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**Market Imperfection, Farm Household Consumption Behavior and the Life Cycle Model:
Evidence From East Africa**

Seydina Ousmane Sene
Department: Agricultural Economics and Agribusiness
Organization: LSU AgCenter
Address 1: 128 Martin D Woodin Hall
Baton Rouge, LA 70803 – 5604

Dr. Ashock Mishra
Department: Agricultural Economics and Agribusiness
Organization: LSU AgCenter
Address 1: 128 Martin D Woodin Hall
Baton Rouge, LA 70803 – 5604

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I. Introduction

Empirical evidence helping to understand farm behavior in developing countries is undisputable. Moreover, from the aggregate structural data in hand, it is clear that farm household and small farm business in East Africa are not static institutions but adapt and evolve in response to the changing economic circumstances and regulatory frameworks in the past three decades. In these agriculture-based economies like Uganda, Kenya, Tanzania, and Ethiopia, smallholder farming accounts for approximately 75 percent of total employment while the impact of agriculture (production, investment) on the recent growth trends is very limited. For instance, in the past two decades, Uganda has registered strong economic growth, and is now making significant and consistent strides towards poverty alleviations by improving the quality of life and access to services such as education, health and community infrastructures. Therefore, in order to continue to promote pro-poor economic growth in East Africa, a formal microeconomic model of the farm household explaining consistently the dynamics of household consumption, production, saving and investment is required. Such models will help and support budget strategy as part of the implementation of the National Development Strategy, and postulate a complete and clear understanding of the linkages/interplay between the structured agricultural sector under market imperfections and the decisions in agricultural households, farms family and farm business.

To do so, the objective of the paper is to test if small household farm consumption behavior is inconsistent with the life cycle model in the presence of market imperfection, and the interactions between labor (farm, off-farm work), consumption, production uncertainty, and land tenure in East Africa. Therefore, an understanding of small household farm consumption behavior and investment decisions and the phenotype and archetype of farm household relation to its family members, labor, farm and off-farm income is at stake. This paper, therefore, sheds light on the different and distinct behavioral assumptions and models upon the standard microeconomic framework assuming that farm household in East Africa, and especially in

Uganda are rational agents with well defined and characterized preferences. Consequently, this paper provides an integrative framework for policy analysis on income dynamics at the household level and capacity building towards poverty alleviation, which will greatly assist and support the Annual Policy Implementation Review in East Africa, especially in Uganda. Now, given that a dynamics and structured agricultural sector is required to alleviate poverty in Sub-Saharan Africa, the future of all Sub-Saharan African countries will depend partially and greatly to the ability of smallholder farm household to save and invest while they attempt to find the best set of outcomes under market imperfection and rapid population growth especially in Uganda. This is very important since agricultural investment increases food production capacity and agribusiness activities, which adds quickly and exponentially to the Gross Domestic products and stimulate productivity growth and capital efficiency uses in inputs. Thus, if East African economies invest more in agriculture, they can increase their competitive efficiency of domestic agriculture in world markets as price are pressure down from investment induced technology, and also determine the wealth and health of their farm sector to spark access to credit by leveraging future farm output.

In the ongoing and intensifying policy debate of agricultural reforms (farm and policy adjustments changes), this study has significant distributional and incidence analysis of agricultural production, food supply, and employment in East Africa. Therefore, understanding farm household behavior in Africa's agriculture is undisputable to foster innovation in the context of market imperfections, rapid demographic changes, and rising private sector investment on infrastructure and market access, jointly with China and Brazil's efforts. However, the planning and implementation of agricultural development and policy across the public, private sectors in Africa is necessarily and sufficiently influenced by the interaction between smallholder farming household's decision on labor allocations (farm and off-farm work), production uncertainty, consumption, and leisure which in turn greatly affect their ability to save and invest on the farm business and its development. Looking at the existing literature,

the African development research group posits, “despite the numerous devised agricultural policies adopted by most countries, implementation has been lagging in east Africa, especially in Uganda (p.1, 2010).

The contribution of the paper is that it delivers a useful typology for agricultural policy and support to smallholder household farmer both as producers and consumers in the presence of market imperfections. The interdependence between labor, production, consumption, and land tenure in East Africa show how the agricultural sector is far more closely entrenched to and integrated to the global economy. Farm policy in East Africa, therefore is more effective if it more closely coordinated and analyses with the overall fiscal, monetary, and labor market policies and regulations. This important because in the existing literature, farm investment modeling relies heavily not only upon the theory of the firm (Phimister, 1993), Mairesse et al. (1999), Gallerani et al. (2008) Bokusheva et al. (2009) etc. But under market imperfections the inclusion of uncertainty, contract enforcement, land tenure, market access, credit and financial constraints (Blanchard et al. 2006), investment characteristics (Boetel et al. (2007) accounting for age structure, reversibility have been identified in the literature as important determinant of investment in agriculture. We use Uganda and extensive national panel survey carried out over twelve month on a nationally representative sample of household which took into consideration the seasonality associated with the composition of and expenditure on consumption in three visits, for the period of 2005/06/2009-2010/2010-2011/2011-2012 from the LSMS-ISA project. The dataset overcomes various measurement issues in answering if smallholder farm household in East Africa plan in a fashion consistent with intertemporal optimization. If so, is the life cycle model in the presence of market imperfections an adequate spatial representation of farm household consumption model in East Africa? The rest of the paper is organized as follow: Section II the literature, section III explains the data, section IV dwelled into the conditions required for farm household consumption and production behavior and its possible deviation from the behavior predicted by the theory of the consumer and theory of the firm. Section V

provides the results and Section VI concludes.

II. The Literature

In the literature, Phimister (1993) among others researchers argues that it is crucial that farm household not be perceived as immutable and static, but as an institution which is evolving continuously over time (p. 8). Smallholder farm household can make provision for their family, and more generally, adapt their consumption patterns to their needs at different production level (uncertain), income, and leisure independent of their age. This theory leads to important and complex distributional and incidence analysis, and non evident predictions about farm household consumption behavior, saving and investment which has huge implications on the rate of growth of national income via agricultural development in East Africa in particular and Sub-Saharan Africa in general. In East Africa, market imperfections, and the interactions between labor (farm, off-farm), consumption, production uncertainty, and land tenure shape households' labor allocation decisions, consumption, and food security status, within rural smallholder farm households. Therefore, a farm household model to explain and inform agricultural reforms (farm and policy adjustments changes) in East Africa hence consumption, production, saving and investment under capital market imperfection and borrowing constraint is at stake. In East Africa, market imperfections impact practically transaction cost, market access and generate costs that interfere with household consumption's decisions, production, labor, saving and investment in agriculture. Consequently, identifying and alleviating the inherent agricultural problems linked to these imperfections remain an ongoing challenge to model farm household behavior in Uganda's agriculture. In the literature, the understanding and requirement to perceive farm household a separate entity of economic analysis date back to Chayanov (1925), Nakajima (1957), Becker's (1981), Singh and Strauss (1986). However, according to Phimister (1993), the standard neoclassical approach of farm maximizing profits assumptions have been criticized and the theoretical models have progressively evolved to incorporate relevant behaviors of farm household such as labor (farm, off-farm) allocation,

consumption, production uncertainty, and leisure especially smallholder farm structured in Sub-Saharan Africa (Gasson (1973); Gasson et al (1973); Lau, Lin & Yotopoulos (1978); Adulavidhaya et al (1979); Staruss (1984); Brase and Ladue (1989); Benjamin (1992); Jacoby(1993); Skoufias (1994). Given these variations and characteristics, many researchers like Phimister (1989) argue that in the presence of market imperfections, the farm household should be perceived as a unique agent of economic analysis which challenges the assumptions of profit maximizing behavior. As a result, in East Africa where market imperfection prevails, coupled with rapid demographic changes, and rising private sector investment on infrastructure, the question is not whether smallholder farm household maximize profit but whether this is useful to predict farm household consumption, production, saving and investment in agriculture. A preview of the data reveals important changes and variations, which have taken, place in East Africa's typical farm household, market structure, and community in the last 20 years. These changes highlight the impetus relative to the spatial distribution of samllholder farming and land tenure in Uganda and motivate the quest for understanding and modeling farm household consumption behavior, production, saving and investment. Land tenure in Uganda was mainly leased by government entity, which tends to impose some constraints on land use and development. However, considering the land act of 1998 which gives recognition to those who hold land under customary tenure, total land and land tenure plays a major role in farm output, expectation and investment it is important to note that there are four types of land systems: Customary, Mailo, freehold and lease hold. The land act 1998 in Uganda defines Freehold tenure as a tenure that originates its legality from the constitution and the written law of the country. Freehold tenure: is "characterized by a grant of land in perpetuity or for a lesser specific time period and that the holder of land in freehold has full power of ownership". One party granting another party the right to exclusively possess the land for a specific time period in exchange of a payment or rent characterizes leasehold. Mailo or customary tenure is also similar to freehold tenure, where land can be held perpetually and a Mailo owner is also able to enjoy all

the right and privilege of a freehold ownership. However, Mailo tenure cannot use his powers against the interest of customary tenants, bona fide or lawful occupants according to the shelter and settlements alternatives in Uganda.

III. The Data

The data used in this study is from the farmer household survey conducted in East Africa by the World bank as part of the Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) project, titled: The Uganda National Panel Survey (UNPS) 2011/12. Uganda has experienced strong economic growth over the past two decades, and important changes and variations, which have taken, place in East Africa's typical farm household, market structure, and community. The survey were conducted in 2005/2006 and covered the district of Kampala, and 72 Enumeration Areas (58 rural and 14 urban) in each of the (i) Central Region with the exception of Kampala District, (ii) Eastern Region, (iii) Western Region, and (iv) Northern Region. Moreover, the panel dataset covered multiple objectives comprising the Household, Gender, Agriculture including a Livestock, the Community, and the Market In each panel survey for the year 1 (2009-2010): 3,123 households were surveyed; year 2 (2010-2011): 2,716 households were surveyed, and year 3 (2011-2012): 2,716 households were surveyed.

The variables are C_{t+1} and C_t which are the consumption levels at time t and $t+1$, income, Y_{it} , net worth, NW_{it} , long term debt, LD_{it} , long term debt, SD_{it} , gross output: total debt ratio, , $GV A_{it}:TD_{it}$, owned land: total land ratio, $OL_{it}:TL_{it}$, and total debt: net worth ratio, $TD_{it}:NW_{it}$, total asset, TA_{it} . Its also important to not that

We also include some demographics and characteristics of the household such as age AG_{it} and family size, FS_{it} . Most importantly the Euler equation is perfectly fine compare to Phimister (1993) as we have available data on consumption along the spectrum of all household expenditure ranging from food, energy, health, education, fuel, seeds, fertilizers and pesticides, labor, animal care, household bills. Therefore we would not run into difficulties like when the data relates only household's total expenditure and includes only expenditure on consumer

durables. Like Hall and Mishkin (1982), Shapiro (1984), Altonji and Siow (1986), Zeldes (1989b), our dataset distinguishes food expenditure, which allows for the direct application of the Euler equation if an additional separability assumption is imposed in the model. So far we discover that this paper is the first to solve this problem as it was left unsolved like in Hayashi (1985), Langemeier and Patrick (1990), Phimister (1993).

IV. Analytical Framework and Methods

In this paper, smallholder farm household is studied in the framework of the neoclassical economic perspective and perceived farm household as a distinct unique entity which behaves differently from others agents or actors in the economy in East Africa. From this perspective, the interactions between labor (farm, off-farm work), consumption, production uncertainty, and land tenure are considered. Therefore, intertemporal, smallholder farmer in the economic setting of Uganda in East Africa must decide its required or needed level of consumption, hence simultaneously and concomitantly determine the level of saving, investment, thus labor (farm and off-farm work) allocations and production. This is a very important feature in East Africa because the interactions between production uncertainty and consumption are entrenched in the structural distribution and attribution of land tenure and control in the farm household family setting. Furthermore, this gives rise to the potential tradeoff between household's current consumption and farm investment, analogous to Chayanov's balance between household consumption and the drudgery of labor, (Phimister, 1993, p.11). The market imperfections which are prevalent in East Africa are characterized by main categories such as capital market imperfections (time inconsistent preferences, non competitive market, asymmetry of information, principal agents problems, etc.), and the inherent existence of risk and uncertainty (price volatility, weather, frequency of droughts and floods, lack of markets, barrier to output markets...) in the agricultural sector in East Africa especially in Uganda. Within this framework, a basic life cycle model with production uncertainty is extended and following Phimister (1993)

the link between the marginal utilities in two consecutive periods is derived under the constant elasticity of substitution assumption in Uganda.

IV.1 Testing the alternative models and approach of models consumption in East Africa:

In this section we attempt to explain consumption pattern or behavior in east Africa by focusing on small farm household in Kampala, Central, Eastern, Northern, and Western Uganda. The strategy and approach of models consumption we set in this section will help provides in new insight to policy-makers in understanding what really works and what are the factors and constraint that alter household behavior in Uganda and generally in East Africa. Furthermore this study provides answers to one key question: How to improve income dynamics at the household level in East Africa and provide policy insight on service delivery and consumption expenditure on poverty and service outcomes. Second following Phimister, 1993 we generate a tractable and testable model to test our hypothesis about life cycle model with uncertainty. Now since, the interpretation of a rejection is difficult as the rejection does not distinguished between rejecting all set of assumptions about the constraints facing household or a rejection of the whole process of optimization of farm household consumption behavior. Following Phismister (1993), Shapiro (1984), Zeldes (1989b) and the existing literature, we assume that the test of the basics life cycle model is an alternative hypothesis of a model of the household.

IV.2 The life cycle model: General specification and Derivations.

According to Phimister, in the presence of uncertainty characterized by market imperfection, the opportunity of replanning should be clearly taken into consideration especially in East Africa. Because if household can re-plan its stream of consumption and production at any given time t in perfect market conditions at the beginning of every decision, we should not witness or observe any variation on the decision making process of the farm household behavior whatsoever. Which mean that over time farm household behavior in east Africa and especially in Uganda is subsequently consistent over time. However, in this paper we do not have the privilege of such condition because farm household in east Africa, an especially in Uganda face

production uncertainty, credit constraint, lack of market and investment, land degradation, pluviometrics and precipitations issues. Therefore, at the beginning of every periods, lets say from 2005 to 2012 farm household in East Africa face completely a new waves of information which also mean that its strategy and options toward consumption, production, investment might not carry past realization and subsequent life events in farm household respectively. Therefore, Phimister argue that the household decision to consume, produce, and invest must be identified by the period τ in which the decision is happening. Thus following closely Phimister (1993), we specify the model as follow:

$$Max \quad E_t \left(\sum_{t=\tau}^T \frac{U(C_t)}{(1 + \rho)^{t-\tau}} \right) \quad (1)$$

$C_t, K_{t+1}, d_t, I_t, Y_t$ subject to :

$$d_{t+1} = (1 + r)d_t - P_t Y_t + P_t^k I_t + C_t \quad (2)$$

$$Y_t = f(K_t, \Pi_t) \quad (3)$$

$K_{t+1} = (1 - \delta)K_t + I_t$ where $d_{T+1} \leq 0$ and d_t and K_t are fixed and C_t – consumption expenditure, Y_t – production, k_t – capital stock, I_t – investment, d_t – debt owed, r_t – interest rate, p_t^k – capital good price, ρ – rate of time depreciation, δ – depreciation rate, and Π_t – random shock at time t.

This optimization problem can be solve easily using dynamic programming technique under the assumptions that the subutility function are twice differentiable, strictly concave and boubded above I all parameters. In addition, we set the rate of time preference to be $\rho \geq 0$ and the prodcution uncertainty is restricted such that in every period t there rae multiple state of the world (N) and for every given level of capital , the corresponding level of production in state s for the household in East Africa is capture and express as $Y_t = \prod_s f(K_t)$, $s=1, \dots, N$. since the shock are randomly distributed and the probability of realization in each state s is assumed to be independent of time t thus we can write $\Pr(\Pi_{st} = \pi_s) = p_s$

When $s=1, \dots, N$; $t=\tau, \dots, T$. It is also important to note that the production function $f(\cdot)$ is

restricted to be also twice differentiable, strictly concave and bounded above in all parameters and the initial level of production is revealed to the household at the beginning of time t before the household makes decision on consumption or investment for the same time period. As a result, we reformulate the constraints facing the household by using the composite variable Z_t where:

$$Z_t = P_t Y_t - (1 + r)d_t \quad (4)$$

Now substituting for d_t and d_{t+1} in the first set of constraints above yield the constraints in terms of Z_t and Z_{t+1} where:

$$Z_{t+1} = (1 + r)(Z_t - P_t I_t - C_t) + P_{t+1} \pi_s f(k_{t+1}) \quad s = 1, \dots, N \quad (5)$$

Therefore, under the uncertainty environment, for any given value of C_t , Z_t , I_t , and k_t , Z_{t+1} can take at the maximum N possible values. Now within this framework, the household decision problem at time τ is equivalent to solving the dynamic programming model express as follow:

$$V_t(Z_t, k_t) = \max \left[U(C_t) + \frac{1}{1+\rho} E_t V_{t+1}(Z_{t+1}, K_{t+1}) \right] \quad (7)$$

$$C_t \geq 0 \quad \text{and} \quad I_t \geq -(1 - \delta)K_t$$

where, $Z_{t+1} = (1 + r)(Z_t - P_t^k I_t - C_t) + p_{t+1} \pi_s f(k_{t+1})$, $s = 1, \dots, N$ and

$$k_{t+1} = (1 - \delta)k_t + I_t$$

and now we can write:

$$V_t(Z_t, k_t) = \max[U(C_t)] \quad (8)$$

$$I_t \geq -(1 - \delta)K_t \quad C_t \geq 0 \quad (9)$$

$$Z_t - P_t^k I_t - C_t \geq 0 \quad (10)$$

$$k_{t+1} = (1 - \delta)k_t + I_t \quad (11)$$

Now following (Blume et al, (1982) and Phimister (1993), it is assume that both the value function and the optimal policy function C_t^* are differentiable and it can be shown that the optimal solution to this problem is characterized by the state variable Z_t and K_t so that we can have a unique solution to this problem with a unique policy functions $C_t^* = C_t^*(Z_t, k_t)$ and

$$I_t^* = I_t^*(Z_t, k_t).$$

Solving for the first order conditions as usual we have:

$$\frac{\partial U}{\partial C_t} - \frac{1+r}{1+\rho} E_t \frac{\partial V_{t+1}}{\partial Z_{t+1}} = 0 \quad (12)$$

$$E_t \left[\frac{\partial V_{t+1}}{\partial Z_{t+1}} \right] + E_t \left[\frac{\partial V_{t+1}}{\partial K_{t+1}} (P_{t+1} \frac{\partial f}{\partial K_{t+1}} \pi - (1+r)P_t^k) \right] = 0 \quad (13)$$

Up to now these two equations above have not yet quiet capture the behavior of the household yielding the optimal solution characterizing the interplay between production and consumption.

Therefore, evidently we know that at the optimal solution:

$$V_t(Z_t, k_t) = \max \left[U(C_t^*) + \frac{1}{1+\rho} E_t V_{t+1} [(1+r)(Z_t - P_t^k I_t^* - C_t^*) + p_{t+1} \pi_s f(1-\delta)k_t + I_t^*] \right] \quad (14)$$

Consequently, using the differentiability feature of the optimal value function concomitantly with the first order conditions we derived the following indirect utility function which is strictly concave and increasing in Z_t , and k_t (see appendix in Phimister (1993)).

$$\frac{\partial V_t}{\partial Z_t} = \frac{\partial U_t}{\partial C_t} \quad (15)$$

$$\frac{\partial V_t}{\partial K_t} = \frac{\partial U_t}{\partial C_t} (1-\delta)P_t^k = \frac{\partial V_t}{\partial Z_t} (1-\delta)P_t^k \quad (16)$$

Obviously, for consumption we can take the expectations at time t+1 of the first equation above and write $E_t \left[\frac{\partial V_{t+1}}{\partial Z_{t+1}} \right]$ and substitute it into equation (12) to have

$$E_t \left[\frac{\partial U / \partial C_t}{\partial C_t / \partial C_{t+1}} \cdot \frac{1+\rho}{1+r_{t+1}} \right] = 1 \quad (17)$$

Here in equation (17) the state of the world is revealed to the household at t+1 and the household will choose a specific level of consumption. Therefore the marginal utility between t+1 and t is expressed as:

$$\frac{\partial U / \partial C_t}{\partial C_t / \partial C_{t+1}} \cdot \frac{1+\rho}{1+r_{t+1}} = 1 + e_{t+1} \quad (18)$$

where the term e_{t+1} capture the household struggle and innovation in solving his consumption

constraint as explain in (Hayashi (1985) or forecast error as in Zeldes (1989b) and Phimister(1993). Then the household capacity of production and interest rate variation is not observe or information about production and interest rate is not perfect and the state of the world at time t is even not yet fully realized. Consequently, equation (17) tells us that any available information w_t available to the household should and must be uncorrelated with the term e_{t+1} in equation (18). As a result the relationship between the term e_{t+1} and w_t is given as:

$E\left(\frac{e_{t+1}}{w_t}\right) = 0$ or $E(e_{t+1} \cdot w_t) = 0$, assuming that household future expectations are rational and that any information w_t available at time t has no explanatory power in explaining the left hand side of equation (18). Therefore one can say without loss of generality that household has optimal plans when facing multiple strategies under market imperfections at time t. thus the relationship between the left and right side of equation (17) at time t are assumed to have an impact on the prevalence of constraint and stock variables such as: income, debt (short term, long term), debt to wealth ratio, land etc. Now using the FOC (first order conditions) in equation (15) and (16) we derive the following:

$$\frac{\partial U/\partial C_t}{\partial C_t/\partial C_{t+1}} \cdot \frac{1+\rho}{1+r} \geq 1 \quad (19)$$

where the inequality in (19) hold if and only if the household is not constraint by borrowing at time t. Now bringing equation (17) to the data from 2005 to 2012 we need to do some reparametrization before hand and assumed constant elasticity of substitution (CES) (Shapiro (1984), Mankiw (1981) Zeldes (1989b) etc. Consequently for the case of east Africa if household are assumed to have identical preferences, then the substitutability function for the ith household is assumed to take the form expressed as:

$$U(C_{it}, Z_{it}) = \frac{C_{it}^{1-1/\eta}}{1-1/\eta} \exp(Z_{it}) \quad (20)$$

where Z_{it} represents the taste shifter and η represent the consumption substitution elasticity. Now using equation (18) under the specification of equation (20) we can derive the consumption of the household in subsequent period for each household in East Africa especially in Uganda as

follow:

$$\frac{1 + \rho}{1 + r_{it+1}} \left[\frac{C_{it+1}}{C_{it}} \right]^{1/\eta} \exp(Z_{it} - Z_{it+1}) = 1 + e_{it+1} \quad (21)$$

However, it is also important to note that we assumed that the taste shift Z_{it} has a very seductive characteristic such that the individual effect for the household is constant between the two periods and will not affect the relationship established in equation (21). Moreover, the individual family's household taste shifter at time t is assumed to be determined in a simple fashion as a simple linear function of time invariant household component φ_i , age of the head household, A_{it} and total family size, FS_{it} in the following linear expression:

$$Z_{it} = \varphi_i + \alpha_1 A_{it} + \alpha_2 A_{it}^2 + \alpha_3 \ln FS_{it} \quad (22)$$

Here (22) the introduction of the age of the household and the taste shifter simply implies that the subutility functions of the household is age dependent and if we substitute Z_{it} and Z_{it+1} in equation (21) we get:

$$\begin{aligned} \ln \left[\frac{C_{it+1}}{C_{it}} \right] &= \eta [\alpha_1 + \alpha_2 - \ln(1 + \rho) + \ln(1 + r_{it+1})] + 2\eta\alpha_2 A_{it} + \eta\alpha_3 \ln \left[\frac{FS_{it+1}}{FS_{it}} \right] \\ &+ \eta \ln(1 + e_{it+1}) \quad (23) \end{aligned}$$

From the basis of equation (23) we built an estimable functions under rational expectations assumption which is not bounded to implies that $e_{it+1} = 0$ but instead following Hayashi (1985) we can write: $1 + e_{it+1} = (1 + e_{it+1}^*)(1 + \vartheta_{it+1})$ where e_{it+1}^* is the aggregate shock and ϑ_{it+1} the individual specific effect assuming that both ϑ_{it+1} and e_{it+1}^* have mean zero and are independent of each other and the forecast variance $\sigma_{uit}^* = \sigma_u^2$ varying overtime and household. Individual interest rates $r_{it+1} = (1 + r_{it+1})\mu_i$ where μ_i is the household specific individual factor with $E(\mu_i) = 1$ and $\text{Var}(\mu_i) = \sigma_\mu^2$ and also the common portion of the interest rate is independent of u_{it+1} and μ_i . Now under this framework, equation (23) is rearrange to:

$$\ln \left[\frac{C_{it+1}}{C_{it}} \right] = \beta_1 + \beta_2 A_{it} + \beta_3 \ln \left[\frac{FS_{it+1}}{FS_{it}} \right] + \epsilon_{it+1} \quad (24)$$

where $\beta_1 = \eta [\alpha_1 + \alpha_2 - \ln(1 + \rho) + \alpha_2 + 1/2(\sigma_u^2 + \sigma_\mu^2)] + \ln(1 + e_{it+1}^*) + \ln(1 + r_{t+1})]$

$\beta_2 = 2\alpha_2\eta$; $\beta_3 = \alpha_3\eta$ and $\epsilon_{it+1} = \eta[\ln(1 + u_{it+1}) + \ln\mu_i - 1/2(\sigma_u^2 - \sigma_\mu^2)]$. Now when applying the Taylor series expansion to $\ln(1 + u_{it+1})$ and $\ln\mu_i$ we have $E(u_{it+1}) = 0$ and $E(\mu_i) = 1$, then $E(\epsilon_{it+1}) \approx 0$. However, we need to note that the coefficients β_1 and ρ are intertwined with the intercept and cannot be separated empirically from an estimation point of view and also the identification of η ; β_2, β_3 is difficult. But fortunately for the purpose of this paper, equation (24) can be used to test empirically if small household farm consumption behavior is inconsistent with the life cycle model in the presence of market imperfection, and the interactions between labor (farm, off-farm work), consumption, production uncertainty, and land tenure in East Africa. Thus we can express the simple static consumption function, estimate it and test for our hypothesis.

$$\ln C_{it} = Z_i + \beta_1 A_{it} + \beta_2 A_{it}^2 + \beta_3 \ln FS_{it} + \beta_4 Y_{it} + \beta_5 NW_{it} + \epsilon_{it} \quad (25)$$

where Z_i is the household individual component, A_{it} the age of the head of household, Y_{it} is the household disposable income, and NW_{it} is the household net wealth at time t. Equation (25) will be estimated in the first difference to eliminate the individual specific effects. Thus we have:

$$\Delta \ln C_{it+1} = (\beta_1 + \beta_2) + 2\beta_2 A_{it} + \beta_3 \Delta \ln FS_{it+1} + \beta_4 \Delta Y_{it+1} + \beta_5 \Delta NW_{it+1} + \Delta \epsilon_{it+1} \quad (26)$$

Now in what follow we can test the Euler equation in (24) plus a set of financial variables exogenous at time t considers important in determining the impact of borrowing constraints and then used the nonnested hypothesis to evaluate (24) against the consumption function (26). The financial variables are: net worth, NW_{it} , long term debt, LD_{it} , long term debt, SD_{it} , gross output: total debt ratio, $GV A_{it}: TD_{it}$, owned land: total land ratio, $OL_{it}: TL_{it}$, and total debt: net worth ratio, $TD_{it}: NW_{it}$, total asset, TA_{it}

V. The results

Table 1[About Here]

Table 2[About Here]

Table 3[About Here]

Table 4[About Here]

VI. Conclusion

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