Demand for aflatoxin-safe maize in Kenya: Dynamic response to price and advertising

May 2017

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Abstract

In countries where regulatory enforcement is weak, voluntary third party verification of firms' food safety processes may provide a way for consumers to ensure food safety when the food safety attributes are otherwise unobservable. However, it is unclear whether consumer demand for certified products translates into a sufficiently large market incentive for producers to certify. We examine the case of aflatoxin contamination in maize flour. Aflatoxin can cause immediate sickness or death in high concentrations and has been linked to liver cancer and child stunting under chronic exposure. We present results from a randomized controlled trial in which we track sales of the first maize flour brand in Kenya to be labeled as aflatoxin-tested. We test the impact of randomly assigned temporary marketing efforts and discounts on sales of the flour over time. We find that there is an immediate response in sales to marketing efforts, but that this effect disappears as soon as marketing efforts cease. Sales remain elevated in the weeks after a temporary discount is offered, but this effect also diminishes over time.

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1. Introduction

This paper explores the impact of efforts to build consumer demand for food safety in Kenya, in particular, demand for aflatoxin-tested maize. Consumption of high levels of aflatoxin can be fatal, but is relatively rare. Of greater concern is chronic exposure, which has been linked in numerous studies to liver cancer and may also contribute to child stunting (Strosnider et al., 2006). In Kenya, where maize is a staple in the diet, a significant proportion of maize and maize flour samples fail to meet regulatory standards. One study by researchers with the CDC found that 65% of maize samples collected from 20 major millers did not meet the national standard (Gathura 2011) and a study using 2013 data found that 26% of branded maize flour samples were above this standard (Hoffmann and Moser, 2017). Because aflatoxin is unobservable and regulatory standards are imperfectly enforced, even informed consumers cannot be confident of the safety of maize or maize flour available in the market. Using a randomized controlled trial, we track the sales and prices of branded maize flour both before and after one of the brands becomes the first in Kenya to have its aflatoxin-testing procedures verified by a third party lab and to use a logo indicating this on its package.

In general, investment in preventive health technologies in developing countries is low, likely for reasons including lack of awareness about the effectiveness or cost effectiveness of prevention measures, liquidity and credit constraints, present-biased time preferences, and attention constraints (Dupas, 2011; Spears, 2014; Kremer and Glennerster, 2011). However, unlike other health investments that require discrete shifts in one's use of time, attention or other scarce resources, households already purchase food; purchasing a brand that has been tested for a food safety issue requires only a minor change in behavior.

Further, the cost of purchasing safe food is a marginal increase to an unavoidable cash outlay; consumers are known to be less price sensitive to additional costs compared to stand-alone costs (Munro and Sugden, 2003). Finally, food safety may be correlated with, or be perceived as correlated with, highly valued food attributes, such as taste or consistent quality.

This paper contributes to the literature in several ways. First, little is known about consumer demand for food safety. In markets with well-developed regulatory systems, safety is a requirement for market participation. In markets without effective food safety regulation, information on food safety is typically not available. The case of aflatoxin contamination in Kenya constitutes a unique research opportunity; firms are beginning to respond to consumer awareness of the toxin by investing in third-party verification of their testing processes and incorporating food safety claims in their marketing strategies.

By providing consumers with information about food safety, third-party labeling has the potential to reduce aflatoxin contamination of the food supply. However, there is also a risk that if firms adopting the label reduce contamination in their product simply by rejecting lower-quality maize, the rejected maize will be sold to other firms or distributed through the informal sector.

Second, we contribute to the understanding of sustained behavior change. Consumers may believe that tested maize will have other desirable attributes such as better taste, and revert to untested maize if this is not found to be the case. Although high willingness-to-pay for food safety has been shown in the context of one-time purchases (Ifft, Roland-Holst, and Zilberman; 2012), consumer demand will only have a significant impact on either firm behavior or health if sustained over the long term. While several studies test the impact of information on health behavior at a single point in time (Madajewicz et al, 2007; Jalan and Somanathan, 2008), the literature on persistence of health behavior after an information shock is far more limited. Learning and limited attention models give different predictions about the dynamic impact of information on health behavior. A learning model predicts that information leads to permanent behavior change, whereas a limited attention model, in which information increases the salience of a particular health risk temporarily, predicts that the effect of information diminishes over time (Banerjee and Mullainathan, 2008; Karlan et al., 2016). One recent study analyzed dietary changes following a diagnosis of diabetes and found a small but significant decrease in purchased calories in the months following diagnosis, but the change became smaller and insignificant after a year. Some dietary changes, including a reduction in calories from non-whole grains, soft drinks, and red meat, were more persistent (Oster, forthcoming). The results suggest that attention constraints may lead consumers to focus on changing their consumption of a limited number of food types.

The paper is organized as follows. The next section provides some background on the issue of aflatoxin contamination. Section 3 explains the study design and section 4 describes the data and presents the results.

2. Background

2.1 Aflatoxin

Aflatoxin is a by-product of certain molds in the genus *Aspergillus*, and is a global problem that affects a wide range of crops. Maize and groundnuts are of particular concern because of their susceptibility to the fungus and the widespread consumption of these crops (Khlangwiset, Shephard, and Wu, 2011). Aflatoxin can be present in foods with no noticeable effect on taste, smell, or appearance.

Fungal growth can be encouraged both by conditions in the field and during post-harvest handling and storage. Drought, soil type, and pest infestations can make the crop more vulnerable to fungal infection pre-harvest. Post-harvest conditions affecting growth include inadequate drying, length of storage, and poor storage conditions (Gnonlonfin et al., 2013). Even sufficiently dried foods can develop pockets of contamination during storage in the presence of insects, which can increase moisture through respiration (Williams et al., 2004). While in the developed world aflatoxins pose little risk to consumers because of systematic testing for aflatoxins and modern processing and storage technologies, billions of people may be exposed to potentially dangerous levels of aflatoxins in the developing world (Williams et al., 2004; Strosnider et al., 2006).

Consumption of high levels of aflatoxin can be fatal but deaths from acute aflatoxin poisoning are rare (Williams et al. 2004). Of greater concern is chronic exposure to sub-lethal levels. Concerns over chronic exposure have led regulatory authorities in most countries to set safe limits of aflatoxin at 20 parts per billion (ppb) or less for human consumption; acute aflatoxin poisoning likely occurs at levels well over 1000 ppb.

Chronic exposure to aflatoxins has been associated in numerous studies with liver cancer in humans (Williams et al., 2004; Strosnider et al., 2006). Evidence also suggests that aflatoxin exposure is related to stunting and underweight in children and suppressed immune response (Gong et al., 2004; Williams et al., 2004; Turner et al., 2007). While human studies on this topic are limited, animal studies have clearly established, both in farm and laboratory animals, that chronic aflatoxin exposure compromises immunity and negatively affects the metabolism of protein and micronutrient absorption (Williams et al., 2004).

2.2 The Kenyan context

Kenya is one of the countries most at risk of aflatoxin exposure because of both high maize consumption and high levels of contamination in maize in certain parts of the country. Some of the most severe recorded outbreaks have been in Kenya, including one in 2004 during in which at least 317 people were sickened and 125 died of acute aflatoxin poisoning (Azziz-Baumbartner et al., 2005). Natural variations in rainfall and seasonal storage requirements result in a high degree of variability in aflatoxin levels by year, region and season. The US Center for Disease Control and Prevention tested maize grain samples in eastern Kenya in 2005, 2006 and 2007 and found that 41, 51, and 16 percent of samples, respectively, exceeded 20 ppb (Daniel et al., 2011).

There is an official regulatory limit for allowable levels of aflatoxin in Kenya. The current standard, set by the Kenya Bureau of Standards, is 10 ppb. The standard was initially 20 ppb, which is also the current US standard, but it was later lowered because of the greater potential for chronic exposure through maize consumption in Kenya (Daniel et al., 2011). However, enforcement of this standard in the formal sector is weak. Regulators do collect samples at both the mill and shop levels, but interviews with millers suggest that mills are not being cited for violation of the standard despite studies demonstrating that flour frequently exceeds the allowable limit. In a 2013 study of branded flours, Hoffmann and Moser (2017) found that 26 percent of samples tested above the regulatory limit of 10 ppb, but there were large between-brand differences.

Some mills do test for aflatoxins and reject lots that are contaminated above the allowable level. However, poor testing protocols and possibly corruption allow poor quality maize to get through (Kirimi et al., 2011). The cost of testing for the mills depends on the technology used. Many mills test for moisture content, which is a measure of overall quality. High moisture content at some point after harvest is necessary for fungal growth, and thus may be correlated with aflatoxin contamination, but this is not a reliable measure. Rapid binary tests require little equipment and little expertise and, according to interviews with millers, cost approximately $11-$16 per 10 to 28 metric ton truckload of maize. More precise methods require several thousand dollars of upfront investment in equipment with costs per test that are similar to the binary tests.

Despite poor regulatory enforcement at present, there are several reasons why millers might invest in aflatoxin testing. First, aflatoxin outbreaks occasionally make the news in Kenya and millers might worry about an outbreak being linked to their product. Second, the widespread availability of easy-to-use binary tests means that researchers, the media, or even private citizens can test maize flour. For example, writing in the Daily Nation, Gathura (2011) cites a study by the CDC and the Kenyan Ministry of Health finding that 65 percent of samples from 20 major millers across 6 provinces were contaminated. While this article did not name specific millers, there is little to prevent this from happening. Finally, millers might believe that enforcement of the standard is imminent and they should prepare for that eventuality.

While some mills had been testing for aflatoxins at the time this study was initiated, there were no systems in place to validate or verify their sampling or testing protocols. Uncertainty about the legality of making food safety claims on product labeling, lack of confidence in their own test results, and fear of increased scrutiny were all barriers to advertising aflatoxin testing practices. Without firm-specific information on food safety practices or outcomes, the average consumer in Kenya had no way to discern the likelihood that maize or maize flour they might purchase was contaminated.

The maize in Kenya can be roughly categorized into three groups: subsistence maize for home consumption, informal market maize and formal market maize flour. The informal market can be defined as the market for loose, whole grain maize sold in open-air markets and small shops throughout the country and appears to still be the dominant source of purchased maize. Consumers take this maize to small, local hammer mills to be ground into flour. Increasingly, informal maize millers are competing directly with the formal sector by processing maize and selling flour to consumers. However, the market appears to be highly segmented; based on the nationally representative Household Consumption and Expenditure Survey (HCES) survey conducted in 2006, Fiedler et al. (2014) find that 96 (90) percent of consumers who purchase branded (informal market) flour only purchased that kind.

The formal market consists of a small number of large roller mills that package flour in sealed paper packages with their brand name. The number of formal sector mills is in the low hundreds, with the three largest millers accounting for 67 percent of formal market sales (Juma and Wafula, 2011). According to Fiedler et al. (2014), in 2006 only 33 percent of households reported purchasing branded maize flour in the previous week even though 94 percent reported consuming maize. However, the formal sector maize market is growing in Kenya, particularly in urban areas (Muyanga et al., 2005).

Our study focuses on the potential for reducing aflatoxin contamination in the formal sector for several reasons. The informal sector consists of thousands of mostly small sellers and hammer mills throughout the country and, because maize is widely grown, there are no centralized locations through which maize passes, making regulatory enforcement cost prohibitive. Costs of compliance for the seller or miller per unit of output would also be higher in the informal sector because of the smaller scale of these firms. Finally, because the maize is sold out of unsealed bags, traceability is not possible.

There is precedent in Kenya for enforcing regulation in the formal maize market. Since 2012, maize flour is required to have micronutrient fortification. In this case, government and donors worked to ensure that formal sector millers had the necessary equipment and training. According to Fiedler et al. (2014), it was determined to be infeasible to enforce these standards at the level of the local hammer mills (i.e., the informal market) because of the cost and monitoring difficulties.

3. Study design and intervention

3.1 The APTECA program

Aflatoxin Proficiency Testing for Eastern and Central Africa (APTECA), was launched by Texas A&M AgriLife Research in 2014 to build the aflatoxin testing capacity of maize industry and regulatory bodies in the region. This initiative is patterned after a successful aflatoxin co-regulation program in Texas, where aflatoxin contamination of maize can be as severe as in Africa. [1]

In order to use the APTECA logo (see figure 1) on packaging or marketing materials, millers must satisfy a number of requirements. They must pass an aflatoxin analysis proficiency test, must conduct weekly analysis of laboratory control samples to ensure testing accuracy, and must develop and adhere to a rigorous aflatoxin food safety plan, which includes a sampling and testing procedure for inbound truckloads of maize and testing flour from each batch prior to packing. Audits of test records and related processes are performed weekly and companies that repeatedly test above the regulatory limit for aflatoxin must undertake corrective action and face a temporary suspension of APTECA logo use.

The authors partnered with the first commercial maize miller in Kenya to join the APTECA program and incorporate the "Alfatoxin tested verified by APTECA" logo on its packaging and marketing materials.[2] Because this is a potentially high-risk investment for a miller, costs of compliance with APTECA requirements beyond the firms' current procedures during the study period were covered through the research budget, and APTECA membership was provided free of charge by Texas AgriLife Research.

3.2 Sales tracking

More than six months before introduction of the labeled product, and, while the miller was working towards meeting APTECA requirements, shops that carried the miller's products were selected from customer lists obtained from the miller and the miller's distributors in the six main rural counties served

[1] See http://apteca.tamu.edu/ for details on APTECA.
[2] At the time of writing, 12 firms had expressed interest in joining APTECA's third party verification program.

by the miller.[3] These counties are also among the most aflatoxin-affected in Kenya. Fifteen shops in each county were initially selected at random from these lists. If more than one shop in a given village or within walking distance of another sampled shop was selected, only the first of these was included. Selected shops were visited and screened for eligibility based on the inclusion criterion of selling at least 48 kg of the miller's flour each week. Shops that did not meet this criterion were replaced with the next shop on the randomly ordered list located in the same village. If no such shop existed, the next shop on the list outside of the village was taken as the replacement.

After eligibility screening, shop owners were invited to participate in the study. They were told that if they chose to participate, they would be asked to track maize flour sales daily and provide this information to the study staff weekly; in compensation they would receive bi-weekly payment of 2000 Kenyan shillings (approximately $22 US at the time). A shop survey was then administered to the shop owner, which covered the volume of sales of the participating miller's products as well as maize flour more generally, and basic characteristics of the shop.

Sales and prices of all maize flour brands were recorded by participating shop owners in a ledger provided to them. Field officers collected sales tracking ledgers weekly, and reviewed entries with the owners before entering the data electronically. In this way, shop owners were trained and retrained on how to correctly complete the sales sheets. The price of whole grain maize at a vendor near each participating shop was also recorded by study staff during data collection visits. Over the first two months of sales tracking, several shops were dropped from the sample based on failure to consistently complete sales

[3] These counties are Embu, Kathiani, Kitui, Meru, Murgang'a, and Nyeri; Nairobi was excluded due to the difficulty of defining a 'catchment area' for urban shops as well as anticipated challenges of sampling and surveying urban consumers.

records. Of the remaining 78 shops, five shops with much higher total maize flour sales than the rest were dropped from the sample.[4]

In June 2015 the miller's existing brand began appearing in shops with the APTECA logo. Shops were assigned to the following treatment groups based on random assignment after stratifying by county and average weekly sales of the miller's product:

T1. Control (24 shops)

T2. Initial marketing only (12 shops)

T3. Multiple marketing rounds, no discount (12 shops)

T4. Initial discount + marketing (12 shops)

T5. Multiple discount + multiple marketing rounds (13 shops)

Once the mill began using the packages with the logo, all shops stocked the new packages, but in the control shops nothing was done to draw attention to the product change. The miller did not change their own marketing to reflect the change and thus our interventions were likely customers' only exposure to the significance of the APTECA logo. The interventions were introduced over a four-week period. Thus one-fourth of the one-time marketing shops, one-fourth of the multiple marketing shops, etc. were treated in the first week. The week of intervention was randomly assigned within each treatment.

[4] Each of these shops had average weekly sales of 1265 kg or more per week; the next highest sales value was 678 kg. The large volume shops often also served as wholesalers to smaller shops in outlying areas.

Marketing treatments (T2-T5) consisted of leafletting for five days at the shop and nearby open-air market where whole-grain (i.e., informal market) maize was sold in addition to hanging posters at the shop for the duration of the study. Figure 1 shows an image of the leaflet, which was similar to the poster.

Field officers were trained to explain the leaflet content in local languages. The discount treatment consisted of a 5-shilling (0.05 USD) discount per kilogram, applied during the week of the promotion. The 5-shilling discount, approximately 10% of the product price, was designed to be sufficient to induce consumers of cheaper brands or whole grain maize in the informal market to switch. In the multiple marketing group (T3), the leafletting was repeated every four weeks for a total of three rounds. In the multiple discount group (T5), the discount and leafletting was repeated once, four weeks after the initial intervention, for a total of two rounds. A third intervention round in these shops, four weeks after the second discount week, consisted of leafletting only.[5]

3.3. Consumer surveys

Two Consumer surveys were conducted, one before introduction of the labeled product in March 2015, and one at the end of the study period, approximately 22 weeks after its introduction, in November 2015. Shoppers were recruited at two locations per shop: immediately outside of the study shop, and also at the nearest location outside the shop where unbranded maize flour or bulk grains could be purchased. The two locations were used to increase the likelihood that consumers whose primary source of maize was the informal market maize were also surveyed. The surveys collected information on maize purchasing and consumption behavior, as well as basic household demographics. The pre-treatment survey sampled on average 25 consumers per shop and the post-treatment sampled 17 per shop, including those surveyed at the nearby informal market. The post-treatment survey was similar to the

[5] The third round of discounting was suspended due to complaints to the miller from competing shops.

pre-treatment but added additional questions about the study brand, aflatoxin, and knowledge of the marketing campaign.

4. Descriptive statistics and balance tests

In this section we present sales, price data, and consumer data for the 73 shops in our study beginning in November 2014 and ending late November 2015. The treatment was rolled out in June 2015. Figures 2 and 3 show the average weekly sales and prices across shops. The number of shops with completed sales tracking forms is provided in figure 4. Shop-owner compliance was low in the early months as it took some time for shop owners to become accustomed to completing the weekly forms.

During the study period, all shops carried at least one other brand in addition to the study brand; on average shops stocked roughly 3 other brands. The study brand is the lowest-priced or priced the same as the lowest-priced flours in 86% of shop-week observations. The data suggest that stocking out of a particular brand was uncommon, but was more common for the study brand than for other brands. Overall, a brand in stock on Monday was sold out by Sunday in only 2.3% of cases for which no delivery of that brand was taken during the week.[6] For the study brand, the rate of stock outs was over double the average, at 5.1% of all shop-weeks. In the next section, we test whether the interventions affected sales of the study brand by increasing its availability rather than affecting consumer demand by looking at the impact of the treatments on the study brand stocks at the beginning of the week.

Table 1 presents balance-test regression results using pre-treatment sales and prices.[7] The models regress pre-treatment weekly sales and price on treatment arm dummies and other controls (not shown).

[6] Date of delivery was not recorded. It is possible that temporary stockouts could have occurred in shops that took deliveries as well.

[7] Due to a coding error, the variable used for stratification (mean study brand sales) was based partially on study brand sales and partially on sales of a different brand, depending on the questionnaire version. Since the

Observations are at the shop-week level, and standard errors are clustered by shop. Panels A, B, and C show regression results for the different permutations of the treatments used in the analysis below. Panel A includes only two dummies—one for marketing (T2 and T3) and one for discount (T4 and T5). Estimations in panel B include dummies for each treatment group separately, while panel C uses overlapping dummies for marketing (T2 and T3), discount (T4 and T5) and multiple weeks (T3 and T5). The results indicate that total maize flour sales were higher for shops assigned to the marketing only group, and higher in the one-time discount group compared to those assigned to the control treatment, and that total sales were higher in the one-time marketing group. We control for the variables presented in this table in the analysis of sales data below.

Table 2 provides some basic consumer characteristics from the baseline and endline surveys. The consumer characteristics are similar across treatments, with some differences in maize purchasing behavior. While the main focus of this paper is the effect of treatment on sales, we are also interested in the effect of treatment on consumer knowledge and self-reported maize purchases. The main variables of interest from the post-treatment survey are provided in table 3. No questions were asked in the pre-treatment survey about the study brand or aflatoxin testing so as not to bias future work. Customers were, however, asked whether they had heard of aflatoxin at baseline and approximately 72 percent responded that they had. Treatment does not seem to have had an effect on awareness of the issue. However, awareness that some millers test for aflatoxin, and the identification of the study brand as tested were higher among consumers interviewed at treatment shops at endline. These consumers were also more likely to have heard of the study brand, to have tried it, and to have purchased it during the

stratification dummies contain some, but not all, data on baseline sales, we control both for these, and for the natural log of actual baseline sales prior to initiation of the intervention in the regression analysis presented below.

previous six months, relative to those interviewed at control shops. When presented with several logos, consumers were generally unable to identify the APTECA logo regardless of treatment group.

5. Results

5.1 Estimation strategy

Our main dependent variable is the weekly sales of the study brand and we are interested in the effects during and after the week-long marketing drives and accompanying temporary discounts, when offered. Since maize flour sales and inventories are highly skewed, we use the inverse-hyperbolic sine (IHS) transformation to normalize the data and reduce the influence of extreme values. Standard errors are clustered at the shop level in all specifications, and time dummies are included from the week of intervention onset.[8] Models 1 and 3 include the full set of stratification dummies (county quartile of pre-treatment sales), and time dummies for every four-week interval after the start of marketing. Models 2 and 4 include weekly fixed effects during the intervention period. Models 3 and 4 include price variables. While these variables are measured after the onset of the intervention, and could theoretically be affected by the experimental treatments, regressing them on treatment dummies indicates that they are not.[9]

All specifications include the IHS-transformed means of pre-intervention study brand sales, total maize flour sales, study brand price, and the mean price of all maize flour brands sold. In addition, specifications 3 and 4 include contemporaneous prices of the study brand and the mean price of other brands sold at the shop, as well as a dummy variable indicating that no other brands were sold.

[8] To preserve degrees of freedom, we do not include time dummies prior to the start of marketing.
[9] Results not shown but available from the authors upon request.

For the first marketing push, lags beyond the third week were defined only for the shops assigned to the one-time marketing or discount group (since the second push occurred four weeks later for those assigned to receive multiple marketing pushes). Similarly, the third marketing push occurred four weeks after the second. We therefore include dummies for only three post-intervention weeks after the first and second marketing pushes. After the third marketing push, we include three post-intervention week dummies for the pure marketing group, among which any impact on sales has faded by this point. In the discount group we include seven post-marketing week dummies after the final marketing push (which did not include a discount) in order to capture the full duration of this stronger intervention.

Table 4 shows the impact of marketing and discount treatments on study brand sales. For ease of exposition, the first part of table 4 reports results of the marketing interventions and controls, and the second reports those of the discount intervention.

The marketing only treatments (T2 and T3) show a positive effect of marketing during that week for the first and second rounds of marketing. The estimated effect of the second marketing push is larger in magnitude, though not statistically distinguishable from the first. However, the third and final marketing push has no statistically significant effect and the size of the effect is much smaller. We find no effect in the weeks following any of the pure marketing pushes. We do not believe poor quality or taste of the flour dissuaded consumers from repeat purchases. We conducted blind taste tests of the study brand and two other brands offered at the shops at endline and the study brand was consistently rated higher than other brands.

The results in the second part of table 4 suggest that the discount was more powerful than marketing alone. Not surprisingly, the discount significantly increased sales while the discount was in place, but the magnitude of the increase is large. Following the first discount push, sales remained statistically significantly higher across all models for the next three weeks. Although the magnitude of the effect is lower in the weeks after the discount has ended, the coefficient values are higher than those for the actual marketing week. Sales were also statistically significantly higher (at $p<0.10$) in all specifications for the first and third weeks following the second discount campaign.

The final treatment in the multiple discount arm ("post discount marketing") consisted of marketing only. The estimated impact of this round of marketing on sales is not statistically distinguishable from the lingering effect of the second marketing push, and appears to continue the decreasing trend in sales post-discount. Following this, sales remain somewhat elevated relative to those in control group shops, but both the magnitude and statistical significance decline and by the seventh week after the final marketing push, none of the models show an effect.

Given that our discount treatment was clearly advertised as being for "this week only" and given that other brands were available most weeks in each study shop, we do not think the increased sales result from customers returning in subsequent weeks hoping for a discount. Field staff were careful not to alert consumers and shop owners in the multiple discount shops that the promotion would be repeated. There are several possible explanations for the lingering effect of the discount treatment. First, the discount could give the safety claim more credibility. Second, the message may be more memorable when combined with a significant discount. Third, customer loyalty could have been generated through the temporary discount. Unfortunately, we are unable to test between the competing explanations in our current data.

5.3 Effect of treatment on stocks and sales of other brands

The increased sales of the study brand evident in table 4 could be driven by current shop customers switching from other brands or from new customers to the shop drawn in by the promotions. The next set of estimations (table 5) explores this question by regressing the IHS transformation of sales of other brands on the same set of variables. The first discount treatment reduced sales of other brands during the discount week but not after. This suggests that the increased sales of the study brand are not only coming from reduced sales of other brands at the shop and the treatments likely brought new customers.

Table 6 presents results of selected estimations using the IHS of stocks as the dependent variable; we do this in order to rule out whether sales might be driven by an increase in stocking by the shop owner in anticipation of the treatments. The potential problem is that shops frequently run out of stock before the next delivery and anticipation of treatment could have changed shop owner behavior such that they were less likely to run out of stock. There is little evidence that shops dramatically changed stocking beheavior. Stocks were higher in the first week of the marketing intervention and again four weeks after the last discount intervention. This latter results suggest that shop owners may have anticipated another round of marketing 4 weeks after the last round. .

5.4 Consumer knowledge and behavior

The next set of estimations uses the customer responses from the post-treatment survey to assess the effect of treatment on knowledge and behavior. In these models, we interact the treatment with a dummy that equals one if the consumer was surveyed away from the shop at the nearby informal market. We do this to test if the treatments had a distinct impact on consumers recruited at the informal market.

In these estimations, we combine the treatment dummies into marketing (T2, T3), discount (T4 and T5), and multiple (T3 and T5) to increase statistical power.

The dependent variables in table 7 are all dummy variables related to various aspects of aflatoxin and the promotion. Looking at the first estimation, the discount treatment slightly increased the awareness among consumers in the informal market. The lack of broader effect may be due to the relatively high degree of awareness of the problem in the study area. The treatment groups increased awareness that some brands were tested for aflatoxin (model 2) and increased the probability that the respondent named the study brand as the one tested for aflatoxin (model 3). In the discount treatment these effects were limited to the informal market consumers. Respondents in the treatment areas were likely to recall the promotion, but the treatments did not affect whether someone could correctly identify the APTECA logo.

Table 8 shows the effect of treatment on the study brand. Respondents in one of the multiple treatment groups were more likely to have heard of the study brand, as were those in the informal market in the discount treatment. Respondents in the treatment areas generally did recall the promotions and could name the brand promoted. Consumers in the multiple treatment groups and in discount groups in the informal sector were more likely to have tried the study brand in the previous six months.

6. Conclusions

Analysis of nearly a year of sales data (22 weeks post intervention) shows that an intensive, temporary promotion of a food safety labeled product – in particular one which involves a temporary discount—can generate demand that endures beyond the promotion itself. The impact of marketing efforts without a temporary discount was far weaker. Sales of the study brand were higher during the first and second weeks during which a marketing agents were actively handing out flyers and talking with consumers, but this impact did not last beyond the active marketing phase in the first two rounds, and was absent entirely during the third phase of active marketing.

The temporary discount increased consumer awareness of labeling for aflatoxin safety as well as the likelihood that the consumer tried the study brand. These effects found among consumers surveyed at the nearby informal market as well as those surveyed at the study shop. Consumers recruited at the nearby informal market were more likely to consume unbranded maize grains, for which the feasibility of introducing food safety assurance measures is low due to lack of traceability.

Implications of these results for the profitability of food safety marketing depend on the nature of competition faced within a particular market and by the particular firm. The firm with which we collaborated competes primarily on price, and earns margins far thinner than the temporary discount made possible through the study budget. To the extent that this situation is typical of firms serving mass markets in low-income settings, it is unrealistic to expect such firms to invest heavily in food safety based marketing. There remains an important role for the public sector in driving consumer awareness of and demand for food safety. By combining social marketing with voluntary labeling based and third party verification, there is scope for public-private collaboration to provide consumers with opportunities to choose safer food.

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Table 1. Summary statistics at baseline and balance check, key sales variables

	Tupike sales (ihs kg)	Total sales (ihs kg)	Tupike price / kg	Mean price, all brands / kg
Control group mean	4.21	5.59	50.5	51.9
		Panel A		
Marketing only	0.020	0.182**	-0.279	-0.181
	(0.076)	(0.079)	(0.340)	(0.427)
Temporary discount	-0.152	-0.022	0.080	0.784
	(0.117)	(0.135)	(0.663)	(0.822)
		Panel B		
One-time marketing	0.138	0.406***	0.155	0.352
	(0.134)	(0.133)	(0.819)	(0.900)
One-time discount	-0.311**	-0.132	-0.219	1.297
	(0.153)	(0.154)	(0.920)	(1.065)
Multiple marketing	-0.302	-0.458*	-0.947	-0.643
	(0.254)	(0.233)	(1.637)	(1.830)
Multiple discount	-0.002	-0.354	-0.524	-2.287*
	(0.197)	(0.229)	(1.285)	(1.340)
		Panel C		
Marketing	0.060	0.379***	0.054	0.707
	(0.125)	(0.135)	(0.739)	(0.805)
Discount	-0.166	-0.082	0.012	0.619
	(0.117)	(0.142)	(0.719)	(0.875)
Multiple weeks	-0.081	-0.381*	-0.772	-1.865
	(0.193)	(0.207)	(1.306)	(1.346)
Observations (all panels)	1738	1800	1727	1789

Notes: Coefficents are shown from regressions of each variable on treatment indicators pre-intervention, controlling for stratification dummies (not shown). Standard errors, shown in parentheses, are clustered at the shop level. * p<0.1; ** p<0.05; *** p<0.01

Table 2. Baseline and endline consumer survey statistics

	T1	T2	T3	T4	T5
	Control	1-time marketing, no discount (1M)	Multiple marketing, no discount (MM)	1-time marketing and discount (1D)	Multiple marketing and discount (MD)
Baseline		*Panel A*			
Age	35.65	34.61	36.66	36.71	37.55
Male	0.45	0.37*	0.36**	0.34	0.42
Respondent is married	0.64	0.69	0.62	0.67	0.64
Number of household members	4.31	4.44	4.33	4.52	4.43
Number of children ages 0-5	0.62	0.72	0.67	0.73	0.66
Household has electricity	0.33	0.41	0.46**	0.32	0.34
Area cultivated (acres)	1.84	2.34	1.78	1.70	1.76
Grows maize	0.60	0.67**	0.63	0.64	0.61*
Months regularly ate homegrown maize	4.89	5.88**	4.86	4.61	5.65
Months regularly ate purchased maize	4.27	5.03	5.30	4.88	5.55*
Months regularly ate branded flour maize	7.30	6.68	7.03	7.64	7.27**
Surveyed at Informal Market	0.45	0.50	0.50	0.49	0.52**
Sample size	642	274	283	296	317
Endline		*Panel B*			
Age	36.51	35.46	36.87	37.74	38.23
Male	0.42	0.40	0.43	0.43	0.39
Respondent is married	0.66	0.72	0.60	0.63	0.68
Number of household members	4.35	4.18	4.10	4.09	4.38
Number of children ages 0-5	0.66	0.64	0.68	0.59	0.71
Household has electricity	0.44	0.53	0.43	0.45	0.40
Informal Market	0.43	0.39	0.39	0.38	0.43
Sample size	442	194	207	192	193

*** p<0.01, ** p<0.05, * p<0.1, indicates p-value for difference between treatment and control.

Table 3. Selected endline consumer survey statistics

	T1	T2	T3	T4	T5
Proportion responding yes	Control	1-time marketing, no discount (1M)	Multiple marketing, no discount (MM)	1-time marketing and discount (1D)	Multiple marketing and discount (MD)
Heard of aflatoxin	0.76	0.76	0.76	0.71	0.76
Heard of aflatoxin and know that some brands are tested for it	0.14	0.25***	0.30***	0.20**	0.26***
Named study brand as labeled for aflatoxin safety	0.07	0.19***	0.25***	0.18***	0.22***
Apteca label indicates tested	0.24	0.30*	0.24	0.21	0.23
Heard of study brand	0.83	0.86	0.93***	0.86	0.90***
Has tried study brand	0.69	0.70	0.82***	0.79**	0.79**
Recalls promotions	0.14	0.31***	0.40***	0.53***	0.55***
Named study brand as promoted brand	0.08	0.26***	0.30***	0.42***	0.48***
Purchased study brand in the past 6 months	0.58	0.61	0.72***	0.70***	0.74***
Sample size	442	194	207	192	193

*** p<0.01, ** p<0.05, * p<0.1, indicates p-value for difference between treatment and control.

Table 4. Impact of marketing and temporary discount on sales

Dep.Var=ihs(kg sold)	(1)	(2)	(3)	(4)
Marketing only				
First marketing week	0.189*	0.214*	0.175*	0.200*
	(0.104)	(0.110)	(0.101)	(0.106)
First marketing + 1	0.148	0.138	0.144	0.131
	(0.094)	(0.104)	(0.093)	(0.106)
First marketing + 2	0.099	0.088	0.106	0.092
	(0.110)	(0.123)	(0.111)	(0.127)
First marketing + 3	0.108	0.106	0.113	0.108
	(0.097)	(0.104)	(0.095)	(0.104)
Second marketing week	0.336*	0.341**	0.324*	0.336*
	(0.170)	(0.170)	(0.168)	(0.170)
Second marketing + 1	0.108	0.096	0.078	0.083
	(0.177)	(0.191)	(0.178)	(0.194)
Second marketing + 2	0.039	0.054	0.002	0.044
	(0.307)	(0.315)	(0.302)	(0.310)
Second marketing + 3	0.125	0.178	0.076	0.125
	(0.185)	(0.220)	(0.183)	(0.222)
Third marketing week	0.137	0.158	0.098	0.122
	(0.190)	(0.199)	(0.187)	(0.194)
Third marketing + 1	0.156	0.184	0.110	0.125
	(0.165)	(0.170)	(0.157)	(0.167)
Third marketing + 2	0.108	0.164	0.074	0.117
	(0.136)	(0.165)	(0.138)	(0.164)
Third marketing + 3	0.122	0.130	0.102	0.124
	(0.145)	(0.158)	(0.137)	(0.157)
Baseline controls				
Baseline Tupike sales (ihs kg)	0.901***	0.846***	0.761***	0.766***
	(0.153)	(0.129)	(0.137)	(0.129)
Baseline Tupike price	-0.000	0.001	0.000	0.001*
	(0.000)	(0.001)	(0.000)	(0.000)
Baseline total sales (ihs kg)	0.091	0.067	0.160	0.121
	(0.096)	(0.103)	(0.099)	(0.106)
Baseline mean price	-0.010	-0.017	-0.017	-0.022
	(0.012)	(0.013)	(0.013)	(0.015)
Contemporaneous price controls				
(pre-discount) Tupike price			-0.004	-0.004
			(0.005)	(0.006)
Mean price of other brands			0.013***	0.012**
			(0.005)	(0.005)
No other brands offered			0.156*	0.133
			(0.086)	(0.096)

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 4. (Continued) Impact of discount on sales

Marketing plus temporary discount				
First discount week	1.300***	1.293***	1.281***	1.275***
	(0.206)	(0.213)	(0.207)	(0.218)
First discount + 1	0.461***	0.438***	0.451***	0.428**
	(0.147)	(0.162)	(0.147)	(0.165)
First discount + 2	0.474***	0.445***	0.467***	0.444***
	(0.134)	(0.150)	(0.133)	(0.150)
First discount + 3	0.417***	0.398***	0.398***	0.382**
	(0.135)	(0.149)	(0.134)	(0.151)
Second discount week	1.135***	1.116***	1.128***	1.108***
	(0.292)	(0.303)	(0.284)	(0.300)
Second discount + 1	0.402**	0.354*	0.370**	0.332*
	(0.181)	(0.185)	(0.178)	(0.187)
Second discount + 2	0.346	0.349	0.291	0.317
	(0.232)	(0.245)	(0.230)	(0.248)
Second discount + 3	0.470**	0.503**	0.435**	0.446**
	(0.213)	(0.227)	(0.204)	(0.216)
Post discount marketing	0.385*	0.373*	0.343	0.329
	(0.218)	(0.223)	(0.214)	(0.222)
Post discount marketing + 1	0.417*	0.427*	0.389*	0.384
	(0.232)	(0.256)	(0.225)	(0.242)
Post discount marketing + 2	0.331*	0.364**	0.323*	0.333*
	(0.175)	(0.182)	(0.171)	(0.180)
Post discount marketing + 3	0.219	0.196	0.207	0.187
	(0.192)	(0.199)	(0.187)	(0.193)
Post discount marketing + 4	0.400**	0.387**	0.381**	0.371**
	(0.167)	(0.184)	(0.169)	(0.184)
Post discount marketing + 5	0.220	0.177	0.209	0.170
	(0.184)	(0.183)	(0.182)	(0.183)
Post discount marketing + 6	0.266*	0.219	0.246*	0.206
	(0.142)	(0.145)	(0.140)	(0.145)
Post discount marketing + 7	0.196	0.166	0.173	0.157
	(0.195)	(0.194)	(0.188)	(0.191)
County baseline sales quarties	Yes	No	Yes	No
County dummies	Yes	Yes	Yes	Yes
Post-intervention time dummies	4-Week	Weekly	4-Week	Weekly
Observations	3,340	3,342	3,316	3,318
Number of shops	73	73	73	73

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5. Impact of marketing and temporary discount sales of other brands

Dep.Var=ihs(kg sold)	(1)	(2)	(3)	(4)
Marketing only				
First marketing week	-0.304	-0.228	-0.213	-0.193
	(0.305)	(0.307)	(0.132)	(0.149)
First marketing + 1	0.060	0.156	-0.176	-0.152
	(0.238)	(0.279)	(0.136)	(0.156)
First marketing + 2	0.299	0.461	-0.132	-0.068
	(0.228)	(0.292)	(0.129)	(0.154)
First marketing + 3	0.343	0.456	-0.024	0.038
	(0.223)	(0.296)	(0.144)	(0.170)
Second marketing week	0.173	0.200	-0.051	-0.009
	(0.424)	(0.476)	(0.151)	(0.165)
Second marketing + 1	0.086	0.074	-0.147	-0.105
	(0.421)	(0.460)	(0.199)	(0.209)
Second marketing + 2	0.025	0.043	-0.095	-0.072
	(0.495)	(0.506)	(0.297)	(0.331)
Second marketing + 3	0.544	0.546	0.084	0.079
	(0.388)	(0.474)	(0.235)	(0.253)
Third marketing week	0.417	0.459	-0.105	-0.098
	(0.369)	(0.408)	(0.232)	(0.235)
Third marketing + 1	-0.010	0.038	-0.073	-0.033
	(0.552)	(0.538)	(0.245)	(0.253)
Third marketing + 2	-0.114	-0.101	-0.010	-0.011
	(0.478)	(0.491)	(0.172)	(0.192)
Third marketing + 3	-0.101	-0.176	-0.203	-0.238
	(0.418)	(0.477)	(0.168)	(0.196)
Baseline controls				
Baseline Tupike sales (ihs kg)	-2.017***	-2.009***	-0.731***	-0.806***
	(0.391)	(0.413)	(0.183)	(0.155)
Baseline Tupike price	0.003*	0.003**	0.001	0.001
	(0.002)	(0.001)	(0.001)	(0.001)
Baseline total sales (ihs kg)	2.771***	2.667***	1.526***	1.511***
	(0.315)	(0.336)	(0.126)	(0.126)
Baseline mean price	-0.034	-0.003	0.024	0.032*
	(0.032)	(0.038)	(0.017)	(0.018)
Contemporaneous price controls				
(pre-discount) Tupike price			0.009	0.009
			(0.008)	(0.008)
Mean price of other brands			-0.023***	-0.022**
			(0.009)	(0.010)
No other brands offered			0.125	0.103
			(0.092)	(0.104)

Robust clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 5. (Continued) Impact of marketing and temporary discount sales of other brands

Marketing plus temporary discount				
First discount week	-0.801*	-0.721*	-0.366*	-0.313
	(0.407)	(0.415)	(0.214)	(0.215)
First discount + 1	-0.048	-0.007	-0.083	-0.038
	(0.239)	(0.313)	(0.129)	(0.160)
First discount + 2	0.250	0.329	0.072	0.146
	(0.217)	(0.272)	(0.128)	(0.141)
First discount + 3	0.164	0.234	0.044	0.110
	(0.235)	(0.283)	(0.152)	(0.164)
Second discount week	-0.563	-0.687*	-0.280	-0.231
	(0.371)	(0.378)	(0.246)	(0.265)
Second discount + 1	-0.100	-0.231	-0.060	-0.037
	(0.349)	(0.376)	(0.229)	(0.234)
Second discount + 2	-0.303	-0.430	0.055	0.065
	(0.437)	(0.475)	(0.175)	(0.187)
Second discount + 3	-0.195	-0.345	0.019	0.051
	(0.391)	(0.431)	(0.176)	(0.191)
Post discount marketing	-0.211	-0.289	-0.067	-0.045
	(0.392)	(0.423)	(0.129)	(0.143)
Post discount marketing + 1	-0.421	-0.532	-0.166	-0.155
	(0.357)	(0.393)	(0.196)	(0.225)
Post discount marketing + 2	-0.135	-0.241	-0.131	-0.129
	(0.420)	(0.442)	(0.173)	(0.199)
Post discount marketing + 3	-0.254	-0.377	-0.086	-0.083
	(0.462)	(0.463)	(0.198)	(0.217)
Post discount marketing + 4	0.289	0.220	0.226	0.263
	(0.681)	(0.653)	(0.268)	(0.282)
Post discount marketing + 5	-0.584	-0.540	-0.056	-0.006
	(0.443)	(0.473)	(0.147)	(0.175)
Post discount marketing + 6	-0.567	-0.681*	0.055	0.120
	(0.386)	(0.401)	(0.137)	(0.172)
Post discount marketing + 7	0.189	0.206	0.210	0.235
	(0.253)	(0.271)	(0.159)	(0.190)
County baseline sales quarties	Yes	No	Yes	No
County dummies	Yes	Yes	Yes	Yes
Post-intervention time dummies	4-Week	Weekly	4-Week	Weekly
Observations	3,127	3,129	3,116	3,118
Number of shops	73	73	73	73

Robust clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6. Impact of marketing on study brand stocks at the start of the week

Dep.Var=ihs(kg sold)	(1)	(2)	(3)	(4)
Marketing only				
First marketing week	0.475**	0.323	0.460**	0.267
	(0.238)	(0.250)	(0.225)	(0.239)
First marketing + 1	0.099	0.026	0.075	-0.031
	(0.303)	(0.372)	(0.289)	(0.357)
First marketing + 2	-0.353	-0.375	-0.366	-0.425
	(0.268)	(0.346)	(0.266)	(0.334)
First marketing + 3	-0.432	-0.502	-0.444	-0.550
	(0.358)	(0.398)	(0.352)	(0.386)
Second marketing week	-0.201	-0.188	-0.218	-0.226
	(0.264)	(0.293)	(0.271)	(0.290)
Second marketing + 1	0.198	0.160	0.158	0.113
	(0.279)	(0.330)	(0.294)	(0.334)
Second marketing + 2	0.255	0.191	0.243	0.160
	(0.338)	(0.395)	(0.336)	(0.386)
Second marketing + 3	-0.334	-0.279	-0.396	-0.353
	(0.400)	(0.447)	(0.415)	(0.446)
Third marketing week	-0.035	-0.033	-0.078	-0.081
	(0.364)	(0.433)	(0.386)	(0.439)
Third marketing + 1	0.002	0.183	-0.052	0.111
	(0.292)	(0.310)	(0.266)	(0.287)
Third marketing + 2	-0.124	-0.160	-0.161	-0.191
	(0.248)	(0.312)	(0.266)	(0.321)
Third marketing + 3	-0.183	-0.240	-0.213	-0.264
	(0.437)	(0.503)	(0.405)	(0.476)
Baseline controls				
Baseline Tupike sales (ihs kg)	0.123	0.606**	0.082	0.626**
	(0.346)	(0.233)	(0.352)	(0.239)
Baseline Tupike price	0.004**	0.002	0.004**	0.001
	(0.002)	(0.001)	(0.002)	(0.001)
Baseline total sales (ihs kg)	-0.238	-0.216	-0.367*	-0.230
	(0.233)	(0.197)	(0.211)	(0.199)
Baseline mean price	-0.036	-0.010	-0.042	-0.019
	(0.030)	(0.031)	(0.030)	(0.031)
Contemporaneous price controls				
(pre-discount) Tupike price			0.002	0.002
			(0.013)	(0.013)
Mean price of other brands			0.021**	0.023**
			(0.008)	(0.011)
No other brands offered			0.125	0.103
			(0.092)	(0.104)

Robust clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 6. (Continued) Impact of marketing on study brand stocks at the start of the week

Dep.Var=ihs(kg sold)	(1)	(2)	(3)	(4)
Marketing only				
First marketing week	0.475**	0.323	0.460**	0.267
	(0.238)	(0.250)	(0.225)	(0.239)
First marketing + 1	0.099	0.026	0.075	-0.031
	(0.303)	(0.372)	(0.289)	(0.357)
First marketing + 2	-0.353	-0.375	-0.366	-0.425
	(0.268)	(0.346)	(0.266)	(0.334)
First marketing + 3	-0.432	-0.502	-0.444	-0.550
	(0.358)	(0.398)	(0.352)	(0.386)
Second marketing week	-0.201	-0.188	-0.218	-0.226
	(0.264)	(0.293)	(0.271)	(0.290)
Second marketing + 1	0.198	0.160	0.158	0.113
	(0.279)	(0.330)	(0.294)	(0.334)
Second marketing + 2	0.255	0.191	0.243	0.160
	(0.338)	(0.395)	(0.336)	(0.386)
Second marketing + 3	-0.334	-0.279	-0.396	-0.353
	(0.400)	(0.447)	(0.415)	(0.446)
Third marketing week	-0.035	-0.033	-0.078	-0.081
	(0.364)	(0.433)	(0.386)	(0.439)
Third marketing + 1	0.002	0.183	-0.052	0.111
	(0.292)	(0.310)	(0.266)	(0.287)
Third marketing + 2	-0.124	-0.160	-0.161	-0.191
	(0.248)	(0.312)	(0.266)	(0.321)
Third marketing + 3	-0.183	-0.240	-0.213	-0.264
	(0.437)	(0.503)	(0.405)	(0.476)
Baseline controls				
Baseline Tupike sales (ihs kg)	0.123	0.606**	0.082	0.626**
	(0.346)	(0.233)	(0.352)	(0.239)
Baseline Tupike price	0.004**	0.002	0.004**	0.001
	(0.002)	(0.001)	(0.002)	(0.001)
Baseline total sales (ihs kg)	-0.238	-0.216	-0.367*	-0.230
	(0.233)	(0.197)	(0.211)	(0.199)
Baseline mean price	-0.036	-0.010	-0.042	-0.019
	(0.030)	(0.031)	(0.030)	(0.031)
Contemporaneous price controls				
(pre-discount) Tupike price			0.002	0.002
			(0.013)	(0.013)
Mean price of other brands			0.021**	0.023**
			(0.008)	(0.011)
No other brands offered			0.125	0.103
			(0.092)	(0.104)

Robust clustered standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 7. Endline consumer survey—knowledge of aflatoxin and promotion

VARIABLES	(1) Heard of aflatoxin	(2) Aware that some brands are tested for aflatoxin	(3) Names study brand as tested flour	(4) Can identify APTECA logo
Treatment groups				
Marketing	-0.0174	0.0909*	0.0856**	0.0377
	(0.0583)	(0.0458)	(0.0426)	(0.0744)
Discount	-0.0869*	0.0471	0.0822***	-0.0665
	(0.0509)	(0.0326)	(0.0273)	(0.0480)
Multiple	0.0110	0.131***	0.152***	-0.000335
	(0.0438)	(0.0419)	(0.0419)	(0.0479)
Surveyed at informal market = 1	0.0326	0.0218	-0.00820	0.0155
	(0.0492)	(0.0305)	(0.0255)	(0.0618)
Interactions				
Marketing X informal	0.0524	0.0752	0.0830	0.0999
	(0.0956)	(0.0608)	(0.0627)	(0.0983)
Discount X informal	0.134*	0.126*	0.133**	0.137*
	(0.0683)	(0.0665)	(0.0634)	(0.0822)
Multiple X informal	0.0416	0.0533	0.0338	-0.0102
	(0.0678)	(0.0567)	(0.0576)	(0.0731)
Controls for stratification	Yes	Yes	Yes	Yes
Log of weekly avg. price	Yes	Yes	Yes	Yes
Observations	1,228	1,228	1,228	1,228
R-squared	0.116	0.096	0.098	0.113
Mean: Control	0.762	0.136	0.0747	0.240

Robust clustered standard errors in parentheses.*** p<0.01, ** p<0.05, * p<0.1

Table 8. Endline consumer survey—knowledge of brand

VARIABLES	(1) Heard of study brand	(2) Has tried study brand	(3) Recalls promotion	(4) Names study brand as the promoted brand	(5) Purchased study brand in last 6 months
Treatment groups					
Marketing	0.0212	0.00398	0.0164	0.0859	-0.0239
	(0.0504)	(0.0662)	(0.0590)	(0.0604)	(0.0908)
Discount	-0.0181	0.0774	0.278***	0.228***	0.0871
	(0.0490)	(0.0583)	(0.0620)	(0.0453)	(0.0616)
Multiple	0.116***	0.154***	0.269***	0.278***	0.147***
	(0.0340)	(0.0436)	(0.0587)	(0.0493)	(0.0503)
Surveyed at informal market = 1	0.0285	0.0275	-0.124***	-0.0899***	-0.0806
	(0.0397)	(0.0543)	(0.0325)	(0.0226)	(0.0637)
Interactions					
Marketing X informal	-0.0666	-0.130*	0.315***	0.197**	0.00200
	(0.0764)	(0.0757)	(0.0900)	(0.0824)	(0.0861)
Discount X informal	0.118*	0.0961	0.226***	0.236***	0.166**
	(0.0660)	(0.0697)	(0.0711)	(0.0584)	(0.0717)
Multiple X informal	-0.106*	-0.145**	0.117	0.0621	-0.0283
	(0.0557)	(0.0714)	(0.0747)	(0.0591)	(0.0845)
County controls	Yes	Yes	Yes	Yes	Yes
Pre-treatment ave. sales	Yes	Yes	Yes	Yes	Yes
Observations	1,228	1,228	1,228	1,228	1,228
R-squared	0.103	0.174	0.160	0.156	0.183
Mean: Control	0.833	0.695	0.143	0.0814	0.581

Robust clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 1. Promotional leaflet with APTECA logo

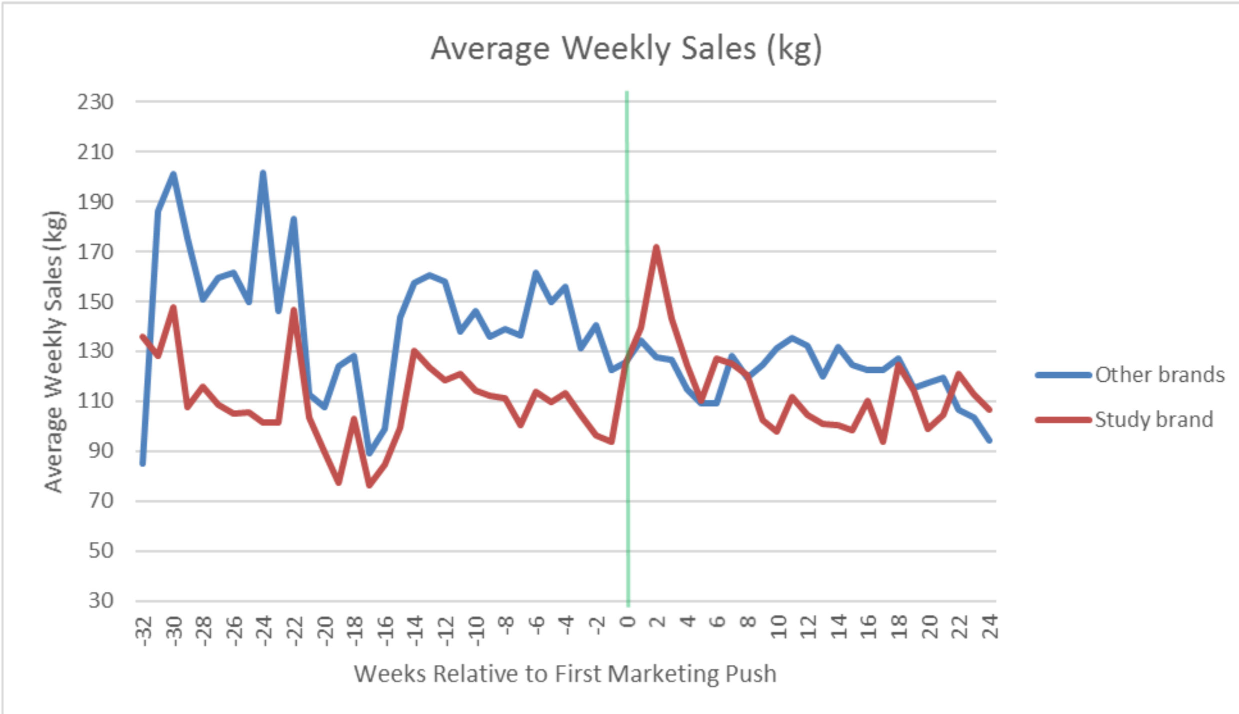

Figure 2. Average weekly sales in kilograms for study brand and other brands in recruited shops

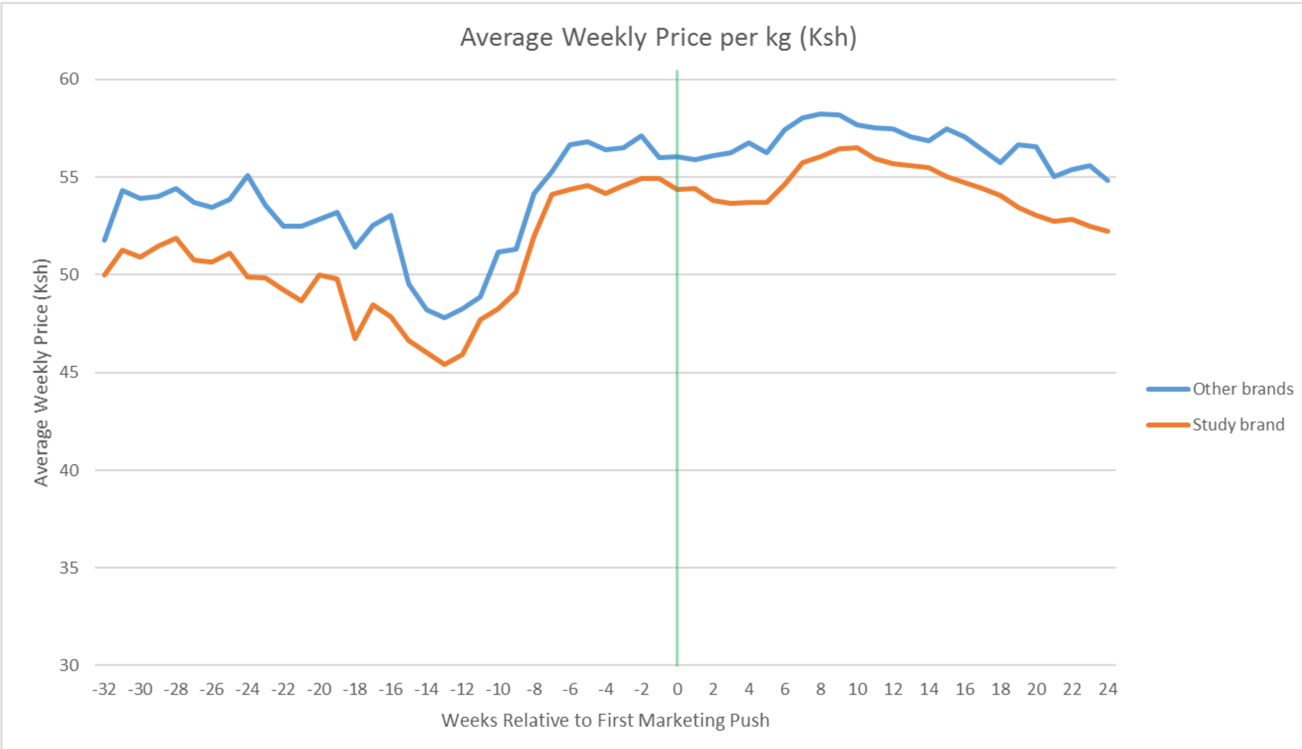

Figure 3. Average weekly price in Kenyan Shillings for study brand and other brands in recruited shops

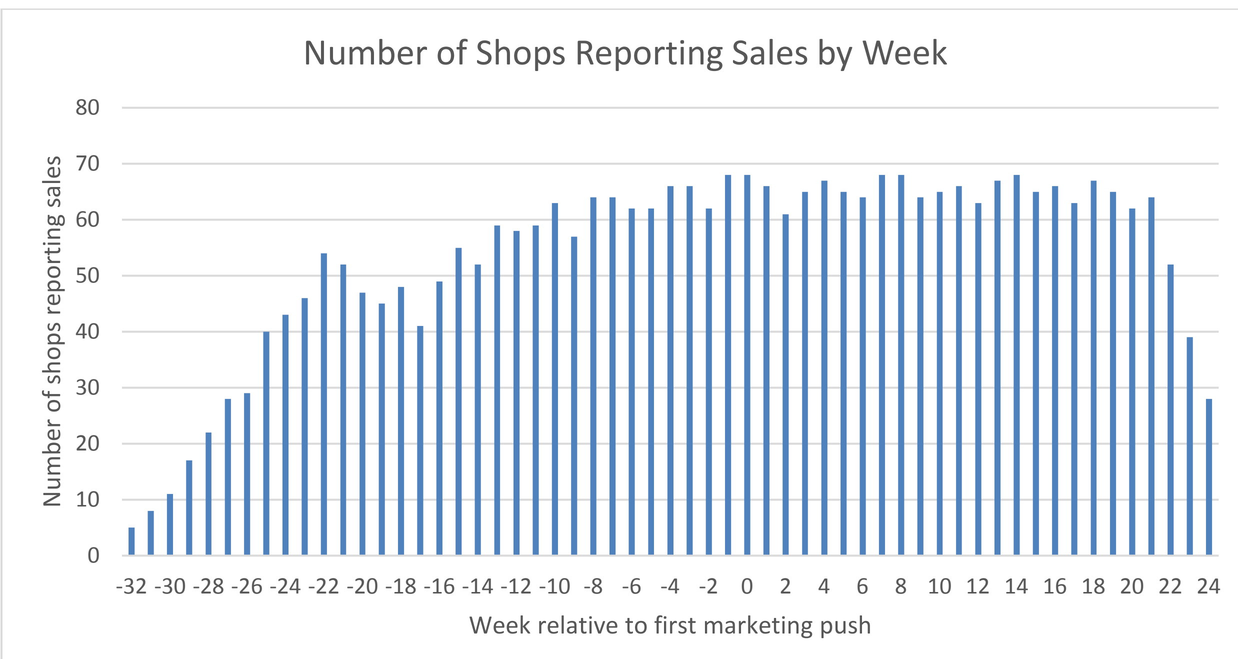

Figure 4. Number of shops reporting sales by week