The Accumulation Structure of Consumer Durables
and its Empirical Analysis

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Summary: For market research and other purposes it is of interest to know the accumulation process of consumer durables, and in particular whether almost all households acquire durables in the same order or whether almost all households acquire a certain durable at the same level of the accumulation process. The first part of the article describes the accumulation process and its structure. In the second part estimation and test procedures are proposed for analyzing empirically the accumulation structure. The test procedure is compared with Paroush’s methods. In contrast to Paroush’s method the relation between “almost all households” and the test statistic is now intelligible. Numerical examples illustrate the difference of both approaches.

Introduction

By purchasing durable goods in the passage of time a household is accumulating its stock of durables. The household can accumulate the durables in different orders. For each order there may exist a fixed proportion of households in a population choosing the same order. The fixed proportions are called the accumulation structure of the population. The structure of accumulation will be analyzed empirically in this article.

In section 1 we describe the choice and purchase behaviour of households that lead to the accumulation structure. The empirical analysis of the accumulation structure is presented in section 2. Estimation and test procedures are proposed and compared with Paroush’s methods [1965 and 1973]. Numerical examples illustrate the difference of both approaches.

1) This paper is an abridgement of the longer working paper “Accumulation Model of Consumer Durables and the Structure of Accumulation”. The working paper may be received upon request.

1. Accumulation Model of Several Durables and its Structure

1.1 Main Feature of the Accumulation Model

A durable is a unit which generates a flow of services over several periods. For example, televisions sets, refrigerators, and washing machines are durables if the unit of a period is, say, a year, since the life span of such household appliances certainly exceeds one year.

Our empirical analysis will be based on aggregates of products, called durable or good. A convenient rule for aggregation of products is based on Lancaster's approach. Here products have associated with them characteristics which are directly relevant to the consumer. A technology of consumption allocates a certain bundle of characteristics to the product independently of the individual taste. An aggregation rule of products into a good refers to the characteristics instead of the preference structure [compare Lancaster, in particular chapter 8, Group analysis]. Associated with every product is at least one positive characteristic. These characteristics are denoted as group characteristic [compare Lancaster, pp. 132 and 133]. Possibly a great number of products can be aggregated into one good. For instance, cars irrespective of the size and of age can be regarded as one good in this sense. On the other hand, cars, refrigerators, washing machines, vacuum cleaners and television sets are distinct goods. One convenient choice of characteristics to identify these goods, is for example transportation per dollar of gas, washing capacity, cleaning power, choice of programs.

Consider now $G$ distinct durable goods ($G \in \mathbb{N}$). There exist $2^G$ different bundles of goods. A bundle is denoted by a set $J$ containing certain durables. Let every good be represented by an integer number $g$ ($g = 1, 2, \ldots, G$). The set of all durables is denoted by $V := \{1, 2, 3, \ldots, G\}$ and the potential set of $V$ by $W$. Consider a household having a set $J$ of durable goods at a given point of time. The household will enlarge its set in the future by buying further durables.

With respect to the accumulation process we call the bundle $J$ the position of accumulation and the number of goods in the bundle $|J| = k$ ($k = 0, 1, 2, \ldots, G$) the level of accumulation. The choice and purchase decision change the position of the household. By purchasing good $g$ in position $J'$, the household moves from $J'$ to position $J$, $J = J' \cup \{g\}$.

Let us consider a population of households accumulating durables in the period $(0, T)$. This period is subdivided in $T$ short periods of equidistant length. The period $(t - 1, t)$ is denoted by $t$ ($t = 1, 2, \ldots, T$). The number of durables are $G$. At beginning of the period 1 no household owns a durable and no household is dissolved in $(0, T)$.

With respect to households we distinguish two concepts. First, the household is the microeconomic unit choosing and purchasing durable goods. Assuming identical households the choice and purchase behaviour of these single households can lead to the accumulation structure of the population. Second, the household is a fictive but well defined unit which is called typical household. The typical household is randomly chosen out of a parent population. Thus, this typical household is a representative of the whole population and as such a macroeconomic unit. The choice and purchase behav-