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Intertemporal propensity to consume

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Abstract Cross-sectionally estimated Engel curves tend to exhibit shapes that imply ultimately decreasing marginal propensities to consume as income rises. This suggests at first sight a tendency to slow down in private consumption. This tendency has to be reconsidered taking into account the fact that Engel curves usually shift significantly over time. We introduce the notion of "intertemporal propensity to consume" to shed more light on the drivers and patterns of the evolution of Engel curves. Using this notion, we are able to identify and measure the direction of the expansion path of consumption as time goes by, while controlling for household characteristics and price levels. Using German household data, we show that, over time, the intertemporal propensity to consume systematically offsets the consumption paths implied by the marginal propensity to consume that is derived cross-sectionally at one point in time. We claim that this difference between marginal and intertemporal propensity to consume should be ascribed to variations in the socioeconomic structures that occur over time and that may be linked both to the supply side (innovation and technical change) and the demand side (learning dynamics of consumers). We also show that changes in relative prices play a minor role in the evolution of Engel curves.

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1 Introduction

The paths that household expenditures on specific categories of goods and services trace as income changes are traditionally described in the estimate of Engel curves. An Engel curve is a regression function that captures the statistical dependence of a specific expenditure on income (usually proxied by total expenditure). In the last decades, the econometric literature has made notable progress in the estimation of Engel curves, exploiting recent developments in nonparametric statistics (Banks et al. 1997; Blundell et al. 2007; Engel and Kneip 1996; Härdle 1990). The new statistical techniques have allowed the researcher to obtain a more accurate estimation of income elasticities which, in a nonparametric framework, are not tied to a priori assumptions about the functional form of the Engel curve and are permitted to float as income changes (Manig and Moneta 2014). A strand of literature has focused on scrutinizing the tendency of Engel curves to flatten out at higher levels of income, and, at the same time, on studying the evolution of their shape over time (Härdle and Jerison 1991; Moneta and Chai 2014; Chai and Moneta 2014).

The flattening-out tendency has also been contrasted with the tendency of Engel curves to move over time and to procrastinate their "saturation levels". These counteracting tendencies have, in turn, been associated with demand-driven structural change: if demand for some specific goods and services slows down or tends to stagnate, firms and entrepreneurs could react to this situation by innovating (Pasinetti 1981; Witt 2001; Saviotti 2001; Foellmi and Zweimüller 2008).

In order to shed more light on the patterns and drivers of the evolution of Engel curves, this paper proposes an empirical analysis of households' intertemporal expenditure paths. To this end, we first link the traditional cross-sectional analysis of Engel curves to the marginal propensity to consume,[1] which measures the direction of the expenditure path as income increases. Since this analysis holds time constant, the expenditure expansion (or contraction) is hypothetical or counterfactual. Second, we propose the notion of "intertemporal propensity to consume", which allows us to capture the direction that the *factual* expenditure path takes over time when not only income but also the socioeconomic structure changes. Changes in the socioeconomic structure encompass changes in the supply side (innovation and technical change) and changes in the demand side (learning dynamics of consumers). An important feature of the intertemporal propensity to consume is that it provides a synthetic indicator of the changes of Engel curves over time as regards both shape and position.

[1] Here we use the term marginal propensity to consume as referring to particular categories of goods and services, unlike the macroeconomic literature in which this term is usually associated with aggregate consumption.

We contrast the marginal propensity to consume with the intertemporal propensity to consume to reveal patterns that can be linked to socioeconomic change.

Moreover, we analyze the role that changes in relative prices play in the movements of Engel curves over time. If the evolution of Engel curves is mostly determined by changes in relative prices, one could argue that changes in consumption patterns over time are mostly driven by substitution effects, which should not be associated with changes in preferences or learning dynamics of consumers (for a critical view see Lavoie, 1994). Pasinetti (1981, p. 73) makes the point that price changes cannot affect the basic shapes of Engel curves: "price changes can only postpone or anticipate a time path which, if real income increases, is going to take place anyhow. This means that, in the long run, it is the level of real income — not the price structure — that becomes the relevant and crucial variable". We do not want to claim, however, that changes in relative prices reflect only nominal changes and cannot be associated with structural change. Technical change and innovation, for example, may render certain goods cheaper than others. But we argue that if changes in relative prices turn out *not* to influence significantly the shifts in Engel curves, then the cause of these shifts must be ascribed to changes in the socioeconomic structure of the economy which can, and most likely do, include *variations* in the structure of the demand side of the economy (e.g. learning dynamics of consumers).

Using German household data for the time waves 1978-1983, 1983-1988, and 1988-1993 we find that the intertemporal propensity to consume increases over time for many categories of expenditures in which the marginal propensity to consume is decreasing across income. The results are sensitive to the quartiles of the income distribution that are analyzed, suggesting that industries may address specific parts of the income distribution to escape satiation tendencies. Using British household data, which have the advantage of consisting of yearly cross sections of households for several decades, we find that relative prices play overall a minor role in the shifts of Engel curves, highlighting the importance of structural change rather than nominal change in the evolution of Engel curves.

2 Background and cross-sectional analysis

In the fourth chapter of his 1981 book *Structural Change and Economic Growth*, Pasinetti rightly lamented that the "consumers' demand theory" as developed at that time was "... built on entirely static premises. It relies on the existence of a perfectly known and consistent set of preferences defined at a given level of per capita income. Such a theory ... is clearly unable to offer us any guide to the investigation of changes in demand following successive and persistent *increments* to income" (Pasinetti 1981, p. 69). This state of affairs has changed quite significantly in the last two decades. Several works have emerged, under the interpretative framework of evolutionary economics, which attempt to build an explanation of the time path taken by consumption, abandoning the assumption of exogenous preferences (Aversi et al. 1999; Witt 2001; Saviotti 2001; Nelson and Consoli 2010; Valente 2012). Most of these works do not share the same degree of formalization with standard demand theory, as articulated in economic textbooks. But they do provide insights into the motivations to consume

that are sufficient for the present analysis. Witt (2001), in particular, insisted that the motives underlying decisions to consume originate in human needs and wants that may either be the result of the biological evolution of mankind or acquired as the result of cultural development of the society in which consumers live.

For the sake of our empirical investigation, we relate the expenditure that a given household devotes to a category of goods and services in order to satisfy its needs, to household income, household characteristics (i.e. size of the household, age of its members, educational background, etc.), and the socioeconomic structure. This dependence can be formally expressed as

$$Exp_{it}^{j} = f(I_{it}, H_{it}, S_t), \tag{1}$$

where Exp_{it}^{j} denotes the expenditure of household i at time t on the category of goods and services j, I_{it} denotes the income of household i at time t, H_{it} denotes characteristics of household i at time t, and S_t denotes the socioeconomic structure in t. We use the term "socioeconomic structure" to capture all determinants of Exp_{it}^{j} but income and household characteristics. The socioeconomic structure covers, but is not limited to, the structure of available goods and services supplied in the market, the set of relative prices, and status considerations, which include dynamics of imitation and distinction among consumers (Hirsch 1978). The socioeconomic structure changes over time, but is constant within each time period t. We make here the simplifying assumption that the socioeconomic structure is the same for all households. Changes in prices, that is both changes in the price levels and changes in relative prices, may be important causes of changes in consumption. Uniform changes in the price levels have simple income effects and can be accounted easily as changes in income. Changes in relative prices can be abscribed to changes in the socioeconomic structure. By holding the socioeconomic structure constant across households, we thus abide by the law of one price.

By analogy to the macroeconomic notion of the marginal propensity to consume (MPC), which corresponds to the derivative of the aggregate consumption function with respect to disposable income, we define here the MPC of a given category of expenditure as the partial derivative of Exp_{it}^{j} with respect to I_{it}.[2] The MPC so defined, and being derived from Eq. 1 identifies a *ceteris paribus* relationship between (incremental) changes of income (for each level of income) and (incremental) changes of household expenditure, holding constant household characteristics and the socioeconomic structure. Therefore, the MPC is a counterfactual measure as household characteristics and the socioeconomic structure actually change over time.

The focus of this paper is on intertemporal consumption paths. The notion of MPC cannot be an adequate measure of long-run patterns of consumption because it is built on static premises, as suggested above. For that aim we propose the notion of intertemporal propensity to consume (defined in more detail in the next section). In this section, we estimate cross-sectional Engel curves to infer from their shapes

[2]The MPC so defined differs from the notion of income elasticity only in the sense that, to calculate the income elasticity of expenditure for a given level of income, both expenditure and income have to be taken in logarithms.

tendencies to slow down in the expenditures on a given category as income rises. These counterfactual consumption paths are the basis for the intertemporal analysis carried out in the next section.

The cross-sectional analysis is performed through estimation of Engel curves. Engel curves, interpreted in the traditional way (Engel 1857), are regression functions in which the dependent variable is expenditure on a specific category j and the independent variable is total expenditure (proxy for disposable income). Engel curves are estimated for a sample of households located in a specific region (or country) and active in consumption in a specific time window. Prices and time (i.e. socioeconomic structure) are held constant.

We use the sample survey of income and expenditure (EVS) from the German federal statistical office (Statistisches Bundesamt 2014). This sample survey is a quota sample of the German population and, due to reasons of guaranteeing anonymity, we are allowed to work with an 80 % random sample of this quota sample. The EVS is available every five years beginning in 1978. As the comparison of Engel curves over time that we need for the intertemporal analysis requires a comparable data collection procedure, we restrict our analysis to the years 1978, 1983, 1988, and 1993, as the data collection procedure remained basically the same for these years, changing substantially in 1998 (Fleck and Papastefanou 2006). The EVS provides information at the household level such as age and occupation of the head of the household, household size, and location of the household. Moreover, detailed information about the expenditures for various categories is provided for each household that was gathered over a period of one year. Table 1 gives an overview of the categories of expenditure. The sample size is 46941 households in 1978, 43614 households in 1983, 44185 households in 1988, and 40230 households in 1993. For 1993, we restrict our analysis to West-German households to be consistent with the years 1978-1988 before reunification. The long reporting interval of one year, the large sample sizes, the high comparability of the data across years, and the availability of detailed information

Table 1 Categories of Expenditure

Expenditure Category	Description
Food	Food and non-alcoholic beverages at home
Alcohol and tobacco	Alcohol and tobacco
Clothing and footwear	Clothing and footwear including repairs
Housing	Rent, rent values for owners, and energy
Household goods and services	Furniture, equipment and repairs
Bodycare	Bodycare
Mobility	Mobility services, purchase and repairs of vehicles
Communication	Post and telephone
Leisure goods and services	Leisure, entertainment, culture, and all-inclusive tours
Education	Child care and further education costs
Hotel and restaurant	Hotels and restaurants
Personal goods and services	Jewelry, handbags, etc. including repairs

about the household characteristics guarantee perfect conditions for robust empirical estimations of Engel curves and their comparability over time.

Each Engel curve can be written in the following way:

$$Exp_i^j = m_j(x_i) + \varepsilon_i, \tag{2}$$

where Exp_i^j denotes the expenditure of household i on category j, x_i is total expenditure (proxy for income) allocated by household i , $m_j(x) = E(Exp_i^j|x_i)$ and ε_i is the (household specific) error term such that $E(\varepsilon_i|x_i) = 0$. Equation 2 can then be estimated using a cross section of household data by linear or nonlinear least squares, depending on the functional form assumed for $m_j(x)$. However, imposing a functional form would heavily condition our results. Therefore it is preferable to use a nonparametric approach (i.e. a kernel regression) which lets $m_j(x)$ to be determined by the data. In our empirical analysis, Eq. 2 is estimated using the local linear kernel regression proposed by Fan and Gijbels (1992) and Fan (1993). The estimator is defined as $\hat{m}_j(x_i)$, such that

$$\hat{m}_j(x_i) = \arg\min_{\gamma} \sum_{k=1}^{N} \left[Exp_k^j - \gamma - \delta(x_k - x_i) \right]^2 \mathrm{K}_{b_N}(x_k - x_i), \tag{3}$$

where $\mathrm{K}_{b_N}(\cdot)$ is a suitable kernel function depending on a bandwidth b_N, N is the total number of households present in the sample, and γ and δ are parameters for which the sum on the right hand side is minimized. In comparison with other kernel estimators, e.g. the Nadaraya–Watson and the Gasser–Müller estimator (cfr. Nadaraya 1964; Watson 1964; Gasser and Müller 1979), the local linear estimator (Eq. 3) has the advantage of having a relatively small bias for finite samples, of being asymptotically efficient, and of displaying better behavior at the extremes of the sample. (For a comparison see Fan and Gijbels 2003). The choice of the bandwidth can be based on different methods. In our empirical analysis we choose the bandwidth on the basis of the minimization of a polynomial approximation of the mean integrated square error (of $\hat{m}_j(x_i)$), following the approach proposed by Fan and Gijbels (2003).

Nonparametric kernel estimation is prone to the presence of outliers. Banks et al. (1997) suggest cutting the data at three standard deviations above the mean for the distribution of total expenditure and for the distribution of the expenditure on a given category. However, expenditure on a given category is characterized by increasing variance (across households) as total expenditure increases. Cutting the data at fixed values ignores heteroskedasticity and may substantially influence the estimated shapes of Engel curves, as large values of expenditure on a given category may be systematically deleted from the data. Therefore, we use a procedure to identify outliers that takes heteroskedasticity into account. We standardize the total expenditure distribution and the distribution of expenditures on a given category to the unit interval and use the 0.2 Euclidean distance around each data point to define its neighborhood. Those data points with less than five data points in the neighborhood are defined as outliers and are deleted from the data. This procedure allows us to

identify extreme outliers and ensures that as many data points as possible are utilized for the estimation, guaranteeing a robust and reliable inference on the shape of cross-sectional Engel curves. Figure 1 illustrates this procedure.

The non-parametrically estimated Engel curves yield smooth shapes and the bootstrapped confidence points are very narrow, confirming the shapes of the estimated Engel curves. The estimated shapes of Engel curves are sensitive to the portion of the distribution of total expenditure used for the analysis. For large values of total expenditure, the data become sparser and the confidence points become wider, reflecting the higher degree of uncertainty about the expenditure path on a given category for large values of total expenditure. If the entire distribution of total expenditure is considered, almost all cross-sectional Engel curves provide shapes that imply decreasing MPC for large values of total expenditure. In order to be conservative, we estimate the Engel curves using the full range of the total expenditure distribution, but we infer the shapes of Engel curves only based on the total expenditure distribution up to three standard deviations above the mean. Concave shapes imply MPC that are decreasing across all parts of the total expenditure distribution, whereas convex shapes indicate the opposite. S-shaped Engel curves imply that the lower quantiles of the total expenditure distribution exhibit increasing MPC contrasting decreasing MPC for the larger quantiles of the total expenditure distribution.

Even with the conservative strategy of inferring the shape of Engel curves based on only up to three standard deviations above the mean of total expenditure, the vast majority of the estimated Engel curves display shapes that imply ultimately decreasing MPC for large values of total expenditure. These patterns can be associated with the idea of saturation levels for large levels of income. An exception is, for example,

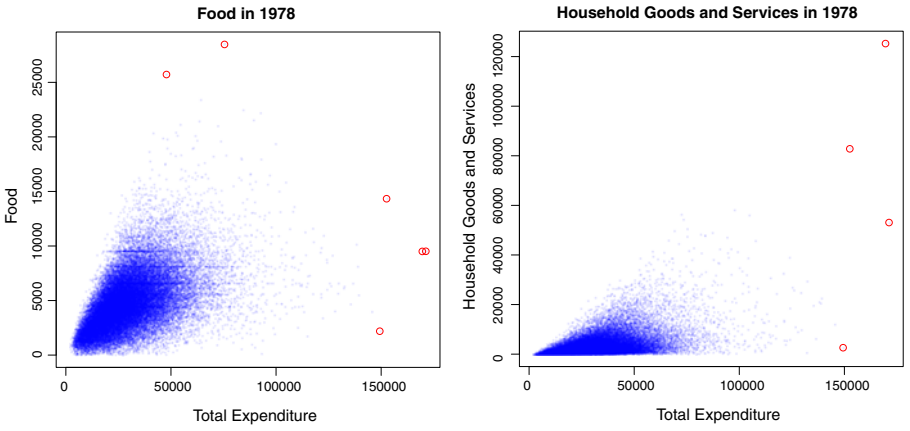

Fig. 1 Outlier Cleaning. Expenditures on food and household goods and services in 1978 in relation to total expenditure are presented. The circles mark those data points identified as outliers that have been deleted from the data

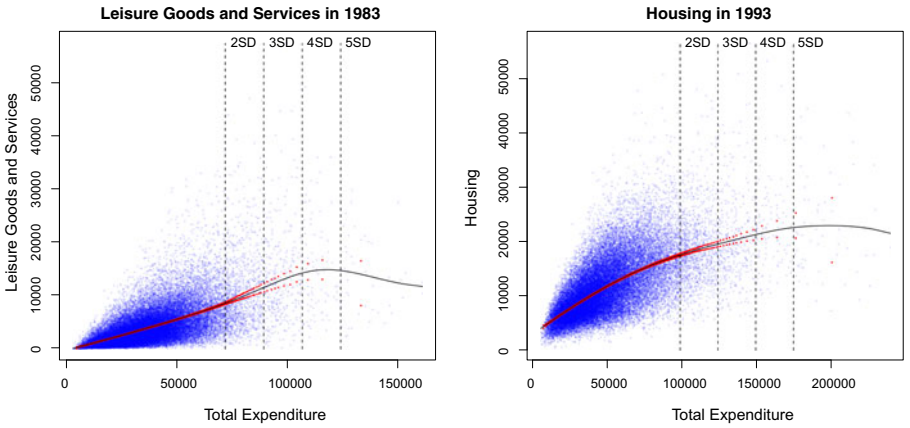

Fig. 2 Cross-Sectional Engel Curves. Cross-sectional Engel curves for leisure goods and services in 1983 and housing in 1993 are shown with bootstrapped confidence points and the underlying data points. The vertical lines represent the border of two (three, four, five) standard deviations above the mean of the total expenditure distribution (2SD, 3SD, 4SD, 5SD). The left graph illustrates how the shape of Engel curves may depend on the utilized values of the total expenditure distribution, whereas the right graph reflects the majority of cases where the shape is largely independent of the utilized values of the total expenditure distribution

expenditure on leisure goods and services in 1983. Here, an S-shaped Engel curve becomes convex if the shape is inferred based on values of total expenditure up to three standard deviations above the mean. Figure 2 illustrates how the shape may depend on the segment of total expenditure used. Table 2 provides an overview of the results about shapes based on the conservative strategy of using values of total expenditure up to three standard deviations above the mean.

Our findings largely confirm the tendency of MPC to decrease as income rises, which Moneta and Chai (2014) found in their analysis of the UK Family Expenditure Survey. Notice that our analysis is based on more than 40,000 observations. Engel curves estimated on the basis of the UK Family Expenditure Survey appear to be much more erratic in their shapes. This may be caused by the much smaller sample sizes (less than 2500 observations) and the short reporting interval of two weeks. Furthermore, the UK Family Expenditure Survey provides evidence that saturation points of cross-sectional Engel curves defined as the local or global maximum of the Engel curve often lie within three standard deviations above the mean of total expenditure. By contrast, the EVS provides evidence that saturation points never lie within three standard deviations above the mean of total expenditure. This difference can be driven by country-specific characteristics, but it is more likely to be driven by the difference in sample sizes. The larger sample size of the EVS allows us to derive more reliable estimates for larger values of total expenditure, given that observations in this range become sparse.

Table 2 Shapes of Cross-Sectional Engel Curves

	Alcohol and tobacco	Clothing and footwear
1978	concave	concave
1983	concave	concave
1988	concave	concave
1993	concave	concave
	Communication	Food
1978	concave	concave
1983	concave	concave
1988	concave	concave
1993	concave	concave
	Housing	Hotel and restaurants
1978	concave	concave
1983	concave	linear
1988	concave	concave
1993	concave	concave
	Bodycare	Education
1978	S	S
1983	S	S
1988	S	S
1993	S	S
	Household goods and services	Mobility
1978	S	S
1983	S	S
1988	S	S
1993	S	S
	Leisure goods and services	Personal goods and services
1978	convex	convex
1983	convex	convex
1988	concave	linear
1993	S	concave

Notes: The shapes of cross-sectional Engel curves for each category of expenditure and year are presented as concave, convex or S-shaped

Overall, both the UK Family Expenditure Survey and the EVS support the finding that cross-sectional Engel curves display shapes that imply an ultimately decreasing MPC as income rises, though S-shaped Engel curves indicate increasing MPC for lower quantiles of the total expenditure distribution. These findings suggest that

private consumption slows down at least for large values of total expenditure for almost all categories. However, these counterfactual estimations are based on holding particularly the socioeconomic structure, S_t, constant.[3]

3 Intertemporal analysis

The expenditure path described by a cross-sectional Engel curve in practice never realizes itself. Indeed, as household income changes, time goes by, and with the passing of time both the socioeconomic structure and household characteristics may change. The recognition of this fact has triggered studies on the evolution of Engel curves (Härdle and Jerison 1991; Moneta and Chai 2014). Differently from previous studies, we introduce here the notion of the intertemporal propensity to consume (IPC). Our aim is to shed more light on the role played by socioeconomic change in the evolution of Engel curves. Socioeconomic change refers here to the change from one socioeconomic structure at a given point in time to a potentially different socioeconomic structure at a later point in time. This includes changes in the production side of the economy due to innovation and technical change, changes in the market structure, and variations in the demand side of the economy associated with changes in preferences, changes in consumer behavior driven by status consideration, imitation, and specialization.

We define the IPC as:

$$IPC^{j}_{igh} = \frac{Exp^{j}_{ih}(I_i = x_h, H_i, S_h) - Exp^{j}_{ig}(I_i = x_g, H_i, S_g)}{x_h - x_g}, \tag{4}$$

where $Exp^{j}_{ig}(I_i = x_g, H_i, S_g)$ denotes expenditure of household i on category j given income x_g and socioeconomic structure S_g at time g; $Exp^{j}_{ih}(I_i = x_h, H_i, S_h)$ denotes expenditure of household i on category j given income x_h and socioeconomic structure S_h at time h with $h > g$. Household characteristics, H_i are held constant between time g and time h. Hence, IPC^{j}_{igh} measures the impact of a change in the socioeconomic structure from time g to time h on the expenditures of household i on category j given a change in income from x_g to x_h ($x_g \neq x_h$).

Our estimation strategy of the IPC is based on using cross-sectional Engel curves to obtain estimates of $Exp^{j}_{ig}(I_i = x_g, H_i, S_g)$ and $Exp^{j}_{ih}(I_i = x_h, H_i, S_h)$. Evaluating the impact of socioeconomic change on the intertemporal expenditure path requires controlling for changes in household characteristics over time. Otherwise, shifts in Engel curves may be caused by changes in the composition of household

[3]The shapes of cross-sectional Engel curves may be also sensitive to household characteristics, if these influence expenditure on a given category and if household characteristic change with the level of total expenditure. We estimate cross-sectional Engel curves for subgroups selected on the basis of household size, occupation of the head of the household, and age of the head of the household. The Engel curves estimated with these samples largely confirm the shapes of the Engel curves derived by pooling the households. This allows us to use the pooled data for our intertemporal analysis in the next section that requires a large cross-sectional sample size. Results are available upon request.

characteristics over time rather than by socioeconomic change. In order to control for this potential cause, we match households across years according to their characteristics. We define the year 1978 as baseline and we match each household in 1978 with one household in 1983, 1988, and 1993. If we find four households that fulfill our matching criteria, each household is stored in the respective year of our matched data set and these households are deleted from the matching procedure to avoid double selection. If we do not find a match in 1983, 1988, and 1993 for a given household of 1978, we delete the household in 1978 and continue with the next household. We match households by ensuring that the occupation of the head of the household (white collar, blue collar, no work) for the four matched households is the same, the age of the head of the household for the four matched households is the same but for a gap of ± 5 years, the size of the household in terms of number of family members for the four matched households is the same, and income of the household for the four matched households is the same but for a gap of ± 1000 DM.

Our data is a 80% random sample of a quota sample. Neither the original samples are representative nor are the matched data. The analysis is conducted for an artificial composition of household characteristics, but this composition remains constant over time. The sample size after the matching is 24654 for each year. We deflated all expenditures with category-specific deflators for the matching procedure. This matching ensures that the household composition of the years 1978 to 1993 is the same, controlling for changing household characteristics as potential causes for shifts in Engel curves over time.

We estimate IPC for Germany over the years 1978, 1983, 1988, and 1993. We conduct the estimations separately for four quantiles (i.e. quartiles) of the total expenditure distribution and we take the average of total expenditure within each of the quartiles. The mean of total expenditures of each quartile and for each year is given by x_t^q, where $q = 1, \ldots, 4$ and $t = 1978, 1983, 1988, 1993$. Thus, for example, the change in the mean of total expenditure from 1978 to 1983 as regards the first quartile is referred to as $\left(x^1_{1983} - x^1_{1978}\right)$.

Estimating cross-sectional Engel curves for the matched data allows us to derive average values of $Exp^j_{ig}(I_i = x^q_g, H_i, S_g)$ and $Exp^j_{ih}\left(I_i = x^q_h, H_i, S_h\right)$ with constant household characteristics over time. The estimate of the IPC between year g and h for quartile q of the total expenditure distribution and category j is then given by:

$$\widehat{IPC}^j_{qgh} = \frac{EC^j_h\left(x^q_h\right) - EC^j_g\left(x^q_g\right)}{x^q_h - x^q_g}, \tag{5}$$

where x^q_h and x^q_g are the means of total expenditure within quartile q at time h and g and $EC^j_h(\cdot)$ and $EC^j_g(\cdot)$ are the estimates of the cross-sectional Engel curves evaluated at points x^q_h and x^q_g.

Figure 3 depicts the probability density function (p.d.f.) of total expenditure over time. We can see from Fig. 3 that, from 1983 to 1988 and 1993, the p.d.f. has moved rightwards towards higher levels of income, while the peak has decreased. However, from 1978 to 1983, the tendency is opposite and the p.d.f. has slightly moved leftwards and the peak has increased. In the time window between 1978 and 1983 West Germany was hit by a fairly severe recession (originating in the US while Paul

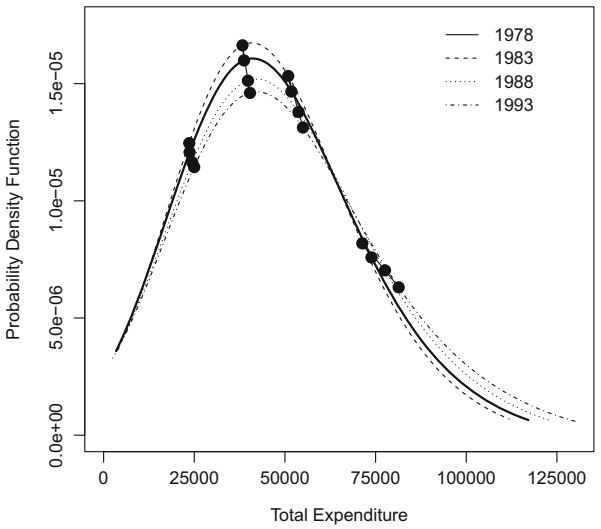

Fig. 3 Probability Density Functions of Total Expenditure (1978-1993). The means of total expenditure within each quartile of the total expenditure distribution are represented by the connected dots

Volcker was chairman of the Federal Reserve). The years of the recession in West Germany are 1980 and 1981: real income and private consumption decreased by some 2 % in these years, while unemployment rose from 4 % to 6 %. Recovery started in 1982. Figure 3 shows how the means of total expenditure for each quartile of the total expenditure distribution moved over the considered years.

Figure 4 illustrates the estimates of the cross-sectional Engel curves for the four different years. The points depicted on the figures are located in the coordinates <

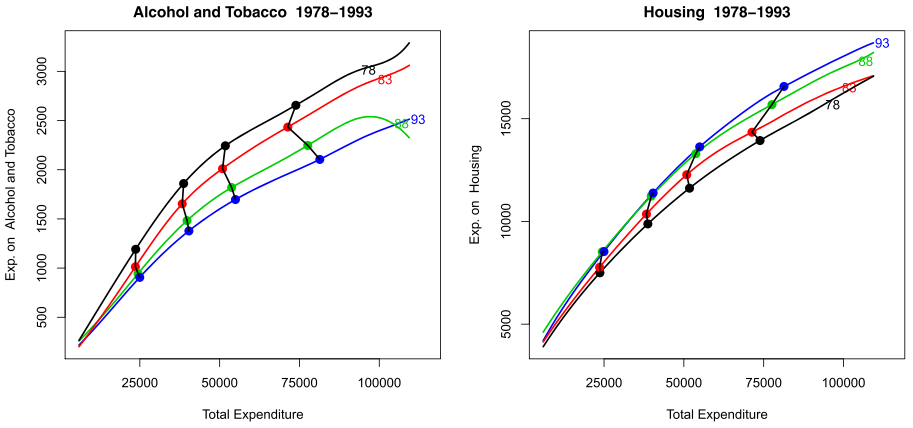

Fig. 4 Engel Curves and Intertemporal Propensities to Consume (1978-1993). Cross-sectional Engel curves for the matched data with constant household characteristics over time are displayed for alcohol and tobacco and housing. The slopes of the lines that connect these cross-sectional Engel curves depict the IPC for each quartile of the total expenditure distribution

Table 3 Intertemporal Propensity to Consume (1978-1983)

	Q1 1978-1983	Q2 1978-1983	Q3 1978-1983	Q4 1978-1983
Food	0.6433	0.0404	−0.0236	−0.0352
Alcohol and tobacco	1.8156	0.4818	0.2642	0.0878
Clothing and footwear	2.6629	1.0867	0.6234	0.2591
Housing	−2.7354	−1.1211	−0.7433	−0.1600
Household g. and s.	0.1992	0.1914	0.0961	0.1333
Bodycare	0.4177	0.1326	0.2003	0.3267
Mobility	−0.9453	0.0740	0.4080	0.2481
Communication	−1.1365	−0.1942	−0.0773	−0.0113
Leisure g. and s.	−1.8917	−0.7995	−0.4731	−0.1175
Education	−0.2082	−0.1624	−0.1387	−0.1060
Hotel and restaurant	2.4274	1.2136	0.8685	0.4051
Personal g. and s.	−0.3012	0.1868	0.1669	0.1099

Notes: The intertemporal propensity to consume is displayed for each quartile of the total expenditure distribution. Given that the change in total expenditure between 1978 and 1983 is negative for all quartiles, negative (positive) values of the IPC denote increases (decreases) in the expenditure on a given category

$x_t^q, EC_t^j\left(x_t^q\right) >$, for $t = 1978, 1983, 1988, 1993$ and $q = 1, \ldots, 4$. The slopes of the lines connecting these points define $\widehat{IPC}_{qgh}^{j}$. These figures show the evolution of Engel curves over time due to socioeconomic change.

The intertemporal propensity to consume between 1978 and 1983, reported in Table 3, has to be interpreted with caution, because the total expenditure shift (i.e. $x_{1983}^q - x_{1978}^q$) is negative. Thus, a positive value of the intertemporal propensity to consume for this time window denotes a reduction of expenditure on the given category, whereas a negative value denotes an increase in expenditure. The interpretation of the IPC between 1983 and 1988 and between 1988 and 1993 (Table 4) is more straightforward. In these cases, since the total-expenditure shift is positive, a positive value of the intertemporal propensity to consume denotes an increase in the expenditure on a given category and a negative value indicates a decrease in expenditure.

These IPC estimates often reveal patterns that are opposite to the cross-sectional consumption paths analysed in the past section. The findings can be classified in three broader cases with respect to upward and downward shifts of the cross-sectional Engel curves over time. First, as regards the categories of housing, leisure goods and services, and communication, expenditures increase over time, even from 1978 to 1983 when total expenditure decreases across all quartiles. Housing displays a concave cross-sectional Engel curve, which implies a decreasing MPC as income increases. Although this tendency is intertemporally offset by upward shifts of the

Table 4 Intertemporal Propensity to Consume (1983-1988 and 1988-1993)

	Q1		Q2		Q3		Q4	
	1983-88	1988-93	1983-88	1988-93	1983-88	1988-93	1983-88	1988-93
Food	0.2226	0.4048	0.1831	0.4790	0.1345	0.2931	0.0765	0.1521
Alcohol and tobacco	−0.0813	−0.0732	−0.1132	−0.1837	−0.0671	−0.1012	−0.0298	−0.0377
Clothing and footwear	0.0131	−0.0818	0.0722	−0.0918	0.0841	0.0141	0.0588	0.1410
Housing	0.8962	0.0203	0.5793	0.2638	0.3597	0.2743	0.2149	0.2347
Household g. and s.	−0.1678	−0.2290	−0.0813	−0.1927	−0.0615	0.1073	−0.0539	0.2090
Bodycare	0.0811	0.8341	0.0882	1.1161	0.1360	0.7333	0.2177	0.3557
Mobility	0.0216	0.4738	−0.0802	0.2448	−0.0183	−0.1196	0.1838	−0.2658
Communication	0.0716	0.2945	0.0436	0.3066	0.0304	0.1651	0.0240	0.0584
Leisure g. and s.	0.1366	0.1070	0.2406	0.1656	0.2642	0.1859	0.1978	0.2491
Education	0.0064	0.0023	0.0195	−0.0279	0.0252	−0.0203	0.0185	−0.0108
Hotel and restaurant	0.0731	−0.4118	0.2118	−0.6326	0.2019	−0.3061	0.1257	−0.0565
Personal g. and s.	−0.0293	−0.0885	−0.0210	−0.1080	−0.0123	−0.0541	−0.0008	−0.0218

Notes: The intertemporal propensity to consume is presented for each quartile of the total expenditure distribution. Given that the change in total expenditure between 1978 and 1988 as well as 1988 and 1993 is positive for all quartiles, negative (positive) values of the IPC denote decreases (increases) in the expenditure on a given category

Engel curves, the IPC shrinks from 1983 to 1993 (but maintaining a positive value), indicating an intertemporal slowdown in expenditures. But this is not true for the fourth quartile of the total expenditure distribution. One reason why the fourth quartile can escape the tendencies to satiate may be that firms target the larger quartiles of the total expenditure distribution with, for example, luxury housing. Leisure goods and services display an intertemporal expenditure pattern similar to housing, but this category is characterized by shapes of the cross-sectional Engel curves that change from convex to S-shaped. It is again the fourth quartile of the total expenditure distribution that provides an increasing IPC potentially triggered by luxury leisure goods and services that were introduced to the market.

Communication even provides increasing IPC from 1983 to 1993, offsetting the concave cross-sectional Engel curves that actually imply decreasing MPC. The concave cross-sectional Engel curves may indicate that expenditures on this category slow down within a given socioeconomic structure, but the technological development in this category may explain why the IPC even increases, implying an acceleration in the expenditures over time. Moreover, food and body care show increasing IPC for 1983 to 1993, but they provide decreases in expenditures from 1978 to 1983 for the first and second quartile of food and for all quartiles of body care. The cross-sectional Engel curves of food provide concave shapes and those of body care provide S-shapes. All these categories have in common

that the shapes of cross-sectional Engel curves largely indicate ultimately decreasing MPC as income rises. However, these tendencies are offset by increases in expenditures over time that are larger than the consumption path implied by the cross-sectional Engel curves. Increases in expenditures are even accelerating for some of these categories across all quartiles of the total expenditure distribution mirroring increasing IPC.

Second, the categories of alcohol and tobacco and personal goods and services show a consistent decrease in expenditures over time, as described by downward shifts of the corresponding Engel curves. The IPCs of these categories are negative and even decreasing for most of the quartiles of the total expenditure distribution, indicating an acceleration in the decrease of expenditures on these categories. For alcohol and tobacco, these patterns may be driven by regulatory changes in the socioeconomic structure such as non-smoking policies. Personal goods and services show shapes of cross-sectional Engel curves that change from convex to concave over time. This development from an increasing MPC to a decreasing MPC is supported by a consistent downward shift of the cross-sectional Engel curves over time. Only the first quartile of the total expenditure distribution indicates an increase in the expenditures from 1978 to 1983. Household goods and services also show a decrease in expenditures over time, with the exception of the third and fourth quartile from 1988 to 1993. Engel curves for this category are S-shaped, which indicates increasing MPC for the lower quartiles and decreasing MPC for the larger quartiles. This development is opposed by the intertemporal expenditure path, which exhibits decreases for the lower quartiles and increases for the larger quartiles. It is again the larger quartiles of the total expenditure distribution that offset the cross-sectional patterns.

Third, results for education, hotel and restaurant, mobility, and clothing and footwear are mixed. Education expenditures increase between 1978 and 1988, but either decrease between 1988 and 1993 or increase with a decreasing IPC. Clothing and footwear expenditures decrease between 1978 and 1983 and consistently increase between 1983 and 1988, and increase between 1988 and 1993 as regards the first two quartiles. The IPC for the third quartile decreases and the IPC for the fourth quartile increases. Again, the fourth quartile seems to offset all satiation tendencies. As regards hotel and restaurant and mobility (except the first quartile), IPCs have different signs between 1983-1988 and 1988-1993.

Overall, the implications derived by the cross-sectional analysis are systematically offset by the intertemporal analysis. These results suggest that socioeconomic change is an important determinant of household expenditure, though our analysis does not permit an identification of single components of socioeconomic change. Our results also indicate that the interaction of households and firms seems to vary across the quartiles of the income distribution. If intertemporal slowdowns in the expenditure on a given category occur, this is usually not true for the fourth quartile of the total expenditure distribution. More affluent households seem to behave intertemporally differently compared to less affluent households potentially driven by status considerations or triggered by innovations in goods and services that target higher income classes.

4 Price analysis

The discrepancy between the MPC and the IPC, which we have shown in the previous section, suggests that there are other factors than income (and household characteristics, which were kept constant in the analysis) that drive the patterns of consumption. We have referred to such influences as "socioeconomic structures." One obvious and potentially important part of the socioeconomic structure is linked to the set of relative prices. In our empirical analysis, we have controlled for uniform changes in prices by deflating data (using category-specific price indices), but changes in relative prices may still play a role in influencing shifts in Engel curves. In general, substitution effects may be of minor relevance to our analysis as we consider that broad categories of expenditures and substitution effects within these categories do not affect our analysis, whereas substitution effects between these categories may be small.

If it turns out that the role of prices in influencing consumption patterns is small, then this would confirm the conjecture of Deaton and Muellbauer (1980, p. 323) that "influences other than current prices and current total expenditure must be systematically modeled if even the broad pattern of demand is to be explained in a theoretically coherent and empirically robust way". On the other hand, shifts in Engel curves could be predominantly explained by relative prices diminishing the role of other factors of socioeconomic change.

Analyzing the effect of changes in relative prices on the shifts of Engel curves requires a reasonable amount of temporal observations. The EVS provides a large amount of cross-sectional observations, but the availability of temporally comparable observations is limited. This is why we restricted our analysis to the waves from 1978 to 1993. By contrast, the UK Family Expenditure Survey provides limited observations at the cross-sectional level, but covers a large time span, from 1977 to 2006. For this reason, we use this latter source of data to explore the role of relative prices in the evolution of Engel curves. On the basis of the UK Family Expenditure Survey (FES) 1977–2001 jointly with the Expenditure and Food Survey (EFS) 2002–2006, Barigozzi and Moneta (2015) build a dataset that permits them to track expenditures of 100 "representative" households (i.e. artificial households which are representative of quantiles of total expenditure) over time.

The data set recovers information about total expenditure and expenditures on fourteen aggregated categories: (1) housing (net); (2) fuel, light, and power; (3) food; (4) alcoholic drinks; (5) tobacco; (6) clothing and footwear; (7) household goods; (8) household services; (9) personal goods and services; (10) motoring, fares and other travel; (11) leisure goods; (13) leisure services; and (14) miscellaneous and other goods. The 14 categories add up to total expenditure. The last category is omitted from the analysis because it amounts to a very small share of total expenditure, so that we have 13 categories. In order to have samples of households that are demographically homogeneous, the data set controls for the number of members of each household and it considers four different possibilities: one member, two members, two or three members, and two to four members. In the results shown below

we restrict our analysis to the two-four members group.[4] Since we have 100 representative households each year (for the details of the procedure used to get the representative households see Barigozzi and Moneta 2015), and we pool 30 years (from 1977 to 2006), our sample size is 3000.

Consider the identity:

$$Exp_{it}^{j} = p_{it}^{j} \cdot q_{it}^{j} \tag{6}$$

where Exp_{it}^{j} are the expenditures of household i on category j at time t, p_{it}^{j} is the price observed by household i of category j at time t, and q_{it}^{j} is the consumed quantity of household i of category j at time t. Bringing prices on the left hand side of the equation provides the consumed quantity. Taking logs and first differences we get:

$$\Delta log\left(\frac{Exp_{it}^{j}}{p_{it}^{j}}\right) = \Delta log(q_{it}^{j}). \tag{7}$$

The term $\frac{Exp_{it}^{j}}{p_{it}^{j}}$ can be measured by using cross-sectionally estimated Engel curves that are based on expenditures that are corrected by category-specific deflators. For each household i, we evaluate the cross-sectional Engel curve for a given category j at time t for the household's level of total expenditure to obtain an estimate of $\frac{Exp_{it}^{j}}{p_{it}^{j}}$ which corresponds to q_{it}^{j}. We are interested in measuring the extent by which the changes in consumed quantity are driven by changes in prices. Therefore, we regress the estimate of the change in consumed quantity on the changes of prices of all categories to analyze which portion of the change in consumed quantity is the result of changes in prices:

$$\Delta log\left(EC_{it}^{j}(x_i)\right) = \alpha_i^{j} + \sum_{j}^{13} \Delta log\left(p_{it}^{j}\right) + u_{it}^{j} \tag{8}$$

where $EC_{it}^{j}(x_i)$ are the expenditures on category j for a given level of total expenditure x_i obtained by a cross-sectionally estimated Engel curve, α_i^{j} is a household specific effect, and $j = 1, ..., 13$ are the categories of goods and services. The distance between Engel curves over time is reflected by $\Delta log(EC_{it}^{j}(xi))$ and Eq. 8 analyzes which portion of this distance can be explained by changes in prices or changes that are associated with prices as well as by a household-specific constant. We can interpret $1 - R_{adj}^{2}$ as a measure for as a measure for the portion of $\Delta log\left(EC_{it}^{j}(x_i)\right)$ that is explained by changes in $\Delta log\left(EC_{it}^{j}(x_i)\right)$ that are induced by changes in the socioeconomic structure apart from changes in relative prices or changes that are associated with changes in relative prices.

Table 5 presents the $R_{adj.}^{2}$ for each category of expenditures. The role of prices in explaining the shifts of Engel curves seems to be limited for most of the categories.

[4]Results for the other member groups, which are not qualitatively different from the two-four members group, are available upon request.

Table 5 Adjusted R^2 of Eq. 8

Housing	0.17	Household goods	0.14
Fuel, light, and power	0.43	Household services	0.77
Food	0.16	Personal goods and services	0.25
Alcoholic drinks	0.17	Motoring	0.67
Tobacco	0.10	Fares and other travel	0.37
Clothing and footwear	0.20	Leisure goods	0.12

The adjusted R^2 is particularly low as regards housing, food, tobacco, household goods, and leisure goods. This means that relative prices do not play a major role in driving changes of expenditures devoted to such categories. As regards fuel, light and power, household services, motoring, fares and other travel, the adjusted R^2 tend to be larger, indicating that larger shares of the expenditures on these categories can be explained by changes in prices. These categories tend to reflect acquired needs such as mobility and household services. These patterns may be explained with the hypothesis that goods and services satisfying acquired needs display prices that are relatively decreasing over time in comparison with prices of goods and services connected with basic needs.

5 Conclusions

The aim of this paper has been to improve the empirical understanding of the dynamic patterns of demand. We have first presented cross-sectional estimates of Engel curves using German data between 1978 and 1993 and argued that the marginal propensity to consume is not an adequate notion to study the dynamic patterns of consumption because it is a hypothetical measure that assumes everything remaining constant as income rises over time. We have therefore introduced the notion of intertemporal propensity to consume, which has permitted us to identify the influence of factors other than household characteristics on the evolution of demand patterns. We link these other factors to socioeconomic change, describing the consumption environment such as innovations and status considerations.

The estimated Engel curves imply decreasing marginal propensities to consume as income increases for most categories of expenditures. The estimated intertemporal propensities to consume show that the implications of the marginal propensities to consume are systematically offset due to shifts of Engel curves over time. We have also addressed the issue of disentangling the role of prices within the socioeconomic structure. Our empirical results show that the role of prices is quite small as regards the UK data. For most categories of expenditure, changes in relative prices do not have a major influence on the expenditure path over time.

This raises the question as to which remainder of socioeconomic change is mostly responsible for the dynamic path of consumption. These factors may represent structural changes such as innovations in goods and services that change the structure of the markets. An important avenue of further research is to identify the

effect of single components of socioeconomic change on the evolution of Engel curves and the implied intertemporal consumption patterns. This avenue should also include an analysis of the interaction between firms and consumers. Moreover, our explorative results indicate that socioeconomic change has different effects on the different quartiles of the total expenditure distribution. An important finding is that the larger quartiles of the total expenditure distribution do not seem to be affected by intertemporal slowdowns in consumption, though the static cross-sectional analysis systematically suggests this. Future research may continue on this finding, elaborating the role of the income distribution in dynamic consumption patterns. This should be related with a more deep analysis of heterogeneity in tastes and preferences across households. In our terminology, this means relaxing the assumption that the socioeconomic structure is the same for all households (within a time interval). Important insights to explore this avenue of research, which from an empirical point of view has to be addressed using longitudinal data, are found in Calvet and Comon (2003) and Lewbel (2007).

Our results also offer some insights to an important question about the future of consumption: *does private consumption slow down?* Our results suggest that, if the socioeconomic structure remains stable, private consumption does slow down. As far as our data are concerned, however, private consumption does not slow down, because the evolution of the socioeconomic structure prevents the slowdown. We can speculate, although our empirical results cannot show any evidence of this, that technological innovation plays an important role in shaping socioeconomic structural change. If this is true, a persistent slowdown in innovation in all sectors is likely to cause a slowdown in private consumption.

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