Climate change, income and happiness: An empirical study for Barcelona

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ABSTRACT

The present article builds upon the results of an empirical study exploring key factors which determine life satisfaction in Barcelona. Based on a sample of 840 individuals we first look at the way changes in income, notably income reductions, associated with the current economic situation in Spain, affect subjective well-being. Income decreases which occur with respect to one year ago have a negative effect on happiness when specified in logarithmic terms, and a positive one when specified as a dummy variable (and percentage change). The divergence in results is discussed and various explanations are put forward. Both effects are however temporary and do not hold for a period longer than a year, probably for reasons of adaptation and a downward adjustment of reference consumption and income levels. Next, we examine the implications of experiencing forest fires and find a lasting negative effect on life satisfaction. Our results suggest that climate policy need not reduce happiness in the long run, even when it reduces income and carbon-intensive consumption. Climate policy may even raise life well-being, if accompanied by compensatory measures that decrease formal working hours and reference consumption standards, while maintaining employment security.

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1. Introduction

Attention for happiness in economics has been growing steadily over the last decades, resulting in a literature that is rich in thematic diversity. A persistent theme is the relationship between long-term income growth and subjective well-being. A number of studies find that income growth contributes little to life satisfaction over time (Brockmann et al., 2008; Clark et al., 2008; Di Tella and MacCulloch, 2006; Blanchflower and Oswald, 2004; Gardner and Oswald, 2001; Easterlin, 1974). Others strive to challenge this finding (Sacks et al., 2012). A recent assessment concludes that a positive causal link between income growth and happiness is far from being empirically established (Easterlin, 2012).

The present article places the income-happiness debate in the context of climate policy. As argued by FitzRoy et al. (2012), van den Bergh, 2004 and Cohen and Vandenbergh (2008), standard climate economics tends to underestimate the potential of climate change mitigation to raise subjective well-being, even when it implies a slowdown of GDP growth. While a large number of studies deal with the relation between income growth and life satisfaction, research on the impact of income decreases on happiness is scarce. Boyce et al. (in press), Di Tella et al. (2010), Ferrer-i-Carbonell and van Praag (2008), Vendrik and Woltjer, 2007, and Diener and Biswas-Diener, 2002 are a few notable exceptions. In accordance with the Prospect Theory of Kahneman and Tversky (1979), one would expect that income losses have a heavier imprint on well-being (than income gains). Empirical evidence, however, seems mixed. In a study on loss aversion, Vendrik and Woltjer show that life-satisfaction is influenced more strongly by having lower (rather than higher) income in comparison with a reference group. While Boyce et al. (in press) find that experienced falls in income have a larger impact on well-being than equivalent income gains, Ferrer-i-Carbonell and van Praag show that happiness adapts easier to income decreases (than to equivalent income increases). Di Tella et al. (2010) find no evidence for an asymmetry between the happiness effects of income losses and of income gains. They show that a person experiencing a 10% income reduction reports a similar level of happiness as a person who experienced a 21% income raise (given the final levels of income of both individuals are equal). Diener and Diener do not find proofs for automatic increases in subjective well-being after a rise in earnings, nor for a decline in happiness following income decreases in longitudinal data on income change.

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Using a sample of retired and working individuals, Diener et al. (1993) find that the group whose income declined was the happiest, and the group whose income increased – the least happy.

Assuming that effective climate policy leads to an effective reduction of carbon-intensive consumption and income, happiness research can provide some empirical indications on the size and sign of the associated changes in subjective well-being. Since stringent climate policy is practically non-existent, one way to approximate its impact on happiness is by studying reductions in income and consumption during periods of widespread economic crisis. As an observable proxy, we take the financial, economic and housing-market crisis in Spain, using the city Barcelona as a study area. Some relevant indicators for the economic situation in Spain during our study period are: an unemployment rate of 21.52% for the 3rd quarter of 2011 and 43.5% for individuals below 25 years. An important cause for the widespread income reduction in Catalonia is the fiscal cuts in public spending. As an illustration, since 2009 the budget for education has been reduced by 12%, with cuts in university budgets rising up to 19%. This has resulted in an increase in university access fees by 66.7% and a dismissal of 3500 university workers. In this context we examine how income reductions relate to happiness, while controlling for unemployment, conspicuous consumption and a number of socio-demographic variables.

A second tentative focus of this paper concerns the 'happiness costs' of extreme climate events. For the purpose we look at two types of extreme events as they are happening now, without assuming that these were caused by climate change. Research on the interface between happiness and environmental factors can provide some relevant insights in this relation. Endowment of location-specific amenities, and even concern for biodiversity preservation, have been found to have a significant positive influence on subjective well-being (Moro et al., 2008; Ferrer-i-Carbonell and Gowdy, 2007), while proximity to a landfill or an airport, and poor air quality have been shown to adversely affect well-being (van Praag and Baarsma, 2005; Brereton et al., 2008; Ferreira et al., 2012; Luechinger, 2009; MacKerron and Mourato, 2009; Welsch, 2006, 2007). Environmental factors are also relevant for happiness in China, where residents of cities with high levels of atmospheric pollution, environmental disasters and traffic congestion report low life satisfaction (Smyth et al., 2008).

Relevant mentioning here is the literature on climate conditions and well-being. For Ireland, researchers find a positive association between higher temperatures and subjective well-being (Ferreira and Moro, 2010) and a negative one between wind speed and happiness (Brereton et al., 2008). Using data on Russia, Frijters and van Praag (1998) show that harsh winters do not affect well-being in a particularly positive way. Using data from a wide set of countries, Rehdanz and Maddison (2005) and Maddison and Rehdanz (2011) find that variation in temperatures and precipitation patterns, including the duration of coldest and hottest periods of the year can explain differences in self-reported well-being. The authors conclude that climate change might alter the distribution of happiness between nations. Similarly, Murray et al. (2011) find that little sunshine and high humidity tend to be associated with low levels of happiness in various regions of Europe.

Few studies, however, look at the impact of extreme climate events on happiness. Carroll et al. (2009) find that episodes of droughts during spring are associated with lower levels of life satisfaction in rural areas. Luechinger and Raschky, 2009 arrive at a similar conclusion for the case of flood disasters. The lasting effect of experiencing droughts and floods on happiness corresponds to findings in happiness research that subjective well-being adapts incompletely to changes in non-pecuniary domains, such as personal relationships, free time, health, autonomy and environment (Easterlin, 2003). Here we look at reported experiences of droughts and forest fires, and test for their effect on life satisfaction. Spain belongs to the regions which are expected to come under severe climate change pressure, with a high possibility of increased incidences of these two types of extreme climate events (IPCC, 2007). Forest fires are common in Spain. The Catalan Statistics Institute has estimated that respectively 5767 ha and 34,518 ha of forest were lost in 2008 and 2009 respectively, due to 421 forest fire incidences in the first and 746 in the second year. Regarding droughts, in 2007 and 2008 Catalonia suffered the most severe water deficit in the last 70 years.

When studying happiness one should note that what exactly it constitutes differs between philosophical traditions. Following hedonistic philosophy, happiness can be defined as the absence of sadness and seeking of pleasure, while according to the eudaimonic tradition happiness is what brings meaning and fulfilment in life, including the realization of one's potentials. Waterman (1993) attempt to bridge the two concepts suggesting that people who experience an "eudaimonic living" will also experience a "hedonic enjoyment", but not vice versa. In what follows we adopt satisfaction with life as a multidimensional construct based on demographic parameters, emotional well-being, social life, values and concern for the environment and society, which is closer to the hedonistic concept but is broader than it. Life satisfaction is used here interchangeably with the terms happiness and well-being.

The remainder of this article is structured as follows. Section 2 provides the theoretical framework of the analysis and the particular models used. Section 3 presents the data, including key descriptive statistics. Section 4 provides the empirical results. The following section discusses the findings, drawing on their implications for climate policy. Section 6 concludes.

2. Theory and empirical approach

Here a self-reported approach to happiness analysis is adopted, based on asking individuals to assign a value to their level of life satisfaction. Answers are numerical and range from 1 to 10, where 1 corresponds to complete dissatisfaction and 10 to complete satisfaction with life. The reliability of the happiness measure has been extensively tested and correlations have been documented between satisfaction with life and various objective physiological and medical criteria (Krueger and Schkade, 2008; Di Tella and MacCulloch, 2006; Kahneman and Krueger, 2006). Findings also show that reported satisfaction with life is relatively stable and reflects actual changes in life circumstances (Ehrhardt et al., 2000; Eid and Diener, 2003).

The present modelling approach is based on the assumption that self-reported satisfaction with life can be explained by variation in a number of observable characteristics. The two approaches most frequently used in the literature are Ordinary Least Squares (OLS) and Ordered Probit (OP). Considering that the dependent variable is always a discrete number between 1 and 10, the alternative statistical approach commonly used is OP, which assumes that answers are only ordinarily comparable and explains responses by the probability that an individual has a particular level of happiness, given a number of personal characteristics. Following Ferrer-i-Carbonell and Frijters (2004), we assume that the two model specifications are equally robust and providing comparable results.

Certain demographic variables are considered key happiness determinants (such as age, gender, education, marital and employment status, health, income and leisure). The set of factors which influence well-being is far larger and can be extended to personality traits, temperament, trust in the others, social relations, state of the natural environment, commuting, political freedom and equality. Some happiness determinants (such as

peculiar life circumstances), however, cannot be easily captured and usually remain hidden in the error term. The baseline equation we estimate here is as follows:

$$LS_i = \beta o + \beta_1 Z_i + \beta_2 \text{Ln } Y_{li} + \beta_3 E_i + \beta_4 C_i + \epsilon_i \quad (1)$$

where LS is a measure of satisfaction with life (in 2011), the index i refers to the number of observation, l reflects the year, Z is vector of demographic and socio-economic variables (gender, age, and marital, health, education and employment status, free time activities, environmental awareness, social interactions and temperament), LnY_i is the natural logarithm of monthly net income in the present year, E is a dummy variable which registers experiences with extreme events, such as a drought and a forest fire. Apart from climatic variables we also test for the effect of conspicuous consumption, registered by vector C.

Given our research question, we are furthermore interested in the relation between a reduction in earnings and happiness in the context of the economic crisis in Spain. For this we estimate an extended version of (1):

$$LS_i = \beta o + \beta_1 Z_i + \beta_2 \text{Ln } Y_{li} + \beta_3 E_i + \beta_4 C_i + \beta_5 \Delta \text{Ln } Y_i * D_l + \epsilon_i \quad (2)$$

The change in income variable is specified as an interaction term. Here $\Delta \text{Ln } Y_{li}$ represents a change in the logarithm of income, where three different specifications are tested, namely $LnY_{2011} - LnY_{2010}$, $LnY_{2011} - LnY_{2009}$, and $LnY_{2011} - LnY_{2006}$. Next, D is a dummy variable capturing negative income changes.

3. Data

The analysis in the following sections is based on an independent survey administered in 2011 among 950 individuals in Barcelona. Results are most representative for Barcelona, to some extent for Catalonia, but not for Spain. Data is cross-sectional and includes questions on past income and (past) happiness. The rejection rate ranged between 80% and 90%, depending on the urban district and age group. High rejection rates are common for Barcelona and big cities in general, whose residents are saturated with marketing and publicity surveys.

The major part of the data was collected via face-to-face interviews in randomly selected houses in all city districts. Somewhat 60 respondents filled in the questionnaires on Internet. The age structure of the sample is representative for the individuals below 65 years. The number of respondents above the age of 65 years is, however, 40% lower than what a representative sample for Barcelona would look like. This is partly a result of dropping 50 responses for missing values on key parameters, such as income. Many of these belonged to senior individuals who refused to disclose their incomes, most probably for reasons of personal security. The number of individuals older than 65 in the sample, however, remains fairly high (117). The under-representation of senior individuals is corrected by applying weighting and a dummy variable in the regression analysis. After dropping responses with missing values, the final sample size amounts to 840, among which 85% have Spanish or Catalan nationality.

As seen in Table 1, the questionnaire included sections on free time, consumption, commuting, social relations, income, temperament, extreme events. The descriptive statistics on the key parameters is then given in Table 2. Hereafter, we provide some highlights on the key categories.

3.1. Work and education

Worth noting is the particularly high percentage of individuals with flexible working conditions, or working without a contract and a fixed job. They make up more than one fifth of the sample and

Table 1
Description of the variables used.

Variable name	Description
Life satisfaction	Taking all things together, how satisfied do you feel with your life at present? (dependent variable)
Female	Dummy variable taking value of 1 if respondent is female
Age	Years of respondent
Age 65	A dummy variable taking value of 1 if respondent is aged above 65
Separated	A dummy variable taking value of 1 if respondent is single, after being in a relationship/marriage
Education	A discrete variable which takes the following values: Without education = 1, primary studies = 2, secondary studies = 3, professional studies = 4, univ. degree = 5
Flexwork	A dummy variable taking value of 1 if respondent has flexible working conditions
Unemployed	A dummy variable taking value of 1 if responder is unemployed
Doctor	A variable reflecting the number of visits to a doctor per year
LY2011	Logarithm of personal income in 2011
Spirit	A discrete variable reflecting the frequency of spiritual activities, where daily = 6, weekly = 5, monthly = 4, less frequency than once a month = 3, yearly = 2, never = 1
Sport	A discrete variable reflecting the frequency of doing sports, where daily = 6, weekly = 5, monthly = 4, less frequency than once a month = 3, yearly = 2, never = 1
Ecolg	A dummy variable taking value of 1 if respondent normally purchases ecological products
Share	A dummy variable taking value of 1 if respondent is willing to share (and to continue sharing)
Angry	A discrete variable reflecting the frequency of feeling anger, where Very often = 5, often = 4, sometimes = 3, rarely = 2, almost never = 1
Worried	A discrete variable reflecting the frequency of feeling worried, where Very often = 5, often = 4, sometimes = 3, rarely = 2, almost never = 1
Forest fire	A dummy variable taking a value of 1 if respondent has experienced a forest fire
Drought	A dummy variable taking a value of 1 if respondent has experienced a drought
Buy clothes	A discrete variable reflecting the frequency of buying clothes, where every 2 weeks = 7, monthly = 6, every 6 months = 5, yearly = 4, every 5 years = 3, every 10 years = 2, never = 1
Change car	A discrete variable reflecting the frequency of buying cars, where every 2 weeks = 7, monthly = 6, every 6 months = 5, yearly = 4, every 5 years = 3, every 10 years = 2, never = 1
Buy electr. appliances	A discrete variable reflecting the frequency of buying electronic appliances, where every 2 weeks = 7, monthly = 6, every 6 months = 5, yearly = 4, every 5 years = 3, every 10 years = 2, never = 1
Buy furniture	A discrete variable reflecting the frequency of buying furniture, where every 2 weeks = 7, monthly = 6, every 6 months = 5, yearly = 4, every 5 years = 3, every 10 years = 2, never = 1
Income increase-1	A dummy variable taking a value of 1 if the individual has had a lower income 1 year ago than the present year
Income increase-2	A dummy variable taking a value of 1 if the individual has had a lower income 2 years ago than the present year r
Income increase-5	A dummy variable taking a value of 1 if the individual has had a lower income 5 years ago than the present year
Income decrease-1	A dummy variable taking a value of 1 if the individual has had higher incomes 1 year ago than the present year
Income decrease-2	A dummy variable taking a value of 1 if the individual has had higher incomes 2 years ago than the present year
Income decrease-5	A dummy variable taking a value of 1 if the individual has had higher incomes 5 years ago than the present year

Table 2
Key descriptive statistics.

Variable	Mean	Std. dev.	Min	Max
Income 2011 (euro)	1310	1224	200	9000
Income 2010 (euro)	1334	1209	200	9000
Income 2009 (euro)	1374	1265	200	9000
Income 2006 (euro)	1346	1348	200	9000
Life satisfaction 2011	7.20	1.66	1	10
Life satisfaction 2010	6.95	1.78	1	10
Life satisfaction 2009	6.93	1.88	1	10
Female	0.53	0.5	0	1
Age	42.97	16.35	18	93
Education	4.11	1.11	1	5
Separated	13%	0.34	0	1
Single	27%	0.44	0	1
In a relationship	60%	0.49	0	1
Number children	0.96	1.24	0	8
Working full-time	46%	0.5	0	1
Having flexible working conditions	23%	0.41	0	1
Unemployed	9%	0.28	0	1
Number doctor visits per year	1.28	2.62	0	40
Frequency of spiritual activity	1.88	1.39	1	6
Frequency of doing sports	3.65	1.92	1	6
Ecological consumption	0.25	0.43	0	1
Share	0.68	0.47	0	1
Angry	2.76	0.95	1	5
Worried	3.4	0.97	1	5
Forest fire	0.11	0.31	0	1
Drought	0.1	0.3	0	1
Buying clothes	4.92	1.1	1	7
Buying electronic devices	3.29	1.14	1	6
Buying furniture	2.51	1.21	1	7
Buying a car	1.46	0.68	1	4
Income increase-1[*]	0.17	0.37	0	1
Income increase-2[a]	0.22	0.42	0	1
Income increase-5[a]	0.32	0.47	0	1
Income decrease-1[a]	0.18	0.38	0	1
Income decrease-2[a]	0.24	0.43	0	1
Income decrease-5[a]	0.24	0.43	0	1

[a] Dummies: means reflect proportion of sample with income increase/decrease.

are the largest group after full-time workers. As a comparison, Eurostat reports that part-time workers make up 13.2% of the labour force in Spain for 2011. The fraction of university degrees is 52% of the sample, which is fairly high, probably due to the urban location of the survey. The European Social Survey for Spain in 2008 reports that university and upper secondary degrees are held by about 36% of the population (Cuñado and Gracia, 2012).

3.2. Free time, social relations, and sharing

Some 40% of the respondents go out and socialize at least once a week, 15% do sports and 65% use a computer and a TV daily for entertainment. The belief that people are mainly selfish is shared by 76% of the respondents, while 58% state that the others can be trusted. An innovative feature of the study is the inclusion of questions on the practice of sharing houses, cars, electro-domestic appliances and tools (used in the kitchen, garden, and repair-works). About 68% of the respondents state they are willing to share, and 26% share a car, and 50% – a house (not only with a partner).

3.3. Income and consumption

As reflected in Table 2, average net monthly incomes are falling between 2009 and 2011, which coincides with the start of the economic crisis in Spain. The deteriorating economic situation in the country is furthermore reflected in Fig. 1, illustrating that the fraction of individuals living on less than 630 € per month is increasing at the expense of the fraction of individuals with higher earnings than 1500, (whose share is diminishing). The data reveals

a slightly more uneven income distribution than what the European Social Survey (ESS) finds for 2011 for the Spain. While the individuals with an income lower than 1050 € per month make 32% in the ESS sample for Spain, it is 44% in ours. The individuals with an income higher than 3500 € per month make 8% of the ESS sample, and only 4% in ours. This difference is certainly due to the fact that our sample is limited to Barcelona city (and is not representative for Spain), and that the majority of the high-income individuals reside in posh urban districts outside the city. Income levels are furthermore not corrected for inflation.

The individuals who have lower income than last year in the sample are 140%, or 17% (as seen in Table 2). As shown in Table 2a, 30% of them experienced a 30% decline, and 30% a decline between 30% and 50% (over the last year). In absolute terms, 43% experienced an income reduction of less than 500 euro per month, and 22% – a reduction between 500 and 1000 euro.

The highlights from the reported consumer behaviour can be summed as follows: 46% of the sample report to buy clothes every 6 months, 35% purchase electronic equipment annually, 17% buy a piece of furniture once a year, and 9% change their car every five years. Ecological products are preferred by 26% of the sample. It we assume that clothes, cars and electro-domestic appliances have features of status goods, conspicuous consumption is relatively high, despite the economic crisis.

3.4. Satisfaction with life

Descriptive statistics indicate that individuals perceive themselves as happier than the others, and as happier at present than in earlier years. About 30% of the respondents state that they feel
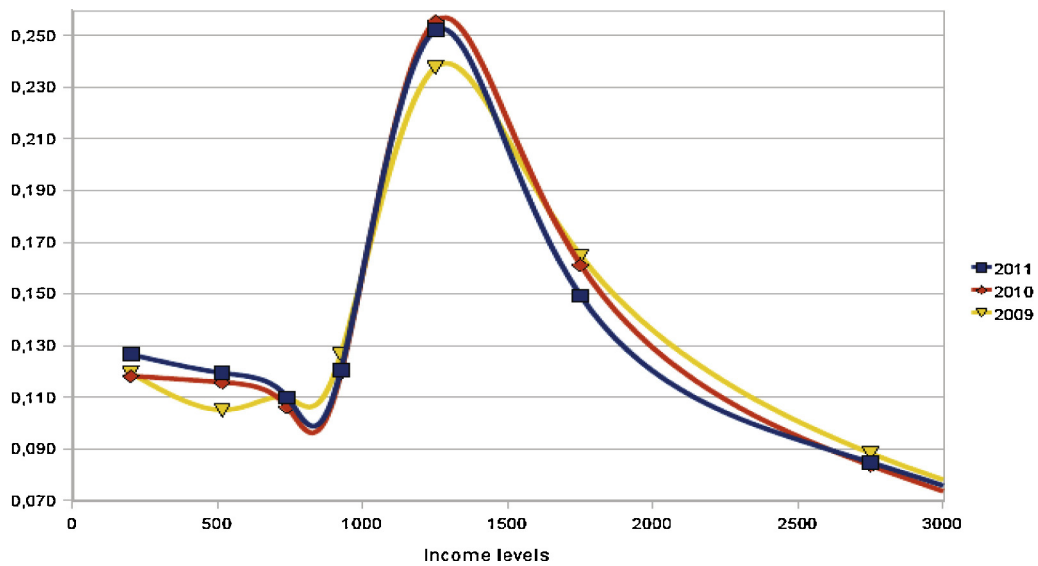
Fig. 1. Distribution of income levels in the sample for the period 2009–2011.

Table 2a
Distribution of the income decreases experienced in 2011 with respect to 2010.

Size of reduction	% of fraction with income declines
Income reduction <30%	30.00%
Income reduction of 30 to 50%	30.00%
Income reduction of 50 to 75%	26.00%
Income reduction of >75%	14.00%
Income reduction of 90%	1.00%
Income reduction <500 €/month	43.00%
Income reduction between 500 and 1000 €/month	22.00%
Income reduction between 1000 and 1500 €/month	14.00%
Income reduction between 1500–2500 €/month	2.00%
Income reduction >2500 €/month	1.00%

While for monthly earnings lower than 1750 € correlation is positive, beyond this income level it turns (and remains) negative. Using retrospective statements on self-reported satisfaction with life as for one and two years ago we can compare the trends in mean happiness and income for the last three years (Fig. 2). Backward-looking reports on happiness were asked only for one and two years ago, while reports on past income are for one, two and five years ago. The figure shows that while average incomes are falling, life satisfaction tends to increase. This result is inquiring, though inconclusive given that assessment of past happiness is not highly reliable since it can differ from valuation done at the very moment in time. According to Kahneman and Riis (2005), past happiness is based on the "remembering and evaluating self" rather than on the "experiencing self". They note that past experiences are normally evaluated by the memories of several peak periods rather than by summing happiness of each single moment.

3.5. Extreme climate events

Given our second research interest, the survey included a section on extreme climate events. From all respondents 10% declare to have experienced a drought (83 individuals), 18% a heat wave (153 individuals), and 11% a forest fire (90 individuals).

happy all of the time and only 5% believe that others feel happy all of the time, implying a substantial underestimating of the well-being of the others. The mean self-reported life-satisfaction in Barcelona for 2011 is 7.2, which does not diverge significantly from the level reported by ESS for the same year in Spain (7.57).

In terms of the relation between current income and happiness manifested in the descriptive statistics, we find a threshold point beyond which correlation between the two variables changes sign.
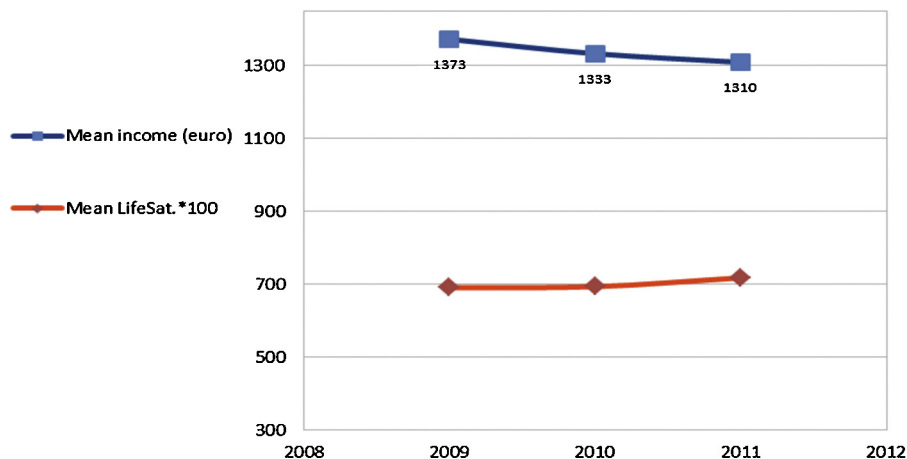

Fig. 2. Average incomes versus happiness in Barcelona for the period 2009–2011.

Experiences with heat waves, droughts and forest fires in the sample correlate highly and positively, implying that the three variables are likely to capture an overlapping climatic phenomenon. Moreover, correlation between all three climatic variables and happiness is negative.

4. Empirical results

The OLS estimations of Eqs. (1) and (2) with life satisfaction in 2011 as a dependent variable are given in Tables 3 and 4. Table 3 provides two variations of the baseline specification, which differ in terms of controlling for conspicuous consumption.

Table 3
Baseline regressions.

Life satisfaction (2011)	coef.	s.e.	coef.	s.e.
Female	0.22**	0.11	0.25**	0.11
Age	−0.01**	0.01	−0.01**	0.00
Age 65	−0.03	0.23	0.1	0.23
Separated	−0.68***	0.17	−0.60***	0.17
Flexible work	−0.29**	0.14	−0.27*	0.14
Unemployed	−0.30	0.21	−0.31	0.21
Doctor visits	−0.05**	0.02	−0.05**	0.02
Log income 2011	0.14*	0.08	0.06	0.08
Furniture-purchase			0.09*	0.05
Car-purchase			0.21**	0.09
Spiritual activities	0.13***	0.04	0.13***	0.04
Sport	0.08**	0.03	0.07**	0.03
Ecological consumption	0.28**	0.12	0.27**	0.12
Share	0.26**	0.12	0.24**	0.12
Angry	−0.37***	0.06	−0.38***	0.06
Worried	−0.25***	0.06	−0.25***	0.06
Forest fire	−0.31*	0.17	−0.32*	0.17
cons	8.02	0.58	8.11	0.59
R-squared	0.20		0.21	
Adj. R-squared	0.19		0.20	
Number of Obs	810		794	

* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.

Table 4
Expanded regressions.

Life satisfaction (2011)	coef.	s.e.	coef.	s.e.	coef.	s.e.
Female	0.23**	0.11	0.22**	0.11	0.20**	0.11
Age	−0.01**	0.01	−0.01**	0.01	−0.01**	0.01
Age 65	0.01	0.23	0.00	0.23	−0.05	0.23
Separated	−0.65***	0.17	−0.66***	0.17	−0.68***	0.17
Flexible work	−0.33**	0.14	−0.31**	0.14	−0.29**	0.14
Unemployed	−0.41**	0.21	−0.31	0.21	−0.24	0.21
Doctor visits	−0.05**	0.02	−0.05**	0.02	−0.05**	0.02
Log income 2011	0.20**	0.08	0.16**	0.08	0.11	0.08
Income de-1[a]	−0.36**	0.17				
Income de-2[b]			−0.04	0.15		
Income de-5[c]					0.18	0.13
Spiritual activities	0.13***	0.04	0.13***	0.04	0.13***	0.04
Sport	0.07**	0.03	0.08**	0.03	0.08**	0.03
Ecological consumption	0.29**	0.12	0.29*	0.12	0.28**	0.12
Share	0.27**	0.12	0.27**	0.12	0.28**	0.12
Angry	−0.39***	0.06	−0.38**	0.06	−0.38***	0.06
Worried	−0.24***	0.06	−0.24**	0.06	−0.24***	0.06
Forest fire	−0.31*	0.17	−0.31**	0.17	−0.30**	0.17
cons	7.58	0.61	7.88	0.62	8.14	0.6
R-squared	0.21		0.20		0.20	
Adj. R-sqrd	0.19		0.19		0.19	
Numb. Obs	807		807		807	

* Significant at 10% level.
** Significant at 5% level.
*** Significant at 1% level.
[a] An interaction variable reflecting a logarithmic reduction in income 1 year ago.
[b] An interaction variable reflecting a logarithmic reduction in income 2 years ago.
[c] An interaction variable reflecting a logarithmic reduction in income 5 years ago.

The effect of ageing is negative and significant but does not quite follow the U-shape often found in other studies. The dummy variable corresponding to the individuals older than 65 was insignificant, though positive. This can be explained by the fact that the elderly people we surveyed often declared to feel unsafe and socially isolated. There are some indications in the literature that elderly people living in the countryside are happier for having stronger ties with the community, better health conditions and more security (Warburton, 2009). In a recent paper Frijters and Beatton (2012) note that the typical U-shape is often the result of structural problems in surveying, namely that older unhappy people are less willing to participate in surveys, which results in an over-representation of happier older people.

The regression results for the demographic variables are generally consistent with other studies. Women are happier than men and the dummy for being *separated* is significant and having the expected negative signs. Having *flexible working conditions* has a pronounced and negative effect on life-satisfaction in all model specifications. While more flexibility in work is normally expected to enhance personal freedom and well-being, in the Spanish context flexible working conditions often imply having a precarious and unstable job, which can contribute to stress and material insecurity. *Unemployment* has the expected negative sign but is significant in few of the specifications (Table 3). *Full-time* employment was not significant in any of the models and was not included in the final results. The variable reflecting the level of education was also not significant, unlike finding of Cuñado and Gracia (2012) that (higher) education has a positive and direct impact on happiness. The difference might come from the data, as we did not formulate our question in terms of years of schooling.

The *frequency of doing sports* and *spiritual activities* were the only significant variables among the ones related to free time. Both appear as strong positive determinants of well-being in all model specifications. The willingness to *share* is also positive and significant at 5% in all model specifications. Psychological characteristics, such as how often one feels *angry* and *worried*, have a pronounced negative effect on happiness. Variables reflecting ethnicity were not significant, nor did they improve the overall fit of the model. This can probably be explained by the fact that Latin American respondents make up the majority of non-Spanish individuals in the sample and their satisfaction with life is not significantly different from the levels reported by Spanish and Catalan nationals. This is confirmed by the well-being measurement of the Gallup and the World Value Survey for 2011.

The variable reflecting *ecological awareness* is positive and significant at 5% in all specifications. Ecological awareness might contribute to happiness as individuals who care about the environment tend to spend more time in nature which has been shown to positively influence happiness (Kellert and Wilson, 1993). Next, the frequencies of purchasing clothes, cars, electronic devices, and furniture were introduced as proxies of status consumption. The significant variables from the set are the ones reflecting car and furniture purchase, which are both positive. The positive contribution of these two variables is probably due to their conspicuous nature. This holds especially for cars, which are often valued, more for the associated status effect than for their use value (Verhoef and van Wee, 2000). This can be seen by looking at the bi-variate relation between life satisfaction and car use in the sample. Tripling the number hours of car-commuting is associated with a sharp decline in the level of happiness. Furthermore, for each income category, the life satisfaction of people who purchase a car every five years is lower among those who do it less frequently. This could be interpreted as an indication of the short-lasting effect of car-purchase on happiness. Buying a personal vehicle can then serve as a strategy to regain the social prestige and satisfaction lost as one gets accustomed to the old one.

4.1. The role of income changes for happiness

As seen in Tables 3 and 4, the income coefficient is positive and significant in all specifications which exclude the variables *frequency of car-change* and *furniture-purchasing*. This result might be due to the fact that buying expensive goods is dependent on the income level. Furthermore the inclusion of the two variables reduces the income coefficient by almost 60%. For this reason Eq. (2) is estimated without the conspicuous consumption variables.

We firstly tested the effect of income increases (using absolute, percentage, logarithmic, relative logarithmic and dummy specifications) which reflect changes with respect to one, two and five years ago. None of the variables were, however, significant. Given the economic situation in Spain, however, income reductions are likely to come out as stronger determinants of happiness and this is seen in Table 4, which presents the results of estimating Eq. (2). As mentioned in Section 2, the variable is introduced as an interaction term between the change of the logarithm of income and a dummy which controls for the cases with income decreases with respect to one, two and five years ago. As seen in Table 4, having a lower income now, than one year ago, bears a negative relation with life satisfaction. Earning less than two and five years ago has, however, no significant effect on life satisfaction.

It should be noted that the changes in income which the majority of individuals in the sample have experienced are not marginal. The mean decline in earnings over the period 2010–2011 is 663 €. As shown in Table 2a, 39% of the sample lost up to 30% of their income, and 59% lost up to 50%. The temporary effect of an income decrease on happiness could be due to social comparison, which drives aspirations down when many peers also face income reductions. The importance of comparison income for happiness has been well established in the literature. Comparison income is based on internal reference points, such as own past earnings, and on external ones, i.e. the incomes of a so-called reference group (consisting of family members, neighbours, friends, co-workers, or fellow citizens). Clark et al. (2008) estimate that about two-thirds of income increases have no effect on happiness, because it is status-related and "disappears" through social comparison. This effect, whoever, might also hold in the context of an income fall.

4.2. Forest fires

Eq. (2) was estimated separately for *droughts*, *heat-waves* and *forest fires*. The coefficients of all three climate variables are negative, and only *forest fire* is significant. This is based on 90 reported incidences of such events in the sample. The significance of forest fires in an urban context is somewhat surprising. Carroll et al. (2009) find that springtime droughts are associated with a decline in life satisfaction of rural communities, (due to an expected drop in future incomes) but not of urban ones. Forest fires, on the other hand, have a more sudden, intensive and even life-threatening character, suggesting that their psychological or physical impacts may be substantial, even for urban citizens who happen to have experienced a forest fire in the countryside.

This result should be interpreted in the context of the dry and hot climate of Catalonia, featured by frequent forest fires that eventually spread out to urban settlements. Looking at the descriptive statistics, the mean age of the people who experienced a forest fire is higher than the sample average, and the same holds for their working time and income level. The frequency of illness and having a negative emotional status is also higher among those who experienced a forest fire. Next, an Ordered Probit regression is used to identify the variables which best explain forest fire experiences and these are: possession of large and secondary houses, the level of personal income and undertaking frequent trips to nature. Their coefficients are all positive and significant, implying that forest fires were most

likely experienced in the countryside, and during a stay in a secondary house.

Given that we do not have information on the type, extent and timing of the forest fires which individuals have experienced, it is impossible to ascertain the exact channel through which the event affects life satisfaction. One plausible interpretation is that forest fires have lasting psychological or physical impacts. This is somewhat supported by the higher frequencies of health problems and negative emotional status among the individuals who experienced a forest fire. An alternative interpretation could be that there is a (hidden) characteristic shared by all individuals who lived through forest fires which determines their low level of subjective well-being. This is, however, unlikely.

4.3. Robustness tests

To correct for possible under-representation of older individuals in the sample, regressions were also weighted, giving larger weights to answers by older respondents. The weight applied to the responses of individuals older than 65 was 1.66, to the ones between 30 and 44–0.84, and for these younger than 30–0.78, as derived from Catalan statistics on the age distribution of the population of Barcelona. The difference between the results of the weighted and non-weighted model specifications was only in terms of the *forest fire* variable, which was no longer significant (note that only 11% of the sample experienced *forest fires*). Moreover, dropping the 60 observations collected from Internet did not result in changes of the regression results.

The high number of income-related variables might cause problems of multicollinearity. However, we find that the correlation between all variables is generally low. The highest level (0.38) is found for the frequency of buying a car and income. Running tests indicates that there are no problems of multicollinearity among the variables used. Moreover *ecological consumption, angry, worried, sharing, sports* and *spiritual activities* were also tested for endogeneity using a two stage Durbin-Wu-Hausman test. Some authors argue that environmental awareness may be correlated with individuals' psychological traits and therefore with the error term of the well-being equation. This is, however, not the case in our data. The null hypothesis of endogeneity was however rejected in all tests.

Finally, testing different specifications of *income decreases* provided more nuanced results on the relation between lower earnings and happiness. Table 5 shows a model estimation where *income decreases* are specified as a dummy variable that takes a value of one if individuals experienced a reduction in earnings (specified as *D* in Eq. (2)). The signs and significance of the parameters which reflect income decrease with respect to two and five years ago correspond to their equivalents in the specification discussed in Table 4. Surprisingly however, experiencing a recent income loss (i.e. having a lower income than one year ago) bears a positive relation with happiness. This curious result holds as well when the *income decrease* parameter is specified as a percentage change (rather than a dummy variable). The result emerges when controlling for recent entry in *unemployment*, which is negative and significant at 5% (Table 5). One possible explanation for this finding is that the negative effect of a recent income loss which does not lead to unemployment could be more than off-set by other factors, (such as an increase in autonomy, social activities and availability of more free time for doing meaningful activities).

5. Discussion and policy relevance

Given the underlying focus of this study, namely undertaking a happiness analysis in a set-up that can provide insights for climate policy, two results merit a closer look. The first and major one

Table 5

Life satisfaction (2011)	coef.	s.e.	coef.	s.e.	coef.	s.e.
Female	0.23**	0.11	0.21**	0.11	0.21*	0.11
Age	−0.01**	0.01	−0.01**	0.01	−0.01**	0.01
Age 65	−0.03	0.23	−0.05	0.23	−0.08	0.23
Separated	−0.65***	0.17	−0.67***	0.17	−0.68***	0.17
Flexible work	−0.30**	0.13	−0.26**	0.14	−0.25**	0.14
Start unemployment	−0.58**	0.21	−0.45**	0.21	−0.39*	0.21
Doctor visits	−0.06**	0.02	−0.05**	0.02	−0.05**	0.02
Log income 2011	0.16**	0.08	0.12	0.08	0.10	0.08
Income_de-1[a]	0.38**	0.15				
Income_de-2[b]			−0.02	0.14		
Income_de-5[c]					−0.18	0.13
Spiritual activities	0.13***	0.04	0.14***	0.04	0.14***	0.04
Sport	0.07**	0.03	0.07**	0.03	0.07**	0.03
Ecological consumption	0.30**	0.12	0.29**	0.12	0.28**	0.12
Share	0.27**	0.12	0.27**	0.12	0.27**	0.12
Angry	−0.37***	0.06	−0.37***	0.06	−0.36***	0.06
Worried	−0.26***	0.06	−0.26***	0.06	−0.26***	0.06
Forest fire	−0.31**	0.17	−0.31**	0.17	−0.3**	0.17
_cons	7.86	0.59	8.14	0.59	8.23	0.58
R-squared	0.21		0.21		0.21	
Adj. R-sqrd	0.20		0.19		0.19	
Numb. Obs	808		808		806	

* Significant at 10% level.
** Significant at 5%.
*** Significant at 1%.
[a] A dummy variable reflecting lower income than 1 year ago.
[b] A dummy variable reflecting lower income than 2 years ago.
[c] A dummy variable reflecting lower income than 5 years ago.

concerns the way income declines affect well-being, and the second, minor one, relates to the impact of forest fires on happiness.

One could interpret the temporary impact of income decline on well-being as an illustration of adaptation to income change, which is found in many studies and debated in others. In our sample, some individuals have initially experienced certain discomfort with the income loss, and have later adapted. This is reflected in the significance and negative sign of the income reduction variable (with respect to one year ago) and the lack of significance of the coefficients corresponding to experiencing income reduction with respect to two and five years ago. The short-lasting effect of income decline can also be driven by social comparison or adaptive income aspirations. Possibly, the economic crisis has resulted in larger changes in internal income reference points than in external ones. This means that while individual income altered with respect to the past, the ratio between own income and a reference group's income changed to a less extent. Indeed, as shown in Table 2 more individuals experienced income decreases than income increases.

Thus we might capture the happiness effect of a decline in reference income levels. This is one of the possible ways to understand the positive causality between recent income reduction and subjective well-being (when income reduction is specified as a dummy variable and percentage change). It is a surprising finding, also in view of the budgetary cuts in Catalonia which gave rise to much social unrest. If losses in income are not associated with becoming unemployed, one likely explanation of this result is the reduction of formal working time. The reasoning here is that individuals who lose part of their income because of a reduction in working hours might have been compensated by other changes in their personal life circumstances. For example, more leisure time may have allowed people to engage in social, unpaid activities that provide a sense of meaningfulness. This is evidently a hypothesis which requires more research. Some support for it can be found in Conill et al. (2012).

To test whether the positive effect of recent income decrease (when specified as a dummy variable) is driven by a reduction of formal working hours, we introduced *working hours* as an

independent variable in Eq. (1). While the new variable is not significant with the entire sample, restricting it to the individuals working more than 16 h per week resulted in a significant and negative coefficient (of *working hours*). Indeed, correlation between life satisfaction and *working hours* turns negative once number of hours surpasses 2 days per week. High working efforts thus tend to have a negative impact on life satisfaction of people in Barcelona, although the exact threshold beyond which the increase of formal working hours starts to negatively affect happiness cannot be defined with certainty. In addition, the divergence between the effects of a recent income decrease on happiness can be assigned to the type of specification. The dummy variables in Table 5 treat equally, or assign an equal weight to, all types of income losses, while the variables specified in log terms take the differences in the size of income changes into account.

A widespread concern with climate policy is that it will have a huge economic cost, among others, by restricting consumption, either through lower income or higher prices of energy-intensive goods and services. Placing our results in the context of climate policy would thus mean that lowering consumption might not have a negative impact on subjective well-being, especially if accompanied by a fall in reference income standards. Moreover, climate policy could have a positive impact on happiness if accompanied by compensatory life-style changes, such as lowering of working hours while maintaining employment security.

With regard to results on conspicuous consumption, we find that the frequency of purchasing, (rather than the sheer use of) cars and furniture bear positive effects on life satisfaction. One way of interpreting this result is that frequent acquisition of expensive goods might serve as a strategy to maintain one's well-being level high, given that satisfaction with earlier purchases wears off with time due to habituation and social comparison. The importance of status-based consumption for life satisfaction (indicated by this finding) implies that climate policy which does not take conspicuous consumption and unequal access to status goods into account could have a negative effect on happiness. Climate policy should thus best 'correct' in some way for rivalry and adaptation to the increasing consumption of CO_2-intensive goods.

In term of the second focus of this paper, the negative contribution of forest fires to happiness merits some further discussion. Certainly, forest fires have been there for centuries and need not occur only as a result of climate change. But they can serve as a proxy of extreme events that will become more likely with a warmer climate. Furthermore, if forest fires already have a lasting impact on the well-being of urban citizens, their effect on the residents of rural areas (or the happiness loss there) is likely to be of the same if not larger magnitude.

6. Conclusions

Studying well-being in the context of an economic crisis, associated with income and consumption decline, can provide a different perception of climate policy. It was argued above that if climate policy results in a reduction of consumption, as proxied by income decreases, its well-being cost need not be high. Drawing on the empirical evidence from the city of Barcelona, we perform econometric tests for the effect of various economic and socio-demographic parameters on happiness. Empirically, the effect of an income decrease on happiness depends on its timing and econometric specification in the sample. The long-term impact of an income decrease on happiness is close to zero in most of the specifications. An income decrease with respect to one year ago has a negative effect on happiness when specified as a logarithmic transformation, and a positive one when specified as a dummy variable or percentage change. The first specification takes differences in the size of the income declines into account, while

the second one treats all income reductions equally. Both effects are however temporary and do not hold for a period longer than one year in most models, probably because of adaptation, and a downward adjustment of reference income standards. Nevertheless, we should note that entry in unemployment and having flexible working conditions have a pronounced negative effect on life-satisfaction in Barcelona, which reflects the negative impact of the economic crisis.

The higher frequency of purchasing goods like cars and furniture emerges as a positive determinant of life satisfaction. Conspicuous consumption might thus be seen as a myopic strategy to maintain life satisfaction sufficiently high when adaptation and social comparison wear-off the positive gains of earlier acquisitions. Another remarkable result is that the citizens of Barcelona who have once experienced a forest fire (in the countryside) tend to have significantly lower level of life satisfaction than rest of the sample. One potential reason for this result is that forest fires are sudden, difficult, if not impossible to adapt to, and often safety- and life-threatening.

Climate policy that leads to a reduction in consumption is not the most logical thing to do in the context of a crisis. Our results suggest though that climate policy need not reduce happiness in the long run, even when it reduces income and carbon-intensive consumption. Its impact can even be positive for life satisfaction, if accompanied by compensatory measures that facilitate the decrease of formal working hours and reference consumption standards, while maintaining employment security.

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