Who are the Joneses?

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Abstract

A burgeoning literature investigates the extent to which self-reported well-being (or happiness) or satisfaction with income is negatively related to the income of others. In many of the empirical studies, the assumption is that the incomes that matter are those of other individuals or households in the same geographical area.

In an experiment conducted in the American Life Panel, we elicit the strength of comparison with different groups, including neighbors, individuals of similar age and coworkers. Individuals are much more likely to compare their income to the incomes of their family and friends, their coworkers and people their age than to people living in the same street, town, in the US, or in the world. Using American Community Survey and Internal Revenue Service data, we find both at the zip code and at the PUMA geographic level that own income or rank in the local income distribution matter for happiness and satisfaction with income, but incomes in the same geographic region do not influence own happiness when controlling for own income. When asking respondents directly for how they rate the position of own and others' income we find that higher estimates of neighbors' income are negatively related with satisfaction with own income. Additionally, respondents who compare more intensively with their neighbors perceive the difference between their own income and that of their neighbors to be larger. For both happiness and satisfaction with income the relation with the rating of one's own income is always positive. Using age-based reference groups instead of geography-based reference groups, we find a consistent negative effect of the log median income and the perceived income in an individuals' age group, while own income and perceived income are positive throughout. Overall, these results indicate that comparisons with neighbors may not be the most important channel through which perception of others' income impacts one's own well-being.

1. Introduction

There is an extensive literature arguing that subjective well-being is influenced by how well others are doing in an individual's reference group (roughly defined as: others the individual compares herself with). It is generally found that there is a positive relation between own income and subjective well-being, but the effect of reference groups appears considerably harder to pin down. When studying the effect of reference groups, two fundamental issues need to be addressed: (1) what exactly constitutes a person's reference group, and (2) in what way do incomes in the reference group affect individuals' subjective well-being. The latter point includes the issue of how individuals perceive other people's income.[1]

Reference groups have traditionally been defined *a priori*, e.g. by assuming that individuals mainly compare themselves to others in the same geographical area (Blanchflower and Oswald, 2004; Luttmer, 2005; Ferrer-i-Carbonell, 2005; Clark et al. 2008; Barrington-Leigh and Helliwell, 2008) or by using individuals' characteristics to define groups, for instance based on education, gender, or age (McBride, 2001, Ferrer-i-Carbonell, 2005, Clark and Senik, 2012). Similarly, coworkers or individuals in the same profession have been used as reference groups to explain the impact of individuals' income rank on job or the amount of pay received (Brown et al., 2008).

Among the studies using geographic reference groups, Clark et al. (2008) note that two effects can be expected concomitantly from residing in a rich neighborhood: individuals' well-being could be lowered if their income relative to their neighbors' is low[2], while it could also be increased by living in a nice area, likely to offer better public goods. Based on Danish panel data, they find evidence supporting the latter, with a positive coefficient on neighbors' income. They also find a strong positive effect of individual ranking in a neighborhood on economic satisfaction when keeping neighborhood and individual income constant. Luttmer (2005) finds a negative effect of an increase in neighbor's incomes, where however neighbors are defined liberally, including areas of about 144,000 inhabitants in the United States. Canadian data on urban environments (Barrington-Leigh and Helliwell, 2008) show no evidence of any effect of neighbor's income on one's own income at the municipal level but do find significant negative effects at higher geographical levels. Using the Gallup Healthways Well-being Index survey, Deaton and Stone (2013) also find no evidence to support the theory that the positive effect of one's own income on life evaluation could be offset by the negative effect of average income at the zip code, county, congressional district, metropolitan statistical area, or state level. Kingdon and Knight (2007) as well as Brodeur and Fleche (2013) find a positive effect of neighbors' incomes on own well-being at smaller geographical levels, but find a negative effect at a larger geographic scale using South African and American data respectively. The latter finding would be consistent with the findings of Barrington-Leigh and Helliwell. Clark and Senik (2012) find a positive impact of median village household income when explaining the satisfaction with income in China.

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[1] We will use different well-being measures: happiness and satisfaction with income, to be defined more precisely later on.

[2] We shall generally refer to this phenomenon as a relative income hypothesis

Using reference groups defined by education, age, and living in East or West Germany, Ferrer-i-Carbonell (2005) finds a negative effect of average reference group income on individual subjective well-being. When asking respondents in post-transition countries directly whether they felt they had done better in life than their high school mates or their parents, Senik (2009) finds favorable comparisons to have a positive impact on life satisfaction, with welfare effects of income comparisons larger than that of household expenditure. Finally, Graham and Felton (2006) find average wealth in an individual's city in Latin America to impact negatively on his or her well-being, while relative wealth (the difference between an individual's wealth and average wealth) contributes to life satisfaction for those wealthier than average, and decreases life satisfaction for those below average wealth.

Boyce et al (2010), using data from the British Household Panel Survey, find evidence of asymmetric comparisons such that individuals give more weight to comparisons with others with higher incomes than to those with lower incomes. Their definition of a reference group is either the whole sample, or subgroups based on gender, geography, age, and education. Senik (2004) uses Russian data to build a reference group based on individuals' education, years of experience, region, branch, age, sex and primary occupation code, and finds reference income to have a positive effect on individual life satisfaction.

Studies focusing on the workplace have shown that job satisfaction depends on relative pay comparisons for individuals paid below the median for their unit and occupation, while those earning above the median showed no effect in terms of job satisfaction (Card et al., 2010). Furthermore, Brown et al. (2008) show not only the importance of relative wage for workers' satisfaction with income – with the average pay in the workplace negatively impacting one's satisfaction with influence, achievement and respect. They also find a strong impact of the rank of one's wage in the pay distribution, leading them to conclude that rank may matter more than the absolute level of pay. Clark and Oswald (1996) build a reference earnings level through a prediction based on a cross-section of employees in the British Household Panel Study and find a negative coefficient for the latter when used as an explanatory variable for satisfaction with pay and overall job satisfaction. Thus, several studies are finding a detrimental effect of being low in the earnings distribution. While this result seems intuitive as a result of envy for status, Hirschman and Rothshild (1973) point at a potentially positive effect of high earnings by others as individuals could define their own future prospects based on others' salaries – the so-called "tunnel effect". A prosperous reference group of workers could signal positive future outcomes for an individual. Data from the Danish sample of the European Community Household Panel provide some evidence for the tunnel effect, with a positive impact of coworkers' wages on individual job satisfaction (Clark, Kristensen and Westergård-Nielsen, 2009).

Few surveys have included a direct assessment by the respondent of his or her personal reference groups (Clark, 2012, Senik, 2009, Brown et al., 2008). Kapteyn, Melenberg, and Alessie (1991) established reference groups by asking individuals about the age

class, typical household size, average income, education level, and employment status for most people in their social environment and find a significant impact of reference groups on individuals' self-reported minimum consumption needs. Clark and Senik (2010) and Clark et al. (2013) find that a majority of respondents compare their income with colleagues at work or friends. Goerke and Pannenberg (2013) use pretest modules of the German Socio Economic Panel for the years 2008-2010, which contain questions about the importance of different groups for income comparisons[3]. Their sample is restricted to employed respondents aged 17 to 65. They find that only colleagues at work, other people with the same occupation and friends matter. They also find the intensity with which one compares with others to influence subjective well-being beyond the effect of a reference group's income: the more intensely one compares to others, the lower subjective well-being.

Knight et al. (2008) found that about seventy percent of the respondents living in Chinese villages declared to compare themselves mainly to either their neighbors or other people in the village when asked to choose their main comparison group among their neighbors, relatives, people in the village, township, county, city, or all of China. Households that estimated their income to be above average in their village were significantly happier, while evidence of relative deprivation for the poorest households was also found.

Overall, the literature so far has yielded widely diverging outcomes on the effect of reference groups on income satisfaction or happiness. In this paper, we aim to investigate the effect of reference groups, by drawing on individuals' self-described reference group definition. An equally important aspect is to model how reference groups are supposed to influence income satisfaction or happiness. There appear to be four approaches to the modeling of reference group incomes on individual subjective well-being.

The first approach and probably most often adopted assumption is that an individual compares his or her own income or consumption level to some reference income or consumption level.[4] This idea dates back to at least Duesenberry (1949). Papers by Luttmer (2005), Barrington-Leigh, Christopher, and Helliwell (2008), Deaton and Stone (2013), Card et al. (2010), Clark and Senik (2010), Brodeur and Flèche (2013), among many others, take this approach. The reference income typically is taken to be the mean or median in the reference group.

The second approach revolves around the notion that what really matters is one's rank in the income distribution in the reference group, e.g. Boyce, Brown, and Moore (2010),

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[3] For example in the 2010 wave respondents were asked ""*When you think about your gross labour income compared to that of other individuals: How important is it to you how your gross income compares to that of: (a) your neighbours, (b) your friends, (c) your colleagues at the workplace, (d) other people in your occupation, (e) people of your age, (f) your parents when they were your age, (g) your partner, (h) other women or (i) other men"*. Respondents are asked to state the intensity of income comparisons with each of these groups on a seven-point scale, ranging from "*completely unimportant (1)*" to "*extremely important (7)*".

[4] Since incomes are generally not observable, while expenditures are (at least partly), it seems plausible that individuals either infer incomes of others from their expenditures, or that utility is based directly on a comparison of own expenditures with expenditures of others. Observationally, the two mechanisms are very similar, as expenditures are constrained by incomes, so that the relation between subjective well-being and income can be seen as reflecting indirect utility. Nevertheless, expenditure patterns in reference groups can mutually influence each other, so that consumption patterns in reference groups reflect an equilibrium where potentially everyone in a reference group influences everybody else. See for instance, Alessie and Kapteyn (1991) and Kapteyn et al. (1997).

Clark (2012), Clark, Frijters, and Shields (2008), Clark, Westergård-Nielsen, and Kristensen (2009), Van Praag (2011). This idea can be generalized by also including past income distributions so that it incorporates habit formation (or adaptation). Kapteyn (1977) defines a "perceived income distribution", which is a time weighted convex combination of income distributions one has experienced up to the present. These past income distributions include one's own past incomes so that today's consumption standards are influenced by incomes of others one has experienced both in the past and today, but also by one's own income history. Kapteyn and his co-authors have quantified and tested this theory in a sequence of papers (see, the review by Kapteyn and Wansbeek, 1985), of which the most complete one is by Van de Stadt, Kapteyn and Van de Geer (1985). The latter paper finds that about two thirds of one's consumption standard is formed by own past consumption (the habit formation part), while one third is formed by the consumption of others (the reference group part).

The third approach, a generalization of the notion that one's well-being is influenced by one's ranking in a relevant distribution of income or wages, is due to Parducci (1995) and named "Range-Frequency Theory" (RFT). Essentially, income (or some other stimulus) is judged by a convex combination of the rank of the income in a distribution and by where it is within the range of incomes. Brown et al. (2008) conduct a number of clever experiments to test this theory in the context of wage comparisons. It turns out that next to own log-wage, both the rank of one's wage in the wage distribution and where it is in the range of wages are highly significant contributors to one's satisfaction with pay.

Finally, the fourth approach focuses on the fact that even with a given reference group, there may be a distinction between objective characteristics of individuals in a reference group and how these characteristics are perceived. As pointed out by de la Garza et al. (2010), individuals could suffer disutility from perceived differences in income, even if in reality all wages were equal. Their study, based on a Japanese survey of workers, finds that perceived wages of other workers of the same age with a similar job[5] have a consistent negative effects on subjective well-being, while alternative approaches based on somehow modeling wages in the reference group lead to highly unstable results, with for instance the sign of the coefficient of the reference group wages depending on the particular model specification.

In this paper we address a number of the issues discussed so far. We are able to test the relative income hypothesis in terms of geographic and age-based reference groups. We further ask respondents directly to whom they compare themselves most, while we also ask for their perception of the incomes of others in different reference groups and their perception of their own income in comparison.

The next section describes the data and presents descriptive statistics in the distribution of happiness and satisfaction with various life domains. Section 3 provides information on the reference groups individuals tend to use as comparison groups when evaluating happiness or satisfaction with life domains. In Section 4 we describe how we estimate a

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[5] The perceived wage is measured by asking workers the following question: "What do you think is the average wage of corporate employees who are the same age as you and doing the same job?"

household's income rank in a reference group. Section 5 presents evidence on the relative income hypothesis in terms of geographic and age-based reference groups. In Section 6, we further explore patterns of subjective ratings of both own income and income in various potential reference groups, such as people who live on the same street, or in the same town, or people in the same age group. Section 7 studies the effect of these ratings on subjective well-being. Section 8 concludes.

2. Data and Descriptive Statistics

We conducted a survey of respondents in the RAND American Life Panel (ALP). Respondents in the ALP do not need Internet access to participate, although the majority of the panel members have their own Internet access. The remaining panel members (approximately 10% of the sample) have been provided Internet access by RAND through the provision of a laptop or a Microsoft TV2 and/or an Internet subscription, eliminating the bias found in many Internet surveys that include only computer users (Chang and Krosnick, 2009; Yeager et al., 2011). The TV2 is an Internet player that allows respondents to open email accounts and browse the Internet. Sampling weights are provided by the ALP to adjust for sample selection. Upon joining the panel, respondents complete an initial survey collecting individual socio-demographic information, work history and household composition information. They are asked to update their background information every quarter. About once or twice a month, respondents receive an email with a request to fill out a questionnaire. Response rates average 70-80%.

The survey on which our analysis is based (to be called the subjective well-being survey, SWB survey) was originally fielded in April 2009. The ALP has grown substantially since 2009. To make panel members familiar with the ALP, the SWB survey is the first one they answer after joining the panel. As a result of this our dataset covers 5,475 respondents who responded to the survey between April 2009 and May 2013. An important advantage of the ALP is that it allows researchers to easily link newly collected data to data from other modules, both past and future, as well as detailed geographic data.

In the SWB survey, the respondent's satisfaction in five domains (household's total income, family life, number of friends, job or other daily activities, and health), as well as his or her general happiness, were asked. This paper will be focusing on the general happiness question and on satisfaction with income.

The innovative aspect of the survey lies in the inclusion of various detailed measures of reference frames used by the respondents in those five domains, such as the intensity levels of comparison for various reference groups, as well as ratings of their own and reference group's position in each of those domains.

2.1. Satisfaction and Happiness

The survey included questions related to how happy the respondent felt at the beginning of the survey, thereby avoiding any possible framing bias (Graham, 2009). The happiness question is worded as "How happy are you?" with a 5-point response scale:

"Very Happy", "Happy", "Neither happy nor unhappy", "Unhappy", "Very unhappy". Satisfaction with income is measured by asking "How satisfied are you with the total income of your household?" with a 5-point response scale: "Very satisfied" "Satisfied", "Neither satisfied nor dissatisfied", "Dissatisfied", "Very dissatisfied". Similar satisfaction questions are asked with respect to family life, number of friends, job or other daily activities, and health. Figure 1 shows the distribution of reported levels of happiness and of satisfaction levels for total household income, family life, number of friends, job or daily activities, and health.

The majority of respondents report to be happy, while about 16% report to be neither happy nor unhappy and 22% report to be very happy. Among the different domains, satisfaction with income is lowest. Only 43% are satisfied or very satisfied with their total household income. About three quarters of the respondents report to be satisfied or very satisfied with their family life and number of friends. About 63% are satisfied or very satisfied with job or daily activities and with their health.

Figure 1. Distribution of levels of happiness and satisfaction with various life domains (n=5,508)
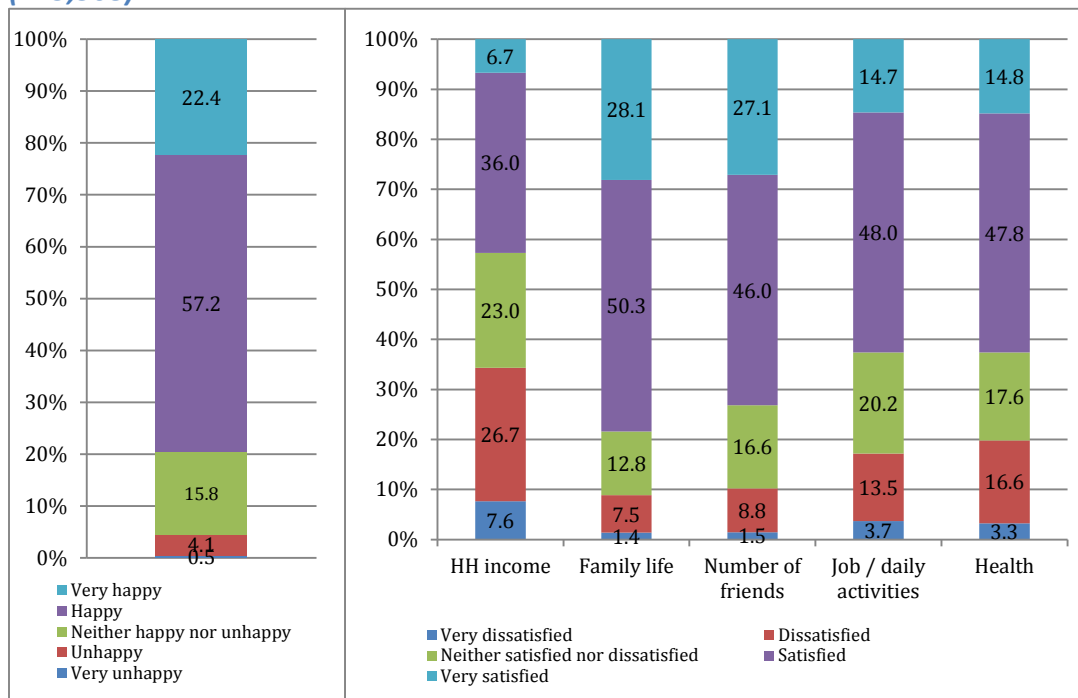
3. Who Compares to Whom?

The survey contains a number of questions to elicit whom respondents compare themselves with in different domains. For instance, for the income domain respondents are asked "When people evaluate their household income they often compare themselves to others. Typically, how much do you compare yourself to the people below when you evaluate your own household income?" They are then shown a number of categories and

for each category they can indicate how much they compare themselves with people in that category (we will call that "comparison intensity"). The screen shots included in the Appendix display the questions for the domain of income. Similar questions are asked for the other domains (family life, number of friends, job or daily activities, health).

Figure 2 shows the levels of income comparison reported by the respondents on a scale from 1 ("Not at all") to 10 ("Very much") for each reference group. Respondents compare their household incomes mostly with people their age, coworkers and colleagues, and family, friends and acquaintances. About half of the respondents report income comparison intensity 6 or higher in those reference groups. They compare themselves much less with geographically defined reference groups, such as people living on their street, people living in their town, or in the US or in the world. This in itself suggests that the construction of reference groups solely based on geography may severely underestimate comparison effects.

Figure 2. Household income comparison intensities

Intensity	Family, friends and acquaintances	Coworkers and colleagues	People my age	People living on my street	People in my town	People in the US	People in the world
10	11.2	8.75	7.96	2.87	2.5	3.01	2.96
9	6.86	6.48	6.37	2.08	2.03	2.83	2.61
8	13.37	11.98	12.51	4.86	4.78	5.6	3.56
7	14.3	12.91	13.46	6.31	6.39	7.21	4.36
6	9.62	9.4	11.14	8.12	7.92	7.96	5.15
5	14.16	14.26	16.35	15.12	15.44	16.58	12.78
4	6.75	6.74	7.12	8.83	9.78	9.6	7.61
3	7.32	7.1	7.42	10.93	11.45	11.48	10.77
2	5.18	5.61	5.57	11.04	11.45	10.39	14.11
1	11.24	16.78	12.09	29.85	28.26	25.34	36.08

Household income

It is of interest to see if respondents choose the same reference groups for every domain. To investigate this we plot the percentage of the sample reporting comparison intensities 6 through 10 for each domain and reference group in Figure 3. It turns out that the same groups that are important for income comparisons are also important for comparisons in the other domains. But there is some variation within this general pattern. Health is compared most to people of the same age, while satisfaction with one's job or daily activities is compared mainly with coworkers and colleagues as well as with family, friends, and acquaintances. Overall, when evaluating how many friends one has, the tendency to compare with reference groups is much lower than for the other domains. In general, the geographically defined categories are much less used for comparison than family, friends, coworkers and people of the same age, confirming the earlier observation that geographic definitions of reference groups may not be the most appropriate.

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Figure 3. High levels of comparison intensity by reference group and dimension
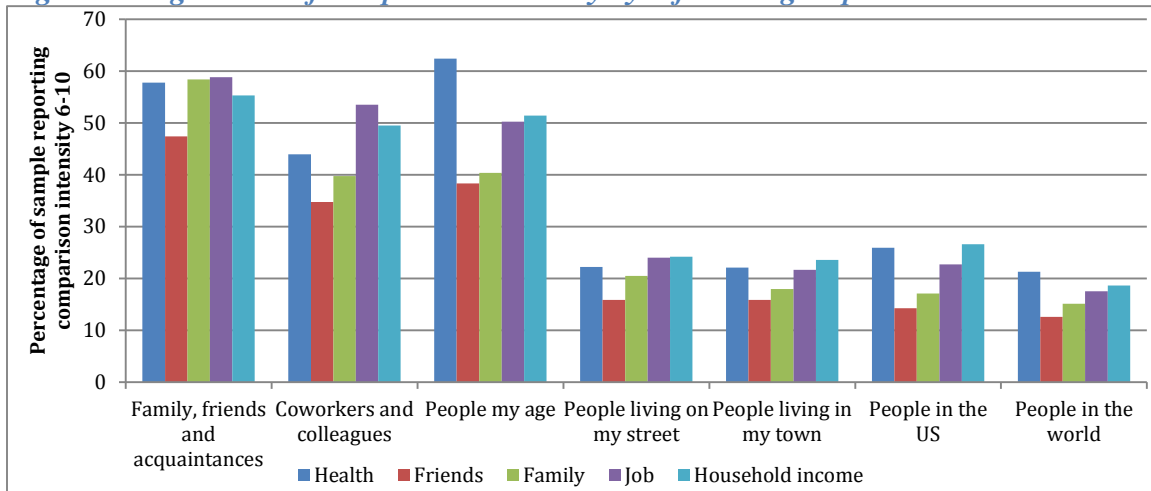
Next, we investigate how the intensity of income comparisons with different reference groups is affected by individual characteristics. Table 1 shows the results of such individual-level analysis, where we regress the extent to which individuals compare their income with the various possible reference groups on demographics. We observe an interesting pattern: higher income individuals are more likely than others to compare their income with family and friends, coworkers, and people their age. Men are more likely than women to compare their income with their coworkers, people in their town and people in the US. Individuals' ranking in the income distribution in the zip code (to be defined more precisely below) plays a role for the levels of comparison at the street and town level. For instance, controlling for the level of income, higher ranking individuals compare themselves less with people on their street or in their town. Overall, younger individuals compare their incomes with others more than older individuals. Married individuals compare somewhat more to people on their street than non-married individuals. This may be the result of married couples being more settled and hence more likely to interact with neighbors. Blacks and Hispanics are more likely than Whites to compare their income to people in their town, in the US and in the world. Blacks are less likely to compare to their family and friends. Hispanics are more likely than others to compare with coworkers. There is some indication of an education gradient in comparison intensity, whereby higher education leads to more comparisons with others. Employment status does not appear to have a strong effect on comparison intensity, with the exception of comparisons to coworkers and colleagues. Disabled individuals, retired, and unemployed compare significantly less than working individuals to their coworkers, which is intuitive. The retired in general seem to compare themselves less to others than the non-retired.

Table 1. Determinants of income comparison intensities by reference group

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			How much do you compare your income to…				
	Family & friends	Coworkers and colleagues	People my age	People living on my street	People in my town	All people in the US	All people in the world
Log own income	0.330***	0.310***	0.275***	0.241***	0.120*	-0.0888	-0.160**
	(0.0791)	(0.0802)	(0.0780)80	(0.0751)	(0.0732)	(0.0749)	(0.0731)
Rank in zip code	-0.129	0.154	-0.316	-0.850***	-0.837***	-0.149	-0.276
	(0.254)	(0.258)	(0.251)	(0.241)	(0.235)	(0.241)	(0.235)
Male	-0.0570	0.250***	0.0854	0.140*	0.170**	0.238***	0.0141
	(0.0776)	(0.0788)	(0.0765)	(0.0736)	(0.0718)	(0.0735)	(0.0718)
Age	-0.0407***	-0.0353***	-0.0318***	-0.00692**	-0.0129***	-0.0171***	-0.00254
	(0.00319)	(0.00323)	(0.00315)	(0.00302)	(0.00295)	(0.00302)	(0.00295)
Married	0.0997	0.000900	-0.0251	0.151*	0.0676	0.0865	-0.00557
	(0.0864)	(0.0876)	(0.0852)	(0.0820)	(0.0799)	(0.0818)	(0.0799)
Black	-0.612***	-0.0376	-0.0592	0.382***	0.466***	0.456***	0.874***
	(0.128)	(0.131)	(0.127)	(0.122)	(0.119)	(0.122)	(0.119)
Hispanic	0.0344	0.481***	0.301***	0.645***	0.659***	0.779***	1.036***
	(0.102)	(0.104)	(0.101)	(0.0968)	(0.0945)	(0.0967)	(0.0944)
Asian	0.0789	0.258	0.269	0.649***	0.286	0.594**	0.624***
	(0.257)	(0.260)	(0.254)	(0.243)	(0.238)	(0.243)	(0.238)
Other ethnicity	-0.867***	0.0113	-0.611**	0.0786	0.146	0.201	0.363
	(0.266)	(0.270)	(0.262)	(0.252)	(0.246)	(0.252)	(0.246)
High school or less	-0.750***	-0.964***	-0.662***	0.0651	-0.0684	-0.324**	0.252**
	(0.135)	(0.137)	(0.134)	(0.128)	(0.125)	(0.128)	(0.125)
Some college	-0.426***	-0.644***	-0.307***	-0.0494	-0.0377	-0.301***	0.165
	(0.119)	(0.121)	(0.118)	(0.113)	(0.110)	(0.113)	(0.110)
Bachelor	-0.119	-0.216*	0.0556	0.177	0.132	-0.142	0.0686
	(0.127)	(0.129)	(0.125)	(0.120)	(0.118)	(0.120)	(0.118)
Household size	-0.0469*	-0.0764***	-0.0412	0.0507*	0.0202	-0.0188	0.0354
	(0.0273)	(0.0277)	(0.0269)	(0.0259)	(0.0253)	(0.0259)	(0.0253)
Unemployed	0.143	-0.242*	0.187	0.153	0.109	0.0569	-0.0157
	(0.122)	(0.123)	(0.120)	(0.115)	(0.113)	(0.115)	(0.113)
Retired	-0.271*	-0.946***	-0.392**	-0.0621	-0.0404	-0.234	-0.0611
	(0.156)	(0.158)	(0.153)	(0.148)	(0.144)	(0.147)	(0.144)
Disabled	0.0711	-0.861***	0.168	0.105	-0.0211	-0.0242	0.124
	(0.132)	(0.134)	(0.130)	(0.125)	(0.122)	(0.125)	(0.122)
Constant	-0.0544	-0.772***	-0.149	0.189*	-0.0594	-0.136	-0.0862
	(0.119)	(0.120)	(0.117)	(0.112)	(0.110)	(0.112)	(0.110)
Observations	5,399	5,395	5,393	5,389	5,396	5,396	5,397
R-squared	0.078	0.118	0.051	0.021	0.027	0.037	0.061

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

4. Income Distribution in the Zip code

To characterize the income distribution in one's neighborhood or town, we use income information at the zip code level, based on the American Community Survey (ACS) 2011 five-year estimates. In particular, the Census releases data on income in 2011 inflation-adjusted dollars at the family level. The data on income were derived from answers to Questions 47 and 48, which were asked of the population 15 years old and over. "Total income" is the sum of the amounts reported for wage or salary income; net self-employment income; interest, dividends, net rental or royalty income or income from estates and trusts; Social Security or Railroad Retirement income; Supplemental Security Income (SSI); public assistance or welfare payments; retirement, survivor, or disability pensions; and all other income. Receipts from the following sources are not included as income: capital gains, money received from the sale of property (unless the recipient was engaged in the business of selling such property); the value of income "in kind" from food stamps, public housing subsidies, medical care, employer contributions for

individuals, etc.; withdrawal of bank deposits; money borrowed; tax refunds; exchange of money between relatives living in the same household; gifts and lump-sum inheritances, insurance payments, and other types of lump sum receipts[6].

The Census Bureau only releases mean, median, as well as the distribution of inhabitants in each zip code in 10 different income categories. In order to estimate an income distribution for a zip code, we use the following methodology.

Let the upper bound of the $i-$th family income bin in each zip code be denoted z_i, $i = 1,...9$ (the 10-th bin has no upper bound). Denote the cumulative proportion of families in zip-code k with incomes less or equal to z_i by w_{ik}. Let Y be an income drawn from zip code k. Then w_{ik} is defined as $w_{ik} = \Pr[Y \leq z_i]$

Assuming that the distribution of incomes in a zip code is approximately log-normal with log-mean μ_k and log-standard deviation σ_k, we have

$$w_{ik} = N\left(\frac{\ln z_i - \mu_k}{\sigma_k}; 0; 1\right)$$

Where $N(.;0;1)$ is the standard normal cumulative distribution function. This implies

$$\frac{\ln z_i - \mu_k}{\sigma_k} = N^{-1}(w_{ik})$$

Thus:

$$\ln z_i = \mu_k + \sigma_k N^{-1}(w_{ik})$$

Hence

$$N^{-1}(w_{ik}) = \frac{-\mu_k}{\sigma_k} + \frac{\ln z_i}{\sigma_k}$$

We can then estimate the parameters μ_k and σ_k for each zip code k by running a regression with nine observations of the form:

$$y_{ik} = \beta_0 + \beta_1 \ln z_i + \epsilon_{ik}$$

where ε_{ik} is an error term, $y_{ik} = N^{-1}(w_{ik})$, $\beta_0 = \dfrac{-\mu_k}{\sigma_k}$, $\beta_1 = \dfrac{1}{\sigma_k}$ so that we can retrieve μ_k

and σ_k from:

$$\sigma_k = \frac{1}{\beta_1}$$

$$\mu_k = -\frac{\beta_0}{\beta_1}$$

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[6] See Census Bureau: ACS Data Definitions – Income (available at http://webapp1.dlib.indiana.edu/cgi-bin/virtcdlib/index.cgi/4291881/FID2/acs_html/html/meth_doc/datadef/income2.htm)

After estimating the parameters μ_k (with sample mean 10.8) and σ_k (with sample mean 0.9), we can infer a respondent's ranking in the zip code distribution. For instance, if a respondent's income in zip code k is equal to Y, his ranking will be equal to

$$\mathcal{N}\left(\frac{\ln Y - \mu_k}{\sigma_k}; 0,1\right).$$

5. Testing the Relative Income Hypothesis using Objective Information

We are interested in identifying whether subjective well-being might be based on relative income concerns. As we noted in the introduction, it is not *a priori* clear how to operationalize reference groups, nor is it *a priori* clear what form the influence of reference group incomes take. We will explore these aspects in a number of different ways. As dependent variables in our analyses we use both income satisfaction and self-reported happiness. The influence of reference group incomes is taken to be summarized by either log-median income in the reference group, or by one's ranking in the income distribution in the reference group, or by both simultaneously. For the operationalization of reference groups we consider various geographical definitions (either zip codes or PUMA regions), as well as a definition based on geography and age jointly. All of this uses objective income information as right hand side variables plus a large number of individual and neighborhood variables.

Tables 2 and 3 display the results when using ordinary least squares to investigate the determinants of self-reported happiness and satisfaction with income. All specifications include controls for the respondent's gender, age, education, race, household size and work status, as well as neighborhood level characteristics including log median value of houses, log median rent, percentage of vacant housing, median number of rooms, percentage of residents living in a different house a year ago, percentage of non-US citizens, percentage without a High School degree, percentage with a Bachelor's degree or more, percentage speaking English only at home, unemployment rate, average household size, and percentage of households living in poverty. These variables represent a socio-economic and demographic profile of a neighborhood, and we assume they may be proxying for the provision of local public goods. Including these characteristics could thus allow us to control for some of the possible confounding effects of public goods in the relationship between log median income in a reference group and subjective well-being. Finally, all specifications include dummies for the comparison intensity reported by the respondent with respect to each specific reference group.

The first row of Tables 2 and 3 shows the results when explaining happiness and satisfaction with income by the log median income in the respondent's zip code, as well as his or her own income, and the above mentioned controls. The second row displays the results when adding the respondent's ranking in the zip code's income distribution.

In both these specifications, the effect of log median income in the zip code is positive and statistically significant when explaining satisfaction with income, but insignificant for happiness. For both happiness and satisfaction with income, the inclusion of ranking

in the zip code renders own family income totally insignificant. Generally, we observe a much higher R^2 when using satisfaction with income as the left-hand side variable.

We next check the robustness of these results, first by addressing possible concerns related to the definition of income, and then by looking at additional indicators of public good provisions in the region.

A first robustness check addresses the definition of income across different surveys. Given that the ALP asked respondents about the total income of their household without more details, the measures of income between ALP and ACS may not match perfectly. To investigate sensitivity to the income measures used, we use data from the Internal Revenue Service. The data contains incomes for every zip code for which 250 or more returns were filed for the year 2008[7]. We perform the same analysis as for the first two rows in Tables 2 and 3, but restrict the sample to individuals who responded in 2009. Similar to the ACS, the IRS provides data on the proportion of inhabitants reporting incomes in categories. The income measure is Adjusted Gross Income (AGI) minus 21 possible deductions, including trade and business deductions, rents and royalties, retirement savings, alimonies, moving expenses, higher education or health savings deductions. There are seven such AGI categories.

The second robustness check revolves around the role of local public goods. The previous specifications include a set of socio-economic and demographic variables provided by the ACS at the neighborhood level, which may proxy for the supply of local public goods. We explore the role of local public goods in more depth by including two other variables. The first variable is the level of state and local taxes collected, which should be correlated with the resources available for local public goods. Data on the level of state and local taxes paid in the zip code is made available through the IRS dataset. Another marker of public goods is the local crime rate. We incorporate data from the SpotCrime database, containing data on 8 basic crimes and their locations, based on public websites data as well as public feeds[8][9]. Caution needs to be exercised in interpreting the coefficients, as not all zip-codes are covered and we do not have details on SpotCrime's exact data collection methods or on how the sample of cities was selected.

As noted, we limit the sample to respondents who answered the survey in 2009 in order to match the IRS reference period. We further restrict the sample to individuals living in areas covered by the SpotCrime database. Rows 3, 4, and 5 in Tables 2 and 3 show the specifications using this limited sample. The control variables are the same as in row 2.

Note that the specification and variable definitions in rows 3 are identical to those in rows 2; the only difference is in the sample selection. Comparing rows 3 with rows 2, shows that the signs of the coefficients are the same, but the sizes of coefficients vary substantially. This may be at least partly due to the smaller size of the restricted sample, leading to larger standard errors.

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[7] http://www.irs.gov/uac/SOI-Tax-Stats-Individual-Income-Tax-Statistics-Zip code-Data-%28SOI%29

[8] https://www.ncjrs.gov/pdffiles1/nij/grants/239908.pdf

[9] Http://blog.spotcrime.com

Rows 4 display the results when using the log median income based on the IRS with the same covariates, but with income rank and median income now based on the IRS dataset. The results are qualitatively similar to those in rows 3, although the positive coefficient of the household income rank is now insignificant when explaining happiness. The effect of log median income remains insignificant for happiness, but positive and significant for satisfaction with income.

The next specification uses the same IRS sample, now including the crime rate, measured by the number of thefts per 100 residents, as well as the level of local and state taxes paid in addition to the other controls. For the explanation of happiness the addition of taxes and crime rates has only a moderate effect (Table 2, row 5), though the respondent's rank is now significant again. For the explanation of income satisfaction the log median income in the zip code is now barely significant (at the 10% level; Table 3, row 5). This suggests that log-median income does indeed proxy for the availability of public goods. In the specifications in row 4 where public goods are not explicitly included, log-median income is highly significant, whereas the inclusion of some public goods indicators in row 5 reduces significance of the effect of long-median income.

Barrington-Leigh and Helliwell (2008) found that the sign of the effect of incomes in a surrounding geographical area may depend on how large that area is chosen to be. We perform the same estimations as in rows 1 and 2, but now employ a geographic unit identical to the one used by Luttmer (2005), with Public Use Microdata Areas (PUMA) for the full sample. We estimate the income distribution in the PUMA following the same methodology as previously done at the zip code level. The results are presented in rows 6 and 7. We observe patterns similar to earlier analyses at the zip code level. Once again the effect of own income largely disappears when rank in the PUMA income distribution is added as an explanatory variable, although now own income remains marginally significant for satisfaction with income (with a negative sign: Table 3, row 7). The log median income in the PUMA (which includes about 150,000 inhabitants on average) is not statistically significant in explaining happiness (table 1, rows 6 and 7), but is statistically significant in explaining satisfaction with income (table 2, rows 6 and 7). Thus in contrast to Barrington-Leigh and Helliwell (2008) we do not find an appreciable effect of the size of the geographic area that is taken as a reference group.

Given our finding in Figure 2 that the income comparison intensity with neighbors is low compared to other groups, such as family, co-workers and others of the same age, the lack of relationship between subjective well-being – in particular, happiness - and neighbors' income should not be surprising. The fact that income comparison intensities were highest for family and friends as well as people in the same age category raises questions about the assumption of a purely geographic definition of reference income. Though our data do not contain objective information on the incomes of family and friends, we can use the data on income and age categories by zip code. Using the age groups defined by the ACS (under 25 years old, between 25 and 44, between 45 and 64, and over 65 years old), we define an individual's reference group by the age group and the zip code he or she lives in.

We now find a significantly negative effect of the log median income in one's age-zip group, (Tables 2 and 3, row 8). When including the age and zip code specific rank, the effect of log-median income becomes insignificant for the explanation of income satisfaction (Table 3, row 9), but it remains significantly negative when explaining happiness (Table 2, row 9). As in all other specifications where it is included, the ranking in the income distribution has a significantly positive effect, with a much larger coefficient when explaining satisfaction with income than when explaining happiness.

Overall, we thus find log median income to be positively related to satisfaction with income but not with happiness, both at the zip code and PUMA level. These results are robust to different income definitions, and the inclusion of taxes paid and crime level in the neighborhood. We find a negative effect of log median income in one's age category, both for happiness and satisfaction with income. The effect of one's rank in the reference income distribution dominates the effect of own household income, and is positively correlated with both happiness and satisfaction with income for all definitions of reference groups we have considered. One slight exception is row 4 in Table 2, where the effect of income rank, defined using IRS data, is insignificant.

Altogether these results appear consistent with the notion that median incomes in zip-codes or PUMA regions mainly proxy for the availability of public goods, whereas age groups serve as a frame of reference. One likes to live in an area with excellent public goods provision, but does not like to have an income that is below that of others of similar age.

Table 2. Happiness and income of reference groups

Dependent variable: Happiness

	Reference group	Log median income Coeff	SE	Own income Coeff	SE	Rank Coeff	SE	Demographics	Area characteristics[1]	Comparison intensity	Other	N	R²	Sample
(1)	Zip code	-0.011	0.11	0.057***	0.01	-	-	Gender, age, education, race, HH size, work status	House value, rent, vacant housing, number of rooms, residents living in a different house a year ago, non-US citizens, education speaking English only at home, unemployment rate, household size, poverty	Yes	No	5268	0.06	ACS
(2)	Zip code	0.035	0.11	-0.0189	0.03	0.274***	0.10			Yes	No	5268	0.06	ACS
(3)	Zip code	0.175	0.26	-0.11	0.08	0.644**	0.26			Yes	No	1152	0.08	IRS, w/ ACS median & rank
(4)	Zip code	0.193	0.20	-0.047	0.12	0.452	0.42			Yes	No	1150	0.08	IRS, w/ IRS median & rank
(5)	Zip code	0.195	0.26	-0.107	0.08	0.633**	0.26			Yes	Crime + taxes[2]	1150	0.09	IRS, w/ IRS median & rank
(6)	PUMA	0.0912	0.13	0.059***	0.01	-	-			Yes	No	5393	0.06	ACS
(7)	PUMA	0.137	0.13	-0.033	0.03	0.350***	0.11			Yes	No	5393	0.06	ACS
(8)	Age	-0.164***	0.04	0.065***	0.01	-	-			Yes	No	5259	0.06	ACS
(9)	Age	-0.106**	0.05	-0.011	0.03	0.254***	0.09			Yes	No	5252	0.07	ACS

* significant at 10% level; ** significant at 5% level; *** significant at 1% level

Table 3. Satisfaction with income and income of reference groups

Dependent variable: Satisfaction with income

	Reference group	Log median income Coeff	SE	Own income Coeff	SE	Rank Coeff	SE	Demographics	Area characteristics[1]	Comparison intensity	Other	N	R²	Sample
(1)	Zip code	0.311**	0.14	0.375***	0.02	-	-	Gender, age, education, race, HH size, work status	House value, rent, vacant housing, number of rooms, residents living in a different house a year ago, non-US citizens, education speaking English only at home, unemployment rate, household size, poverty	Yes	No	5268	0.22	ACS
(2)	Zip code	0.536***	0.14	-0.005	0.04	1.372***	0.13			Yes	No	5268	0.23	ACS
(3)	Zip code	0.695**	0.35	-0.171	0.11	2.173***	0.34			Yes	No	1152	0.25	IRS, w/ ACS median & rank
(4)	Zip code	0.943***	0.26	-0.149	0.16	2.210***	0.57			Yes	No	1150	0.23	IRS, w/ ACS median & rank
(5)	Zip code	0.670*	0.35	-0.172	0.11	2.172***	0.34			Yes	Crime + taxes[2]	1150	0.25	IRS, w/ ACS median & rank
(6)	PUMA	0.457***	0.17	0.379***	0.02	-	-			Yes	No	5393	0.22	ACS
(7)	PUMA	0.686***	0.17	-0.073*	0.04	1.736***	0.14			Yes	No	5393	0.24	ACS
(8)	Age	-0.222**	0.05	0.388***	0.02	-	-			Yes	No	5259	0.22	ACS
(9)	Age	0.078	0.06	0.014	0.04	1.215***	0.10			Yes	No	5252	0.24	ACS

* significant at 10% level; ** significant at 5% level; *** significant at 1% level

[1]: Area characteristics include log median value of houses, the log median rent, the percentage of vacant housing, the median number of rooms, the percentage of residents living in a different house a year ago, the percentage of non-US citizens, the percentage without a High School degree, the percentage with a Bachelor's degree or more, the percentage speaking English only at home, the unemployment rate, average household size, and the percentage of households living in poverty.

[2]: Crime rate represents the number of thefts per 100 residents. Taxes represent, the level of local and state taxes paid in the zip code.

6. Analysis using Subjective Ratings of Oneself and Others

One of the key innovative questions in our survey asked respondents to rate themselves as well as various others on a scale from 1 through 23[10] for each of the five domains (health, income, friends, family life and job or daily activities, see for instance the questions in Figures 1, 2 and 3 in the Appendix). Since we also have this information about reference group incomes and one's own position in the reference group, we now consider specifications using that information. There are good reasons for doing this. As we don't have a theory about how reference groups are formed, nor how reference group incomes are perceived, it seems natural to use respondents' own statements about how much they refer to these potential reference groups and what their perceptions are of incomes in these groups. Using ratings may allow us to measure directly the impact of respondents' perceptions of others and themselves, which ultimately might matter more when determining the psychological externality that neighbor's earnings might represent for one's own utility, as mentioned by Luttmer (2005).

The data allow us to compare how individual ratings of own income and of income of other people correlate with the various objective quantities defined in the preceding sections. Table 4 shows the correlations by comparison intensity between own rating and the rank in the reference group for various reference group definitions. We show the correlation levels for own rating and the ranking of the respondent in his or her zip code (column 1); own rating and the ranking of the respondent in his or her PUMA (column 2); as well as own rating and the ranking in the age and zip code income with people the same age (column 3).

We then show the correlations between ratings given to each reference group and the log median income in that reference group (columns 4 through 6). Finally, we show the difference between ratings given to self and to others in the different reference groups (columns 9 through 11).

Four patterns can be identified in Table 4. First, the correlations between own rating and estimated rank in the reference-group specific income distribution are much higher (ranging from 0.45 to 0.67 in columns 1 through 3) than the correlations between the ratings given to a reference group and its log median income (ranging from 0.1 to 0.42 in columns 4 through 6). Second, when the comparison intensity increases, the correlation between own rating and rank in the reference group tends to go down (the correlations between the numbers in columns 1 through 3 and the comparison intensities are approximately -.50). In other words, people who compare less intensely seem to have a somewhat more accurate idea of average incomes in the various reference groups than people who compare more. Third, on average, respondents rate their own income lower than that of the people living on their street, in their town, or in their age group (columns 7 through 9). Fourth, these differences increase in magnitude with the respondents' comparison intensity: the correlations between columns 7 through 9 and comparison intensity are respectively -.81, -.91 and -.73. Thus, the more one compares with others in

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[10] The number 23 is the number of radio buttons that could fit on a screen; see the screen shots in the Appendix

geographic proximity, the more likely one is to believe that own income is below that of the neighbors.

Table 4. Comparing and Rating Income.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		Correlations own rating with:			Correlations rating others with log median			Difference between own rating and:		
		Rank in Zip	Rank in PUMA	Rank in Age & Zip	Rating Street / Log med Zip	Rating Town / Log med PUMA	Rating Age / Log med Age & Zip	Rating at Street-level	Rating at Town level	Rating at Age-level
Comparison intensity[1]	1	0.58	0.6	0.61	0.29	0.14	0.25	-0.53	-1.31	-2.14
	2	0.52	0.59	0.62	0.33	0.14	0.32	-0.4	-0.65	-1.34
	3	0.56	0.58	0.67	0.43	0.22	0.28	-0.47	-0.46	-1.35
	4	0.65	0.57	0.53	0.28	0.24	0.27	-0.54	-0.77	-1.85
	5	0.51	0.56	0.56	0.21	0.24	0.21	-0.91	-1.33	-1.53
	6	0.53	0.58	0.56	0.3	0.23	0.26	-1.64	-2.17	-1.84
	7	0.46	0.48	0.51	0.2	0.18	0.17	-1.63	-2.11	-2.05
	8	0.57	0.48	0.52	0.25	0.27	0.21	-2.05	-2.69	-2.2
	9	0.45	0.43	0.54	0.3	0.32	0.2	-1.97	-3.04	-2.38
	10	0.51	0.61	0.59	0.42	0.35	0.11	-1.18	-3.47	-3.06

[1] Comparison intensities correspond to each comparison group, i.e. "people on my street" when referring to the rank and log median in the zip code income distribution, "people in my town" when referring to the rank and log median in the PUMA income distribution, "people my age" when referring to the rank and log median in the zip code and age income distribution.

Table 5 shows the results of OLS regressions using rating of own income as the dependent variable. Throughout all specifications, the respondents' demographic and socio-economic characteristics have a statistically significant effect on the rating of their own income. In column 1, we observe the expected patterns: males, married respondents, higher educated and employed respondents all rate their income higher. When we control for actual household income (column 2), many of the patterns remain the same, although effects become smaller. There is one notable change in the pattern of coefficients across columns 1 and 2. The ethnic categories have a markedly different effect. Whereas in column 1, blacks and Hispanics had negative coefficients (albeit not significantly different from zero for Hispanics), in column 2, these coefficients are highly significant and positive. Thus, conditional on income, these groups tend to rate their incomes highly.

In columns 3 through 5, we include the comparison intensities and income rank of the respondents for each reference group. The addition of comparison intensities and ranking does not change the patterns of the coefficients of the other variables in any substantial way. The comparison intensities have highly significant effects on the ratings of own income. Essentially, higher comparison intensities are associated with higher ratings, though this effect seems much more limited for age-based comparisons: the rank correlations between the estimated dummy coefficients and the comparison intensities are .47 for "Street"; .42 for "Town"; and .29 for "Age". The fact that a higher comparison intensity is associated with a higher rating of own income, may point at some reverse causality in that individuals who believe they compare favorably to others may be more likely to compare with those others. As we will see below (and consistent with Table 4) this is not the case, since individuals who compare themselves a lot with others also estimate the incomes of others to be higher.

The coefficient of the rank in the reference group income distribution is always highly significant, while the log of own income is also positive and statistically significant across all specifications. The R^2 increases substantially when including own income

(from 0.22 to 0.38), and slightly when including ranking and comparison intensities, to about 0.4.

Table 6 shows the results of OLS regression using the rating given to the income of people in the three reference groups as the dependent variable. Columns 1, 3, and 5 display the results when including the log median income in each reference group, as well as the respondent's ranking in the reference group income distribution, and his or her demographic characteristics. That is, in column 1 the ranking is based on the income distribution in the zip code, while in column 3 it is based on the income distribution in the town, and in column 5 on the age and zip code specific distribution. Columns 2, 4, and 6 show the results when adding the comparison intensities specific to each reference group as well as the previously used area characteristics.

The R^2-s in Table 6 are considerably lower than in Table 5, possibly reflecting more uncertainty on the part of the respondents about the level of income of others in their street, their town, or in the same age group. Nevertheless, also here demographics and socio-economic status seem to play an important role. Once again, rank in the zip code is highly significant, except at the town level.

As one would expect, log-median income in the reference group has a very strong effect on the rating of the reference group's income. This remains true if we also add the comparison intensities and area characteristics, though the magnitude and statistical significance of log median income in the town-level reference group decreases (column 4). Area characteristics are jointly highly significant, although their individual effects appear to be modest (not shown here). Education level and the percentage speaking English in the zip code have a significant positive influence on the rating of incomes on one's street. The effects of the comparison intensities in Table 6 are stronger than in Table 5. The rank correlations between the dummy coefficients and the comparison intensities are .62 for "Street; .81 for "Town"; and .89 for "Age". This has the effect that if one looks at the difference between own ratings and ratings of incomes on the street where one lives, these differences will be negative. Moreover, looking at pairwise comparisons of the coefficients by comparison intensity between Table 5 and Table 6 suggests that the difference between the two ratings will increase with the comparison intensity, consistent with Table 4.

Table 5. Determinants of rating of own income

	(1)	(2)	(3)	(4)	(5)
Reference group			**Street**	**Town**	**Age**
Log own income		2.829***	2.119***	1.978***	1.839***
		(0.075)	(0.120)	(0.125)	(0.119)
Rank			2.937***	3.546***	3.739***
			(0.385)	(0.416)	(0.349)
Male	0.479***	0.280**	0.193	0.219*	0.209*
	(0.133)	(0.119)	(0.118)	(0.118)	(0.118)
Age	0.0196***	0.0009	0.0015	0.0015	0.003
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Married	1.776***	0.384***	0.338***	0.349***	0.346***
	(0.142)	(0.132)	(0.131)	(0.131)	(0.131)
Black	-0.368*	0.650***	0.380*	0.368*	0.503***
	(0.215)	(0.194)	(0.195)	(0.194)	(0.194)
Hispanic	-0.178	1.304***	0.928***	0.976***	1.057***
	(0.165)	(0.152)	(0.155)	(0.153)	(0.153)
Asian	-0.672	-0.0510	-0.264	-0.115	-0.134
	(0.438)	(0.393)	(0.388)	(0.388)	(0.390)
Other ethnicity	-1.115**	-0.299	-0.326	-0.327	-0.344
	(0.454)	(0.406)	(0.403)	(0.403)	(0.402)
High school or less	-3.424***	-0.808***	-0.816***	-0.752***	-0.654***
	(0.219)	(0.207)	(0.205)	(0.205)	(0.206)
Some college	-2.789***	-1.397***	-1.361***	-1.329***	-1.271***
	(0.200)	(0.182)	(0.180)	(0.181)	(0.181)
Bachelor	-1.365***	-0.703***	-0.711***	-0.711***	-0.629***
	(0.217)	(0.194)	(0.192)	(0.192)	(0.193)
Household size	-0.00966	-0.154***	-0.177***	-0.177***	-0.164***
	(0.0467)	(0.042)	(0.041)	(0.0413)	(0.0415)
Unemployed	-3.245***	-1.557***	-1.554***	-1.557***	-1.614***
	(0.202)	(0.186)	(0.184)	(0.184)	(0.185)
Disabled	-3.913***	-1.559***	-1.464***	-1.485***	-1.435***
	(0.257)	(0.238)	(0.236)	(0.235)	(0.236)
Retired	-0.530**	0.352*	0.472**	0.469**	0.185
	(0.223)	(0.201)	(0.199)	(0.199)	(0.200)
Other	-1.351***	-0.245	-0.263	-0.230	-0.247
	(0.201)	(0.181)	(0.179)	(0.179)	(0.180)
Comparison intensity 2[1]			0.0601	-0.136	-0.258
			(0.195)	(0.194)	(0.284)
Comparison intensity 3			0.156	-0.0203	-0.409
			(0.195)	(0.194)	(0.258)
Comparison intensity 4			0.617***	0.570***	-0.156
			(0.211)	(0.205)	(0.261)
Comparison intensity 5			0.619***	0.515***	-0.0217
			(0.175)	(0.175)	(0.211)
Comparison intensity 6			1.377***	0.890***	0.352
			(0.219)	(0.222)	(0.232)
Comparison intensity 7			1.813***	1.600***	0.542**
			(0.243)	(0.242)	(0.221)
Comparison intensity 8			1.635***	1.512***	0.518**
			(0.270)	(0.273)	(0.225)
Comparison intensity 9			0.912**	1.536***	0.254
			(0.396)	(0.401)	(0.273)
Comparison intensity 10			0.350	-0.310	-0.579**
			(0.342)	(0.365)	(0.255)
Constant	12.55***	-17.54***	-11.68***	-10.38***	-8.996***
	(0.352)	(0.855)	(1.200)	(1.233)	(1.186)
Observations	5,449	5,411	5,386	5,394	5,359
R-squared	0.217	0.382	0.401	0.400	0.400

Table 6. Determinants of rating of others' income

	(1)	(2)	(3)	(4)	(5)	(6)
	Ratings of reference group					
	Street	**Street**	**Town**	**Town**	**Age**	**Age**
Log median in group	3.450***	1.840***	2.747***	0.518*	1.606***	2.593***
	(0.191)	(0.602)	(0.205)	(0.277)	(0.130)	(0.204)
Rank in group	1.722***	1.869***	0.326	0.0427	1.289***	1.120***
	(0.272)	(0.265)	(0.269)	(0.265)	(0.210)	(0.208)
Male	-0.0385	-0.0965	-0.149	-0.147	-0.0195	-0.0803
	(0.130)	(0.127)	(0.123)	(0.120)	(0.110)	(0.109)
Age	0.0174***	0.0200***	0.0006	0.0043	0.0377***	0.0433***
	(0.0053)	(0.0052)	(0.0050)	(0.0049)	(0.0045)	(0.0045)
Married	0.245*	0.0587	-0.142	-0.129	0.102	0.0994
	(0.144)	(0.142)	(0.136)	(0.134)	(0.124)	(0.123)
Black	-0.698***	-0.459**	-0.0283	0.0110	-0.129	-0.126
	(0.214)	(0.220)	(0.202)	(0.207)	(0.182)	(0.189)
Hispanic	0.0459	0.439**	-0.315**	-0.0878	0.536***	0.281
	(0.172)	(0.203)	(0.159)	(0.191)	(0.147)	(0.174)
Asian	-0.259	0.155	-0.169	-0.0781	0.374	0.223
	(0.429)	(0.438)	(0.406)	(0.412)	(0.365)	(0.377)
Other	-0.396	0.110	-0.603	-0.280	0.320	0.336
	(0.446)	(0.436)	(0.421)	(0.411)	(0.377)	(0.374)
HS or less	-0.352	-0.305	0.174	0.500**	-0.511***	-0.328*
	(0.229)	(0.227)	(0.216)	(0.214)	(0.194)	(0.196)
Some college	-0.379*	-0.314	0.211	0.468**	-0.210	-0.155
	(0.201)	(0.201)	(0.191)	(0.190)	(0.171)	(0.173)
Bachelor	-0.300	-0.405*	-0.0511	-0.0658	-0.0679	-0.116
	(0.213)	(0.209)	(0.202)	(0.197)	(0.181)	(0.180)
HH size	0.128***	0.105**	0.0126	0.00197	0.0260	0.0449
	(0.0457)	(0.0452)	(0.0433)	(0.0426)	(0.0389)	(0.0389)
Unemployed	0.0355	0.131	0.355*	0.381**	0.0738	0.0368
	(0.202)	(0.197)	(0.191)	(0.186)	(0.171)	(0.169)
Disabled	-0.0496	0.209	-0.305	-0.262	-0.812***	-0.783***
	(0.260)	(0.255)	(0.246)	(0.240)	(0.220)	(0.218)
Retired	0.720***	0.714***	-0.236	-0.254	-1.712***	-1.403***
	(0.220)	(0.215)	(0.209)	(0.203)	(0.190)	(0.195)
Other	0.278	0.141	0.0505	-0.0436	-0.273	-0.220
	(0.198)	(0.193)	(0.187)	(0.182)	(0.168)	(0.167)
Area characteristics	No	Yes	No	Yes	No	Yes
Comparison intensity 2		0.227		-0.506**		-0.730***
		(0.211)		(0.198)		(0.264)
Comparison intensity 3		0.141		-0.593***		-0.761***
		(0.210)		(0.197)		(0.239)
Comparison intensity 4		0.568**		-0.0411		-0.470*
		(0.228)		(0.209)		(0.242)
Comparison intensity 5		0.964***		0.429**		-0.162
		(0.189)		(0.178)		(0.196)
Comparison intensity 6		2.705***		1.440***		0.641***
		(0.237)		(0.225)		(0.215)
Comparison intensity 7		2.870***		2.183***		1.495***
		(0.264)		(0.248)		(0.206)
Comparison intensity 8		3.084***		2.603***		1.451***
		(0.292)		(0.278)		(0.209)
Comparison intensity 9		2.514***		2.455***		1.536***
		(0.429)		(0.411)		(0.253)
Comparison intensity 10		0.826**		0.994***		0.911***
		(0.370)		(0.372)		(0.237)
Constant	-27.55***	-9.429	-17.71***	0.694	-5.997***	-10.60***
	(2.203)	(5.866)	(2.354)	(3.496)	(1.469)	(2.791)
Observations	5,399	5,265	5,400	5,261	5,370	5,249
R-squared	0.112	0.176	0.043	0.118	0.089	0.140

7. Ratings and Subjective Well-being

After exploring the effects of "objective" variables such as log median income and characteristics of the zip code and own income on subjective well-being, as well as the determinants of ratings given to oneself and others, this section focuses on the relationship between those ratings and subjective well-being.

Table 7 shows the results of specifications similar to those shown in Table 2 row 1, now using ratings instead of objective variables. The rating of others has a positive, barely statistically significant effect on happiness for those living on the same street (row 1) and is insignificant for those living in the same town (row 2). Own rating has a statistically significant and positive effect on happiness. The results of income comparisons at the street and town level are thus quite similar to the results when using objective data on median income in the zip code (Table 2, row 1) and PUMA (Table 2, row 6). Next, we use the same strategy, now turning to age-based reference groups. Row 3 displays the results when explaining happiness by the ratings of others in the same age category and by own income. As with the earlier specifications with objective variables, we now find a (marginally significant) negative effect of the ratings of others in the same age group on own happiness.

Given the above-mentioned evidence on the relationship between ratings given to others or oneself and "objective" variables, as well as between subjective well-being and "objective" variables, it is of interest to investigate whether the ratings reported by the respondents might be endogenous to subjective well-being. An example would be that optimistic people rate their own income and the income of others higher than pessimists, while also enjoying higher subjective well-being. To address this possibility we adopt an instrumental variable strategy (rows 4, 5 and 6).

We use the log of own income and the log median income in the reference group as instruments for the rating of one's own income and of others' incomes in that reference group. Row 4 shows that the rating given to own income and others' income is insignificant for happiness at the street/zip code. This contrasts with the results in row 1, where the street level rating was significant at the 10% level and own rating was significant at the 1% level. Row 5 shows that the rating given to others at the town level are insignificant for happiness, but that own rating is, similar to the findings in row 2, highly significant and positive. Finally, row 6 shows that the instrumental variables specification has a large effect on the estimated effect of rating of others in the same age group. The coefficient increases tenfold and is larger in absolute value than the effect of one's own rating.

Table 7. Happiness and ratings

	Dependent variable: Happiness									
	Reference group	Rating others		Own rating		Demographics	Neighborhood characteristics	Comparison intensities	N	R2
		Coeff	SE	Coeff	SE					
(1)	Street	0.004*	0.00	0.035***	0.00	Yes	Yes	Yes	5, 298	0.1
(2)	Town	0.002	0.00	0.036***	0.00	Yes	Yes	Yes	5, 423	0.1
(3)	Age	-0.005*	0.00	0.037***	0.00	Yes	No	Yes	5,434	0.1
(4)	IV (zip code)	-0.018	0.08	0.025	0.02	Yes	Yes	Yes	5, 262	
(5)	IV (PUMA)	-0.034	0.10	0.021***	0.01	Yes	Yes	Yes	5,258	
(6)	IV (age)	-0.068**	0.02	0.034***	0.01	Yes	No	Yes	5,246	

Table 8 shows the results of the previous specifications, now using satisfaction with income as the dependent variable. The effects of rating of others, whether at the street (row 1), town (row 2), or age (row 3) are now negative, whereas only the median earnings of members of the same age group and zip code were previously negatively related to satisfaction with income (Table 3, row 8). Own rating whether instrumented or not has a positive effect, with a large coefficient, and is highly statistically significant (rows 4, 5 and 6). Once again, instrumenting ratings of others in the same age group increases (in absolute value) the estimated coefficient (it almost quadruples).

Table 8. Satisfaction with income and ratings

	Dependent variable: Happiness									
	Reference group	Rating others		Own rating		Demographics	Neighborhood characteristics	Comparison intensities	N	R2
		Coeff	SE	Coeff	SE					
(1)	Street	-0.012 ***	0.00	0.125***	0.00	Yes	No	Yes	5,418	0.4
(2)	Town	-0.12	0.19	0.177***	0.05	Yes	No	Yes	4,765	0.4
(3)	Age	-0.021***	0.00	0.124***	0.00	Yes	No	Yes	5,434	0.4
(4)	IV (zip code)	-0.011***	0.00	0.121***	0.00	Yes	Yes	Yes	5, 298	
(5)	IV (PUMA)	0.053	0.12	0.133***	0.01	Yes	Yes	Yes	5,258	
(6)	IV (age)	-0.077***	0.02	0.156***	0.01	Yes	No	Yes	5,246	

In comparison with Tables 2 and 3, the R^2-values in Tables 7 and 8 are substantially higher. This may have different causes: since in the specifications in Table 7 both sides of the equation include subjective variables, there may be correlated measurement error, which drives up the R^2. It is also possible however that the zip code data are a poor approximation of incomes on one's street, while moreover respondents' perceptions of incomes on the street are probably imprecise.

8. Conclusion

In this paper, we use objective and subjective measures of own income and of others' income to evaluate the relative income hypothesis. The perhaps most obvious finding revolves around the differences between the two subjective well-being measures. Self-reported happiness and satisfaction with income show different patterns, in particular

when looking at the role played by income and relative position. The lack of consensus in the literature on relative income effects on subjective well-being is not surprising if one considers the range of subjective well-being measures used, such as happiness yesterday (Deaton and Stone, 2013), satisfaction with current income (Clark and Senik, 2012), life satisfaction (Barrington-Leigh and Helliwell, 2008), happiness these days (Luttmer, 2005), or satisfaction with economic conditions (Clark et al., 2008). While subjective well-being may always be at the core, it is crucial to distinguish between the particular indicators, and take into account the fact that the concepts they capture may vary and thus lead to differences in findings.

Reference groups vary by dimension of well-being, so that individuals are more likely to compare their income with their coworkers, family and friends or people their age than with people living on their street or in their town. Individuals are however much more likely to compare their health with people their age. While this finding may not be surprising, it leads us to conclude that studying the relative income hypothesis in terms of geographic reference groups is probably misleading. The only way to know who people refer to may be to ask them directly, as we have done in this paper.

The sensitivity of findings to the choice of reference group is borne out by our results. For instance, when using reference groups based on geographical proximity, whether at the zip code or PUMA level, log median income does not seem to matter for happiness, while it is positive for satisfaction with income. However, log median income in the respondent's age group has a negative effect on both happiness and satisfaction with income.

Individuals vary in their intensity of comparison with others. In particular, demographics, such as ethnicity, marital status, work status, or income, play a role in how much we look at others. If others' income enters one's subjective well-being function only if there is a certain degree of comparison, then it is important to take this factor into account.

Next, we gathered evidence on individuals' perception of their own and others' income, and studied their relationship to measures of own and others' income. We find the perceived gap between others' and own income to increase with the intensity of comparison, and the ratings to covary with demographics. We find little effect of others' income on own happiness, with one major exception: once we instrument the ratings of own income and the income of others in the same age group, the latter exerts a sizeable and statistically significant negative effect on happiness.

Satisfaction with income is negatively affected by the ratings of others living in the same street or in the same age category, although the effects are not statistically significant for the rating of others in the same town. The strongest pattern is the negative effect of others' income in the same age group, both objective and perceived, on happiness and satisfaction with income.

The two papers most closely related to the present study are Goerke and Pannenberg (2013) and de la Garza et al. (2010). Like the former paper, we investigate the effect of

comparison intensity with respect to different potential reference groups. They find that in particular colleagues at work, other people with the same occupation, and friends matter. Their sample is different from ours in that they only consider employees between 17 and 65. Nevertheless, our results largely overlap: we find that family, friends and acquaintances, coworkers and colleagues, and people of similar age matter most. The only difference obviously is that Goerke and Pannenberg (2013) find less evidence that age matters. Like we, they find that geographically defined reference groups are not important for comparison purposes.

Similarly to de la Garza et al. (2010) we find that perceived incomes (in their case perceived wages) appear more relevant for subjective well-being than actual incomes.

Thus, it appears that to make progress in investigating the relative income hypothesis one should not define reference groups *a priori*, nor should one only rely on objective measures. At the end of the day, what matters for subjective well-being are perceptions.

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APPENDIX:

Figure 1. Rating own income.

Income

Please click on the scale at a place that would best describe your own household income.

Myself:

Low ○ **High**

Me

Figure 2. Rating the income of others.

For each group on the following screens, please think about the income of the people in that group. Then click on the scale where you think it would best describe the average household income of the people in that group.

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Income

Income of family, friends and acquaintances:

Low ○ **High**

Others

Figure 3. Comparison intensity.

When people evaluate their household income they often compare themselves to others. Typically, how much do you compare yourself to the people below when you evaluate your own household income?

	1 Not at all	2	3	4	5	6	7	8	9	10 Very much
Family, friends and acquaintances	○	○	○	○	○	○	○	○	○	○
Coworkers and colleagues	○	○	○	○	○	○	○	○	○	○
People my age	○	○	○	○	○	○	○	○	○	○
People living on my street	○	○	○	○	○	○	○	○	○	○
The people in my town	○	○	○	○	○	○	○	○	○	○
All people in the U.S.	○	○	○	○	○	○	○	○	○	○
All people in the world	○	○	○	○	○	○	○	○	○	○