

ECONOMICS 245B  
EXERCISE 3

Consider a model of household demand that consists of a system of regression equations. The budget share directed to demand for category  $g$  is given by the nonlinear regression

$$Y_{gt} = h_g(X_t, \beta) + U_{gt}, \quad t = 1, \dots, n$$

in which  $X_t$  and  $\beta$  are  $K \times 1$  vectors and  $h_g$  is a known function.

a) What does the fact that the budget shares sum to one for each  $t$ ,  $\sum_{g=1}^G Y_{gt} = 1$ , imply about  $(U_{1t}, \dots, U_{gt})$ ?

b) Let  $Y_t$  and  $U_t$  be  $G \times 1$  vectors and let  $h(\cdot)$  be a vector-valued function. The full system of  $G$  budget shares is

$$Y_t = h(X_t, \beta) + U_t,$$

in which  $U_t$  is i.i.d. with density  $f(u, \theta)$ . To estimate  $\beta$  (by maximum likelihood), do we need to estimate all  $G$  equations?