

models can be made formally equivalent to the Tobit, Tobin (1958) model e

$$\begin{aligned}
 & x; 13 + u_i \\
 Y_i = & \begin{cases} \text{if } y \geq 0 \\ \text{otherwise} \end{cases} \\
 = & \quad , \qquad \qquad \qquad (104)
 \end{aligned}$$

and the estimation of this is well-understood.

However, there are a number of extremely difficult problems in applying the Tobit model to the analysis of consumer behavior_ First, there is typically more than one good and whenever the demand for one commodity switches regime (i.e. becomes positive having been zero, or vice versa), there are, in general, regime changes in all the other demands, if only to satisfy the budget constraint. In fact, the situation is a good deal more complex since, as will be discussed in Section 6 below, non-purchase is formally equivalent to a zero ration and the imposition of such rations changes the functional form for other commodities in such a way as to generate both income and substitution effects. With a *n* goods in the budget, and assuming at least one good purchased, there are $2^n - 1$ possible regimes, each with its own particular set of functional forms for the non-zero demands. Wales and Woodland (1983) have shown how, in principle, such a problem can be tackled and have estimated such a system for a three good system using a quadratic (direct) utility function. Even with these simplifying assumptions, the estimation is close to the limits of feasibility. Lee and Pitt (1983) have demonstrated that a dual approach is as complicated. An alternative approach may be possible if only a small number (one or two) commodities actually take on zero values in the sample. This is to condition on non-zero values, omitting all observations where a zero occurs, and to allow specifically for the resulting sample selection bias in the manner suggested, for example, by Heckman (1979). This technique has been used by Blundell and Walker (1982) to estimate a system of commodity demands simultaneously with an hours worked equation for secondary workers.

The second problem is that it is by no means obvious that the Tobit specification is correct, even for a single commodity. In sample surveys, zeros frequently occur simply because the item was not bought over a relatively short enumeration period (usually one or two weeks, and frequently less in developing countries). Hence, an alternative to (104) might be

$$\begin{aligned}
 & y = x; 13 + u_i, \\
 & = \quad \text{with probability } \gamma_i,
 \end{aligned}$$

$y = 0$) with probability $(1 - \theta)$. (105)