)	(0.5401)	(0.4572)	(0.7487)	(0.5426)	(0.9429)
cut4	4.5746***	5.6458***	4.8766***	5.3821***	4.4182***	6.4063***
	(0.3484)	(0.5402)	(0.4574)	(0.7489)	(0.5427)	(0.9430)
rho	0.5190	0.5145	0.5281	0.5242	0.5090	0.5041
Obs.	153,729	153,729	82,679	82,679	71,050	71,050

Note: Control variables and year dummies are included in all specifications. Significance: *** 99% confidence level, ** 95% and * 90%. Rel.Deprivation and Rel.Satisfaction are refered to Refoccup.

B.2 Appendix: Wald and Hausman Tests

This appendix summarizes the Wald and Hausman tests conducted to test whether unobserved heterogeneity is correlated with the regressors.

The null hypothesis of the Wald test is whether the coefficients of the panel-level means introduced in the Mundlak's estimations are jointly equal to 0. Table B.9 shows that this null hypothesis is rejected for the three samples of this study and all the reference groups based on occupation.

Additionally, the Hausman test analyses the difference between the RE and FE estimations. Again, the null hypothesis that there are not systematically differences is rejected.

Both tests confirm that unobserved heterogeneity might be correlated with the control variables.

Table B.9: Wald and Hausman Tests, 1994-2010

	Refoccup		Refoccup2		Refoccup3		Refoccup4	
	Wald	Hausman	Wald	Hausman	Wald	Hausman	Wald	Hausman
TOTAL								
Chi2	469.41	388.81	458.36	378.02	454.70	372.85	454.42	372.75
Prob $\succ chi2$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Null Hypothesis	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected
MALE								
Chi2	240.78	206.00	233.55	195.04	235.45	199.22	194.57	232.69
Prob $\succ chi2$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Null Hypothesis	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected
FEMALE								
Chi2	212.33	251.55	215.57	251.44	207.51	243.75	211.57	247.82
Prob $\succ chi2$	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Null Hypothesis	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected	Rejected

C Appendix: State dependence in Self-assessed health in Spain

Table C.1: Variable labels, definitions and descriptives

Variables	Definition	Mean	Std. Dev.
SAH	Self-Assessed Health	3.698	0.937
female	1 if female, 0 otherwise	0.518	0.450
age	Age in years of the individual	46.219	18.456
age2	$Age^2/100$	24.769	18.631
age3	$Age^3/1000$	14.833	15.747
age4	$Age^4/10000$	9.606	12.868
educmax2	1 if max. level of education is primary studies, 0 otherwise	0.463	0.499
educmax3	1 if max. level of education is secondary studies, 0 otherwise	0.211	0.408
educmax4	1 if max. level of education is tertiary studies, 0 otherwise (reference group of education is no studies)	0.163	0.370
ln(income)	Log of equivalised total net household income	14.022	0.745
divorced	1 if divorced, 0 otherwise	0.021	0.143
widowed	1 if widow, 0 otherwise	0.082	0.275
single	1 if single, 0 otherwise (reference group of civil status is married)	0.294	0.456
inactive	1 if inactive, 0 otherwise	0.468	0.499
unemployed	1 if unemployed, 0 otherwise (reference group of labour status is employed)	0.101	0.301
immi	1 if immigrant, 0 otherwise	0.016	0.126
hhsize	Number of members of the household	3.873	1.738
numchild0-4	Number of children in household aged 0-4	0.125	0.380
numchild5-11	Number of children in household aged 5-11	0.245	0.551
numchild12-17	Number of children in household aged 12-18	0.290	0.587
numadults65	Number of adults in household aged 65 or more	0.531	0.766

Source: Own calculation on the ECHP, 1994-2001.

Table C.2: Model specifications for self-assessed health in Spain, 1994-2001 (standard errors in parenthesis)

	Model 1		Model 2		Model 3		Model 4		Model 5			
											IC	
$h_{t-1}(1)$			-2.0769	***	-0.7414	***	-0.7348	***	-0.8605	***		
			(-0.0239)		(-0.0336)		(-0.0337)		(-0.0326)			
$h_{t-1}(2)$			-1.5766	***	-0.6118	***	-0.607	***	-0.7089	***		
			(-0.0119)		(-0.0188)		(-0.0189)		(-0.0183)			
$h_{t-1}(3)$			-0.7858	***	-0.2938	***	-0.291	***	-0.3237	***		
			(-0.0093)		(-0.0129)		(-0.013)		(-0.0127)			
$h_{t-1}(5)$			0.4009	***	0.0747	***	0.0745	***	0.0364	***		
			(-0.011)		(-0.0141)		(-0.0141)		(-0.0141)			
$h_0(1)$					-1.7155	***	-1.6955	***				
					(-0.0435)		(-0.0438)					
$h_0(2)$					-1.2731	***	-1.2566	***				
					(-0.0245)		(-0.0246)					
$h_0(3)$					-0.618	***	-0.6097	***				
					(-0.0175)		(-0.0176)					
$h_0(5)$					0.3318	***	0.3316	***				
					(-0.0192)		(-0.0192)					
age	-0.1272	***	-0.0868	***	-0.0982	***	-0.0449		-0.06		-0.1648	***
	(-0.0152)		(-0.0213)		(-0.03)		(-0.0502)		(-0.0507)		(-0.0639)	
age2	0.276	***	0.1735	***	0.1937	**	-0.1016		-0.0872		0.3775	*
	(-0.0467)		(-0.0663)		(-0.0942)		(-0.1619)		(-0.1637)		(-0.2092)	
age3	-0.3348	***	-0.19	**	-0.2064	*	0.2408		0.2195		-0.4865	*
	(-0.0602)		(-0.0866)		(-0.1238)		(-0.2168)		(-0.2195)		(-0.2854)	
age4	0.1568	***	0.0818	**	0.084		-0.1586		-0.1475		0.2385	*
	(-0.0277)		(-0.0402)		(-0.0577)		(-0.1022)		(-0.1035)		(-0.1378)	
divorced	-0.2254	***	-0.1387	***	-0.1416	***	-0.1238	*	-0.123	*	-0.0627	
	(-0.0151)		(-0.0229)		(-0.0353)		(-0.0678)		(-0.0682)		(-0.0695)	
widowed	-0.0536	***	-0.0237		-0.0084		0.0166		0.014		-0.0301	
	(-0.0089)		(-0.0146)		(-0.0232)		(-0.054)		(-0.0545)		(-0.0494)	
single	-0.0618	***	-0.0252	**	-0.0293		0.0153		0.0241		-0.0559	
	(-0.0084)		(-0.0126)		(-0.0197)		(-0.0428)		(-0.0427)		(-0.0395)	

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Table C.3: Model specifications for self-assessed health in Spain, 1994-2001 (continued from previous page)

	Model 1		Model 2		Model 3		Model 4		Model 5			
											IC	
hhsize	0.001		-0.0017		-0.0007		0.0075		0.0066		0.0137	
	(-0.0022)		(-0.0033)		(-0.0049)		(-0.0091)		(-0.0092)		(-0.0096)	
ln(income)	0.0861	***	0.0507	***	0.0413	***	0.012		0.0082		0.0837	***
	(-0.0045)		(-0.0058)		(-0.0073)		(-0.0091)		(-0.0091)		(-0.0138)	
immi	0.1472	***	0.0806	***	0.0557		0.0746		0.1559	***	0.2811	***
	(-0.0195)		(-0.0275)		(-0.0481)		(-0.0485)		(-0.055)		(-0.0875)	
educmax2	0.307	***	0.1589	***	0.1598	***	0.1474	***	0.3131	***	0.458	***
	(-0.0062)		(-0.0106)		(-0.0182)		(-0.0184)		(-0.0202)		(-0.032)	
educmax3	0.505	***	0.2849	***	0.2993	***	0.2615	***	0.5004	***	0.7602	***
	(-0.0092)		(-0.0141)		(-0.0245)		(-0.0253)		(-0.0277)		(-0.0437)	
educmax4	0.6272	***	0.3662	***	0.3901	***	0.3344	***	0.6199	***	0.9297	***
	(-0.0108)		(-0.0158)		(-0.0273)		(-0.029)		(-0.0317)		(-0.0544)	
numchild0-4	0.026	**	0.0161		0.0182		0.0014		0.0018		0.0125	
	(-0.0102)		(-0.0131)		(-0.0166)		(-0.0231)		(-0.0231)		(-0.0316)	
numchild5-11	0.0405	***	0.031	***	0.0326	***	0.0186		0.0187		-0.0317	
	(-0.0066)		(-0.009)		(-0.0124)		(-0.0199)		(-0.02)		(-0.024)	
numchild12-17	0.029	***	0.0177	**	0.0167		0.0125		0.013		0.0396	*
	(-0.0062)		(-0.0086)		(-0.0111)		(-0.0157)		(-0.0159)		(-0.0216)	
numadults65	-0.018	***	-0.0152	**	-0.0043		0.028	*	0.0261		0.0439	**
	(-0.0047)		(-0.0071)		(-0.0103)		(-0.0157)		(-0.0159)		(-0.0214)	
female	-0.0711	***	-0.0445	***	-0.0465	***	-0.0282	**	-0.0588	***	-0.0841	***
	(-0.005)		(-0.0077)		(-0.0133)		(-0.0139)		(-0.0155)		(-0.0249)	
unemployed	-0.0204		-0.004		-0.0003		0.0481	**	0.0499	**	-0.0283	
	-0.0131		(-0.0154)		(-0.0183)		(-0.0211)		(-0.0212)		(-0.0373)	
inactive	-0.2517	***	-0.131	***	-0.1264	***	-0.048	**	-0.033	*	-0.3386	***
	(-0.0075)		(-0.0105)		(-0.0145)		(-0.0197)		(-0.0198)		(-0.0301)	
cut 1	-3.655	***	-4.2742	***	-5.1966	***	-4.9414	***	-5.0023	***	-4.7578	***
	(-0.1844)		(-0.254)		(-0.3553)		(-0.4771)		(-0.5352)		(-0.7145)	
cut 2	-2.5901	***	-2.9837	***	-3.6922	***	-3.4354	***	-3.517	***	-3.4208	***
	(-0.1841)		(-0.2536)		(-0.3547)		(-0.4768)		(-0.5348)		(-0.7135)	
cut 3	-1.6023	***	-1.7814	***	-2.2781	***	-2.0197	***	-2.1184	***	-2.0908	***
	(-0.1843)		(-0.2536)		(-0.3546)		(-0.4768)		(-0.5348)		(-0.7127)	

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Table C.4: Model specifications for self-assessed health in Spain, 1994-2001 (continued from previous page)

	Model 1	Model 2	Model 3		Model 4		Model 5		
									IC
cut 4	0.0659	0.0512	-0.1856		0.0739		-0.0225		-0.1822
	(-0.1842)	(-0.2536)	(-0.3546)		(-0.4767)		(-0.5347)		(-0.7122)
σ_{κ_i}			0.5664	***	0.5662	***	0.6999	***	
			(-0.0078)		(-0.0078)		(-0.009)		
m(age)					-0.0883		-0.1239	*	
					(-0.0638)		(-0.0679)		
m(age2)					0.4003	*	0.5111	**	
					(-0.2048)		(-0.217)		
m(age3)					-0.5857	**	-0.732	**	
					(-0.2739)		(-0.2895)		
m(age4)					0.3122	**	0.3833	***	
					(-0.1292)		(-0.1363)		
m(divorced)					-0.021		-0.0674		
					(-0.0799)		(-0.0827)		
m(widowed)					-0.0558		-0.0684		
					(-0.0608)		(-0.0622)		
m(single)					-0.0514		-0.0959	*	
					(-0.0492)		(-0.0508)		
m(hhsize)					-0.0106		-0.0075		
					(-0.011)		(-0.0116)		
m(numchild0-4)					0.0187		0.0202		
					(-0.0375)		(-0.039)		
m(numchild5-11)					0.023		0.036		
					(-0.0268)		(-0.0285)		
m(numchild12-17)					0.0019		0.0207		
					(-0.0239)		(-0.0253)		
m(numadults65)					-0.0598	***	-0.0504	**	
					(-0.0214)		(-0.0223)		
m(unemployed)					-0.0945	**	-0.0927	**	
					(-0.0436)		(-0.0462)		

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Table C.5: Model specifications for self-assessed health in Spain, 1994-2001 (continued from previous page)

	Model 1	Model 2	Model 3	Model 4		Model 5		
								IC
m(inactive)				-0.1547	***	-0.2892	***	
				(-0.0298)		(-0.0313)		
m(ln(income))				0.0777	***	0.1172	***	
				(-0.0161)		(-0.0168)		
θ						1.1932	***	
						(-0.0276)		
ln-L	-88513.25	-80104.07	-77338.14	-77281.94		-95004.95		

Source: Own calculation on the ECHP, 1994-2001. Significance: *** 99% confidence level, ** 95% and * 90%. Each regression includes year dummies. m(variable) refers to time-varying variables mean.
Note:
Model 1: Ordered probit
Model 2: Dynamic ordered probit
Model 3: Random effects dynamic ordered probit
Model 4: Random effects dynamic ordered probit with time-varying variables means
Model 5: Dynamic ordered Heckman probit with time-varying variables means