A Hedonic Price Analysis of Processed Food Attributes in Tanzania

Dr. Jason Snyder, Michigan State University, snyde138@msu.edu; Dr. David Tschirley, Michigan State University, tschirle@anr.msu.edu; Dr. Thomas Reardon, Michigan State University, reardon@anr.msu.edu; Dr. Brent Ross, Michigan State University, rross@anr.msu.edu

Selected Paper prepared for presentation at the 2019 Agricultural & Applied Economics Association Annual Meeting, Atlanta, GA, July 21 – July 23

Introduction

Numerous authors have shown that shopping in supermarkets and consumption of processed foods both rise with income (Senauer et al., 1986; Gehlhar and Regmi, 2005; Pingali, 2007; Tschirley et al., 2015; Goldman, 1982; Reardon et al., 2003). A longstanding critique of supermarkets in developing countries is that they cater almost exclusively to the middle and upper income classes (Goldman, 1974; Rodríguez et al., 2002; D'Haese et al., 2008; Figuié and Moustier, 2009), selling higher quality items at a higher price. However recent studies in developing countries suggest that while this may be true in the early stages of supermarket penetration, in the longer run supermarkets, especially as they get larger and obtain economies of scale in procurement, can offer equivalent or even lower prices than traditional retail for similar processed food products (Minten and Reardon, 2008), thus appealing to lower income consumers.

We aim to test the idea that supermarkets are price competitive with traditional retail in developing countries for processed food products, by using a hedonic price analysis to: (a) evaluate supermarket price competitiveness for specific product attributes, in addition to products, (b) compare across two different sized cities that are at different stages of retail modernization, (c) evaluate processed food products that have not been considered in previous studies, i.e., maize and mixed flour products, and (d) look specifically at the value of nutritional signaling with these products in the African context.

Strands of relevant literature

Three strands of literature relate to supermarket price competitiveness relative to traditional retail: (a) consumer demand for processed food, (b) the value of food quality attributes, and (c) the choice of retail outlet type given the demand for processed food, and in turn, the direct impact of retail choice on processed food consumption.

An important finding in the first strand concerns the value of time to consumers (Becker 1965): with income growth, increasing opportunity cost of time, especially for women entering the labor market, drives the demand for time-saving strategies, such as eating food away from home (Prochaska and Schrimper, 1973; Chauliac et al., 1997) and purchasing processed foods (Senauer et al., 1986).

Following the hedonic approach of Lancaster (1966) and later Rosen (1974) (and as discussed in more detail below), the second strand estimates the retail market value (or marginal price) of intrinsic (quality/type of ingredients) and extrinsic (packaging, labeling, branding, safety certification) processed food attributes, which is jointly determined by demand and supply in market equilibrium (e.g. Minten et al., 2013).

Related to this strand is a literature that evaluates consumer reactions to health claims. (Lähteenmäki, 2013), summarizing the literature, notes that many factors may influence consumer perception and response to health claims, depending on "claim structure and content, product category, and consumer related factors". For example, a study of consumers in Nordic countries evaluating the perceptions of health claims in bread, yoghurt, and pork products found that much hinged on consumer familiarity with the claim. Overall there was a perceived tradeoff

between health benefits on the one hand, and taste and "naturalness"[1] on the other, resulting in a negative impact of health claim on perceived value (Lähteenmäki et al., 2010). Other studies have found that certain health claims translate into a price premium for the product.

Some developed country examples: Bimbo et al. (2014) found in the Italian yoghurt market a price premium of 210% for a claim of cholesterol risk reduction (Bimbo et al., 2014); others in the same market found a price premium on products of 5.7% and 20.6% for "nutrition claims" and "health claims", respectively (Szathvary and Trestini, 2014). A study in the U.S. yoghurt market found a price premium of 7.0% for "specific health claims" (Bonanno, 2016). A hedonic study of a range of different products in the Netherlands and Denmark found generally positive values associated with nutritional labels on healthy products (Edenbrandt et al., 2017).

However, there is very little research on consumer reactions to health claims for foods in developing countries, especially processed foods. Most of the emphasis is on the price premium or willingness to pay for bio-fortified foods if the nutritional benefits are given: Chowdhury et al. (2011) found, in a choice experiment in Uganda that there was a premium of 25% for bio-fortified deep-orange variety of sweet potato over the white variety. Banerji et al. (2016) find from experimental auctions in India that consumers were willing to pay 29-32% more for bio-fortified high-iron millet over local variety. A similar study in Nigeria for bio-fortified yellow cassava found a log willingness to pay from 7% to 27%, depending on the state, method of delivery, and variety (Oparinde et al., 2016).

The third strand documents supermarket competitiveness relative to traditional markets for processed food products. This literature contains multiple sub-strands. The first generally

[1] The authors state that "naturalness" is "closely linked with perceived healthiness", and yet is distinct in that it specifically refers to the health benefit being based on "components that are naturally present in the product".

shows that supermarkets quickly gain market share and have a competitive advantage for processed food relative to fresh perishable food items in developing countries (Reardon et al., 2003). A second sub-strand explores sources of supermarket competitive advantage (discussed in more detail below). A third sub-strand is starting to show that supermarket shopping leads to the increased consumption of processed foods, increased diet diversity (e.g. see Rischke et al. (2015) for Kenya), and increased diet quality (e.g. see Tessier et al. (2008) for Tunisia). This can lead to reduced child undernutrition on the one hand, but also a higher probability of adults being overweight (Kimenju et al., 2015) and having a higher body mass index (BMI) (Kimenju et al., 2015; Demmler et al., 2018).[2]

A fourth sub-strand documents the diffusion of supermarkets relative to income. The literature has for some time shown that supermarket shopping is not limited to only high income consumers in developing countries (e.g. Neven et al. (2006) and D'Haese and Van Huylenbroeck (2005)). However, it does consistently show that poorer consumers still often persist in shopping at more traditional outlets for most of their items because, for example, they are more spatially accessible, offer credit, and offer goods in smaller and more convenient quantities (Goldman 1982; Neven et al., 2006; (Figuié and Moustier, 2009; Tessier et al., 2010; Tschirley et al., 2010; Battersby and Peyton, 2014). Moreover, traditional markets(with many vendors may also receive high marks for offering good product diversity within a small distance (Figuié and Moustier, 2009), while supermarkets in low income areas may stock less healthy food (Battersby and Peyton, 2014).

[2] Note that not all studies found a link between supermarket shopping and BMI, for example Umberger et al., (2015) did not find a statistically significant link among adults in Indonesia, and found mixed results among children.

Gaps in the relevant literature

There are some important gaps in the literature related to the above strands. First, several case studies suggest that processed food products are often more price competitive in supermarkets than in traditional retail outlets in developing countries (summarized by Minten and Reardon (2008)). However, as Minten et al. (2010) points out, most of the earlier studies had significant data representation and methodological issues. Moreover, a recent case study of modern retail - including private supermarkets and public fair price shops, cooperatives - in Ethiopia, where supermarkets are just starting to emerge, found that processed food was significantly more expensive compared to the traditional sector (Assefa et al., 2016). Clearly, more studies are required in countries where supermarket penetration is relatively recent.

Second, we have also not seen any studies that directly evaluate supermarket price competitiveness for individual product attributes, such as packaging, branding, and nutritional labeling. Schipmann and Qaim (2011) run hedonic regressions on the value of product attributes in wet markets and modern retail separately, but they don't statistically compare the two sets of results in each type of retail outlet.

Third, there are very few studies that analyze the value of specific product attributes and supermarket price competitiveness across cities of different sizes and type. Related to the former, Vandeplas and Minten (2015) compare retail price differences of rice attributes for cities in Madagascar and India. While these cities have distinctly different average income, they are roughly equivalent in size. Related to the latter, (Tschirley et al., 2010) calculate supermarket share for five different sized cities in Zambia and Kenya, but they do not compare prices

Fourth, there has been very little of this type of analysis for processed food products in sub-Saharan Africa (SSA). The available studies only compare the prices of milled rice attributes (Dalton, 2004; Minten and Reardon, 2008; Vandeplas and Minten, 2015). This is relevant because the signs of food system transformation are quite recent and are just beginning to be understood. These signs include: (a) newly emerging evidence that processed food comprises a significant and growing portion of the diet for a broad swath of the population (Nel and Casey, 2003; Tschirley et al., 2015; Ronquest-Ross et al., 2015) and (b) newly emerging, but still limited, evidence of rapid but "quiet" value chain and food processing transformation (Minten et al., 2015; Reardon et al., 2015).

Fifth, while there are numerous studies on the value of nutritional signaling on packaged foods, we have not seen any of this analysis in a developing country context. This gap is particularly salient given the concerns over the nutrition transition in developing countries – a rise in obesity and non-communicable diseases partially associated with a rise in processed food consumption (Asfaw, 2011; Popkin, 2014; Zhou et al., 2015). A price markup for nutrition signaling might suggest a higher willingness of the average consumer to pay for good nutrition and/or higher supplier markup due to additional costs. But, on the other hand, it might suggest that poorer consumers will not be able to pay for nutritional attributes.

To address these gaps, this paper will focus on the following research questions: (a) how price competitive are supermarkets for maize and mixed flour (lishe) products and for the specific branding, packaging, and nutritional signaling attributes of these products? And (b) how does the price competitiveness of supermarkets for these products and attributes vary across primary and secondary cities in Tanzania?

This paper proceeds as follows: (a) the general theoretical framework is presented, including hypotheses to be tested; (b) the specific research context, process of data collection, and empirical strategy is discussed; and (c) the results are presented and discussed.

Theoretical framework and hypotheses

The price competitiveness of modern retail

Let us consider the retail market for a certain processed food product Q. We can characterize the aggregate supply of this product using the following general formulation:

$$S_Q = f(P_Q, P_x, \sigma_x, K) \quad (1)$$

where S_Q is the supply, P_Q is the market price, P_x is a vector of input prices, σ_x is the riskiness of production, and K is a vector of capital and assets available to the retail sector.

Likewise, let the aggregate demand for this product take the following form:

$$D_Q = f(P_Q, I, T) \quad (2)$$

where D_Q is the demand, P_Q is again the market price, I is the average income of consumers, and T is a vector of other demand shifters (e.g. consumer tastes and preferences). By setting $S_Q = D_Q$ we can solve for P_Q in equilibrium:

$$P_Q = f(P_x, \sigma_x, K,\ I,\ T) \tag{3}$$

As mentioned previously, there is a growing literature on the sources of supermarket competitive advantage. This literature generally finds that supermarkets offer a greater diversity of products (one stop shopping), higher quality products in a cleaner environment, and in the longer run, competitive pricing for equivalent products. Competitive pricing maybe be due to the fact that supermarkets have greater access to capital (although this link has not been formally tested), translating into more shelf space and the ease of storage, greater economies of scale, and efficiency in procurement and inventory management (e.g. Ho (2005) for Hong Kong, (D'Haese and Van Huylenbroeck 2005) for South Africa, Neven et al. (2006) for Kenya, Minten and Reardon (2008) for Madagascar, and Minten et al. (2010) for India). In other words, there is reason to believe that supermarkets have lower costs of production which may translate into lower prices on final goods, and lower prices for specific product attributes. In the context of our research, we will be testing the link between supermarkets and lower prices, i.e., that $\frac{\partial P_Q}{\partial K_s} < 0$, where ∂K_s represents an increase in capital associated with supermarkets. This leads to the first hypothesis.

Hypothesis 1: Modern retail is <u>more</u> price competitive for processed food products than traditional retail

In theory, if products in supermarkets are more price competitive, the associated market value of specific product attributes (P_{Q_i}) should also be more price competitive, i.e., $\frac{\partial P_{Q_i}}{\partial K_s} < 0$ for most i. However, it is not clear how this would be distributed across attributes. For example, it is

possible that supermarkets could be more price competitive in products with nutritional attributes, but not in products with more complex packaging, if products with complex packaging are ubiquitous and acquired by most retail outlets, while products with nutritional attributes are rarer and require specialized procurement channels. This leads to the second hypothesis:

Hypothesis 2: Price premiums for branding, packaging, and nutritional signaling attributes are lower in modern retail outlets than in traditional retail outlets due to their overall price competitiveness.

Price competitiveness and city size

There has been some research in other sectors demonstrating a positive relationship between market size and (1) the average quality of products that are available (in industries where fixed costs determine quality), (2) the range of qualities available (in industries where variable costs determine quality) (Berry and Waldfogel, 2010)[3], (3) the average size of retail outlets in terms of sales and employment, and (4) the dispersion in size of retail outlets (Campbell and Hopenhayn, 2005).

There has also been much discussion on the link between city size and firm productivity. In a recent review of the literature, Combes and Gobillon (2015) find that agglomeration economies for producers have increasing and concave benefits, but also increasing and convex

[3] For (1) they look at the newspaper industry as an example and define three measures of quality: (a) the number of page of the paper, (b) the number of reporters on staff, and (c) the number of Pulitzer Prizes won by the reporters from 1980-1990. For (2) they look at the restaurant industry and define two measures of quality: (a) the number of restaurants given four or five Mobil stars, and (b) Zagat's quality rankings (from local surveys).

costs, leading to a concave bell-shaped net impact on productivity. The growth of smaller cities initially leads to higher productivity due to positive labor and technology externalities, but there are diminishing and potentially negative returns for larger cities due to congestion costs and rising factor prices. The size at which net marginal productivity turns negative depends on sectoral, urban, and country characteristics. For example, the benefits of agglomeration tend to be higher in the service industry than in the manufacturing sector (Melo et al., 2009). If this increasing (or decreasing) productivity is passed-on to consumers, it might imply a lower (higher) price premium for similar products and product attributes.

Basic economic theory suggests that shifts in income will increase demand and thus lead to higher prices for products. But in a city that is much larger, which can lead to positive or negative impact on productivity and prices, and has a higher average income[4], which may lead to higher prices, will the prices for products overall be more or less competitive? To test this, we propose two contradictory hypotheses:

Hypothesis 3a: Price premiums for products in Dar es Salaam are higher than in Arusha, due to a combination of negative returns to city size (population 4+ million in Dar es Salaam vs. < 1 million in Arusha) and the income effect (lower average incomes in Arusha leads to lower prices).

Hypothesis 3b: Price premiums for products in Dar es Salaam are lower than in Arusha, due to increasing returns to city size over and above the income effect (lower average incomes in Arusha leads to lower prices).

[4] As of 2012, GDP per capita in Dar es Salaam was around 1.4 times larger than in Arusha according to the Tanzania Human Development Report for 2014.

Packaging and branding, and nutritional signaling

Lancaster (1966) proposed an approach to consumer theory that assumes that consumers derive utility not from consumption of a set of products *per se*, but instead from their respective attributes. This notion helped lay the groundwork for modern hedonic demand theory dating back to Rosen (1974), who derived market price as a market clearing, "joint-envelope" function P(**z**), where **z** is a vector of product attributes associated with a given product. Quality differentiated attributes that (a) provide a higher utility, and (b) are costlier to produce, are likely to translate into a price premium.

There are multiple examples of this in the literature. An example is the literature on *consumer brand equity*, defined by Keller (1993, pg. 2) as "the differential effect of brand knowledge on consumer response to the marketing of the brand". According to Erdem and Swait (1998, pg. 7), "a clear and credible brand signal creates value to consumers by decreasing both information costs and the risk perceived by the consumer and thus increasing consumer-expected utility." Over time consumers develop a "personal relationship" with certain brands (Fournier, 1998), evincing loyalty and paying a higher price (Leone et al., 2006).

In many developing country food markets, the local packaging and branding of products, as opposed to the sale of undifferentiated commodities or of packaged and branded imports, is a relatively new phenomenon, and appears to mark an important shift in the evolution of the food system (e.g see Pingali (2007) for Asia, or Ijumba et al. (2015) for an example in Africa).

The incipient research that has been done on the emergence of local brands cum packaging suggests that branding and packaging add about 10%-20% of value to the final price.

For example, Minten et al. (2013) estimate a price premium of 11% and 10% for the packaging and branding, respectively, of makhana products in India, while Costello et al. (2013) use experimental auctions in Senegal to estimate a 17% consumer willingness to pay for a preferred locally known branding of rice (assuming identical contents).

There is also tentative evidence that the price premium for specific attributes is higher in cities with a higher income (Vandeplas and Minten, 2015) – tentative because it's based on comparison of only two cities), perhaps because there is a higher willingness to pay for the same amount and type of quality.

Like above for products, the hypothesized effects of the city on the price of specific product attributes depends on the relative impact of city size and consumer income. This leads to the next pair of hypotheses.

Hypothesis 4a: Price premiums for branding, packaging, and nutritional signaling attributes in Dar es Salaam are higher than in Arusha due to a combination of negative returns to city size and the income effect.

Hypothesis 4b: Price premiums for branding, packaging, and nutritional signaling attributes in Dar es Salaam are lower than in Arusha due to increasing returns to city size over and above the income effect.

The interaction of the price competitiveness of modern retail, and city size

So far we have proposed hypotheses separately testing the price competitiveness of products and their attributes across types of retail, and across cities of different characteristics.

We can also ask whether there is an interaction effect between retail type and city type for products. In other words, will the city size effect and income effect described earlier differentially impact the price competitiveness of supermarkets compared to traditional outlets? There seem to be many possibilities:

1. As discussed earlier, lower income consumers often persist in shopping in traditional retail because it is more spatially accessible, among other reasons. This suggests that the higher income effect in Dar es Salaam would fall with a higher proportion on supermarkets, which tend to attract higher income consumers, i.e., the higher income effect (in Dar es Salaam relative to Arusha) decreases supermarket price competitiveness (in Dar es Salaam relative to Arusha).
2. Dolislager (2017) posits that:
    a. city congestion due to city size increases the cost of time of driving to supermarkets, which differentially affects higher income consumers (who own vehicles) and makes supermarket shopping relatively unattractive for them[5], i.e., city size (in Dar es Salaam relative to Arusha) increases supermarket price competitiveness (in Dar es Salaam relative to Arusha) by decreasing the relative income effect from high income consumers on supermarkets.
    b. congestion can increase the value of one-stop shopping (i.e., having most of one's shopping needs in one place), which supermarkets are well placed to provide, but again are probably most accessible to higher income consumers with vehicles, i.e., city size (in Dar es Salaam relative to Arusha) decreases supermarket price

[5] We suggest that this causes a decrease in the demand in supermarkets from high income consumers who normally create an upward pressure (income effect) on price.

competitiveness (in Dar es Salaam relative to Arusha) by increasing the relative income effect on supermarkets.

c. rising cost of land in large cities may hurt the price competitiveness of supermarkets more than traditional retail, where informal vendors are often not paying the explicit cost of land, i.e, a city size cost (in Dar es Salaam relative Arusha) decreases supermarket price competitiveness (in Dar es Salaam relative to Arusha) by increasing the cost of production mostly for supermarkets.

3. Finally, the positive agglomeration effects of city size on productivity would seem to benefit supermarkets the most by increasing their market size and attracting external investors to leverage economies of scale, possibly improving their price competitiveness, i.e,. the city size benefit (in Dar es Salaam relative to Arusha) increases supermarket price competitiveness (in Dar es Salaam relative to Arusha) by increasing their relative economies of scale mainly for supermarkets.

The net impact of the city size and income effect (in Dar es Salaam relative to Arusha) on supermarket competitiveness depends on the relative weights of many different factors (including the ones above). This leads to the final set of conflicting hypotheses:

Hypothesis 5a: Modern retail is most price competitive, compared to traditional retail, for processed food products in Arusha compared to Dar es Salaam, due to a combination of net negative impacts on supermarket price competitiveness from city size and the income effect.

Hypothesis 5b: Modern retail is most price competitive, compared to traditional retail, for processed food products in Dar es Salaam compared to Arusha, due to a combination of net

positive impacts on supermarket price competitiveness from city size, over and above the negative income effect.

Research context and data collection

Research context

Since the market and political reforms of the 1990's, food retail in Tanzania has rapidly modernized. This is evidenced by the rapid penetration of international and national chain supermarkets, mini-supermarkets, and new format retail clusters, coexisting alongside traditional markets and shops (Ichumba et al., 2015). In the food processing sector, there has been a proliferation of micro-, small-, and medium-size food processing firms for basic staples such as rice, maize, other grain, and mixed flour products. Evidence from other countries suggests that the proliferation of micro and small processing firms is only a first stage in food system modernization, and that at some point – with the timing depending on the characteristics of the broader economy as well as the economics of production and consumption in particular sectors - there will be a second stage of industry consolidation into a handful of large and medium size firms (Reardon and Timmer, 2012). For example rapid consolidation occurred in the US food processing sector from the 1950s onward (Sexton, 2000) and the Brazilian dairy processing sector through the 1980s and 1990s (Farina, 2002).

Food system modernization has occurred unevenly across Tanzania. We focus on two cities in particular: Dar es Salaam and Arusha. Dar es Salaam is a rapidly growing coastal mega-city with a current population of around 4.5 million and a higher average GDP per capita. Of the two cities it has undergone the most significant food retail transformation, boasting at least 10

supermarket chains with at least 30 total outlets, and hundreds of mini supermarkets. Arusha has a population of under half a million and is a popular tourist destination with a relatively large middle class. It has a number of semi-national food processing companies that produce flour products with relatively advanced types of packaging (relative to Dar es Salaam) (Ijumba et al., 2015).

The product focus will be on processed maize flour and lishe flour, i.e., mixed flour that is generally perceived to be healthy. These are two products that (a) are found in nearly all retail outlet types, (b) are relatively simple in their processing, but show increasing product differentiation (in terms of packaging, labeling, brand recognition, etc.) and are dominantly produced within Tanzania, and (3) continue to occupy an important part of the Tanzanian diet.

In particular, lishe products have become very popular and are specifically marketed as a nutritional supplement for infants. Furthermore, there are dozens if not hundreds of individual brands competing for market share in a competitive environment (Ijumba et al., 2015). Most of these brands are differentiated not only by the type of packaging and branding, but also by explicit signals of health and nutrition. These include claims about immune system health, improved sight, and removal of toxins from the body. We also test for what we argue are implicit signals of health, such as the presence of nutritional information on the package and the range and number of ingredients.

Data Collection

The data for this paper is based on (a) a survey of retail outlets in Dar es Salaam (April – June, 2016[6]) and Arusha (July – August, 2016). As depicted in Figure 3.1, we conducted a multi-stage sampling strategy of five types of food retail outlets in the two cities. Starting with the most traditional, these types are:

1. non-self-service open air municipal market stalls,
2. small enclosed shops (dukas) located both within and outside of municipal markets that are the most ubiquitous and appear to serve most of the population for most of their food needs,
3. self-service grocery stores (or mini-supermarkets) that together with the larger dukas appear to serve a similar function to the "neighborhood stores" described by Dannhaeuser (1980) in the Philippines as being indicative of an "intermediate stage of development" and early vertical market integration, and
4. large chain and independent supermarkets that have rapidly arisen in Latin America and Asia (Reardon et al., 2003), and have also occurred more recently in some African countries, notably South Africa (Weatherspoon and Reardon, 2003), and countries like Tanzania within the last 10-15 years.

Sampling

In each city, we first conducted a census of all large supermarket outlets, in Dar es Salaam, 29 stores across 14 chains, and in Arusha, 4 stores across 3 chains[7]. Due to difficulties

[6] For a number of the large supermarkets we conducted the product inventoried and observational data collection (not interviews) in later months. One mini supermarket in Dar es Salaam was interviewed in a later month.
[7] 2 of these supermarkets were part of the same local Arusha chain, and the other 2 were part of two separate chains that also have representation in Dar es Salaam

obtaining the full collaboration of managers in many of these large outlets, with few exceptions we conducted "product inventories" rather than full surveys. These inventories established the full range of processed products available among maize meal, other flour, rice, and lishe (mixed "healthy" flour), fruit juice products (including sodas that contained some juice content), and dairy products, and their prices, but did not obtain data on sales and procurement.

For all other retail outlet types, we conducted stratified, multi-stage random sampling[8] of outlets that contained at least one of the following items mentioned above. The sampling consisted of three general stages. Strata were districts, three in Dar es Salaam, and one in Arusha, outlets within markets versus those outside of markets, and outlet types. Sampling steps in Dar es Salaam were as follows (see Figure 3.1):

1. We randomly selected 10 markets in each district.
2. We stratified on outlets within each market by listing all outlets and then conducting a separate random sample[9] of stalls, shops that carried lishe products, and shops that did not carry these products; this step was necessary in order to ensure sufficient lishe observations, as the number of outlets carrying them was relatively small.
3. For all outlets not located within markets, we randomly selected 10 wards in each district.
4. We conducted a census of all mini-supermarkets in each of these wards.

[8] All random sampling at each level was conducted by (1) listing the universe of sampling units, (2) assigning each unit a random number in Microsoft Excel, and (3) sorting and sampling the units with the lowest random numbers until the sample size was reached

[9] Details on sample sizes, etc., can be found in Table 2.2.

5. We randomly selected one Mtaa within each ward[10], listed all shops carrying and not carrying lishe products in these Mtaas, and randomly sampling each type of shop in each mtaa, respectively.

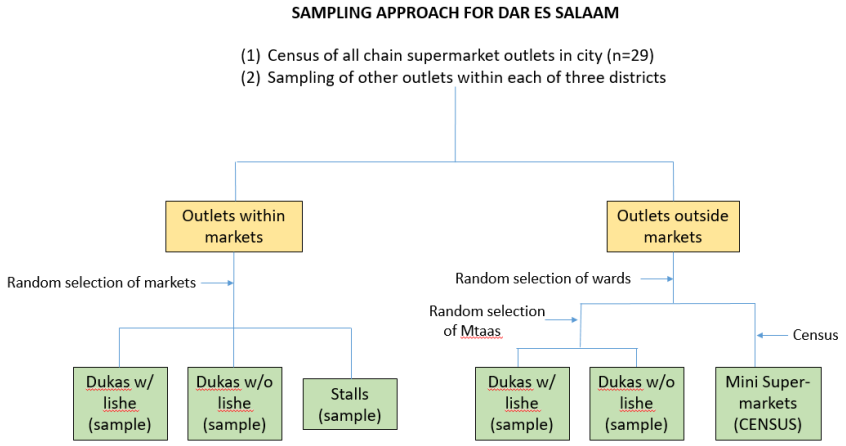

Figure 1. Diagram of multi-stage sampling strategy for food retail outlets in Dar es Salaam

Sampling in Arusha followed a similar approach, with a few exceptions (see Figure 3.2):

1. In all but one market (Kilombero), all outlet types were covered in a census, rather than a sample.
2. In non-markets, traditional outlets were not stratified by store type, but instead by previously listed and newly discovered outlets.

[10] In Dar es Salaam, we first took a sub-sample of 6 wards out of the 10, before taking a sub-sample of mtaas. We did this based on time and cost considerations.

3. The final sample size, and sample sizes per Mtaa, and the total number of sampled Mtaas, varied across cities, due to both the differing number of administrative units in each city, and cost considerations[11].

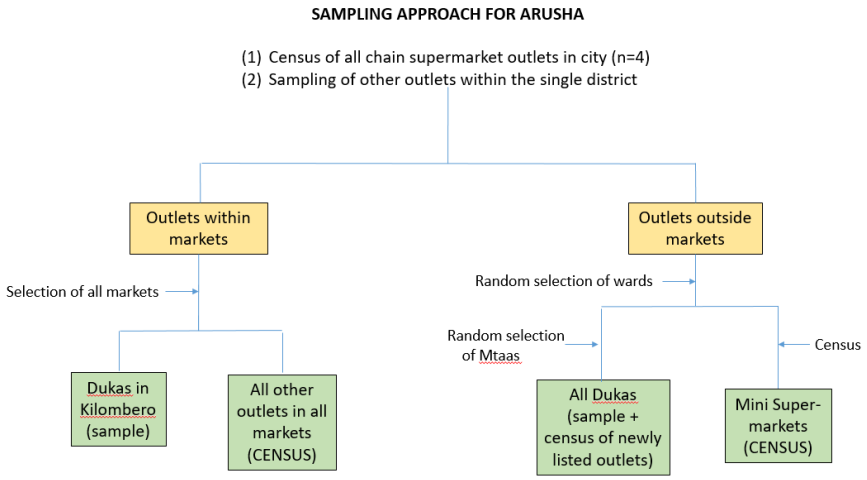

Figure 2. Diagram of multi-stage sampling strategy for food retail outlets in Arusha

Details of the specific sampling strategy, original listing size, final sample size, and estimated population size in the retail survey for each city are shown in Table 1 below[12].

Table 1. Details of retail sampling strategy

City	Market or Non-Market	Sampling cluster	Sampling strategy	Original Listing size	Final Sample size	Estimated population size

[11] Arusha is a much smaller city with many fewer wards and mtaas. We decided to sample one mtaa each from 12 wards (which is 48% of all wards in Arusha) instead of from 18 wards like in Dar es Salaam (which is 18% of all wards in Dar es Salaam), and then take a larger maximum sample within each mtaa.
[12] Also, more information about weighting and stratification can be found in Appendix table 2A.1 (2A.1.1 for Dar es Salaam, and 2A.1.2 for Arusha, respectively)

Dar es Salaam	Market	Shop - Lishe	Attempted full census in each of the 30 sampled sokos	34	30	57
		Shop - non-Lishe	Maximum sample size of 3 outlets in each of the 30 sampled sokos	154	68	224
		Stall	Maximum sample size of 8 outlets in each of the 30 sampled sokos	166	106	260
	Non-market	Shop - Lishe	Maximum sample size of 7 outlets in each of the 18 sampled mtaas	227	106	7349
		Shop - non-Lishe	Maximum sample size of 11 outlets in each of the 18 sampled mtaas	1071	196	37226
		Mini supermarket	Attempted full census in each of the 30 sampled wards	108	95	330
		Large supermarket	Full census, observational data and some partial/full surveys	29	29	29
	Total DES	**All Outlets**		**1789**	**630**	**45475**
Arusha	Market	Shops	Full census (see text for exception)	NA*	108	122
		Stall	Full census	NA	46	46
		Mini supermarket	Mini supermarkets found during survey in sokos	NA	7	7
	Non-market	Shop	Maximum sample size of 30 outlets in each of the 12 sampled mtaas. Census of new outlets discovered	330	278	3409
		Mini supermarket	Attempted full census in each of the 12 sampled wards	70	90**	190
		Large supermarket	Full census, observational data	4	4	4
	Total Arusha	**All Outlets**		**NA**	**533**	**3778**

Notes: Due to small original sample size and large turnover from original listing, most sokos were relisted during survey and complete census was taken. Sample size includes new mini-supermarkets found since the listing

The data was collected using tablet questionnaires, translated into the Swahili language, with questions asked by trained local enumerators eliciting verbal responses. The tablet questionnaires were iteratively pretested in the office and in the field by a subset of the enumerators to make sure that (a) they worked properly, (b) the Swahili translations corresponded with the intended meaning, and (c) the questions themselves were intelligible. All

of the enumerators were then trained on the proper use of the tablets and they assisted in the further refinement of the questionnaire, testing in both the office and in the field.

Empirical Specification

Hedonic approach

Methods for measuring the marginal value of specific food product characteristics can be categorized into stated preference and revealed preference approaches. Stated preference approaches can involve the use of choice experiments, which are designed to elicit willingness to pay for product attributes, or experimental auctions, which are designed to mimic a market scenario to see how consumers will behave under alternative conditions. Both methods are especially suited to estimate the potential value of product attributes that are not yet available on the market.

Revealed preference approaches – those that analyze actual market behavior using observational data - fall under two categories: structural and reduced form. Structural approaches estimate a system of demand and supply equations and then run counterfactual scenarios to isolate the value of specific features. For example Goldfarb et al. (2009) used this approach to estimate the value of specific breakfast cereal brands after controlling for other attributes. Structural approaches are difficult to implement with cross sectional data or with data that lacks detailed information on consumer level characteristics. Alternatively, we opt to use the hedonic method, a reduced form approach that estimates the determinants of market price.

The derivation of the hedonic function assumes that the consumer chooses x, defined as all other products, and **z**, a vector of product attributes for a particular product**,** in order to maximize their concave utility function U(x, **z**) subject to a budget constraint: I = x + p(**z**). From the first order conditions the following relationship is derived: $\frac{du/_{dz_i}}{du/_{dx}} = \frac{dp}{dz_i}$ for all *i = 1..,n*, equating the marginal value of the attribute (p_i) to the marginal rate of substitution (MRS) between that attribute and the composite of all other products. The set of indifference curves for different sets of attributes traces out a consumer's "bid" function, B(**z**, u, I) which defines their maximum willingness to pay for different attribute sets for a given level of utility (u) and income.

The supplier (retailer in this case, whose selling is the "production") similarly chooses the amount of **z** to maximize the following profit function: $\pi = Qp(\mathbf{z}) - C(Q, \mathbf{z})$, yielding the first order condition: $\frac{dp}{dz_i} = \frac{dC/_{dz_i}}{Q}$ for all *i = 1…n*, relating the market value and the marginal cost of producing each attribute of **z.** Similar to the consumer case, the set of indifference curves traces out their "offer" curve $O(\mathbf{z}, \pi)$ – the minimum willingness to accept for the provision of z given a set level of profit.

Finally, the joint-envelope function that relates the price of a good to its set of attributes, traces out the market equilibrium set of intersections between all of the consumer bid functions and producer offer functions, thereby uncovering the implicit marginal price of each individual product attribute. This model can be extended to account for the choice among multiple products each with a distinct attribute set (Ladd and Suvannunt, 1976).

Empirical model

We adapt the semi-log hedonic model (Diewert, 2003). In its most general form Let *s* denote each product found in each particular retail outlet (this assumes that identical products can have different prices in different outlets) such that *s = 1…S*, let N denote the entire set of attributes to be estimated in the model:

$$\text{Log}(P_s) = \alpha_0 + \sum_{n=1}^{N} \beta_n \, z_{ns} + £City + \delta SuperMkt \qquad (4)$$

$$s = 1 \ldots S$$

where P_s is the price per kilogram of each product found in each particular retail outlet, z_{ns} is a vector of product and store attributes of each product, *City* is a city dummy variable (equal to 1 if located in Dar es Salaam), $SuperMkt$ is a supermarket dummy variable, equal to 1 if the product is within a supermarket, ε_s is the error term, and β_n, £, and δ are coefficients to be estimated in each model. Note that the coefficients can be interpreted as the percentage change in total price due to the presence of the corresponding product, locational, or retail type attribute.

We choose this functional form for a number of reasons. First, the log-log variation of the model cannot account for attribute levels of zero, and the linear variation is actually non-linear in parameters or else its linear approximation is difficult to justify according to microeconomic theory (Diewert, 2003). The semi-log model avoids both problems and allows for a non-linear relationship between product attributes and price, or a constant relationship between product attributes and the proportional change in price.

For the purposes of hypothesis testing, we (a) run a pooled regression and estimate key coefficients, and (b) run a series of non-pooled regressions and perform F-tests of the difference of coefficients between groups. For each regression we also control for package size, and for

heteroscedasticity in the error terms using a clustered standard error. Table 2 lists the test for each hypothesis, and Table 3 gives information for each of the variables used in the models.

Table 2. Hypothesis testing

Hypothesis	Description of test	Hypothesis test
Hypothesis 1: Modern retail is more price competitive for processed food products.	Pooled regression.	$\delta < 0$
Hypothesis 2: Price premiums for branding, packaging, and nutritional signaling attributes are lower in modern retail outlets due to their overall price competitiveness.	Separate regressions in supermarkets (sup) and non-supermarkets (trad). F-test of differences between coefficients.	$\beta_n(sup) < \beta_n\ (trad)$ For each n
Hypothesis 3a: Price premiums for products in Dar es Salaam are <u>higher</u> than in Arusha, due to a combination of negative returns to city size and the income effect (lower average incomes in Arusha leads to lower prices).	Separate regressions in Dar es Salaam and Arusha. F-test of differences between coefficients.	$£ > 0$
Hypothesis 3b: Price premiums for products in Dar es Salaam are <u>lower</u> than in Arusha, due to increasing returns to city size over and above the income effect (lower average incomes in Arusha leads to lower prices).	Pooled regression.	$£ < 0$
Hypothesis 4a: Price premiums for branding, packaging, and nutritional signaling attributes in Dar es Salaam are <u>higher</u> than in Arusha due to a combination of negative returns to city size and the income effect.	Separate regressions in Dar es Salaam and Arusha. F-test of differences between coefficients.	$\beta_n(DES) > \beta_n\ (Arusha)$ For each n
Hypothesis 4b: Price premiums for branding, packaging, and nutritional signaling attributes in Dar es Salaam are <u>lower</u> than in Arusha due to increasing returns to city size over and above the income effect.	*Same as above.	$\beta_n(DES) < \beta_n\ (Arusha)$ For each n
Hypothesis 5a: Modern retail is most price competitive, compared to traditional retail, for processed food products in Arusha compared to Dar es Salaam, due to a combination of net negative impacts on supermarket price competitiveness from city size and the income effect.	*Same as above.	$\delta(DES) > \delta\ (Arusha)$
Hypothesis 5b: Modern retail is most price competitive, compared to traditional retail, for processed food products in Dar es Salaam compared to Arusha, due to a combination of net positive impacts on supermarket price competitiveness from city size, over and above the negative income effect.	*Same as above.	$\delta(DES) < \delta\ (Arusha)$

Table 3. Product, store attributes, city, and retail type for both product types

Grouping category	Variable Name	Model	Variable Type	Notes
Retail Type	Mini supermarkets	Both	Dummy (0,1)	1 indicates product is found in mini supermarket. Mini supermarkets are defined as being relatively small, but self-service. They are categorized as "modern retail"
	Large supermarkets	Both	Dummy (0,1)	1 indicates product is found in large supermarket. Large supermarkets are defined as chains and relatively large independent supermarkets. They are categorized as "modern retail"
	All supermarkets	Both	Dummy (0,1)	1 indicates product is found in a mini or large supermarket. Grouped as "All" in non-pooled regression comparing across cities (due to few observations in Arusha)
City designation	Dar es Salaam	Both	Dummy (0,1)	1 indicates product is found in Dar es Salaam
Label attributes	Health claim	Both	Dummy (0,1)	1 indicates vague or explicit health claim on the package (e.g. "highly nutritious" or "improved sight")
	Health information	Both	Dummy (0,1)	1 indicates nutrition information (like calories, protein, nutrients) visible on the package
Product attributes	Whole grain flour (dona)	Maize flour	Dummy (0,1)	1 indicates that it is whole grain maize flour, not highly refined flour
	Number of ingredients	Lishe flour	Integer	The number of major ingredients that are contained in the lishe flour (e.g., millet, soy, peanuts, carrot)
	Contains animal products	Lishe flour	Dummy (0,1)	1 indicates that it contains at least one animal product, such as milk or fish powder
	Contains produce	Lishe flour	Dummy (0,1)	1 indicates that it contains at least one fruit or vegetable
	Contains nuts	Lishe flour	Dummy (0,1)	1 indicates that it contains at least one type of nut
	Contains legumes	Lishe flour	Dummy (0,1)	1 indicates that it contains at least one type of legume
Packaging attributes	Poly-sack packaging	Maize flour	Dummy (0,1)	1 indicates that the product has poly-sack packaging
	Clear plastic packaging	Maize flour	Dummy (0,1)	1 indicates that the product has clear plastic packaging
	Color plastic NZ packaging	Both	Dummy (0,1)	1 indicates that the product has colored plastic (excluding ziplock) packaging

Table 3. (cont'd)

Grouping category	Variable Name	Model	Variable Type	Notes
	Paper bag	Both	Dummy (0,1)	1 indicates that the product has paper bag packaging
	Other packaging ZL	Both	Dummy (0,1)	1 indicates that the product has all other packaging (including colored plastic with ziplock
	Other packaging Cpa	Maize flour	Dummy (0,1)	1 indicates that the product has other packaging (including colored plastic and paper bag). Note this is a different grouping of "other packaging" which is used when sample size necessitates.
Brands	Major brand	Both	Dummy (0,1)	1 indicates that the firm has 10 – 74 maize, lishe, or other flour products in the sample (across both cities)
	Top brand	Both	Dummy (0,1)	1 indicates that the firm has greater than 75 maize, lishe, or other flour products in the sample (across both cities)
	Top or major brand	Maize flour	Dummy (0,1)	1 indicates that the firm has greater than 10 maize, lishe, or other flour products in the sample (across both cities)
Store level attributes	Outlet size (100 sq meters)	Both	Continuous	The size of the outlet in 100s of square meters
	Has parking	Both	Dummy (0,1)	1 indicates that the outlet has parking available
	Has annex services	Both	Dummy (0,1)	1 indicates that the outlet contains annex services linked with/within the outlet such as an eating area attached to outlet, ATM machine/bank, cell phone banking services (e.g. MPESA, TIGO)
	Number of cash registers	Both	Integer	Integer variable indicating the number of mechanical cash registers
Package size (control)	Size of package (if packaged) (kgs)	Both	Continuous	Size of the package in kgs (if packaged)

Results

Table 4 displays the share of maize product attributes by city and retail outlet type. There are interesting distinctions both across cities and across retail outlet types. Across cities, mini supermarkets in Arusha tend to carry products that have more value added than Dar es Salaam. There are three examples of this. First, 35% and 32% of products in mini supermarkets of Arusha

make a health claim and contain nutrition information on the package, respectively, while in Dar es Salaam only 8% and 6% do the same. Second, the packaging in mini supermarkets in Arusha is more "complex" – only 31% of products are sold loose or packaged in polypropylene sacks or clear plastic, while in Dar es Salaam 95% of products are packaged in this way. Third, the products sold in Arusha mini supermarkets tend to be a major or top brand (93%), while this is not the case in Dar es Salaam (only 27%). On the other hand, mini supermarkets in Dar es Salaam carry a higher share of whole grain (dona) flour, 45% compared to only 11% in Arusha. This aligns with the discussion in Ijumba et al. (2015) that in Dar es Salaam but not Arusha, there has been a resurgence of interest among consumers in healthier eating via the purchase of whole grain maize flour.

Across outlet types, there is a large difference in the types of product attributes found in traditional markets compared to supermarkets, and, in Dar es Salaam, a large difference between mini and large supermarkets. First, products in traditional markets are predominantly sold loose, while this is rare in supermarkets. Second, in Dar es Salaam, there is a clear differentiation in the "complexity" of packaging type between mini and large supermarkets – mini supermarkets predominantly carry products packaged in polypropylene sacks (76%), while large supermarkets are much more likely to carry products packaged in clear plastic, colored plastic, and paper bags (26%, 40%, and 23%). Moreover, a larger share of products in large supermarkets of Dar es Salaam make health claims (40% compared to 8%), have nutrition information (24% compared to 6%), and are a major or top brand (74% compared to 27%).

Traditional retail shows little difference in product attributes across the two cities. In each city, traditional retail is dominated by minor brands sold loose and thus featuring no health claims.

Table 4. Maize flour – attributes weighted frequency of occurrence

	DES			Arusha		
	Large supermarket	Mini supermarket	Traditional retail	Large supermarket	Mini supermarket	Traditional retail
# of sample observations	104	112	768	15	116	562
Estimated total # of observations	104	388	69560	15	236	4824
Label attributes (%)						
Health claim	40	8	5	0	35	2
Health information	24	6	0	33	32	2
Product attributes (%)						
Highly refined (sembe)	57	55	71	100	89	64
Whole grain flour (dona)	43	45	29	0	11	36
Total (%)	**100**	**100**	**100**	**100**	**100**	**100**
Packaging attributes (%)						
Sold loose	3	9	85	0	2	91
Poly-sack packaging	5	76	15	7	22	3
Clear plastic packaging	26	10	0	47	7	1
Color plastic NZ packaging	40	1	0	0	38	3
Paper bag	23	1	0	40	16	1
Other packaging ZL	3	4	0	7	15	1
Total packaging (%)	**100**	**100**	**100**	**100**	**100**	**100**
Brands (%)						
Minor brand	26	73	80	40	7	91
Major brand	54	27	20	20	28	2
Top brand	20	0	0	40	65	6
Total brands (%)	**100**	**100**	**100**	**100**	**100**	**100**
Store level attributes*						
Outlet size (sq meters)	3732	70	15	2523	526	19
Has parking (%)	88	52	1	100	34	3
Has annex services (%)	71	30	8	100	27	11
Number of cash registers	5.1	0.1	0.0	7.8	0.4	0.0

Notes: to make consistent with hedonic regression model, outlet characteristics averaged across all products, i.e, there is an implicit weighting by number of products. Not all observations have data for all attributes. There are very few observations for Arusha large supermarkets, and so the results are greyed out and will not be used for interpretation

Table 5 displays the share of lishe product attributes by city and retail outlet type. One major difference from the maize flour products is that across all retail types and both cities, most product are sold packaged. In Dar es Salaam most products are packaged in clear plastic or paper

bags (for clear plastic, 31% in traditional markets, 48% in mini supermarkets, and 25% in large supermarkets, while for paper bags, it is 55%, 36%, and 45%, respectively). In Arusha on the other hand, the majority of products are sold in paper bags only (73% in traditional retail, and 85% in mini supermarkets).

Across retail outlet types in both cities, traditional retail markets have a higher share of top brands than do supermarkets, however this is not the case for major brands. For example, in Dar es Salaam, 57% of products in traditional markets are a top brand, while in mini supermarkets it is only 28% and in large supermarkets it is 38%. In both cities, products in traditional markets are less likely to make a health claim than products in supermarkets (e.g. in Dar es Salaam, 42% for traditional retail, 55% for mini supermarkets, and 81% for large supermarkets). In Dar es Salaam, traditional retail outlets tend to have more lishe products that contain nutrition information, while in Arusha it is just the opposite.

Table 5. Lishe flour – attributes weighted frequency of occurrence

	DES			Arusha		
	Large supermarket	**Mini supermarket**	**Traditional retail**	**Large supermarket**	**Mini supermarket**	**Traditional retail**
# of observations	95	175	76	21	158	**126**
Population weighted # of observations	95	607	2704	21	317	**686**
Label attributes (%)						
Health claim	81	55	42	62	50	43
Health information	61	80	84	95	85	75
Product attributes (%)						
Number of ingredients	4.5	4.7	4.5	4.9	5.6	5.3
Contains animal products	4	3	6	10	4	9
Contains produce	7	17	6	19	29	33
Contains nuts	47	69	71	33	58	62
Contains legumes	58	52	37	76	72	55

Packaging attributes (%)						
Sold loose	1	0	10	0	0	12
Poly-sack packaging	0	1	2	0	0	0
Clear plastic packaging	25	48	31	0	2	4
Color plastic NZ packaging	17	5	0	5	7	2
Paper bag	45	36	55	76	85	73
Other packaging ZL	12	11	1	19	6	9
Total packaging (%)	**100**	**100**	**100**	**100**	**100**	**100**
Brands (%)						
Minor brand	32	52	30	38	29	28
Major brand	31	20	12	24	33	21
Top brand	38	28	57	38	38	52
Total brands (%)	**100**	**100**	**100**	**100**	**100**	**100**
Store level attributes*						
Outlet size (sq meters)	2328	56	19	2983	317	25
Has parking (%)	89	49	7	100	25	1
Has annex services (%)	71	25	4	100	30	24
Number of cash registers (#)	3.3	0.1	0.0	3.0	0.2	3.2

Notes: To make consistent with hedonic regression model, outlet characteristics averaged across all products, i.e, there is an implicit weighting by number of products. Not all observations have data for all attributes. There are very few observations for Arusha large supermarkets, and so the results are greyed out and will not be used for interpretation

In Table 6 we test the first hypothesis that "modern retail" is more price competitive for processed food products. To do this, we decompose modern retail into two types, mini supermarkets and large supermarkets, and test whether the respective coefficients are significantly negative, i.e., whether $\delta < 0$ from the general model above. Our results do not support the hypothesis. First, starting with the pooled maize flour model, we find that, after controlling for product and store attributes, maize flour products in mini supermarkets are 9.3% more expensive than in traditional markets, and large supermarkets are 23.1% more expensive. Second, In the pooled lishe flour model, the coefficients are not statistically significant, suggesting that supermarkets do not influence the prices of these products.

There is another interesting observation from Table 6[13]. First, we would expect there to be a price premium for packaging and labeling attributes. And indeed, in the maize flour model, this is born out. For labeling, there being a health claim and health information on the package yield a 1.8% and 3.6% premium, respectively. Relative to the product sold loose, poly-sack packaging, clear plastic packaging, colored plastic packaging (without a ziplock), paper bags, and other packaging yield 3.9%, 39%, 28.2%, 20.1% and 39%, respectively. Apart from poly-sack packaging (which is ubiquitous within Tanzania), these premiums are higher than the 10%-20% price premium range for packaging that we discussed above.

However, in the lishe flour model, there is not a consistent premium for these attributes. There is not a significant difference in price for the health claim and health information attributes, and colored plastic (without ziplock) is the only type of packaging, relative to product sold loose, clear plastic, and poly-sack packaging[14], that has a positive and significant price premium, of 25.5%. Paper bag packaging and other packaging carry significantly negative premiums of 11.7% and 13.7%, respectively. On the other hand, counter to the maize flour model, there is a significant price premium of 8.1**%** and 11.5% for major and top brands, respectively.

In table 6 we also test hypothesis 3a and 3b and find that the prices in Dar es Salaam are around 16-17% higher than in Arusha. This confirms hypothesis 3a and suggests that, overall, the higher price impact of the productivity costs of city size and the income effect outweigh the lower price impact of the productivity benefits of city size.

[13] Note, below we will discuss the city price premium and the negative premium for whole grain maize flour when comparing across cities.
[14] These "less complex" types of packaging were lumped together into the default due to their low product occurrence rates.

Table 6. Pooled hedonic regression models

	Maize flour model	Lishe flour model
Mini supermarkets	0.093***	0.011
	(0.02)	(0.04)
Large supermarkets	0.231***	0.047
	(0.02)	(0.06)
Dar es Salaam	0.165***	0.160***
	(0.02)	(0.03)
Health claim	0.018***	-0.027
	(0.01)	(0.03)
Health information	0.036**	-0.030
	(0.02)	(0.04)
Whole grain flour (dona)	-0.023***	--
	(0.01)	--
Poly-Sack	0.039**	--
	(0.02)	--
Clear plastic packaging	0.390***	--
	(0.04)	--
Number of ingredients	--	-0.022**
	--	(0.01)
Contains animal products	--	0.114
	--	(0.07)
Contains produce	--	0.105**
	--	(0.05)
Contains nuts	--	-0.028
	--	(0.04)
Contains legumes	--	0.027
	--	(0.03)
Color plastic NZ packaging	0.282***	0.255***
	(0.02)	(0.05)
Paper bag	0.201***	-0.117***
	(0.03)	(0.03)
Other packaging ZL	0.390***	-0.137***
	(0.05)	(0.05)
Major brand	0.012	0.081*
	(0.01)	(0.05)
Top brand	0.017	0.115**
	(0.02)	(0.05)

Notes: p<0.10, ** p<0.05, *** p<.01. For presentation purposes, store level attributes included in analysis, but excluded from table. The dependent variable is log[price/kg]

In Tables 7 and 8, for maize flour products and lishe flour products, respectively, we test the second hypothesis that price premiums for branding, packaging, and nutritional signaling attributes are lower in modern retail outlets due to their overall price competitiveness. To do this, we ran separate models in supermarkets - with mini supermarkets and large supermarkets pooled together - and traditional outlets, using the same set of variables, and then conducted F-tests of differences between each of the coefficients. Analogous to first hypothesis, the results largely do not confirm the second hypothesis for labeling and packaging attributes, but they do for top brands.

First, there is no significant difference in the price of labeling attributes in either the maize flour or the lishe flour model. Second, while packaging attributes contribute to a positive price premium for maize flour products in both supermarkets and traditional outlets, the premium is significantly higher in supermarkets, except for paper bag packaging; the difference is not significant, i.e., they are more expensive[15]. In the lishe flour model, paper bags and other packaging types grouped together mainly carry a negative premium in both outlet types and are significantly more negative in traditional markets, i.e., again more expensive in supermarkets. However, colored plastic carries a positive premium in both cities, and this premium is significantly lower in supermarkets.

Third, while there is no consistent premium for major brands and top brands in supermarkets, there is a 6.8% premium for top maize brands and a 16.8% premium for top lishe

[15] As a robustness check, we the same maize flour model, but group color plastic packaging, paper bag packaging, and other packaging into one category (Appendix Table 3A.3). We do this do to the relative low number of observations of these packaging types in the traditional retail sector. We get the same general result that packaging is relatively more expensive in supermarkets than in traditional retail outlets.

brands in traditional retail outlets. Moreover, top brands, holding all else constant, are significantly less expensive in supermarkets for both types of products.

Finally, for lishe products, there is not a consistent relationship between ingredients and supermarket price competitiveness. More ingredients decrease the premium in both supermarkets and traditional outlets, but this decrease is significantly less pronounced in supermarkets, a decrease of 1.5% in supermarkets compared to a decrease of 4.1% in traditional outlets, i.e., ingredients are more expensive in supermarkets. The animal products ingredient (dairy or meat) also carries a higher price premium in supermarkets. On the other hand, produce ingredients (fruits and vegetables) carry a lower price premium, i.e., are less expensive in supermarkets.

Table 7. Hedonic maize flour models – supermarket vs. traditional retail

	Non-pooled coefficients		F - Test	
	Supermarket model	Traditional retail model	F	Prob > F
Dar es Salaam	0.222***	0.165***	2.54	0.1147
	(0.03)	(0.02)		
Health claim	0.018	0.019***	0.00	0.9859
	(0.03)	(0.00)		
Health information	0.097**	0.023	2.38	0.1262
	(0.05)	(0.01)		
Whole grain flour (dona)	0.003	-0.023***	2.13	0.1476
	(0.02)	(0.01)		
PolySack	0.147***	0.037**	7.52	**0.0074**
	(0.03)	(0.02)		
Clear plastic packaging	0.508***	0.322***	7.41	**0.0078**
	(0.07)	(0.02)		
Color plastic NZ packaging	0.362***	0.268***	2.79	**0.0985**
	(0.05)	(0.02)		
Paper bag	0.305***	0.161**	2.35	0.1288
	(0.06)	(0.07)		
Other packaging ZL	0.528***	0.317***	4.60	**0.0348**
	(0.11)	(0.02)		
Major brand	0.048	0.011	0.57	0.4532
	(0.05)	(0.01)		
Top brand	-0.026	0.068***	6.11	**0.0154**

	(0.04)	(0.01)		
Outlet size (100 sq meters)	0.002*	0.008	0.20	0.6565
	(0.00)	(0.01)		
Has parking	-0.020	0.002	1.10	0.2966
	(0.02)	(0.01)		
Has annex services	-0.015	-0.009	0.06	0.8067
	(0.03)	(0.01)		
Number of cash registers	0.005	0.020	0.92	0.3400
	(0.01)	(0.01)		
Size of package (kgs)	-0.013***	-0.006***	8.78	**0.0039**
	(0.00)	(0.00)		

Notes: p<0.10, ** p<0.05, *** p<.01. The dependent variable is log[price/kg]. The significant results from the F-Test are in bold. The size of package assumes that it is a packaged product.

Table 8. Hedonic lishe flour models – supermarket vs. traditional retail

	Non-pooled coefficients		F - Test	
	Supermarket model	Traditional retail model	F	Prob > F
Dar es Salaam	0.174***	0.145**	0.26	0.612
	(0.03)	(0.05)		
Health claim	0.047***	0.002	1.1	0.2991
	(0.02)	(0.03)		
Health information	0.004	-0.102	2.55	0.1152
	(0.02)	(0.06)		
Number of ingredients	-0.015**	-0.041***	4.23	**0.0436**
	(0.01)	(0.01)		
Contains animal products	0.180***	-0.051	4.9	**0.0303**
	(0.06)	(0.09)		
Contains produce	0.048*	0.217***	5.79	**0.0189**
	(0.02)	(0.07)		
Contains nuts	-0.011	-0.096	2.26	0.1372
	(0.01)	(0.06)		
Contains legumes	0.030*	0.042	0.12	0.7289
	(0.02)	(0.03)		
Color plastic NZ packaging	0.245***	0.365***	1.39	0.2433
	(0.06)	(0.08)		
Paper bag	-0.048*	-0.213***	7.63	**0.0074**
	(0.03)	(0.06)		
Other packaging ZL	-0.037	-0.307***	8.02	**0.0061**
	(0.05)	(0.08)		
Major brand	-0.011	-0.017	0.01	0.9223

	(0.02)	(0.04)		
Top brand	0.024	0.168**	4.26	**0.0429**
	(0.02)	(0.07)		
Outlet size (100 sq meters)	0.000	0.039	0.47	0.496
	(0.00)	(0.06)		
Has parking	0.049**	0.506***	49.46	**0.000**
	(0.02)	(0.06)		
Has annex services	-0.011	-0.163	2.1	0.1519
	(0.02)	(0.10)		
Number of cash registers	-0.003	-0.085**	4.47	**0.0381**
	(0.00)	(0.04)		
Size of package (kgs)	-0.470***	0.172**	29.63	**0.000**
	(0.10)	(0.07)		

Notes: p<0.10, ** p<0.05, *** p<.01. The dependent variable is log[price/kg]. The significant results from the F-Test are in bold. The size of package assumes that it is a packaged product.

In Tables 10 and 11, for maize flour products and lishe flour products, respectively, we test the remaining hypotheses by running separate models in Dar es Salaam and Arusha, and then conducting F-tests of differences between each of the coefficients.

The fourth hypothesis tests whether price premiums for branding, packaging, and nutritional signaling attributes are higher in Dar es Salaam (hypothesis 4a), or higher in Arusha (hypothesis 4b), depending again on the same considerations as in hypotheses 3a and 3b. Like above, the results for labeling and packaging appear to slightly support the former hypothesis, that overall higher incomes in combination with a diminishing or negative city size effect leads to higher prices in Dar es Salaam. First, there is no significant difference in the price of labeling attributes across cities in the maize flour model, but in the lishe flour model, health information carries a significantly higher premium in Dar es Salaam. Second, most packaging attributes have a significantly higher premium in Dar es Salaam for maize flour products, except for poly-sack packaging. They are not significantly different across cities for lishe flour products, except for color plastic packaging, which carries a significantly higher price premium in Arusha.

Arusha has a significantly higher premium for both major and top maize flour brands, but a lower premium for major brands for lishe, and not significantly different for top brands. This may also suggest something about consumer attitudes in each city. Table 9 shows the mean number of brands per store (in stores that have that product type) for both maize and lishe flour. While both cities have a similar number of minor brands per store for each product, major brands have a relatively lower premium in the city where they are most common. This may suggest that consumers place a higher value on novelty, i.e., are less willing to pay a premium for products that they are more familiar with. However, this pattern doesn't hold up for top maize brands.

Table 3.9. Mean brands per food retail outlet

Type of flour	City	Minor brand	Major brand	Top brand	All brands
Maize	Dar es Salaam	1.34	0.34	0.00	1.69
	Arusha	1.41	0.06	0.15	1.62
Lishe	Dar es Salaam	0.41	0.17	0.61	1.18
	Arusha	0.41	0.35	0.67	1.44

The fifth hypothesis tests whether modern retail is the most price competitive for processed food products in Arusha (hypothesis 5a) or alternatively in Dar es Salaam (hypothesis 5b), depending on (respectively) whether the city size effect in combination with a the income effect has a net negative impact on supermarket price competitiveness, or if the city size effect has a positive impact on supermarket price competitiveness over and above the income effect, respectively.[16] The initial results do not support either effect. For both maize flour and lishe, the price premium of products in supermarkets is not significantly different between Dar es Salaam and Arusha. However, as a further investigation, in the Appendix Tables A.1 and A.2) we show

[16] Note, unlike in table 6, we group mini supermarkets and large supermarkets together because the number of large supermarkets in Arusha is very small (there were only four in total).

the results of the same models but excluding large supermarket observations. This is arguably justified because of the small number of large supermarkets in Arusha, and therefore excluding them is a more direct comparison. Here we find that the mini supermarket price premium for maize flour is significantly higher in Dar es Salaam. This suggests that Arusha is more price competitive for supermarkets due to a negative city size effect on price competitiveness in combination with a higher income effect on price competitiveness in Dar es Salaam compared to Arusha. However, like before, the difference is not significant for lishe flour.

Table 10. Hedonic maize flour models – Dar es Salaam vs. Arusha

	Non-pooled coefficients		F - Test	
	Dar es Salaam model	Arusha model	F	Prob > F
All supermarkets	0.079***	0.038**	2.31	0.1321
	(0.02)	(0.02)		
Health claim	0.015***	0.038***	2.73	0.1019
	(0.01)	(0.01)		
Health information	0.008	0.045***	2.26	0.1362
	(0.02)	(0.02)		
Whole grain flour (dona)	-0.015***	-0.117***	92.74	**0.0000**
	(0.01)	(0.01)		
PolySack	0.038**	0.083***	3.16	**0.0790**
	(0.02)	(0.02)		
Clear plastic packaging	0.507***	0.265***	11.68	**0.0010**
	(0.07)	(0.02)		
Color plastic NZ packaging	0.367***	0.215***	13.79	**0.0004**
	(0.04)	(0.02)		
Paper bag	0.327***	0.199***	3.71	**0.0574**
	(0.04)	(0.05)		
Other packaging ZL	0.875***	0.242***	9.41	**0.0029**
	(0.21)	(0.02)		
Major brand	0.012	0.070***	5.40	**0.0224**
	(0.01)	(0.02)		
Top brand	-0.109*	0.062***	8.92	**0.0036**
	(0.06)	(0.01)		

Outlet size (100 sq meters)	-0.002	0.005***	9.82	**0.0023**
	(0.00)	(0.00)		
Has parking	0.000	0.001	0.00	0.9730
	(0.02)	(0.02)		
Has annex services	-0.007	-0.009	0.01	9.266
	(0.01)	(0.01)		
Number of cash registers	0.035**	-0.000	4.07	**0.0467**
	(0.02)	(0.00)		
Size of package (if packaged) (kgs)	-0.005***	-0.011***	6.81	**0.0106**
	(0.00)	(0.00)		

Notes: p<0.10, ** p<0.05, *** p<.01. The dependent variable is log[price/kg]. The significant results from the F-Test are in bold. The size of package assumes that it is a packaged product.

Table 11. Hedonic lishe flour models – Dar es Salaam vs. Arusha

	Non-pooled coefficients		F - Test	
	Dar es Salaam model	Arusha model	F	Prob > F
All supermarkets	0.119***	0.016	0.00	0.9772
	(0.04)	(0.03)		
Health claim	0.101***	0.019	0.41	0.5218
	(0.03)	(0.03)		
Health information	0.001	-0.106**	7.32	**0.0086**
	(0.03)	(0.05)		
Number of ingredients	-0.002	-0.018	1.64	0.2042
	(0.01)	(0.01)		
Contains animal products	0.204***	-0.045	10.78	**0.0016**
	(0.08)	(0.07)		
Contains produce	0.058	0.065	0..07	0.7878
	(0.05)	(0.04)		
Contains nuts	-0.017	-0.070*	0.70	0.4043
	(0.03)	(0.04)		
Contains legumes	0.039	0.058*	2.27	0.1368
	(0.03)	(0.03)		
Color plastic NZ packaging	0.180***	0.554***	6.18	**0.0154**
	(0.06)	(0.10)		
Paper bag	-0.041	-0.020	0.02	0.8917
	(0.04)	(0.08)		
Other packaging ZL	-0.008	0.060	0.09	0.7608
	(0.04)	(0.09)		
Major brand	0.039	-0.135***	10.9	**0.0015**
	(0.03)	(0.04)		

Top brand	0.077*	-0.024	2.15	0.1470
	(0.04)	(0.04)		
Outlet size (100 sq meters)	-0.002	0.004**	20.15	**0.0000**
	(0.00)	(0.00)		
Has parking	0.016	0.068*	2.86	**0.0954**
	(0.03)	(0.04)		
Has annex services	-0.011	0.014	3.00	**0.0878**
	(0.03)	(0.03)		
Number of cash registers	0.006	0.000	1.22	0.2740
	(0.01)	(0.01)		
Size of package (kgs)	-0.131**	-0.366***	0.06	0.8117
	(0.05)	(0.09)		

Notes: p<0.10, ** p<0.05, *** p<.01. The dependent variable is log[price/kg]. The significant results from the F-Test are in bold. The size of package assumes that it is a packaged product.

Finally, it is worth noting the results for whole grain maize flour (dona flour): (a) dona flour carries an overall negative price premium of 2.3% (Table 6); (b) this premium is negative and significant in traditional retail but not in supermarkets (although the difference between the two groups is not significant) (Table 7), and (c) the negative premium is significantly more negative in Arusha than it is in Dar es Salaam (11.7% compared to 1.5%, respectively)[17]. We will discuss possible interpretations of this in the discussion section.

Conclusion

In addition to providing another case study on the development and price competitiveness of modern food retail in developing countries, this study fills three specific gaps in the food system and development literature: (1) it adds to the previous literature in Sub-Saharan Africa on

[17] These results should be interpreted with some caution because the majority of dona observations in Arusha occur in traditional retail outlets (dona only accounts for 11 percent of flour products in mini supermarkets and is not found in large supermarkets) (table 4).

the hedonic price of processed product attributes by extending the domain of study beyond rice to include maize flour and mixed flour products; (2) it is the first study to explicitly compare the value of processed food attributes across cities of different sizes; and (3) it is the first study to our knowledge that evaluates the hedonic value in processed foods of health signals in a developing country context. Five results stand out.

First, our results do not confirm the first hypothesis that supermarkets in general are more price competitive than traditional retail in these products. They also do not confirm the portions of the second hypothesis that supermarkets are price competitive regarding specific product attributes such as labeling and packaging. However, they do confirm from the second hypothesis that top brands of both maize flour and lishe flour, controlling for other attributes, are more price competitive in supermarkets than in other outlet types. As discussed above, the evidence for the price competitiveness of supermarkets in developing countries is not well established – some of the earlier supporting literature was not well founded methodologically and empirically, and the more recent literature provides mixed results (e.g., see Minten et al. (2010) for supporting evidence, and Assefa et al. (2016) for contradictory evidence), suggesting that supermarket price competitiveness depends on the stage of supermarket development within the country.

While there is a growing literature on the sources of supermarket competitive advantage resulting in lower cost of production on the supply side, the hedonic model is an equilibrium outcome of both supply and demand factors. Supermarkets are a relatively new phenomenon in Tanzania (Nishiura, 2010), and despite tremendous growth in the sector over the past decade, these results suggest that they are still catering mostly to the middle and upper income classes (as was argued by Goldman (1974)), who are better able to access supermarkets and are willing and able to pay a higher price to shop in the supermarket environment. We would expect, based on

trends in other countries, supermarkets to gradually reach lower income markets, gain market share[18], and become more price competitive over time. And indeed, our results point in this direction, as indicated by (a) the supermarket price competitiveness of top brands of both flours, (b) the fact that there wasn't a significant price difference in supermarkets for lishe products and (c) the fact that mini supermarkets had a third to a half of the market share for lishe flour (in Dar es Salaam and Arusha, respectively).

Second, counter to maize flour products, the value of lishe flour product attributes was often insignificant and sometimes negative. This might suggest that these products follow a diminishing innovation effectiveness curve (Sarkar and Costa, 2008), i.e., the mixing of flour to create lishe is already a product innovation and therefore additional returns for lishe attributes are lower than returns for similar maize flour attributes. It also indicates that there is a significant initial price benefit for companies selling maize flour to make some investments in basic differentiating technologies like plastic or paper bag packaging.

Third, we found partial evidence that the price premiums for products and specific product attributes tended to be significantly higher in Dar es Salaam. Mini supermarkets were also relatively more expensive in Dar es Salaam, but only for maize flour. These results may suggest three things, (a) that higher average incomes in Dar es Salaam cause an outward shift of the demand curve relative to Arusha, translating into higher equilibrium prices overall, (b) that the population of Dar es Salaam is such that there are now decreasing or even negative productivity returns to its population growth, and (c) that these effects also translate into higher

[18] We did not collect volume data in most of the large supermarkets, but we did collect this data for all other outlet types. Among all non-large supermarket outlets, mini supermarkets currently have a very low maize flour market share of 0.6% in Dar es Salaam and 2.3-3.4% in Arusha. However, the market shares for lishe flour are much higher, 33-35% in Dar es Salaam and 45.6-51.9% in Arusha. See Table 3A.4 in the Appendix for the table and more information on the two measures that we used (giving the bounds on the range).

mini-supermarket prices (compared to traditional market prices) in Dar es Salaam (compared to Arusha), for maize flour products specifically.

Fourth, we found that wholegrain (dona) flour is less expensive overall, carries a negative premium in traditional retail but not in supermarkets, and that the premium in traditional retail is significantly more negative in Arusha than in Dar es Salaam. These results are expected on the supply side, but the possible implication on the demand side is more interesting. On the supply side, whole grain flour requires less processing and is therefore less expensive to produce. Dona flour yields 1 kg of flour per 1 kg of grain, while sembe flour yields 0.65 – 0.85 kgs of flour per 1 kg of grain, and the byproduct is not as valuable. It is thus not surprising that this product would be less expensive than sembe flour overall. On the demand side, consumers still appear to prefer sembe flour due to both taste considerations and ease of storage, i.e., dona flour spoils faster. But, this preference appears to diminish in supermarkets and in Dar es Salaam, perhaps due to the growing perceived health benefits of whole grain flour among higher income consumers, similar to recent trends in the United States and elsewhere.

Finally, regarding the value of specific health attributes, we find that the presence of a health claim and health information on the package contributed to only a small but positive price premium for maize flour products (1.8% and 3.6% respectively), but not for lishe flour products. Clearly more work is needed to evaluate developing country processed food health claims in developing countries.

There are several ways that this analysis can be extended in the future. First, hedonic analysis uses a supply and demand equilibrium concept to estimate the total premium for product attributes; the technique does not disentangle supply side and demand side effects. In future work

it would be useful to combine this kind of analysis of the overall price effect with a strictly demand side analysis using consumer choice experiments and experimental auctions. This would provide additional insight not only for products that are already on the market, but hypothetical products not currently on the market, which companies could use in determining the most profitable way to differentiate their product.

Second, it would be useful to conduct a similar analysis again in 5-10 years to test whether the price premiums for supermarkets are decreasing over time, again paired with other methodological complements.

Third, it would also be useful to test the income effect and the positive or negative city size effect hypothesis with a sample that includes more cities with considerable variation of both income and size, perhaps even across countries within the East African region. This would help to better isolate the different effects and to better estimate the point at which there are diminishing, and even negative productivity returns to city size. Finally, it would be useful to conduct a cost-benefit analysis, comparing the marginal price premium of product attributes with the marginal costs of producing them. This would help to determine the most profitable investment strategies for food processing companies.

Appendix

Table A.1. Hedonic maize flour models – Dar es Salaam vs. Arusha – Mini supermarkets

	Non-pooled coefficients		F - Test	
	Dar es Salaam model	**Arusha model**	**F**	**Prob > F**
Mini	0.090***	0.034*	4.16	**0.0454**
	(0.02)	(0.02)		
Health claim	0.016***	0.039**	2.37	0.1284
	(0.01)	(0.01)		
Health information	0.009	0.041**	1.65	0.2033
	(0.02)	(0.02)		
Whole grain flour (dona)	-0.016***	-0.117***	94.93	**0.0000**
	(0.01)	(0.01)		
PolySack	0.038**	0.081***	3.01	**0.0877**
	(0.02)	(0.02)		
Clear plastic packaging	0.454***	0.265***	4.04	**0.0485**
	(0.09)	(0.02)		
Color plastic NZ packaging	0.435***	0.219***	54.56	**0.0000**
	(0.02)	(0.02)		
Paper bag	0.294***	0.207***	0.75	0.3911
	(0.08)	(0.06)		
Other packaging ZL	0.867***	0.244***	8.00	**0.0062**
	(0.22)	(0.02)		
Major brand	0.011	0.072***	5.54	**0.0217**
	(0.01)	(0.02)		
Top brand	--	0.059***	--	--
	--	(0.02)		
Outlet size (100 sq meters)	0.005	0.005***	0.00	0.9989
	(0.01)	(0.00)		
Has parking	-0.000	-0.001	0.00	0.9860

	(0.02)	(0.02)		
Has annex services	-0.009	-0.009	0.00	0.9766
	(0.01)	(0.01)		
Number of cash registers	-0.094*	0.011	4.77	**0.0325**
	(0.05)	(0.01)		
Size of package (kgs)	-0.006***	-0.011***	7.35	**0.0086**
	0	(0.00)		

Notes: p<0.10, ** p<0.05, *** p<.01. The dependent variable is log[price/kg]. The significant results from the F-Test are in bold. The size of package assumes that it is a packaged product.

Table A.2. Hedonic lishe flour models – Dar es Salaam vs. Arusha – Mini supermarkets

	Non-pooled coefficients		**F - Test**	
	Dar es Salaam model	**Arusha model**	**F**	**Prob > F**
Mini	0.021	0.033	0.04	0.8469
	(0.05)	(0.02)		
Health claim	-0.041	-0.003	0.41	0.5256
	(0.04)	(0.03)		
Health information	0.009	-0.134***	7.44	0.0082
	(0.04)	(0.04)		
Number of ingredients	-0.009	-0.030*	1.61	0.2094
	(0.01)	(0.02)		
Contains animal products	0.286***	-0.088	10.75	**0.0017**
	(0.06)	(0.09)		
Contains produce	0.075	0.070	0.03	0.8543
	(0.05)	(0.05)		
Contains nuts	-0.015	-0.081	0.70	0.4044
	(0.05)	(0.05)		
Contains legumes	-0.003	0.050*	2.36	0.1293
	(0.04)	(0.03)		
Color plastic NZ packaging	0.095*	0.544***	6.32	**0.0143**
	(0.06)	(0.14)		
Paper bag	-0.085	-0.096**	0.04	0.8500
	(0.06)	(0.04)		
Other packaging ZL	-0.147*	-0.184***	0.09	0.7674
	(0.08)	(0.05)		
Major brand	0.109*	-0.080***	10.46	**0.0019**
	(0.06)	(0.03)		
Top brand	0.135*	0.010	2.25	0.1382
	(0.07)	(0.04)		
Outlet size (100 sq meters)	0.020	0.001	17.40	**0.0001**

	(0.03)	(0.00)		
Has parking	0.234***	0.088*	2.78	**0.1000**
	(0.07)	(0.05)		
Has annex services	-0.202	0.010	2.98	**0.0890**
	(0.12)	(0.02)		
Number of cash registers	0.022	-0.066**	1.46	0.2318
	(0.09)	(0.03)		
Size of package (kgs)	0.138	0.136	0.07	0.7964
	-0.1	(0.08)		

Notes: p<0.10, ** p<0.05, *** p<.01. The dependent variable is log[price/kg]. The significant results from the F-Test are in bold. The size of package assumes that it is a packaged product.

Table A.3. Hedonic maize flour models – supermarket vs. traditional retail, alt. packaging

	Non-pooled coefficients		**F - Test**	
	Supermarket model	**Traditional retail model**	**F**	**Prob > F**
Dar es Salaam	0.217***	0.166***	1.91	0.1707
	(0.03)	(0.02)		
Health claim	-0.016	0.019***	1.17	0.2822
	(0.03)	(0.00)		
Health information	0.107**	0.025*	3.21	**0.0768**
	(0.04)	(0.01)		
Whole grain flour (dona)	-0.006	-0.024***	0.83	0.3646
	(0.02)	(0.01)		
PolySack	0.154***	0.037**	7.98	**0.0058**
	(0.04)	(0.02)		
Clear plastic packaging	0.525***	0.319***	9.52	**0.0027**
	(0.07)	(0.02)		
Other packaging Cpa	0.407***	0.262***	4.40	**0.0389**
	(0.07)	(0.02)		
Major brand	0.031	0.011	0.16	0.6922
	(0.05)	(0.01)		
Top brand	-0.045	0.071***	7.30	**0.0083**
	(0.04)	(0.01)		
Outlet size (100 sq meters)	0.002*	0.009	0.22	0.6380
	(0.00)	(0.01)		
Has parking	-0.009	0.003	0.31	0.5797
	(0.02)	(0.02)		
Has annex services	-0.012	-0.009	0.02	0.8970
	(0.03)	(0.01)		
Number of cash registers	-0.000	0.041**	5.03	**0.0274**

	(0.01)	(0.02)		
Size of package (kgs)	-0.013***	-0.006***	9.30	**0.0030**
	(0.00)	(0.00)		

Notes: p<0.10, ** p<0.05, *** p<.01. The dependent variable is log[price/kg]. The significant results from the F-Test are in bold. The size of package assumes that it is a packaged product.

Table A.4. Share of mini supermarket sales to all sales, excluding large supermarkets

	Dar es Salaam		**Arusha**	
	Maize flour	**Lishe flour**	**Maize flour**	**Lishe flour**
Share of mini supermarket sales: 1st measure	0.6%	33%	3.4%	45.6%
Share of mini supermarket sales: 2nd measure	0.6%	35%	2.3%	51.9%

*****Note: we present both measures of sales. The 1st measure is estimated based on total kgs purchased and the time interval between purchases. The 2nd measure is based on a question on total sales in the last three months

References

Asfaw, Abay. 2011. “Does Consumption of Processed Foods Explain Disparities in the Body Weight of Individuals? The Case of Guatemala.” *Health Economics* 20 (2): 184–95.

Assefa, Thomas, Thomas Assefa, Girum Abebe, Girum Abebe, Indra Lamoot, Indra Lamoot, Bart Minten, and Bart Minten. 2016. “Urban Food Retailing and Food Prices in Africa: The Case of Addis Ababa, Ethiopia.” *Journal of Agribusiness in Developing and Emerging Economies* 6 (2): 90–109.

Banerji, Abhijit, Ekin Birol, Bhushana Karandikar, and Jeevant Rampal. 2016. “Information, Branding, Certification, and Consumer Willingness to Pay for High-Iron Pearl Millet: Evidence from Experimental Auctions in Maharashtra, India.” *Food Policy* 62: 133–41.

Battersby, Jane, and Stephen Peyton. 2014. “The Geography of Supermarkets in Cape Town: Supermarket Expansion and Food Access.” In , 25:153–64. Springer.

Becker, Gary S. 1965. “A Theory of the Allocation of Time.” *The Economic Journal*, 493–517.

Berry, Steven, and Joel Waldfogel. 2010. “PRODUCT QUALITY AND MARKET SIZE*.” *The Journal of Industrial Economics* 58 (1): 1–31.

Bimbo, Francesco, Alessandro Bonanno, Rosaria Viscecchia, Gianluca Nardone, and others. 2014. “Market Valuation of Health Claims’ Types and Strength: The Italian Yogurt Market.” In *2014 International Congress, August 26-29, 2014, Ljubljana, Slovenia*. European Association of Agricultural Economists. http://ageconsearch.umn.edu/bitstream/182738/2/Bimbo-

Market_valuation_of_health_claims%C3%A2%C2%80%C2%99_types_and_strength-345_a.pdf.

Bonanno, Alessandro. 2016. “A Hedonic Valuation of Health and Nonhealth Attributes in the US Yogurt Market.” *Agribusiness* 32 (3): 299–313.

Campbell, Jeffrey R, and Hugo A Hopenhayn. 2005. “Market Size Matters.” *The Journal of Industrial Economics* 53 (1): 1–25.

Chauliac, M, N Bricas, E Ategbo, W Amoussa, and I Zohoun. 1997. “[Food Habits Outside the Home by School Children in Cotonou (Benin)].” *Sante (Montrouge, France)* 8 (2): 101–8.

Chowdhury, Shyamal, JV Meenakshi, Keith I Tomlins, and Constance Owori. 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.

Combes, Pierre-Philippe, and Laurent Gobillon. 2015. “The Empirics of Agglomeration Economies.” In *Handbook of Regional and Urban Economics*, 5:247–348. Elsevier.

Costello, Caitlin, Matty Demont, and Maïmouna Ndour. 2013. “Marketing Local Rice to African Consumers.” *Rural* 21: 32–34.

Dalton, Timothy J. 2004. “A Household Hedonic Model of Rice Traits: Economic Values from Farmers in West Africa.” *Agricultural Economics* 31 (2): 149–59.

Dannhaeuser, Norbert. 1980. “The Role of the Neighborhood Store in Developing Economies: The Case of Dagupan City, Philippines.” *The Journal of Developing Areas* 14 (2): 157–74.

Demmler, Kathrin M, Olivier Ecker, and Matin Qaim. 2018. “Supermarket Shopping and Nutritional Outcomes: A Panel Data Analysis for Urban Kenya.” *World Development* 102: 292–303.

D’Haese, Marijke, Marrit Van den Berg, and Stijn Speelman. 2008. “A Country- wide Study of Consumer Choice for an Emerging Supermarket Sector: A Case Study of Nicaragua.” *Development Policy Review* 26 (5): 603–15.

D’Haese, Marijke, and Guido Van Huylenbroeck. 2005. “The Rise of Supermarkets and Changing Expenditure Patterns of Poor Rural Households Case Study in the Transkei Area, South Africa.” *Food Policy* 30 (1): 97–113.

Diewert, W Erwin. 2003. “Hedonic Regressions. a Consumer Theory Approach.” In *Scanner Data and Price Indexes*, 317–48. University of Chicago Press.

Dolislager, Michael James. 2017. “Food Consumption Patterns in Light of Rising Incomes, Urbanization and Food Retail Modernization: Evidence from Eastern and Southern Africa.”

Edenbrandt, Anna Kristina, Sinne Smed, and Léon Jansen. 2017. “A Hedonic Analysis of Nutrition Labels across Product Types and Countries.” *European Review of Agricultural Economics* 45 (1): 101–20.

Erdem, Tülin, and Joffre Swait. 1998. “Brand Equity as a Signaling Phenomenon.” *Journal of Consumer Psychology* 7 (2): 131–57.

Farina, Elizabeth MMQ. 2002. “Consolidation, Multinationalisation, and Competition in Brazil: Impacts on Horticulture and Dairy Products Systems.” *Development Policy Review* 20 (4): 441–57.

Figuié, Muriel, and Paule Moustier. 2009a. “Market Appeal in an Emerging Economy: Supermarkets and Poor Consumers in Vietnam.” *Food Policy* 34 (2): 210–17.

Fournier, Susan. 1998. “Consumers and Their Brands: Developing Relationship Theory in Consumer Research.” *Journal of Consumer Research* 24 (4): 343–53.

Gehlhar, Mark, and Anita Regmi. 2005. “Factors Shaping Global Food Markets.” *New Directions in Global Food Markets*, 5–17.

Goldfarb, Avi, Qiang Lu, and Sridhar Moorthy. 2009. “Measuring Brand Value in an Equilibrium Framework.” *Marketing Science* 28 (1): 69–86.

Goldman, Arieh. 1974. “Outreach of Consumers and the Modernization of Urban Food Retailing in Developing Countries.” *The Journal of Marketing*, 8–16.

———. 1982. “Adoption of Supermarket Shopping in a Developing Country: The Selective Adoption Phenomenon.” *European Journal of Marketing* 16 (1): 17–26.

Ho, Suk-Ching. 2005. “Evolution versus Tradition in Marketing Systems: The Hong Kong Food-Retailing Experience.” *Journal of Public Policy & Marketing* 24 (1): 90–99.

Keller, Kevin Lane. 1993. “Conceptualizing, Measuring, and Managing Customer-Based Brand Equity.” *The Journal of Marketing*, 1–22.

Kimenju, Simon C, Ramona Rischke, Stephan Klasen, and Matin Qaim. 2015. “Do Supermarkets Contribute to the Obesity Pandemic in Developing Countries?” *Public Health Nutrition* 18 (17): 3224–33.

Ladd, George W., and Veraphol Suvannunt. 1976. “A Model of Consumer Goods Characteristics.” *American Journal of Agricultural Economics* 58 (3): 504. https://doi.org/10.2307/1239267.

Lähteenmäki, Liisa. 2013. “Claiming Health in Food Products.” *Food Quality and Preference* 27 (2): 196–201.

Lähteenmäki, Liisa, Piritta Lampila, Klaus Grunert, Yasemin Boztug, Øydis Ueland, Annika Åström, and Emilia Martinsdóttir. 2010. “Impact of Health-Related Claims on the Perception of Other Product Attributes.” *Food Policy* 35 (3): 230–39.

Lancaster, Kelvin J. 1966. “A New Approach to Consumer Theory.” *The Journal of Political Economy*, 132–157.

Leone, Robert P, Vithala R Rao, Kevin Lane Keller, Anita Man Luo, Leigh McAlister, and Rajendra Srivastava. 2006. “Linking Brand Equity to Customer Equity.” *Journal of Service Research* 9 (2): 125–38.

Melo, Patricia C, Daniel J Graham, and Robert B Noland. 2009. “A Meta-Analysis of Estimates of Urban Agglomeration Economies.” *Regional Science and Urban Economics* 39 (3): 332–42.

Minten, Bart, and Thomas Reardon. 2008. “Food Prices, Quality, and Quality’s Pricing in Supermarkets versus Traditional Markets in Developing Countries.” *Applied Economic Perspectives and Policy* 30 (3): 480–90.

Minten, Bart, Thomas Reardon, and Rajib Sutradhar. 2010. “Food Prices and Modern Retail: The Case of Delhi.” *World Development* 38 (12): 1775–87. https://doi.org/10.1016/j.worlddev.2010.04.002.

Minten, Bart, K.M. Singh, and Rajib Sutradhar. 2013. “Branding and Agricultural Value Chains in Developing Countries: Insights from Bihar (India).” *Food Policy* 38 (February): 23–34. https://doi.org/10.1016/j.foodpol.2012.09.003.

Minten, Bart, Seneshaw Tamru, Ermias Engida, and Tadesse Kuma. 2015. “Transforming Staple Food Value Chains in Africa: The Case of Teff in Ethiopia.” *The Journal of Development Studies*, 1–19.

Nel, Johanna Helena, and Annette Casey. 2003. “Secondary Data Analyses of Dietary Surveys Undertaken in South Africa to Determine Usual Food Consumption of the Population.” *Public Health Nutrition* 6 (07): 631–44.

Neven, David, Thomas Reardon, Jonathan Chege, and Honglin Wang. 2006. “Supermarkets and Consumers in Africa: The Case of Nairobi, Kenya.” *Journal of International Food & Agribusiness Marketing* 18 (1–2): 103–23.

Nishiura, Akio. 2010. “The Food Industry and Supermarkets in Eastern Africa: A Preliminary Report on Research in Tanzania and Ethiopia.” *African Producers in the New Trends of Globalization: An Interim Report*, 43–56.

Oparinde, Adewale, Abhijit Banerji, Ekin Birol, and Paul Ilona. 2016. “Information and Consumer Willingness to Pay for Biofortified Yellow Cassava: Evidence from Experimental Auctions in Nigeria.” *Agricultural Economics* 47 (2): 215–33.

Pingali, Prabhu. 2007. “Westernization of Asian Diets and the Transformation of Food Systems: Implications for Research and Policy.” *Food Policy* 32 (3): 281–98. https://doi.org/10.1016/j.foodpol.2006.08.001.

Popkin, Barry M. 2014. “Nutrition, Agriculture and the Global Food System in Low and Middle Income Countries.” *Food Policy* 47 (August): 91–96. https://doi.org/10.1016/j.foodpol.2014.05.001.

Prochaska, Fred J, and Ronald A Schrimper. 1973. “Opportunity Cost of Time and Other Socioeconomic Effects on Away-from-Home Food Consumption.” *American Journal of Agricultural Economics* 55 (4 Part 1): 595–603.

Reardon, Thomas, and C. Peter Timmer. 2012. “The Economics of the Food System Revolution.” *Annual Review of Resource Economics* 4 (1): 225–64. https://doi.org/10.1146/annurev.resource.050708.144147.

Reardon, Thomas, C Peter Timmer, Christopher B Barrett, and Julio Berdegué. 2003. “The Rise of Supermarkets in Africa, Asia, and Latin America.” *American Journal of Agricultural Economics* 85 (5): 1140–46.

Reardon, Thomas, David Tschirley, Bart Minten, Steven Haggblade, S Liverpool-Tasie, Michael Dolislager, Jason Snyder, and Claire Ijumba. 2015. “Transformation of African Agrifood Systems in the New Era of Rapid Urbanization and the Emergence of a Middle Class.” *Beyond a Middle Income Africa: Transforming African Economies for Sustained Growth with Rising Employment and Incomes. IFPRI, Washington DC. Http://Ebrary. Ifpri. Org/Cdm/Ref/Collection/P15738coll2/Id/130005*.

Rischke, Ramona, Simon C Kimenju, Stephan Klasen, and Matin Qaim. 2015. “Supermarkets and Food Consumption Patterns: The Case of Small Towns in Kenya.” *Food Policy* 52: 9–21.

Rodríguez, Elsa, Miriam Berges, Karina Casellas, Rosángela Di Paola, Beatriz Lupín, Laura Garrido, and Natacha Gentile. 2002. “Consumer Behaviour and Supermarkets in Argentina.” *Development Policy Review* 20 (4): 429–39.

Ronquest-Ross, Lisa-Claire, Nick Vink, and Gunnar O Sigge. 2015. “Food Consumption Changes in South Africa since 1994.” *South African Journal of Science* 111 (9–10): 01–12.

Rosen, Sherwin. 1974. “Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition.” *The Journal of Political Economy*, 34–55.

Sarkar, Soumodip, and Ana IA Costa. 2008. “Dynamics of Open Innovation in the Food Industry.” *Trends in Food Science & Technology* 19 (11): 574–80.

Schipmann, Christin, and Matin Qaim. 2011. “Modern Food Retailers and Traditional Markets in Developing Countries: Comparing Quality, Prices, and Competition Strategies in Thailand.” *Applied Economic Perspectives and Policy* 33 (3): 345–62.

Segal, David. 1976. “Are There Returns to Scale in City Size?” *The Review of Economics and Statistics*, 339–50.

Senauer, Ben, David Sahn, and Harold Alderman. 1986. “The Effect of the Value of Time on Food Consumption Patterns in Developing Countries: Evidence from Sri Lanka.” *American Journal of Agricultural Economics* 68 (4): 920–27.

Sexton, Richard J. 2000. “Industrialization and Consolidation in the US Food Sector: Implications for Competition and Welfare.” *American Journal of Agricultural Economics* 82 (5): 1087–1104.

Szathvary, Serena, and Samuele Trestini. 2014. “A Hedonic Analysis of Nutrition and Health Claims on Fruit Beverage Products.” *Journal of Agricultural Economics* 65 (2): 505–17.

Tessier, Sophie, Pierre Traissac, Nicolas Bricas, Bernard Maire, Sabrina Eymard-Duvernay, Jalila El Ati, and Francis Delpeuch. 2010. “Food Shopping Transition: Socio-Economic Characteristics and Motivations Associated with Use of Supermarkets in a North African Urban Environment.” *Public Health Nutrition* 13 (09): 1410–18.

Tessier, Sophie, Pierre Traissac, Bernard Maire, Nicolas Bricas, Sabrina Eymard-Duvernay, Jalila El Ati, and Francis Delpeuch. 2008. “Regular Users of Supermarkets in Greater Tunis Have a Slightly Improved Diet Quality.” *The Journal of Nutrition* 138 (4): 768–74.

Tschirley, David L, Miltone W Ayieko, Munguzwe Hichaambwa, Joey Goeb, and Wayne Loescher. 2010. “Modernizing Africa’s Fresh Produce Supply Chains without Rapid Supermarket Takeover: Towards a Definition of Research and Investment Priorities.” *MSU International Development Working Papers*, no. 106.

Tschirley, David, Thomas Reardon, Michael Dolislager, and Jason Snyder. 2015. “The Rise of a Middle Class in East and Southern Africa: Implications for Food System Transformation.” *Journal of International Development* 27 (5): 628–46.

Umberger, Wendy J, Xiaobo He, Nicholas Minot, and Hery Toiba. 2015. “Examining the Relationship between the Use of Supermarkets and Over-Nutrition in Indonesia.” *American Journal of Agricultural Economics* 97 (2): 510–25.

Vandeplas, Anneleen, and Bart Minten. 2015. “Food Quality in Domestic Markets of Developing Economies: A Comparative Study of Two Countries.” *Agricultural Economics*.

Weatherspoon, Dave D, and Thomas Reardon. 2003a. “The Rise of Supermarkets in Africa:

Implications for Agrifood Systems and the Rural Poor.” *Development Policy Review* 21: 333–55.

Zhou, Yijing, Shufa Du, Chang Su, Bing Zhang, Huijun Wang, and Barry M Popkin. 2015. "The Food Retail Revolution in China and Its Association with Diet and Health." *Food Policy* 55: 92–100.