Hence, if, $p(u_i)$ is the p.d.f. of u, the likelihood for the model is

$$L = \mathbf{11}\ (1 - {}^{7}\mathrm{r},\ )\quad \mathrm{P}\qquad xfii^{9} \tag{106a}$$

This can be maximized directly to estimate 13 and Tr, given some low parameter specification for $v.,$. But note in particular that for = /7. for all i and $u,$ taken as ii.d_N(0, 0^2) the likelihood is, for n, the number of zero A's,

$$= WY' \qquad 77' \,71 \tag{106b}$$

Hence OLS on the positive y,'s alone is consistent and fully efficient for *Pqr* and 6/7r. The MLE of /r is simply the ratio of the number of positive y,'s to the sample size, so that, in this case, all parameters are easily estimated. If this is the true model, Tobit will not generally be consistent. However, note that (105) allows y_i to be negative (although this may be very improbable) and ideally the Tobit and the binary model should be combined_ A not very successful attempt to do this is reported in Deaton and Irish (1984). See also Kay, Keen and Morris (1984) for discussion of the related problem of measuring total expenditure when there are many zeroes.

In my view, the problem of dealing appropriately with zero expenditures is currently one of the most pressing in applied demand analysis. We do not have a theoretically satisfactory and empirically implementable method for modelling zeroes for more than a few commodities at once. Yet all household surveys show large fractions of households reporting zero purchases for some goods. Since household surveys typically contain several thousands observations, it is important that procedures be developed that are also computationally inexpensive.

There are also a number of other problems which are particularly acute in cross-section analysis and are not specific to the Tobit specification. *Heteroscedas-ticity* tends to be endemic in work with micro data and, in my own practical experience, is extremely difficult to remove. The test statistics proposed by Breusch and Pagan (1979) and by White (1980) are easily applied, and White has proposed an estimator for the variance-covariance matrix which is consistent under heteroscedasticity and does not require any specification of its exact form. Since an adequate specification seems difficult in practice, and since in micro studies efficiency is rarely a serious problem, White's procedure is an extremely valuable one and should be applied routinely in large cross-section regressions. Note, however, that with Tobit-like models, untreated heteroscedasticity generates inconsistency in the parameter estimates, see Chapter 27, thus presenting a much more serious problem. The heteroscedasticity introduced by *grouping* has become