Demographic versus expenditure flexibility in Engel curves

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Abstract We consider the effects of demographic and expenditure variables on consumer demand in a system of Engel curves using a smooth coefficient semiparametric model where the expenditure effects on the budget shares vary nonparametrically with demographic variables such as the age of head and number of children in the household. Our findings, based on UK micro data, suggest that with a smooth coefficient semiparametric model there is no need for nonlinear logarithmic expenditure effects in the budget shares. Furthermore, we find evidence of a trade-off between demographic and expenditure effects in Engel curves and that a rank-2 system of Engel curves where the logarithmic expenditure effects are allowed to vary with demographic characteristics either nonparametrically or as a third degree polynomial function cannot be rejected against a rank-3 (quadratic logarithmic) model. The implications on household behavior and welfare are also examined.

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1 Introduction

There has been considerable interest in econometrics in developing models that incorporate both parametric and nonparametric components. The regression relationship is usually expressed in terms of variables that enter parametrically because they are known to interact with the dependent variable in a specific way, and those that enter nonparametrically since there is no a-priori reason for them to follow a particular pattern.

In the context of Engel curves most empirical studies allow demographic and other household characteristics to enter parametrically and expenditure to enter nonparametrically. This is because knowledge of the expenditure effect on demand is of primary concern in analyzing consumer behavior and welfare and the use of nonparametric methods is part of the effort to find appropriate ways of modeling this effect in empirical applications. In particular, investigators have been interested in the rank of demand system, the maximum dimension of the expenditure space spanned by Engel curves, given that demand systems with a rank above three cannot be integrable (Gorman 1981; Lewbel 1991).

This paper is motivated by the empirical finding that while the rank of Engel curves tends to be above three in studies that do not control for demographic heterogeneity in preferences (Grodal and Hildenbrand 1992; Hildenbrand 1994; Kneip 1994), it becomes three when either (a) a relatively small, demographically homogeneous subset of data is used (Lewbel 1991; Banks et al. 1997; Donald 1997; Hausman et al. 1995); or (b) the effects of demographic heterogeneity are removed using a semiparametric estimation technique (Lyssiotou et al. 1999a,b). These findings suggest that the effects of demographic characteristics on consumer demand may not be as uncomplicated as commonly assumed and a search for an appropriate Engel curve specification may have to place as much emphasis on avoiding a-priori restrictions on demographic effects as it does on the expenditure effects.

To examine this issue, we employ a smooth coefficient model combining parametric and nonparametric components: the large number of household characteristics typically captured by binary variables (gender, housing location and tenure, occupation etc.) enter linearly while important demographic variables such as the age of the household head and/or the number of children, are allowed to directly affect the coefficients of the model. Thus, unlike the linear semiparametric model, the smooth coefficient approach yields expenditure effects that vary with consumer characteristics. In fact, it is a special case of a varying coefficient model offering a particular way of combining parametric and nonparametric components, see Fan and Zhang (1999), Cai et al. (2000a,b) and Zhang et al. (2002). Li et al. (2002) used such a model to estimate the production function of the non-metal mineral industry in China.