Nutritional Barriers to Agricultural Productivity in Smallholder Farm Households: Panel Data Evidence from Uganda

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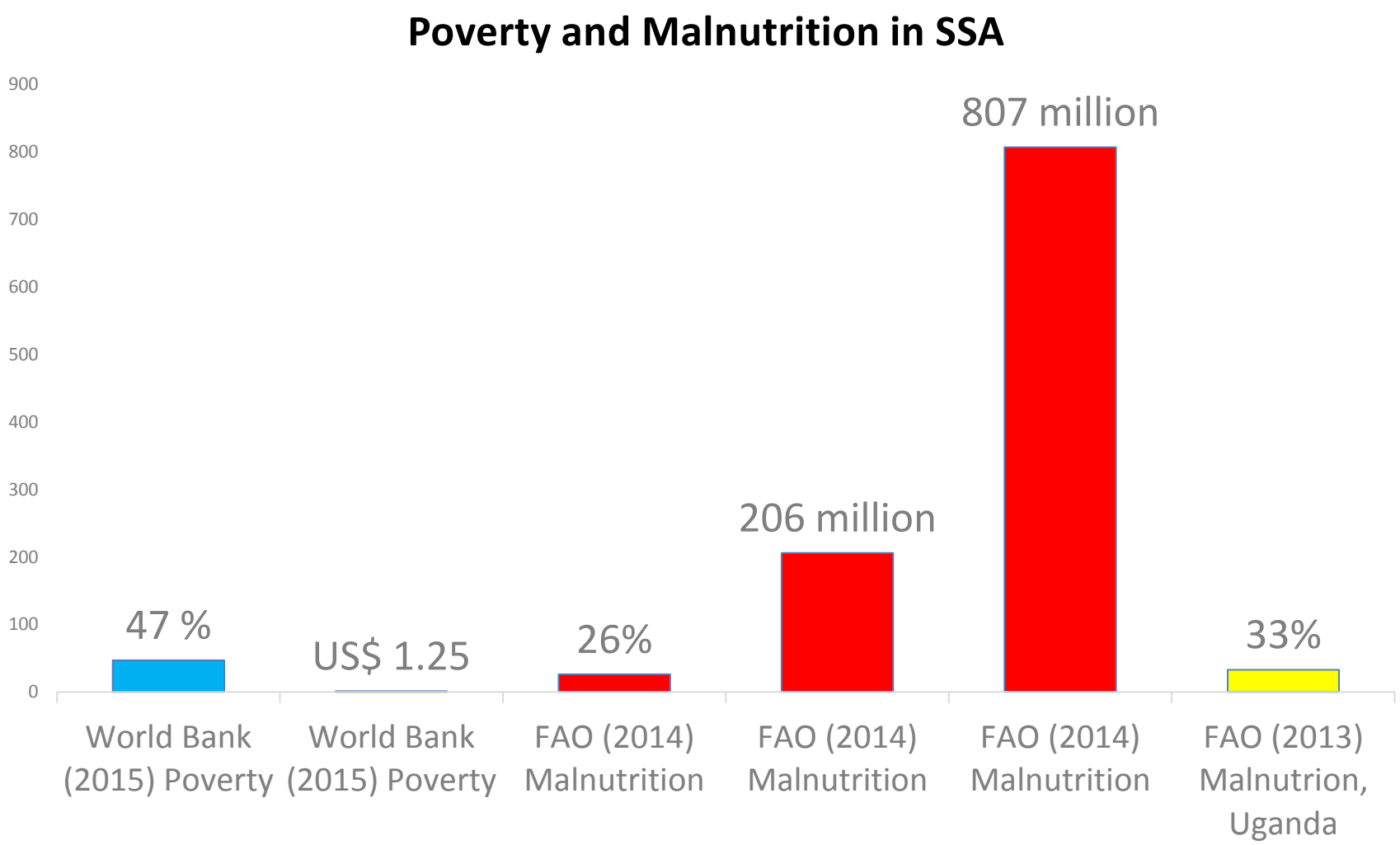
Introduction



The Case of Uganda

- There has been significant economic growth over the past twenty years in Uganda.
- However, agricultural productivity has failed to increase at the same pace (Kyomugisha 2008).
- Several measures have been put in place by the government, NGOs and market forces including encouraging adoption of new seed varieties, chemical fertilizers but with limited rates of adoption (UBOS household survey data, 2009/10).
- In contrast, little attention has been given to the nutritional causes of low productivity in the agricultural sector.
- Few studies have explored the link that connects nutrition with low labor productivity in agriculture, which employs a majority of the population.

Objectives

- 1) Assess the impact of nutritional intake on agricultural productivity and, hence, labor productivity.
- 2) Examine gender differences in deficiency of these nutrients and the resulting effect on productivity.
- 3) Assess the threshold levels for macronutrient and micronutrient intake needed to achieve some level of agricultural productivity.

Methodology: Data

- The study utilizes a panel dataset from Uganda National Panel Surveys (UNPS) that has four waves; 2005/06, 2009/10, 2010/11 and 2011/12.

- Balanced panel with 1,634 observations per wave
- Total – 6,536 observations.

Methodology: Empirical Models

- **Objective one:** We estimate a Cobb Douglas production function in which effective labor is a function of nutrient intake. Due to methodological pitfalls such as:

- 1) Unobserved fixed effects such as genetic endowment, high metabolic rate of some individuals that may be problematic in estimating the nutrition productivity relationship.
- 2) Causality that can run in both directions.

- Fixed Effects Instrumental Variable (FEIV) approach is used.

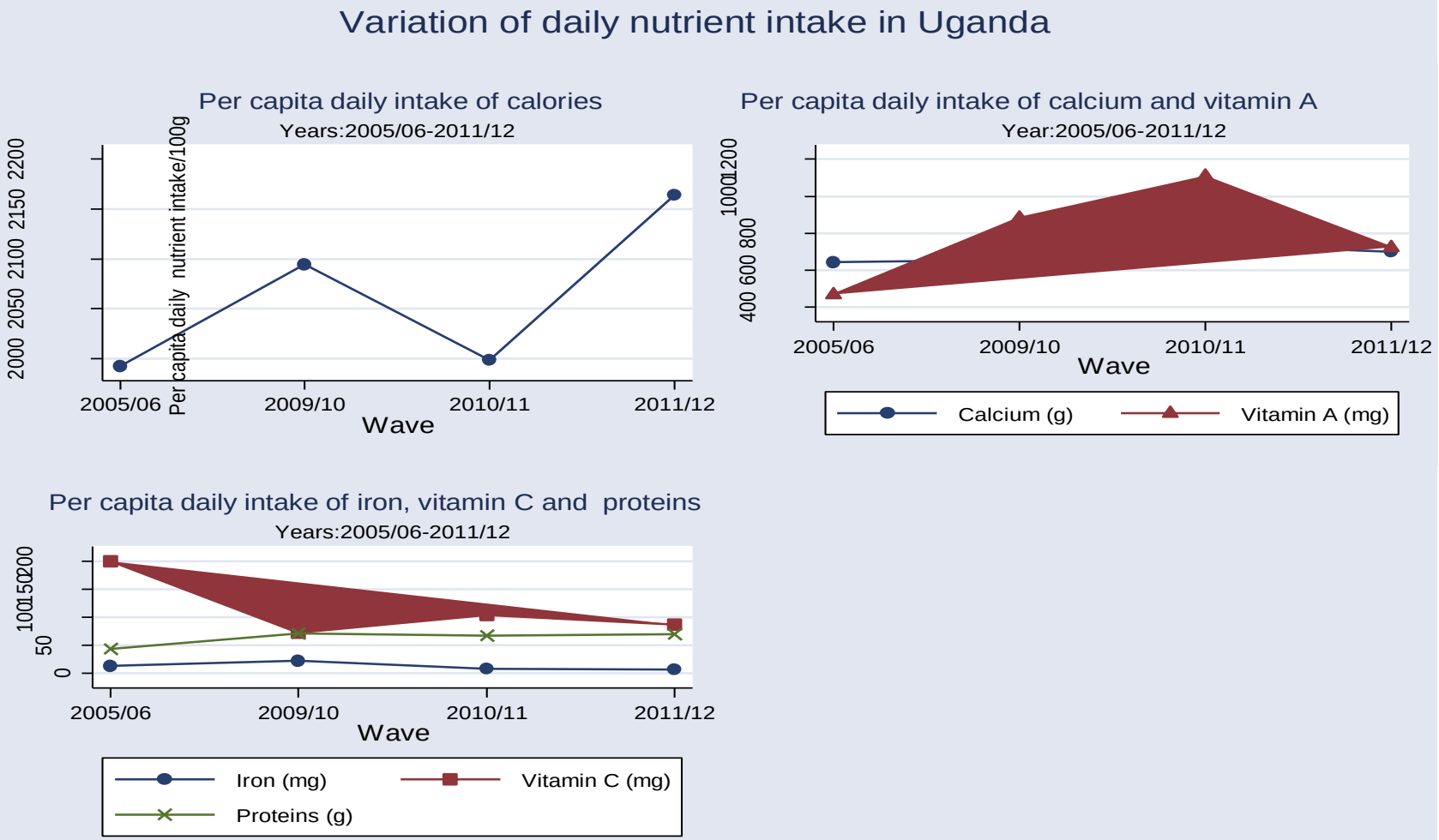
- **Objective 2:** We disaggregate the data based on gender and estimate the C-D function using FEIV.

- **Objective 3:** First use multivariate analysis specifically, cluster analysis, to characterize the population using nutrient intake profiles. The dissimilarity measure used in the classification was Euclidean distance between these quantitative variables.
- Thereafter, instrumental variable threshold regression is used after obtaining threshold values (Ward's 1963).

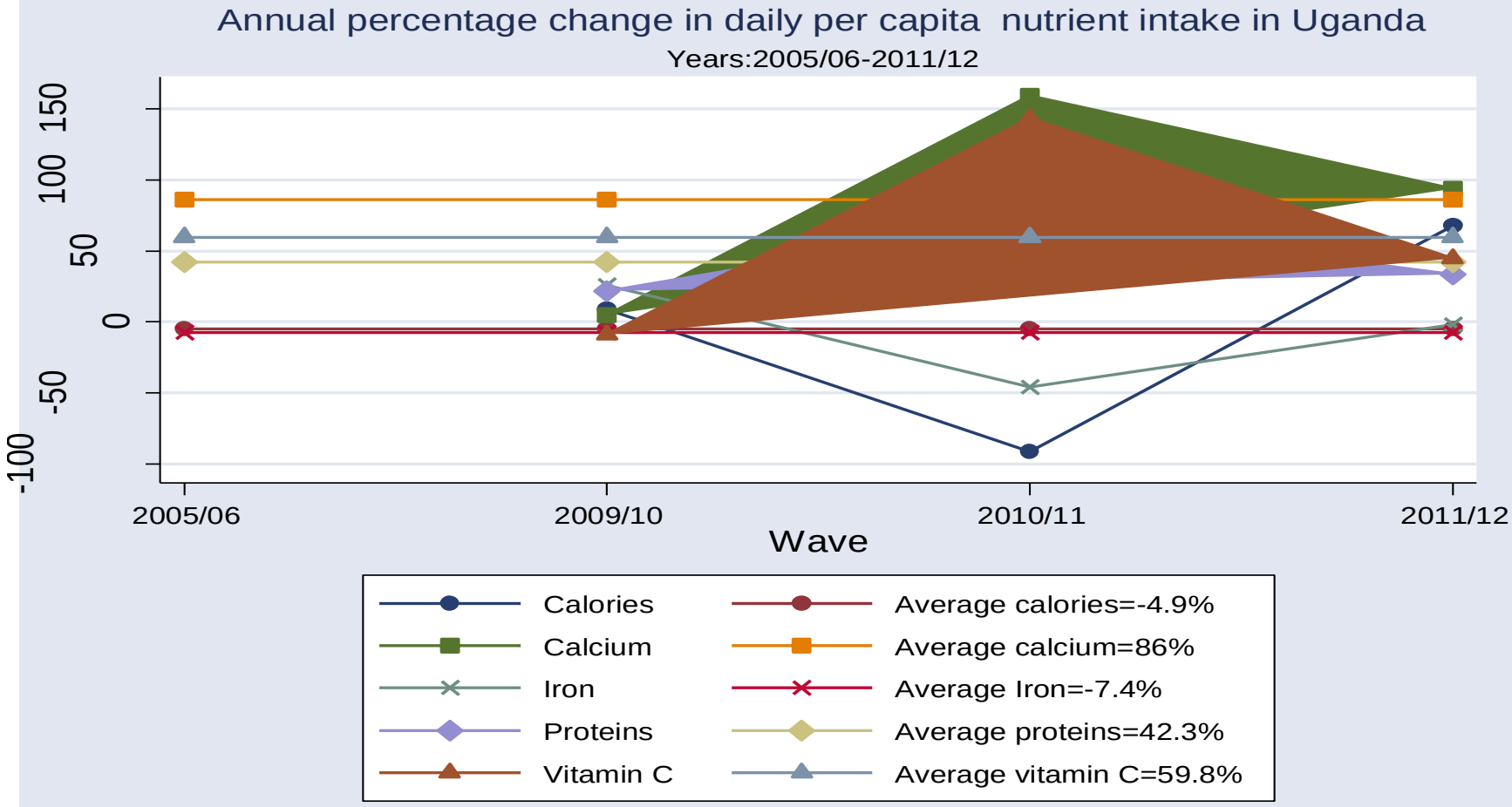
Results: Descriptive Statistics for the Waves

	2005/06	2009/10	2010/11	2011/12	Panel
	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)	Mean (S.D)
Socio-demographic					
Age of head	43.90 (15.02)	47.87 (14.90)	48.54 (14.84)	49.42 (14.55)	47.43 (14.97)
Education of head	3.22 (3.47)	2.79 (3.22)	3.17 (3.56)	5.39 (4.12)	3.64 (3.75)
Sex of head	0.73 (0.44)	0.72 (0.45)	0.69 (0.46)	0.69 (0.46)	0.71 (0.45)
Household size	6.13 (2.96)	6.93 (3.18)	7.58 (3.46)	8.17 (3.74)	7.20 (3.43)
Productivity					
Cropland (acres)	11.38 (14.99)	8.66 (9.80)	9.33 (11.70)	6.95 (6.87)	9.08 (11.34)
Hired labor	26.26 (75.66)	38.62 (370.82)	21.69 (42.41)	17.73 (40.75)	26.08 (191.62)
Family labor	138 (153)	871 (1225)	817 (878)	1606 (10605)	858.25 (5380)

Variation in Daily Nutrient Intake in Uganda in 2005/06-2011/12



Annual Percentage Changes in Daily Nutrient Intake in Uganda in 2005/06-2011/12



Econometric Results: FEIV Estimates for Productivity and Nutrient Intake (Objective 1)

	Calories	Proteins	Calcium	Iron	Vitamin C	Vitamin A
Nutrients	3.518***	3.903***	2.928***	6.140***	1.806***	-1.576***
	(0.423)	(0.478)	(0.394)	(0.873)	(0.388)	(0.570)
Cropland (ln)	1.229***	1.163***	1.200***	1.307***	1.274***	1.094***
	(0.0925)	(0.0910)	(0.0952)	(0.0952)	(0.0897)	(0.0976)
Family labor (ln)	1.292***	1.322***	1.483***	1.333***	1.321***	1.353***
	(0.0738)	(0.0731)	(0.0801)	(0.0743)	(0.0688)	(0.0793)
Hired labor (ln)	0.348***	0.302***	0.255***	0.394***	0.446***	0.352***
	(0.0471)	(0.0485)	(0.0536)	(0.0464)	(0.0424)	(0.0582)
Input cost (ln)	0.0541***	0.0483***	0.0474**	0.0599***	0.0633***	0.0396*
	(0.0178)	(0.0177)	(0.0184)	(0.0178)	(0.0165)	(0.0204)
Constant	-23.41***	-12.62***	-16.16***	-12.34***	-5.722***	11.38***
	(3.146)	(1.901)	(2.556)	(2.157)	(1.821)	(3.214)
R^2 overall	0.073	0.051	0.054	0.037	0.130	0.042
Prob > chi^2	0.000	0.000	0.000	0.000	0.000	0.000
Rho	0.157	0.239	0.130	0.278	0.112	0.188
Observations	6,536	6,536	6,536	6,536	6,536	6,536
Number of years	4	4	4	4	4	4

The Effect of Nutrient Intake on Labor Productivity

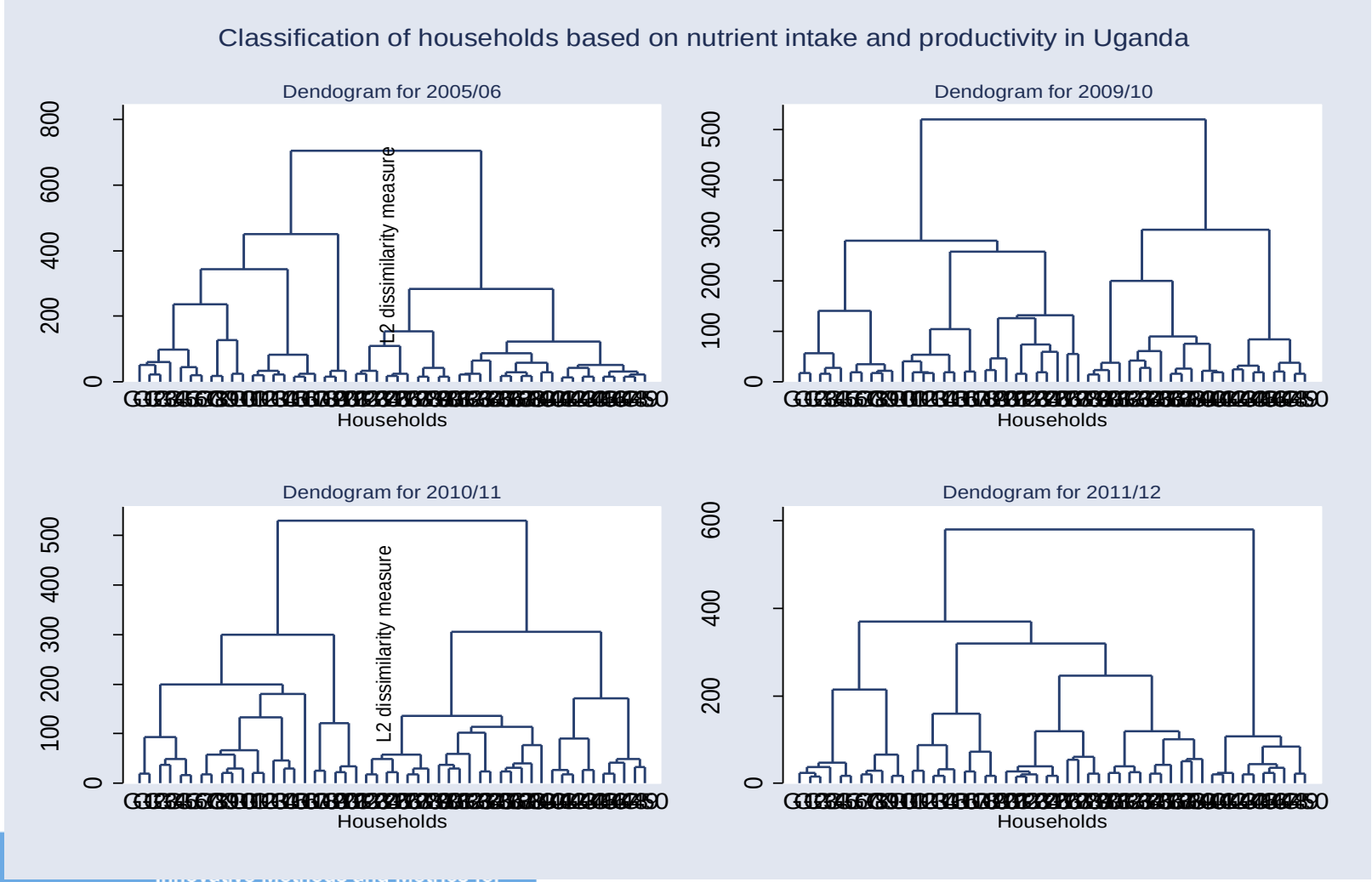
- $$lnh = \frac{L^*}{L} = 2.723\ ln\ C_{it} + 2.952\ ln\ P_{it} + 1.974\ ln\ Cl_{it} + 4.606\ ln\ I_{it} + 1.367\ ln\ Vc_{it} - 1.165\ ln\ Va_{it}$$

The results show that the elasticity of h with respect to calories, proteins, calcium, iron and vitamin C is significantly different from zero.

Production Function Estimation Results after Gender Disaggregation (Objective 2)

Variable	Male Model Estimates	Female Model Estimates
Calories	2.980***	4.960***
	(0.473)	(0.849)
Proteins	3.354***	5.588***
	(0.549)	(0.926)
Calcium	2.433***	4.893***
	(0.437)	(0.890)
Iron	5.686***	10.08***
	(1.035)	(1.827)
Vitamin C	1.186**	3.676***
	(0.481)	(0.674)
Vitamin A	-1.660***	-0.468
	(0.640)	(0.996)

Objective 3: Visualizing Clusters



Threshold Values and Estimates from IV Threshold Regression

Nutrient	Threshold value	Below the threshold estimates	Above the threshold estimates
calories	2635.85 (18.88)	2.996*** (0.759)	5.419*** (1.113)
Proteins	79.30 (0.79)	3.101*** (0.767)	8.534*** (1.943)
Calcium	931.68 (12.14)	1.993*** (0.718)	1.522*** (0.636)
Iron	15.41 (0.27)	4.395*** (1.227)	1.396 (1.365)
Vitamin C	149.83 (2.19)	0.890 (0.967)	1.124* (0.576)
Vitamin A	449.10 (11.36)	2.518*** (0.86)	9.512 (9.239)

Conclusion and Recommendations

- The study finds strong significant effect of calories, proteins, calcium, iron and vitamin C intake on productivity and hence, labor productivity.
- Women's productivity more than doubles with additional nutrient intake.
- An IV threshold estimation shows that households were better off when their nutrient intake was above the threshold value.
- Therefore, policies that focus on enhancing intake of these nutrients have a great potential for delivering considerable benefits to SHF.
- In addition, policies that take into consideration gender will greatly benefit especially women who provide the bulk of agricultural labor.