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Growing their own: Unobservable quality and the value of self-provisioning☆

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ABSTRACT

Many important food quality and safety attributes are unobservable at the point of sale, particularly in informal markets with weak reputation effects. Through a framed field experiment conducted in western Kenya, we show that farmers place a large premium on maize they have grown themselves, relative to that available for purchase. Providing information on the origin of maize, and on its taste and safety, reduces this gap. We conclude that information which is unavailable during typical market transactions is important to how consumers value maize, and that imperfect information may contribute to the prevalence of agricultural production for subsistence needs in developing countries.

1. Introduction

Regulations and inspections to ensure food quality and safety are the norm in developed countries, but are largely absent in the informal markets of the developing world. In Kenya, maize commonly contains fungal contaminants, which affect both taste and food safety, but are not always visible. If attributes that are not observable at the point of sale are sufficiently important to consumers, and reputation mechanisms are weak, consumers may choose to produce food for their own consumption in order to ensure high quality, at a potential efficiency cost.

We designed a two-stage framed field experiment to understand the importance of observable and unobservable attributes to smallholder farmers in rural Kenya. In the first stage, the participants were offered the opportunity to sell maize they had stored for household use to researchers at randomly varied prices. A large proportion of these farmers were reluctant to sell their maize, even at several times the prevailing market price. The participants were then invited to participate in a second-price auction, through which they could purchase back the maize they had previously sold, maize that had been purchased from a fellow study participant, and maize purchased from a local trader. Information on taste and food safety attributes, typically unobservable at the time of purchase, was varied experimentally. Through this second stage of the experiment, we show that the premium on self-grown maize remains, and document a large effect of both taste and food safety information on consumers' willingness to pay for marketed maize.

This paper contributes to a large literature investigating developing country farmers' reliance on semi-subsistence agriculture.[1] A number of explanations for autarky or semi-autarky in staple foods have been proposed, including marketing transaction costs (de Janvry et al., 1991), food price risk (Fafchamps, 1992), and heterogeneity in the quality of self-produced versus purchased crops (Singh et al., 1986). Empirical support has been found for the roles played by transaction costs (Goetz, 1992; Jayne, 1994; Key et al., 2000; Omamo and Were, 1998) and risk mitigation (Kurosaki and Fafchamps, 2002). The third hypothesis, that quality heterogeneity impedes market participation, has received relatively little empirical investigation. A notable exception is a study by Arslan and Taylor (2009), who show that the shadow price of traditional self-grown maize varieties in Mexico is significantly above the market price, and speculate that this is driven partly by preferences for consumption attributes associated with particular genetic traits, and partly by the value ascribed by farmers to preservation of the family's seed line.

In Kenya, maize is the main staple crop, and is grown by 98% of farm households outside of arid and semi-arid areas (Mathenge and Tschirley, 2008). In rural areas, maize is typically purchased as unmilled kernels from traders who frequent open air markets, held in most towns during one or two days of the week, and less commonly as flour from small-scale millers or shops. When a consumer purchases maize, she may inspect its visible attributes, for example discoloration due to

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[1] Barrett (2008) provides a recent summary of the conceptual foundations of this literature, as well as a review of empirical evidence from eastern and southern Africa.

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mold, integrity of kernels, and presence of insects and other debris. However, other important attributes may not be observable the point of sale. For example, consumers are only able to observe taste upon consumption, as dried maize kernels are difficult to crack with one's teeth, and even if cracked do not release much flavor.

In addition to taste, another quality of potential importance to consumers is food safety. In Kenya, contamination of maize with certain fungal byproducts, most notoriously aflatoxin, poses a serious threat to public health (Shephard, 2008). While fungal contamination can be visible, this is not always the case; one study found that removing broken and discolored kernels from contaminated maize reduced the aflatoxin level by as little as 40% (Park, 2002). Awareness of fungal toxins in Kenya is reasonably high: during the 10 year period before data collection for the present paper, aflatoxin was mentioned in 70 articles published in one of Kenya's two leading daily newspapers,[2] and 75% of consumers surveyed in one recent study demonstrated knowledge of the symptoms of aflatoxin poisoning (Daniel et al., 2011).

While reputation effects could theoretically overcome problems of incomplete information, the structure of the maize market in Kenya makes the origin of grain difficult to trace. Because growing seasons vary by region, traders exploit spatial arbitrage opportunities, purchasing in surplus regions immediately after harvest and transporting to regions of scarcity (Kirimi et al., 2011). Maize purchased from many small farms is typically aggregated by traders prior to transport, and then disaggregated for resale in the destination region.

The paper proceeds as follows. We begin by outlining a simple theoretical model of how consumers value food attributes in Section 2. We then describe recruitment, survey, and experimental procedures in Section 3. In Section 4, we describe the survey data and present results from the experiment. In Section 5 we discuss alternative mechanisms for the experimental results and argue that none of these fully explain the findings. We conclude with a summary of the results, a discussion of their implications, and suggestions for future research.

2. Theoretical framework

Our theoretical model builds on that used by Fafchamps et al. (2008), and similarly follows Lancaster's (1966) approach of modeling utility as a function of the characteristics of goods. Consider a model in which a risk-averse farm household derives utility from two consumption goods, a staple food f, which can be produced by the household or purchased on the market, and x, a numeraire good which is only available through the market. The staple food is characterized by a vector of attributes $\overline{a} = [o, t, u]$, where o represents observable qualities, such as the presence of visibly rotten grains or debris, t represents experience attributes such as taste, observable only after consumption, and u represents credence attributes that are completely unobservable with the technology available to the household, such as contamination with toxins. When the household produces food itself, many elements of u and t can be controlled, for example by adequate drying and careful storage. However, when food is purchased, the consumer is only able to observe o before purchase. Reputation effects may transmit information about t, but u is unknowable.

Denote the overall quality of the self-produced food consumed by the household as $q(\overline{a}_h)$, and the quality of the staple food purchased on the market and consumed as $q(\overline{a}_p)$. The quality of food is increasing with respect to each of its attributes. Prior to consumption, the expected values of $q(\overline{a}_h)$ and $q(\overline{a}_h)$ depend on the observed attributes o_h and o_p respectively, and the household's expectations over t_h, u_h, t_p, and u_p. The quantities of food consumed from home production f_h and purchase f_p, scaled by their respective quality values, enter additively into the first argument of the utility function, in which utility is increasing and concave. If the quality of food is discovered after purchase or harvest to be so bad that it cannot be consumed, $q(a_j) = 0, j = \{h,p\}$, and it contributes nothing utility. The household's decision problem can thus be expressed as:

$$\mathrm{Max}EU(f, x) = \int\int u\left[f_h \cdot q(\overline{a}_h) + f_p \cdot q\left(\overline{a}_p\right), x\right] d\overline{a}_h d\overline{a}_p, \tag{1}$$

subject to a budget constraint, in which income is derived from sale of a quality-invariant cash crop c at price p_c, and from sales of the food crop, which are equal to the amount harvested h, less the amount retained for consumption, f_h The household spends its income on inputs for food and cash crop production and storage, m_f and m_c, food from the market f_p, and the numeraire good x:

$$c.p_c + (h - f_h) \cdot p_f(o_h) \geq \left(m_f + m_c\right) \cdot p_m + q_p \cdot p_f\left(o_p\right) + x. \tag{2}$$

As shown in Eq. (2), both the sales and purchase prices of the food crop are functions only of the crop's immediately observable properties.

Both the quantity of the food crop produced, h, and its quality attributes, $\overline{a}_h$ are assumed to be increasing and concave in pre and post-harvest inputs m_f. Each is subject to an additive stochastic component due to exogenous shocks to growing conditions such as rainfall and pest attacks, represented in the quantity production function by the variable ε_f, and in the quantity production function by the vector $\overline{\varepsilon}_a$. The quantity and quality production functions for the food crop are thus respectively:

$$h = h\left(m_f\right) + \varepsilon_f, \tag{3}$$

and

$$q(\overline{a}_h) = q\left(\overline{a}_h\left(m_f\right) + \overline{\varepsilon}_a\right). \tag{4}$$

The quantity of the cash crop, which is assumed to be its only attribute, is likewise increasing and concave in inputs:

$$c = c(m_c) + \varepsilon_c. \tag{5}$$

Note that the experience (t) and credence (u) attributes of self-grown maize are influenced by the household's farm practices, whereas these attributes in market-sourced maize are entirely outside of its control.

While, for the sake of tractability, we do not explicitly include a time dimension in the model, we do not envision any restriction on the timing of food sales after harvest. The household may sell its produce immediately after harvest if it faces cash constraints and a high marginal utility of x. Alternatively, it may store its produce for sale later in the season when prices are anticipated to be higher, or spread its sales over time as the need for non-food consumption arises.

The model yields three testable predictions. First, the expected variance of the experience and credence attributes of a given farmer's food crop, $E[Var(t_{h,i})]$ and $E[Var(u_{h,i})]$, are lower than the variance of experience and credence attributes for maize found in the market, $E[Var(t_p)]$ and $E[Var(u_p)]$. Concavity of the utility function thus implies that satisfying the food needs of the household through consumption of self-produced food will be preferable even in the absence of transaction costs, and assuming the average quality of food available on the market is equal to that of home-produced food. If the average quality of purchased food is lower, for example due to differences in post-harvest processing, or selection of the highest quality portion of the crop for producers' own consumption, the preference for consumption of self-produced food would be even stronger.

Second, the value of the self-produced food crop to the farmer is increasing in inputs that affect quality. Since there is no market for quality attributes that are unobservable at the point of sale, these attributes can only be reliably obtained through home production. Constraints to home production, due for example to failures in agricultural input

[2] Online search of The Daily Nation: http://www.nation.co.ke.