

**Using Experimental Auctions to Estimate Willingness-to-Pay for a New Maternal Nutrient Supplement in Ghana**

April 2014

**Katherine P. Adams (corresponding author), University of California, Davis**

Postdoctoral scholar, Department of Agricultural and Resource Economics  
One Shields Avenue, Davis, CA 95616  
kpitten@primal.ucdavis.edu  
+1(520) 260-9996

**Travis J. Lybbert, University of California, Davis**

Associate professor, Department of Agricultural and Resource Economics  
One Shields Avenue, Davis, CA 95616  
tlybbert@ucdavis.edu

**Stephen Vosti, University of California, Davis**

Adjunct professor, Department of Agricultural and Resource Economics  
One Shields Avenue, Davis, CA 95616  
vosti@primal.ucdavis.edu

**Emmanuel Ayifah, University of Ghana**

iLiNS Project SES Manager, Department of Food Science and Nutrition  
P. O. Box LG 25, Legon, Ghana  
eayifah@yahoo.com

# Using Experimental Auctions to Estimate Willingness-to-Pay for a New Maternal Nutrient Supplement in Ghana

## **ABSTRACT**

Scaling up access to supplements designed to prevent undernutrition, such as new lipid-based nutrient supplements (LNS), may require both public channels and retail markets. The viability of LNS retail markets will hinge on demand. We use experimental auctions to characterize willingness-to-pay (WTP) for a maternal LNS product in Ghana. WTP is positive for most participants, though below the estimated cost of production for many. WTP varies depending on income, assets, and parity status; information about the long-term benefits of preventing undernutrition has no effect on WTP. These findings have implications for designing public health policy and hybrid public-private delivery mechanisms.

**Key Words:** Undernutrition; lipid-based nutrient supplements; willingness-to-pay; experimental auctions; Ghana.

## Acknowledgement

This manuscript is based on research funded in part by the Bill & Melinda Gates Foundation. The findings and conclusions contained within are those of the authors and do not necessarily reflect positions or policies of the Bill & Melinda Gates Foundation. We would also like to thank the Clif Bar Family Foundation for partial funding of this research. We thank Anna Lartey and Seth Adu-Afarwuah, Boateng Bannerman and the data entry team in Accra, Harriet Okronipa and the iLiNS DYAD-G management team in Kpong, and the iLiNS DYAD-G SES enumerators for their work in the field. We also thank Mary Arimond and the iLiNS Steering Committee (<http://ilins.org/>). Special thanks to the nurses at Akuse Government Hospital prenatal clinic for their willingness to work with us and help in facilitating auction recruitment. Finally, we thank Kay Dewey for her valuable comments on an earlier draft. All errors are those of the authors alone.

# Using Experimental Auctions to Estimate Willingness-to-Pay for a New Maternal Nutrient Supplement in Ghana

## 1. INTRODUCTION

Maternal and early childhood undernutrition are responsible for millions of childhood deaths and episodes of disease every year in developing countries (Black et al. 2013). These nutritional deficiencies can have troubling long-term effects: children who suffer undernutrition during critical early stages of life can suffer permanent developmental impairments that stifle their cognitive functioning and physical growth, ultimately leading to deficits in schooling and losses in adult productivity (Alderman & Behrman, 2006; Alderman, Behrman, & Hoddinott, 2007; Hoddinott, Maluccio, Behrman, Flores, & Martorell, 2008; Victora et al., 2008; Martorell et al., 2010; Hoddinott et al., 2013). In this context, improving maternal and early childhood nutrition among vulnerable populations can reduce infant mortality, dramatically improve health outcomes and generate productivity gains and economic benefits in the longer term (Alderman, 2010; Hoddinott, Alderman, Behrman, Haddad, & Horton, 2013). Such nutritional improvements, however, can be difficult to achieve in practice since they hinge on behavioral and consumption changes within households – changes that cannot be administered or directly prescribed by health clinics. While public health investments can help, nutritional outcomes among poor households are shaped critically by private consumption decisions.

The demonstrated success of ready-to-use therapeutic foods (RUTFs) in the treatment of severely malnourished children in the developing world (Briend & Collins, 2010) has spurred the development of similar, ready-to-use products but with a much different focus: the *prevention* of maternal and early childhood undernutrition (Dewey & Arimond, 2012). In contrast to energy-dense RUTFs which are typically administered to children in large doses over a short duration<sup>1</sup>

for rehabilitative purposes, these preventative products, known as small-quantity lipid-based nutrient supplements (SQ-LNS), are intended to be consumed daily over many months and are designed to provide essential micronutrients and fatty acids as a supplement to breastfeeding and traditional foods (Arimond et al., 2013; Nutriset, 2011). And while RUTFs have historically been purchased by international aid organizations (e.g., UNICEF, World Food Programme, Doctors Without Borders) and distributed free of charge through public channels, delivery of LNS products will likely require a mix of public channels and retail markets (Lybbert, 2012). Within this hybrid public-private delivery context, policy makers and donor agencies will face different challenges in ensuring reliable, sustainable access to preventative LNS products and to stimulate demand for the supplements. Navigating these novel delivery dilemmas will demand a richer empirical basis with which to formulate delivery decisions. At their core, the policy challenges associated with delivering preventative LNS products to nutritionally-vulnerable and, often, resource-poor households begin with household-level demand. Developing an effective hybrid public-private delivery system will require that policy makers understand private valuation of LNS products. It will require an understanding of how household characteristics – demographics, education, socioeconomic status, food insecurity, etc. – shape demand and also how these characteristics might be utilized to develop cost-effective non-price (e.g., educational campaigns) and price-based (e.g., subsidies) targeting strategies. And, it will require an understanding of the persistence of demand over the long-term. With hybrid delivery, the retail price of LNS becomes a policy decision – and this richer understanding of private demand for LNS provides an empirical basis for crafting such a decision.

The answers to these questions are dynamic and context-specific and raise many more questions including if and how public and private delivery systems can coexist in the long term,

what the costs associated with targeting strategies to promote demand might be, who would bear such costs, etc. In this paper we aim to begin building an understanding of households' valuation of preventative LNS products and the factors that influence their valuations, and suggest ways in which the results presented here can inform policy in the short term, and also suggest more comprehensive market research activities to inform policy in the future.

We conducted a series of experimental auctions with pregnant and breastfeeding women in Ghana to elicit willingness-to-pay (WTP) for one specific preventative SQ-LNS product, LNS-P&L, which is formulated for maternal consumption during pregnancy and throughout the first six months postpartum. Our results provide insight into households' demand for LNS-P&L as well as factors that may impede their use of this supplementary nutritional product. The analysis also highlights individual and household characteristics that shape demand for LNS-P&L and suggests potentially important policy and delivery implications.

We find that WTP for LNS-P&L is positive for almost all auction participants, but for a substantial portion of participants, WTP is below preliminary production cost estimates. WTP varies across auction participant and household characteristics, including level of education, being pregnant with or breastfeeding one's first child, household income, and access to credit. Quantile regression results show that, in some cases, the relationship between these characteristics and WTP varies in terms of magnitude and statistical significance across the distribution of WTP. Finally, we find that exposure to information about the long-term benefits of preventing maternal and early childhood undernutrition does not affect WTP. These findings have implications for the design of public health policy and hybrid public-private delivery mechanisms that will be required for vulnerable rural households to benefit from promising LNS products.

## **2. BACKGROUND: UNDERNUTRITION & DEMAND FOR HEALTH PRODUCTS**

The first 1,000 days in a child's life, from conception through the second birthday, have been identified as *the* critical window for preventing undernutrition (Save the Children, 2012; World Food Programme, 2012), as the effects of undernutrition during this time, which can include growth faltering (i.e., deficits in growth relative to reference values), delayed motor, cognitive, and behavioral development, and increased morbidity and mortality, may be largely irreversible (Martorell, 1999; Dewey & Adu-Afarwuah, 2008; Victora et al., 2008). Children generally do not make a full recovery from the growth and developmental deficits imposed by undernutrition experienced before age two, ultimately leading to lower attained schooling, shorter adult stature, lower income, and decreased offspring birthweight, all of which impose considerable long-term private and social costs (Belli, Bustero, & Preker, 2005; Alderman & Behrman, 2006; Alderman et al. 2007; Victora et al., 2008).

Motivated by these critical first 1,000 days, the International Lipid-Based Nutrient Supplement (iLiNS) Project conducted a randomized controlled nutrition trial in Ghana to test the efficacy of preventative LNS products, including LNS-P&L.<sup>2</sup> Although the use of products such as micronutrient powders to enhance the nutritional content of maternal diets in developing countries is not new, LNS-P&L is a novel product designed to supplement the everyday diet of women during pregnancy and the first six months postpartum. LNS-P&L contains vegetable fat, peanut paste, milk powder, sugar, and a vitamin-mineral mix, and the 20-gram daily dose meets or exceeds the micronutrient content of the United Nations International Micronutrient Preparation (UNIMMAP) for women during pregnancy and lactation (Arimond et al., 2013). And, because the micronutrients in LNS-P&L are embedded in a lipid-based paste, not only do the supplements provide some additional macronutrients (fats, protein, and carbohydrates), some

of the micronutrients may be more readily absorbed by the body than those delivered in capsule or powder form (Chaparro & Dewey, 2010).

Preliminary results suggest that LNS-P&L may be associated with improved birth outcomes for some vulnerable populations (Adu-Afarwuah et al., 2014), so preventative LNS products may become an attractive option for incorporation into maternal and early childhood nutrition strategies. Given that the delivery of these products will require a mix of public channels and retail markets, many households may face out-of-pocket costs to access them – even if at subsidized prices. The literature on the demand for preventative health and nutritional products in developing countries suggests that households generally underinvest in these products relative to their potential private returns (Dupas 2011 provides an overview). There are two primary explanations for this common finding: (1) a lack of information about health risks and the potential returns to prevention and (2) financial impediments to adoption including credit constraints and barriers to savings (Dupas, 2011; Meredith, Robinson, Walker, & Wydick, 2013).

Experimental valuation methods have been used in a number of studies in developing countries to evaluate the effect of information on the returns to investing in preventative health and nutritional products and technologies, with mixed results. De Groote et al. (2010a) found that radio information on the enhanced vitamin-A content of biofortified maize and the benefits associated with its consumption had a positive effect on WTP in Ghana. Meenakshi et al. (2012) also found that information on the nutritional content and potential health benefits associated with consuming biofortified maize generated a premium for orange maize in Zambia. Similarly, Chowdhury, Meenakshi, Tomlins, & Owor (2011) found that exposure to nutritional information about orange-fleshed sweet potato resulted in a premium over the traditional white variety of sweet potato. De Groote, Kimenju, & Morawetz (2010b), however, found consumers'



knowledge<sup>3</sup> of the nutritional quality of fortified maize had no statistically significant impact on WTP in Kenya. Ashraf, Jack, & Kamenica (2013) found that Zambian consumers who were informed about the chemical concentration in an unfamiliar water filter were no more likely than uninformed consumers to purchase the new filter (although the marginal impact of a price subsidy for the filter was larger among informed consumers). And finally, Meredith et al. (2013) found that information about the health risks associated with hookworm and the effectiveness of shoes to prevent it had no effect on WTP for rubber-soled shoes for children in Kenya. Our auctions were characterized by a randomized information treatment on the potential long-term benefits of preventing maternal and early childhood undernutrition, and the estimated effect of that information on WTP for LNS-P&L contributes additional evidence to the varied findings in the literature.

A number of studies have also explored the role of financial constraints in the adoption of preventative health and nutritional products. Tarozzi et al. (2011), for example, found that household ownership of bednets increased significantly over a one-year period in India among villages that had been offered the option of purchasing bednets on credit. In a study in Kenya, Meredith et al. (2013) randomized cash payouts to households to test the effect of liquidity on a household's decision to use a coupon to purchase rubber-soled shoes for children to prevent hookworm. The authors found that coupon redemption varied positively with the size of the cash payout, suggesting liquidity was an important consideration in the household's decision to purchase the shoes. Although our auctions were not designed to directly evaluate whether easing financial constraints might increase demand for LNS-P&L, we use data on household income, asset ownership, and access to credit to assess the relationship between these potential indicators of binding financial constraints and WTP for LNS-P&L.

The timing and sizes of the expected streams of costs and benefits associated with LNS-P&L may also increase the likelihood that households will underinvest in the supplement. In particular, the costs associated with consuming LNS-P&L regularly as prescribed, which may include the opportunity cost of time spent procuring LNS-P&L and mixing it with food as recommended, perceived unpleasant physical side-effects associated with its consumption, and, if not fully subsidized, an out-of-pocket cost, are incurred well before many of the expected benefits are realized (e.g., economic returns to a child's improved physical and cognitive ability in adulthood). Furthermore, many of the more immediate expected benefits, such as improved maternal micronutrient stores and higher infant birthweight, may be difficult for households to observe and directly attribute to LNS-P&L. Within this context, it may be particularly important to identify effective mechanisms to help households overcome insufficient information and financial constraints.

### **3. SETTING AND AUCTION DESIGN**

#### *(a) Research Setting*

The experimental auctions were held in the Manya Krobo District in the Eastern Region of Ghana, approximately 75-80 km northeast of the capital city, Accra. The district features a busy commercial corridor, and many households are primarily engaged in small-scale petty trade. Rates of maternal and early childhood undernutrition in this particular region of Ghana are, in general, comparable to national rates. Approximately 10% of babies born in Ghana are low birthweight, defined as weighing less than 2.5 kg at birth, and the rate of low birthweight in the Eastern Region is slightly higher at 11.4% (Ghana Statistical Service, Ghana Health Service, & ICF Macro, 2009). Among all children under five in Ghana, 28% are stunted.<sup>4</sup> The rate of stunting among children under five in the Eastern Region is 37.9%, the highest of Ghana's ten

regions. Approximately 73% of children 6-59 months old in the Eastern Region are anemic,<sup>5</sup> compared to the national rate of almost 80% among the same age group. Rates of anemia in pregnant and breastfeeding women in Ghana are 70% and 62%, respectively (Ghana Statistical Service et al., 2009).

Auction recruitment, which ran from approximately March to July of 2011, took place at a prenatal clinic at Akuse Government Hospital. At recruitment, all women<sup>6</sup> receiving pre- or postnatal services who were pregnant or breastfeeding a child six months of age or younger were read a brief statement about LNS-P&L and were told that their task in the auction would simply be to decide how much LNS-P&L was worth to them. In total, 368 pregnant or breastfeeding women were screened for participation in an auction. Of those screened, 59 (16%) were ineligible<sup>7</sup> (n = 35) or uninterested (n = 24) in participating. Eligible and interested women (n=309) were asked to return to the prenatal clinic for the next auction session, which was typically within the next 48 hours. Of those recruited, 213 (68.9%) ultimately participated. Recruitment took place outside the iLiNS project randomized controlled trial catchment area, so auction participants were not part of the iLiNS randomized trial<sup>8</sup> and had no previous knowledge of LNS-P&L.

Table 1 compares the basic characteristics of women who were screened but not recruited for an auction both to women who were screened and recruited but did not participate in an auction and to those who were screened, recruited, and did participate in an auction. To a large extent, the average characteristics of women who were screened are similar across the three groups. Two exceptions are transport price and transport time from a woman's home to the prenatal clinic where screening took place and the auctions were held. These differences are not unexpected, as both the monetary cost and the opportunity cost of a woman's time to attend an

auction increase the farther she lives from the auction site. As long as women who live further away are not systematically different from those who live closer to the clinic, this should not bias our results. Given that the area around the clinic is largely homogeneous, we expect this to be the case. Among the subset of recruited women, there are no statistically significant differences between women who did and did not ultimately participate.

[Table 1 here]

Variable definitions and summary statistics for the characteristics of auction participants and their households are presented in Table 2. The data on household income were elicited by asking participants the following: “Including wages, salaries, self-employment, and any other source of income, which of the following income groups best describes the total combined income of your household last month?” Participants who reported a combined household income of under GH¢ 100 (approximately \$65), which was the lowest income group option, were categorized as having low monthly income. The household asset index was constructed using principal component analysis of household ownership of a set of assets (Vyas & Kumaranayake, 2006). Food security data were collected using an abbreviated version of the Household Food Insecurity Access Scale developed by USAID’s Food and Nutrition Technical Assistance (FANTA) project (Coates, Swindale, & Bilinsky, 2007). Each household received a score between 0-15 based on how frequently the household experienced each of five food insecurity conditions in the past four weeks, where higher scores indicate higher levels of food insecurity.

[Table 2 here]

Our auction sessions were characterized by a randomized information treatment focused on the long-term benefits of preventing maternal and early childhood undernutrition. Despite the randomization of the information treatment, it is possible that by chance alone, imbalance

occurred between the two treatment groups across observable characteristics. Tests for differences across the two information treatment groups show no statistically significant differences in any of the characteristics in Table 2.

*(b) Experimental Auction Design*

A total of 44 auction sessions, composed of anywhere from two to 13 participants, were conducted between March and July of 2011 at Akuse Government Hospital in a private room near the prenatal clinic. As participants arrived they were assigned an enumerator to record their bids and answer questions, and participants were given GH¢ 4 (approximately \$2.67) as compensation for their time. Participants were told the money, which is roughly equivalent to a day's wage, was theirs to keep and they could choose to spend it however they wanted.

The auctions used the Becker-DeGroot-Marschak (BDM) mechanism to elicit WTP, which disconnects a participant's auction bid from the price paid for the auction item. Essentially, participants submit a bid for an auction item and then a market price is randomly determined. If a participant's bid is equal to or above the market price, she purchases the item at the market price. If her bid is below the market price, she does not receive the good and pays nothing. The BDM has been shown to work well,<sup>9</sup> and it provides an incentive for participants to reveal their true reservation price as their bid (Becker, DeGroot, & Marschak, 1964; Lusk & Shogren, 2007).

The auctions were managed by a facilitator, and in an effort to make each auction session as similar as possible, the facilitator was the same person for each of the 44 auctions. Then, participants were read an information statement about LNS-P&L; the content of the information statement varied randomly across auction sessions. In a randomly selected half of the auctions, participants were read information about LNS-P&L usage,<sup>10</sup> participated in a (voluntary) taste

test, and were read the following information about the short-term benefits of preventing undernutrition:

From the time a baby is conceived through the first two years of his/her life, it is very important that s/he gets enough nutrients to ensure that his/her body and mind grow and develop well. When a baby is still in his mother's womb and after the baby is born and is being exclusively breastfed, the nutrition of the baby's mother is extremely important since the baby is fed through his/her mother. If a baby gets enough nutrients from his/her mother before s/he is born and while s/he is being breastfed, the baby is less likely to fall sick with things like diarrhea, pneumonia, or malaria and is less likely to die. Also, the baby's brain and body will be more likely to develop and grow well if the baby is properly nourished.

In addition to all of the information about usage and short-term benefits as well as the taste test, participants in the other half of the auctions received the following additional information about the potential long-term benefits of preventing undernutrition,

Preventing a child from becoming undernourished before s/he is born and during the first two years of his/her life can also affect him/her as s/he gets older, goes to school, and begins to work. When a child is well nourished, his/her mind and body are better able to grow and develop. This may help him/her be prepared to enter school earlier and perform better in school. And, when children do well in school, they are often able to earn more money as adults. Research in other countries has shown that compared to children who are undernourished, children who are properly nourished early in life often attend more school, have an easier time learning, and earn more money in their work as adults because their minds and bodies are stronger.

The full auction protocol is available in the Appendix.

Participants were led through two practice auctions for a week's supply (seven 20-gram sachets) of LNS-P&L and a final, binding auction for a week's supply of LNS-P&L. In each of the practice auctions and the binding auction, participants (privately) submitted bids for LNS-P&L to their assigned enumerators. Overall, 58.7% of all auction participants bid high enough to purchase LNS-P&L in the binding round. The auction sessions concluded with a short questionnaire to gather individual and household socioeconomic characteristics. Enumerators then ranked their assigned participants' comprehension of the auction procedure on a scale of 1-

5, where one was a poor understanding and five was an excellent understanding. The average comprehension rating was 4.3, indicating enumerators' perception of the participants' understanding of the auction procedure was generally good.

*(c) Limitations*

Before presenting our empirical models and results, it is important to describe some limitations of experimental auctions in this case. First, participants bid on a one-week supply of LNS-P&L during the auctions, and because the product is not available outside the auctions, participants could not get more than the week's supply. WTP is therefore contingent on only being able to purchase a week's supply. Furthermore, some studies have shown that experimentation with a preventative health or nutritional product to learn first-hand about its costs and benefits is extremely important in helping convince households of the returns to investing in the product. Dupas (2014), for example, found that when households were given the opportunity to experiment with a new, long-lasting insecticide-treated bednet by providing it for free or at a highly subsidized price, WTP for another net a year later was higher. Beyond tasting the product, our auctions did not allow for any experimentation with the product, so WTP in this case represents each woman's beliefs, conditional on her constraints, about the costs and benefits of LNS-P&L before she gained any personal experience using the product. While over the course of a few months or even a year such experimentation cannot shed light on long-term benefits, it could shed light on how to use the product and possible short-term benefits.

Also, efficacy results from the iLiNS randomized controlled trials were not available at the time the auctions were conducted, so we were not able to make any definitive claims about the efficacy of the product. Instead, our information treatment focused on: (a) what is known about the nutritional shortfalls of traditional diets vis-à-vis the needs of pregnant women, (b) the

nutrient contents of LNS-P&L, (c) the relationships between maternal and early childhood nutrition and health, and (d) the links between a child's long-term human capital development and his/her labor market performance. The effect of the information treatment on WTP, then, is conditional on the fact that women were not told that LNS-P&L in particular could improve their own health and nutritional status during pregnancy and the health, nutritional, and developmental outcomes of their children.

Finally, when interpreting our results it is important to note the data are based on a sample of women who are not a random sample of the population of pregnant and breastfeeding women in this particular area of Ghana, which may have implications for the generalizability of our results. In particular, since all women who participated in an auction were receiving formal pre- or postnatal care at a hospital, we might be concerned that their level of WTP as well as the factors associated with WTP might be different from women who do not seek formal care. This distinction is not particularly relevant in this case, however, since approximately 95% of women in Ghana receive at least some prenatal care during pregnancy and the rate is even higher at 96.4% in the Eastern Region (Ghana Statistical Service et al., 2009).

#### **4. ANALYSIS & RESULTS**

In this section, we use the WTP data collected in the auction to understand the potential demand for LNS-P&L. We begin with summary statistics and density estimates of WTP and compare these to preliminary estimates of the cost of producing LNS-P&L at a factory in Niger, which serves as a lower bound benchmark for possible market prices. Then, we model WTP in multivariate frameworks using ordinary least squares (OLS) and unconditional quantile regression methods to estimate the determinants of WTP. Results of the multivariate analysis provide insight into the factors systematically associated with WTP and suggest potential



avenues through which policy efforts might address potential barriers to adoption and low demand.

(a) *Summary Statistics*

Table 3 summarizes WTP for a week's supply of LNS-P&L. The average bid on seven sachets of LNS-P&L across all auctions and participants is \$1.74 (2011 US Dollars), which equates to roughly \$0.25 per day for a sachet of LNS-P&L. For participants exposed to information about the potential short-term benefits of preventing undernutrition, the average bid on seven sachets of LNS-P&L is \$1.75 (fourth-quarter 2011 USD), while the average is slightly lower (though not statistically different) at \$1.73 for participants exposed to information on the short- and long-term benefits of preventing undernutrition. Based on preliminary calculations, it costs roughly \$1.33<sup>11</sup> to produce a week's supply of LNS-P&L at a factory in Niger (preliminary results, authors' computations). Bearing in mind that the production cost estimates do not include additional costs associated with transportation, distribution, marketing, etc., among the participants exposed to the short-term benefits of preventing undernutrition, approximately 69.4% value a week's supply of LNS-P&L at \$1.33 or more, indicating they would be willing to pay at least that much for the product. We can also use the preliminary product cost estimate as a lower-bound benchmark and assume various percentage mark-ups on the final market price over the production costs. If we assume transportation, marketing, etc. will increase the price by 30% over the production cost, the market price is \$1.73 for a week's supply of LNS-P&L. Our results suggest that about 46% (approximately 43% for those exposed to the short-term benefits and 48% for those exposed to the short- and long-term benefits) of our sample would purchase it at this market price. If we assume the market price is 50% higher than the cost of production (\$2.00), just 38% of our sample (including both information treatment groups) would purchase it.

[Table 3 here]

Kernel density estimates of WTP by information treatment group are depicted in Figure 1. The vertical line at approximately \$1.33 divides the distribution at the estimated production cost such that everyone to the right of the line is willing to pay at least as much as the cost of producing a week's supply of LNS-P&L. The vertical line at approximately \$1.73 represents a possible market price point after accounting for an assumed 30% mark-up for transportation, marketing, etc. The densities show that exposure to information about the potential long-term benefits of preventing maternal and early childhood undernutrition does not change the distribution in any significant way; based on a Kolmogorov-Smirnov test,<sup>12</sup> the difference in the distributions is not statistically significant ( $p = .24$ ).

[Figure 1 here]

#### (b) *Ordinary Least Squares*

To build on this descriptive assessment of WTP for LNS-P&L, we now use regression to shed light on the determinants of demand. In this sub-section, we use ordinary least squares (OLS)<sup>13</sup> to estimate WTP as a function of several participant, household and auction session variables. These OLS results are presented in the first column of Table 4. While each session was conducted by the same person and pre-testing and training emphasized uniformity across all sessions,<sup>14</sup> the composition of a particular session, questions that arose during a session, or other session-specific factors could lead to correlation in bids among participants in a particular session. We therefore cluster standard errors clustered at the session level (Cameron & Miller, 2011).<sup>15</sup> Thus, we model WTP across  $i = 1, 2, \dots, N$  auction participants and  $s = 1, 2, \dots, S$  auction sessions as  $WTP_{is} = X'_{is}\beta + \alpha_s + u_{is}$  where  $WTP_{is}$  is willingness-to-pay for a week's supply of LNS-P&L for participant  $i$  in sessions  $s$ ,  $X_{is}$  is a vector of observed individual,

household, and auction characteristics,  $\alpha_s$  is the auction session fixed effect, and  $u_{is}$  is the error term.

These OLS results are presented in the first results column of Table 4. Among the participant characteristics, if a participant is pregnant with or breastfeeding her first child, her WTP for a week's supply of LNS-P&L is estimated to be approximately \$0.50 higher ( $p < .01$ ) on average than a participant who has other children, all else constant. Our finding agrees with the finding in Hoffmann, Barrett, & Just (2008) that WTP for an insecticide-treated bednet was negatively related to the number of children under five years of age in the household, which the authors attributed to the quantity-quality tradeoff among children in the household. Pregnancy is also significantly associated with WTP. If a participant is pregnant, her WTP for a week's supply of LNS-P&L is \$0.58 lower ( $p < .01$ ) on average than if she is breastfeeding, holding all other variables constant. Because pregnancy outcomes, particularly in developing country settings, are subject to uncertainty, this relationship is sensible since a woman may be less inclined to invest in the health of a child before she has observed the outcome of her pregnancy. Once that uncertainty is resolved with the arrival of the baby, investments in the health of her baby become more salient.

Finally, education is negatively related to WTP; on average, WTP is estimated to be \$0.03 lower for each additional year of education, suggesting that a one standard deviation increase in education (3.74 years) decreases WTP by about \$0.11. The findings in the literature on the role of education are mixed. While Chowdhury et al. (2011) found a positive relationship between education and WTP for orange-fleshed sweet potato in Uganda, Berry, Fischer, & Guiteras (2012) found that in Ghana, people who had attended school had a lower WTP for a water filter than those who had never attended school. In this case, we speculate that the

negative relationship might be due to more educated participants having more confidence in their ability to maintain a healthy diet, more skepticism about the potential health benefits, or higher awareness of the demanding daily regime of recommended usage. Other participant characteristics, including the participant's position in the household, age, and personal experience using a nutritional supplement, are not statistically significantly related to WTP.

Turning now to household characteristics, household income is a statistically significant predictor of WTP for LNS-P&L. If a household's self-reported, estimated combined income is less than \$65 (2011 USD), WTP is, on average, approximately \$0.37 lower ( $p < .01$ ) than for households with monthly incomes above \$65, reflecting the importance of a household's budget constraint in determining WTP. The asset index, another measure of the household's socioeconomic status, is also statistically significant, where a higher household asset index (a higher index indicates a higher socioeconomic status) is positively associated with WTP, *ceteris paribus*. Thus, even after controlling for low income, a household's socioeconomic status, measured based on asset ownership, is systematically related to WTP. Participants whose households borrowed money in the previous year in order to purchase food have an approximately \$0.25 higher ( $p < .10$ ) WTP for LNS-P&L on average than households who did not purchase food on credit. After controlling for household assets, the composite measure of household food security, however, is not significantly related to WTP.

Finally, we turn to the role of information about the long-term benefits of preventing undernutrition on WTP. Counter to our expectations, the effect of the information treatment, which was randomly assigned across auctions, is negative, very small in magnitude, and statistically insignificant in the model. That is, WTP for LNS-P&L is not statistically different for women who were told about the potential impact of nutritional status during pregnancy and

in early childhood on long-term human capital accumulation and adult earnings than for women who did not receive this information. This result indicates that, at least based on the way the information was presented during the auctions and given the auction idiosyncrasies previously discussed, the conditional effect of knowledge of these long-term benefits does not translate into a statistically significantly higher valuation of LNS-P&L. Potential explanations for this result include (1) ineffective message content and/or delivery, and hence ‘poorly-informed’ low undiscounted stream of expected benefits associated with LNS-P&L consumption, (2) completely informed but still low undiscounted stream of expected benefits associated with LNS-P&L consumption, or (3) high personal discount rates that reduce the present value of the long-term benefits to a level lower than expected (shorter-term) costs. We address each of these potential explanations in the implications section below.

### *(c) Unconditional Quantile Regression*

Based on a linear conditional mean function,  $E(y|x)$ , ordinary least squares estimates the average relationship between a particular covariate and the dependent variable, which constrains the nature of the relationship to be the same over the entire distribution of the dependent variable (Koenker & Hallock, 2001). This average response, however, is only a partial view of the relationship, and, depending on the policy question being addressed, may provide misleading or incomplete information about the effect of a particular variable on the outcome of interest.

Unconditional quantile regression (UQR) techniques, proposed by Firpo, Fortin, & Lemieux (2009), allow for the possibility that the size and nature of the relationship between a covariate and the dependent variable may differ from the mean effect at different points along the unconditional distribution. That is, UQR allows us to estimate the marginal effect of a small

change in an explanatory variable on a specific quantile of the unconditional distribution of the dependent variable.<sup>16</sup>

UQR is based on the two-step estimation procedure outlined in Firpo et al. (2009). First, a re-centered influence function (RIF) is estimated, where  $RIF(y; q_\tau) = q_\tau + IF(y; q_\tau)$ . Here,  $q_\tau$  is the  $\tau^{th}$  quantile, and  $IF(y; q_\tau)$  is what is known as the influence function, defined as

$$IF(y; q_\tau) = \begin{cases} \frac{\tau - 1}{f_y(q_\tau)}, & y \leq q_\tau \\ \frac{1}{f_y(q_\tau)}, & y > q_\tau \end{cases}$$

where  $f_y(q_\tau)$  is the density of the dependent variable  $y$  (WTP in our case) at  $q_\tau$  estimated using a kernel density estimator. The influence function of a particular quantile, as described by Firpo et al. (2009), is the influence of an individual observation on that quantile. The influence function is then re-centered by adding back the  $\tau^{th}$  quantile. The second step is then to regress the RIF on the set of covariates using OLS to obtain coefficient estimates,  $\hat{q}_\tau$ , for the  $\tau^{th}$  sample quantile.

We estimate a set of UQR models (at the 10<sup>th</sup>, 25<sup>th</sup>, 50<sup>th</sup>, 75<sup>th</sup>, and 90<sup>th</sup> quantiles) with bootstrapped standard errors clustered at the auction session level (Table 4). Plots of the UQR at every 10<sup>th</sup> quantile and OLS coefficients for key variables are displayed in Figure 2.

[Table 4 here]

[Figure 2 here]

The UQR estimates provide evidence that the size and significance of factors associated with WTP for LNS-P&L are, in some cases, not constant across the distribution of WTP, and therefore unconditional quantile regression analysis provides a more comprehensive characterization of the determinants of WTP than OLS. We see heterogeneity across the distribution of WTP in the size and significance of the marginal effect of being pregnant with or

breastfeeding one's first child. The effect is small (and insignificant) below the median of the unconditional distribution of WTP, but above the median the effect of being pregnant with or breastfeeding a first child is large and statistically significant. Keeping in mind that preliminary production cost estimates are \$1.33 for a week's supply of LNS-P&L, which falls between the 25<sup>th</sup> and 50<sup>th</sup> quantiles of WTP, this result has potentially important policy implications, since the relationship between WTP and having a first child is smaller and insignificant at the lower end of the distribution where subsidization might be necessary to boost demand.

As the OLS results suggest, the UQR estimates also generally show that women who are pregnant have a lower WTP for LNS-P&L than women who are breastfeeding. However, we again see heterogeneity across the distribution, where the magnitude of the estimated coefficient is substantially larger (and significant) for women at the 75<sup>th</sup> and 90<sup>th</sup> quantiles. Finally, we see that having previous experience with a baby who was thin or low birthweight when s/he was born has a positive and significant effect on WTP for women at the 10<sup>th</sup> quantile, a significant relationship that is concealed by OLS.

Turning to household characteristics, the UQR results show that low income levels are associated with a lower WTP for LNS-P&L, but this relationship is only statistically significant at the median value of WTP and above. This result is important because it potentially suggests that for women in the lower tail of the WTP distribution, it is not necessarily the household's budget constraint that is driving down their WTP relative to other women in the sample. The positive and significant coefficient on the household's asset index at the 10<sup>th</sup> and 25<sup>th</sup> quantiles (and not elsewhere on the distribution), however, suggests that there is something important about a household's socioeconomic status in determining WTP for women who value the

product relatively less, and the asset index is picking up that relationship in a different way than the indicator for low monthly income.

Finally, the effect of the information treatment, which is very small in magnitude and not statistically significant in the OLS specification, varies across the distribution of WTP. The effect is positive, though imprecisely estimated, at the 75<sup>th</sup> and 90<sup>th</sup> quantiles and negative, though again imprecisely estimated, at the 10<sup>th</sup>, 25<sup>th</sup>, and 50<sup>th</sup> quantiles.

#### **4. IMPLICATIONS FOR POLICY, PRICING & DELIVERY**

Although LNS-P&L and other nutritional supplements appear to be a promising means of improving nutritional and health outcomes among malnutrition-prone households, these preventative products raise some challenging delivery dilemmas (see Lybbert, 2012). These dilemmas stem from the fact that free public distribution, which has worked remarkably well for RUTFs that treat severe acute malnutrition, is an unrealistic delivery strategy for preventative products designed for daily consumption by a much broader group of beneficiaries over longer periods of time. This section describes how the results in this paper relate to these delivery dilemmas.

Our experimental auction results indicate that while most women in our sample place a positive value on LNS-P&L, more than half would not purchase LNS-P&L if it was available at a price of 30% above current costs of production. Although production costs may fall gradually over time, our results suggest that private demand alone will not be sufficient to encourage widespread distribution of these supplements. If these products are shown to reduce maternal undernutrition, to improve the health and development of children, and to generate intergenerational benefits and productivity gains (Alderman et al., 2007), there may be



compelling economic arguments for policy actions to bridge this gap between private demand and total benefits (Alderman, 2010; Hoddinott et al., 2013).

The heterogeneity of demand for LNS-P&L that is evident in our data suggests some policy instruments to reduce potential barriers to adoption, to stimulate demand for LNS-P&L where household-level valuation is low despite potentially high private returns, and to use targeted subsidies to encourage the development of broad supply chains. While the conventional regression analysis above sheds light on some of the determinants of demand and can inform policy actions that aim to reduce specific constraints, it does not generate direct implications for targeted subsidies because targeting cannot hold all else equal. Whereas these regressions allow us to test the effect of different variables on LNS-P&L demand *conditional* on other variables held constant (the familiar *ceteris paribus* assumption), targeted subsidies have to commit to a dimension along which heterogeneity is pronounced *unconditionally* and can be feasibly targeted. This implies that unconditional demand differences (so-called *mutatis mutandis*, “let all other variables change as they will”) ought to be the basis of targeting (see Lybbert, Magnan, Spielman, Bhargava, & Gulati, 2013).

With this distinction in mind, the implications of our results are easier to discuss. We find that education (-), first pregnancy (+), pregnant (versus breastfeeding) (-), income (+) and assets (+) conditionally shape demand for LNS-P&L. This suggests that policies that aim to directly affect these variables may indirectly stimulate demand. Of these relationships, three – first pregnancy, income, and assets – also are significantly and *unconditionally* related to demand for LNS-P&L. This suggests that targeted subsidies that make the supplement cheaper for women with low income, low assets, or multiple children might reasonably expand LNS-P&L usage in our study area.

At a more basic level, we can use these variables to consider how the price of LNS-P&L, which becomes a key decision variable under hybrid private-public delivery, might shape the characteristics of the pool of purchasers at different price points. Figure 3 shows the percentage of auction participants who, based on their auction bid, would be expected to purchase a week's supply of LNS-P&L at various price points – essentially an inverse demand curve - and summarizes purchasers' characteristics. At high price points, the pool of purchasers may include a large percentage of women who are pregnant with or breastfeeding their first child, a small percentage of women from low income households, and women from households with relatively high asset index scores. A subsidy to move the price of LNS-P&L left in Figure 3 would increase the number of purchasers and change the composition of the pool of purchasers to include more low income households, households with lower relative asset index scores, and more multiple-children households. As such, subsidies can encourage more wide-spread adoption of LNS-P&L by specific 'types' of women – women from low income households, for example – who would otherwise have been priced out of the market.

[Figure 3 here]

Conspicuously missing from this list of potentially actionable results is general information campaigns that showcase how nutritional investments today during the first 1,000 days translate into large future benefits. Exposure to information about long-term benefits neither conditionally nor unconditionally increases WTP among auction participants. There are several potential explanations for this result.

The first potential explanation is that auction participants did not understand or identify with the content of the information on the long-term benefits of preventing undernutrition, perhaps because the information was not conveyed in a convincing or engaging manner.

However, the statement on long-term benefits was developed with the guidance of a Ghanaian nutritionist and went through many rounds of pretesting with women drawn from the same population of women who ultimately participated in the auctions, so we feel confident the content of the information was appropriate.<sup>17</sup>

A second possibility is that respondents' (informed) estimates of expected future benefits of LNS-P&L were lower than their assessments of expected short-term costs. Expected future benefit streams would depend, among other things, on mortality rates, migration patterns, and site-specific employment prospects, all assessed 15 years or more from the auction date.

Finally, even if we assume auction participants were able to comprehend the information and expected future benefits flows were much greater than expected short-term costs, high personal discount rates could also explain the lack of an effect. Because many of the potential long-run benefits described in the information treatment are realized many years in the future when the baby eventually enters the labor market, the present discounted value of those benefits would effectively be zero given a sufficiently high discount rate. Personal discount rates in developing country settings have been shown to be much higher than in developed countries (Poulos & Whittington, 2000). Moreover, some studies in developed countries have shown that higher personal discount rates are associated with lower levels of preventative health behavior (e.g., Chapman & Coups 1999; Levy, Micco, Putt, & Armstrong, 2006). Thus, if auction participants heavily discount the future, the present discounted value of the long-term benefits of preventing maternal undernutrition during pregnancy and breastfeeding may be close to zero and would therefore not influence their WTP for LNS-P&L today.

Two final perspectives on hybrid private-public delivery of LNS-P&L come from limitations of the experimental auctions we use as the basis of our analysis. The first limitation is

temporal: Participants in the auctions bid on a one week supply of LNS-P&L, but what really matters is consistent consumption week-in and week-out throughout the first 1,000 days.

Preliminary analysis of an ongoing market demand assessment in neighboring Burkina Faso reveals that persistent demand for an LNS product formulated for children may be at least 25% lower than demand for a single week's supply. Continued analyses of these new data will no doubt provide insight into the persistence of demand and the role of price in promoting regular consumption of LNS. For now, though, these preliminary data suggest that WTP for a week's supply of LNS-P&L revealed via experimental auction bids in Ghana likely represents an upper-bound on what we might expect people to pay for the supplement over the long-term – an important qualification to keep in mind when interpreting these results and a promising area for future research.

The second limitation is geographic: Most of our participants came from within 10 km of the clinic where we staged the auctions. Thus, our sample is quite homogeneous, which has obvious implications for what we can learn about demand differences. If we had been able to stage auctions throughout several regions of Ghana – including the distinct and relatively poor northern regions – we would have much larger variation in individual and household characteristics. This broader variability in the data might change the significance of the demand differences that emerge in the present analysis. Even more importantly, a broader geographic scope would enable us to explore the effect of subsidies that target specific regions, which can be both feasible and promising when unconditional geographic demand differences are pronounced (see Lybbert, 2002).

## 5. CONCLUSIONS

The failure of traditional diets to meet women's nutritional needs during pregnancy is common in the developing world, and research is demonstrating the large and sometimes irreversible health, developmental and economic consequences for their children. In the long term, reductions in poverty, improvements in agricultural markets and a better understanding of dietary needs may resolve many nutrient intake problems. Meanwhile, changing dietary habits in ways and to the extents recommended by nutritionists may be challenging, especially among the resource-poor and those with strong preferences for less-healthy foods and non-food items, so dietary supplements may have a role to play in resolving targeted nutrient deficiencies, especially among pregnant women and young children. Therefore, transitioning from the focus on (and measurement of) nutritional needs to the focus on (and measurement of) demand for dietary supplements that can help meet those needs is essential to understanding the roles that these products might play, and the types and degrees of public policy action required to promote them.

This research points up some opportunities and some obstacles if policy makers choose to transition from the efficacy trial to broad-based consumption of that product. Positive WTP for most auction participants suggests expected benefits of LNS-P&L consumption are positive and in some cases quite significantly so, suggesting that retail markets may reach some beneficiaries with minimal public policy effort. Associations among some household/participant characteristics and WTP may make targeting possible and inexpensive; preliminary nutrition trial results suggest that some targeting will be wise. However, challenges will need to be overcome. Estimated production and product distribution costs are high relative to average WTP, and participants priced out of the market may be those most likely to benefit from LNS-P&L consumption and also may be the most difficult to target using standard policy instruments. Pilot

market tests of LNS-P&L and of LNS products formulated for young children, involving hybrid distribution platforms and undertaken along a poverty/remoteness gradient, are the logical next step in identifying the most cost-effective mechanisms for delivering SQ-LNS products to intended beneficiaries.

## REFERENCES

- Adu-Afarwauh, S., Lartey, A., Okronipa, H.E., Peerson, J.M., Vosti, S., Ashorn, P., Dewey, K. (2014). Lipid-Based Nutrient Supplement (LNS) for Pregnant Women Improve Birth Outcomes among Primiparous but not Multiparous Women in Ghana. 2014 Experimental Biology meeting abstracts.
- Alderman, H. (2010). The Economic Cost of a Poor Start to Life. *Journal of Developmental Origins of Health and Disease*, 1(1): 19-25.
- Alderman, H., & Behrman, J. (2006). Reducing the Incidence of Low Birth Weight in Low-Income Countries Has Substantial Economic Benefits. *The World Bank Research Observer*, 21(1): 25-48.
- Alderman, H., Behrman, J., & Hoddinott, J. (2007). Economic and Nutritional Analyses Offer Substantial Synergies for Understanding Human Nutrition. *The Journal of Nutrition*, 137: 537-544.
- Arimond, M., Zeilani, M., Jungjohann, S., Brown, K.H., Ashorn, P., Allen, L.H., & Dewey, K.G. (2013). Considerations in Developing Lipid-Based Nutrient Supplements for Prevention of Undernutrition: Experience from the International Lipid-Based Nutrient Supplements (iLiNS) Project. *Maternal & Child Nutrition*. doi: 10.1111/mcn.12049.
- Ashraf, N., Jack, K., & Kamenica, E. (2013). Information and Subsidies: Complements or Substitutes? *Journal of Economic Behavior & Organization*, 88(2013): 133-139.
- Becker, G., DeGroot, M., & Marschak, J. (1964). Measuring Utility by a Single Response Sequential Method. *Behavioral Science*, 9(3): 226-32.
- Belli, P.C., Bustero, F., & Preker, A. (2005). Investing in Children's Health: What are the Economic Benefits? *Bulletin of the World Health Organization*, 83(10): 777-784.

- Berry, J., Fischer, G., & Guiteras, R. (2012). Eliciting and Using Willingness to Pay: Evidence from Field Trials in Northern Ghana. Working Paper, The London School of Economics and Political Science, London, UK.
- Black, R., Victora, C., Walker, S., Bhutta, Z., Christian, P., de Onis, M., ... & Child Nutrition Study Group. (2013). Maternal and Child Undernutrition and Overweight in Low-Income and Middle-Income Countries. *The Lancet*, 382(9890): 427-451.
- Briend, A., & Collins, S. (2010). Therapeutic Nutrition for Children with Severe Acute Malnutrition: Summary of African Experience. *Indian Pediatrics*, 47(655-659).
- Cameron, C., & Miller, D. (2011). Robust Inference with Clustered Data. In A. Ullah & D. E. Giles (Eds.), *Handbook of Empirical Economics and Finance* (1-28). Boca Raton, FL: CRC Press.
- Cameron, C., & Trivedi, P. (2005). *Microeconometrics*. New York, NY: Cambridge University Press.
- Cameron, C., & Trivedi, P. (2010). *Microeconometrics Using Stata*. College Station, TX: Stata Press.
- Carson, R., & Hanemann, W.M. (2005). Contingent Valuation. In *Handbook of Environmental Economics Volume 2*. Maler, K.G., & Vincent, J.R. (Eds.). North-Holland: Elsevier.
- Chaparro, C., & Dewey, K.G. (2010). Use of Lipid-based Nutrient Supplements (LNS) to Improve the Nutrient Adequacy of General Food Distribution Rations for Vulnerable Sub-groups in Emergency Settings. *Maternal and Child Nutrition*, 6(s1): 1-69.
- Chapman, G., & Coups, E. (1999). Time Preferences and Preventive Health Behavior: Acceptance of the Influenza Vaccine. *Medical Decision Making*, 19(3): 307-314.
- Chowdhury, S., Meenakshi, J.V., Tomlins, K., & Owori, C. (2011). Are Consumers in Developing Countries Willing to Pay More for Micronutrient-Dense Biofortified Foods? Evidence from a Field Experiment in Uganda. *American Journal of Agricultural Economics*, 93(1): 83-97.



- Coates, J., Swindale, A., & Bilinsky, P. (2007). Household Food Insecurity Access Scale (HFIAS) for Measurement of Food Access: Indicator Guide. Academy for Educational Development, Washington, DC: Food and Nutrition Technical Assistance Project (FANTA).
- De Groote, H., Tomlins, K., Haleegoah, J., Awool, M., Frimpong, B., Banerji, A., ... & Meenakshi, J.V. (2010a). Assessing Rural Consumers' WTP for Orange, Biofortified Maize in Ghana with Experimental Auctions and a Simulated Radio Message. Paper prepared for submission to the African Agricultural Economics Association Meetings – Cape Town, 19-23 September, 2010.
- De Groote, H., Kimenju, S.C., & Morawetz, U. (2010b). Estimating Consumer Willingness-To-Pay for Food Quality with Experimental Auctions: The Case of Yellow versus Fortified Maize Meal in Kenya. *Agricultural Economics*, 42(1): 1-16.
- Dewey K.G., & Arimond, M. (2012). Lipid-Based Nutrient Supplements: How Can They Combat Child Malnutrition? *PLoS Med*, 9(9): e1001314.
- Dewey, K.G., & Adu-Afarwuah, S. (2008). Systematic Review of the Efficacy and Effectiveness of Complementary Feeding Interventions in Developing Countries. *Maternal and Child Nutrition*, 4:24-85.
- Dupas, P. (2011). Health Behavior in Developing Countries. *Annual Review of Economics*, 3: 425-449.
- Dupas, P. (2014). Short-Run Subsidies and Long-Run Adoption of New Health Products: Evidence from a Field Experiment. *Econometrica*, 82(1): 197-228.
- Firpo, S., Fortin, N.M., & Lemieux, T. (2007). Unconditional Quantile Regressions. NBER Technical Working Paper No. 339, National Bureau of Economic Research. Available from <http://www.nber.org/papers/t0339>.
- Firpo, S., Fortin, N.M., & Lemieux, T. (2009). "Unconditional Quantile Regressions." *Econometrica*, 77(3): 953–973.

- Fournier, J., & Koske, I. (2012). Less Income Inequality and More Growth – Are they Compatible? Part 7. The Drivers of Labour Earnings Inequality – An Analysis Based on Conditional and Unconditional Quantile Regressions. OECD Economics Department Working Papers No. 930, OECD Publishing.
- Ghana Statistical Service (GSS), Ghana Health Service (GHS), & ICF Macro. (2009). *Ghana Demographic and Health Survey 2008*. Accra, Ghana: GSS, GHS, and ICF Macro.
- Hoddinott, J., Alderman, H., Behrman, J., Haddad, L., & Horton, S. (2013). The Economic Rationale for Investing in Stunting Reduction. *Maternal & Child Nutrition*, S2: 69-82.
- Hoddinott, J., Behrman, J., Maluccio, J., Melgar, P., Quisumbing, A., Ramirez-Zea, M., ..., and Martorell, M. (2013). Adult Consequences of Growth Failure in Early Childhood. *American Journal of Clinical Nutrition*, 98: 1170-1178.
- Hoddinott, J., Maluccio, J., Behrman, J., Flores R., & Martorell, R. (2008). Effect of a Nutrition Intervention During Early Childhood on Economic Productivity in Guatemalan Adults. *The Lancet*, 371: 411-416.
- Hoffmann, V., Barrett, C., & Just, D. (2008). Do Free Goods Stick to Poor Households? Experimental Evidence on Insecticide Treated Bednets. *World Development*, 37(3): 607-617.
- Koenker, R., & Bassett, G. (1978). Regression Quantiles. *Econometrica*, 46(1): 33-50.
- Koenker, R., & Hallock, K.F. (2001). Quantile Regression. *Journal of Economic Perspectives*, 15(4): 143-156.
- Levy, A. G., Micco, E., Putt, M., & Armstrong, K. (2006). Value for the Future and Breast Cancer-Preventative Health Behavior. *Cancer Epidemiology, Biomarkers, and Prevention*, 21(11): 955-960.

- Lusk, J., & Shogren, J. (2007). *Experimental Auctions. Methods and Applications in Economic and Marketing Research*. New York: Cambridge University Press.
- Lybbert, T. (2002). Technology Transfer for Humanitarian Use: Economic Issues and Market Segmentation Approaches. *Intellectual Property Strategy Today*, 2: 17-24.
- Lybbert, T. (2012). Hybrid Public-Private Delivery of Preventative Lipid-Based Nutrient Supplement Products: Key Challenges, Opportunities and Players in an Emerging Product Space. *SCN News*, UN Standing Committee on Nutrition. 39: 32-39.
- Lybbert, T., Magnan, N., Spielman, D., Bhargava, A., & Gulati, K. (2013). Targeting Technology to Reduce Poverty and Conserve Resources. Experimental Delivery of Laser Land Leveling to Farmers in Uttar Pradesh, India. Discussion Paper 01274, Washington, DC: International Food Policy Research Institute.
- Martorell, R. (1999). The Nature of Child Malnutrition and its Long-Term Implications. *Food and Nutrition Bulletin*, 20(3): 288-292.
- Martorell, R., Horta, B., Adair, L., Stein, A., Richter, L., Fall, C., ... & Consortium on Health Oriented Research in Transitional Societies Group. (2010). Weight Gain in the First Two Years of Life is an Important Predictor of Schooling Outcomes in Pooled Analyses from Five Birth Cohorts from Low and Middle-Income Countries. *The Journal of Nutrition*, 140: 348-354.
- Meenakshi, J.V, Banerji, A., Manyong, V., Tomlins, K., Mittal, N., & Hamukwala, P. (2012). Using a Discrete Choice Experiment to Elicit the Demand for a Nutritious Food: Willingness-to-Pay for Orange Maize in Rural Zambia. *Journal of Health Economics*, 31: 62-71.
- Meredith, J., Robinson, J., Walker, S., & Wydick, B. (2013). Keeping the Doctor Away: Experimental Evidence on Investment in Preventative Health Products. *Journal of Development Economics*, 105: 196-210.

- Morawetz, U.B., De Groote, H., & Kimenju, S.C. (2011). Improving the Use of Experimental Auctions in Africa: Theory and Evidence. *Journal of Agricultural and Resource Economics*, 36(2): 263-279.
- Nutriset. (2011). Prevention of Malnutrition. Available from <http://www.nutriset.fr/en/product-range/prevention-of-malnutrition.html>.
- Nutriset. Plumpy'Nut Ready-to-Use Therapeutic Food (RUTF). Available from <http://www.nutriset.fr/en/product-range/produit-par-produit/plumpy-nut-ready-to-use-therapeutic-food-rutf.html>.
- O'Donnell, O., van Doorslaer, E., Wagstaff, A., & Lindelow, M. (2008). *Analyzing Health Equity Using Household Data. A Guide to Techniques and Their Implementation*. Washington, DC: The World Bank.
- Poulos, C., & Whittington, D. (2000). Time Preferences for Life-Saving Programs: Evidence from Six Less Developed Countries. *Environmental Science and Technology*, 34: 1445-1455.
- Save the Children. (2012). Nutrition in the First 1,000 Days: State of the World's Mothers 2012. Available from <http://www.savethechildren.org/atf/cf/%7B9def2ebe-10ae-432c-9bd0-df91d2eba74a%7D/STATE-OF-THE-WORLDS-MOTHERS-REPORT-2012-FINAL.PDF>
- Statistical Analysis Handbook. Kolmogorov-Smirnov, Online Handbook. Available from [http://www.statsref.com/HTML/index.html?komogorov\\_smirnov.html](http://www.statsref.com/HTML/index.html?komogorov_smirnov.html).
- Tarozzi, A., Mahajan, A., Blackburn, B., Kopf, D., Krishna, L., & Yoong, J. (2011). Micro-loans, Insecticide-Treated Bednets and Malaria: Evidence from a Randomized Controlled Trial in Orissa (India). Unpublished manuscript. Duke University. Available from [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1881075](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1881075).

Victora, C.G., Adair, L., Fall, C., Hallal, P., Martorell, R., Richter, L., Sachdev, H.S. (2008). “Maternal and Child Undernutrition: Consequences for Adult Health and Human Capital.” *The Lancet*, 371: 340-357.

Vyas, S., & Kumaranayake, L. (2006). “Construction socio-economic status indices: how to use principal components analysis.” *Health Policy and Planning*, 21(6): 459-468.

World Food Programme. (2012). “The First 1,000 Days Campaign.” Available from <http://usa.wfp.org/about/first1000days>.

World Health Organization. (1997). WHO Global Database on Child Growth and Malnutrition. de Onis, M., & Blössner, M. (Eds.). Geneva, Switzerland: WHO Press.

---

<sup>1</sup> The recommended duration of treatment is approximately 6-10 weeks but varies depending on the child’s nutritional status (Nutraset).

<sup>2</sup> The International Lipid-Based Nutrient Supplement Project (iLiNS project) is currently evaluating the efficacy of these preventative LNS products in randomized controlled trials in Ghana, Malawi, and Burkina Faso.

<sup>3</sup> The experimental auction did not involve an information treatment but rather asked participants a series of questions about the nutritional value of biofortified maize to gauge their knowledge.

<sup>4</sup> Children with a height-for-age z-score of < -2 SD below the reference population are considered stunted (World Health Organization, 1997). Height-for-age is a cumulative measure of nutritional status and reflects the effect of chronic undernutrition on linear growth (O’Donnell, van Doorslaer, Wagstaff, & Lindelow, 2008).

<sup>5</sup> Anemia is defined as a hemoglobin concentration in the blood of less than 11 g/dL (Ghana Statistical Service et al., 2009).

<sup>6</sup> During the recruitment period, recruitment took place during all hours of operation every day the prenatal clinic was open.

<sup>7</sup> Women were deemed ineligible to participate in an auction if they were not pregnant or breastfeeding a child under six months of age, if they were part of the main iLiNS study, if they had previously participated in an LNS auction, if they were asthmatic, or if they had a peanut or milk allergy.

---

<sup>8</sup> The decision to conduct the auctions with women not participating in the iLiNS study was because (1) some of the iLiNS study participants receive LNS-P&L for free as part of the study and would therefore not have an incentive to buy it, and (2) we did not want to introduce LNS-P&L into households randomized into the non-LNS-P&L arms of the iLiNS study.

<sup>9</sup> The BDM structure has been shown to work just as well as first-price auction formats in African contexts in terms of generating comparable average bids with similar levels of variance (Morawetz, De Groot, & Kimenju, 2011).

<sup>10</sup> The information provided on usage included that women could take LNS-P&L every day throughout pregnancy and the first six months of breastfeeding to help ensure proper nourishment of the mother and her baby. Given the intended duration of usage, the fact that the auctions were for a week's supply of LNS-P&L and the product was not available outside of the auctions may have influenced participants' WTP. We discuss this and other auction characteristics that may have influenced WTP at the end of this section.

<sup>11</sup> The production cost estimates do not incorporate costs associated with transportation, marketing, etc., so these estimates are likely lower bounds.

<sup>12</sup> The Kolmogorov-Smirnov test statistic quantifies the distance between the empirical distribution functions of two samples. Under the null hypothesis, the samples are drawn from the same distribution (Statistical Analysis Handbook).

<sup>13</sup> Although WTP is potentially left-censored at zero, we observe only seven bids (3%) of zero in the auctions, so we use OLS to estimate the determinants of WTP, which does not depend on the assumptions of normality and homoskedasticity for consistency. In general, OLS estimates of censored data are inconsistent because the conditional mean of censored data differs from that of uncensored data (Cameron & Trivedi, 2005). As a result, WTP data are often estimated using a tobit maximum likelihood estimator (Lusk & Shogren, 2007), which is consistent under the assumption that the errors are normally distributed and homoskedastic. If these assumptions are violated, however, tobit estimates are inconsistent. Using lagrange multiplier tests based on the tobit generalized residuals and scores, the assumptions of normality and homoskedasticity are both rejected at the 1% level (Cameron & Trivedi, 2010). Our regression results do not change in any substantial way when we estimate WTP using a tobit framework.

<sup>14</sup> For instance, auction participants were asked not to talk amongst one another, participants were seated such that there was an enumerator between participants, and bids were reported and recorded privately.

---

<sup>15</sup> Alternatively, we could include auction session dummy variables to control for auction fixed effects. We opted not to do this since we have 44 auction sessions (some of which are composed of just two or three women), resulting in a large loss of degrees of freedom. Additionally, apart from what happened during a particular auction session, there are no outside factors (e.g., location of household, group membership, etc.) that would connect auction participants in a particular session in any way.

<sup>16</sup> This is in contrast to (conditional) quantile regression, introduced by Koenker & Bassett (1978), in which the marginal effect is an estimate of a very small change in an explanatory variable on a specific quantile of the conditional distribution. That is, it estimates the marginal effect of a change in an explanatory variable on a specific quantile *after* conditioning on other covariates at a particular value (commonly the mean) and assuming that the conditional quantile of a particular individual/observation does not change with the change in the explanatory variable, making it more difficult to interpret the conditional coefficients than the unconditional coefficients (Fournier & Koske, 2012). As pointed out in Firpo, Fortin, & Lemieux (2007), if the conditional and unconditional distributions are very similar, then the difference in the conditional and unconditional regression estimates will be small. However, when the conditional and unconditional distributions are more dissimilar, there will be large differences in the estimated coefficients across the two methods.

<sup>17</sup> The information was delivered by the auction facilitator, and it is also possible that the source of the information was not deemed credible by auction participants. Future research may incorporate delivery of the information by different sources (e.g., a nurse, community leader, radio message, or television clip) to assess the effect of how the information is delivered.

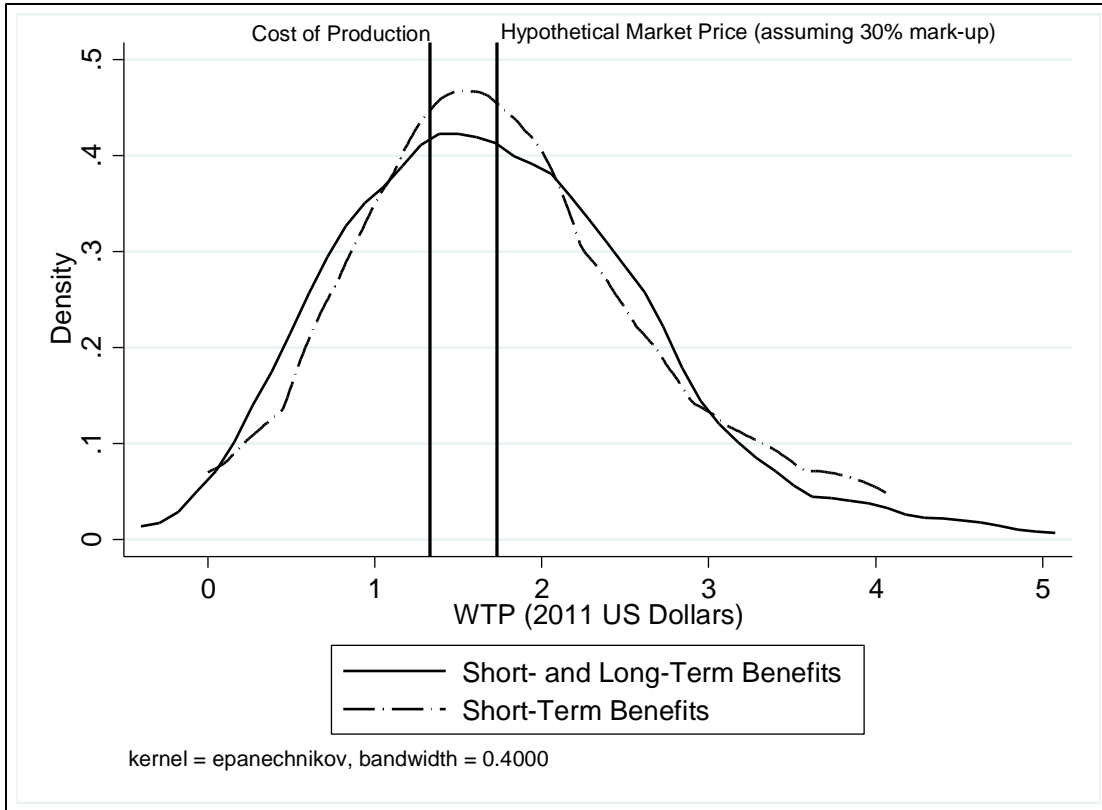


Figure 1. *Kernel Densities of WTP for LNS-P&L by Information Treatment*



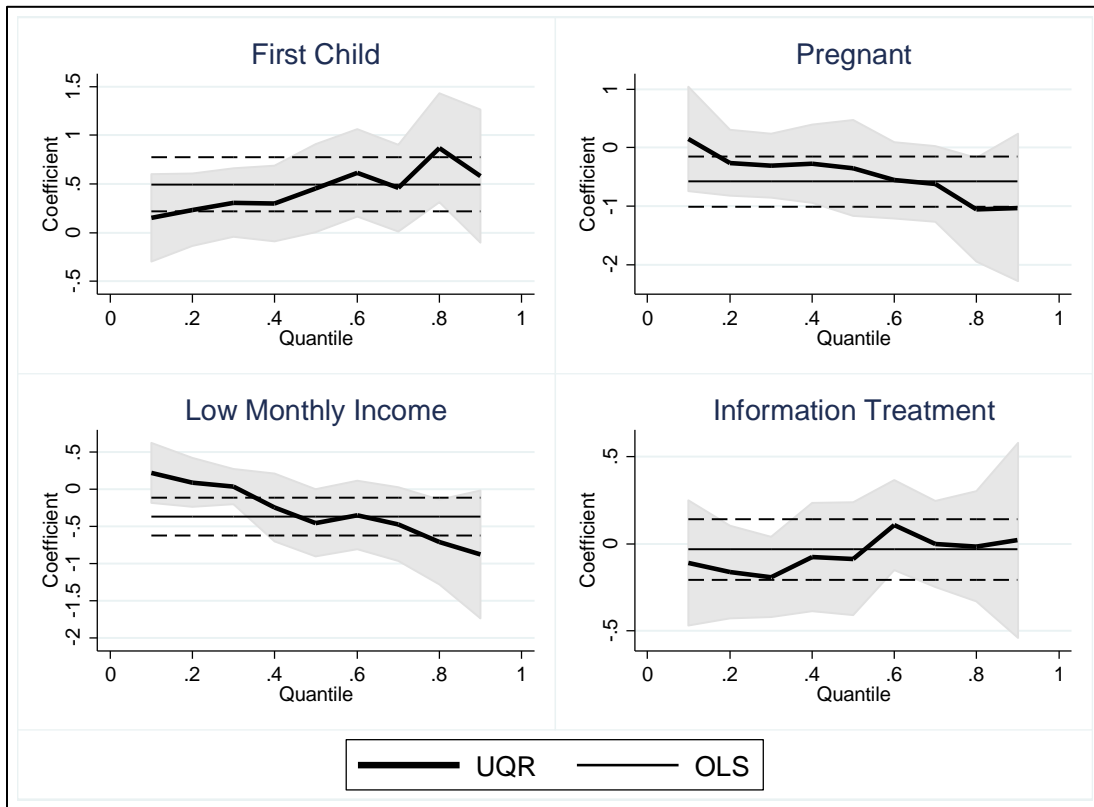


Figure 2. OLS and UQR Coefficients with 95% Confidence Intervals

Note: 95% confidence intervals are represented by dashed lines for OLS coefficients and shaded areas for UQR coefficients.

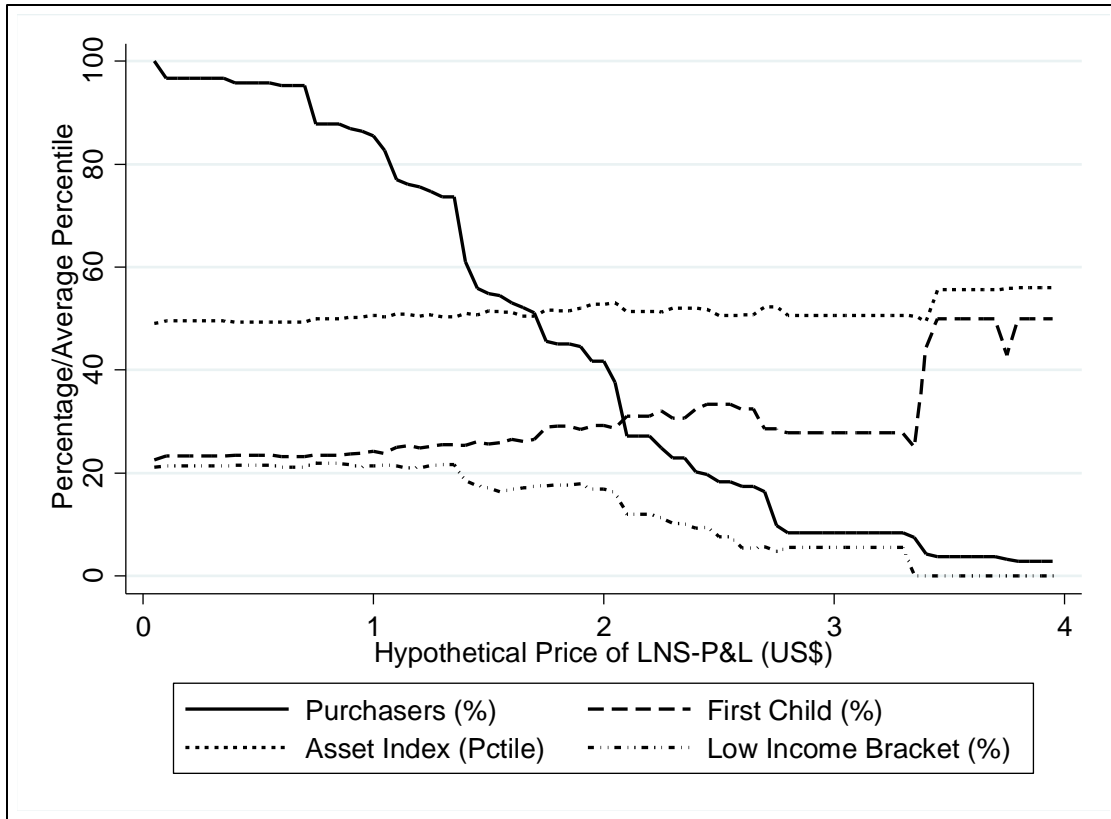


Figure 3. *Characteristics of Buyers along a LNS-P&L Price Continuum*

Table 1. *Characteristics of Women Screened for Experimental Auctions*

Variable	Definition	Mean/Percentage		
		Not Recruited	Recruited But Did Not Participate	Recruited and Participated
Pregnant	= 1 if pregnant (= 0 if breastfeeding a child under 6 months old)	90.2%	92.4%	94.8%
Weeks Pregnant	Gestational age of pregnancy at screening in weeks	25.37	24.18	24.6
Used Supplement	= 1 if previously used a nutritional supplement while pregnant or breastfeeding	58.8%	60.9%	67.6%
Transport Price	Price of transport from home to prenatal clinic in fourth quarter 2011 USD	1.07***	0.77	0.77
Transport Time	Minutes taken to travel from home to prenatal clinic	51.07***	37.7	38.9
N	Number of women	51	92	213

Significance codes: \*\*\* (p < .01), \*\* (p < .05), \* (p < .1) indicated difference in means between women who were not recruited (column 1) and women who were recruited (columns 2 and 3) and difference in means between recruited women who did not participate in an auction (column 2) and did participant in an auction (column 3).

Table 2. *Participant and Household Characteristics*

	Variable	Definition	Mean/ Frequency	Std Dev/ Percent	Min, Max
Participant Characteristics	Head	=1 if the participant is head of household	28	13.2%	
	Age	Participant's age	27.7	6.3	17, 44
	Education	Participant's years of education	6.7	3.7	0, 15
	First Child	=1 if the participant is pregnant with or breastfeeding her first child	48	22.5%	
	Pregnant	= 1 if the participant is pregnant ( = 0 if breastfeeding a child under 6 months old)	202	94.8%	
	Thin Baby at Birth	= 1 if any baby in the participant's household was thin/low weight when they were born	30	14.1%	
Household Chars.	Low Monthly Income	=1 if the participant reported total combined household income of < \$65 USD in previous month	45	21.1%	
	Asset Index	Proxy measure of socioeconomic status based on asset ownership	0	1.0	-1.8, 2.7
	HFS Score	Household Food Security Score	4.8	4.1	0, 15
	Borrowed For Food	= 1 if the household borrowed on credit to purchase food in the past 12 months	28	13.2%	

N = 213

Table 3. *Average WTP for Week's Supply of LNS-P&L (2011 US Dollars)<sup>a</sup>*

	N	Mean (Std Error)	Std Dev	Min, Max	Zero Max WTP
Overall	213	1.74 (0.06)	0.87	0, 4.67	7 (3.3%)
Short-Term Benefits	115	1.75 (0.08)	0.88	0, 4.06	5 (4.4%)
Short- and Long- Term Benefits	98	1.73 (0.09)	0.87	0, 4.67	2 (2.0%)

<sup>a</sup>The estimated cost of producing a week's supply of LNS-P&L at a factory in Niger is \$1.33.

Table 4. OLS and UQR Results: WTP for a Week's Supply of LNS-P&L

Variable	OLS <sup>a</sup>	Quantile <sup>b</sup>					
		.10	.25	.5	.75	.90	
Participant Characteristics	Head of Household (0/1)	0.125 (0.174) <sup>c</sup>	-0.355 (0.317)	0.049 (0.193)	0.016 (0.227)	0.321 (0.229)	0.373 (0.473)
	Age (years)	0.005 (0.008)	-0.010 (0.017)	-0.005 (0.012)	0.008 (0.015)	0.014 (0.015)	0.005 (0.022)
	Education (years)	-0.030** (0.015)	-0.007 (0.033)	-0.020 (0.020)	-0.011 (0.023)	-0.018 (0.030)	-0.070 (0.045)
	First Child (0/1)	0.497*** (0.139)	0.152 (0.232)	0.226 (0.166)	0.456** (0.226)	0.504** (0.240)	0.580* (0.328)
	Pregnant (0/1)	-0.578*** (0.213)	0.149 (0.492)	-0.298 (0.301)	-0.347 (0.406)	-0.807** (0.356)	-1.027* (0.583)
	Thin Baby at Birth (0/1)	0.236 (0.141)	0.496** (0.234)	0.106 (0.239)	0.278 (0.267)	0.086 (0.250)	0.491 (0.439)
	Used Supplement (0/1)	-0.079 (0.088)	0.126 (0.158)	-0.157 (0.132)	-0.108 (0.139)	-0.129 (0.161)	-0.051 (0.258)
Household Chars.	Low Monthly Income (0/1)	-0.367*** (0.125)	0.221 (0.211)	-0.023 (0.135)	-0.454** (0.221)	-0.560** (0.252)	-0.877** (0.415)
	Asset Index	0.134** (0.055)	0.201* (0.113)	0.159* (0.087)	0.081 (0.082)	0.053 (0.092)	0.134 (0.101)
	HFS Score	0.007 (0.014)	-0.012 (0.020)	0.022 (0.020)	0.006 (0.019)	0.006 (0.022)	0.007 (0.033)
	Borrowed for Food (0/1)	0.252* (0.130)	0.478* (0.281)	0.256 (0.215)	0.521*** (0.188)	0.387 (0.288)	-0.216 (0.430)
Information Treatment (0/1)	-0.034 (0.086)	-0.111 (0.190)	-0.193 (0.119)	-0.087 (0.163)	0.007 (0.136)	0.019 (0.281)	
Constant	0.576 (0.366)	-0.597 (1.120)	0.137 (0.794)	-0.700 (0.652)	1.177* (0.681)	2.871** (1.319)	
R <sup>2</sup>	0.432	0.215	0.283	0.302	0.272	0.227	
Mean/Quantile	1.738	0.677	1.194	1.669	2.188	2.688	

N=213

Significance codes: \*\*\* (p < .01), \*\* (p < .05), \* (p < .1)

Note: Controls for enumerator, participant comprehension of the auction process, market price in the last practice LNS bidding round, and whether the participant would have purchased LNS-P&L in the last practice round are also included in model (unreported).

<sup>a</sup>Standard errors are clustered at the auction session level.

<sup>b</sup>Standard errors for quantile regressions were obtained over 400 bootstrap replications clustered at the auction level.

<sup>c</sup>Numbers in parentheses are cluster-robust standard errors.

## APPENDIX

### **Experimental Auction Protocol: INCLUDES LONG-TERM BENEFITS INFORMATION**

Please announce the auction ID and that **this auction will include information on the long-term benefits of nkate pa** to the enumerators so they can record it on each bidding sheet. Then begin the auction by introducing yourself.

Thank you for agreeing to participate in today's session. As you entered the room, you should have been given an envelope containing 4 cedis. This money is yours to keep. When you leave the auction today, any money that you do not spend is your money to take home. There is also an ID number written on your envelop. We will use your ID number to identify you during this research session. We use random numbers in order to ensure confidentiality.

Before we begin, I want to emphasize that your participation in this session is completely voluntary. If you do not wish to participate in the auction, please say so at any time. You will not be penalized for refusing to participate. I want to assure you that the information you provide will be kept strictly confidential and used only for the purposes of this research.

In today's session, we are interested in how much a new nutritional supplement for pregnant and breastfeeding women is worth to you. The nutritional supplement is called nkate pa, which is a new product that is not yet available for sale.

Today we are going to give you an opportunity to buy a week's supply of nkate pa. We will conduct an auction for the nkate pa in order to understand how much the product is worth to you. You may be familiar with harvest auctions at church. The auction for nkate pa will be similar to a harvest auction, although you will not be competing against one another and some of the rules will be different. To explain how the auction will work and to help explain the rules, we will begin with a practice auction for toffee. We will ask you to tell us how much the toffee is worth to you. Here is an example to explain what we mean when we ask you how much the toffee is worth to you:

Imagine that the toffee is available at a nearby market but you don't know its price. A friend you trust is going to the market, and you have to decide how much money to send with your friend to buy the toffee for you. If your friend reaches the market and discovers that the toffee costs more than you sent, the friend will not buy the toffee and will return your money. If your friend has enough money to buy the toffee, the friend will buy it and bring back the toffee and your balance. In this case you will only send as much money with your friend as you are willing to spend to buy the toffee, and you will tell your friend not to add any of his own money if the price is higher than the amount you sent. If the toffee is more expensive than you would like, you won't buy it, and if it is less expensive, you get your balance.

If you send more money than you want your friend to spend on the toffee, you risk buying the toffee at a higher price than what the toffee is worth to you. If you send less money than you

would like to spend, your friend may not be able to buy the toffee for you if the price is higher than the amount you sent. So you see that you should give your friend exactly as much money as the toffee is worth to you. When you think about how much the toffee is worth to you, think about how much money you would send with your friend to buy the toffee at the market.

### **Practice Auction Instructions:**

I would now like to explain the steps in the toffee auction.

- 1) First, we will ask you to tell your assigned enumerator how much money you would send with your friend to the market if you did not know the price of the toffee, that is, how much the toffee is worth to you. Your enumerator will write down this amount on a piece of paper. You should not tell anyone except your assigned enumerator how much money you would send with your friend.
- 2) Next, we will determine the price of the toffee that will be quoted to your friend when s/he reaches the market by choosing a market price out of a bag.
- 3) Then, everyone who sent sufficient money with their friend to purchase the toffee will then purchase the toffee at the market price. In other words, everyone who stated that the toffee is worth an amount equal to or greater than the market price will purchase the toffee at the market price. Everyone who did not send sufficient money with their friend will not purchase the toffee. Since the market price is higher than how much the toffee is worth to them, these people are happy to keep their money rather than spend more than they think it is worth.

I will now show you how the market price for the toffee will be determined.

Demonstrate the selection of the random market price by picking a price out of the bag and announcing it to the participants. The enumerators should then privately ask each participant whether or not they would purchase the toffee at that price. (Note: **this is a yes or no question.**) Repeat this process at least five times (choose a random price, announce it, and have enumerators ask their participants whether they would purchase the toffee at the chosen price). This exercise is meant to **demonstrate to the participants that the market price is random** and to **help the participants begin thinking about how much the toffee is worth to them.**

These prices are all examples of prices your friend may be quoted at the market, and these prices should not influence how much the toffee is worth to you personally. How much the toffee is worth to you depends on your individual preferences and your own situation. When you decide how much money the toffee is worth to you, you should think about how much money you would send with your friend to purchase the toffee if you did not know the market price.

Important notes to read to participants:

- If your stated value of the toffee is equal to or above the market price, you must actually pay money for the toffee. If your stated value of the toffee is below the market price, you will not be allowed to purchase the toffee. This procedure is not hypothetical.
- If the toffee is not worth anything to you, you can tell your enumerator it is worth 0 cedis.



- In this auction the best strategy is to tell your enumerator exactly what the toffee is worth to you.

### **Demonstration Auction:**

We would now like to demonstrate the toffee auction with the enumerators to make sure you understand the procedure. Please feel free to ask questions at any point during this example. We will ask the enumerators to decide how much they would send with a friend to purchase the toffee at the market, and we will write their answers on the board. Please note that when you tell your assigned enumerator how much the toffee is worth to you, it will not be written on the board. This is just for demonstration purposes.

Ask the assistant to write the bids of two enumerators on the board. After their bids have been recorded, ask one of the enumerators to draw a market price from the bag. The assistant should then write the market price on the board. At this point, **engage the participants in a discussion about the outcomes.** Ask them which of the enumerators would purchase the toffee and what price they would pay. Also ask what would happen with the enumerators whose bids are lower than the market price. Have the enumerators actually pay for the toffee and give them their balance (if any). **Allow enough time before beginning the next section for all enumerators to discuss the demonstration auction procedure, outcomes, and transactions with their assigned participants.**

### **Toffee Auction Procedure:**

Ask the assistant to pass out 20 pesewas to all participants be used in the toffee auction. Tell participants this is the money they will be using for the toffee auction only.

Does anyone have any questions before we begin the auction for the toffee?

From this point forward, I ask that there be no talking among the participants, but you may talk to me or your assigned enumerator. This is to protect each participant's confidentiality and to ensure that everyone makes their own decisions. Failure to comply with these instructions will result in disqualification from the auction. Are there any questions before we begin?

We would like to know how much this toffee is worth to you. This is a [NAME OF TOFFEE] toffee, and it is [FLAVOR OF TOFFEE]. Consider how much money you would send with your friend to a nearby market to purchase this toffee. Remember, there are many prices that your friend may be quoted at the market. Some prices may be higher than how much the toffee is worth to you and some may be lower, but as long as you send exactly as much money as the toffee is worth to you, you will be happy when your friend returns from the market. Just for practice this time, please tell your enumerator how much the toffee is worth to you.

Wait until all practice bids are recorded by the enumerators, and then ask one of the participants to draw a random market price for the toffee. The assistant should write the market price on the board. Explain that everyone who bid at or above the market price would purchase the toffee if this were their real bid. Then, **allow time for the enumerators to talk with each participant individually about their own bid in comparison to the market price.**

You are now going to tell your enumerator how much the toffee is worth to you, but this time it is not for practice. Please tell your enumerator how much you would send with your friend to the market to purchase the toffee.

After participants have submitted their real bids, draw a market price and announce it to the participants. The assistant should record the market price on the board. Ask the enumerators to talk with each participant individually about their bid in comparison to the market price. Then the enumerators should complete the transaction for the toffee for those participants whose bids are equal to or above the market price. This should be done as discreetly as possible without making any public announcements about individual participant's outcome.

Give participants the opportunity to ask any questions before beginning the auction for the nkate pa.

### **Nkate Pa Auction:**

We will now conduct a similar auction for a week's supply of nkate pa, which is 7 sachets, one for each day of the week. To remind you how the auction works I will read the instructions again.

- 1) First, you will tell your assigned enumerator how much the nkate pa is worth to you. This is the amount of money you would send with your friend to the market to buy nkate pa for you if you did not know its price. You should not tell anyone except your assigned enumerator how much the nkate pa is worth to you.
- 2) Next, we will draw a market price and announce it to you. Like before, you can think of the market price as the price of the nkate pa quoted to your friend when s/he reaches the market.
- 3) Then, everyone who sent sufficient money with their friend to purchase the nkate pa at the market will then purchase it for the market price. In other words, everyone who stated that the nkate pa is worth an amount equal to or greater than the market price will purchase the nkate pa at the market price. Everyone who did not send sufficient money with their friend will not purchase the nkate pa. For these people, the market price is higher than how much the nkate pa is worth to them.

Important notes to read to participants:

- If your stated value of the nkate pa is equal to or above the market price, you must actually pay money for the nkate pa. If your stated value is below the market price, you will not be allowed to purchase the nkate pa. This procedure is not hypothetical.
- If the nkate pa is not worth anything to you, you can tell your enumerator it is worth 0 cedis.
- In this auction the best strategy is to tell your enumerator exactly what the nkate pa is worth to you.

I want to begin these auctions by describing how to use nkate pa. If something is unclear please ask me questions. I would like everyone to understand what nkate pa is and why women might eat it when they are pregnant or breastfeeding.

### **Full Information Statement:**

Please read the following information statement to participants. This information is meant to draw participants' attention to undernutrition and why it occurs. It also gives participants information about how nkate pa should be used. Then, it highlights some of the short-term and long-term benefits of proper nutrition early in life.

**Read the statement as closely as possible to how it is written below.** It is important that the **participants hear the entire statement** and that the information is **delivered to them in the same way during each auction session** so that participants' bids across different auctions can be compared.

As you may know, undernutrition in young children is a problem in Ghana. Children can become undernourished when the foods they eat do not provide them with enough vitamins, minerals, and energy to grow properly. Undernutrition can even begin during pregnancy or breastfeeding if a mother does not get sufficient amounts of vitamins and minerals.

The nutrients contained in the staple foods in the Ghanaian diet, such as yam, plantain, cassava, and corn, are often not sufficient to ensure that a mother and her baby are properly nourished during pregnancy or while breastfeeding. There are a variety of nutritional supplements that women might use to add to the nutrients in their normal diet and help prevent the mother and the baby from becoming undernourished during pregnancy or while breastfeeding. You may have heard of or used some of these supplements, like soya beans flour or multi vitamins (e.g., Pregna Care, Multivite, B-Complex, Fesolate, Zincovite, or Feroglobin).

Nkate pa is a new, fat-based vitamin and mineral supplement, and it is one way to provide pregnant and breastfeeding women with extra vitamins, minerals, and energy. Nkate pa is not a substitute for other foods. It should be used to supplement a healthy diet during pregnancy or while breastfeeding. Pregnant or breastfeeding women should eat 1 sachet of nkate pa per day mixed with any food they prefer. Each sachet is 20 grams. It may be taken every day throughout pregnancy and every day throughout the first six months of breastfeeding, which will help ensure that a mother and her baby are properly nourished. Nkate pa should not be eaten by anyone who is allergic to groundnuts or milk.

Take a short break from the information statement for participants to taste nkate pa. Enumerator should give a small quantity of nkate pa to each participant on a spoon. While participants are tasting, enumerators should **remind them that nkate pa is to be mixed with other foods rather than eaten alone**. After the tasting is complete, resume the information statement.

From the time a baby is conceived through the first two years of his/her life, it is very important that s/he gets enough nutrients to ensure that his/her body and mind grow and develop well. When a baby is still in his mother's womb and after the baby is born and is being exclusively breastfed, the nutrition of the baby's mother is extremely important since the baby is fed through his/her mother. If a baby gets enough nutrients from his/her mother before s/he is born and while s/he is being breastfed, the baby is less likely to fall sick with things like diarrhea, pneumonia, or malaria and is less likely to die. Also, the baby's brain and body will be more likely to develop and grow well if the baby is properly nourished.

Take another short break from the information statement to display the drawing of a mother and her baby, beginning in pregnancy. Explain the four stages depicted in the drawing to the participants while holding it up for them to see.

Begin the final section of the information statement, which emphasizes the **long-term benefits of proper nutrition in early childhood**. Because the inclusion of this part of the statement will be randomized (you will read it during some auctions while in others you will not), it is **crucial that this section of the statement be delivered very clearly and very consistently across all auctions**.

Preventing a child from becoming undernourished before s/he is born and during the first two years of his/her life can also affect him/her as s/he gets older, goes to school, and begins to work. When a child is well nourished, his/her mind and body are better able to grow and develop. This may help him/her be prepared to enter school earlier and perform better in school. And, when children do well in school, they are often able to earn more money as adults. Research in other countries has shown that compared to children who are undernourished, children who are properly nourished early in life often attend more school, have an easier time learning, and earn more money in their work as adults because their minds and bodies are stronger.

Conclude the information statement by displaying the drawing of a child growing into an adult. Explain the four stages depicted in the drawing to the participants while holding it up for them to see. Then, **ask the participants if there are any questions about nkate pa or the auction process**.

### **Nkate Pa Auction Procedure:**

We would like to know how much a week's supply of nkate pa is worth to you. First, I will show you how the market price will be determined.

Demonstrate the selection of the random market price by picking a price out of the **demonstration bag** and announcing it to the participants. The enumerators should then privately ask each participant whether or not they would purchase nkate at that price. (Note: **this is a yes or no question.**) Since we want to show a range of potential prices, do not put the price back into the bag before picking the next price. Repeat this process at least five times (choose a random price, announce it, and have enumerators ask their participants whether they would purchase nkate pa at the chosen price). This exercise is meant to **demonstrate to the participants that the market price is random** and to **help the participants begin thinking about how much the nkate pa is worth to them.**

These prices are all examples of prices your friend may be quoted at the market, and these prices should not influence how much nkate pa is worth to you personally. Just for practice, please tell your enumerator how much the nkate pa is worth to you. That is, how much money would you send with your friend to a nearby market to purchase a week's supply of nkate pa if you did not know the market price? Remember, you can decide to send any amount you like with your friend, considering any money you brought with you plus the 4 cedis you were given when you arrived at today's auction.

Wait until all participants' bids are recorded by the enumerators, and then ask one of the participants to draw a market price. The assistant should write the market price on the board. Explain that everyone who bid at or above the market price would purchase the nkate pa if this were their real bid. Then, **allow time for the enumerators to talk with each participant individually about their own bid in comparison to the market price.**

Repeat another round of practice bids for nkate pa, again allowing time at the end for enumerators to discuss the outcomes with their participants.

You are now going to tell your enumerator how much a week's supply of nkate pa is worth to you, but this time it is not for practice. After we draw a market price, those who quoted an amount equal to or higher than the price will actually purchase the nkate pa. Remember, there are many prices that your friend may be quoted at the market. Some prices may be higher than how much the nkate pa is worth to you and some may be lower, but as long as you send exactly as much money as the nkate pa is worth to you, you will be happy when your friend returns from the market. Please tell your enumerator how much money you would send with your friend to the market to purchase a week's supply of nkate pa.

Draw a market price and announce it to the participants. The assistant should record the market price on the board. The enumerators should then complete the transaction for the nkate pa for those participants whose bids are equal to or above the market price. This should be done as discreetly as possible without making any public announcements about individual participant's outcomes.

Before beginning the auction debriefing procedure, have all enumerators **complete the bidding sheet for each participant (Comprehension and Long-Term Purchase Price questions)**.

### **Auction Debriefing Procedure:**

Today you have participated in an auction for nkate pa. You had an opportunity to tell us how much the nkate pa is worth to you. We have randomly drawn a market price for the nkate pa. Those of you who said nkate pa is worth an amount equal to or greater than the market price purchased the nkate pa at the market price.

If you purchased nkate pa, I want to remind you that pregnant or breastfeeding women should eat 1 sachet of nkate pa per day mixed with other foods.

Do you have any questions about your experience today?

### **Distribution of Coupons:**

As you learned today, it is important that nkate pa is eaten daily during pregnancy and the first six months of breastfeeding. Although nkate pa is not yet available for sale in Ghana, we would like to give you an opportunity to purchase more nkate pa over the next few weeks if you would like to do so. We will give each of you 2 coupons. Each coupon will allow you to purchase an additional week's supply of nkate pa for [the final random market price] cedis. Even if you did not purchase nkate pa today, you may still choose to purchase it later using your coupons. If you choose to purchase more nkate pa, you will need to bring your coupon and your own money to pay for it. The nkate pa will be available for sale [when and where].

Have enumerators fill in and hand out 2 coupons for each auction participant.

### **Supplemental Questionnaire:**

Thank you all very much for participating in today's auction. Before you leave, we would like to ask you a few questions about yourself and your household that will help us when we are evaluating the outcomes of this study. This additional information will be kept strictly confidential. During this time, we would like to provide you with a snack and drink.

Ask enumerators to administer the supplemental questionnaire to their assigned auction participants who did not complete the questionnaire before the auction began. Pass out snacks. Participants are free to leave after they have completed the questionnaire.

