Household Consumption Response to Demographic Changes: An Analysis using a Demographic Model

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Abstract

In this paper, I use variations in the gestational ages of pregnant woman and the number of adults to estimate the effect of household composition and the timing of birth on household consumption. Based on the empirical results, I find a significant relationship between growth in the number of adults in the household and consumption growth. I also find a negative relationship between the number of adults and consumption per capita. Gestational age and it's interaction with number of adult have a significant effect on labor income. Despite this finding, gestational age does not have a significant effect on labor related income and consumption. This linkage among consumption, household composition, and labor supply is a candidate explanation for the excess sensitivity of consumption growth to income which has been reported in the permanent income hypothesis/life-cycle literature. I argue that number of adults drives both consumption and labor supply thereby resulting in a relationship between consumption growth and income growth.

1. Introduction

Early childhood development has attracted the attention of economists, nutritionists, developmental psychologists, and researchers in other development related fields. After several years of research in these fields, one recurring finding is developmental processes that occur during the first few years of a child's life are vital. Indicators of the outcomes of these processes such as cognitive development have been found to be predictive of educational achievement later in life. These processes occur in an environment that is shaped and continually influenced by income and resource distribution within the household the child is born into. The elements of the development environment include nutrition, postnatal healthcare, and childcare. Hence for poor households in low-income communities, the health of the mother, and the development of infants and children strongly hinges on intrahousehold resource distribution and the ability of these households to smooth their consumption in response to both anticipated and unanticipated changes in the circumstance of the household. In the absence of well-functioning financial markets, low-income households resort to a number of strategies to smooth their consumption which may include selling more of their labor on the labor market.

There is some evidence in the economics literature that households with incomes at or close to subsistence behave differently from households with incomes well above this level (Pitt *et al*, 1990; Gersovitz, 1983). Pitt *et al* (1990) present evidence for linkages among intrahousehold calorie allocation, demographics, and the labor supply in low-income households. They found that low-income households in Bangladesh distribute calories based on age, gender, and the energy intensity of activities household members are engaged in. In addition to intrahousehold sharing rules for food, it is possible that these households have sharing rules for other nondurable consumption goods and services that take into account age, and the energy intensity of activities of household members. As a consequence of the potential relationship between nondurable consumption and labor supply, low-income households with pregnant women may increase their labor supply in anticipation of childbirth. This is because the presence of a pregnant woman and the anticipation of childbirth will decrease household labor supply while at the same time increasing current and future household consumption needs. In some cases, the pregnant woman may temporarily withdraw from the labor market due to cultural factors, and lack of labor market opportunities. The consumption-labor supply relationship combined with the fact that household consumption needs are determined by household composition and size creates a pathway from household demographics to consumption smoothing behavior.

According to the permanent income hypothesis (PIH), consumption growth is unaffected by income growth. Contrary to expectations, this implication has not achieved the empirical consistency economists had hoped for as a number of studies have found violations of the PIH. Sources of these violations include: precautionary savings motive, liquidity constraints, and nonseparability between leisure and consumption. Other studies have found demographics to be a source of this violation (Attanasio and Browning, 1995; Browning and Ejrnæs, 2002). Some of these studies have attempted to explain the excess sensitivity of consumption growth to income. However, to best of my knowledge, none of these studies have explored the possible linkage between consumption and labor supply as an explanation for violations that has been reported in the literature. In this paper, I show that household composition drives both consumption and labor supply thereby resulting in a relationship between consumption growth and income growth. This linkage is likely to be even more salient for low-income households.

The aim of this paper is to investigate how household composition and gestational age affects consumption through their effect on household income. I analyze consumption using a household demographic model. The model incorporates household demographic information and gestational age into a two-period model. I use the model to estimate the net marginal income contribution of adults in utility terms. In addition to estimating the net marginal income contribution of adults, I estimate the effect of gestational age on consumption. Household labor related income and consumption were found to be unresponsive to gestational age. However, household labor income responded strongly to the number of adults in the household.

In this paper, I estimate the consumption and labor effects using variation in household composition and gestational age. Since number of adults and household size are likely to be endogenous, I use the lagged values of number of adults as instruments for the current number of adults and household size. The data set does not include variables for periods before baseline, hence, I am unable to identify the effect of the number of adults and household size on consumption for the baseline period. A positive coefficient on number of adults indicates that the marginal utlity of leisure is greater than the marginal returns to labor valued in utility terms. This suggests that if an increase in the number of adults does not decrease the marginal utility of income sufficiently, then it will result in a decrease consumption per capita. The linkage among consumption, demographics, and labor supply is a candidate explanation for the excess sensitivity of consumption growth to income which has been reported in the permanent income hypothesis/life-cycle literature. Due to the nature of the data collection, we are able to estimate both a household consumption and income function. Data were collected on pregnant women at baseline, 6 months after birth and 12 months after birth. The expected timing of childbirth was different across households due to variation in gestational age at enrollment and timing of data collection.

The rest of the paper follows the following structure. In section 2, I review the existing literature on intertemporal consumption. In section 3, I present the household demographic model and derive implications. In section 4, I describe the data for this paper. In section 5, I present the identification strategy for the paper. In section 6, I describe the empirical method for the paper. In section 7, I present the results of the estimation of the intertemporal consumption function, and income function, and discuss them. In the last section, I conclude.

2. Brief Literature Review

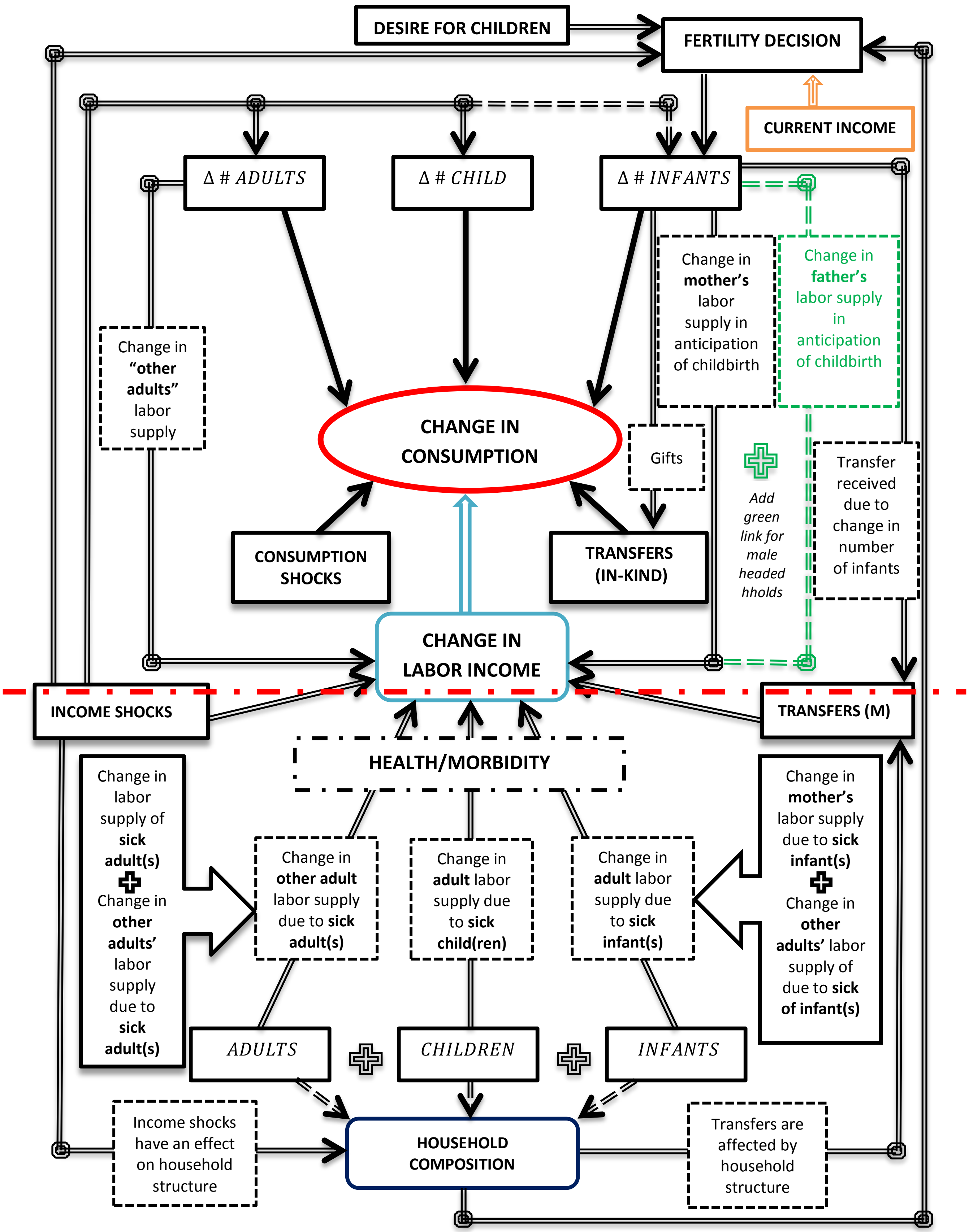
Since its popularization by Milton Friedman through his seminal work in 1957, the life cycle/permanent income hypothesis (LC/PIH) continues to maintain its relevance among economists due to implication for individual consumers and the economy at large. One of the implications of the LC/PIH is that income has no effect on consumption growth. Different versions of this implication have been widely tested in the economics literature. Currently, there is no consensus in the literature on the sensitivity of consumption growth to income. There have been a number of studies—which includes Hall (1978, 1982)—have found violations of the LC/PIH. The data used in these studies have varied from macroeconomic data such as US National Income and Product Accounts to micro level data such as plant level salary data. In addition to these studies, there is another strand of studies that have explored and given empirical credence to different sources of the violation of the LC/PIH. These sources of violation include liquidity/borrowing constraints, precautionary savings motive, demographics, aggregation bias, and non-separability between leisure and consumption.

Among the sources of violation, liquidity constraints is probably the most researched as an explanation for the sensitivity of consumption growth to income. Demographics have also received some attention in the literature. Some of the studies that have explored demographics have shown that the relationship between consumption growth and income is weaker when we include demographic and labor supply variables in the estimation of Euler equations. A number of authors have proceeded a step further by either incorporating demographic variables into the household's utility function or the price index for deflating expenditure. In addition to these, another closely related group of studies have closely analyzed the linkages among demographics, intrahousehold resource distribution, and labor supply.

3. Models

3.1 Basic Model

The diagram below is a heuristic model which describes how a household consisting of infants, children, and adults make consumption decisions over time. In each period of the household's


DESIRE FOR CHILDREN
FERTILITY DECISION
CURRENT INCOME
Δ # ADULTS
Δ # CHILD
Δ # INFANTS
Change in "other adults" labor supply
Change in mother's labor supply in anticipation of childbirth
Change in father's labor supply in anticipation of childbirth
CHANGE IN CONSUMPTION
Gifts
Add green link for male headed hholds
Transfer received due to change in number of infants
CONSUMPTION SHOCKS
TRANSFERS (IN-KIND)
CHANGE IN LABOR INCOME
INCOME SHOCKS
TRANSFERS (M)
HEALTH/MORBIDITY
Change in labor supply of sick adult(s) Change in other adults' labor supply due to sick adult(s)
Change in other adult labor supply due to sick adult(s)
Change in adult labor supply due to sick child(ren)
Change in adult labor supply due to sick infant(s)
Change in mother's labor supply due to sick infant(s) Change in other adults' labor supply of due to sick of infant(s)
ADULTS
CHILDREN
INFANTS
Income shocks have an effect on household structure
HOUSEHOLD COMPOSITION
Transfers are affected by household structure

lifespan, they make current and future consumption decisions based on their expected lifetime resources as well as the current and future composition of the household. For forward-looking households who desire to smooth their consumption, the gap between current and future consumption is of importance. This is even of more importance for households with newborns, infants, and children since large fluctuations in consumption can have deleterious effects on the health of newborns, infants, and children. To simplify the model, let us assume that the household has foresight. Hence, the change in household consumption is determined by expected changes in household composition, consumption shocks, in-kind transfers, and endogenous changes in the labor supply of the mother and father. The change in labor income serves as a link between consumption, and household composition, health/morbidity, income shocks, and transfers.

In the model, I divide the household into infants, children, and adults. An expected change in the number of adults affects household consumption directly and indirectly through its effect on labor supply and consequently labor income. In the case of younger household members, changes in the number of infants and children directly affect household consumption needs. In addition to its effect on consumption, changes in the number of infants affect income through its effect of labor supply of the mother and father of the newborn. For female headed households, the effect of a change in the number of infants on income only occurs through its effect on the mother's labor supply.

Income shocks and other types of shocks including health/morbidity shocks can affect consumption directly and indirectly. For example, a large income shocks is likely to lead to an adult in the household moving to another town or village resulting in a decrease in household income and consumption. Large income shocks can also result in changes in the number of children and infants. Aside from shocks, the number of infants in the household is affected by fertility decisions. The household's decision to have a child depends on their desire for children, their current income, income shocks, and the existing household structure. The existing household structure helps shape the household's fertility decision. A household with only a husband, wife and no children is more likely to decide to have a child than a household with many children.

In this paper, I focus on the area above the broken red line in the heuristic model. This is because I do not have information on most of the elements in the area below the broken red line. Based on this, I develop a household demographic model to examine intrahousehold resource distribution and adult labor supply response to anticipated childbirth. I incorporate household demographics, and the anticipation of childbirth into a two period consumption model. I then derive empirically testable implications from the model.

In the theoretical model, a household chooses the level of consumption that maximizes its utility subject to the household intertemporal budget constraint. To simplify the model, let us assume the household consist of a husband and a wife who make consumption decisions as a consumer unit under certainty. The household's decision problem can be written as:

$$\max_{C_0,C_1} u(C_0, l_0; R_0) + \left(\frac{1}{1+\rho}\right) u(C_1, l_1; R_1)$$

$$s.t$$

$$A_0 + \omega L_0(D_{F0}, D_{M0}, C_0) + \left(\frac{1}{1+r}\right) \omega L_1(D_{F1}, D_{M1}, C_1) = \left(\frac{1}{1+r}\right)^2 A_2 + p_0 C_0 + \left(\frac{1}{1+r}\right) p_1 C_1$$

$$L_t(*) + l_t = \Gamma_t \qquad t = 0, 1$$

where D_{Ft} is an indicator variable for the presence of the husband; D_{Mt} is an indicator variable for the wife and it is always equal to 1 since the pregnant woman is present in both periods; C_t denotes household consumption; p_t denotes a composite price of consumption goods and services; l_t denotes amount of leisure consumed by household members; ρ denotes the discount rate; r denotes the real interest rate; A_t denotes the total value of household assets in period t; Γ_t denotes total household labor endowment; $L_t(*)$ denotes the household labor supply function; ω denotes the wage rate; and $R(*)$ denotes household consumption requirement.

Household labor supply is assumed to be a function of the presence of a husband, a wife and consumption per capita. This is based on a number of studies (e.g. Pitt *et al*, 1990; Behrman, 1988) that suggest that intrahousehold resource distribution is driven by household preferences, labor market considerations, and household composition. In order to derive implications from the model, I make some assumptions about the first derivative of the household's labor supply function. I assume the first derivative of the intertemporal labor supply function is given by the following equations:

$$\frac{\partial L_0(*)}{\partial C_0} = \alpha_F D_{F0} + \alpha_M D_{M0}$$

$$\frac{\partial L_1(*)}{\partial C_1} = \alpha_F D_{F1} + \alpha_M D_{M1}$$

The household's consumption requirement is simply a function of household composition and can be written as:

$$R_0 = \mu_F D_{F0} + \mu_M D_{M0}$$

$$R_1 = \mu_F D_{F1} + \mu_M D_{M1}$$

The coefficients in the above equation represent the household adult equivalence for the husband and wife. Therefore μ_F and μ_M do not add up to 1.

Taking first order conditions of the household's problem and rearranging:

$$\frac{\partial u(*)}{\partial C_0} - \frac{\partial u(*)}{\partial l_0}\frac{\partial L_0(*)}{\partial C_0} = \left\{\lambda p_0 - \omega\lambda\frac{\partial L_0(*)}{\partial C_0}\right\} \quad (1)$$

$$\frac{\partial u(*)}{\partial C_1} - \frac{\partial u(*)}{\partial l_1}\frac{\partial L_1(*)}{\partial C_1} = \left\{\left(\frac{1+\rho}{1+r}\right)\lambda p_1 - \left(\frac{1+\rho}{1+r}\right)\lambda\omega\frac{\partial L_1(*)}{\partial C_1}\right\} \quad (2)$$

$$\frac{\partial L_i(*)}{\partial C_i} > 0; \frac{\partial u(*)}{\partial l_i} > 0$$

where λ is the marginal utility of income. From equation (1), the net marginal cost (in utility terms) of increasing the household consumption in period 0 by an additional unit is equal to the net marginal benefit (in utility terms) of the additional consumption. Equation (2) represents the household's consumption allocation rule in period 1. The net marginal cost (adjusted by the interest rate and the discount rate) of increasing household consumption in period 1 by an additional unit is equal to the net marginal benefit derived from the additional consumption.

The net marginal cost of consumption is the difference between the price of consumption in utility terms and marginal increase in income in utility terms. On the other hand, the net marginal benefit is the difference between the marginal utility derived from additional consumption and the marginal utility (from leisure) forgone as a result of a marginal increase in labor supply. Assuming wage rates is constant, increase in labor supply increases income but decreases leisure at the same time.

We can express equation (1) and (2) as a consumption Euler equation:

$$\frac{\frac{\partial u(*)}{\partial C_0}}{\frac{\partial u(*)}{\partial C_1}} = \frac{\lambda p_0 + \frac{\partial L_0(*)}{\partial C_0}\left\{\frac{\partial u(*)}{\partial l_0} - \lambda\omega\right\}}{\left(\frac{1+\rho}{1+r}\right)\lambda p_1 + \frac{\partial L_1(*)}{\partial C_1}\left\{\frac{\partial u(*)}{\partial l_1} - \left(\frac{1+\rho}{1+r}\right)\lambda\omega\right\}} \tag{3}$$

Using the assumptions about labor supply and consumption requirements, we can rewrite the equation (3) as:

$$\frac{\frac{\partial u(*)}{\partial C_0}}{\frac{\partial u(*)}{\partial C_1}} = \frac{\lambda p_0 + \delta_0\alpha_F D_{F0} + \delta_0\alpha_M D_{M0}}{\left(\frac{1+\rho}{1+r}\right)\lambda p_1 + \delta_1\alpha_F D_{F1} + \delta_1\alpha_M D_{M1}} \tag{4}$$

$$\delta_0 = \left\{\frac{\partial u(*)}{\partial l_0} - \lambda\omega\right\}$$

$$\delta_1 = \left\{\frac{\partial u(*)}{\partial l_1} - \left(\frac{1+\rho}{1+r}\right)\lambda\omega\right\}$$

Assuming isoelastic preferences, the household's utility function can be specified as:

$$u(C, l; R) = \frac{R}{(1-\alpha)}\left(\frac{C}{R}\right)^{1-\alpha} + \frac{l^{1-\alpha}}{(1-\alpha)}$$

Using the above utility function, we can rewrite equation (4) as:

$$\left(\frac{C_1}{C_0}\frac{R_0}{R_1}\right)^{\alpha} = \frac{\theta_0 + f_0 D_{F0} + m_0 D_{M0}}{\theta_1 + f_1 D_{F1} + m_1 D_{M1}} \tag{4'}$$

$$\theta_0 = \lambda p_0$$

$$f_0 = \delta_0\alpha_F$$

$$m_0 = \delta_0\alpha_M$$

$$\theta_1 = \left(\frac{1+\rho}{1+r}\right)\lambda p_1$$

$$f_1 = \delta_1\alpha_F$$

$$m_1 = \delta_1\alpha_M$$

The above parameters represent the net marginal cost of consumption (in utility terms) and labor supply response of the wife and husband. The parameter θ_t represents the unit price of consumption in utility terms. The parameter f_t represents the net marginal income contribution of the father. The parameter m_t represents the net marginal income contribution of the wife.

Taking natural logarithms on both sides of equation (4), we can rewrite the consumption Euler equation in a linear form as:

$$ln\left(\frac{C_1}{C_0}\right) = \frac{1}{\alpha} ln\left\{\frac{\boldsymbol{\theta_0} + \boldsymbol{f_0} D_{F0} + \boldsymbol{m_0} D_{M0}}{\boldsymbol{\theta_1} + \boldsymbol{f_1} D_{F1} + \boldsymbol{m_1} D_{M1}}\right\} + ln\left(\frac{R_1}{R_0}\right) \tag{5}$$

We can write the household's optimal intertemporal consumption decision as two separate equations. Rearranging equation (1) and (2), and taking logarithm of both sides:

$$ln(C_0) = -\frac{1}{\alpha} ln(\theta_0 + f_0 D_{F0} + m_0 D_{M0}) + ln(R_0) \tag{6}$$

$$ln(C_1) = -\frac{1}{\alpha} ln(\theta_1 + f_1 D_{F1} + m_1 D_{M1}) + ln(R_1) \tag{7}$$

3.2 Extension of Model to Household with a Pregnant Woman

In this section, I extend the theoretical model to a household consisting of a pregnant woman, adults, children and infants. I drop the certainty assumption and assume that the household faces uncertainties about household composition and hence, its labor income of adults. The household's problem can be written as:

$$\max_{C_0, C_1} u(C_0, l_0; R_0) + \left(\frac{1}{1+\rho}\right) E_0\{u(C_1, l_1; R_1)\}$$

$s.t$

$$A_0 + \omega L_0(D_{F0}, H_{A0}, C_0) + \left(\frac{1}{1+r}\right)\omega E_0\{L_1(D_{F1}, H_{A1}, C_1)\} = \left(\frac{1}{1+r}\right)^2 A_2 + C_0 + \left(\frac{1}{1+r}\right)C_1$$

$$L_t(*) + l_t = \Gamma_t \qquad\qquad t = 0, 1$$

where E_0 denotes an expectation operator based on information available to the household at baseline; D_{Ft} denotes the presence of a father in the household; and H_{At} denotes the number of adults in the household. The first derivative of the intertemporal labor supply function is given by the following equations:

$$\frac{\partial L_0(*)}{\partial C_0} = \alpha_A H_{A0} + \Phi H_{A0} G$$

$$\frac{\partial L_1(*)}{\partial C_1} = \alpha_A H_{A1}$$

where G denotes gestational age at baseline. The household's consumption requirement in this case can be written as:

$$R_0 = \mu_A H_{A0} + \mu_C H_{C0}$$

$$R_1 = E_0(H_{A1}) + \mu_C E_0(H_{C1}) + \mu_I E_0(H_{I0})$$

Plugging the above equations into the household's problem and taking first order conditions, we get:

$$\frac{\partial u(*)}{\partial C_0} - \frac{\partial u(*)}{\partial l_0}\frac{\partial L_0(*)}{\partial C_0} = \left\{\lambda p_0 - \omega\lambda\frac{\partial L_0(*)}{\partial C_0}\right\} \tag{1'}$$

$$E_0\left\{\frac{\partial u(*)}{\partial C_1}\right\} - E_0\left\{\frac{\partial u(*)}{\partial l_1}\frac{\partial L_1(*)}{\partial C_1}\right\} = \left\{\left(\frac{1+\rho}{1+r}\right)\lambda p_1 - \left(\frac{1+\rho}{1+r}\right)\lambda\omega E_0\left(\frac{\partial L_1(*)}{\partial C_1}\right)\right\} \tag{2'}$$

Assuming rational expectations and rearranging the above:

$$\frac{\frac{\partial u(*)}{\partial C_0}}{\frac{\partial u(*)}{\partial C_1}} = \left\{\frac{\lambda p_0 + \delta_0 \alpha_A H_{A0} + \delta_0 \Phi H_{A0} G}{\left(\frac{1+\rho}{1+r}\right)\lambda p_1 + \delta_1 \alpha_A E_0(H_{A1})}\right\}(1+e)$$

$$\delta_0 = \left\{\frac{\partial u(*)}{\partial l_0} - \lambda\omega\right\}$$

$$\delta_1 = \left\{\frac{\partial u(*)}{\partial l_1} - \left(\frac{1+\rho}{1+r}\right)\lambda\omega\right\}$$

where e denotes optimization errors.

Using the utility function we specified in the previous section, we can rewrite the consumption Euler equation as:

$$\left(\frac{C_1}{C_0}\right)^{\alpha} = \left\{\frac{\theta_0 + h_0 H_{A0} + g_0 H_{A0} G}{\theta_1 + h_1 E_0(H_{A1})}\right\}\left(\frac{R_1}{R_0}\right)^{\alpha}(1+e) \qquad (4'')$$

$$\theta_0 = \lambda p_0$$

$$h_0 = \delta_0 \alpha_A$$

$$g_0 = \delta_0 \Phi$$

$$\theta_1 = \left(\frac{1+\rho}{1+r}\right)\lambda p_1$$

$$h_1 = \delta_1 \alpha_A$$

Appending optimization errors to equation $(4'')$ and taking natural logarithms on both sides:

$$ln\left(\frac{C_1}{C_0}\right) = \frac{1}{\alpha} ln\left\{\frac{\theta_0 + h_0 H_{A0} + g_0 G}{\theta_1 + h_1 E_0(H_{A1})}\right\} + ln\left(\frac{R_1}{R_0}\right) + \frac{1}{\alpha} ln(1+e) + \varepsilon \qquad (5')$$

As we did earlier, we can write the household's optimal intertemporal consumption decision as two separate equations:

$$ln(C_0) = -\frac{1}{\alpha} ln(\theta_0 + h_0 H_{A0} + g_0 H_{A0} G) + ln(R_0) + \epsilon_0 \qquad (6')$$

$$ln(C_1) = -\frac{1}{\alpha} ln\{\theta_1 + h_1 E_0(H_{A1})\} + ln(R_1) + \epsilon_1 \qquad (7')$$

Plugging the optimal marginal utility of income $\lambda^*(\cdot)$ in equation $(1')$ and $(2')$, we can write the optimal consumption rules as:

$$C_0^* = (R_0) \times (\theta_0 + h_0 H_{A0} + g_0 H_{A0} G)^{-\frac{1}{\alpha}}$$

$$E_0(C_1^*) = (R_1) \times \{\theta_1 + h_1 E_0(H_{A1})\}^{-\frac{1}{\alpha}}$$

Based on the above and equation $(5'')$, we can I derive the following implications:

$$\frac{\partial\left(\frac{C_0^*}{R_0}\right)}{\partial H_{A0}} = -\frac{1}{\alpha}(\theta_0 + h_0 H_{A0} + g_0 H_{A0} G)^{\frac{-1-\alpha}{\alpha}}\left\{p_0 \frac{\partial\lambda(*)}{\partial H_{A0}} + h_0 + H_{A0}\frac{\partial\lambda(*)}{\partial H_{A0}} + g_0 G\right\} \gtreqless 0$$

$$\frac{\partial ln\left(\frac{C_1}{C_0}\right)}{\partial ln\left(\frac{R_1}{R_0}\right)} = 1$$

4. Description of Data

4.1 Data

The data to be analyzed were obtained from a socioeconomic survey conducted by the International Lipid-Based Supplements (iLiNS) project. The main objective of the iLiNS project is to develop and test new solutions to help prevent malnutrition in vulnerable populations. The project has three arms: Malawi, Ghana and Burkina Faso. This study uses data solely from the Ghana arm of the project.

TABLE 1–TIMELINE OF DATA COLLECTION

Household Variable	**Baseline**	**35th weeks of pregnancy**	**birth**	**6 months after birth**	**12 months after birth**	**18 months after birth**
Socioeconomic Characteristics	◊	◊		◊		◊
Food Insecurity	◊		◊	◊		
Risk Aversion	◊					
Discount Rate	◊					
Expenditures	◊			◊	◊	
Income	◊			◊	◊	

For the Ghana arm of the project, 864 pregnant women were screened, recruited, and enrolled into a randomized control trial on a rolling basis over a two-year period from December 2009 to December 2011. During the period, women attending selected prenatal clinics in the Manya Krobo and Yilo Krobo districts in the Eastern Region of Ghana. A random subsample of 519 pregnant women was repeated surveyed from the time of their enrollment until about 18 months after childbirth. Each woman was interviewed about their household at different stages of their pregnancy and after childbirth: enrollment, 3th week of pregnancy, birth, 3 months, 12 months and 18 months after birth. The table above shows the type of information collected for different rounds of the survey.

4.2 Household Variables

Socioeconomic Characteristics: Respondents were interviewed about demographic characteristics of household members, educational level, assets, health, previous pregnancies, prenatal care, income and sources of credit. For the purposes of the survey, a household member was defined as anyone who has been regularly sleeping in the dwelling and sharing food from the same cooking pot for at least the last 3 months. This includes people who normally live in the dwelling and eat from the same cooking pot but are temporarily away for schooling, giving birth, vacation, or illness. The interviews were conducted at rounds 1, 2, 4, and 6 of the survey.

Food Insecurity: The module for household food insecurity was designed based on the USAID Food and Nutrition Technical Assistance (FANTA) food insecurity indicator guide. The respondent is asked a number of questions about the occurrence and frequency of particular events. The respondent's responses are then converted into food insecurity scores using a formula. The food insecurity model was administered in rounds 1, 3, 4, and 5.

Risk Aversion: The risk attitudes of respondents were elicited using an experimental game. In the games, the respondent was given GH¢2 ($0.8) and asked to indicated how much of it she would like to bet in a game of chance which depended on the outcome of rolling a 6-side die. If she rolled a one, two, or three, she was given double the amount of money she bet. If she rolled a four, five, or six, she lost half of her bet. Assuming constant relative risk aversion (CRRA) and expected utility maximizing behavior, I convert the amount risked by the respondent into a coefficient of relative risk aversion.[1] The risk attitudes of respondents were only elicited in round 1.

Household Consumption Expenditures: Respondents were interviewed about the expenditures of their households on food, frequently purchased non-food, and infrequently purchased non-

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[1] This is probably more of a measure of risk seeking behavior than it is of risk aversion. Other problems with this measure are:

i. There may also be biases due to a divisibility problem which means bets are likely to be bunched around certain amounts. This is evidenced by the kernel density of bets.
ii. The inability of respondents to risk more than GH¢2 means any respondent with a coefficient of relative risk aversion of 0.5 or less will risk the full amount. Hence respondents who bet the full amount are indistinguishable from one another in terms of risk aversion.

See the Appendix for derivation of the coefficient for relative risk aversion.

food goods or services. Different recall periods were used for each category of expenditures. One week, one month and 12 month recall periods were used for collecting information on food, frequently purchased non-food and infrequently purchased non-food expenditure, respectively. Frequently purchased non-food goods or services include cooking fuel, telephone calls, and reading materials. Infrequently purchased non-food goods or services include clothes, furniture and footwear. For my analysis, I deflate expenditures using consumer prices indexes published by Ghana Statistical Services for the month prior to the month the good or service was purchased. In this paper, total household nondurable consumption expenditure is defined as the sum of total food expenditures time 4 and total expenditure on frequently purchased goods or services. For my analysis, I use only total household nondurable consumption expenditures because the 12 month recall for infrequently purchased goods is likely to lead to overlaps between expenditures in different periods.

Household Income: Respondents were interviewed about household incomes from different sources. They are asked about household income from crop cultivation in the major and minor cropping seasons, enterprises, animal sales, fishing, pensions, property rentals, and other income-generating activities. They also asked about sources of and access to credit.

4.3 Exploiting the Panel Nature of Data

I exploit the panel nature of the data for the estimating of household's intertemporal consumption decisions. Respondents were repeatedly interviewed at different stages of their pregnancy and after they had delivered their babies. Controlling for time (month and year of interview) and assuming that the stages of pregnancy and the first 6 months after childbirth are similar across all women in the sample, the data can be analyzed using panel estimation techniques. I estimate household intertemporal consumption decisions using three reduced form techniques: random effects, fixed effects, and first difference estimators. By controlling for time-invariant heterogeneity which is likely to be correlated with household demographic variables, I obtain consistent estimates.

4.3.1 Summary Statistics

The data for this paper were collected from the peri-urban areas of the Manya Krobo and Yilo Krobo districts of Ghana. Table 2 reports the descriptive statistics of the sample used for this paper.

TABLE 2—SAMPLE DESCRIPTIVE STATISTICS AT BASELINE

Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Age of Woman (Years)	706	27.02	5.48	18	44
Age of youngest child (Years)	415	4.79	2.84	0.98	17.40
Age of Male Household Head (Years)	608	37.21	11.95	20	88
Education level of Woman (Years)	706	7.36	3.72	0	16
Education Level of Male Household Head (Years)	607	8.77	4.00	0	16
Household Size	707	4.08	2.06	1	16
Woman Household Head	706	0.13	0.34	0	1
First Pregnancy	706	0.30	0.46	0	1
Number of Sources of Prenatal Care	145	1.27	0.48	0	3
Relative Risk Aversion Parameters	658	2.16	2.47	0.5	18.60
Food Insecurity Score	706	2.43	4.03	0	19
Deflated Weekly Food Expenditure Per Capita	707	0.04	0.03	0	0.23

Deflated Weekly Nonfood Expenditure Per Capita	706	0.02	0.03	0	0.40
Deflated Weekly Income Per Capita	707	0.03	0.41	0	10.42

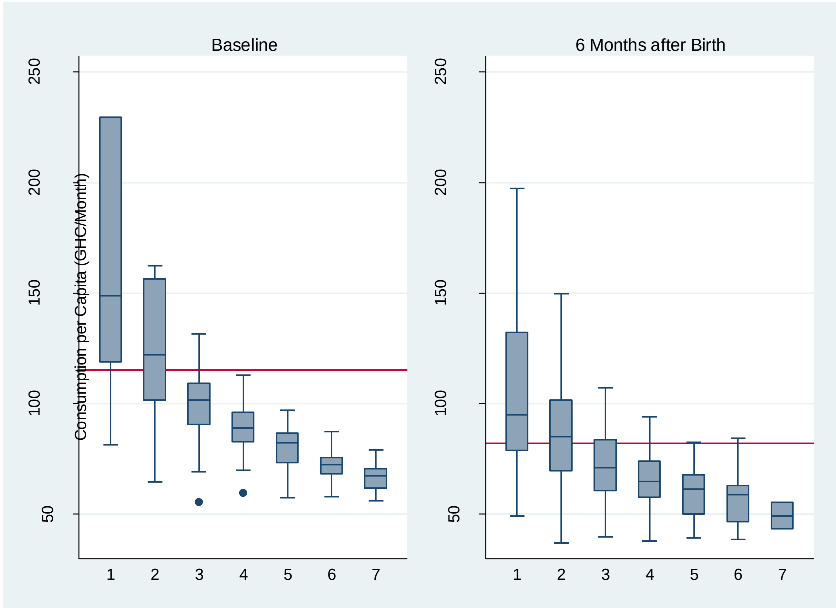
Households in this sample are relatively young: the mean age of pregnant women is 27 years and that of male household heads is 37.2 years. The mean household size of 4.1 is above the national mean of 3.7 years (Ghana Demographic and Health Survey, 2008). Pregnant women and the male heads of their household have a mean level of education which is higher than the national mean of 3.7 years. This is not surprising since the study area is peri-urban and close to the Greater Accra Region which has the highest mean level of education in Ghana.

The mean relative risk aversion parameter is 2.16. This measure is based on a constant relative risk aversion (CRRA) framework. It is quite high in the light of the estimates obtained from various studies (e.g. Chetty, 2006) and the mean education level of pregnant women. Households on the average have a low mean food insecurity score but are likely to have high marginal utilities of income since their weekly income per capita is slightly less than their weekly consumption expenditure.

The left pane of Figure 1 represents the relationship between hosuehold consumption expenditure per capita adjusted for month and year effects, and number of adults at baseline.[2] There seems to be an inverse relationship between number of adults in the household and consumption expenditure per capita. During the data collection period, the exchange rate was on the average 1.4 GHC per US dollar. The figure shows that households with the largest number of adults have the lowest consumption per capita and vice versa.

[2] I obtain the effect of month and year dummies by regressing deflated consumption expenditure on number of adults, total adult equivalents, and month and year dummies. I then predict consumption expenditure and subtract the effect of the month and year dummies from the predicted values.

FIGURE 1—CONSUMPTION EXPENDITURE PER CAPITA

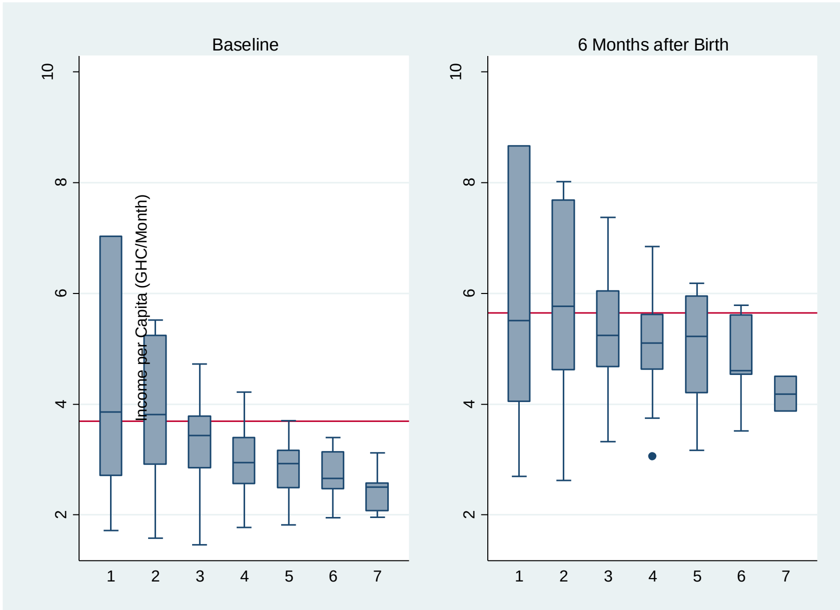


The right panel represents the deflated consumption expenditure per capita adjusted for month and year effects and the number of adults at 6 months after birth. We can still observe the inverse relationship between number of adults and consumption per capita. Comparing the two graphs, we see that the mean level of consumption expenditure (indicated by the red line) during 6 months after birth is substantially lower than consumption at baseline.

Figure 2 represents the relationship between household labor related income[3] per capita adjusted for month and year effects, and number of adults. At both baseline and 6months after birth, there is a strong positive association between labor related income per capita and number of adults. However, holding number of adults constant, the mean income per capita at 6 months after birth is greater than mean income at baseline.

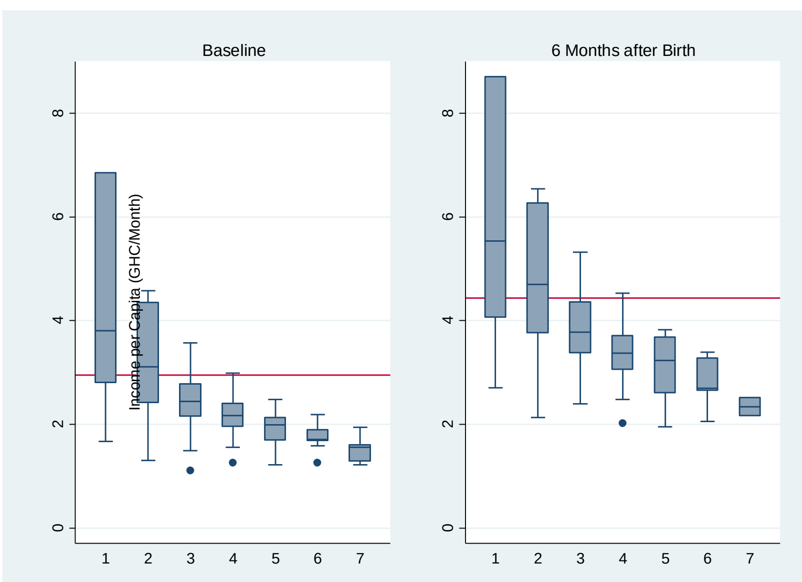
[3] Labor related income is the sum of income from household enterprises, agricultural activities and other income generating activities.

FIGURE 2—INCOME PER CAPITA BY NUMBER OF ADULTS



The left panel of Figure 3 represents the relationship between other income[4] per capita and number of adults in the household at baseline. Similar to labor related income, there is a negative association between other income per capita and number of adults.

FIGURE 3—OTHER INCOME PER CAPITA BY NUMBER OF ADULTS



[4] Other income include gifts, loans, and income from property rentals, remittances, and other sources of income.

The right panel represents the relationship between other income per capita and number of adults at 6 months after birth. Similar to the baseline case, there is a negative association between other income per capita and number of adults in the household.

The main source of household income is labor income. Sources of labor income include petty trading, tailor/seamstress work, and driver/conductor. Figure 4 represents the relationship between household labor income per capita and number of adults at baseline.[5]

FIGURE 4—LABOR INCOME PER CAPITA BY NUMBER OF ADULTS

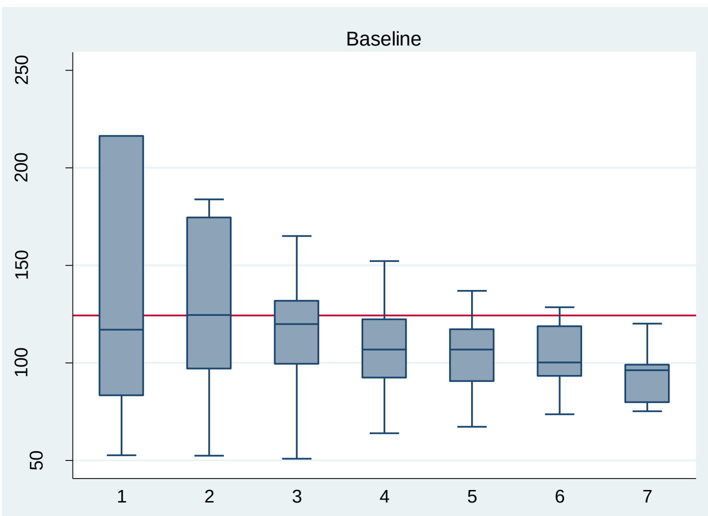
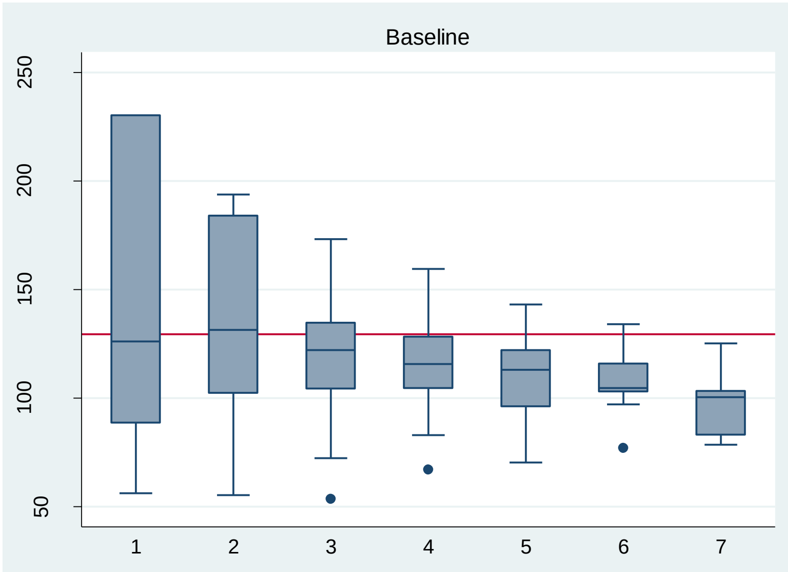


Figure 5 represents the relationship between total household income per capita and number of adults at baseline.[6] It shows that total income per capita decreases as the number of adults increase. This is because labor income per capita, labor-related income per capita, and other income per capita are all have a negative association with number of adults.

[5] The data for labor income at 6 months after birth is currently unavailable. The graph for 6 months after birth will be added as soon as they become available.

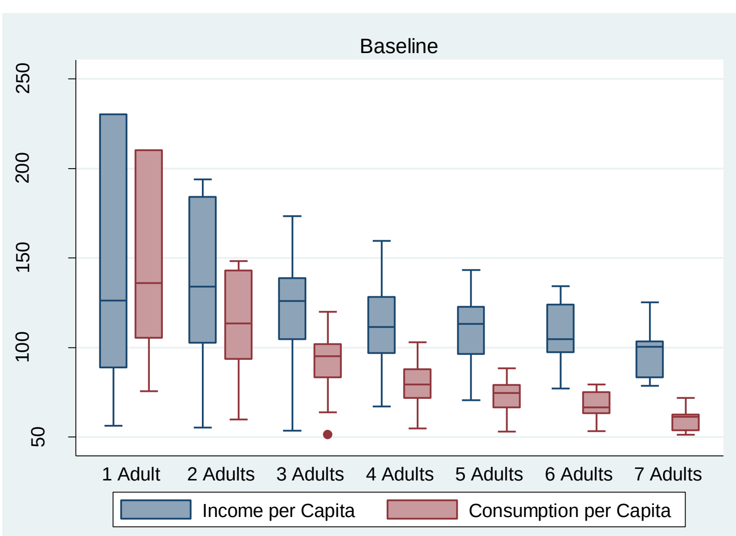
[6] Total household income is the sum of labor related income, other income and labor income. I am unable to construct a graph for 6 months after birth because labor income is unavailable for that period.

FIGURE 5—DEFLATED TOTAL INCOME PER CAPITA BY NUMBER OF ADULTS



On the average, the household's total income per capita is greater than the household's consumption expenditure per capita at baseline and 6 months after birth. This is represented in Figure 6 which also shows that the gap between consumption expenditure per capita and income per capita widens as the number of adults despite the gradual decrease in consumption expenditure per capita.

FIGURE 6—DEFLATED TOTAL INCOME & CONSUMPTION PER CAPITA



5. Identification Strategy

In this paper, I estimate the effect of gestational age and adult members of the household on consumption. Adults in the household have they both have a direct and indirect effect on consumption. The direct effect comes from their consumption requirements while the indirect effect occurs through their labor supply. Therefore we can characterize consumption and labor effects as pre-natal and post-natal. There are a number of issues with estimating these effects using only variations in household composition. One such issue is the correlation between household composition and unobservable household heterogeneity such as taste for children, and the desire to receive visitors. For example, household with plans to have a child in the future are likely to have a lower consumption than household without such a plan. In addition, they are also less likely to be smaller in size. To address this problem, I use first difference, panel regression, and an an instrumental variable approach. I use the first difference and panel regression approaches to estimate the household exante consumption growth function. These two approaches remove all sources of unobservable time-invariant household heterogeneity and therefore avoids the endogeneity problem. I use the instrumental variable approach to estimate expost household consumption function at 6 months after birth. I use household size and number of adults at basline as instruments for household size and number of adults at 6 months after birth. I am unable to estimate the household consumption function at baseline due to lack of good instruments in the data.

As discussed in an earlier section, pregnant women were recruited on a rolling basis at different gestational ages and interviewed multiple times over the course of about 27 months. The recruitment of only pregnant women made it impossible to identify their effect on consumption and labor supply. However, the manner in which they were recruited generated useful exogenous variations in gestational age. I use these variations to identify the effect of gestational age on household consumption and income.

6. Empirical Method

In this section, I estimate equation $(5'')$ using reduced-form and structural methods. This equation represents the household's optimal intertemporal consumption decisions.

6.1 Reduced Form Estimations

I use the reduced-form methods to estimate $(5'')$ which is a rough approximations of equation $(5')$ respectively.

$$ln\left(\frac{C_1}{C_0}\right) = \overline{\boldsymbol{\beta}} + \beta_A ln\left\{\frac{E_0(H_{A1})}{H_{A0}}\right\} + \beta_R ln\left(\frac{R_1}{R_0}\right) + \beta_{T1}T_1 - \beta_{T0}T_0 + \epsilon \qquad (5'')$$

where T_t denotes month and year dummies; and ϵ denotes error terms which are assumed to be independent and identically distributed.

I estimate the above equation using four types of estimators: first difference estimator, random effects estimator, fixed effects estimator, and instrumental variable estimator.

a) *First Difference Estimator*

This involves simply estimating equation $(5'')$ using ordinary least squares. An advantage of this estimator is it removes all unobservable time-invariant heterogeneity. This includes unobservable heterogeneity that may be correlated with some of the include variables such as the family cohesion and the desire to receive visitors. This is exacerbated by the disadvantage of losing observations for households that are not observed in both periods, and the inability to estimate coefficients for variables that are constant or close in value in both periods. Another issue is we lose observations that have zero values since the logarithm of zero is undefined. To address this problem, replace the zeros with very small values in the order of 10^{-8}.

b) Fixed effects estimator

If we treat equation $(5'')$ as a first difference equation and assume the presence of time-invariant unobservable heterogeneity, we can decompose it into the following equations:

$$ln(C_1) = \beta_1 + \beta_\alpha \sigma + \beta_A ln\{E_0(H_{A1})\} + \beta_R ln(R_1) + \beta_{F1} D_{F1} + \beta_{T1} T_1 + \beta_z Z + \mu + \epsilon_1 \qquad (8)$$

$$ln(C_0) = \beta_0 + \beta_\alpha \sigma + \beta_A ln(H_{A0}) + \beta_R ln(R_0) + \beta_G ln(G) + \beta_{F0} D_{F0} + \beta_{T0} T_0 + \beta_z Z + \mu + \epsilon_0 \qquad (9)$$

where μ denotes unobservable household heterogeneity; and ϵ_t denotes error terms which are assumed to be independent and identically distributed within and across periods.

I estimate equation (8) and (9) jointly using a fixed effects estimator. Similar to a first difference estimator, it assumes that all sources of unobservable heterogeneity are time-invariant and addresses the issue of correlation between the time-invariant unobserved heterogeneity and included variables. As opposed to the first difference estimator, it is able to deal with unbalanced panel data.

c) Random effects estimator

I also estimate equation (8) and (9) jointly using a random effects estimator. This estimator allows us to estimate effects of both time-variant and time-invariant variables on the dependent variable of interest. It is based on the assumption that none of the included variables is correlated with the unobservable heterogeneity. We can test this assumption by comparing the random effects and fixed effects estimators using the Hausman test.

d) Instrumental variable estimator

We can also estimate the household's expost consumption function represented by equation $(6')$ and $(7')$ as separate equations using the following approximations:

$$ln(C_1) = \gamma_0^1 + \gamma_\sigma^1\sigma + \gamma_A^1 ln(H_{A1}) + \gamma_R^1 ln(R_1) + \gamma_{DF}^1 D_{F1} + \gamma_{inc}^1 ln(inc_1) + \gamma_T^1 T_1 + \gamma_z^1 Z + \mu + \epsilon_1 \qquad (6'')$$

$$ln(C_0) = \boldsymbol{\gamma_0^0} + \gamma_\sigma^0\sigma + \gamma_A^0 ln(H_{A0}) + \gamma_{AG}^0 ln(H_{A0}G) + \gamma_R^0 ln(R_0) + \gamma_{DF}^0 D_{F0} + \gamma_{inc}^0 ln(inc_0) + \gamma_T^0 T_0 + \gamma_z^0 Z + \mu + \epsilon_1 \qquad (7'')$$

Due to the possible correlation between number of adults and unobservables, I use the number of adults and household size at baselines as instruments for number of adults and household size at 6 months after birth in the estimation of equation $(6'')$. I am not able to do the same for equation $(7'')$ due lack of good instruments.

6.2 Labor Supply Response of Adults in the Household

In this section, I examine some of the assumptions of the household labor supply function. I examine the intertemporal labor supply functions of adults. Since we do not directly observe the household's labor supply, I analyze the household's labor related income while assuming wage rates or the returns to labor is constant. The household's labor related income is modeled as a function of the number of days left before delivery, and the number of adults in the household. In low-income communities, in absence of a well-functioning credit market, households rely on wage labor to smooth their consumption. Adults are assumed to increase their labor supply in response to income shortfalls due to the decrease in the labor supply of the mother, and the anticipation of childbirth. Equation (9) and (10) represent the household's labor income function:

$$ln(\omega L_0^*) = \beth^0 + \rho_1^0 ln(H_{A0}) + \rho_2^0 ln(G) + \rho_3^0 T_0 + \rho_4^0 Z + \varepsilon_L^0 \quad (9)$$

$$ln(\omega L_1^*) = \beth^1 + \rho_1^1 ln(H_{A1}) + \rho_2^1 T_1 + \rho_3^1 Z + \varepsilon_L^1 \quad (10)$$

where ω denotes the wage rates or returns to labor which is assumed be constant within and across periods; t is an index for period; ε_L^t denotes the error term which is assumed to be i.i.d with zero mean; and ωL_t denote labor income. In the estimation of equation (10), I use number of adults at basline as instruments for number of adults at 6 months after birth.

7. Estimation Results

The empirical strategy in this paper generally relies on the variation gestational age and household composition both across and within periods. In keeping with the theoretical model, I divide household members into infants, children and adults. For the purposes of my analyses, I define an infant as a household member who is less than 1 year while a child is 1 years or older but less than 15 years. An adult is a household member who is 15 years or older.

7.1 Reduced Form Estimation Results

In order to analyze the effect of household composition on household intertemporal consumption decisions, I estimate equation $(5'')$ using reduced-form methods. I then use the estimates to test the null hypothesis that $\beta_R = 1$ which is an implication of the theoretical model. Table 5 reports the estimation results of the household consumption Euler equation. The five columns represent different specifications of the household consumption Euler equation. Column (1), (2), (4) and (5) also test for the sensitivity of consumption growth to income growth.

TABLE 3—FIRST-DIFFERENCE ESTIMATION OF HOUSEHOLD CONSUMPTION EULER EQUATION

	$ln(C_1/C_0)$				
VARIABLES	(1)	(2)	(3)	(4)	(5)
$ln(adults_1/adults_0)$	0.051	-0.564**	-0.452**	-0.489**	-0.490**
	(0.101)	(0.226)	(0.229)	(0.229)	(0.230)
$ln(R_1/R_0)$		0.761***	0.707***	0.746***	0.746***
		(0.251)	(0.255)	(0.254)	(0.254)
$ln(income_1/income_0)$	0.005***	0.005***		0.005***	0.005***
	(0.002)	(0.002)		(0.002)	(0.002)
$ln(other\ income_1/other\ income_0)$	0.000	0.000			0.000
	(0.002)	(0.002)			(0.002)
Month & year dummies			Yes	Yes	Yes
Constant	0.030	-0.066*	-0.089	-0.078	-0.078
	(0.023)	(0.039)	(0.179)	(0.179)	(0.179)
Observations	570	570	574	570	570
R-squared	0.013	0.029	0.092	0.104	0.104
Adjusted R-Squared	0.00795	0.0221	0.0451	0.0563	0.0546
$\mathrm{P-Value}: \beta_R = 1$		0.341	0.251	0.317	0.319

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

My analysis focuses on the last four specifications. The variable for the growth in the number of adults in the household has a significant negative effect at 5% level of significance across all the four specifications. The average effect of growth in number of adults is about -

0.5%. This means adjusting for growth in household size, a 10% increase in the expected growth in the number of adults in the household will decrease the expected growth in deflated consumption expenditure by about 5%. I fail to reject the null hypothesis that the coefficient on the variable for the growth in household size is equal to 1. The coefficients are significantly different from zero and have very low standard errors.

In violation of the permanent income hypothesis, the variable for growth in income has a significant effect on consumption growth. Based on the theoretical model used in this paper, this is not surprising as both consumption and income are driven by number of adults in the household. The effect of income growth on consumption growth is very significant at 1% level of significance but low in magnitude compared to the variables for growth in the number of adults and household size. The statistical significance and magnitude of the coefficient are the same across specification. We should expect the effect of income growth on consumption to be very small compared to the effect of number of adults on consumption because the effect of income on consumption growth exist because its relationship with number of adults. I will test these relationship between income and number of adults in the next subsection.

Now let us go back to equation $(5'')$. Since the coefficient on $ln(R_1/R_0)$ is statistically close to 1, we can rewrite it as:

$$ln\left(\frac{C_1}{C_0}\right) - ln\left(\frac{R_1}{R_0}\right) = \overline{\boldsymbol{\beta}} + \beta_A ln\left\{\frac{E_0(H_{A1})}{H_{A0}}\right\} + \beta_{T1}T_1 - \beta_{T0}T_0 + \epsilon$$

$$ln\left(\frac{c_1}{c_0}\right) = \overline{\boldsymbol{\beta}} + \beta_A ln\left\{\frac{E_0(H_{A1})}{H_{A0}}\right\} + \beta_{T1}T_1 - \beta_{T0}T_0 + \epsilon$$

where c_t denotes consumption per capita in period t.

Based on the equation and the findings above, households consumption per capita growth can be decomposed into the effect of the growth of the number of adults $\beta_A ln\{E_0(H_{A1})/H_{A0}\}$, and the time (month and year) effects. The coefficient on income growth is very small in magnitude but statistically significantly greater than zero.

Another reduced-form technique we can use to estimate equation (15) is panel regression. In addition to the first difference estimator, I also estimate the consumption Euler equation using a fixed-effects and random-effects estimator. Table 6 reports the results of the estimation of the consumption Euler equation.

TABLE 4—PANEL DATA ESTIMATION OF HOUSEHOLD CONSUMPTION EULER EQUATION

	Random Effects		Fixed Effects	
VARIABLES	(1)	(2)	(3)	(4)
$ln(income\ )$	0.00527***	0.00502***	0.00560***	0.00473***
	(0.00137)	(0.00138)	(0.00169)	(0.00168)
$ln(other\ income)$	0.00261*	0.00267*	-0.000297	-0.000193
	(0.00153)	(0.00153)	(0.00188)	(0.00187)
EIS	-0.0293	-0.0321		
	(0.0298)	(0.0299)		
$ln(adults)$	0.116	0.116	-0.497**	-0.533**
	(0.0743)	(0.0744)	(0.229)	(0.228)
$ln(R)$	0.208***	0.205***	0.741***	0.787***
	(0.0698)	(0.0699)	(0.254)	(0.254)
Woman household head	0.0521	0.0506		
	(0.0578)	(0.0580)		
First pregnancy	0.0462	0.0463		
	(0.0457)	(0.0459)		
Woman's education level	0.0182***	0.0202***		
	(0.00492)	(0.00489)		
Woman's age	0.0108***	0.0105***		
	(0.00388)	(0.00390)		
Food insecurity score	-0.00803**		0.000788	
	(0.00366)		(0.00491)	
Month & year dummies	Yes	Yes	Yes	Yes
Constant	-0.957***	-0.990***	-0.642***	-0.695***
	(0.137)	(0.137)	(0.157)	(0.155)
Observations	1,174	1,191	1,257	1,277

R-squared			0.082	0.079
Number of WID	659	659	707	707

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To decide on which of the two models to select, I statistically compare the estimates of the fixed-effects model to that of the random-effects model using the Hausman Test. I compare column (1) to (3) and column (2) to (4). For both tests, I strongly reject the null hypothesis that the estimates of the two models are not systematically different and hence the estimates of the random-effects model are inconsistent. The coefficients in column (3) and (4) of Table 6 are quite similar in value. The logarithm of the number of adults in the household has a similar but relatively large effect on consumption growth. The mean coefficient on $ln(adults)$ for both models is -0.515%. The large negative effect of the variable for number of adults on consumption is likely to be as a result of the large net marginal cost of adult consumption. Based on the results in both columns, I fail to reject the null hypothesis that the coefficient on household size $ln(R)$ is equal to 1. For column (3), the variable for household food insecurity does not have a significant effect on consumption growth.

In general the coefficients obtained using the fixed-effects estimators are similar to those from the first-difference estimator. The coefficients of the first-difference model and the fixed-effects model have similar levels of significance. However, the first-difference effect model has a lower adjusted R-squared than the fixed-effects model. Since the fixed-effects model has a larger number of observations, it is likely to be the less biased of the two models.

7.2 Household Income and Intertemporal Consumption

In this section, I examines the consumption decisions of the hosuehold at baseline and 6 months after birth. Table 7 reports the results of estimating the household consumption function at baseline. The coefficient on the logarithm of the number of adults is significant at 1% for the first two columns and at 5% for the remaining three. The coefficient on household size is significant at 1% level of significance. However, I reject the hypothesis that the coefficient on household size is equal to 1.

TABLE 5—HOUSEHOLD CONSUMPTION AT BASELINE

	$ln(C_0)$					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
EIS	-0.0435	-0.0532	-0.0574	-0.0610*	-0.0611*	-0.0603*
	(0.0364)	(0.0362)	(0.0366)	(0.0362)	(0.0347)	(0.0342)
$ln(gestation \times \#adults)$	-0.0289	-0.0611	-0.0128	-0.0242	-0.0529	-0.0449
	(0.0493)	(0.0537)	(0.0500)	(0.0497)	(0.0478)	(0.0515)
$ln(\#adults)$	0.528***	0.299***	0.239**	0.261**	0.217**	0.171*
	(0.0755)	(0.108)	(0.107)	(0.106)	(0.102)	(0.104)
$ln(R)$		0.278***	0.221***	0.208**	0.274***	0.296***
		(0.0817)	(0.0833)	(0.0826)	(0.0797)	(0.0786)
Woman's education	0.0128**	0.0114*	0.0134**	0.0119*	0.00306	-0.00100
	(0.00614)	(0.00615)	(0.00615)	(0.00611)	(0.00599)	(0.00600)
Woman's age	0.0129***	0.00957**	0.00462	0.00472	0.000320	0.000320
	(0.00458)	(0.00471)	(0.00484)	(0.00479)	(0.00463)	(0.00457)
Woman household head	0.0955	0.0579	0.152**	0.137*	0.162**	0.148**
	(0.0715)	(0.0721)	(0.0752)	(0.0746)	(0.0716)	(0.0711)
Household head's education	0.0213***	0.0232***	0.0278***	0.0274***	0.0186***	0.0188***
	(0.00573)	(0.00571)	(0.00599)	(0.00593)	(0.00580)	(0.00570)
Food insecurity score	-0.000204	0.000760	0.000800	0.000822	0.00711	0.00694
	(0.00535)	(0.00544)	(0.00544)	(0.00538)	(0.00524)	(0.00523)
First pregnancy	-0.00632	0.0469	0.0409	0.0363	0.0639	0.0714
	(0.0549)	(0.0562)	(0.0568)	(0.0562)	(0.0540)	(0.0533)
$ln(income\ at\ baseline)$			0.0152***	0.0144***	0.0140***	0.0142***
			(0.00332)	(0.00328)	(0.00314)	(0.00308)
$ln(labor\ income\ at\ baseline)$			0.00896	0.00911	0.00485	0.00372
			(0.00747)	(0.00739)	(0.00712)	(0.00705)
$ln(other\ income\ at\ baseline)$				0.00572***	0.00537***	0.00591***
				(0.00210)	(0.00202)	(0.00201)
Asset index at baseline					0.161***	0.178***
					(0.0226)	(0.0235)
Month & year dummies	No	Yes	No	No	No	Yes
Constant	-1.327***	-0.921***	-1.067***	-0.972***	-0.681***	-0.520*

	(0.216)	(0.284)	(0.225)	(0.225)	(0.220)	(0.273)
Observations	608	608	600	600	600	600
R-squared	0.160	0.202	0.154	0.171	0.239	0.272
Adjusted R-Squared	0.146	0.169	0.136	0.152	0.220	0.236
Durbin P-value			0.000387	0.000934	0.00137	0.00106

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

It is important to note that because number of adults and household size are endogenous, we can only interpret the results in Table 7 as mere associations between variables and not as causal relationships. From table, we see that there is a significant positive association between the logarithm of the number of adults and consumption. However, the interaction of the number of adults and gestational age is not associated with consumption at baseline. Household labor-related income and non-labor related income also have a significant positive association with consumption growth. These coefficients are small in magnitude compared to the coefficients on the variable for number of adults and houshehold size.

Table 8 reports the results of estimating the household's expost consumption decisions at 6 months after birth using an instrumental variable approach. The coefficient on the logarithm of number of adults is significantly different from zero at a 5% level of significance for all the specifications. The magnitude of the coefficient for the variable for number of adults is similar to those obtain in Table 7. However, we cannot make any inferences about their relative magnitudes. The positive coefficient indicates that the net marginal contribution of adults to income is negative if we take into consideration the cost of their leisure. For household with many adults, adding an adult to the will decrease consumption per capita.

TABLE 6—IV ESTIMATION OF HOUSEHOLD EXPOST CONSUMPTION FUNCTION AT 6 MONTHS AFTER BIRTH

	$ln(C_1)$			
VARIABLES	(1)	(2)	(3)	(4)
$ln(\#adults)$	0.454***	0.283***	0.244**	0.224**
	(0.078)	(0.100)	(0.099)	(0.095)
$ln(R_1)$		0.122	0.182*	0.206**
		(0.098)	(0.097)	(0.094)
EIS	0.028	0.011	0.009	0.014
	(0.035)	(0.033)	(0.032)	(0.030)
$ln(income)$		0.014***	0.012***	0.012***
		(0.003)	(0.003)	(0.003)
$ln(other\ income)$		0.057***	0.049***	0.047***
		(0.007)	(0.007)	(0.007)
Asset index score			0.135***	0.125***
			(0.022)	(0.021)
Woman's education	0.016***	0.014**	0.004	0.005
	(0.006)	(0.005)	(0.006)	(0.005)
Woman's age	0.013***	0.009**	0.005	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
Woman household head	0.215***	0.212***	0.212***	0.178***
	(0.072)	(0.066)	(0.064)	(0.062)
Household head's education	-0.000*	-0.000*	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Food insecurity score	0.014**	0.013**	0.006	0.007
	(0.006)	(0.005)	(0.005)	(0.005)
First pregnancy	0.013	0.041	0.046	0.062
	(0.053)	(0.050)	(0.049)	(0.047)
Month & year dummies	No	No	No	Yes
Constant	4.561***	4.736***	4.910***	5.123***
	(0.161)	(0.157)	(0.154)	(0.166)
Observations	533	533	524	524
R-squared	0.144	0.281	0.330	0.387
Adjusted R-Squared	0.131	0.266	0.314	0.356

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9 reports the results of estimating the household labor related income function at baseline. The variable for the number of adults has a positive association with household labor related income. The coefficient is very significant at a 1% level of significance. Even though this is a strong effect in percentage terms, its absolute effect is low since the labor related income of the average household is low compared to their consumption. This is consistent with the positive sign on the coefficient on the number of adults in the consumption equation.

TABLE 7—HOUSEHOLD LABOR RELATED INCOME AT BASELINE

	Household Labor related Income			
VARIABLES	(1)	(2)	(3)	(4)
$ln(\#adults)$	4.181***	5.506***	5.550***	4.494***
	(1.263)	(1.881)	(1.883)	(1.343)
$ln(gestation \times \#adults)$		-1.011	-0.954	
		(1.286)	(1.288)	
$ln(gestational\ age)$				-1.011
				(1.286)
Asset index score			-0.335	
			(0.584)	
Woman's education	-0.00455	0.0421	0.0579	0.0421
	(0.136)	(0.143)	(0.149)	(0.143)
Woman's age	0.270***	0.243**	0.246**	0.243**
	(0.100)	(0.106)	(0.107)	(0.106)
Woman household head	-3.013*	-2.500	-2.731	-2.500
	(1.607)	(1.721)	(1.736)	(1.721)
Household head's age	-0.00313	-0.00219	-0.00200	-0.00219
	(0.00654)	(0.00669)	(0.00670)	(0.00669)
Head's education	-0.331**	-0.339**	-0.324**	-0.339**
	(0.128)	(0.133)	(0.137)	(0.133)
Food insecurity score	-0.143	-0.174	-0.190	-0.174
	(0.122)	(0.129)	(0.131)	(0.129)
First pregnancy	0.153	-0.177	-0.226	-0.177
	(1.215)	(1.294)	(1.296)	(1.294)
Month & year dummies	No	Yes	Yes	Yes
Constant	-18.90***	-12.34*	-12.63*	-12.34*
	(3.408)	(6.670)	(6.699)	(6.670)
Observations	702	654	653	654
R-squared	0.056	0.074	0.076	0.074
Adjusted R-Squared	0.0455	0.0421	0.0421	0.0421

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Even though the number of adults is strongly associated with household consumption, the interaction between number of adults in the household and gestational age does not have a significant effect on consumption. This is consistent with the results in Table 7 and 8.

Gestational age at baseline is also insignificant in terms of its association with household labor related income.

Table 10 reports the results of estimating the household labor related income function at baseline. The variable for the number of adults at baseline is associated with labor income for all the three specifications. The coefficients are very significant at a 1% level of significance. The coefficient on the variable for the interation between gestational age and number is positive in column (2) and (3) and very significant at a 1% level of significance. In column (4), the variable for gestational age has a very significant effect on labor income at a 1% level of significance.

TABLE 8—HOUSEHOLD LABOR INCOME AT BASELINE

	Household Labor Income			
VARIABLES	(1)	(2)	(3)	(4)
$ln(\#adults)$	0.574***	0.883***	0.865***	0.544***
	(0.0851)	(0.123)	(0.121)	(0.0881)
$ln(gestation \times \#adults)$		-0.338***	-0.335***	
		(0.0843)	(0.0835)	
$ln(gestational\ age)$				-0.338***
				(0.0843)
Asset index score			0.152***	
			(0.0378)	
Woman's education	0.0277***	0.0352***	0.0247***	0.0352***
	(0.00904)	(0.00928)	(0.00956)	(0.00928)
Woman's age	0.0193***	0.0206***	0.0168**	0.0206***
	(0.00671)	(0.00690)	(0.00689)	(0.00690)
Woman household head	-0.746***	-0.808***	-0.755***	-0.808***
	(0.111)	(0.115)	(0.115)	(0.115)
Household head's age	0.000739	0.000886	0.000813	0.000886
	(0.000602)	(0.000599)	(0.000592)	(0.000599)
Head's education	0.0575***	0.0534***	0.0449***	0.0534***
	(0.00855)	(0.00864)	(0.00880)	(0.00864)
Food insecurity score	-0.0364***	-0.0307***	-0.0265***	-0.0307***
	(0.00812)	(0.00843)	(0.00841)	(0.00843)
First pregnancy	-0.123	-0.131	-0.121	-0.131
	(0.0815)	(0.0848)	(0.0839)	(0.0848)
Month & year dummies	No	Yes	Yes	Yes

Constant	-4.590***	-2.835***	-2.683***	-2.835***
	(0.228)	(0.438)	(0.434)	(0.438)
Observations	684	638	637	638
R-squared	0.293	0.343	0.359	0.343
Adjusted R-Squared	0.284	0.320	0.335	0.320

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 11 reports the results of estimating the household expost labor related income function at 6 months after birth using an instrumental variable approach. The effect of the number of adults on labor related income is positive and large in magnitude as compared to the its corresponding effect on consumption. A 10% increase in the number of adults will result in about a 37% increase in labor related income. However, the mean level of labor related income per capita is disproportional lower than the mean level of consumption per capita, hence this income effect is not likely to result in an increase in consumption per capita.

TABLE 9—HOUSEHOLD LABOR RELATED INCOME AT 6 MONTHS AFTER BIRTH

	Household Labor related Income		
VARIABLES	(1)	(2)	(3)
$ln(\#adults)$	3.678***	3.778***	3.772***
	(1.108)	(1.120)	(1.123)
Asset index at 6 months after birth		0.638*	0.663*
		(0.341)	(0.345)
Woman's education	-0.00512	-0.0559	-0.0584
	(0.0837)	(0.0869)	(0.0870)
Woman's age	0.0737	0.0643	0.0673
	(0.0609)	(0.0616)	(0.0617)
Woman household head	-1.497	-1.478	-1.649
	(1.036)	(1.036)	(1.043)
Household head's age	-0.00446	-0.00410	-0.00439
	(0.00365)	(0.00363)	(0.00376)
Household head's education	-0.0398	-0.0628	-0.0589
	(0.0785)	(0.0812)	(0.0809)
Food insecurity score	-0.147*	-0.138*	-0.125
	(0.0769)	(0.0786)	(0.0798)
First pregnancy	-0.228	-0.202	-0.200
	(0.757)	(0.759)	(0.763)

Month & year dummies			
Constant	-9.993***	-9.265***	-11.08***
	(2.216)	(2.272)	(2.540)
	3.678***	3.778***	3.772***
Observations	(1.108)	(1.120)	(1.123)
R-squared		0.638*	0.663*
Adjusted R-Squared		(0.341)	(0.345)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In the case of other sources of income, the variable for the number of adults in the household is not statistically associated with other income. The coefficient on the interaction term, and logarithm of gestational age all have an insignificant effect on household income. We cannot make any causal inferences based on this result. However, it is suggestive evidence that as expected, the household's non-labor sources of income are unlikely to be related to the number of adults in the household. Table 12 reports the results of estimating the household non-labor related income function at baseline.

TABLE 10—HOUSEHOLD NON LABOR RELATED INCOME AT BASELINE

	Non-Labor Related Income			
VARIABLES	(1)	(2)	(3)	(4)
$ln(\#adults)$	0.975	-0.0146	0.975	1.091
	(1.060)	(1.552)	(1.060)	(1.108)
$ln(gestation \times \#adults)$		1.105		
		(1.061)		
$ln(gestational\ age)$				1.105
				(1.061)
Woman's education	0.284**	0.241**	0.284**	0.241**
	(0.114)	(0.118)	(0.114)	(0.118)
Woman's age	0.000594	0.0280	0.000594	0.0280
	(0.0842)	(0.0871)	(0.0842)	(0.0871)
Woman household head	3.584***	3.905***	3.584***	3.905***
	(1.349)	(1.420)	(1.349)	(1.420)
Household head's age	-0.00706	-0.00531	-0.00706	-0.00531
	(0.00549)	(0.00552)	(0.00549)	(0.00552)
Head's education	0.0309	0.0616	0.0309	0.0616
	(0.108)	(0.110)	(0.108)	(0.110)
Food insecurity score	0.0198	0.0408	0.0198	0.0408

	(0.102)	(0.107)	(0.102)	(0.107)
First pregnancy	0.497	0.285	0.497	0.285
	(1.020)	(1.068)	(1.020)	(1.068)
Month & year dummies	No	Yes	No	Yes
Constant	-12.20***	-12.91**	-12.20***	-12.91**
	(2.861)	(5.504)	(2.861)	(5.504)
Observations	702	654	702	654
R-squared	0.026	0.058	0.026	0.058
Adjusted R-Squared	0.0150	0.0255	0.0150	0.0255

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 13 reports the results of estimating the household's expost non-labor related function using an instrumental variable approach . The number of adult in the household has no effect on household non-labor related income. Hence at 6 months after birth, the addition of an adult to the household will result in a decrease in the household's non-labor related income per capita since it has no effect on total non-labor related income.

TABLE 11—IV ESTIMATION OF HOUSEHOLD NON LABOR RELATED INCOME AT 6 MONTHS AFTER BIRTH

	Non Labor-related Income		
VARIABLES	(1)	(2)	(3)
$ln(\#adults)$	0.578	0.526	0.543
	(0.521)	(0.532)	(0.528)
Asset index score		0.168	0.0975
		(0.162)	(0.162)
Woman's education	0.0549	0.0456	0.0398
	(0.0393)	(0.0413)	(0.0409)
Woman's age	0.0626**	0.0589**	0.0605**
	(0.0286)	(0.0293)	(0.0290)
Woman household head	1.175**	1.158**	1.208**
	(0.487)	(0.492)	(0.491)
Household head's age	-0.00315*	-0.00307*	-0.00244
	(0.00171)	(0.00173)	(0.00177)
Household head's education	-0.0149	-0.0299	-0.0263
	(0.0368)	(0.0386)	(0.0381)
Food insecurity score	-0.0541	-0.0501	-0.0457
	(0.0361)	(0.0373)	(0.0375)
First pregnancy	0.329	0.314	0.389
	(0.356)	(0.361)	(0.359)

Month & year dummies	No	No	Yes
Constant	-4.342***	-4.020***	-3.444***
	(1.041)	(1.079)	(1.195)
Observations	571	561	561
R-squared	0.042	0.044	0.076
Adjusted R-Squared	0.0281	0.0281	0.0377

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The findings above strongly suggest that adults in the household respond to the addition of other adults by increasing their labor supply to the labor related activities which will results in an increase in income from these sources. In spite of these positive response the total household income per capita decreases as the number of adults in the household increases. This decrease in total income per capita translates into a decrease in consumption per capita and gap between consumption per capita and income per capita. This is because the labor related income has the strongest proportional response (>1) to changes in number of adults but the lowest absolute response. For labor income which is the largest source of household income, the elasticity with respect to the number of adults is less than 1.

Among all the different sources of income, only the household's labor income has a negative association with gestational age. The estimates of the household labor income function at baseline indicates that the labor supply for adults decreases as we get closer to the expected birth date of the child. The magnitude of the decrease in household labor income is comparable in magnitude to the increase in labor income as a result of an increase in the number of adults. Based on the results, I argue that all the above results can be interpreted as causal. For all the instrumental variable estimations, I fail to reject the null hypothesis of exogeneity.[7] This means that number of adults and household size are probably both exogenous in the context of the data used for estimation.

7.3 Implications of Results for Household Welfare

Household composition and size affect consumption in two ways. Firstly, it affects the household's consumption per capita in the household for both present and future periods. Secondly, it affects consumption growth over time through its effect on household income. For low-income households, the ability to incorporate current and future information about household composition in their decisions has implications for consumption smoothing and the general level of consumption in the household.

In this paper, I use consumption per capita as a measure of the general level of consumption in a household. The findings discussed in the above sections suggest that the growth in household consumption per capita over time changes in response to an anticipated growth in the number of adults in the household. A 10% percent increase in the anticipated change in the number of adults from period 0 to period 1 will result in about a 50% decrease in consumption growth. If we assume symmetry, a 10% percent decrease will have the exact opposite effect. Therefore households expecting a large change in number of adults will have a lower growth in consumption per capita than households expecting a small change in number of adults. For these households, an increase in number of adults will decrease consumption per capita over time. This decrease is as a result of the fact that the net marginal contribution of

[7] This is based on the Durbin and Wu-Hausman tests.

adults to income is negative. In effect, the addition of adults to the household will decrease consumption per capita since the elasticity of labor income--which is the largest source of income—is less than 1. Consequently, the household uses non-labor related income to finance the increase in consumption requirement due to the the addition of adults to the household. However, non-labor related income is invariant to increases in number of adults in the household, therefore, the household is unable to use it to completely offset the increase in consumption requirement as a result of the addition of adults to the household.

From the results above, gestational age does not have a significant effect on the any of the outcome variables except for labor income at baseline. The negative of gestational age on labor income is large enough to have an economically important effect on consumption expenditure per capita since labor income is the largest source of income for the household.

In the light of the above discussions, on the average the consumption of individuals in households with many adults and a pregnant woman is likely to be lower than their counterparts with fewer adults. This has implications for the welfare of children and infants in households with a large number of adults. Therefore, when considering safety nets to protect the consumption of members of poor households, it is important to strongly consider household composition and whether or not a pregnant woman is present. The elasticity of labor income with respect to the number of adults is a reflection of the ability of other adults to respond to the decreasing labor supply of the pregnant woman in terms of their labor supply.

8. Conclusion

One implication of the life cycle version of permanent income hypothesis is that if we discount shocks, consumption growth will be invariant to the expected growth in income. For low income households in developing countries, this prediction is likely to be voilated due to the underlying relationship between household demographic and labor income. Inefficiencies in the labor market which is the main source of income of these households create a strong relationship between the number of adults in the household and income.

In this paper, I use a household demographic model to show that due to the link between the consumption and the labor supply of poor households, the number of adults in the household should have a significant effect on consumption growth. In adition to this, I show that there is a non zero relationship between consumption per capita and the number of adults in the household. In the presence of labor market inefficiencies, the income of households with a pregnant woman will also depend on the gestational age. Thus, we should expect gestational age to have a significant effect on both consumption per capita and consumption growth.

Testing the above implications of the model empirically, I find a significant relationship between growth in the number of adults in the household and consumption growth. As expected income growth has a significant but trivial effect on consumption growth. I also find a negative relationship between the number of adults and consumption per capita. This is explained by the low (<1) elasticity of labor income with respect to number of adults. Labor income is the largest source of income for the household. However, the absolute effect of adults on household labor income is not enough to offset the increase in household consumption requirement resulting from an increase in the number of adults. Gestational age and it's interaction with number of adult have a significant effect on labor income. Despite this finding, gestational age does not have significant effect on labor related income and consumption.

Collectivelly, the empirical finding above point to household size and the presence of a pregnant woman as important criteria when thinking of households whose consumptions are vaulnerable and therefore need to be protected. Households with many adults are likely to have a lower level of consumption per capita as compared to their counterparts with only a few members.

Appendix

Recovering Estimates for Coefficient of Relative Risk Aversion

Assuming CRRA and expected utility maximizing behavior, the respondent $i's$ problem can be written as

$$\max_{r_i \geq 0} \frac{1}{2}\frac{(w - r_i + 2r_i)^{1-\theta_i}}{1-\theta_i} + \frac{1}{2}\frac{(w - r_i + r_i/2)^{1-\theta_i}}{1-\theta_i}$$

$s.t.$

$w - r_i \geq 0$

where r_i denotes the amount individual i decides to gamble with; the coefficient of relative risk aversion $\theta_i < \infty$ is assumed to be strictly positive.

The Lagrangean of the problem can be written as

$$\mathcal{L}(r_i) = \frac{1}{2}\frac{(w - r_i + 2r_i)^{1-\theta_i}}{1-\theta_i} + \frac{1}{2}\frac{(w - r_i + r_i/2)^{1-\theta_i}}{1-\theta_i} + \lambda(w - r_i) + \alpha r_i$$

First order conditions

$$\frac{1}{2}(w+r_i)^{-\theta_i} - \frac{1}{4}(w-r_i/2)^{-\theta_i} - \lambda = 0$$

$$\lambda(w-r_i) = 0$$

$$\alpha r_i = 0$$

Case 1: $w - r_i > 0;\ r_i > 0$

$$\frac{1}{2}(w+r_i)^{-\theta_i} = \frac{1}{4}(w-r/2)^{-\theta_i} \qquad (G.1)$$

Solving equation $(G.1)$ for θ_i and r_i, I get

$$log\left(2^{\frac{1}{\theta_i}}\right) = log\left[\frac{(w+r_i)}{(w-r_i/2)}\right]$$

$$\frac{1}{\theta_i}log2 = log\left[\frac{(w+r_i)}{(w-r_i/2)}\right]$$

$$\boldsymbol{\theta_i(w,r_i)} = \frac{log(2)}{log\left[\frac{(w+r_i)}{(w-r_i/2)}\right]}$$

$$\boldsymbol{r_i}^*(\boldsymbol{w},\boldsymbol{\theta_i}) = \frac{2^{\frac{1}{\theta_i}}w - w}{1 + 2^{\frac{1}{\theta_i}-1}}$$

Case 2: $w = r_i > 0$

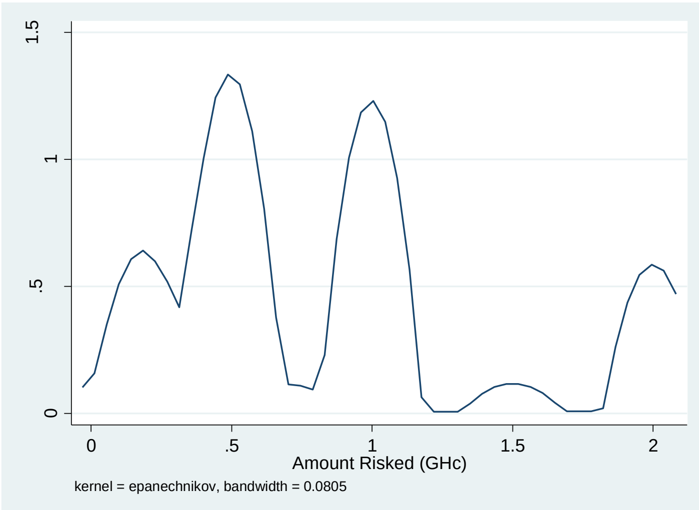
$$\frac{1}{2}(w+r_i)^{-\theta_i} - \frac{1}{4}(w-r/2)^{-\theta_i} = \lambda$$

$$\frac{1}{2}(w+r_i)^{-\theta_i} - \frac{1}{4}(w-r_i/2)^{-\theta_i} \geq 0 \qquad (G.2)$$

Simplifying equation $(G.2)$, I get the inequality

$$\boldsymbol{\theta_i} \leq \boldsymbol{\frac{1}{2}}$$

FIGURE G.1—KERNEL DENSITY OF BETS BASED ON FULL SAMPLE



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