SHORT-TERM CONSUMPTION BEHAVIOR, SEASONALITY, AND LABOR MARKET UNCERTAINTY IN RURAL INDIA

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CONTENTS

LIST OF TABLES

LIST OF APPENDIX TABLES

LIST OF FIGURES

ABSTRACT

This paper examines the short-term consumption behavior of a sample of Indian rural households observed over 52 weeks. We focus on the effects of uncertainty in employment opportunities and labor income faced by the household members. We estimate season-specific and person-specific probabilities of unemployment due to illness and other involuntary causes for every sample individual, and we construct corresponding household-level measures of expected income loss and volatility. These measures are used as explanatory variables in various consumption functions. We find that short-term income uncertainty causes a family to significantly reduce its consumption, but that predictable seasonal income volatility has no such effect. On the whole rural households respond more to transitory or unanticipated income than to permanent income, and this is more true of landless households than of cultivating households. We also note that illness causes great uncertainty, along with labor demand deficiency; the labor revenue sources of the rural households depresses consumption expenditure. The high volatility in revenue sources seems to affect low-income households more. All these indicate the necessity for appropriate food and income stabilization policies to secure such impoverished rural households from the dangers of poverty, malnutrition, destitution, starvation, illness, and death.

1. INTRODUCTION

The subject of consumption behavior has been a challenging area of research for at least half a century. Various theoretical and heuristic explanations have been provided for the observed pattern of consumption, behavior of household units, but of all the explanations Friedman's (1957) Permanent Income Hypothesis (PIH) has been the most controversial and has dominated research into consumption behavior. Many recent studies have been concerned with testing whether consumption (as observed in expenditure) responded only to the permanent component of income (Hall 1978; Flavin 1981; Nelson 1987; Campbell and Mankiw 1989).

Another stream of studies has focused on consumption behavior in low-income countries. This literature (notably Rosenzweig and Wolpin 1985; Lucas and Stark 1985; Rosenzweig 1988a, 1988b; Rosenzweig and Stark 1989) provides a rationale for the observed patterns of implicit contractual arrangements of families, especially marriage and migration and other household characteristics, in terms of consumption smoothing. The main thrust of this line of research is that agricultural activity is inherently risky and subject to various informational constraints and uncertainties, which prevent formal income insurance, thus implying that it is in the interest of the household and its members to form nonmarket arrangements to overcome such difficulties. These analyses have rationalized the existence of extended landed families, and their organization of production activities and informal contractual arrangements as a rational form of insurance against fluctuations in the standard of living. It is important to understand the implications of some of these models and their performance in explaining observed consumption and income variability patterns in the rural sector.[1]

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[1] Canagarajah (1991), Chapter 3, describes and rationalizes the main institutional responses to imperfect information and uncertainty in this village.

We focus on the implications of seasonality for agricultural activity and related uncertainty in labor opportunity and wage income for the consumption behavior of the rural households. Thus, our analysis differs from the above-mentioned literature, although it is also concerned with the responses of rural agrarian households to income risk. We use a data set that spans 52 weeks for a sample of 40 Indian households from a single village. It thus differs from other common forms of panel data that have an annual or quarterly breakdown. A second distinctive feature of our study is that it highlights the risks faced by the individual members of the households in their dealings in the labor market from unemployment caused by demand deficiency or illness. We formulate the expectation and standard deviation of income loss through these causes for each individual and then aggregate over working household members to give measures for the household as a whole. The probabilities of unemployment due to illness and involuntary reasons are estimated for each week of the year, using a nonlinear logistic function estimated at the individual level. Thus the importance of uncertainty for each individual working member is highlighted, and household composition enters naturally into the final measure of exposure to income risk. We incorporate these ideas into a series of simple consumption models that differ in their functional form and the measure of consumption used as the dependent variable. Each model is an explicit closed-form approximation of the optimal consumption-income relationship, rather than the indirect Euler equation representation used by Hall (1978) and others.

In our estimation, we take account of an important statistical problem raised by the very short-term nature of our data. When recorded on a weekly basis, conventional expenditure measures of consumption are often zero in the sample. These zeros do not represent a corner solution and are actually fortuitous, as every individual has to consume some food every day in order to survive. Therefore, neither sample truncation nor the use of the Tobit technique is appropriate here. Instead we apply a P-Tobit model to accommodate this fortuitous nature of the zeros (Deaton and Irish 1984; Blundell and Meghir 1987; Pudney 1989).

This paper is organized as follows. Section 2 describes the data set and provides a preliminary analysis of the measures of consumption and income.

Section 3 outlines a theoretical model that forms the basis for the following empirical exercise and provides a justification for the same. Section 4 deals with the econometric issues of the analysis. Other than discussing the econometric framework, it also presents two variants of the consumption function used in the estimation and also discusses other estimation, diagnostic, and specification issues. Section 5 reports and discusses the econometric results, along with some extensions and consistency checks, and Section 6 concludes with a summary of the main findings. Definitions and summary statistics of the variables used in the study and some ancillary estimations carried out in relation with this study are given in the Appendix.

2. DESCRIPTION OF DATA

Our data set comes from a single village, Dokur, 124 kilometers south of Hyderabad in Mahbubnagar District of Andhra Pradesh State of India.[2] Although the village is in a dry district, it has numerous reservoirs, tanks, and wells, built by ancient rulers and modern local governments. These provide irrigation facilities for rice cultivation and other crop production, which is usually carried out by farmers year round. The prevalent red soil of this village can hold very little moisture and soil erosion is an additional problem. Recent estimates based on census information reveal that there are roughly 400 households in the village, with a total population of around 4,000. The main cultivation period is during the rainy season (*kharif*), from June to September or July to November, depending on the time of ploughing. *Rabi*, the second main season, lasts from December to March or April. Out of the cropped area, 48 percent is under paddy, 29 percent under groundnut and groundnut mixtures. The common form of crop rotation is sorghum-pigeon pea intercrop followed by groundnut-pigeon pea (Asokan et al. 1985). Land is the major asset and constitutes 60 percent of the total asset value of the households in Dokur. "Leasing-in" and "leasing-out" of land is mainly due to the "balancing effect" in resource ownership (Jodha 1984). Share cropping is the most common arrangement in the village. Labor earnings constitute the second largest component of average household income, next to cultivation. All landless, small, and medium landowners and some large landowning family members participate in the village agricultural labor market. Daily rated labor, regular farm servants, and group contracts are the prominent forms of labor relations observed in this village. Labor scarcity and peak demand in the village occurs during June, July, and November, when agricultural activity is highest and immigrants flow into Dokur from neighboring villages. Males are paid around Rs 13 to 15 per day all year.

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[2] See Canagarajah (1991), Chapter 1, for an extensive discussion of the village characteristics, nature, and quality of the data set.

Female wages are around Rs 11 from December to April, Rs 3 September to October, and Rs 5 through the rest of the year. Agricultural activity is gender-related, with males performing heavy tasks and females performing less strenuous tasks. Out of the total labor input requirement, 48 percent comes from hired labor with women contributing most of it. Service castes receive pay in kind for their services, which is referred to as the *Jajmani* system.

The Institute for Rural Health Studies sample, which is used for the present study, was chosen on the basis of households with a resident child under five whose mother either worked as an agricultural laborer or belonged to a cultivating family. The sample consisted of 40 households and 349 individuals, of whom 182 actively participated in the labor market. Similar to the whole village proportions, the sample had 72.5 percent of households with their own cultivation or agricultural labor as their main occupation. *Reddy* castes were mostly cultivators, while *Harijan* castes were predominantly laborers. Nine and two-tenths percent of the sample working population worked as permanent servants.

The data used in the present study were collected from April 1982 to April 1983 over 52 weekly rounds by two investigators.[3] The data set is quite extensive in its coverage and contains information relating to most of the socioeconomic aspects of the village. The variables used in the present study were generated from files relating to the census and the survey questions related to diet, morbidity, health, anthropometry, labor force participation, economic transactions, crop production, and assets.

The census contained information about household demographic structure and economic activity. Dietary recall had 52 rounds of information on how much and what type of food was consumed by the individuals during the previous week. In order to be able to cover 20 households each week, the two investigators had to interview an average of four households per day. Once every quarter morbidity records were collected with the help of a physician. Anthropometric information on every individual in the sample was collected over 13 monthly rounds. Fifty-two rounds of data were gathered on economic transactions for each household, covering all components of income and expenditure. A balance sheet format was

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[3] The two investigators resided in the village throughout the survey period except for one week, the records for which were collected the following week.

used to obtain this information in order to maintain consistency and to allow cross-checking.

The file on labor force participation also contains 52 rounds of information on all working members of the household, both adults and children, for each day of the previous week on a recall basis. The following information was collected in relation to labor participation: the general labor pattern (on-farm or off-farm); principal work pattern for the given week; days spent on various activities — in agricultural (own farm or agricultural labor), as a permanent servant, in shepherding or animal care, on other business, etc.; income earned in cash and kind (if in kind the product and its quantity); days not worked, reasons for not working, and number of days for each reason. Most of the variables were constructed or generated from this comprehensive list of information on all working individuals.

The crops produced by each household were recorded at harvest. Information was collected on the amount of crop sold, stored for family consumption, given to laborers as payment for services, and given as payment towards interest and capital of debt, along with the value of the crop at the time of transaction.

The nutritive value of food consumed was converted using tables of average nutritive values for Indian food items (Rao et al. 1959) and the recommended daily allowance for Indians was used (Gopalan et al. 1977) to construct the value for energy consumption in relation to the requirement. We also constructed a very simple nutritional index, using a crude hedonic regression to generate valuations of the major food constituents. After deleting insignificant constituents, this index contained only calories and protein with weights 0.008 and 0.07, respectively. We use this as an indicator of nutritional status.

We start with a preliminary analysis of the village income, expenditure, and nutrition variables. In these calculations, income in any week is defined as wage income plus the operating surplus of any domestic landholding, both included only when actually received in that week. The wage component of income includes the current market valuation of any payment in kind, at the time the payment is received, other than the cash income received as payment for labor. Note that this may differ from the time the corresponding labor is supplied, since payment in advance (usually in kind) is a widespread form of credit in this village.[4] The operating surplus is more problematic still. We define this component of income as the output of the farm harvested during the week, valued at current prices, less any payments (in cash or kind) to hired laborers and other input costs on which we have information. We do not have sufficient information to subtract other farm costs, such as the purchase of seed and equipment; consequently, we are forced to overestimate landowning households' disposable income (Deaton 1990). Similarly, for most households the food expenditure is underestimated since respondents report only the major expenses and do not disclose other small expenses related to food which they deem unimportant.[5] This also leads to many zero entries in the food expenditure records, a feature which is similar to the misreporting problem highlighted by Deaton and Irish (1984).

Using the coefficient of variation as a summary measure, Table 1 reveals a very low variation in both food and total expenditure when compared with wage and total income. Nutritional intake varies even less.[6]

The simple measures of relative volatility presented in Table 1 suggest, unsurprisingly, that the high level of short-term income variability is smoothed somewhat in total expenditure, still more so in food expenditure, and is very low indeed in the basic physical nutritive components of consumption. Figures 1 through 3 illustrate the seasonal component of this variation. They show average household income and expenditure, average wage income and nonwage income, and

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[4] It would be more natural to treat this explicitly as a credit agreement, and to count the payment as income accruing in the week the work was actually done, with the corresponding consumption taking place in the week the payment is received. Such a convention would emphasize the consumption smoothing aspect of the transaction. However, the structure and organization of our data set does not always allow us to identify the timing of the work, so this approach is not open to us.

[5] This is especially true of farmers who do not include some of their own produce they consume.

[6] An indication of the low variation in food expenditure in relation to other measures of income and expenditure according to various classifications of sample households can be observed from Tables A.1 through A.5 in the Appendix.

Table 1 — Coefficients of Variation of per Capita Expenditure, Income and Nutritional Intake

Variable	Coefficient of Variation
Wage Income	5.48
Total Income	4.21
Food Expenditure	3.05
Total Expenditure	3.13
Calories	0.14
Protein	0.19
Calcium	0.52
Vitamin C	0.88
Nutritional Index	0.26

Note: Coefficients of variations are measured around household means for all the variables.

Figure 1 — Pattern of Mean Total Expenditure and Income per Week

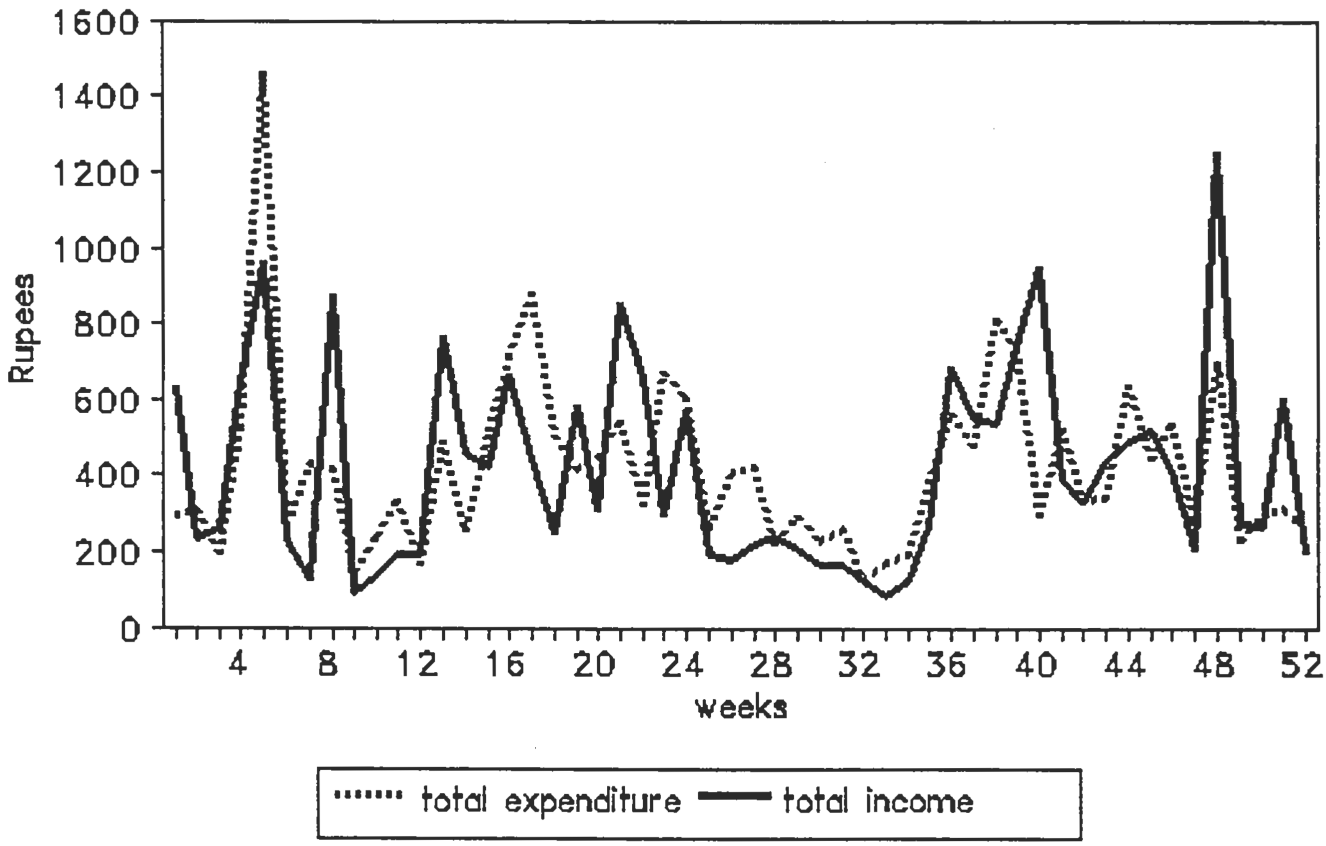


Figure 2 — Pattern of Mean Wage and Nonwage Income per Week

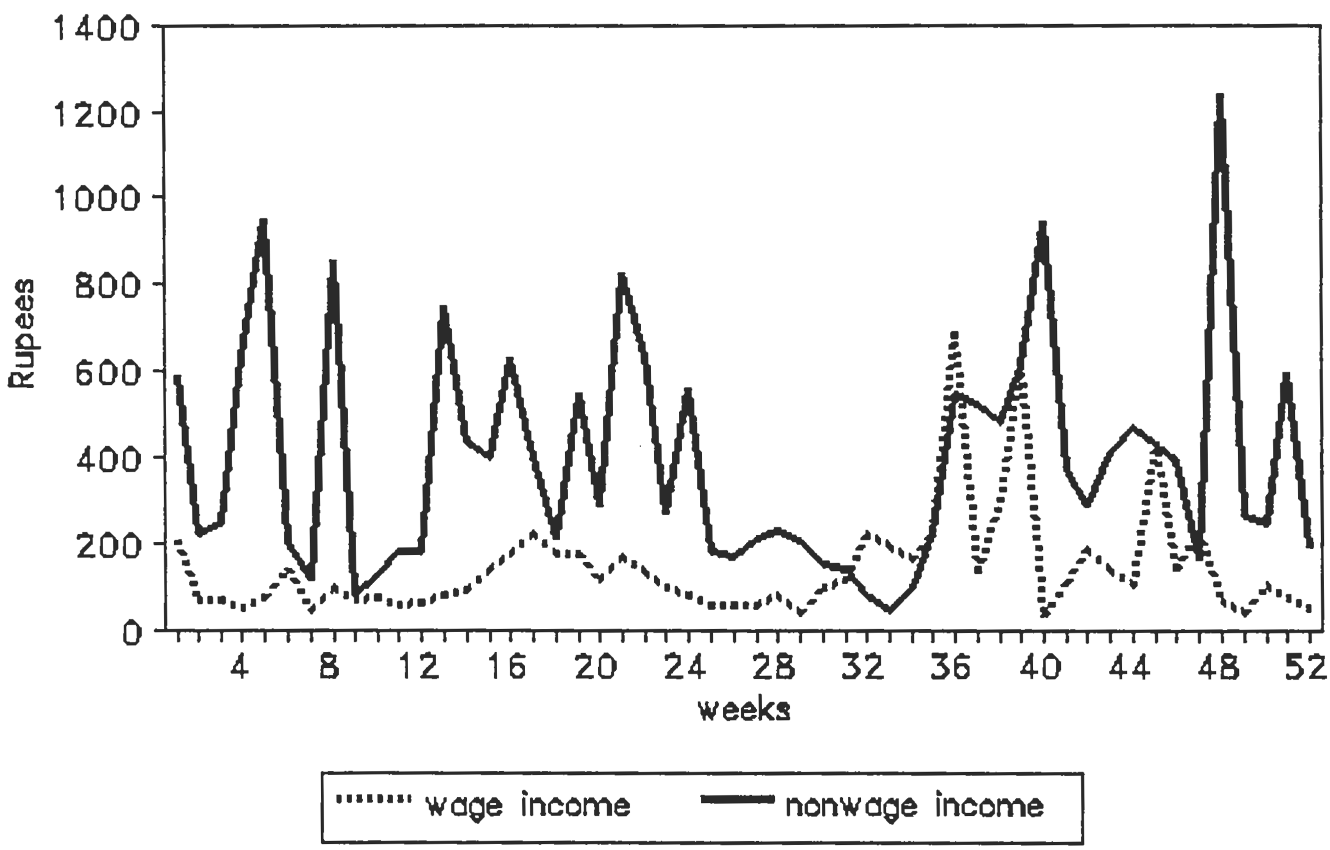
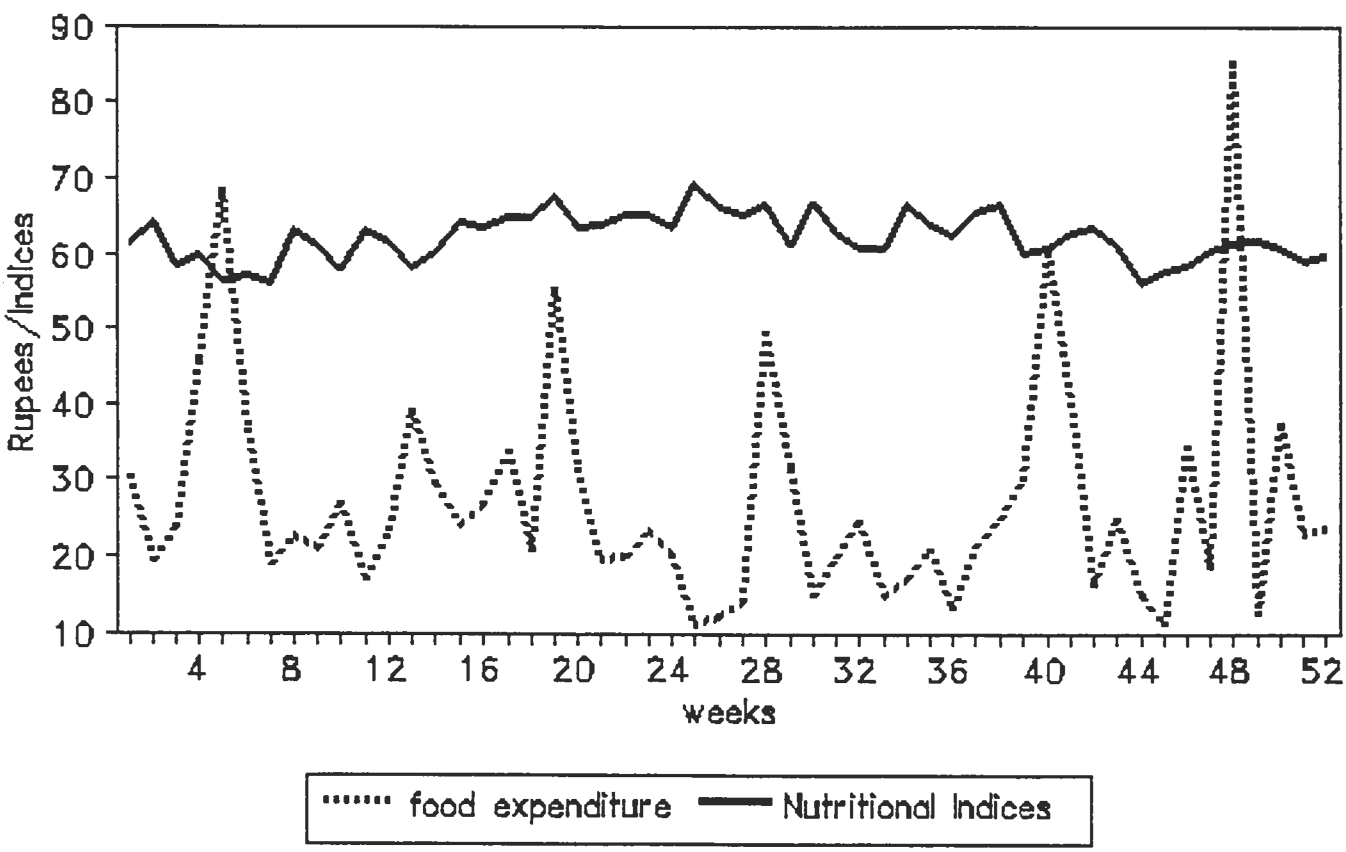


Figure 3 — Pattern of Food Expenditure and Nutritional Indices per Week



food expenditure and nutritional (kilocalorie) indicator of consumption for the sample households for 52 weeks, respectively.[7]

Income may be uncertain for many different reasons for each household member. We are particularly concerned here with the effects of income uncertainty stemming from ill-health or the nonavailability of paid work for household members. Survey respondents give information on the number of days in each week when they were out of the labor force through illness or seeking paid work but unable to find it.[8] The incidence of involuntary unemployment (and possibly also ill-health) is almost certainly understated by the survey, since some unemployed respondents chose to perform relatively unproductive work at home or on their own land and declare themselves to be working, rather than unemployed. The average level of interruption to labor supply through unemployment and ill-health is consequently rather low, averaging only 4.8 percent and 3.9 percent of total working days, respectively. Figure 4 shows the seasonal pattern of total number of days worked, while Figure 5 shows the seasonal pattern of the interruptions in employment due to illness and involuntary unemployment of sample household working members.

We now turn to a more structured analysis of this pattern of behavior.

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[7] Wage income has been multiplied by five in order to compare its pattern over the weeks with that of nonwage income.

[8] Minor complications, such as an individual who is both ill and lacking work opportunities, are ignored. This information is not available in our data set, so our treatment of uncertainty is an approximation.

Figure 4 — Pattern of Total Number of Days Worked per Week

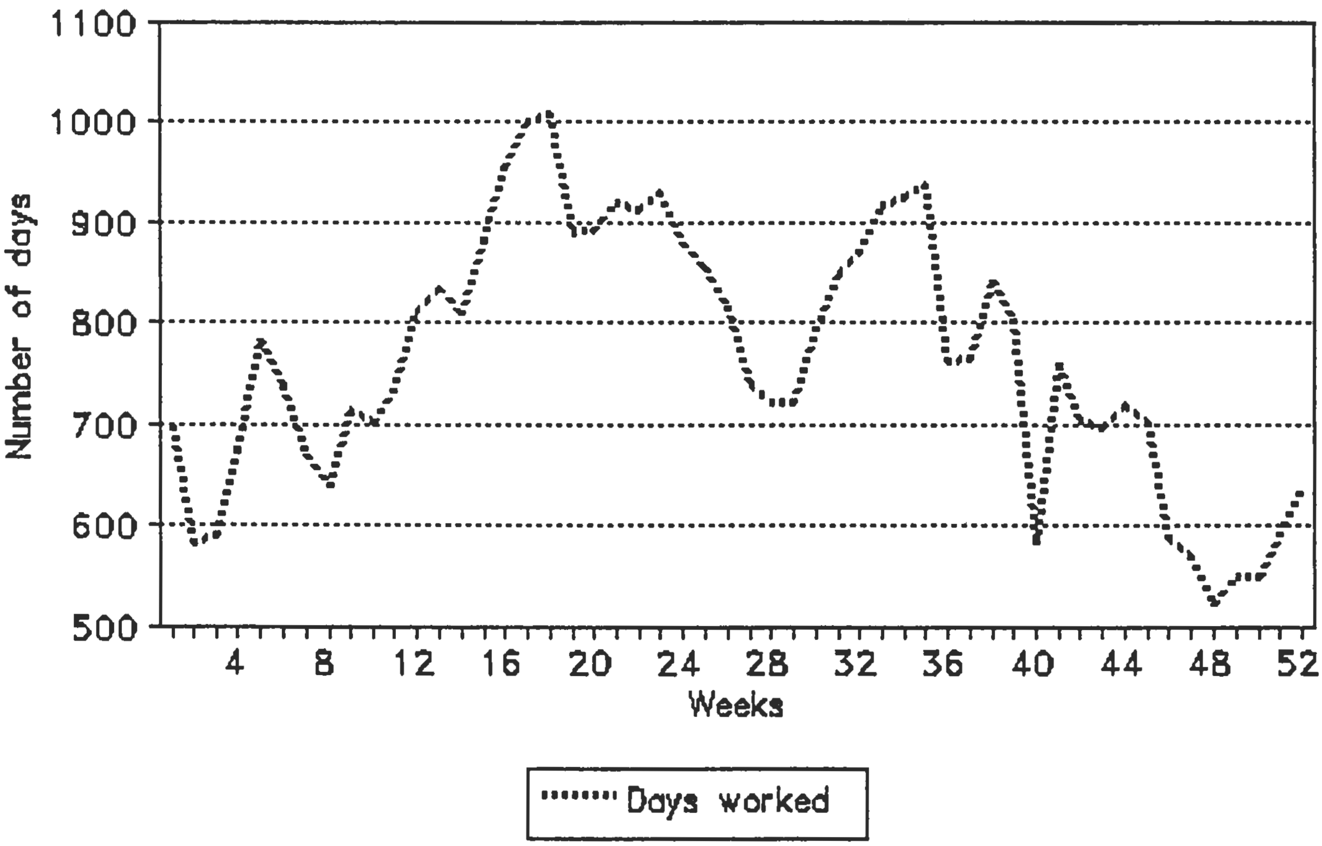
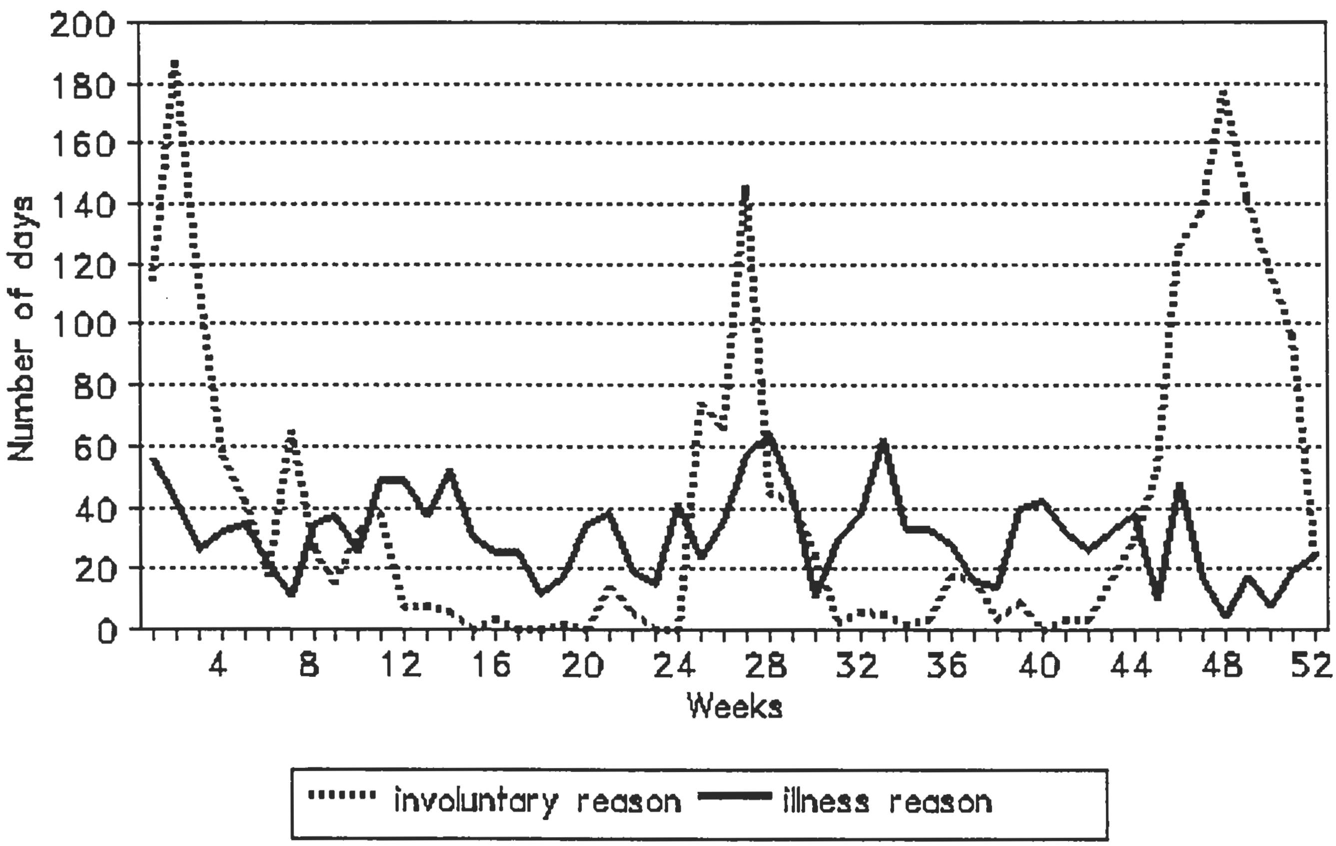


Figure 5 — Pattern of Involuntary and Illness Unemployment per Week



3. THE MODEL

Our sample contains a mixture of landed and purely laboring households. Consider a typical household with a small landholding, which receives income both from its own cultivation and from selling the labor of its members on the local labor market. Its basic resources are land, L, and its potential supplies of labor of various types, arranged in a vector λ. Given the anticipated trajectories of input and output prices through the year, this household will generate optimal levels of wage income, nonwage income, and consumption for every week t, which may be represented in many different forms. We write these planned levels in the following forms:

$$\tilde{y}_w(t) = \sum_i \tilde{d}_i(t) w_i(t) \quad (1)$$

$$\tilde{y}_{nw}(t) = g(L,\lambda,z) \quad (2)$$

$$\tilde{c}(t) = \alpha + \beta(\tilde{y}_w + \tilde{y}_{nw}). \quad (3)$$

Equation 1 is a structural equation for wage income, expressing planned wage income, $\tilde{y}_w(t)$, as the sum of planned days worked, $\tilde{d}_i(t)$, by each member of the household multiplied by $w_i(t)$, the wage commanded by that person in the labor market. Equation 2 is a reduced form expression, giving planned nonwage income, $\tilde{y}_{nw}(t)$, as a function of household preferences, z, and any other factors relevant to the household's decision, namely, L and λ. Equation 3 is essentially a consumption function of the *permanent income* type, expressing an index of consumption as a linear function of the year's average level of planned income. This consumption function can be justified under certain assumptions on preferences and production technology. However, we choose not to spell out a particular specification of the relationships underlying Equations 2 and 3, mainly because of the difficulties raised by the dynamics of production. Such high-frequency data complicates the relationship between farm surplus and the cumulated stream of past labor input. Rather than attempting a detailed formulation of the underlying relationships, we work with Equations 1, 2, and 3 as simple approximations.

4. ECONOMETRIC ISSUES

THE ECONOMETRIC FRAMEWORK

Our data set is unique in that observations on food purchases are available for each week for a total of 52 weeks for 40 households. Thus, the data are similar to cross-section surveys in which frequency of purchases over a brief period of the survey is recorded and used as an indicator of actual consumption. It is well-known in such circumstances that weekly purchases do not equal corresponding consumption and a zero observation in purchase does not mean zero consumption. Hence, zero observations do not indicate a corner solution to the consumer's utility maximization problem, nor do positive observations denote the true rate of consumption. In our case since everyone has to consume some food every day, and more so each week, the zero observations are fortuitous. These problems have been well-known to economists since the early days of Engel-curve analysis. Only recently did Deaton and Irish (1984) provide a basis for a solution.[9] Their formulation defines a true demand model in terms of unobservable consumption and a purchasing model, which links consumption and purchase. These form the basis of the *P-Tobit model*, which we propose to use in our estimation and the features of which are discussed in the following section.[10] The original specification of Deaton and Irish (1984) is a simple one, but many generalizations are possible as can be seen from the work of Blundell and Meghir (1987) and Pudney (1988; 1989).

THE P-TOBIT MODEL

Let $C_h^*(t)$ be the unobservable true rate of consumption of household h, at time t. If $C_h(t)$ is the observed total expenditure per week, summing over a long

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[9] This model belongs to the same family as the *double hurdle model* of Cragg (1971), which was applied to the case of demand for durable goods.

[10] The discussion on P-Tobit model draws heavily on Pudney (1989, 173-180).

period of time $C_h(t)$ would be equal to the true rate of consumption of household, which is determined by the household's demand function.[11] The precise relationship between these two will vary from one household to another, depending on household resource endowments, storage capacity, and other relevant household characteristics that determine household response to risk and uncertainty (Deaton 1990). If we denote all relevant observable determinants of the frequency of purchase (P_h) by ξ_h, the purchasing behavior can be represented by the probability

$$P_h = P\left[C_h^*(t), \xi_h\right]. \tag{4}$$

We know that on average consumption equals observed expenditure, i.e.,

$$\begin{aligned} E\left[C_h(t) \mid C_h^*(t), \xi_h\right] &= C_h^*(t) \\ &= E\left[C_h(t) \mid C_h(t), \xi_h\right] P\left[C_h^*(t), \xi_h\right]. \end{aligned} \tag{5}$$

Thus

$$E\left[C_h(t) \mid C_h(t) > 0, C_h^*(t), \xi_h\right] = C_h^*(t) / P\left[C_h^*(t), \xi_h\right]. \tag{6}$$

Therefore, conditionally on $C_h^*(t)$ and ξ_h, the P-Tobit model implies the following distribution for $C_h(t)$:

1. with probability $(1 - P_h), C_h(t) = 0$; and
2. with probability $P_h, C_h(t)$ is a random drawing from a distribution with mean $C_h^*(t)/P_h$, described by a probability density function $g\left[C_h(t) \mid C_h^*(t)/P_h, \xi_h\right]$.

The above model is only a statistical device for relating the unobservable to the observable. Hence we require specific forms for $P\left[C_h^*(t), \xi_h\right]$ and $g\left[C_h(t) \mid C_h^*(t)/P_h, \xi_h\right]$

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[11] Since we have continuous data for 52 weeks, we later develop a time aggregated model to approximate the true consumption responses and confirm the relationship estimated through the P-Tobit model.

and some assumption about $C_h^*(t)$. Deaton and Irish assume that $C_h^*(t)$ is determined by a conventional Tobit model as

$$C_h^*(t) \mid \xi_h \sim LCN(\gamma'\xi_h, \sigma^2, 0), \tag{7}$$

where *LCN* denotes lower censored normal distribution, $\gamma'\xi_h$ denotes expected value, σ^2 denotes variance, and 0 denotes the censoring point. The zeros generated by this model are to be interpreted as permanent nonconsumption or corner solution. Since zeros are fortuitous, some alternative specifications, like a log-normal model, would be suitable in the case of some commodities that everyone consumes always. That is,

$$log C_h^*(t) \mid \xi_h \sim N(\gamma'\xi_h, \sigma^2) \tag{8}$$

may perform better (Blundell and Meghir 1987; Pudney 1988).

In terms of purchase probability we can see that the standard Tobit model is a special case of the P-Tobit structure of Deaton and Irish. In the standard Tobit model

$$P\left[C_h^*(t), \xi_h\right] = 0 \text{ for } C_h^*(t) = 0 \tag{9}$$

$$P\left[C_h^*(t), \xi_h\right] = 1 \text{ for } C_h^*(t) > 0. \tag{10}$$

Deaton and Irish (1984) in proposing the P-Tobit model make the simplest possible generalization, by allowing for a constant value of P instead of 1 in Equation 10, i.e.,

$$P\left[C_h^*(t), \xi_h\right] = P \text{ for } C_h^*(t) > 0. \tag{11}$$

In its simplest form, a P-log-normal model with a constant probability of purchase arises from the following structure:

$$\begin{aligned} \log C_h(t) &\sim N(\beta' \xi_h(t), \delta^2) \\ C_h(t) &= C_h^*(t)/P \text{ with probability } P \\ &= 0 \text{ with probability } (1 - P), \end{aligned} \tag{12}$$

where $C_h(t)$ is observed expenditure and $C_h^*(t)$ is the true underlying rate of consumption. Such a model can be estimated very simply. The maximum likelihood estimator is asymptotically equivalent to the following two steps:

1. estimate P as the proportion of positive observed expenditures in the sample;
2. using only the positive observations, regress $log C_h^*(t)$ on $\xi_h(t)$, and subtract $log \hat{P}$ from the intercept term.

The resulting slope coefficients are consistent estimates of the consumption responses.[12]

As opposed to this we can replace the constant P by an exogenously variable P and generalize the constant P-Tobit to a variable *P-log-normal model*. We can model purchase-nonpurchase distinction via a probit relationship as

$$P_h = \Phi(\delta' \xi_h), \tag{13}$$

where δ is a vector of coefficients requiring estimation along with γ and σ, which, except for expanding the parameter space, does not materially alter anything.[13]

A two-step estimator of this P-log normal model, asymptotically equivalent to the maximum likelihood estimator, can be easily defined by performing the following:

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[12] Deaton and Irish (1984) point out that the model can be also seen as representing a misreporting model where with probability P any positive value will be misreported as a zero.

[13] The probit estimates reported for the present study in the Appendix (Tables A.6 and A.7) give evidence to the fact that the probability of purchase does vary exogenously and is not a constant. The Likelihood Ratio test of the null hypothesis, that slope coefficients are zero, is rejected.

1. run a simple probit analysis on purchase-nonpurchase dichotomy to estimate δ and form $\hat{P}_h = \Phi(\hat{\delta}' \xi_h)$;
2. regress $\log(\hat{P}C_h(t))$ on ξ_h using only the positive purchase. Except for the intercept term the procedure is still consistent even though $C_h(t)$ randomly deviates from $(C_h^*(t)/P_h)$.

The resulting slope coefficients are consistent estimates of the true consumption responses. Although these limited generalizations of the Deaton and Irish model are valuable, some unattractive features remain:

1. P_h is treated as independent of $C_h^*(t)$ whereas in reality one would expect P_h to be an increasing function of $C_h^*(t)$;
2. the nonstochastic nature of the relation in Equation 6 implies that, given the prevailing rate of consumption and frequency of purchase, goods are always bought in the same quantity. A realistic model would be to equate $C_h(t)$ to $C_h^*(t)/P_h$ only on average.

However, since these modifications would complicate the likelihood function and introduce cumbersome numerical integration, we choose to retain the exogenously variable frequency of purchase and nonstochastic relation of expenditure to consumption in the P-log-normal model discussed above as the basis of our estimation.[14]

DIAGNOSTIC ISSUES

The two-step estimation procedure adopted above for the P-log-normal model does not allow any meaningful specification and diagnostic tests to be performed. Since the error structure of the first stage probit analysis is unknown, we only estimate robust standard errors in the second step to treat for probable presence of heteroscedasticity. Our estimation also does not indicate substantial difference between normal and robust standard errors. These P-Tobit models are still in their early stages of development and not many diagnostic tests have

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[14] See Pudney (1988) for a model where the above modifications are successfully incorporated and estimated.

been defined yet. Thus we are unable to do any robust tests of the specifications or estimators.

However, given the unusually extensive information in our data set we check model consistency and adequacy with a "time aggregated" consumption model,[15] as mentioned above, regressing annual average consumption on various measures of income. We check for the consistency of the relationships identified in both the log-normal P-Tobit model and the "time aggregated" consumption model, the results of which are discussed in the empirical section. This proves to be a meaningful and efficient way of cross-checking the robustness of the results obtained from our initial estimates.

ALTERNATIVE SPECIFICATIONS

The basic tenets of the Permanent Income Hypothesis guide our investigation. Friedman stated that permanent consumption, C_p, is a fixed proportion of permanent income, Y_p. The ratio of C_p to Y_p depends on a set of variables, and is represented by Friedman (1957) as follows:

$$C_p = k(i,w,u)Y_p. \tag{14}$$

Thus, the ratio k is independent of the size of Y_p and dependent on i,w, and u, where i is the rate of interest at which consumer can borrow or lend; w is the ratio of nonhuman wealth to income, which indicates the relative importance of property and nonproperty income; and u represents factors determining consumer units' intertemporal preferences and aversion to risk. The strongest determining factors of u are the size and composition of the household (cf. Deaton 1990, 70 and 76).

Depending on the household's attitude towards risk, the scale of transitory factors affecting income may also be an important determinant of k. A suitable measure of uncertainty is the standard deviation of the probability distribution of the transitory components relative to the size of the corresponding permanent

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[15] The time aggregated consumption model is generally believed to better represent true consumption responses (cf. Pudney 1989, 174).

component. Using relationship Equation 14 as our basis of inquiry, we investigate the effects of labor market uncertainty on the consumption behavior of these rural households, for whom labor market uncertainty is such an important consideration (cf. Deaton 1990).

Below are two separate specifications that have the same objective but different ways of capturing the effects of the expectation of and uncertainty in income on the consumption behavior of these rural household.

SPECIFICATION 1

Initially we consider a specification of labor market uncertainty as follows. We first estimate the mean daily probabilities of interruptions to labor supply through illness, $\rho_{hi}(t)$, and loss of work through other involuntary causes, $\pi_{hi}(t)$ for each week, t, for each working member, i, of the h-th household. For this, we use a nonlinear logistic function with a set of explanatory variables which include age, education, fitness, time of the year, sex, and nutritional intake. We adopt a simple approach by assuming that each day's participation for any individual is an independent Bernoulli variate,[16] so that the number of days lost in a week is a Binomial $(7, \rho_{hi}(t))$ or $(7, \pi_{hi}(t))$ as the case may be.

Consider illness, the most basic of the interruptions to labor income. The mean of the Binomial distribution is:

$$E(\text{no. of lost days within week } t) = 7\rho_{hi}(t). \tag{15}$$

Assume now that $\rho_{hi}(t)$ depends on a set of variables $X_{hi}(t)$ through a logistic function:

$$E(\text{no. of lost days } / \ 7) = 1/(1 + \exp[-\alpha' X_{hi}(t)]. \tag{16}$$

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[16] We do not insist on this interpretation. Many different processes might give rise to an expected loss of income. One possible way this might be approximated is shown in subsequent equations for $\rho_{hi}(t)$ and $\pi_{hi}(t)$. Provided we include appropriate variables in X_{hi}, we can expect to achieve an adequate approximation.

Hence:

$$\rho_{hi}(t) = 1/(1 + \exp[-\alpha' X_{hi}(t)]) + u_{hi}(t), \tag{17}$$

where $u_{hi}(t)$ is a zero-mean random error. Thus α can be estimated consistently (albeit inefficiently) by running a nonlinear least squares regression, and a predicted probability then constructed as follows:

$$\hat{\rho}_{hi}(t) = 1/(1 + \exp[-\hat{\alpha}' X_{hi}(t)]). \tag{18}$$

A similar method is used to construct an estimate of $\pi_{hi}(t)$, which is the probability of occurrence of some secondary form of unemployment (including demand deficiency in the labor market). Since such unemployment can only occur when the individual is classified as fit for work, the appropriate regression equation is:

$$\begin{aligned} E(\text{no. of lost days}/(7 - \eta_{hi}(t))) &= 1/(1+\exp(-\beta' z_{hi}(t))) \\ \text{or } \pi_{hi}(t) &= 1/(1+\exp(-\beta' z_{hi}(t))) + \upsilon_{hi}(t) \end{aligned} \tag{19}$$

where $\eta_{hi}(t)$ is the number of days in week t that individual i has been unable to work due to illness; $z_{hi}(t)$ and $\upsilon_{hi}(t)$ are a vector of explanatory variables and a stochastic error term, respectively.[17] Now we can construct the variables for expected loss of income due to involuntary unemployment, $U_{hi}(t)$, and expected loss of income due to illness, $I_{hi}(t)$, for each working member i, of the h-th household, for week t. By aggregating over all the working members of each household we can estimate $U_h(t)$ and $I_h(t)$, i.e., each household's mean daily expected income loss through unemployment and illness respectively for each week t, as follows:

$$U_h(t) = \sum_{i=1}^{m} \hat{\pi}_{hi}(t) w_{hi}(t) \tag{20}$$

$$I_h(t) = \sum_{i=1}^{m} \hat{\rho}_{hi}(t) w_{hi}(t), \tag{21}$$

[17] The respective nonlinear fit obtained for $\hat{\rho}_{hi}(t)$ and $\hat{\pi}_{hi}(t)$ are reported in the Appendix (Table A.8). These were estimated using SHAZAM 6.1, which uses Quasi-Newton methods for estimation.

where $i = 1,\ldots,m$ is the working members in the household and $t = 1,\ldots,52$ is the number of weeks, respectively.[18]

On the other hand, aggregating over the weekly wage income, $W_{hi}(t)$, of working members in the family we could arrive at $W_h(t)$, which refers to the total wage income of the household in week t , which is defined as

$$W_h(t) = \sum_{i=1}^{m} W_{hi}(t). \tag{22}$$

$W_h(t)$ represents short-term seasonal expected income, while $U_h(t)$ and $I_h(t)$ represent short-term seasonal income uncertainty by the expected loss of income through involuntary unemployment and illness. Let nonwage income of household h at time t be denoted by $Y_h(t)$ with standard deviation σ_h. Let the annual averages of $W_h(t)$ and $Y_h(t)$ for each household h, i.e., $\overline{W_h}$ and $\overline{Y_h}$, represent permanent income under uncertainty, while $\overline{I_h}$, $\overline{U_h}$, and σ_h represent long-term uncertainty adjustment. We can represent very short-term resource constraints by $y_h(t)$ and $S_h(t) = \sum_{i=1}^{4} s_h(t-i)$, where $y_h(t)$ is current total family disposable income and $s_h(t)$ is net savings in week t , while $S_h(t)$ is net savings in the month ending in week t.[19]

Our first model of consumption of household h at time t , $C_h(t)$, can be expressed as a function of the above defined variables and a set of household composition variables $\underline{z}_h$ to account for other unobservable differences in

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[18] Wherever the mean daily wage rate was not available for a particular week, an average daily wage rate for the village of Rs 13 for males and Rs 5 for females was used as a proxy for $w_{hi}(t)$.

[19] Here net savings, $s_h(t)$, is defined as income minus expenditure in week t.

consumption patterns and preferences of these households, together with a family specific effect, u_h, and a random disturbance $\upsilon(t)$:[20]

$$C_h(t) = f(\overline{W_h},\overline{I_h},\overline{U_h},\overline{Y_h},\sigma_h,\underline{z_h},W_h(t),I_h(t), \\ U_h(t),y_h(t),S_h(t) + u_h + \upsilon(t)). \tag{23}$$

SPECIFICATION 2

Our second consumption specification uses time-specific and household-specific income volatility measures to represent uncertainty. Such variables can be calculated for the whole year and for the season and we can thus show how consumption expenditure varies over the seasonal cycle according to the expectation of, and uncertainty in, income.

In order to construct the expected income variable, in addition to the probabilities of illness and involuntary unemployment, we also have to construct an expected nonwage income variable. Nonwage income is approximated by fitting a Tobit model, since there are many zero values in the weekly observed variable. This fitted model then provides expressions for both the conditional expectation and variance of nonwage income. The expressions for the Tobit model non-wage income expectation, $\Omega_h(t)$, and its variance, $\omega_h(t)$, are constructed using the formulas given below (cf. Pudney 1989, 309):

$$\Omega_h(t) = \gamma'(t)\xi(t)\Phi(\gamma'\xi(t)/\sigma) + \sigma\varnothing(\gamma'\xi(t)/\sigma) \tag{24}$$

$$\omega_h(t) = \left[\sigma^2(\gamma'\xi(t)/\sigma)\right]\left[1 - \gamma'\xi(t)/\sigma\right]\lambda^*(\gamma'\xi(t)/\sigma) \\ + 2(\gamma'\xi(t)/\sigma)\lambda^*(\gamma'\xi(t)/\sigma) + (\gamma'\xi(t)/\sigma)^2, \tag{25}$$

where $\lambda^*(.) = \varnothing(.)/\Phi(.)$ is the complement of the inverse Mill's ratio; γ = Tobit coefficients; $\xi_h(t)$ = vector of explanatory variables; and σ = error standard

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[20] One way to estimate an equation like the one below is to use a within-group regression, which will remove u_h (but also $\overline{W_h},\overline{I_h},\overline{U_h},\overline{Y_h},\sigma_h$, and $\underline{z_h}$) from the equation. Alternatively, some form of random effects estimator could be used. However, the complications arising from zero observations preclude an estimation along these lines.

deviation. Here $\xi_h(t)$ could contain time of year, landholding, household size, dependency ratio, and family type. Given the probabilities of disruption in employment due to illness and involuntary unemployment, we can define the daily probability of interruption to labor supply, Q_{hi}, as follows:

$$Q_{hi}(t) = \rho_{hi}(t) + \pi_{hi}(t) - \rho_{hi}(t)\pi_{hi}(t). \tag{26}$$

Now we construct the expected income variable using our estimates of probabilities of illness and involuntary unemployment.

(1) Expected income for the season:

$$Y_h^e(t) = \sum_{i=1}^{m} (1 - [Q_{hi}(t)])7.w_{hi}(t) + \Omega h\ (t); \tag{27}$$

(2) Expected income for the year:

$$Y_h^e = \sum_{i=1}^{52} Y_h^e(t); \tag{28}$$

(3) Unanticipated income:

$$Y_h^u(t) = \sum_{i=1}^{m} \left(1 - \upsilon_{hi}(t)\right) w_{hi}(t) + [Y_h(t) - \Omega_h(t)], \tag{29}$$

where $\upsilon_{hi}(t)$ = number of actual days worked in a week t, $Y_h(t)$ is the observed nonwage income of household h in time t, 7. $w_{hi}(t)$ denotes the weekly average wage income, and $\Omega_{hi}(t)$ is the predicted nonwage income from the Tobit estimation. Similarly, we construct the uncertainty variables from the estimates of wage and nonwage income variables as follows:

(1) Standard deviation for the season:

$$\sigma_h(t) = \sqrt{\sum_{i=1}^{m} Q_{hi}(t)[1 - Q_{hi}(t)]7.w_{hi}(t) + \omega_h(t)}; \tag{30}$$

(2) Standard deviation for the year:

$$\sigma_h = \sqrt{\sum_{i=1}^{52} \sigma_h^2(t)}, \tag{31}$$

where $\omega_h(t)$ is the variance function of the Tobit model fitted to nonwage income.

Note that Equation 30 assumes a zero covariance between the random components of wage and nonwage income. In the short run, this is a reasonable assumption, because of the lag between work put into the household's own land and the eventual return on that labor. In the sample, the correlation (about household means) between wage and non-wage income is -0.001.

Now we could define our second model for the analysis of the role of permanent income and uncertainty variables on consumption expenditure, $C_h(t)$, as follows:

$$C_h(t) = f\left(Y_h^e, Y_h^e(t), Y_h^u(t), \sigma_h, \sigma_h(t), \underline{z_h}\right) + u_h + \upsilon_h(t)\Big). \tag{32}$$

Both specifications are defined in terms of log-linear forms in our estimations. Both specifications are run under constant P-Tobit and variable P-Tobit estimation methods and also under the "time aggregated" consumption model regressions. The results of these experiments are discussed in detail in the following section.[21]

21 LIMDEP 5.1 (Greene 1989) is used for estimating these specifications.

5. EMPIRICAL RESULTS

Given that least squares estimates based either on the whole sample or subsample of nonzero observations are biased and inefficient, and similarly the conventional Tobit model approximates a corner solution model, we report only the results of the P-log-normal model. The estimates are carried on the alternative specifications, already discussed, using the log of food expenditure as the dependent variable, ln $(C_h(t))$, and the log of expectation and uncertainty measures of various sources of income together with household characteristics as explanatory variables. The estimations are carried out on a sample of 1,845 observations, which had positive consumption expenditure observations in line with the P-log normal model. Each specification is estimated for *variable P-Tobit model* and *constant P-Tobit model*.[22] We present t-ratios corrected for White standard errors in all our estimations, although it is not certain whether this is a valid method to treat the unknown error structure ensuing from two-stage estimation adopted in the case of P-Tobit models.

In line with Friedman's permanent income hypothesis (PIH) we first incorporate variables to represent the permanent and transitory component of income. We also develop variables to reflect the uncertainty of income in order to get an appreciation of its effect on consumption expenditure. Wherever possible we try to incorporate the above effects for short and long run considerations. Other than these we include a set of household characteristics to reflect their influence on household consumption preferences (cf. Deaton and Case 1987; Strauss 1986, 123). For instance in specification 1 we represent

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[22] Equations 1 and 3 denote *variable P-Tobit* model, while Equations 2 and 4 display the results for *constant P-Tobit* model. The results seldom show any difference in the estimates, the main difference being small deviations in either the size or the significance of estimated coefficients. Given the ability to capture the dynamics of purchases and consumption and also because we have already established in Appendix Tables A.6 and A.7 that the probability of food purchase is exogenously varying, we prefer the *variable-P* model.

effects of expectation and uncertainty in income through the mean and standard deviation of preliminary wage and nonwage variables, while in specification 2 we construct variables from the preliminary set of variables specifically to measure the above mentioned effects.[23] Thus, both specifications have the same objective, but different approaches. We expect to achieve some consensus on the effect of various components of expectation and uncertainty of income on consumption through trials of the two different specifications. Since Friedman himself states that statistical discrimination plays a very important role in these kinds of issues (cf. Friedman 1957, 23), we try to see how the variation in the specifications enables us to capture the significant components of expectation and uncertainty in the consumption behavior of rural households.

PRELIMINARY SPECIFICATIONS

In this section we focus on the preliminary specifications defined in previous sections. In specification 1, the permanent income variable based on the wage, $\overline{W_h}$, assumes a very significant and negative relationship, contrary to our expectation, in line with the standard PIH (see Table 3). The short-term counterpart of this variable, $W_h(t)$, is completely insignificant.

However, the permanent nonwage income, $\overline{Y_h}$, assumes a positive coefficient with an elasticity of 0.13 in the variable P model. This indicates the importance of the nonwage or budget balancing income variable, as opposed to permanent wage income. The measures of short-term resource constraints, $S_h(t)$ and $y_h(t)$, are highly significant and positive, having elasticities of 0.02 and 0.07, respectively, with respect to consumption expenditure. This further emphasizes the importance of transitory factors in the consumption function as opposed to permanent components of income. We also find strong evidence for the negative effect of income uncertainty through illness and involuntary unemploy-

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23 The mean and standard deviations of variables used in both specifications are shown in Table 2.

Table 2 — Descriptive Statistics of Variables — Specification 1 and 2

Variable	Mean	Standard Deviation
$C_h(t)$	27.43	86.050
$W_h(t)$	28.65	154.300
$I_h(t)$	0.91	0.476
$U_h(t)$	0.84	1.190
$y_h(t)$	418.00	1760.800
$S_h(t)$	-12.31	2776.500
$\overline{W}_h$	28.65	31.330
$\overline{I}_h$	0.91	0.294
$\overline{U}_h$	0.84	0.336
$\overline{Y}_h$	389.30	1757.700
σ_h	978.00	1390.100
C_h	27.43	19.510
$\overline{Y}^e_h$	41856.00	17727.000
$\overline{Y}^e_h(t)$	804.90	343.400
$\overline{Y}^u_h(t)$	416.90	1755.700
σ_{yh}	11942.00	148.70
$\sigma_{yh}(t)$	1656.00	20.960
Household size	8.79	3.560
Occupational dummy	0.50	0.500
Landholding	6.43	8.530
No. of children	2.51	2.100
No. of workers	6.28	3.760
Dependency ratio	1.14	0.970
Nuclear family dummy	0.50	0.500

Table 3 — Log Normal P-Tobit Model of Consumption Expenditure — Specification 1

Dependent Variable = ln $C_h(t)$

Variables	Equation Nos.	
	1(Variable-P)	2(Constant-P)
CONSTANT	1.300 (4.790)	1.560 (5.370)
$W_h(t)$	0.020 (1.220)	0.007 (0.410)
$I_h(t) + U_h(t)$	-0.110 (2.270)	-0.080 (1.590)
$y_h(t)$	0.070 (5.740)	0.060 (5.020)
$S_h(t)$	0.020 (2.140)	0.014 (1.810)
$\overline{W}_h$	-0.070 (2.910)	-0.070 (2.640)
$\overline{I}_h + \overline{U}_h$	-0.070 (0.500)	-0.080 (0.590)
$\overline{Y}_h$	0.130 (1.400)	0.160 (1.690)
σ_h	-0.072 (0.790)	-0.071 (0.790)
Occupational dummy	0.110 (1.400)	0.050 (0.700)
Landholding	0.003 (0.570)	0.003 (0.750)
No. of children	0.090 (4.750)	0.080 (4.320)
No. of workers	0.040 (3.810)	0.040 (3.150)
SER	1.020	1.020
$\overline{R}^2$	0.150	0.14
F	28.04	26.09
n	1,845	1,845

Note: t-ratios based on robust standard errors in parenthesis.
SER = Standard error of regression.

ment, $I_h(t) + U_h(t)$.[24] The coefficient indicates that a 10 percent increase in loss of income through these two causes reduces consumption by 1.1 percent. The long-term counterpart of this variable is, however, insignificant.

On the side of household composition variables, neither occupational pattern[25] nor operational landholding assume a significant coefficient. However consumption is positively and significantly related to number of children and number of working members in the household, with a larger coefficient for children. This difference indicates the greater importance of this variable in relation to consumption expenditure. Both variable and constant P models share these results with minimal differences in significance and parameter estimates.

Specification 2, i.e., Table 4, indicates a positive, significant relationship for long-term expectation of income, Y_h^e, with consumption. The coefficient indicates an elasticity of 1.5, although it is not significantly different from 1 when tested for the expected ratio of 1 between consumption and permanent income. However the short-term counterpart of this variable, $Y_h^e(t)$, exerts a negative pull, although it is insignificant. The measure of unanticipated income, $Y_h^u(t)$, assumes a positive and significant coefficient, where the coefficient indicates that a 10 percent increase in income would increase consumption by 0.7 percent. The annual measure of uncertainty, σ_{yh}, is negative and significant as expected, although the short-term counterpart of it is positive and marginally significant. However, the total effect is negative, i.e., when we add the effect of short and long-term coefficients to measure uncertainty in general, the coefficient is negative. Again the number of children and number of working members variables are positively related to consumption. The larger coefficient of children indicates the greater burden of "non-earning" children on the size of household budget. Here also, cultivating households have

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24 Since involuntary unemployment was insignificant and unstable in its relationship to consumption we have added it with illness to form a single variable.

25 A dummy that assumed 1 for cultivating households and 0 for laborer households was used, where the occupational classification is based on primary occupation of the household in terms of the source of income.

Table 4 — Log Normal P-Tobit Model of Consumption Expenditure — Specification 2

Dependent Variable = $C_h(t)$

	Equation Nos.	
Variables	**3 (Variable-P)**	**4 (Constant - P)**
CONSTANT	223.9 (4.37)	187.7 (3.66)
Y_h^e	1.46 (1.98)	1.60 (2.16)
$Y_h^e(t)$	-0.55 (0.79)	-0.90 (1.28)
$Y_h^u(t)$	0.071 (6.06)	0.06 (5.03)
$\sigma_y h$	-49.67 (2.95)	-47.21 (2.78)
$\sigma_y h\ (t)$	31.34 (1.89)	33.25 (1.99)
Occupational Dummy	0.21 (3.61)	0.20 (3.20)
Landholding	-0.005 (0.82)	-0.0005 (0.08)
Number of Children	0.12 (6.76)	0.11 (6.39)
Number of Workers	0.046 (4.91)	0.044 (4.59)
SER	1.02	1.02
$\bar{R}^2$	0.14	0.13
F	34.93	31.30
n	1,845	1,845

Notes: t-ratios based on robust standard errors in parenthesis;
SER = Standard error of regression.

a higher average consumption expenditure than laborer households. It must also be mentioned that when dependency ratio or family size were incorporated they assumed a positive significant relationship.[26]

The $\overline{R}^2$ in the two specifications considered above are not very different, and the significant F in both specifications indicates the overall significance of estimated coefficients. Thus we see that although they capture different effects, both indicate significant relationships for unanticipated or nonwage income and the short-term resource component of income as opposed to permanent income.

AN EXTENSION

In this section we extend the specifications discussed in the previous section. The interaction between the explanatory variables and the occupational dummy helps us to identify any special effects or relationships and to obtain information on consumption responses in terms of the explanatory variables for the different occupations. The total interaction of all the explanatory variables with the occupational dummy produced weak results for most of the variables, leading to insignificant coefficients. Thus we report here only the interacted specifications that are economically meaningful and chosen on the basis of standard econometric and economic criteria (see Tables 5 and 6).

First, from specification 1 (Table 5) we see that the wage component of permanent income has a lower and more significant elasticity for cultivating households than for the laborer households, namely, -0.05 against 0.14. The lower elasticity probably indicates the heavy dependence of laborer households, as opposed to cultivating households, on wage income to satisfy their basic needs. The long-term uncertainty that enters through loss of income due to illness and involuntary unemployment, $\overline{I_h} + \overline{U_h}$, is significantly negatively related to consumption expenditure for cultivating households; as opposed to laborer households for whom the short-term counterpart, $I_h(t) + U_h(t)$, is significant and negative. $W_h(t)$ and $\overline{Y_h}$ were extremely insignificant and have been dropped from the specification reported here. Short-term resource

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[26] Household composition could be represented many ways in these equations. We have shown here the impact of only a subset of such variables.

Table 5 – Log Normal P-Tobit Model of Consumption Expenditure – Specification 1

Dependent Variable = $\ln C_h(t)$

Variables	Equation Nos. 5 (Variable-P)	Equation Nos. 6 (Constant - P)
CONSTANT	0.88 (2.45)	1.19 (2.98)
$W_h(t)$	0.14 (2.20)	0.14 (2.18)
$I_h(t) + U_h(t)$	-0.10 (1.64)	-0.07 (1.09)
$y_h(t)$	0.12 (5.21)	0.11 (4.71)
$S_h(t)$	0.025 (1.87)	0.021 (1.65)
$\bar{W}_h$	0.14 (2.20)	0.14 (2.19)
$\bar{I}_h + \bar{U}_h$	-0.015 (0.16)	-0.01 (0.14)
$\bar{Y}_h$	0.18 (1.92)	0.22 (2.30)
σ_h	-0.11 (1.19)	-0.10 (1.17)
$\bar{W}_h$ x Occupational Dummy	-0.19 (2.99)	-0.18 (2.87)
$I_h(t) + U_h(t)$ x Occupational Dummy	-0.015 (0.16)	-0.010 (0.10)
$\bar{I} + \bar{U}_h$ x Occupational Dummy-	-0.61 (2.89)	-0.64 (3.02)
$y_h(t)$ x Occupational Dummy	-0.073 (2.69)	-0.069 (2.56)
$S_h(t)$ x Occupational Dummy	0.02 (1.14)	0.02 (1.11)
σ_h x Occupational Dummy	0.06 (0.83)	0.05 (0.70)
Occupational Dummy	-0.2 (0.37)	-0.26 (0.50)
Landholding	0.0003 (0.05)	0.001 (0.26)
No. of children	0.09 (4.43)	0.08 (4.04)
No. of workers	0.04 (3.04)	0.03 (2.42)
SER	1.01	1.01
$\bar{R}^2$	0.16	0.16
F	20.95	19.51
n	1,845	1,845

Notes: t- ratios based on robust standard errors in parenthesis; SER = Standard error of regression.

Table 6 — Log Normal P-Tobit Model of Consumption Expenditure — Specification 2

Dependent Variable = $C_h(t)$

Variables	Equation Nos. 7 (Variable-P)	Equation Nos. 8 (Constant - P)
CONSTANT	215.8 (4.10)	179.9 (3.41)
Y_h^e	1.61 (2.14)	1.75 (2.33)
$Y_h^e(t)$	-0.61 (0.87)	-0.95 (1.37)
$Y_h^u(t)$	0.12 (5.47)	0.11 (4.87)
$\sigma_y h$	-49.50 (2.94)	-47.06 (2.78)
$\sigma_y h(t)$	32.01 (1.94)	33.91 (2.04)
Occupational dummy	0.47 (2.23)	0.44 (2.10)
Landholding	-0.03 (1.96)	-0.023 (1.63)
No. of Children	0.15 (4.25)	0.14 (4.04)
No. of Workers	0.046 (2.54)	0.042 (2.32)
$Y_h^u(t)$ x Occupational Dummy	-0.07 (2.66)	-0.07 (2.59)
Landholding x Occupational Dummy	0.02 (1.65)	0.022 (1.63)
No. of Children x Occupational Dummy	-0.045 (1.10)	-0.043 (1.06)
No. of Workers x Occupational Dummy	0.003 (0.14)	0.004 (1.19)
SER	1.02	1.02
$\bar{R}^2$	0.15	0.13
F	25.39	22.82
n	1,845	1,845

Notes: t-ratios based on robust standard errors in parenthesis.
SER = Standard error of regression.

constraints affect cultivating households less than laboring households in terms of consumption. For instance, disposable income, $y_h(t)$, assumed a coefficient of 0.05 for cultivating households and 0.12 for laboring households.

In the other specification (Table 6) we were able to obtain meaningful interaction only for unanticipated income and household characteristics. For cultivating households unanticipated income is less important for consumption needs, assuming a coefficient of 0.05 as opposed to a coefficient of 0.12 for laboring households, although both were significant. Also the number of children and number of working members have a lower burden on a cultivating household as they assume smaller coefficients. It seems that ownership of land by laborer households, as opposed to cultivating households, reduces the consumption burden substantially, as landholding and occupational dummy interaction indicates. As found in specification 1, the consumption expenditures of cultivating households are greater than those of laboring households.

A MODEL CONSISTENCY CHECK

The sum of consumption expenditure over a long period of time, say per annum, should reflect the average true rate of consumption, which is determined by the household's demand function (cf. Pudney 1989, 174). Also, since we have data for 52 consecutive weeks, which is extremely rare in consumption analysis, we can define an approximation of the true demand model by using the annual weekly average of consumption expenditure for each household as the dependent variable. This by definition should reflect the true responses of consumption in relation to expectation of and uncertainty in income, along with household characteristics that were used in the specifications discussed above. This would therefore serve as a consistency (and also adequacy) check of the log normal P-Tobit model we have estimated above. We estimated this "time aggregated" consumption model on linear and log-linear basis, for both specifications with and without occupational dummy interactions. The results are displayed in Tables 7 to 10.

Specification 1 shows that loss of income due to illness has a significant, negative coefficient on the consumption responses of households, while involuntary unemployment is extremely insignificant. The former effect, although

Table 7 — A Time Aggregated Consumption Model - Specification 1

Dependent Variables	(C_h)	($\ln C_h$)
	Equation Nos.	
Variables	**9**	**10**
CONSTANT	27.82 (2.81)	0.72 (0.98)
$\bar{I}_h$	-103.4 (2.91)	-0.47 (1.73)
$\bar{U}_h$	-5.26 (0.15)	0.15 (0.75)
$\bar{S}_h$	-0.003 (1.21)	0.019 (0.74)
$\bar{W}_h$	-0.06 (1.56)	0.04 (0.71)
$\bar{Y}_h$	0.02 (2.61)	0.31 (1.56)
σ_h	-0.008 (3.70)	-0.12 (0.57)
Occupational Dummy	-1.61 (0.49)	0.04 (0.21)
Landholding	-0.045 (1.84)	0.0036 (0.42)
No. of Children	0.67 (0.71)	0.11 (2.81)
No. of Workers	0.2 (0.38)	0.06 (2.16)
SER	8.11	0.42
$\bar{R}^2$	0.83	0.55
F	19.65	5.75
n	40	40

Notes: t- ratios based on robust standard errors in parenthesis.
SER = Standard error of regression.

Table 8: A Time Aggregated Consumption Model — Specification 1 (Interacted)

Dependent Variables	(C_h)	$(\ln C_h)$
Variables	Equation	
	11	12
CONSTANT	17.0 (1.63)	1.84 (2.98)
$\bar{I}_h$	-91.24 (2.36)	-0.62 (2.43)
$\bar{U}_h$	55.01 (1.32)	0.70 (3.46)
$\bar{S}_h$	-0.028 (4.26)	-0.12 (3.56)
$\bar{W}_h$	0.10 (3.22)	0.22 (2.33)
$\bar{Y}_h$	0.15 (4.00)	0.83 (3.96)
σ_h	-0.04 (2.86)	-0.58 (3.92)
$\bar{W}_h$ x Occupational Dummy	-0.10 (1.64)	-0.16 (1.41)
$\bar{I}_h$ x Occupational Dummy	-59.34 (1.04)	0.30 (0.76)
$\bar{U}_h$ x Occupational Dummy	-113.1 (2.09)	-0.98 (3.48)
$\bar{S}_h$ x Occupational Dummy	0.022 (3.56)	0.15 (3.02)
σ_h x Occupational Dummy	0.049 (3.43)	0.97 (2.60)
Occupational Dummy	24.49 (1.76)	-3.18 (2.45)
Landholding	-0.7 (2.62)	-0.001 (0.11)
No. of children	1.05 (1.00)	0.08 (2.16)
No. of Workers	-0.49 (1.21)	0.01 (0.56)
SER	7.86	0.35
$\bar{R}^2$	0.83	0.68
F	13.59	6.19

Notes: t-ratios based on robust standard errors in parenthesis.
SER = Standard error of regression.

Table 9 — A Time Aggregated Consumption Model — Specification 2

Dependent Variables	(C_h)	$(\ln C_h)$
Variables	Equation	
	13	14
CONSTANT	435.3 (1.52)	-31.91 (0.68)
$\bar{Y}_h^e$	0.0007 (1.80)	0.038 (0.08)
$\bar{Y}_h^u$	0.04 (7.31)	0.39 (2.79)
$\sigma_y h$	-0.04 (1.50)	3.42 (0.64)
Occupational Dummy	-1.72 (0.59)	-0.13 (0.76)
Landholding	-1.14 (2.11)	-0.004 (0.25)
No. of Children	0.52 (0.58)	0.06 (1.51)
No. of Workers	0.039 (0.96)	0.046 (2.53)
SER	8.43	0.403
$\bar{R}^2$	0.81	0.58
F	25.24	8.62
n	40	40

Notes: t-ratios based on robust standard errors in parenthesis.
SER = Standard error of regression.

Table 10 — A Time Aggregated Consumption Model — Specification 2 (Interacted)

Dependent Variables	(C_h)	$(\ln C_h)$
Variables	Equation	
	15	16
CONSTANT	512.18 (1.93)	-38.66 (0.81)
$\bar{Y}_h^e$	0.0009 (2.71)	0.35 (0.65)
$\bar{Y}_h^u$	-0.03 (0.79)	-0.027 (0.08)
$\sigma_y h$	-0.045 (1.94)	3.96 (0.73)
Occupational Dummy	-0.46 (0.07)	-2.51 (1.85)
Landholding	-0.58 (1.03)	0.002 (0.06)
No. of Children	3.31 (1.78)	0.18 (1.85)
No. of Workers	1.15 (0.99)	0.076 (1.14)
$\bar{Y}_h^u$ x Occupational Dummy	0.75 (1.76)	0.56 (1.60)
Landholding x Occupational Dummy	-1.01 (1.72)	-0.021 (0.73)
No. of Children x Occupational Dummy	-3.28 (1.57)	-0.14 (1.43)
No. of Workers x Occupational Dummy	-0.69 (0.55)	-0.03 (0.43)
SER	8.27	0.40
$\bar{R}^2$	0.82	0.58
F	17.19	5.99
n	40	40

Notes: t-ratios based on robust standard errors in parenthesis.
SER = Standard error of regression.

expected by many, has not been established in earlier studies and is an important finding (cf. Pitt and Rosenzweig 1986; Walker and Ryan 1990, 88). Also, the effect of the illness variable is very robust, as can be observed from both interacted and noninteracted specifications, with an average elasticity of -0.3 to -0.4. Contrary to earlier studies, involuntary unemployment is not significant.[27] As Table 8 shows, permanent wage and nonwage income are positively and significantly related to consumption, although the latter has a higher elasticity. The nonwage uncertainty measure also has a larger negative effect on consumption for laboring households than for cultivating households, indicating the limited ability of laboring households to insure themselves against such uncertainty. The household composition effects in general display similar patterns, except for the occupational dummy. The occupational dummy indicates a negative relationship with consumption expenditure for cultivating households as opposed to laborer households, contrary to the results obtained from our P-Tobit estimates where we allowed for greater frequency of consumption. However, this effect is quite unstable as it is seldom significant and even when significant it assumes a very small coefficient.

In the second specification, unanticipated income is quite important, as opposed to permanent components of income. Household variables follow a similar pattern to previous estimations, along with the occupational dummy, which assumes a negative coefficient with respect to average annual consumption expenditure.

However, neither specification had any sign of heteroscedasticity when tested using the Breusch-Pagan (1979) test. Thus our results seem quite robust for variations in specification and estimation methods. In total the "time aggregated" true consumption model approximation we have constructed establishes similar relationships to that identified through log-normal P-Tobit model. However the P-Tobit model we had estimated earlier allowing for the streams of purchase frequencies enabled us to capture more effects than we are able to

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[27] Cochrane (1989, 15) finds that between loss of employment due to involuntary reasons and loss of employment due to illness, the former is important in relation to consumption. In our case the opposite is more true, maybe because, as mentioned earlier, individuals who are involuntarily unemployed choose to perform relatively unimportant tasks and report to have worked, thus underreporting the incidence of involuntary unemployment.

explain through the time aggregated model. But the similarity in the estimates of the time aggregated model reinforces the consistency in the pattern of the effects identified through our P-Tobit estimates.

6. CONCLUSION

The above experiments with different specifications and estimation methods allow us to conclude that permanent income is less important for the consumption behavior of laboring households, while transitory components are much more important. Also, unanticipated income is less important for the farming households than for laborer households in determining consumption. In addition, farming households are more able to insure themselves against income risks and maintain a smoother consumption pattern than laboring households (cf. Rosenzweig 1988b, 1164), which may in practice be due to diversification in investment and therefore in the sources of (permanent) revenue, and to a larger resource base. The risk-averse laboring households devote all their resources initially to stabilizing their consumption, since this is a substantial burden on their low and uncertain income (Rosenzweig, 1988a, 246; Walker and Ryan, 1990, 70). Seasonality, which enters through the loss of income in terms of unemployment due to illness and demand deficiency, significantly and negatively affects the consumption of most households, especially laboring households, which depend heavily on this source of income to meet their basic needs.[28] The persistence of seasonal uncertainty has forced rural households to take many precautions.[29] Both cultivating and laboring households have to face the adverse effects of unpredictable and unfavorable weather on cultivation and related income sources (cf. Chambers et al. 1979; 1981). It has been suggested that this forces these households to live in extended families, or to migrate and even to enter into marriage with families that have more ability to insure against such risks

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[28] The estimates of probabilities of unemployment due to these two reasons reported in the Appendix (Table A.8) indicate the non-linear, significant effect of seasonality on unemployment, and therefore labor income, through the polynomials of week (time) variable.

[29] Canagarajah (1991, Chapter 3) highlights some institutional responses to uncertainty and risk.

(Rosenzweig 1988a, 1988b; Rosenzweig and Stark 1989). The high volatility of consumption expenditure, and resulting levels of consumption, due to income variability has substantial adverse implications for the nutritional well-being and experiences of poverty for many rural households (e.g., Ravallion 1988, 1171-1173).

APPENDIX

Ancillary Estimations

The following tables give coefficients of variations for measures of income and expenditure by classifying households in terms of various household characteristics. The variations are calculated around group means for all the variables.

Table A.1 — Variations in Expenditure and Income, by Land Ownership

Group	N	Food Expendi-ture	Total Expendi-ture	Wage Income	Total Income	Calorie Consump-tion	Food Expenses/ Total Expenses
ACRES OF LAND							
LANDLESS	6	1.44	3.51	4.82	3.26	0.193	0.178
0.01-2.00	13	1.54	2.16	1.96	2.49	0.186	0.083
2.01-4.00	4	2.48	3.23	6.31	3.22	0.187	0.136
4.01-10.00	9	3.76	1.99	2.69	4.03	0.163	0.064
10.01 ≥	8	2.06	2.38	4.52	2.95	0.136	0.037
ALL HOUSEHOLDS	40	3.05	3.13	5.48	4.21	0.183	0.060

Table A.2 — Variations in Expenditure and Income, by Family Size

Group	N	Food Expendi-ture	Total Expendi-ture	Wage Income	Total Income	Calorie Consump-tion	Food Expenses/ Total Expenses
FAMILY SIZE							
0-5	8	1.35	2.88	2.60	2.84	0.234	0.113
6-10	20	1.67	2.40	5.58	2.75	0.182	0.086
11 ≥	12	3.08	2.50	3.51	3.34	0.144	0.050

Table A.3 — Variations in Expenditure and Income, by Dependency Ratio

GROUP	N	Food Expendi-ture	Total Expendi-ture	Wage Income	Total Income	Calorie Consump-tion	Food Expenses/ Total Expenses
DEPENDENCY RATIO							
LESS THAN ONE	29	3.12	2.89	6.05	3.93	0.174	0.055
EQUAL TO ONE	11	1.58	2.39	1.69	2.74	0.178	0.113

Table A.4 — Variations in Expenditure and Income, by Work Pattern

GROUP	N	Food Expendi-ture	Total Expendi-ture	Wage Income	Total Income	Calorie Consump-tion	Food Expenses/ Total Expenses
WORK PATTERN							
OTHERS FARM	20	1.85	2.82	4.15	2.35	0.196	0.137
OWN FARM	20	3.08	2.47	9.03	3.52	0.168	0.047

Table A.5 — Variations in Expenditure and Income, by Family Type

GROUP	N	Food Expendi-ture	Total Expendi-ture	Wage Income	Total Income	Calorie Consump-tion	Food Expenses/ Total Expenses
FAMILY TYPE							
NON-NUCLEAR	20	3.24	2.92	6.55	3.97	0.152	0.055
NUCLEAR	20	1.61	2.62	2.50	3.70	0.210	0.073

Table A.6 – Probit Model for Probability of Food Purchases – Specification 1

Dependent Variables = P $[C_h(t)]$

Variables	Equation A	Equation B
Constant	1.16	0.07
	(2.88)	(0.17)
$W_h(t)$	0.06	0.03
	(2.43)	(1.20)
$I_h(t) + U_h(t)$	-0.15	-0.19
	(2.01)	(1.89)
$y_h(t)$	0.04	0.13
	(2.50)	(4.09)
$S_h(t)$	0.013	0.026
	(1.02)	(1.29)
$\bar{W}_h$	-0.25	0.09
	(0.67)	(0.89)
$\bar{I}_h + \bar{U}_h$	-0.08	-0.08
	(0.38)	(0.27)
$\bar{Y}_h$	-0.16	-0.16
	(1.03)	(0.93)
σ_h	-0.01	0.02
	(0.07)	(0.14)
$\bar{W}_h$ x Occupational Dummy		-0.15
		(1.38)
$I_h(t) + U_h(t)$ x Occupational Dummy		0.08
		(0.51)
$\bar{I}_h + \bar{U}_h$ x Occupational Dummy		0.31
		(0.95)
$y_h(t)$ x Occupational Dummy		-0.11
		(3.15)
$S_h(t)$ x Occupational Dummy		-0.02
		(0.67)
σ_h x Occupational Dummy		-0.14
		(1.22)
Occupational Dummy	0.31	2.65
	(2.48)	(3.22)
Landholding	-0.003	0.001
	(0.48)	(0.15)
No. of Children	0.04	0.05
	(1.34)	(1.53)
No. of Workers	0.05	0.05
	(2.14)	(2.41)
LL	-712.21	-701.8
RATIO	0.8870	0.8870
χ^2	42.81	63.69
	(12)	(18)
n	2,080	2,080

Notes: t-ratios in parenthesis. Ratio refers to purchase-nonpurchase dichotomy ratio. χ^2 refers to test for constant versus variable probability. LL refers to log-likelihood.

Table A.7 — Probit Model for Probability of Food Purchases — Specification 2

Dependent Variables = P $[C_h(t)]$

Variables	Equation C	Equation D
Constant	152.6 (2.29)	27.2 (1.85)
$\bar{Y}^e_h$	-0.72 (0.69)	-1.12 (1.06)
$\bar{Y}^e_h(t)$	1.69 (1.71)	1.59 (1.61)
$\bar{Y}^u_h(t)$	0.06 (33.72)	0.14 (5.05)
$\sigma_y h$	-8.75 (0.42)	-4.91 (0.24)
$\sigma_y h(t)$	-9.85 (0.42)	-10.73 (0.55)
Occupational Dummy	0.07 (0.76)	1.06 (3.40)
Landholding	-0.022 (2.13)	-0.034 (1.52)
No. of Children	0.03 (1.08)	0.07 (1.38)
No. of Workers	0.012 (0.76)	0.08 (2.56)
$\bar{Y}^u_h(t)$ x Occupational Dummy		-0.12 (3.58)
Landholding x Occupational Dummy		0.034 (1.55)
No. of Children x Occupational Dummy		-0.082 (1.26)
No. of Workers x Occupational Dummy		0.090 (2.40)
LL	-715.25	-705.0
RATIO	0.8870	0.8870
χ^2	36.79 (9)	57.346 (13)
n	2,080	2,080

Notes: t-ratios in parenthesis. Ratio refers to purchase-nonpurchase dichotomy ratio. χ^2 refers to test for constant versus variable probability.

Table A.8 — Non-Linear Estimation of Probabilities of Unemployment

Dependent Variable	$\rho_{hi}(t)$	$\pi_{hi}(t)$
Variables	Equation	
	18	19
Constant	3.9 (10.01)	3.7 (11.1)
Age	0.07 (3.30)	0.05 (3.02)
Age^2	-0.0007 (2.82)	-0.0004 (1.90)
week	0.05 (1.86)	3.7 (11.8)
$(week)^2$	-0.003 (1.72)	-0.01 (9.16)
$(week)^3$	0.00005 (2.06)	0.001 (6.79)
Nutrition	-0.54 (5.03)	
Gender	-0.54 (4.16)	-1.52 (11.29)
LL	5259.3	4150.03
MLE of σ_2	0.013	0.024
n	9295	9295

Notes:

1. Nutrition was dropped from the involuntary unemployment equation since it assumed an extremely insignificant coefficient.
2. None of the anthropometry variables were significant.
3. 182 individuals who were active in the labour market were considered over 52 weeks. Missing observations were dropped.
4. $\rho_{hi}(t)$ refers to unemployment due to illness and $\pi_{hi}(t)$ refers to involuntary unemployment.
5. LL refers to Log-Likelihood.
6. Equation numbers refer to the respective equations in the text.
7. t-ratios in parenthesis.

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