OXFORD BULLETIN OF ECONOMICS AND STATISTICS, 78, 4 (2016) 0305–9049
doi: 10.1111/obes.12111

Envy and Habits: Panel Data Estimates of Interdependent Preferences*

Francisco Alvarez-Cuadrado†, Jose Maria Casado‡ and Jose Maria Labeaga§

†*McGill University, 855 Sherbrooke Street West, Montreal H3A 2T7, CA USA (e-mail: francisco.alvarez-cuadrado@mcgill.ca)*
‡*Banco de España, Alcalá 48, Madrid 28014, Spain (e-mail: jmcasado@bde.es)*
§*UNED, Paseo Senda del Rey 11, Madrid 28040, Spain (e-mail: jlabeaga@cee.uned.es)*

Abstract

We estimate the importance of preference interdependence from consumption choices. Our strategy follows the literature that tests the constraints imposed by optimality on the evolution of individual consumption. The introduction of habits and envy places additional restrictions on the evolution of the optimal consumption path. We use a unique data set to test these restrictions. Our estimates suggest that, if one defines utility over consumption services, a large fraction of these services is relative, with one third of the weight placed in the consumption of the reference group and another third placed in the agent's past consumption.

I. Introduction

The assumption that preferences are separable across time and across households is standard in the economic literature, but it is not particularly appealing. Indeed, social scientists have long stressed the relevance of habit and status-seeking as being important characteristics of human behaviour. In our discipline origins of this proposition can be traced as far back as Smith (1759) and Veblen (1899), although it was not until the works of Duesenberry (1949), Pollak (1976) and Ryder and Heal (1973) that an effort was made to provide these ideas with some micro-theoretic foundations. The subsequent literature has associated two types of reference consumption levels to these non-separabilities. The first is an internal criterion based on the individual's own past consumption levels. This case is often referred to as characterizing 'habit formation' or 'intrinsic habit', Rozen (2010). The second is based

JEL Classification numbers: C23, D12, D91

*The authors are grateful for helpful comments from two anonymous referees and seminar participants at the SAEe 2011, the EEA/ESEM 2012, the NASM 2013 and the Banco de España. We also acknowledge financial support from the Ministerio de Ciencia y Tecnologia under grant ECO2012-39553-C04-01. Additionally, Alvarez-Cuadrado acknowledges financial support from the Social Sciences and Humanities Research Council under grant SSHRC 430-2013-000424. Views expressed in this paper are those of the authors and should not be attributed to the Banco de España or the Eurosystem.

on an external criterion, expressed in terms of the consumption of some outside reference group, typically the average consumption of the community, or the overall economy. This is often referred to as 'envy' as in Varian (1974), 'catching up with the Joneses' as in Abel (1990), 'keeping up with the Joneses' as in Gali (1994), 'status' as in Corneo and Jeanne (2001), 'jealousy' as in Dupor and Liu (2003) or 'rivalry' as in Bruni and Porta (2005) or 'consumption externalities' as in Liu and Turnovsky (2005).

A large body of empirical work investigates the importance of habit formation for consumption behaviour.[1] The point of departure in any of these studies is an Euler equation derived under a preference specification that allows for temporal interdependencies. Then, a linearized version of this equation is estimated using time-series data on consumption and asset returns. Using UK data, Osborn (1988) introduces a consumption specification that allows for seasonal variation and habit persistence finding that the habit coefficients are jointly significant. Ferson and Constantinides (1991) find evidence of habit persistence dominating durability at monthly, quarterly and annual frequencies. Fuhrer and Klein (2006) and Fuhrer (2000) relying on a utility function that assigns relative weights to both current consumption and an internal benchmark find that 80% of the weight should be attached to the latter. Dynan (2000) uses panel data, specifically food consumption from the Panel Study of Income Dynamics, and finds no evidence of habit formation at the annual frequency. As Carrasco, Labeaga and David López-Salido (2005) point out this result could be a consequence of unobserved heterogeneity across households, and show that, after controlling for fixed effects, food consumption and services exhibit habit formation. Browning and Collado (2007) find evidence of habit formation in certain categories of goods, such as, food out of home, alcohol and tobacco, although they conclude that the intertemporal dependence is not sufficiently strong to make composite consumption significantly habit forming. Finally, following the revealed preference tradition, Crawford (2010) characterizes a set of identifying restrictions for the habit formation model. His results suggest that the introduction of habit formation in the standard discounted utility model improves its explanatory power considerably, virtually to the point where 100% of the micro-data are perfectly rationalizable if one allows intertemporal complementarities for many goods.

At the theoretical level, envy has been introduced to rationalize several departures from the predictions of the standard paradigm that assumes preferences that are separable across households. Abel (1990) and Gali (1994) rely on interpersonal comparisons to account for the excess return on equity. Carroll *et al.* (2000) explore the implications of relative consumption for the process of capital accumulation. Alonso-Carrera, Caballe and Raurich (2007) study the impact of interpersonal comparisons in an economy displaying dynastic altruism. Akerlof and Yellen (1990) present a model of worker behaviour where individual effort does not only depend on the workers' own wage but also on the wage received by their coworkers. Liu and Turnovsky (2005) explore the impact of envy on labour supply choices. Wendner and Goulder (2008) find that the marginal excess burden from taxation is lower

[1] The introduction of habits in the standard consumption model induces agents to adjust slowly to permanent income shocks and this helps rationalizing the reported excess smoothness puzzle. See, for instance, Campbell and Deaton (1989). Furthermore, habit formation has been used to reproduce the hump-shaped response of aggregate spending to monetary shocks (Fuhrer (2000)), the link between saving and growth (Carroll, Overland and Weil, 2000) and to improve the empirical fit of business cycle models (Boldrin, Christiano and Fisher, 2001).

in the presence of status concerns. Ljungqvist and Uhlig (2000) find that the optimal tax policy in an economy populated by envious households displays countercyclical Keynesian features. Ng and Wang (1993) and Howarth (2006) explore the implications of envy for environmental degradation and the use of natural resources. Despite this growing theoretical literature there are very few attempts to provide econometric estimates of the importance of envy. The asset pricing literature from Abel (1990) to Campbell and Cochrane (1999) provides some indirect evidence on the relevance of an externally generated reference stock as a mean to rationalize the equity premium puzzle. Additional support for the importance of interpersonal comparisons is provided by the recent literature on happiness. Clark and Oswald (1996), Luttmer (2005) and Dynan and Ravina (2007) are just a few examples that stress the importance of positional concerns as a crucial determinant of self-reported well-being. Oswald (1997) concludes that evidence from psychology and experimental economics supports the claim that satisfaction depends upon the agent's relative position, again emphasizing the role of positional externalities. Nonetheless, to our knowledge, Ravina (2008) and Maurer and Meier (2008) are the only two studies that try to infer the degree of envy using data on individual consumption choices.[2]

Our goal is to assess the importance of both types of non-separabilities from observed consumption choices. Where envy and habits matter, the level of satisfaction derived from a given bundle of consumption depends, not only on the consumption bundle itself but also on how it compares to the bundle of consumption of some reference group or to the agent's own past bundle of consumption. In this context, optimality imposes additional restrictions on the evolution of consumption through time and across households. We exploit these restrictions to estimate the relative importance of these two types of interactions; interdependence across time, habit formation and interdependence across households, envy.[3] Our results provide strong support for preference specifications that allow for both types of non-separability. Specifically, if one expresses the utility derived from consumption services as a weighted average of the absolute (current) level of consumption, the level of consumption relative to that of the reference group, and the current level of consumption relative to the past level of consumption, our estimates suggest that households derive one third of their satisfaction from comparisons between their current and past consumption and another third from comparisons between their consumption and that of their neighbours, with the remaining third being determined by their current consumption choices.

Our data set, the Spanish Continuous Family Expenditure Survey (Encuesta Continua de Presupuestos Familiares, ECPF), recently used by Browning and Collado (2001, 2007), Carrasco *et al.* (2005) and Crawford (2010) has two important advantages over other

[2] In contrast to these studies that focus on total consumption, Grinblatt, Keloharju and Ikäheimo (2008)and Kuhn *et al.* (2011) use more limited measures of consumption. The former restricts their analysis to car purchases. Using Finish data over several years they estimate that the probability of buying a car any given day increases by 12% for each one of your 10 nearest neighbours that purchased a car in the last 10 days. The latter exploits some features of the Dutch Postcode Lottery to evaluate the effect of unexpected income shocks on lottery winners and their neighbour. The authors collect their own data on subjective happiness and certain consumption items such as cars, food, non-durables or whether the household undertook any home renovations. Their analysis suggests the presence of substantial relative consumption concerns.

[3] In contrast to the existing literature, with the sole exception of Ravina (2008), we consider simultaneously the effects of both types of non-separability.

data sets. First, its long time dimension with each household being followed up to eight consecutive quarters. Second, the wealth of data on household geographical and socio-demographic characteristics it includes. The long-time dimension allows identifying the structural parameters in the presence of fixed effects, while the presence of geographic data allows for a sensible characterization of reference groups, that, similar to Frank (1985) and Ravina (2008), we define as those households that live in the same area (census tract) as the household of interest.

Finally, a crucial problem in the identification of models of social interactions is related to the reflection problem Manski (1993), recently stressed by Maurer and Meier (2008) in a context similar to ours. A priori it is difficult to distinguish whether similar behaviour within a group arises from the interaction among group members, endogenous effect or simply results from common exogenous characteristics of the group, exogenous effect or from individuals within the group sharing similar unobservable characteristics or facing similar shocks, correlated effect. Since the construction of our reference group is based on a purely geographical criterion established by the Spanish Statistical Office (INE) and, as we will argue, these groups are not particularly homogeneous in terms of observable characteristics of their members, one may think that the exogenous effects do not drive our estimate for envy. Nonetheless, we conduct several robustness checks. First, we include the neighbours' socio-economic characteristics as an additional regressor. Second, we try to attenuate the effects of shocks at the census tract level including measures of the local unemployment rate and the average interest rate faced by the reference group. Third, we include in our preferred specification an alternative measure of envy based on a reference group constructed using observable socio-demographic characteristics following Maurer and Meier (2008). Our baseline estimates remain robust throughout these exercises.

Our work is closely related to Maurer and Meier (2008) and particularly to Ravina (2008). The first authors propose a social multiplier approach to disentangle consumption externalities from correlated effects. Using US data and a definition of reference group that is based on socio-demographic, as opposed to geographic, characteristics, they report two main findings. First, much of the co-movement of individual consumption within groups reflects correlated effects. Second, once they control for these effects, they still find substantial evidence of consumption externalities. On the other hand, Ravina (2008) uses a sample of US credit card holders to conduct an exercise similar to ours. Nonetheless, several issues arise with her credit card data. First, her measure of consumption is incomplete since it only includes purchases made with a single credit card. Second, it may include purchases of durable consumption that will require an explicit modelling of the flow of services associated with durable goods. Third, the use of this data requires assumptions on the separability of consumption expenditures according to the method of payment, i.e. those paid with credit card should be separable from those paid by other mean. *A priori*, these assumptions are difficult to justify. In contrast, our data set overcomes these shortcomings by including a very comprehensive measure of consumption and a wide range of socio-demographic and geographic characteristics that allow the construction of sensible reference groups.

The paper is organized as follows. Section II sets out the theoretical model and derives the empirical specification. Section III discusses the data. Section IV presents the empirical strategy, while the main results are presented in section V. Some robustness checks

are included in section VI and the conclusions are summarized in section VII, while the Appendices provide some technical details.

II. Theoretical background: A simple model with envy and habits

Consider an endowment economy populated by a continuum of infinitely lived households distributed along the unit interval. At time t the i-th household chooses current consumption expenditures, C_{it} , to maximize,

$$E_t\left[\sum\nolimits_{s=0}^{\infty}\beta_i^s u(\tilde{C}_{it+s};\psi_{it+s})\right] \tag{1}$$

where β_i is her subjective discount factor, $\tilde{C}_{it}$ are consumption services, and ψ_{it+s} is a vector of variables that move marginal utility, 'taste-shifters'. In order to capture the importance of intertemporal and interpersonal comparisons, we model consumption services as,[4]

$$\tilde{C}_{it}=C_{it}-\gamma\bar{C}_{it}-\theta C_{it-1} \tag{2}$$

These services depend not only on the household's current consumption expenditures, C_{it} but also on the current consumption expenditures of her reference group, $\bar{C}_{it}$, and on her own past consumption expenditures, C_{it-1}. Specifically, γ measures the weight that the agent places on the consumption of her reference group and therefore is our measure of envy, while θ measures the importance of habits. The individual budget constraint takes the standard form,

$$A_{it+1}=R_{it+1}(A_{it}+Y_{it}-C_{it}) \tag{3}$$

where A_{it+1} is next period wealth, Y_{it} is current non-interest income and R_{it+1} is the gross return on assets.

The first-order condition for this optimization programme, where $u_{it}^{\tilde{C}}$ is the marginal utility of consumption services for the ith household at time t, is given by,

$$E_t[u_{it}^{\tilde{C}}-\beta_i\theta u_{it+1}^{\tilde{C}}]=E_t[R_{it+1}\beta_i(u_{it+1}^{\tilde{C}}-\beta\theta u_{it+2}^{\tilde{C}})] \tag{4}$$

Under a constant return on wealth, Deaton (1992) shows that equation (4) can be expressed as a second-order difference equation with the following familiar solution,[5]

$$u_{it-1}^{\tilde{C}}=\beta_i E_{t-1}[R_{it}u_{it}^{\tilde{C}}] \tag{5}$$

Now, let us assume our instantaneous utility function takes the standard iso-elastic specification,

$$u(\tilde{C}_{it};\psi_{it})=e^{\psi_{it}}\frac{(\tilde{C}_{it})^{1-\sigma}}{1-\sigma} \tag{6}$$

[4]This additive specification of envy and habits has been widely used in different contexts (see for instance Ljungqvist and Uhlig, 2000). The literature has proposed an alternative modeling strategy that assumes interdependencies enter in a multiplicative way Abel (1990), Carroll *et al.* (2000). Appendix A shows that our estimation equation remains unchanged under this alternative multiplicative approach.

[5]Hayashi (1985) proves that equation (5) holds approximately under static expectations on the evolution of a time-varying return on wealth. See Appendix B for a detailed derivation of equation (5).

where σ, the coefficient of relative risk aversion, governs the rate of change in marginal utility. Replacing equation (6) in (5) we reach,

$$\beta_{it}E_{t-1}\left[R_{it}e^{\psi'_{it}-\psi'_{it-1}}\left(\frac{\tilde{C}_{it}}{\tilde{C}_{it-1}}\right)^{-\sigma}\right]=1 \tag{7}$$

We follow most of the literature by considering a log-linear approximation that, under rational expectations, gives rise to our basic estimation equation.[6]

$$\Delta c_{it}=\mu_i+\frac{1}{\sigma}r_{it}+\gamma\Delta\bar{c}_{it}+\theta\Delta c_{it-1}+\Delta\psi_{it}+\epsilon_{it}\quad\text{where } E_{t-1}(\epsilon_{it})=0 \tag{8}$$

where lower case variables stand for the log of the upper case variable, Δ is the difference operator, μ_i is a combination of the rate of time preference and higher order terms resulting from the linear approximation,[7] and ϵ_{it} includes the approximation error and an expectational error uncorrelated with any information available at time $t-1$. The interpretation of equation (8) is straightforward. After controlling for the effect of taste-shifters, the growth rate of consumption increases with the degree of patience captured by the intercept, with anticipated changes on the return on saving as a consequence of intertemporal substitution, with the growth rate of consumption of the reference group as a consequence of envy, and with the past growth rate of the agent's consumption as a consequence of habit formation. It is worth noticing that if envy and habit do not matter, $\gamma=\theta=0$, equation (8) reduces to the permanent income hypothesis under time separable preferences and time-varying interest rate as stated by Hall and Mishkin (1982) and Campbell and Mankiw (1991). Alternatively if we set $\gamma=0$ our specification reduces to the one used by Dynan (2000).

The estimation of equation (8) poses several challenges. First, consumption data are poorly measured. Second, time averaging may induce first-order serial correlation in consumption growth that may resemble habit formation. Third, some regressors may be endogenous. And fourth, individual choices may be affected by aggregate shocks. Nonetheless, we leave the discussion of these issues for the section on empirical strategy, and now we turn to describe our data.

III. The data

The estimation of equation (8) requires data on household consumption where the same sample of households is followed for several consecutive periods. To implement the model, we use 12 years (1985–96) of the Spanish Household Budget Continuous Survey (ECPF). The ECPF is a rotating panel based on a survey conducted by the Spanish National Statistics Office (Instituto Nacional de Estadistica, INE). The ECPF interviews a sample of 3,200

[6] An alternative approach, see for instance Carroll (2001) and Gourinchas and Parker (2002), uses simulation techniques to estimate a structural model of intertemporal choices. As Attanasio and Low (2004) point out this approach has its own limitations. Given this, and for ease of comparability with most of the existing consumption literature, we will use a linear approximation of equation (7). The details of this approximation are in Appendix C.

[7] We are implicitly assuming that these higher order terms are constant and therefore captured by the intercept. Alternatively we could assume that the innovations to the higher order moments are uncorrelated with the other regressors. In this case, the deviations from the mean of these moments will be captured by the error term.

households, randomly rotating 12.5% of them each quarter. As a result, we can follow a household for a maximum of eight consecutive quarters.[8]

This survey has several advantages compared to other data sets commonly used in the consumption literature such as the Panel Study on Income Dynamics (PSID) and the Consumer Expenditure Survey (CEX) for the US or the Family Expenditure Survey (FES) for the UK. The PSID only reports information on food consumption, not allowing to control for other goods which may well be non-separable from food. The FES interviews each household only once and therefore it lacks the time-series dimension required for the estimation of equation (8). The CEX, although it reports various consumption categories, only follows each household for four quarters. In contrast, the ECPF reports a complete measure of consumption expenditure, follows each household for a long period of time (twice as many quarters as the CEX) and more importantly includes very detailed geographical information on the area of residence of each family. This longer panel structure allows to control for fixed effects and for the use of lagged values of the endogenous variables as instruments, while the geographical information is crucial for the construction of the reference groups.[9]

We construct our dependent variable, total consumption expenditures on non-durable goods and services, as the sum of food, alcohol, tobacco, services and expenditures on other non-durable goods, such as heating fuel, public and private transport, personal care and semi-durable goods like clothing and footwear. This measure of consumption accounts for roughly 80% of total consumption expenditures and its time path is similar to consumption expenditures obtained from national accounts. In order to express nominal expenditures in real terms, we construct a household-specific price index. This index is an average of the nominal price of each category of goods weighted by each household's share of expenditure in that category. Our measure for the nominal interest rate comes from the 12-month non-transferable deposit rate reported by the Bank of Spain. We use household-specific inflation rates to calculate the real rate of return on wealth. Finally, we use several socio-demographic variables, such as age, labour market status and number of adults and children in our estimation. Table 1 describes the construction of all these variables.

The specification of the reference groups is a crucial task in our empirical analysis. As Manski (1993) points out 'inference is not possible unless the researcher has prior information specifying the composition of reference groups (p. 531)'. In an ideal environment, the researcher would use observed behaviour and infer the most relevant determinants of reference groups. Since the data requirements for this endogenous determination of reference groups are prohibitively demanding, the literature has opted for two alternative approaches. A first approach follows the lead of the sociological literature on peer effects (Festinger, 1954; Kapteyn, 1997). This approach argues that people primarily compare themselves with members of their own social group, who are individuals with similar age, gender or education. This is the approach followed by Maurer and Meier (2008) who construct reference groups based on attributes of the head of the household; age, race,

[8] Changes in the design introduced by the INE prevent us from using the second wage of the survey that covers the period 1998–2005. This second wave no longer provides the data required to construct a comprehensive measure of individual consumption for the same household in consecutive periods.

[9] For a complete description of the ECPF see Browning and Collado (2001), Carrasco *et al.* (2005) or Crawford (2010).

TABLE 1

Description of the variables

Variable	*Description*	*Source*
Economics variables		
Δc_{it}	Household non-durable consumption growth rate Household's expenditures in goods and services. In particular, it includes the sum of food, alcohol, tobacco and expenditures on other non-durable goods, such as services, heating fuel, public and private transport, personal care and semi-durable goods like clothing and footwear. We construct growth rate by taking the difference in the logarithms of this variable between time t and $(t-1)$.	ECPF
$\Delta \bar{c}_{it}$	Reference group household non-durable consumption growth rate The change in the logarithm of average consumption of her census tract excluding her own consumption expenditures.	ECPF
y_{it}	Real disposable income	ECPF
r_{it}	Household real interest rate Computed as: $r_{it} = R_t - \pi_{it}$	Authors' calculations
R_t	12 month non-transferable deposit interest rate	Bank of Spain
π_{it}	Household inflation rate Computed as: $\pi_{it} = \frac{P^*_{it} - P^*_{it-1}}{P^*_{it-1}}$ Where $P^*_{it} = \sum_j P^j_t w^j_{it}$	Authors' calculation
P^j_t	Nominal price of commodity j	Spanish National Statistics Institute
w^j_{it}	Weight of commodity j in the i household budget	Authors' calculations
Socio-demographic variables		
nadult	Number of adults	ECPF
nchildren	Number of children (less than 14 years old)	ECPF
dlabourchange	Dummy of change of the head of household labour status	ECPF
Education level	Educational level	ECPF
age	Head of household years old	ECPF
hsex	Sex of head of household	ECPF
drura	Dummy for cities with less than 10,000 citizens	ECPF
dheduc	Dummy for families whose head of household has graduate educational level	ECPF

gender, family status, educational attainment, occupational status and size of the nearest city. Under this approach, it is reasonable to ask whether the observed common behaviour is the result of social interactions or simply results from common and observed characteristics. A second approach stresses the importance of the visibility of consumption expenditures as an important determinant of envious choices Charles, Hurst and Roussanov (2009), and Heffetz (2011). As Frank (1985) points out evolutionary psychology suggests that the relevant reproductive battles were typically decided by competitive balance in highly local environments. In this view, geographical proximity should be an important determinant

of reference groups.[10] Following Ravina (2008), we construct our reference groups using this second approach, although we conduct robustness checks including an alternative reference group constructed following the first approach.

We, therefore, identify reference groups with census tracts. These tracts are spatial, small and permanent statistical subdivisions of the Spanish territory. The boundaries of a census tract are delineated with the intention of being maintained over a long period of time so that statistical comparisons can be made from census to census. The 8,000 Spanish municipalities are divided into 35,000 census tracts. These tracts are grouped into provinces and strata that depend on the size of the municipality to which they belong. To collect data for the ECPF, the INE chooses a representative sample of 584 tracts spread over all strata. The number of census tracts chosen for each of the 17 Autonomous Communities (Spanish regions) is proportional to their population with a minimum of 16 tracts for each region.

In our estimation, the reference group of any given household is composed by the other households that live in the same census tract. For each household, we construct the consumption of her reference group, the neighbourhood consumption, as the average (log) consumption of her census tract excluding her own (log) consumption expenditures.[11] It is worth noticing that as opposed to Ravina (2008), who uses city of residence to construct reference groups, our approach allows for a more exhaustive dissection of spatial interactions. For instance, a city like Madrid, with more than three million inhabitants, will be broken down into more than 50 reference groups.

The original data set includes 30,133 households (148,482 observations). Since, as we will argue, we use lagged variables as instruments for our estimation, we select households reporting full information for at least four consecutive quarters.[12] In line with most of the consumption literature, we restrict our sample to married couples with or without children, and drop households whose head is either very young (younger than 25) or old (older than 60). As a result we avoid dealing with issues relevant to very young households, such as liquidity constraints, and to very old ones, such as retirement or acute health problems. This process leaves us with 13,080 households (81,848 observations). Once we transform the variables for estimation, i.e. we take all the lags and differences, our working sample contains 10,296 households (42,869 observations).[13] Table 2 summarizes this data cleaning process and Table 3 provide summary statistics. Dropping the youngest, less than 25 years old, and oldest, more than 60 years old, households from the original data set increases mean consumption and income. These increases are consistent with the well-known hump-shape life-cycle profiles of both variables. Additionally, the selected

[10] This criterion for the determination of the reference group is by no means exclusive. There might be other relevant approaches to construct reference groups or other relevant reference groups. For instance, the increase in Internet users since the turn of the century and the development of virtual social networks suggest that a criterion based on membership to these networks should have become increasingly important as a determinant of interpersonal comparisons in recent times.

[11] We have chosen mean consumption of the reference group but one might think that neighbourhood effects might be transmitted by distributional features other than the mean. For example, it is easy to believe that the magnitude of envy on individual behaviour may depend on the dispersion of behaviour in the reference group; for instance the smaller the dispersion, the stronger the norm.

[12] We could select those households with eight consecutive quarters in order to simplify the estimation. However, due to some evidence of attrition in the sample, we use the unbalanced panel in the estimation exercise.

[13] The drop from 13,080 households to 10,296 households is a consequence of missing data on some of the exogenous variables.

TABLE 2

Sample selection and data cleaning

Criterion	*Number of households*	*Number of observations*
Whole sample	30,133	148,482
Less than 4 qrts of participation	(9,977)	(17,760)
<25 or >60 years old	(6,573)	(45,635)
Single	(503)	(3,239)
Final sample	13,080	81,848
Differences	10,296	42,869

TABLE 3

Summary statistics

	Whole sample		*Selected sample*		*Mean*	
Variable	*Mean*	*SD*	*Mean*	*SD*	*Difference*	*P-value*
Economics variables						
c_{it} (real non-durable consumption)	€2,894	€1,958	€3,278	€1,918	€384	0.000
r_{it} (real interest rate)	10.7%	3.6%	10.7%	3.6%	0.06%	0.000
y_{it} (real income)	€53,270	€12,212	€13,673	€12,233	€1404	0.000
Socio-demographic variables						
nadult	2.8	1.3	3.1	1.2	0.3	0.000
nchildren	2.1	1.3	1.6	1.4	0.5	0.000
age	52.8	15.4	44.4	9.6	8.5	0.000
hsex (male)	82%	34%	90%	35%	7.9%	0.000
drura	28%	45%	26%	43%	2.5%	0.000
dheduc	8.0%	27%	9.1%	28%	1.2%	0.000
Reference group	No. of groups		Mean size		Median size	
	584		4.65		4	

sample is younger, more urban and educated, and has fewer children than the original sample. This is consistent with overall demographic trends in Spain and with the fact that the group of oldest households is much more numerous than the youngest group. All these differences in mean are significant and therefore our results are only relevant for the age groups represented in our selected sample.

IV. Identification and empirical strategy

The estimation of our empirical model presents several challenges that influence our strategies and choice of techniques. The life-cycle literature on consumption has identified several factors that affect the level of satisfaction derived from a given bundle of consumption, and hence the optimal consumption path. For instance, Attanasio and Browning (1995) highlight several observable demographic characteristics and Carrasco *et al.* (2005) show the importance of controlling for time-invariant unobserved heterogeneity across house-

holds while estimating Euler equations. Following this work, we use the taste-shifters from our theoretical model (ψ_{it}) to capture these household-specific factors. These factors include a set of observables: age (age_{it}) and age-squared (age_{it}^2) of the head of the household, number of adults ($nadult_{it}$) and number of children ($nchild_{it}$) in the household. We also allow for unobservable household specific tastes (which we assume to be constant) by introducing fixed family effects (ω_i) and a purely random error term (v_{it}). As a result,

$$\psi_{it} = \beta_1 age_{it} + \beta_2 age_{it}^2 + \beta_3 nadult_{it} \beta_4 nchild_{it} + \omega_i + v_{it} \tag{9}$$

Furthermore, as Attanasio and Low (2004) point out, under rational expectations the average of equation (8) across time is zero for each household, but in the presence of macroeconomic shocks the cross-sectional mean of these deviations could differ from zero at any point in time. Nonetheless, under the assumption that aggregate shocks affect all families in a similar way, we capture the effects of these shocks by introducing annual and quarterly dummies in our estimation equation, λ_t.[14]

Finally, Deaton (1992) questions the standard assumption on the separability between consumption and leisure that underlies our theoretical model. If consumption and leisure are non-separable, the marginal utility of consumption depends on the level of leisure and, as a result the change in consumption depends on the change in leisure. For instance, households with more workers are likely to spend more resources on travel to work, on clothes, or on meals eaten away Attanasio and Weber (1995). Although the ECPF does not include any measure of hours worked, we try to attenuate the effects of this potential non-separability by controlling for the change in labour market status (ΔLM_{it}), arguably a rough measure of the change in hours worked.[15] As a result equation (8) becomes,

$$\Delta c_{it} = \mu_i + \frac{1}{\sigma} r_{it} + \gamma \Delta_{\bar{c}_{it}} + \theta \Delta_{c_{it-1}} + \beta' \Delta \psi_{it} + \lambda_t + \beta_5 \Delta LM_{it} + \epsilon'_{it} \quad E_{t-1}(\epsilon'_{it}) = 0 \tag{10}$$

To sum up, our methodology attempts to take care of heterogeneity in observable family characteristics, heterogeneity in unobservable time-invariant tastes, the effects of aggregate shocks and seasonal differences in consumption and labour market participation.

Although our estimation equation seems to include most of the factors that the literature highlights as determinants of consumption growth, we still face two problems when trying to estimate equation (10) even under rational expectations. First, unobservable individual effects may be correlated with the lag in consumption growth. Second, there may be some correlation between our regressors and the error term. For example, the real interest rate and the change in labour market status are unknown at time t, and therefore likely to be correlated with the forecast error. Additionally, like with other consumption data,

[14] Although it is equivalent to market completeness, our assumption about the effects of aggregate shocks is somewhat less restrictive. Furthermore, using PSID data, Runkle (1991) finds that aggregate shocks are not very important for individual consumption choices. Collado (1998) obtains a similar result using the ECPF. Similarly, Pischke (1995) finds that aggregate fluctuations account for a very small share of individual uncertainty. The former two authors suggest that time dummies properly capture the effects of aggregate shocks, which are not captured by fluctuations in the interest rate. See also Altug and Miller (1990) for an alternative interpretation of the coefficients on time dummies. Finally, the quarterly dummies also allow controlling for seasonal patterns in consumption data (Browning and Collado, 2001).

[15] Kiley (2010), using techniques that are robust in the presence of weak instruments, finds little support for non-separable preferences between consumption and leisure in explaining consumption fluctuations.

TABLE 4

Consumption autocorrelations

	Δc_{it}	Δc_{it-1}	Δc_{it-2}	Δc_{it-3}
Δc_{it}	1.0000			
Δc_{it-1}	−0.4506*	1.0000		
Δc_{it-2}	−0.0220*	−0.4475*	1.0000	
Δc_{it-3}	−0.0394*	−0.0195*	−0.4507*	1.0000
	c_{it}	Δc_{it-1}		
$\bar{c}_{it}$	0.2163*			
$\Delta \bar{c}_{it}$		−0.0181*		

Notes: *$P < 0.05$.

measurement errors are likely to be prevalent in our habit and envy variables.[16] Table 4 reports a negative autocorrelation in consumption growth that suggests the presence of measurement error and possibly the effects of time averaging of the data Heaton (1993). We can deal with the first problem by first differencing equation (10), though we generate an error with an order-one moving-average structure, which is correlated with the first difference of lagged consumption growth.[17] The second problem will require the use of instrumental variables.

Equation (10) contains several endogenous regressors; in particular, the real interest rate, the change in labour market status, the growth rate of consumption and, possibly, our measure of envy. Under the restrictions imposed by rational expectations, any variable known at time t will be orthogonal to the error term, and thereby a valid instrument. The high level of persistence of these endogenous regressors suggests that lagged variables should perform well as instruments. This point has been stressed by Arellano and Bond (1991) and Arellano and Bover (1995) becoming the standard criterion for the selection of instruments in the estimation of consumption Euler equations (see, for instance, Dynan, 2000; Carrasco *et al.*, 2005; Maurer and Meier, 2008). As a result, apart from all the exogenous variables, we use the lag of the household-specific real interest rate, the lag of labour market status of the head of the household, the lags of the number of adults and number of children and the second lag of the growth rate of consumption of the reference group as instruments.[18] In addition to the first-stage regressions, we report various tests of

[16] Notice that our envy variable is calculated as the (log) average of the individual levels of consumption within a census tract (excluding the household of interest). Therefore, if measurement error is classical and the tract is large enough, these errors will cancel out through the averaging process. Nevertheless, since the average census tract contains five households, caution suggests that we should work under the assumption that measurement error might still be an issue for our envy variable.

[17] It is also possible that the unobservables ϵ'_{it} are correlated within group, and thereby correlated with ΔC_{it-1}. Under the assumption that these group-specific shocks are time-invariant, we can control for them adding group dummies into equation (10). However, the first difference of the resulting equation would be identical to that of equation (10). Furthermore, our robustness checks control for the unemployment rate at the census tract level that is likely to capture the effects of time-varying group-specific shocks.

[18] Notice that the autocorrelation induced by time-aggregation and measurement errors requires the use of, at least, the second lag as an instrument.

TABLE 5

Heterogeneity in observables characteristics within and across reference groups

Pairing of heads of households in	*Age*	*No. of children*	*Income*	*Education*	*Occupation*
	% of pairing with same characteristics				
Same reference group	29.3	25.2	33.2	53.2	47.3
	(2.3)	(3.1)	(2.3)	(3.3)	(2.1)
Different ref. group same city size	26.1	22.4	29.6	48.1	43.9
	(2.5)	(2.1)	(3.6)	(2.1)	(1.9)
Different ref. group	21.3	24.1	29.2	44.1	43.2
	(2.9)	(2.2)	(3.3)	(2.9)	(2.4)

Notes: Standard errors in parentheses.

under-identification, over-identification and weak instruments that cannot reject the validity of our set of instruments, as we will discuss in the next section.[19]

Finally, Manski (1993) discusses the confounding difficulties associated with the estimation of the (endogenous) effect of peer-group's behaviour on individual choices (in our context, the effect of $\Delta\bar{c}_{it}$ on Δc_{it}). He argues that, in addition to the endogenous effect, individuals in the same group may behave similarly because of common exogenous or socio-economic characteristics of the group (exogenous effect) or because they have similar individual unobservable characteristics or face the same shocks (correlated effect). To deal with the exogenous effect we follow two alternative strategies. First, we include the mean of socio-economic characteristics of the reference group as control variables (number of adults, number of children, age and educational level). Second, we explore the degree of heterogeneity in the (observable) characteristics of the households within and across reference groups using a simple exercise. We randomly draw a household in each reference group in a given period. Then, we pair the head of that household with the head of another household, also randomly selected, from (i) the same reference group, (ii) a different reference group and (iii) a different reference group controlling for the size of the municipality of residence. We repeat this experiment 10,000 times. Table 5 reports the percentage of such pairings with the same characteristics between (1) and (2) (and (1) and (3)). Among the pairs of household heads in the same reference groups, roughly one-fourth of them were in the same age group and had the same number of children. About one-third were in the same income bracket and half of them shared the same levels of education and occupational category. The pairing of household heads in different reference groups yields only slightly lower percentages. For example, 29.3% of the pairings within the same reference groups had the two household heads in the same age group, while 26.1% of them were in the same age group for the pairings of heads from different reference groups in municipalities of similar size that those of the household in question. The results, therefore, suggest that although household heads in the same reference groups were more likely to share some common characteristics than those in different reference groups, the difference is small and not statistically significant.[20] Finally, to attenuate the impact of common

[19] We have experimented including other instruments such as c_{it-3}, age_{it-1} *a*nd age^2_{it-1} in our regressions. However, they failed the difference-in-Sargan C-test suggesting that they are not a valid set of instruments.

[20] The non-linearity between Δc_{it} and $\Delta\bar{c}_{it}$ in our model further attenuates the impact of the endogenous effect. But, in general, in the absence of correlated effects, the endogenous effect will be identified when the exogenous

shocks at the census tract level, correlated effects, we include the local unemployment rate and the average interest rate faced by the reference group as additional regressors.

V. Empirical findings

Our basic results are presented in Table 6. The first column reports OLS estimates. The second column reports OLS estimates obtained in first differences that account for unobserved heterogeneity. In line with Carrasco *et al.* (2005), the comparison of these results, which are only valid if the regressors are strictly exogenous, suggests the importance of correlated fixed effects. Columns 3–6 report GMM and LIML estimates where we control for the endogeneity of the regressors. In column 3, we restrict to a model with only envy while in column 4 we restrict to a model with only habits. Columns 5 and 6 allow for both envy and habits. In all cases standard errors are clustered at the census tract level.

To test the validity of our instrument set we conduct tests for under-identification, over-identification and weak instruments. The model is not rejected either by the Kleibergen–Paap LM statistic or the Hansen J statistic.[21] The statistic for the Kleibergen–Paap LM test has a value of 21.49 (chi-square with 2 degrees of freedom) rejecting the null hypothesis of under-identification at any level of significance. Figures of Hansen J statistic of over-identifying restrictions (0.377 for the GMM estimation and 0.373 for the LIML with 1 degree of freedom) suggest the null of validity of the instruments is not rejected, the instruments are uncorrelated with the error term, and the excluded instruments are correctly so. Our set of instruments passes the under-identification and over-identification tests, but GMM regressions still might suffer from the weak instruments problem, Staiger and Stock (1997). If this is the case, the sampling distribution of GMM statistics is non-normal and standard GMM point estimates, hypothesis tests and confidence intervals are unreliable. Table 7 and Table A1 reports a summary of the results for the first-stage regressions to check weak identification that arises when the excluded instruments are correlated with the endogenous regressors, but only weakly.

For multiple endogenous variables, inspection of the standard first-stage F-statistics is no longer sufficient and the conditional F-statistic is required, Sanderson and Windmeijer (2014).[22] These results suggest that the instruments are not weak for any of our endogenous regressors. Finally, as an additional check of the adequacy of the GMM estimates, we have also computed the LIML estimation, which performs better than other methods under weak instruments, without finding significant differences with our GMM estimates. Taking together this evidence suggests that, once one accounts for the potential effects of unobserved heterogeneity, misspecification, if any, does not seem to be severe.

characteristics of the reference group do not affect individual behaviour. Appendix D shows, in a simplified linear version of our model, that this is the case for equation (10) as long as $\Delta\bar{c}_{it-1}$ does not enter directly into our estimation equation, i.e. if the frequency of the data induces a contemporaneous relation between the consumption of an individual and her reference group rather than a lagged one. Ravina (2008), using quarterly data, introduces the lag of envy in her basic regression and finds that the estimated coefficient is not statistically different from zero.

[21] We have also conducted the C-statistic which proves the goodness of an excluded subset of instruments (the first lag of the difference of number of children and number of adults) reject the null hypothesis that both the smaller set of instruments and the additional are valid.

[22] Sanderson and Windmeijer (2014) conditional F-test is similar to the one proposed by Angrist and Pischke (2008), but takes the variance of the multiple equations into account for testing a rank reduction on one of the matrix of reduced from parameters.

TABLE 6

Basic estimation

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
Variables	*OLS*	*FD-OLS*	*FD-GMM1*	*FD-GMM2*	*FD-GMMZ*	*FD-LIML*
$\Delta\bar{c}_{it}$	0.091***	0.067***	0.159**		0.300**	0.309**
	(0.008)	(0.008)	(0.081)		(0.133)	(0.135)
Δc_{it-1}	−0.444***	−0.636***		0.374*	0.334*	0.341*
	(0.005)	(0.005)		(0.218)	(0.200)	(0.203)
r_{it}	−0.000	0.020***	0.053**	0.087**	0.089**	0.089**
	(0.002)	(0.007)	(0.021)	(0.036)	(0.035)	(0.035)
$\Delta nadult$	0.095***	0.043***	0.070***	0.073***	0.073***	0.073***
	(0.008)	(0.009)	(0.015)	(0.018)	(0.018)	(0.018)
$\Delta nchildren$	0.067***	0.036***	0.052***	0.057**	0.060**	0.064***
	(0.010)	(0.012)	(0.019)	(0.023)	(0.023)	(0.024)
ΔAge	0.028*	0.021	0.025	0.033	0.029	0.028
	(0.017)	(0.018)	(0.030)	(0.040)	(0.038)	(0.038)
ΔAge^2	−0.228	−0.168	−0.149	−0.207	−0.167	−0.159
	(0.179)	(0.204)	(0.339)	(0.446)	(0.427)	(0.429)
Labour Change	−0.019**	−0.013	0.016	−0.002	0.007	0.004
	(0.008)	(0.009)	(0.023)	(0.031)	(0.030)	(0.031)
Number of observations	55,778	42,869	30,499	30,499	30,499	30,499
Number of households			10,296	10,296	10,296	10,296
R^2	0.216	0.422	0.101	0.608	0.535	0.551
Kleibergen–Paap LM statistics						
Under-identification test		112.5***	19.87***	21.49***	21.49***	
Hansen J statistic						
Over-identification test			4.933***	0.458***	0.377***	0.373***
C-statistic+					0.377***	0.373***

Notes: Clustered Standard Errors in parentheses. ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$.
Instrumented variables: Δc_{it-1}, $\Delta\bar{c}_{it}$, Labour Change and r_{it}
Instruments sets: r_{it-1}, $\Delta\bar{c}_{it-2}$, $\Delta nadult_{it-1}$, $\Delta nchildren_{it-1}$ and $LabourChange_{it-1}$
Excluded variables in the C-statistic: $\Delta nadult_{it-1}$, $\Delta nchildren_{it-1}$
Seasonal and annual dummies are included in all the regressions.

Now, we turn to the interpretation of our results. At first glance our estimates have the sign predicted by theory and their magnitudes lie in reasonable ranges. Additionally, the robust standard errors reported in parentheses suggest that most of the coefficients of interest are estimated with reasonable precision. As Angrist (2013) points out, one of the concerns with exercises aimed at inferring the effect of a group variable, the change in consumption of the reference group, on the same individual variable, the change in individual consumption, is that the coefficient would be mechanically one if the former is the mean of the latter. Comparison of the estimates of envy and habits across columns 3, 4 and 5 suggests that this is not an issue in our case.[23] Our estimate for the coefficient on the real interest rate, the intertemporal elasticity of substitution, is around 0.09 with a standard

[23] This result is robust to specifications that only include envy or habits without any other additional regressors.

TABLE 7

Weak instruments first-stage F-statistics tests

	Standard first-stage			*Sanderson and Windmeijer*		
Variables	*F-stat*		*P-value*	*Conditional F-stat*		*P-value*
r_{it}	F_1	548.85	0.000	$F_{1\|2,3,4}$	3328.98	0.000
$\Delta\bar{c}_{it}$	F_2	35.66	0.000	$F_{2\|1,3,4}$	194.86	0.000
Δc_{it-1}	F_3	13.28	0.000	$F_{3\|1,2,4}$	29.013	0.000
Labour Change	F_4	648.46	0.000	$F_{4\|1,2,3}$	7805.90	0.000

Notes: The Stock and Yogo (2005) weak instrument critical values have been used for the conditional *F*-statistics.

error of 0.035.[24] This estimate is similar to previous values found under interdependent preferences, for instance Maurer and Meier (2008) finds an intertemporal elasticity of substitution of 0.1. The coefficients on the number of adults and children are both positive and highly significant throughout all our specifications. As expected, the former point estimate is larger than the latter. Our coefficients on age and age-squared are both significant and consistent with the hump-shaped profile of consumption through the life cycle documented by Attanasio and Browning (1995) among others. The coefficient on the change in labour market status is not statistically different from zero and when we drop labor market status the explanatory power of the model remains unchanged. This suggests that either non-separabilities are not very relevant in our sample or that our labour market variable, which only includes changes in labour market status rather than in hours worked, does not exhibit enough variability to precisely estimate their effects. Similar to previous studies that use our data set, such as Collado (1998), aggregate shocks do not seem to be very important for individual consumption choices since there are no significant differences among the magnitude of the (non-reported) time dummies.

When we use OLS (columns 1 and 2), ignoring measurement errors and endogeneity, the resulting estimates of envy and habits present biases consistent with the problems discussed in the previous section. On the one hand, our coefficient of habits has the opposite sign than expected as a result of the negative autocorrelation induced by measurement errors or time averaging of consumption data. On the other hand, our coefficient of envy, although positive and significant, is relatively small, and therefore of limited economic interest. Once we instrument our endogenous regressors, using GMM (column 5) and LIML (column 6), our estimates for envy and habits reveal the importance of preference interdependence for individual consumption choices. The coefficient on the change in consumption of the reference group, our measure of envy, is in the order of 0.30 and statistically significant at the 5% level. The coefficient on the change in past individual consumption, our measure of habits, is around 0.33 and significant at the 10% level. In order to interpret the economic meaning of these coefficients, it is helpful to think in terms of the multiplicative specification of consumption services discussed in Appendix A. In this context, consumption services can be expressed as a weighted average of the absolute

[24] Notice that, as long as the intertemporal elasticity of substitution is small, the estimates on the envy and habit parameters from the additive specification, (8), have the same magnitudes as the ones derived from the multiplicative specification presented in Appendix A (see equation (A1–A3)).

(current) level of consumption, the level of consumption relative to the reference group and the current level of consumption relative to the past level of consumption where the weights are given by our estimates of envy and habits. Specifically, our estimates suggest that, on average, households derive one third of their consumption services from comparisons between their consumption and that of their neighbours, another third of these services from comparisons between their current and past consumption, with the remaining third being determined by their current level of consumption.

Now, we compare our estimates of habits and envy with previous results. Meghir and Weber (1996), using the US CEX, and Dynan (2000), using the PSID, do not find evidence of habit formation. In the first study, the short time dimension of the CEX does not allow to control for time-invariant unobserved heterogeneity. Carrasco *et al.* (2005), using the ECPF, find that when time-invariant unobserved heterogeneity across households is not taken into account preferences seem to be intertemporally separable. However, once fixed effects are controlled for, their results provide strong evidence of habit formation for food consumption and services, with estimates of 0.7 and 0.14 respectively. Contrary to Naik and Moore (1996), Dynan (2000) does not find evidence of habit formation in her analysis of food consumption. As argued by Ravina (2008) this failure to detect habit formation may arise from the limited set of instruments available to Dynan, particularly the absence of a household-specific interest rate. Ravina (2008) reports an estimate for habit formation in the range of 0.5 and one for envy close to 0.3. Our estimate for envy is of the same magnitude, while that of habits is slightly smaller. Finally, and despite of the fact that they define their reference groups in terms of socio-demographic, as opposed to geographic, characteristics, our estimates of envy are consistent with those reported by Maurer and Meier (2008) that range from 0.11 to 0.44. This last study proposes a social multiplier approach to disentangle true consumption externalities from merely correlated effects.

It is also reassuring that our estimates on envy are of similar magnitude as those found recently by the experimental literature. For instance, the experiments reported by Alpizar, Carlsson and Johansson-Stenman (2005) suggest a average degree of envy that varies between 0.2 and 0.5 depending on the characteristics of the consumption good.

VI. Some robustness checks and additional results

In this section, we explore the extent to which our results are driven by the exogenous or correlated effects discussed by Manski (1993), we assess the impact of the inclusion of alternative reference groups following the work of Maurer and Meier (2008), and we provide some preliminary evidence on the role played by the variation in the degree of visibility of different consumption categories on the envy coefficient along the lines suggested by Quintana-Domeque and Turino (2013).

First, we explore the robustness of our estimate of envy to the problems discussed by Manski (1993), particularly the presence of exogenous and correlated effects. The former refers to instances where similar behaviour within a group results from common exogenous characteristics of the group while the latter refers to the case where similar behaviour is driven by common shocks at the group level. To control for exogenous effects, column 2 of Table 8 includes as additional regressors the averages of the observable characteristics of the

TABLE 8

Robustness check I: The reflection problem

Variables	*(1)* *Baseline*	*(2)* *Exogenous effect*	*(3)* *Correlated effect*	*(4)* *Exogenous effect + correlated effect*
$\Delta\bar{c}_{it}$	0.300**	0.305**	0.304**	0.308**
	(0.133)	(0.136)	(0.133)	(0.136)
Δc_{it-1}	0.334*	0.330*	0.332*	0.329*
	(0.200)	(0.198)	(0.199)	(0.197)
r_{it}	0.089**	0.089**	0.090**	0.090**
	(0.035)	(0.035)	(0.035)	(0.035)
$\Delta nadult$	0.073***	0.073***	0.072***	0.072***
	(0.018)	(0.018)	(0.018)	(0.018)
$\Delta nchildren$	0.060**	0.060**	0.060**	0.059**
	(0.023)	(0.023)	(0.023)	(0.023)
ΔAge	0.029	0.029	0.029	0.030
	(0.038)	(0.038)	(0.038)	(0.038)
ΔAge^2	−0.167	−0.173	−0.170	−0.176
	(0.427)	(0.425)	(0.426)	(0.424)
Labour Change	0.007	0.008	0.007	0.008
	(0.030)	(0.030)	(0.030)	(0.030)
$\Delta\overline{nadult}$		−0.045		−0.046
		(0.036)		(0.036)
$\Delta\overline{nchildren}$		−0.013		−0.012
		(0.025)		(0.025)
$\Delta\overline{Age}$		0.002		0.002
		(0.002)		(0.002)
$\Delta\overline{EducationLevel}$		−0.005		−0.008
		(0.017)		(0.017)
$\Delta\overline{UnemploymentRate}$			−0.075	−0.079
			(0.052)	(0.052)
$\bar{r}_{it}$			−0.030*	−0.028*
			(0.016)	(0.016)
Observations	30,499	30,499	30,499	30,499
R^2	0.535	0.529	0.532	0.526
Number of households	10,296	10,296	10,296	10,296
Kleibergen–Paap LM statistics				
Under-identification test	21.49***	21.72 * * *	21.55***	21.78***
Hansen J statistic				
Over-identification test	0.539***	0.513***	0.575***	0.549***

Notes: Clustered and robust standard errors in parentheses. ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$.
Instrumented variables: Δc_{it-1}, $\Delta\bar{c}_{it}$ and Labour Change, r_{it}.
Instruments sets: r_{it-1}, $\Delta\bar{c}_{it-2}$, $\Delta nadult_{it-1}$, $\Delta nchildren_{it-1}$ and $LabourChange_{it-1}$.
Seasonal and annual dummies are included in all the regressions.

TABLE 9

Robustness checks II: Alternative reference groups

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Variables	*Baseline*	*Socio-demographics ref. group*	*Socio-demogeograph. ref. group*	*Random ref. group*	*Random + geo. ref. group*
Δc_{it-1}	0.334*	0.265	0.292	0.409	0.321
	(0.200)	(0.240)	(0.185)	(0.257)	(0.205)
$\Delta \bar{c}_{it}$	0.300**		0.268**		0.276**
	(0.133)		(0.123)		(0.132)
$\Delta \bar{c}_{it_{sociodemographics}}$		−0.136	−0.015		
		(0.190)	(0.028)		
$\Delta \bar{c}_{it_{random}}$				0.177	−0.009
				(0.130)	(0.013)
Observations	30,499	29,774	30,046	26,599	27,783
Number of households	10,296	10,094	10,187	9,367	9,744
R^2	0.535	0.401	0.454	0.698	0.504

Notes: Clustered and robust standard errors in parentheses. $^{**}P < 0.05$, $^{*}P < 0.1$.
Instrumented variables: Δc_{it-1}, $\Delta \bar{c}_{it}$, Labour Change and r_{it}.
Instruments sets: r_{it-1}, $\Delta \bar{c}_{it-2}$, $\Delta nadult_{it-1}$, $\Delta nchildren_{it-1}$ and $LabourChange_{it-1}$.
Seasonal and annual dummies are included in all the regressions.
All estimations include the interest rate, the demographic and labour market control variables and seasonal and annual dummies.
The different sample size in the estimation is due to the construction of the log of consumption for the new reference groups.

reference group, including the number of adults, number of children, age and educational level. The resulting estimate of envy barely changes suggesting that our baseline result does not seem to be driven by exogenous effects.

In order to assess the impact of common shocks at the census tract level, column 3 of Table 8 includes measures of the unemployment rate and the interest rate of the reference group. Once more, the robustness of our envy estimate seems to suggest that local shocks, to the extent that they are captured by our two measures of local economic activity, are not responsible for the co-movement in the changes of individual consumption within reference groups reported in our baseline estimation. The last column of Table 8 combines both exercises including the averages of the observable characteristics of the reference group and the local measures of economic activity. As expected, the coefficient of envy remains consistent with that of our baseline specification.

Second, we conduct several additional checks using alternative reference groups. We report these results in Table 9. First, along the lines of Maurer and Meier (2008), we construct a reference group using socio-demographic characteristics. In particular, we use sex, education, age, employment status, location of the household and number of children to create 128 reference groups.[25]

[25] The educational variable distinguishes primary education and below from secondary education and above; age considers the age of the head of household in the following intervals [25–35], [36–45] and [46–60]; employment status discriminates between employed and self-employment; the location variable separates rural from urban households and the number of children distinguish families with one children or less from the rest of families.

Column 2 reports the estimated envy coefficient replacing our geographical reference group with the socio-demographic one. The estimated coefficient for this alternative reference group is not significant. In Column 3, we consider both reference groups simultaneously. The socio-demographic one still remains insignificant while the coefficient on the geographical reference group does not change neither magnitude nor significance from our baseline exercise. This suggests our characterization of the reference group is sensible. Second, since one can argue that the estimated effect of envy on individual consumption might be spurious, we randomly allocate a reference group to each household from a pool that excludes its own geographical reference group. Column 4 reports the average coefficient for envy after running 1,000 replications using this random reference group while Column 5 reports the estimates for envy using both the random reference group and the geographical one. These results are reassuring for our baseline specification. The coefficient on the random reference group is not significant while the coefficient on the geographical one maintains the same size and significance than our baseline estimation.

Finally, in a recent paper Quintana-Domeque and Turino (2013) highlight the importance of differences in the degree of visibility of consumption categories for interpersonal comparisons. Along these lines the work of Charles *et al.* (2009) and Heffetz (2011) provide direct empirical evidence on the importance of visibility for conspicuous consumption. The former document a positive relationship between visible consumption (jewels, clothes and cars) and reference group income, while the latter finds that income elasticities of demand increase with the degree of visibility of different consumption categories. In order to preserve a framework that exploits the restrictions imposed by optimality on the time path of consumption and that at the same time allows for a meaningful examination of the role of visibility we need to impose one additional assumption. Specifically, we need to assume separability between visible and non-visible consumption categories. Since this assumption might be debatable we believe the results of this exercise should be taken with caution. Our goal is to estimate separate versions of equation (10) for visible and non-visible consumption goods. We classify consumption categories using the visibility index elaborated by Heffetz (2011). This index ranks 30 consumption goods in terms of visibility where 1 is the most visible one. Our measure of visible consumption includes expenditures on tobacco, clothing, leisure and recreational activities and alcohol. These categories rank first, third, sixth and eighth in Heffetz's ranking. Our measure of non-visible consumption includes the remaining non-durable consumption expenditures including educational expenditures, food and health among others. Table 10 reports the results of this exercise.

When our estimation is restricted to visible goods the coefficient on envy increases above 0.4 becoming almost three times the size of the one obtained for non-visible goods.[26,27] This preliminary analysis suggests important variations in the degree of envy across consumption categories. As suggested by Quintana-Domeque and Turino (2013), these variations depend on how visible consumption goods are.

[26] The coefficient on habit formation changes much less across the two specifications, although it only maintains its statistical significance when non-visible goods, which include food, are considered. This aligns well with the results of Carrasco *et al.* (2005) that find evidence of habit formation on food consumption.

[27] These results are consistent with recent work by Quintana-Domeque and Wohlfart (2014) that using UK household data on food consumption find no evidence of relative concerns.

TABLE 10

Visible and non-visible consumption

	(1)	*(2)*	*(3)*
Variables	*Baseline*	*Visible goods*	*Non-visible goods*
Δc_{it-1}	0.334*	0.352	0.248*
	(0.200)	(0.263)	(0.148)
$\Delta \bar{c}_{it}$	0.300**	0.385**	0.136
	(0.133)	(0.187)	(0.103)
Number of observations	30,499	29,543	30,494
Number of households	10,296	10,063	10,294
R^2	0.535	0.570	0.351

Notes: Clustered and robust standard errors in parentheses. $^{**}P < 0.05$, $^{*}P < 0.1$.
Instrumented variables: Δc_{it-1}, $\Delta \bar{c}_{it}$, Labour Change and r_{it}.
Instruments sets: lag r_{it}, $\Delta \bar{c}_{it-2}$, lag $\Delta nadult$, lag $\Delta nchildren$ and lag *LabourChange*.
Excluded variables in the C-statistic: lag of $\Delta nadult$, lag $\Delta nchildren$.
Seasonal and annual dummies are included in all the regressions.
All estimations include the interest rate, the demographic and labour market control variables and seasonal and annual dummies.
Visible goods include alcoholic drinks, tobacco, clothing and footwear, expenditure in leisure and education and non-visible food at home, energy for housing, health and transport expenditures.

VII. Conclusions

In recent years, there has been a growing interest in preference specifications that allow for non-separabilities across time and individuals. We have used data on consumption choices to explore the empirical relevance of these specifications. Our estimates of envy and habits are not only statistically significant but also economically important suggesting that a proper understanding of individual consumption choices requires taking into account at least a partial history of individual consumption choices and the choices of others. As Attanasio (1999) points out 'it is from consumption that, in all likelihood, utility and welfare are in large part determined' and along these lines our estimates suggest that if we define preferences over consumption services, households derive almost one third of these services from comparisons between their consumption and that of their neighbours, another third from comparisons between their current and past consumption, with the remaining third being determined by their current consumption choices.

Our results, derived from explicit consumption choices, complement the large body of empirical evidence that stresses the importance of interpersonal comparisons for self-reported well-being that dates back, at least, to Easterlin (1974). Furthermore, our results have important policy implications. On the one hand, a proper characterization of the determinants of consumption services is crucial for the type of welfare analyses popularized after Lucas (1987). On the other hand, it is well known that the presence of consumption externalities, envy, distorts the marginal rate of substitution between consumption and other sources of utility, such as leisure (Liu and Turnovsky, 2005), human capital formation

(Moav and Neeman, 2010), bequests (Alvarez-Cuadrado and Van Long, 2011) or effort in the extraction of non-renewable natural resources (Alvarez-Cuadrado and Long, 2012). As a result envious households tend to over-consume at the expense of those other activities,[28] i.e. working longer hours, accumulating too little human capital, reducing their saving for bequest motives or exhausting the natural resource. Along these lines, our estimates, together with those of Ravina (2008) and Maurer and Meier (2008), provide a valuable guide for the design of optimal fiscal interventions to internalize the impact of envy, as discussed by Wendner and Goulder (2008).

Appendix A: A model with multiplicative interdependencies

Following Abel (1990) and Carroll *et al.* (2000) consider the problem explored in section II under the assumption that the consumption services for the i-th household in period t are given by the following multiplicative specification of consumption services,

$$\tilde{C}_{it} = \frac{C_{it}}{C_{it}^{-\gamma} C_{it-1}^{\theta}} = \left(C_{it}\right)^{1-\gamma-\theta} \left(\frac{C_{it}}{\bar{C}_{it}}\right)^{\gamma} \left(\frac{C_{it}}{C_{it-1}}\right)^{\theta} \tag{A1}$$

Combining equation (1) with (6) the solution to this programme yields an Euler equation that relates current and past consumption of the household and her reference group according to,

$$1 = \beta_i E_{t-1} \left[\left(\frac{C_{it}}{C_{it-1}}\right)^{-\sigma} \left(\frac{\bar{C}_{it}}{\bar{C}_{it-1}}\right)^{-\gamma(1-\sigma)} \left(\frac{C_{it-1}}{C_{it-2}}\right)^{-\theta(1-\sigma)} R_{it} \right] \tag{A2}$$

Considering a log-linear approximation and assuming expectations are formed rationally we reach,

$$\Delta c_{it} = \mu_i + \frac{1}{\sigma} r_{it} + \frac{\gamma(\sigma-1)}{\sigma} \Delta \bar{c}_{it} + \frac{\theta(\sigma-1)}{\sigma} \Delta c_{it} + \Delta \psi_{it} + \epsilon_{it} \quad \text{where } E_{t-1}(\epsilon'_{it}) = 0 \tag{A3}$$

which is the multiplicative counterpart of our basic estimation equation.

Appendix B: Derivation of equation (5)

Under the assumption that the interest rate is constant, we follow Deaton (1992) to express equation (4) as a second order difference equation using the lead operator, F, as follows

$$u_{it}^{\tilde{C}} - \beta_i(\theta + R_i) E_t[F u_{it}^{\tilde{C}}] + \beta_i^2 \theta R_i E_t[F^2 u_{it}^{\tilde{C}}] = u_{it}^{\tilde{C}} (1 - \beta_i R_i E_t[F])(1 - \beta_i \theta E_t[F]) = 0 \tag{B1}$$

I can rule out the unstable solution associated with the second root using the transversality condition, since $\beta_i \theta > 0$. The stable solution that corresponds to the first root is equivalent to equation (5).

[28] Arrow and Dasgupta (2009) identify the structure of the utility functions for which concerns for relative consumption lead to over-consumption, defined as the difference between the socially efficient level of consumption and its competitive counterpart. Their characterization requires that all goods are visible. Quintana-Domeque and Turino (2013) relax this assumption allowing for the distinction between visible and non-visible goods. In this context, the competitive and socially optimal marginal rates of substitution between these two types of goods always differ.

Appendix C: Derivation of equation (8). Log-Linear Approximation of equation (7)

Starting from equation (7)

$$\beta_i E_{t-1}\left[R_{it}e^{\psi'_{it}-\psi'_{it-1}}\left(\frac{\tilde{C}_{it}}{\tilde{C}_{it-1}}\right)^{-\sigma}\right]=1 \tag{C1}$$

working inside the expectation in equation (4), defining $\ln X_t = x_t$ and linearizing around $x = x^*$ where * denote steady-state values, that by definition are constant or growing at a constant rate we reach

$$\begin{aligned}&\left[R_{it}e^{\psi'_{it}-\psi'_{it-1}}\left(\frac{\tilde{C}_{it}}{\tilde{C}_{it-1}}\right)^{-\sigma}\right]=e^{\Delta\psi'_{it}}e^{r_{it}}e^{-\sigma\tilde{c_{it}}+\sigma\tilde{c}_{it-1}}\simeq e^{\Delta\psi'^{*}_{i}+r^{*}_{i}-\sigma\tilde{c}^{*}_{it}+\sigma\tilde{c}^{*}_{it-1}}+\\ &e^{\Delta\psi'^{*}_{i}+r^{*}_{i}-\sigma\tilde{c}^{*}_{it}+\sigma\tilde{c}^{*}_{it-1}}\left(\Delta\psi'_{it}-\Delta\psi'^{*}_{i}\right)+e^{\Delta\psi'^{*}_{i}+r^{*}_{i}-\sigma\tilde{c}^{*}_{it}+\sigma\tilde{c}^{*}_{it-1}}\left(r_{it}-r^{*}_{i}\right)\\ &-\sigma e^{\Delta\psi'^{*}_{i}+r^{*}_{i}-\sigma\tilde{c}^{*}_{it}+\sigma\tilde{c}^{*}_{it-1}}\left(\tilde{c}_{it}-\tilde{c}^{*}_{it}\right)+\sigma e^{\Delta\psi'^{*}_{i}+r^{*}_{i}-\sigma\tilde{c}^{*}_{it}+\sigma\tilde{c}^{*}_{it-1}}\left(\tilde{c}_{it-1}-\tilde{c}^{*}_{it-1}\right)\end{aligned} \tag{C2}$$

Plugging equation (C2) in (4) and denoting the constant $k = e^{\Delta\psi'^{*}_{i}+r^{*}_{i}-\sigma\tilde{c}^{*}_{it}+\sigma\tilde{c}^{*}_{it-1}}$

$$1=\beta_i E_{t-1}[k+k(\Delta\psi_{it}-\Delta\psi'^{*}_{i})+k(r_{it}-r^{*}_{i})-\sigma k(\tilde{c}_{it}-\tilde{c}^{*}_{it})+\sigma k(\tilde{c}_{it-1}-\tilde{c}^{*}_{it-1})] \tag{C3}$$

using the Euler equation in steady-state, $1 = \beta_i k$ and plugging equation (C2) in (C3)

$$E_{t-1}[\Delta\psi'_{it}+r_{it}-\sigma(c_{it}-\gamma\bar{c}_{it}-\theta c_{it-1})+\sigma(c_{it-1}-\gamma\bar{c}_{it-1}-\theta c_{it-2})]=0 \tag{C4}$$

Rearranging equation (C4)

$$E_{t-1}[\Delta c_{it}]=\mu_{it}+\frac{1}{\sigma}E_{t-1}[r_{it}]+\frac{1}{\sigma}E_{t-1}[\Delta\psi'_{it}]+\gamma E_{t-1}[\Delta\bar{c}_{it}]+\theta E_{t-1}[\Delta c_{it-1}] \tag{C5}$$

that could be estimated as

$$\Delta c_{it}=\mu_{it}+1\sigma r_{it}+\frac{1}{\sigma}\Delta\psi_{it}+\gamma\Delta\bar{c}_{it}+\theta\Delta c_{it-1}+\epsilon_{it}\quad\text{where } E_{t-1}(\epsilon_{it})=0 \tag{C6}$$

defining $\psi'_{it} = \psi_{it}\sigma$

Appendix D: Derivation of model restrictions

Let us assume a general linear version of equation (10) is as follows,

$$\Delta C_{it}=\mu+1\sigma r_{it}+\gamma\Delta\bar{C}_{it}+\theta\Delta C_{it-1}+\eta_1\Delta\bar{C}_{it-1}+\eta_2\bar{r}_{it}+u_{it} \tag{D1}$$

where C_{it} is the household consumption (whereas c_{it} in equation (10) is the logarithm of household consumption) and $\Delta\bar{C}_{it}$ is the average consumption of the reference group, $\frac{1}{N_G}\sum_{j\in G}\Delta C_{jt}$, indexed by G (while in equation (10) is $\Delta\bar{c}_{it}$ is the change in the logarithm of the average consumption of the reference group, $\ln\left(\frac{1}{N_G-1}\sum_{j\in G-i}\Delta C_{jt}\right)$. This leads to

$$\begin{aligned}\Delta\bar{C}_{it} &= \mu + \frac{1}{\sigma}\bar{r}_{it} + \gamma\Delta\bar{C}_{it} + \theta\Delta\bar{C}_{it-1} + \eta_1\Delta\bar{C}_{it-1} + \eta_2\bar{r}_{it} + \bar{u}_{it} \\ &= \frac{\mu}{1-\gamma} + \frac{1/\sigma + \eta_2}{1-\gamma}\bar{r}_{it} + \frac{\theta + \eta_1}{1-\gamma}\Delta\bar{C}_{it-1} + \frac{1}{1-\gamma}\bar{u}_{it}\end{aligned} \tag{D2}$$

Plugging the expression of equation (D2) back into equation (D1), we have

$$\Delta C_{it} = \frac{\mu}{1-\gamma} + \frac{\eta_1 + \theta\gamma}{1-\gamma}\Delta\bar{C}_{it-1} + \frac{\eta_2 + \gamma\sigma}{1-\gamma}\bar{r}_{it} + \theta\Delta C_{it-1} + \frac{1}{\sigma}r_{it} + \frac{\gamma}{1-\gamma}\bar{u}_{it} + u_{it} \tag{D3}$$

To be able to identify our envy parameter, γ , we need to have either of the following restriction: (i) $\eta_1 = 0$, i.e. $\Delta\bar{C}_{it-1}$ does not enter equation (D1); or (ii) $\eta_2 = 0$, i.e. $\bar{r}_{it}$ does not enter equation (1). This second condition additionally requires that the individual interest rate r_{it} enters equation (D1). Given that our estimation equation meets both conditions the coefficient on envy is properly identified. Finally, it is worth noticing that when $\gamma = 0$, equations (D1) and (D3) are the same.

Appendix E: First-stage regressions

TABLE A1

First-state regressions

Variables	r_{it}	$\Delta\bar{c}_{it}$	Δc_{it-1}	*Labour Change*
$\Delta nadult$	0.022***	−0.003	0.009	−0.005
	(0.006)	(0.008)	(0.013)	(0.007)
$\Delta nchildren$	0.014	−0.012	0.000	−0.000
	(0.009)	(0.012)	(0.018)	(0.010)
ΔAge	−0.005	0.007	−0.005	0.003
	(0.012)	(0.016)	(0.028)	(0.018)
ΔAge^2	0.074	−0.092	0.018	−0.094
	(0.140)	(0.187)	(0.326)	(0.204)
r_{it-1}	−0.582***	0.010	0.057***	−0.000
	(0.011)	(0.007)	(0.013)	(0.003)
$\Delta\bar{c}_{it-2}$	0.006***	0.134***	−0.057***	0.011***
	(0.005)	(0.010)	(0.012)	(0.004)
$\Delta nchildren_{it-1}$	0.015	0.004	0.069***	0.006
	(0.009)	(0.011)	(0.020)	(0.009)
$\Delta nadult_{it-1}$	0.009	0.012	0.079***	−0.005
	(0.006)	(0.007)	(0.016)	(0.007)
Labour Change$_{it-1}$	−0.002	0.012	0.016	−0.586***
	(0.006)	(0.008)	(0.013)	(0.010)
Seasonal and annual dummies	Yes	Yes	Yes	Yes

Notes: Clustered and robust standard errors in parentheses. ***$P < 0.01$
Seasonal and annual dummies are included in all the regressions.

Final Manuscript Received: May 2015.

References

Abel, A. B. (1990). 'Asset prices under habit formation and catching up with the joneses', *American Economic Review*, Vol. 80, pp. 38–42.

Akerlof, G. A. and Yellen, J. L. (1990). 'The fair wage-effort hypothesis and unemployment', *The Quarterly Journal of Economics*, Vol. 105, pp. 255–283.

Alonso-Carrera, J., Caballe, J. and Raurich, X. (2007). 'Aspirations, habit formation, and bequest motive', *Economic Journal*, Vol. 117, pp. 813–836.

Alpizar, F., Carlsson, F. and Johansson-Stenman, O. (2005). 'How much do we care about absolute versus relative income and consumption?', *Journal of Economic Behavior and Organization*, Vol. 56, pp. 405–421.

Altug, S. and Miller, R. A. (1990). 'Household choices in equilibrium', *Econometrica*, Vol. 58, pp. 543–570.

Alvarez-Cuadrado, F. and Long, N. V. (2012). 'Envy and inequality', *Scandinavian Journal of Economics*, Vol. 114, pp. 949–973.

Alvarez-Cuadrado, F. and Van Long, N. (2011). 'The relative income hypothesis', *Journal of Economic Dynamics and Control*, Vol. 35, pp. 1489–1501.

Angrist, J. (2013). *The Perils of Peer Effects*, NBER Working Paper No. 19774.

Angrist, J. D. and Pischke, J.-S. (2008). *Mostly Harmless Econometrics: An Empiricist's Companion*, Princeton University Press, Princeton.

Arellano, M. and Bond, S. (1991). 'Some tests of specification for panel data: Monte carlo evidence and an application to employment equations', *Review of Economic Studies*, Vol. 58, pp. 277–297.

Arellano, M. and Bover, O. (1995). 'Another look at the instrumental variable estimation of error-components models', *Journal of Econometrics*, Vol. 68, pp. 29–51.

Arrow, K. and Dasgupta, P. (2009). 'Conspicuous consumption, inconspicuous leisure', *Economic Journal*, Vol. 119, pp. F497–F516.

Attanasio, O. P. (1999). 'Consumption', in Taylor J. B. and Woodford M. (eds), *Handbook of Macroeconomics*, Vol. 1, Amsterdam: Elsevier Science, pp. 741–812.

Attanasio, O. P. and Browning, M. (1995). 'Consumption over the life cycle and over the business cycle', *American Economic Review*, Vol. 85, pp. 1118–1137.

Attanasio, O. P. and Low, H. (2004). 'Estimating euler equations', *Review of Economic Dynamics*, Vol. 7, pp. 405–435.

Attanasio, O. P. and Weber, G. (1995). 'Is consumption growth consistent with intertemporal optimization? evidence from the consumer expenditure survey', *Journal of Political Economy*, Vol. 103, pp. 1121–1157.

Boldrin, M., Christiano, L. J. and Fisher, J. D. M. (2001). 'Habit persistence, asset returns, and the business cycle', *American Economic Review*, Vol. 91, pp. 149–166.

Browning, M. and Collado, M. D. (2001). 'The response of expenditures to anticipated income changes: panel data estimates', *The American Economic Review*, Vol. 91, pp. 681–692.

Browning, M. and Collado, M. D. (2007). 'Habits and heterogeneity in demands: a panel data analysis', *Journal of Applied Econometrics*, Vol. 22, pp. 625–640.

Bruni, L. and Porta, P. (2005). *Rethinking Public Economics: The Implications of Rivalry and Habit*, Oxford University Press, Oxford, pp. 147–169.

Campbell, J. Y. and Cochrane, J. (1999). 'Force of habit: a consumption-based explanation of aggregate stock market behavior', *Journal of Political Economy*, Vol. 107, pp. 205–251.

Campbell, J. Y. and Deaton, A. (1989). 'Why is consumption so smooth?', *Review of Economic Studies*, Vol. 56, pp. 357–373.

Campbell, J. Y. and Mankiw, N. G. (1991). 'The response of consumption to income : a cross-country investigation', *European Economic Review*, Vol. 35, pp. 723–756.

Carrasco, R., Labeaga, J. M. and David López-Salido, J. (2005). 'Consumption and habits: evidence from panel data', *The Economic Journal*, Vol. 115, pp. 144–165.

Carroll, C. D. (2001). 'Death to the log-linearized consumption euler equation! (and very poor health to the second-order approximation)', *The B.E. Journal of Macroeconomics*, Vol. 0, pp. 6–?.

Carroll, C. D., Overland, J. and Weil, D. N. (2000). 'Saving and growth with habit formation', *American Economic Review*, Vol. 90, pp. 341–355.

Charles, K. K., Hurst, E. and Roussanov, N. (2009). 'Conspicuous consumption and race', *The Quarterly Journal of Economics*, Vol. 124, pp. 425–467.
Clark, A. E. and Oswald, A. J. (1996). 'Satisfaction and comparison income', *Journal of Public Economics*, Vol. 61, pp. 359–381.
Collado, M. D. (1998). 'Separability and aggregate shocks in the life-cycle model of consumption: evidence from Spain', *Oxford Bulletin of Economics and Statistics*, Vol. 60, pp. 227–247.
Corneo, G. and Jeanne, O. (2001). 'Status, the distribution of wealth, and growth', *Scandinavian Journal of Economics*, Vol. 103, pp. 283–293.
Crawford, I. (2010). 'Habits revealed', *The Review of Economic Studies*, Vol. 77, pp. 1382–1402.
Deaton, A. (1992). *Understanding Consumption*, Clarendon Press; Oxford University Press, New York, NY.
Duesenberry, J. H. (1949). *Income, Saving and the Theory of Consumer Behavior*, Harvard University Press, Cambridge, MA.
Dupor, B. and Liu, W.-F. (2003). 'Jealousy and equilibrium overconsumption', *American Economic Review*, Vol. 93, pp. 423–428.
Dynan, K. E. (2000). 'Habit formation in consumer preferences: evidence from panel data', *American Economic Review*, Vol. 90, pp. 391–406.
Dynan, K. E. and Ravina, E. (2007). 'Increasing income inequality, external habits, and self-reported happiness', *American Economic Review*, Vol. 97, pp. 226–231.
Easterlin, R. A. (1974). 'Does economic growth improve the human lot?', in David P. A. and Reder M. W. (eds), *Nations and Households in Economic Growth: Essays in Honor of Moses Abramovitz*, New York: Academic Press, pp. 89–125.
Ferson, W. E. and Constantinides, G. M. (1991). 'Habit persistence and durability in aggregate consumption: empirical tests', *Journal of Financial Economics*, Vol. 29, pp. 199–240.
Festinger, L. (1954). 'A theory of social comparison processes', *Human Relations*, Vol. 7, pp. 117–140.
Frank, R. H. (1985). *Choosing the Right Pond*, Oxford University Press, New York.
Fuhrer, J. C. (2000). 'Habit formation in consumption and its implications for monetary-policy models', *American Economic Review*, Vol. 90, pp. 367–390.
Fuhrer, J. C. and Klein, M. W. (2006). 'Risky habits: on risk sharing, habit formation, and the interpretation of international consumption correlations', *Review of International Economics*, Vol. 14, pp. 722–740.
Gali, J. (1994). 'Keeping up with the joneses: consumption externalities, portfolio choice, and asset prices', *Journal of Money, Credit and Banking*, Vol. 26, pp. 1–8.
Gourinchas, P.-O. and Parker, J. A. (2002). 'Consumption over the life cycle', *Econometrica*, Vol. 70, pp. 47–89.
Grinblatt, M., Keloharju, M. and Ikäheimo, S. (2008). 'Social influence and consumption: evidence from the automobile purchases of neighbors', *The Review of Economics and Statistics*, Vol. 90, pp. 735–753.
Hall, R. E. and Mishkin, F. S. (1982). 'The sensitivity of consumption to transitory income: estimates from panel data on households', *Econometrica*, Vol. 50, pp. 461–481.
Hayashi, F. (1985). 'The effect of liquidity constraints on consumption: a cross-sectional analysis', *The Quarterly Journal of Economics*, Vol. 100, pp. 183–206.
Heaton, J. (1993). 'The interaction between time-nonseparable preferences and time aggregation', *Econometrica*, Vol. 61, pp. 353–385.
Heffetz, O. (2011). 'A test of conspicuous consumption: visibility and income elasticities', *The Review of Economics and Statistics*, Vol. 93, pp. 1101–1117.
Howarth, R. B. (2006). 'Optimal environmental taxes under relative consumption effects', *Ecological Economics*, Vol. 58, pp. 209–219.
Kapteyn, A. (1997). 'The demand for food in the United States and the Netherlands: a systems approach with the cbs model', *Journal of Applied Econometrics*, Vol. 12, pp. 529–530.
Kiley, M. T. (2010). 'Habit persistence, nonseparability between consumption and leisure, or rule-of-thumb consumers: which accounts for the predictability of consumption growth?', *The Review of Economics and Statistics*, Vol. 92, pp. 679–683.
Kuhn, P., Kooreman, P., Soetevent, A. and Kapteyn, A. (2011). 'The effects of lottery prizes on winners and their neighbors: evidence from the Dutch postcode lottery', *American Economic Review*, Vol. 101, pp. 2226–2247.

Liu, W.-F. and Turnovsky, S. J. (2005). 'Consumption externalities, production externalities, and long-run macroeconomic efficiency', *Journal of Public Economics*, Vol. 89, pp. 1097–1129.
Ljungqvist, L. and Uhlig, H. (2000). 'Tax policy and aggregate demand management under catching up with the joneses', *American Economic Review*, Vol. 90, pp. 356–366.
Lucas, R.E. (1987). '*Models of Business Cycles*', Wiley-Blackwell, Oxford University Press, Oxford
Luttmer, E. F. P. (2005). 'Neighbors as negatives: relative earnings and well-being', *The Quarterly Journal of Economics*, Vol. 120, pp. 963–1002.
Manski, C. F. (1993). 'Identification of endogenous social effects: the reflection problem', *Review of Economic Studies*, Vol. 60, pp. 531–542.
Maurer, J. and Meier, A. (2008). 'Smooth it like the joneses'? estimating peer-group effects in intertemporal consumption choice', *Economic Journal*, Vol. 118, pp. 454–476.
Meghir, C. and Weber, G. (1996). 'Intertemporal nonseparability or borrowing restrictions? a disaggregate analysis using a U.S. consumption panel', *Econometrica*, Vol. 64, pp. 1151–1181.
Moav, O. and Neeman, Z. (2010). 'The quality of information and incentives for effort', *Journal of Industrial Economics*, Vol. 58, pp. 642–660.
Naik, N. Y. and Moore, M. J. (1996). 'Habit formation and intertemporal substitution in individual food consumption', *The Review of Economics and Statistics*, Vol. 78, 321–328.
Ng, Y.-K. and Wang, J. (1993). 'Relative income, aspiration, environmental quality, individual and political myopia: why may the rat-race for material growth be welfare-reducing?', *Mathematical Social Sciences*, Vol. 26, pp. 3–23.
Osborn, D. R. (1988). 'Seasonality and habit persistence in a life cycle model of consumption', *Journal of Applied Econometrics*, Vol. 3, pp. 255–266.
Oswald, A. J. (1997). 'Happiness and economic performance', *Economic Journal*, Vol. 107, pp. 1815–1831.
Pischke, J.-S. (1995). 'Measurement error and earnings dynamics: some estimates from the psid validation study', *Journal of Business & Economic Statistics*, Vol. 13, pp. 305–314.
Pollak, R. A. (1976). 'Interdependent preferences', *American Economic Review*, Vol. 66, pp. 309–320.
Quintana-Domeque, C. and Turino, F. (2013). *Relative Concerns on Visible Consumption: A Source of Economic Distortions*, Economics Series Working Papers No. 676, Department of Economics, University of Oxford.
Quintana-Domeque, C. and Wohlfart, J. (2014). *Relative Concerns for Consumption at the Top: An Intertemporal Analysis for the UK*, IZA Discussion Papers No. 8502, Institute for the Study of Labor.
Ravina, E. (2008). *Habit Formation and Keeping Up with the Joneses: Evidence from Micro Data*, Discussion Paper, New York University. Available at SSRN: http://ssrn.com/abstract=928248.
Rozen, K. (2010). 'Foundations of intrinsic habit formation', *Econometrica*, Vol. 78, pp. 1341–1373.
Runkle, D. E. (1991). 'Are farrowing intentions rational forecasts?', *American Journal of Agricultural Economics*, Vol. 73, pp. 594–600.
Ryder, H. E. and Heal, G. M. (1973). 'Optimum growth with intertemporally dependent preferences', *Review of Economic Studies*, Vol. 40, pp. 1–33.
Sanderson, E. and Windmeijer, F. (2014). *A Weak Instrument F-Test in Linear IV Models with Multiple Endogenous Variables*, Bristol Economics Discussion Papers No. 14/644, Department of Economics, University of Bristol, UK.
Smith, A. (1759). *The Theory of Moral Sentiments*, Clarendon Press; Oxford University Press, New York, NY.
Staiger, D. and Stock, J. H. (1997). 'Instrumental variables regression with weak instruments', *Econometrica*, Vol. 65, pp. 557–586.
Stock, J. and Yogo, M. (2005). 'Testing for Weak Instruments in Linear IV Regression', in Andrews D.W.K., (ed.), *Identification and Inference for Econometric Models*, New York: Cambridge University Press, pp. 80–108.
Varian, H. R. (1974). 'Equity, envy, and efficiency', *Journal of Economic Theory*, Vol. 9, pp. 63–91.
Veblen, T. (1899). *The Theory of the Leisure Class : An Economic Study of Institutions*, Macmillan, New York.
Wendner, R. and Goulder, L. H. (2008). 'Status effects, public goods provision, and excess burden', *Journal of Public Economics*, Vol. 92, pp. 1968–1985.