Rethinking the Relative Income Hypothesis*

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Abstract

This paper focuses on the understanding of the effect of relative income on health. Traditionally, relative income was expected to have a negative association with individual health by means of negative psychological effects. However, the empirical evidence is not conclusive. In order to explain the results disparity in previous literature, I use new evidence regarding the effect of income comparisons within a reference group on well-being. Using German Socio-Economic Panel data (SOEP), I analyse whether income comparisons affect health through psychological well-being in different directions, depending whether the comparisons are "upwards" or "downwards", and not only through relative deprivation, as it was suggested initially. In addition, income endogeneity, due to omitted variables, have been tackled considering unobserved heterogeneity after a POLS transformation. The results show that relative income is more important for health than absolut income. The association between "upwards" comparisons and health is positive, being negative the effect of "downwards" comparisons.

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1 Introduction

Although the relationship between income inequality and health –also income and health– is well documented in the literature (Wilkinson, 2000; Wagstaff and Van Doorslaer, 2000; Deaton; 2003 and Gravelle and Sutton, 2009), there is no consensus about the effect of income inequality on health yet, due to evidence disparities when both variables are analysed. On the one hand, there is supportive evidence of a negative effect of income inequality on health, but this result seems to vanish depending on the methodological approach used in the analysis[1]. In addition, some other methodological puzzles have not been addressed so far, and they might also distort the association between health and income inequality. For instance, the reverse causality between income and health. Given the difficulty to correct for those feedback effects between income and health, few attempts are found in order to tackle the endogeneity problem in the association between both variables (Ettner, 1996; Theodossiou and Zangelidis, 2009) and therefore previous results might overestimate the effects of income –and income inequality– on health.

Income inequality was introduced in the analyses of health to explain the non-linear relationship between health and income —the relationship between income and health is called *absolute income hypothesis* (Preston, 1975; Rodgers, 1979). Rodgers (1979) observes that the positive relationship between income and health flattens out when countries become richer, suggesting that health is independent on income in the long run, and income inequality might be the main determinant of health. Wagstaff and Van Doorslaer (2000) describe the different mechanisms which relate income inequality and health, differentiating between the *income inequality hypothesis* –when income inequality affects health per se– and the *relative income hypotheses* –when income distribution affects health through income comparisons within a reference group. The evidence does not achieve to disentangle between both hypotheses so far –mainly because of the methodological problems–. For instance, in many cases the impact of income inequality disappears after controlling for relative income (Deaton, 2001 and Gravelle and Sutton, 2009). Nevertheless, the effect of relative income is also controversial. As a matter of fact, relative income is expected to affect health negatively through psychosocial stress. However, while some studies find a negative effect of relative income, in others it is not significant, or even positive (Theodossiou and Zangelidis, 2009; Karlsson et al., 2010; Feng and Myles, 2005; Miller and Paxson, 2006)).

Thus, this paper focuses on the understanding of the effect of relative income on health, considering new evidence regarding the effect of income comparisons within a reference group on individual well-being.

As it has observed in the case of health, Easterlin (1974 and 1995) also finds a low

[1]For instance, the impact of income inequality is less significant when considering less aggregate regional units –within and between countries– (Wilkinson and Pickett, 2006), and also different econometric model specifications lead to different results.

correlation between income and well-being in richer countries, and suggests that a higher income does not make people happier once they rise above a 'subsistence level'. However, income might still have an indirect impact on individual welfare, because the position in the income distribution constitutes a person's social status, in other words, relative income matters.

At the same time, in the literature of individual utility maximization, income comparisons are considered to be important to define individual well-being, that is well-being depends on the individual's own income as well as on the income of a reference group (Duesenberry, 1949; Easterlin, 1974; Ferrer-i Carbonell, 2005). There is still some controversy about the direction of the comparisons. Most of the evidence supports that individuals compare themselves to richer individuals, what is called Relative Deprivation. Thus, individuals might feel more deprived and stressed, the larger the distance between income of richer individuals in the group and their own income. However, Hirschman and Rothschild (1973) finds evidence of a 'tunnel effect' [2], which implies a preference for disadvantageous income inequality. In this case, individuals derive pleasure from having richer people in the group, because they consider it as a future opportunity to improve their own income. On the contrary, new evidence suggests that individuals also take into account downwards comparisons, namely Relative Satisfaction. Fehr and Schmidt (1999) proposes a utility function which includes the effect of the existence of poorer individuals in the reference group, which might be either negative if individuals are inequality adverse, or positive if they interpret it as a prestige effect.

Given that those individual perceptions generate positive and negative psychological effects, we might also expect a negative effect on health when individuals feel deprived or suffer from psychosocial stress, and a positive effect when they feel happier. Although some authors find evidence of those effects on well-being, such a distinction regarding income has not been considered to understand how relative income operates on health.

Thus, the aim of this paper is two fold. First of all in order to shed light on previous research discrepancies, I focus on the relationship between relative income and health based on a relative income measure,which allows us to distinguish between the effect of "upwards" and "downwards" income comparisons on health. Secondly, I take into account the panel-dimension of the data to control for unobserved heterogeneity, in order to correct for income endogeneity. The analysis is based on the German Socio-Economic Panel (SOEP), which includes longitudinal income and health data for the period 1995-2008.

Preliminary results show that relative income is more relevant for health than absolute income. Income comparisons within group, both "upwards" and "downwards", are statis-

[2]The 'tunnel effect' is an analogy from a traffic jam. When on a traffic jam on a road with two lanes, the vehicles that begin to move in one lane give a signal to those in the stationary cars in the other lane. The drivers of the stationary cars anticipate the dissolution of the traffic jam and an imminent resumption of their travel

tically significant. As a matter of fact, Relative Deprivation within the reference group generates a positive effect on health. And Relative Satisfaction affects health negatively.

Thus, the main contribution of this paper is to present evidence of the relevancy of "'upwards"' and "'downwards"' income comparisons for health. As far as I know, this is the first time that this relationship is analysed using panel data and considering endogeneity due to omitted variables.

This paper is structured as follows. Section 2 surveys previous literature regarding the relative income hypothesis and the evidence for the German case. Section 3 describes the data used and the econometric specifications used in the paper. Section 4 describes the empirical findings on the relationship between relative income and health. After, section 5 presents different robustness checks. And finally, Section 6 concludes.

2 Previous Literature

2.1 Relative Income and health

The relationship between relative income and health has been already analysed. The major concern is on the difficulties that an individual might face when he is situated at the bottom of the social ladder (Sapolsky, 1994 and Wagstaff and Van Doorslaer, 2000). Previous evidence claims that health is affected by social status, rather than by absolute income, as is suggested by the non-linear relationship found between income and health (Preston, 1975; Rodgers, 1979 and Wilkinson and Pickett, 2006). Accordingly, Deaton (2003) argues that social status is important in determining how much control individuals have on their own live and the level of participation in society (Whitehallstudies and Marmot, 2004). In this sense, Deaton (2003) points out that a lower social position might threaten health by reducing the access to health enhancing goods. Thus, an individual with a lower income with respect to his reference group peers might suffer from psychosocial stress, due to the difficulties to access health related goods –such as better housing or health services–, or the feeling that he can not reach others' consume level (see Wilkinson, 2000 and Deaton, 2003 for a review of the effects of psychosocial stress on health). It has already been proved that stress derived of psychosocial causes attack the immunological system, and individual health might worsen. This is the aim of the psychosomatic medicine which appeared at the beginning of the XXth century to study and treat stressed based diseases. Therefore, initially relative income hypotheses posit that relative income might have a detrimental effect on health (Deaton, 2001; Theodossiou and Zangelidis, 2009; Subramanyam, Kawachi, Berkman, and Subramanian, 2009). Nevertheless, empirical evidence is not conclusive and there are disparities in the results depending on the measure of relative income and the reference group used.

Three are the measures of relative income mainly found in the literature, which were

collected in the seminal paper of 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* considers a deprivation index as a measure of relative income. In this case, the relevant determinant for health might be the distance between the individual income and an income threshold –usually the poverty threshold–. Again a higher distance would mean that is more difficult for the individual to reach the desired consume level. And finally, the *relative-position hypothesis* from which it can be drawn that it is the relative position in the income distribution what matters, which is measured by the rank. Thus, as suggested by Deaton (2003) being at the bottom of the social ladder might determine individual health status. Although all these three measures have been vastly tested in the literature, there is still controversy about the effect of social status on health.

Thus, 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. Following the same analysis, Hildebrand and Van Kerm (2005) finds 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 worsen 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, this result might contradict the initial hypotheses regarding the effect of relative income on health.

Similarly, the same disparity of results is found using deprivation or relative deprivation measures. Eibner and Evans (2005) analyses 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 on BHPS data from 1991 to 2002 and relative deprivation measures found 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 more clear 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. 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)

In front of these discrepancies 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, new evidence on "individual's happiness" 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 psychological well-being. Thus, 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 psychological well-being, might be positive or negative depending on individual's' beliefs.

Thus, my hypothesis is that the difficulties of assessing the effect of relative income on health is due to the misunderstanding of the complexity of income comparisons and its effect on health. In the next two sections I focus on how those income comparisons take place, how they affect psychological well-being, and how they end up determining individual health.

2.2 Income comparisons and well-being

Since Easterlin proclaimed his paradox about the relationship between income and well-being, a great bulk of studies have focused on the implications of social comparisons –based on income– on individual well-being. Thus, empirical evidence suggests that well-being is affected by the income gap between individuals and their reference group (Easterlin, 1974; Ferrer-i Carbonell, 2005 and 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, for example, individuals imitate others' consump-

tion[3]. 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 affected not only by individual income y_i [4], but also by individual relative income —denoted by y_j— within its reference group, as it is shown in the following equation:

$$U_i = (y_i, y_j, X) \tag{1}$$

Where Ui stands for the utility or well-being level of individual i, and X includes a set of individual and household characteristics, which might also be relevant for individual well-being.

Additionally, income comparisons also provide individuals with information about their self-value, which is a measure of the contentment derived from social status (Dakin and Arrowood, 1981). On the one hand, income comparisons help individuals to assess their own success or failure while on the other hand, relative income is informative about the individual esteem within the reference group (Wunder and Schwarze, 2009).

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

$$U_i = y_i + \alpha \int_{y_i}^{\infty} (z - y_i) dF(y) + \beta \int_{0}^{y_i} (y_i - z) dF(y) \tag{2}$$

Thus, individual's welfare depends positively on own income, and negatively both on disadvantageous inequality and advantageous inequality. Disadvantageous inequality is represented in the second term of the equation by "'upwards"' income comparisons –individuals compare with richer individuals. The third term of the equation is the advantageous inequality, also named "'downwards comparisons"' –individuals compare with poorer individuals.

Fehr and Schmidt (1999) assumed that $-1 < \beta \leq 0$ and $\alpha \leq \beta \leq 0$, in other words, that both upwards and downwards comparisons have a negative effect on well-being, and this effect is higher for upwards comparisons.

However, there is still controversy in the direction and the sign of income comparisons. For example, in 1949 Duesenberry pointed out that individuals compare themselves with 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, because individuals would envy the better off. In this case, individuals would be disadvantageous inequality averse. Ferrer-i Carbonell (2005) using SOEP data also

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

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

finds evidence of upwards comparisons. Thus, poorer individuals' well-being, specially in East Germany, decreases when their income is lower than that of their reference group.

On the contrary, Hirschman and Rothschild (1973) were concerned about the existence of an "information effect", also called "Tunnel effect", for the similarities with a traffic jam in a two lane road. The stationary drivers anticipate the dissolution of the traffic jam, when they observe cars moving in the other lane. 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 average income of the reference group would be seen as an individual's own future income improvement, and individual well-being would be higher [5]. This is what D'Ambrosio and Frick (2007) 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 effect", because it might be informative of individual social success, and individuals might be happier. On the contrary, some individuals might feel "regret" for being richer, that is to say, individuals might have aversion to advantageous inequality. 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.

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.

2.3 Income comparisons and health

As it was mentioned previously, relative income is expected to affect health through psychosocial stress generated by the distance between individual's income and a reference income. This psychosocial stress derives, on one hand, from being material deprived, due to the difficulty to access health enhancing goods. And on the other hand, for the negative psychological effects of feeling deprived. Actually, it has been proved that psychological well-being has an effect on health by triggering psychosomatic diseases. A psychosomatic disease is defined as physical illness believed to be caused by psychological factors, such as recent or early life events, personality, psychological well-being and chronic or daily stress. This medical discipline claims that being happier has a favourable impact on a disease course, for example, on the onset of breast cancers implies a longer survival time. Additionally, it

[5] 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.

plays an important role in coping with stress in transplant treatments, and finally it helps to the immunological, endocrine and cardiovascular systems (Sapolsky, 1994 and Fava and Sonino, 2000). Particularly, psychological well-being is related to different dimensions such as self-acceptance, with a positive attitude toward self, or personal purpose in life, namely, individuals derive psychological well-being from achieving personal goals or having sense of directness (Ryff and Singer, 1996). Following this argument, income comparisons might determine psychological well-being, due to its informative role about consumption possibilities, future income and self-value.

Therefore, in front of the new evidence presented in previous section, which claims that income comparisons might be in both directions, I expect that they might affect health through psychological effects in both directions as well.

Thus, when income comparisons increase psychological well-being, as in the cases of a "tunnel effect" or "prestige" mentioned above, individual health status might improve, because positive psychological well-being helps to cope with daily stress. Alternatively, if what is relevant is the "envy" or the "regret" effect, individual psychological well-being would decreases, and we expect that individual health might worsen off.

Table 1: Income comparisons and health

	Positive effect on health	Negative effect on health
Upwards: Relative Deprivation	Tunnel Effect	Envy
Downwards: Relative Satisfaction	Prestige	Regret

Bearing in mind that these downwards and upwards income comparisons also measure advantageous and disadvantageous inequality. Again inequality within the reference group, could be positive or negative for health as previous empirical evidence has shown, depending on whether the effect of inequality on individuals is material deprivation, or a protective effect because of being with richer individuals in the reference group.

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 "upwards" 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 were 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.

In front of previous evidence, I expect that both, "'upwards"' and "'downwards"' comparisons will be significant for Germany. However, it is not clear what sign they will present.

2.4 Reference Groups

Income comparisons take place within the reference group, which contains the subjects with whom an individual compares himselfs to (Runciman, 1966 and 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, neighbours, co-workers and it might even diverge between countries or individuals. Again the literature is not conclusive, thus, Knight, Song, and Gunatilaka (2008) when analysing rural immigrants in China they find that individuals compare with individuals in the same village. However, for post-transition European countries Senik (2009) finds that people compare their income with individuals who know before the transitions started.

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, central Europe 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 of Mayraz, Wagner, and Schupp (2009) using a pretest module of the SOEP for 2008, finds that the more important income comparisons are work-related, for instance with other people in the same profession —There are no apparent differences in how men and women judge the importance of income comparisons, but there appears to be a big gender difference, with a much greater effect for male—, and less with family and almost unimportant with neighbors. These results are similar to the conclusions found in Clark and Senik (2010). Therefore, I define the reference groups by means of the profession, using the ISCO-88 occupation codes available in SOEP, aggregated into 22 different categories as suggested in Pischke (2010). I also include a geographical criteria, in other words, that individuals compare themselves with individuals in the same occupation living in the same area. For the region criteria, I use 3 different definitions, first

the traditional division between East and West —refoccup2—, the four region division —refoccup4: East-North-Central-South— and finally the 16 Bundeslands —refoccup16. Table 2 shows the number of groups in each reference group.

Table 2: Reference Group

Refgrup	Min.	Max.
refoccup2	1	44
refoccup4	1	88
refoccup16	1	345

3 Data and Methods

The data used in this paper is the German Socio-Economic Panel (SOEP). SOEP is a representative longitudinal study of private households in the Federal Republic of Germany that was started on 1984. We use data for the period 1994-2008 [6].

Our health 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). Although SAH is a subjective health measure, it 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.

I include a set of covariates to control for personal characteristics such as age, age square, gender, individual's number of years of education, nationality, marital status, labour status and household composition —see Table 7.

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]. Any missing income information due to item-nonresponse has been imputed according to the longitudinal and cross-sectional imputation procedures (see Frick and Grabka, 2005; Grabka, 2009 for a detailed description). All income measures are deflacted to 2006 prices, including a correction for purchasing power differences between West and East Germany. As suggested by Cowell and Victoria-Feser (2002), to avoid noise and bias in the estimation of the relative income indices due to outliers and extreme incomes, income distribution has been trimmed 1% of the upper and lower tails of the income distribution.

[6] The data used in this paper was extracted from the SOEP Database provided by the DIW Berlin using the Add-On package Panelwhiz, which has been written by Dr. John P. Haisken-DeNew. Panelwhiz also supplied SOEP Menu Plugins used to ensure longitudinal consistency.

[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)

3.1 The relative income measure

The relative income measure based on social comparisons used in this analysis, follows the deprivation index suggested by Yitzhaki (1979), which defines upwards comparisons as the deprivation felt by a person with income x_i with respect to a person with income x_j[8].

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

(3)

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

$$D_i(x) = \frac{\sum_{j \varepsilon B_i(x)} (x_j - x_i)}{n}, \tag{4}$$

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:

$$RD_i(x) = \frac{\sum_{j \varepsilon B_i(x)} (x_j - x_i)}{n\lambda(x)}, \tag{5}$$

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.

Regarding the downwards comparisons, D'Ambrosio and Frick (2007) suggest a relative satisfaction function of the person with income x_i, $S_i(x)$. The function $S_i(x)$ is

$$RS_i(x) = \frac{\sum_{j \varepsilon W_i(x)} (x_i - x_j)}{n\lambda(x)}, \tag{6}$$

W_i refers to the set of individuals that have a lower income than individual i in the reference group. In this case, deprivation and satisfaction indexes are also calculated for all the reference groups.

3.2 The estimation procedure

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

$$h^*_{it} = X_{it}\beta + y_{it} + RD_{it} + RS_{it} + e_{it} \tag{7}$$

[8] As I mentioned in the introduction, the results of this paper are based on the relative measure suggested by Ferrer-i Carbonell (2005). In the next version of the paper I am going to consider also the deprivation and satisfaction indexes proposed by D'Ambrosio and Frick (2007)

$$h_{it} = k \Leftrightarrow h_{it} \in [\lambda_k, \lambda_{k+1}\} \tag{8}$$

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. In the left-hand side, X_{it} is a set of control variables, y_{it} stays for the income variable and RD_{it} and RS_{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, health has been transformed to a "'pseudo"' continuous variable following the "'Probit OLS"' method (POLS), proposed by Van Praag and Ferrer-i Carbonell (2004). This econometric strategy estimates the conditional expectation $\overline{\mu}_{i_n} = E(\mu \,|\mu_{i-1} < \mu \leq \mu_i)$ of the true values of health, which cannot be directly observed, by means of the normal distribution as suggested by Maddala (1983):

$$\overline{\mu}_{i_n} = E(\mu \,\Big|\, \mu_{i-1} < \mu \leq \mu_i) = \frac{n(\mu_{i_n-1}) - n(\mu_{i_n})}{N(\mu_{i_n}) - N(\mu_{i_n-1})} \tag{9}$$

where $\overline{\mu}_{i_n}$ is a discrete random variable which is used as a proxy of the real individual health. N is the cumulative standard normal distribution and n is the standard normal density function.

Once the transformation is done, h_{it} from equation (6) works as a continuous variable, and the model can be estimated using traditional econometric strategies, allowing to interpret estimated coefficients as marginal effects, and directly to compare the results obtained with different models (Origo and Pagani, 2009).

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

$$h_{it} = X_{it}\beta + y_{it}\gamma_1 + RD_{it}\gamma_2 + RS_{it}\gamma_3 + u_i + \epsilon_{it} \tag{10}$$

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

In order to estimate equation (9), an assumption has to be done regarding the correlation between u_i and the regressors. When this correlation is zero, u_i is considered "'an individual random effect"' (RE), 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 coefficient consistently (Wooldridge, 2010). My intuition says that it is the case, for example, genetics or ability are

individual time invariant unobserved effect, which obviously affects 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 [9].

Both techniques can be easily applied using traditional statistical packages. Nonetheless, one drawback of the FE approach is that it removes panel-level averages — $\overline{h}_i$, $\overline{y}_i$,$\overline{RD}_i$ and $\overline{RS}_{it}$— from each side of equation (9) to get rid off the fixed effect u_i from the model.

$$h_{it}-\overline{h}_i = (X_{it}-\overline{X}_{it})\beta+(Z_i-Z_i)\delta+(y_{it}-\overline{y}_i)\gamma_1+(RD_{it}-\overline{RD}_i)\gamma_2+(RS_{it}-\overline{RS}_{it})\gamma_3+u_i-u_i+\epsilon_{it}-\overline{\epsilon}_i \tag{11}$$

obtaining:

$$\widetilde{h_{it}} = \widetilde{X_{it}}\beta + \widetilde{y_{it}}\gamma_1 + \widetilde{RD_{it}}\gamma_2 + \widetilde{RS_{it}}\gamma_3 + \widetilde{\epsilon_{it}} \tag{12}$$

Then, OLS can be applied to equation (11), and it will produce consistent estimates. However, note that Z_i 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 are numerically identical to within estimates, in other words, to FE estimation. In addition, Mundlak (1978)'s approach allows us 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 convenient. 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).

4 Results

This section shows the results of the two econometric specifications used in this paper:

1. Pooled OLS

2. Panel effects with unobserved heterogeneity

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

4.1 Pooled OLS

Table 3 summarizes Pooled OLS estimation using the whole sample (TOTAL), and two subsamples for MALE and FEMALE. The three specifications include all the covariates. As expected age has a deleterious effect on health due to human capital depreciation —specially for MALES—, 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 the effect of household size and education. All these results coincide with previous research.

Regarding civil status, being married has a protective effect on health, but only for females. The same happens for the case of widowed and divorced individuals. Being single has no effect on SAH. Europeans and non-Europeans report better SAH than Germans, but these variables are only significant for the case of males. However, individuals who affirm being stateless report worse SAH in the three sample. Finally, employment shows a significant and positive effect on SAH with respect to individuals on vocational training, irregular workers and sheltered workers, but not with respect to not employed. In fact, unemployment is believed to affect health negatively. However, in this case the not employed variable might content also individuals who have freely decided not to work, and in this case, not working would not be negative for health. Thus, the unemployment effect might be offset by this positive situation. However, to be not employed is only significant for females.

For the three samples income presents a positive and significant effect on SAH. Nevertheless, the impact is slightly higher for males. In this case, the evidence suggests that *Absolute Income* is relevant for health.

I find also evidence of a significant effect of Relative Income measured by means of "upwards" and "downwards" income comparisons. Thus, RD presents a positive sign and RS is negative for the whole sample specification. Both relative income indexes are significant showing that both "upwards" and "downwards" income comparisons are relevant for health. These results would suggest that there is no evidence of psychosocial stress when individuals compare to richer individuals, on the contrary, it would be a "tunnel effect". On the other hand, richer individuals would feel regret when distance to worse off is higher, and it might worsen health. Moreover, the positive impact of RD is much stronger than the impact of RS, and slightly higher than the effect of income. Thus, in the case of Germany it seems that the negative impact of downward comparison might be compensated by the positive effect of RD.

The same patter is found in the male and female samples. However, the impact of RD is higher for women than for men. Nevertheless, the effect of RS on health is not significant in the female sample.

These results shed light on how relative income operates on health. Notice that depending on the direction of income comparisons the effect on health is different. The results of this

Table 3: Pooled OLS

	TOTAL		MEN		FEMALE	
age	-0,0265	***	-0,0328	***	-0,0213	***
age	0,0002	***	0,0002	***	0,0001	**
female	-0,0422	***				
married	0,0285	**	0,0130		0,0417	*
single	0,0116		0,0123		0,0108	
divorced	0,0238	***	0,0213		0,0239	**
widow	0,0462	**	0,0419		0,0448	*
euro	0,0398	***	0,0663	***	0,0020	
non-euro	0,0288	**	0,0623	***	-0,0114	
stateless	-0,1311	***	-0,0369	**	-0,2422	***
training	-0,0590	***	-0,0617	***	-0,0655	***
mg_working	-0,0064		-0,0514	***	-0,0003	
not_working	0,0681	**	0,0477		0,0817	*
sheltered_working	-0,4937	***	-0,4622	***	-0,5382	***
hsize	0,0168	***	0,0124	***	0,0213	***
educ	0,0101	***	0,0108	***	0,0100	***
lny	0,1920	***	0,1955	***	0,1931	***
RD	0,2186	***	0,2095	***	0,2451	***
RS	-0,0400	**	-0,0614	***	-0,0200	
cte	-1,8140	***	-1,6906	***	-2,0190	***
R2	0.0813		0.0903		0.0719	
obs.	143443		78418		65025	

Note: Control variables are included in all the specifications. All specifications include year dummies. Significance: *** 99% confidence level, ** 95% and * 90%. RD and RS are refered to refoccup.

paper are in concordance with previous research, which finds also evidence of an informative effect of "upwards" comparisons on happiness in the case of Germany (D'Ambrosio and Frick, 2007). However, they contradict the idea that relative deprivation generates psychosocial stress.

Thus, Pooled OLS results show that relative income is relevant for health. And both, "upwards" and "downwards" income comparisons are important to determine health trough psychological well-being.

4.2 Panel effects with unobserved heterogeneity

In this section I present the results when unobserved heterogeneity is considered. As a matter of fact, I focus on two possible scenarios. The first one, when the time-invariant unobserved effect is not correlated with the regressors, that is to say, that the model is estimated using RE. And Secondly, when $X's$ are allowed to be correlated with u_i. In this case, I estimate the model using the Mundlak's approach, which is equivalent to estimate the model by FE.

Table 4 shows the three specifications considered in previous section but now estimated by RE and Mundlak's approach. The sign and significativaty of the covariates under RE specification are similar to the Pooled OLS estimation. However, some of them such as

hsize and *educ* lose their significativity when using Mundalk's approach. It could be because panel variation of both variables is low. Nevertheless, their panel-level means are significant. One possible explanation is that the effect of these variables on health is through omitted variables. Thus, once unobserved heterogeneity is taken into account their effect on health vanishes.

Table 4: Panel Effects: RE and Mundlak's approach estimation

	T_RE		T_Mund		M_RE		M_Mund		F_RE		F_Mund	
age	-0,01990	***	-0,02442	***	-0,02528	***	-0,03079	***	-0,01468	***	-0,01702	***
agesq	0,00008	***	-0,00002		0,00013	***	0,00004		0,00003		-0,00008	***
female	-0,04665	***	-0,04541	***	0,00000							
married	0,04368	***	0,04755	***	0,02173	*	0,02600	*	0,06265	***	0,06714	***
single	0,00580		0,00781		0,00766		0,01441		0,00287		-0,00036	
divorced	0,01730	**	0,02580	***	0,01104		0,01855		0,02053	*	0,03194	**
widow	0,01028		-0,03240		-0,05462	*	-0,09875	**	0,02781		-0,00831	
euro	0,02890	***	0,04846	***	0,05825	***	0,08186	***	-0,00986		0,00447	
non-euro	0,02447	*	0,04159	***	0,05689	***	0,07311	***	-0,01294		0,00543	
stateless	-0,16406		-0,14091		-0,05584		-0,04203		-0,27869	***	-0,22218	***
training	-0,01733	**	-0,01057		-0,01206		-0,00132		-0,02594	**	-0,01969	
mg_working	0,00052		-0,00107		-0,01610		-0,01519		0,00254		0,00188	
not_working	0,06376	***	0,06893	***	0,04105		0,04422		0,08653	***	0,09590	***
sheltered_working	-0,43917	***	-0,06289		-0,45316	***	-0,21620		-0,42906	***	0,49087	***
hsize	0,00713	***	-0,00095		0,00510	**	0,00015		0,00950	***	-0,00193	
educ	0,01273	***	-0,00024		0,01299	***	-0,00068		0,01295	***	0,00008	
lny	0,14057	***	0,06982	***	0,15423	***	0,08708		0,12972		0,05603	**
RD	0,17636	***	0,08149	***	0,17908	***	0,08384	***	0,17892	***	0,08345	*
RS	-0,03107	***	-0,02534	**	-0,04901	***	-0,03876	***	-0,01339		-0,01245	
age_m			-0,00603	**			-0,00676	*			-0,00880	*
agesq_m			0,00023	***			0,00025	***			0,00026	***
married_m			-0,05598	*			-0,02808				-0,07936	*
single_m			0,00559				-0,00473				0,01773	
divorced_m			-0,00689				-0,00977				-0,00517	
widow_m			0,09852	***			0,13299	**			0,07793	*
training_m			-0,09472	***			-0,12082	***			-0,08409	***
mgworking_m			-0,02910	*			-0,06454	*			-0,02365	
notworking_m			0,02446				0,03372				-0,00607	
shelteredworking_m			-0,51250	***			-0,38248	*			-1,05405	***
hsize_m			0,02155	***			0,01371	***			0,02901	***
educ_m			0,01153	***			0,01329	***		***	0,01090	***
lnytrim_m			0,11273	***			0,09234	***		***	0,13154	***
RD_m			0,10906	**			0,12415	*			0,10474	
RS_m			0,00649				0,00779			***	0,00391	
cte	-1,37924	***	-1,71841	***	-1,38104	***	-1,52391	***	-1,4601		-1,9421	***
rho	.47368097		.47297645		.48237327		.48183798		.46106306		.46198226	
obs.	143443		143443		78418		78418		65025		65025	

Note: Control variables are included in all specifications. All specifications include year dummies. Significance: *** 99% confidence level, ** 95% and * 90%. RD and RS are refered to refoccup.

At the same time, estimated coefficients are lower comparing to Pooled OLS estimations, especially in the Mundalk approach. Again, panel-level means might capture part of their effect due to its correlation with unobserved heterogeneity.

Regarding income and relative income variables, the results follow the same pattern as in Pooled OLS estimations. Income is positive and significant. In addition, RD shows a positive effect on health, and RS a deleterious effect, as highlighted in the previous section. However, the estimated coefficients for those three variables are also lower after correcting for unobserved heterogeneity, specially in the Mundak's approach. Thus, the Pooled OLS estimation might overestimate the effect of income and relative income on health. This result is reinforced by the significativity of the panel-level mean of income and RD, showing that part of effect of income on health is due to the correlation of income with omitted variables. In addition, these results might also state that permanent income, or to be deprived recurrently, are more relevant for health than *current* absolut and relative income.

Again, RS is not significant in the female sample.

What is clear is that unobserved heterogeneity still explains almost half of the variability of SAH, as rho shows in all the specifications.

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_{it} are related with the regressors, and the Mundlak's specification is more convenient. Finally, a Hausman test also confirms this result.

5 Robustness checks

In order to test the robustness of previous results, I also estimate previous models using the rest of the reference groups defined in section 2. I obtain similar results [10].

In addition, I also estimate equation (9) considering the ordinal nature of self-assessed health using an ordered probit model. Table 5 shows the results for the three specifications using ordered probit.

When using Probit estimated coefficients cannot be directly interpreted, but the sign are informative about whether the effect is positive or negative. In the case of probit models, results for absolut an relative income measures are similar to the Pooled OLS. The only difference is that RS is also significant for females.

Additionally, unobserved heterogeneity is considered and I estimate the three specifications using RE and Mundlak's approach with the ordinal health variable. Again, the sign and significativity of income, RD and RS is similar to the results obtained with RE and Mundlak's approach after the POLS transformation –See table 6.

[10] Results using refoccup2, refoccup4 and refoccup16 are available under request.

Table 5: Probit

	T_Probit		M_Probit		F_Probit	
age	-0,0560	***	-0,0696	***	-0,0451	***
agesq	0,0003	***	0,0005	***	0,0002	***
female	-0,0921	***				
married	0,0528	**	0,0242		0,0770	**
single	0,0245	**	0,0302	**	0,0175	
divorced	0,0479	***	0,0324	*	0,0566	***
widow	0,1088	***	0,1073	**	0,1030	***
euro	0,0895	***	0,1541	***	0,0015	
non-euro	0,0595	***	0,1311	***	-0,0228	
stateless	-0,3541		-0,0997		-0,6812	***
training	-0,1411	***	-0,1476	***	-0,1527	***
mg_working	-0,0184		-0,1165	***	-0,0045	
not_working	0,1442	***	0,0888		0,1865	***
sheltered_working	-1,0081	***	-0,9915	***	-1,0520	***
hsize	0,0378	***	0,0286	***	0,0468	***
educ	0,0240	***	0,0269	***	0,0222	***
lny	0,4036	***	0,4033	***	0,4152	***
RD	0,4399	***	0,4108	***	0,5061	***
RS	-0,0854	***	-0,1233	***	-0,0523	**
obs.	143443		78418		65025	

Note: Control variables are included in all specifications. All specifications include year dummies. Significance: *** 99% confidence level, ** 95% and * 90%. RD and RS are refered to refoccup.

Table 6: Reoprobit

	T_Reoprobit		T_Mundlak		M_Reoprobit		M_Mundlak		F_Reoprobit		F_Mundlak	
age	-0,0552	***	-0,0675	***	-0,0732	***	-0,0855	***	-0,0397	***	-0,0476	***
agesq	0,0002	***	-0,0002	**	0,0003	***	0,000		0,000		-0,0003	***
female	-0,1365	***	0,0004									
married	0,1308	***	-0,5786		0,0651		0,0770	*	0,1832	***	0,2011	***
single	0,0279		0,1434	***	0,0410	*	0,0534	*	0,0108		0,0086	
divorced	0,0524	**	0,0324		0,0268		0,0582		0,0688	**	0,1181	***
widow	0,0466		0,0896	***	-0,1181		-0,2834	**	0,0903	*	0,0080	
euro	0,0930	***	-0,1243	***	0,1787	***	0,2574	***	-0,0044		0,0165	
non-euro	0,0777	**	0,1486	***	0,1646	***	0,2354	***	-0,0158		0,0278	
stateless	-0,6845		0,1394	***	-0,2118		-0,1348		-0,9158		-0,9158	
training	-0,0684	***	-0,0703		-0,0580	*	-0,0230		-0,0890	***	-0,0687	*
mg_working	-0,0004		-0,0479	*	-0,0548		-0,0499		0,0060		0,0129	
not_working	0,2039	***	0,0014		0,1209		0,1152		0,2921	***	0,3282	***
sheltered_working	-1,0081	***	0,2188	***	-1,3044	***	-0,4754		1,3647	***	1,3647	*
hsize	0,0220	***	-0,0393		0,0146	**	-0,0027		0,0296	***	-0,0033	
educ	0,0424	***	-0,0033		0,0446	***	-0,0039		0,0419	***	0,0051	
lny	0,4344	***	0,2085	***	0,4893	***	0,2577	***	0,3926	***	0,1731	**
RD	0,5169	***	0,2230	***	0,5486	***	0,2289	**	0,5075	***	0,2343	*
RS	-0,0993	***	-0,0871	***	-0,1563	***	-0,1290	***	-0,0444		-0,0481	
age_m			-0,0220	***			-0,0288	**			-0,0261	**
agesq_m			0,0007	***			0,0008	***			0,0008	***
married_m			-0,1377	*			-0,0397				-0,2124	*
single_m			0,0215				0,0111				0,0388	
divorced_m			-0,0613				-0,0517				-0,0791	
widow_m			0,2558	***			0,4388	**			0,1584	
training_m			-0,3036	***			-0,4026	***			-0,2678	***
mgworking_m			-0,1241	***			-0,2081	**			-0,1259	**
notworking_m			0,0385				0,2219				-0,1361	
shelteredworking_m			-1,7196	***			-1,3683	***			-2,9380	***
hsize_m			0,0640	***			0,0471	***			0,0789	***
educ_m			0,0368	***			0,0474	***			0,0290	***
lnytrim_m			0,3517	***			0,3142	***			0,3737	***
RD_m			0,0220				0,0189				0,0350	
RS_m			0,2844	**			0,3535	*			0,2495	
rho	0,5248		0,5208		0,5330		0,5290		0,5149		0,5107	
obs.	143443		143443		78418		78418		65025		65025	

Note: Control variables are included in all specifications. Significance: *** 99% confidence level, ** 95% and * 90%. RD and RS are refered to refoccup.

6 Conclusions

The aim of this paper is to shed light on the relationship between relative income and health, because previous research is not conclusive. Reading existent evidence on the effect of income comparisons on well-being, I realized that deprivation is only part of the story, and individuals might also compare with the worse off. Moreover, these income comparisons might generate satisfaction and discontent. Given that psychological well-being affects health, "upwards" and "downwards" comparisons might also determine health.

Thus, I consider a relative income measure, based on a relative deprivation and a relative satisfaction index, to capture income comparisons. Of course, absolut income is also added in the analysis.

Firstly, I estimate three different specifications using Pooled OLS after a POLS transformation. Secondly, I introduce unobserved heterogeneity in the model in order to correct for income endogeneity due to omitted variables. Thus, RE and Mundlak's approach have been considered.

Preliminary results show that there is evidence that relative income is more relevant for health than absolut income. Regarding income comparisons, both "upwards" and "downwards" comparisons are significant —for females only "'upwards"' comparisons are precisely estimated. As a matter of fact, relative income has a positive effect on health through an "informative or tunnel effect" —in contradiction as initial relative income hypotheses state—, and relative satisfaction is negative for health. It indicates that individuals take advantage of belonging to a reference group with richer individuals. At the same time advantageous inequality is deleterious for health, specially for males.

Once unobserved heterogeneity is considered and it is allowed to be correlated with the regressors, income and relative income coefficients are lower, but still significant — again RS is not significant for females. In addtion panel-level means are significant. One possible explanation is that time-invariant variables affect both health and income and relative income variables. Or on the other hand, what really matters is permanent income and recurrent values of relative deprivation and satisfaction.

These results might explain the discrepancies in previous literature regarding the effect of relative income on health. Previous research only take into account "'upwards"' comparisons, and as this paper shown both "'upwards"' and "'downwards"' comparison might be relevant for health, at least for men.

Moreover, there are still some methodological caveats. For example, reverse causality between income and health has not been considered in this paper. If both variables are determined simultaneity, income will be endogenous and coefficients were not consistently estimated.

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7 Annex

Table 7: Variable labels and descriptives

Variables	Definition	Mean
health	Self-Assessed Health	3.364573
age	Age in years of the individual	47.56113
agesq	Age squared	2543.457
sex	1 if male, 2 if female	.5196775
	(reference group of sex is male)	
Civil status		
married	1 if married, 0 otherwise	0159496
married_sep	1 if married, but separated 0 otherwise	.2048993
divorced	1 if divorced, 0 otherwise	.0732095
widow	1 if widow, 0 otherwise	0651345
	(reference group of civil status is not married)	
Labour status		
training	1 if vocational training, 0 otherwise	.0246439
mg_working	1 if marginal or irregular part-time, 0 otherwise	.0358279
not_working	1 if not employed, 0 otherwise	.4161225
sheltered_working	1 if sheltered workshop, 0 otherwise	.0008953
	(reference group of labour status is employed)	
Origin		
European	1 if European, 0 otherwise	.0839524
Non-European	1 if Non-European 0 otherwise	.0458356
state-less	1 if state-less, 0 otherwise	.0000935
	(reference group of origin is German)	
hsize	Number of members of the household	2.782447
educ	Number of years of education	11.81311
lny	Log of equivalised total net household income	9.717131
RD	Relative Deprivation	.1859625
RS	Relative Satisfaction	.1861219

Source: Own calculation on the SOEP, 1994-2008. RD and RS are referred to refoccup.