

## Local Rice Market Development in Ghana: Experimental Sales of Standardized Premium Quality Rice to Retailers

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The establishment of price-quality connection is a necessary condition for an efficient market and is generally missing in the market of locally produced rice in Sub-Saharan Africa (SSA) including Ghana. Through a rice sales experiment in the markets in peri-urban Kumasi of Ghana, this study reveals that price-quality connection can be established by constant supply of standardized premium quality rice. This study also finds that retailers who adopt the connection perform better than those without it. This is empirical evidence that not only good quality local rice but also standardized quality information matter for market development and performance improvement.

**Key words:** rice market development, price-quality connection, Ghana

### 1. Introduction

Rice demand has been growing in Sub-Saharan Africa (SSA) due to population increase and urbanization, and rice import is also increasing to meet the demand particularly in coastal West African countries including Ghana (Demont, 2013). Therefore, enhancing domestic rice supply and reducing rice import have become urgent policy issues (Futakuchi *et al.*, 2013).

One of the major constraints in promoting locally produced rice is its inferior quality compared with imported rice. This problem is more serious in urban markets since urban consumers are accustomed with high quality imported rice. Thus, for domestic rice to compete with the import in urban markets, it is obvious that the quality of domestic rice must be improved. However, such improvement is not happening yet on a significant scale. Why it is difficult for such an obvious thing to happen is the motivation of this study. To find an answer to this question, we conducted a rice sales experiment in the market.

Literature shows that local consumers are willing to pay premium for high quality rice such as aromatic rice and rice with less broken content (Demont *et al.*, 2017). What is observed in many of SSA markets including our study site is, however, that local rice is retailed at puzzling uniform prices regardless of quality variation. In other words, there is no quality premium for locally produced rice. This disconnection between price and quality should hinder local rice

from the improvement of quality. We conjecture that transaction cost, particularly the cost to obtain quality information, is the cause of the disconnection in the following way. First, traders and millers in SSA are small-scale and their transactions are in small lots and infrequent: as a consequence, rice quality varies much in each transaction. Second, some quality parameters are not easily observable such as the contamination of small white stones. However, since it is too costly to investigate and compare the quality of rice over the space and time, consistent relationship between price and quality cannot emerge. We seek to address this problem by suggesting product quality standardization because it will 1) lower transaction cost of procurement; 2) be effective in connecting quality and price of local rice (Demont *et al.*, 2017; Demont and Neven, 2013); 3) enhance competitiveness and discipline market; and 4) aid in promoting market communication (Busch, 2000). In this situation, we hypothesize that product quality standardization will help the establishment of price-quality connection.

We test the hypotheses by conducting experimental sales of standardized rice in the market. We choose peri-urban markets around Kumasi, the second largest city in Ghana, as our study site because it is the very place where competition between domestic rice and imported rice is taking place and there is no institution that guarantees standards and certifies local rice for quality.<sup>1)</sup>

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1) Exception is a nascent coalition of well-resourced larger firms in product certification, the Ghana Rice Inter-Professional Body (GRIB). However, they do not include small-scale traders and millers that this study deals with.

## 2. Experiment Design

Our experiment is basically an experimental sale of standardized quality rice to retailers. The major constraint to conducting such an experiment was to obtain quality rice regularly since such local rice was not available in the market. In order to overcome the constraint, we decided to act as a rice trader/miller by ourselves.<sup>2)</sup> That is, we bought locally produced paddy of Jasmine rice and milled it at our own milling facility, where we installed an advanced 2-step milling machine with rubber hurlers and an integrated brown rice de-stoner. In addition to the internal de-stoner, we de-stoned further by a second de-stoner of polished-rice with sieving abilities to separate broken grains.

We sold our product as PREMIUM QUALITY RICE, certified by ourselves as; a jasmine variety, higher whole-grain content, higher purity and a standard measurement of 30 kg/bag (i.e. private certification). Only for the purpose of experiment, we sold ordinary quality rice at the same time. We bought the ordinary quality rice from local millers or produced it by ourselves, which retains all quality and measurement issues in local rice retail.

We chose two urban markets ( $M_1$  and  $M_2$ ) and two rural markets ( $M_3$  and  $M_4$ ) in peri-urban Kumasi. Then, one of the two urban markets and one of the two rural markets were randomly selected for the treatment markets ( $M_1$  and  $M_3$ ) and the remaining two markets ( $M_2$  and  $M_4$ ) were assigned as the control. Then, we conducted rice retailers census in March 2015, and identified 143 rice retailers in the 4 markets. Out of them, we retained 83 retailers dealing with local rice for our experiment and conducted a baseline survey. However, 3 retailers are dropped from the analyses due to imperfect information collected from them.

The sales experiment was run for one-year period from September 2015 to August 2016.<sup>3)</sup> During the experiment period, we visited each market every two weeks and sold our rice products to the retailers identified. Total number of sale visits was 23 because we did not have milled rice to sell in July 2016. It was because we could not find paddy to buy

locally due to scarcity. We used the going prices for ordinary quality rice observed at the prominent cluster of millers in central Kumasi as the reference, because retailers and wholesalers usually buy milled rice in such a miller cluster. Over the 12 months, the reference price changed three times as shown in Table 1.<sup>4)</sup>

**Table 1. Wholesale price of rice in our experiment<sup>1</sup>**

Week Period	1-2	3-9	10-19	20-23
Market price <sup>2,3</sup>	92	90	95	100
Bagging fee <sup>4</sup>	1	1	1	1
Transportation <sup>4</sup>	1	1	1	1
Our wholesale price	94	92	97	102

Notes: 1) The prices are in GHS/30 kg of milled rice. GHS stands for Ghana Cedi, the Ghanaian currency. 3.40 GHS = 1.00 USD in 2015.

2) In Kumasi local market, local rice transaction is based on volume, never on weight. At the millers, milled rice is measured by tin, fabricated specially for milled rice transaction. Based on our own measurement, we adopt the conversion rate of 30 kg/tin.

3) We weighed our milled rice and put exactly 30 kg into a bag. Therefore, in our study, per tin and per bag should be the same.

4) We charged an extra GHS 1.00 per bag for transportation since we deliver our product to retailer and an additional GHS 1.00 for bagging, which is a usual bagging cost.

The sales experiment had two phases. The first phase, or random quality phase, was for the first 10 sales, where we sold ordinary quality rice without quality information in all markets. Then, in the second phase, or standardized quality phase, we sold the premium quality rice with quality information only in the treated markets, while the sales of ordinary rice continued both in treated and control markets. The price of premium quality rice was set 15% higher than that of ordinary quality rice.<sup>5)</sup> In addition, we conducted two follow up surveys: a mid-term survey and an end-line survey. Accordingly, in our data structure, the periodicity in product choices is by design biweekly, whereas time varying variables varied at three survey points.

The hypothesis will be tested by examining if retailers that purchase standardized premium quality rice increase their

2) Our milling business is not typical in the study site because small-scale millers do not usually buy paddy, but mill paddy that traders bring to them. The small-scale traders buy paddy from farmers, mill it paying milling fee to millers, and sell milled rice to retailers or wholesalers at the mills. In this system, millers do not have incentive to improve the quality of milled rice. For rice milling in Kumasi, refer to Furuya and Sakurai (2005).

3) As we were just one of wholesalers, retailers could purchase rice from any traders as usual during the experiment period.

4) In addition to the cash sales, any retailers, regardless of the treatment status and phase of experiment, desiring to pay on

credit in a fortnight could do so at an extra cost of GHS 3.00 per bag. We allowed this credit sale because it is a common practice in the study site.

5) The margin was determined based on our preliminary discussion with retailers about their willingness to pay for the premium quality rice, while considering the feasibility of supply side. A simple calculation shows that the 15% quality premium (or about 0.14 USD/kg) will generate an extra revenue of 14,000 USD per year if a miller produced 100 tons of milled rice in a year. It will be enough to invest in a small-scale modern milling machine.

selling price of local rice, because it suggests that price-quality connection is emerging. Moreover, we hypothesize that purchasing standardized premium rice is of benefit to retailers. In this regard, we will investigate if such retailers increase their shares in the market.

### 3. Model and Identification

The retailer's performance outcomes ( $Y_{imt}$ ) are measured by (1) selling price per kilogram of local rice and (2) the share in the industry (i.e. among all the sample retailers) of the  $i^{th}$  retailer in market  $m$  at sales week  $t$ .  $P_{imt}$  is a binary dummy variable for premium rice purchase of  $i^{th}$  retailer in market  $m$  in week  $t$ . Thus, the basic model is given by equation (1) below:

$$Y_{imt} = \alpha + \beta T_m + \gamma S_t + \delta T_m * S_t + \theta P_{imt} + \mu X_{imt} + \varphi Z_{im} + \omega W_t + R_i + \varepsilon_{imt} \quad (1)$$

where  $T_m$  is a binary dummy variable for treated market,  $S_t$  is a binary dummy variable for the weeks of sales of our premium quality rice with standardized quality information ( $S_t = 1$  if  $t > 10$ ), and  $T_m * S_t$  is their interaction term.  $X_{imt}$  and  $Z_{im}$  represent sets of time-variant and time-invariant control variables respectively, detailed in Table 2.  $W_t$  is a vector of sales week dummies, and  $R_i$  is unobserved retailer's characteristics, either fixed or random, depending on the method of estimation.

The impact of product standardization (i.e. sales of premium quality rice with standardized quality information) will be captured by the coefficients for  $T_m * S_t$  or  $P_{imt}$ . The first one is the impact at the market including retailers who do not purchase our premium rice. Hence, it is an Intention-to-Treat (ITT) effect. On the other hand, the second one is the effect only on retailers who purchase our premium rice. Therefore, it is considered as a Treatment Effect on the Treated (TOT). Since purchasing premium rice depends on each retailer's decision given he/she is in the treated market and after the introduction of standardized product, the purchase is endogenous and must be treated as such.

To obtain the ITT effect, equation (1) is estimated as a retailer's fixed effect model dropping the endogenous variable and time-invariant control variables. As for the

TOT, the dummy for quality standardization ( $S_t$ ) is used as an instrumental variable (IV) for the endogenous variable,<sup>6)</sup> and equation (1) is estimated as a retailer's fixed effect model without time-invariant control variables, and as a retailer's random effect model with time-invariant control variables.

### 4. Results

We sold 21.18 MT (706 bags of 30 kg weight) of rice to sample retailers, 12.06 MT of which was bought in treated markets and 4.5 MT of which was premium rice. In the treated markets, there were 41 retailers and they had 13 times of sale visits after standardization. Out of 533 purchase opportunities, 97 premium purchases were observed.

#### 1) Descriptive statistics

Table 2 shows descriptive statistics of retailers' performance variables as well as time-variant/invariant control variables.

Two performance indicators are directly related with the hypotheses: retailer's selling price of local rice and retailer's share in the industry.

Regarding time-variant control variables, our wholesale price of ordinary rice does not differ between treatment and control markets by the experimental design, although they change over time as shown in Table 1. Other time-variant control variables are statistically different although treatment assignment was done randomly at the market level. Since average transportation cost is higher in the control markets, the uniform transportation cost charged by our experiment as shown in Table 1 may have been of more benefit to the control markets. A "margarine cup" is typically used for measuring volume of milled rice in retail shops in our study site. Although the tin cup is the same throughout a year, how much a retailer fills rice in the cup depends on the retailer and rice price while keeping the price unchanged, and hence it is time-variant. Our actual measurement of the weight shows that on average a cup is significantly weightier by 10 grams in the control markets.

#### 2) Estimation results

Table 3 shows the results of estimation of equation (1). According to the hypotheses, we use two kinds of dependent variables: one is retailer's selling price of local rice and the other is retailer's rice sales share in the industry.

6)  $S_t$  satisfies the standard criteria of a valid IV as follows. Retailers became able to buy our premium rice only after the introduction of quality standard (relevance). The quality standardization is exogenously given to retailers, and it influences only on their rice purchase behavior. In other words, since standardization is not

associated with retailer's characteristics or market condition, if it has any effect on the outcomes (either selling price of rice or share in the industry), such an effect must come only through rice purchase (exclusion restriction).

Table 3. Causal effects of purchase types on market share, and prices differentiation<sup>1</sup>

Dependent variable		Selling price of local rice (GHS/kg)			Rice sales share in the industry (%)		
Explanatory variables	Model	Fixed effect	IV-fixed effect	IV-random effect	Fixed effect	IV-fixed effect	IV-random effect
Quality standardization (dummy) <sub>it</sub>		-0.052 [0.040]	NA	NA	0.139 [0.107]	NA	NA
Treatment * Standardization (dummy) <sub>mt</sub>		-0.003 [0.036]	NA	NA	0.059 [0.161]	NA	NA
Purchase of premium rice (dummy) <sup>2</sup> <sub>it</sub>		NA	0.339 [0.164]**	0.346 [0.166]**	NA	1.389 [0.570]**	1.312 [0.605]**
<b>Time-variant control variables</b>							
Our wholesale price of ordinary rice <sub>it</sub>		0.353 [0.141]**	0.046 [0.029]*	0.047 [0.029]	-0.030 [0.578]	0.191 [0.127]	0.056 [0.169]
Actual weight of margarine cup <sub>it</sub>		-1.643 [0.893]*	-1.807 [1.093]*	-2.535 [1.170]**	0.426 [1.382]	-0.161 [0.893]	0.059 [0.587]
Transportation cost for buying rice <sub>it</sub>		0.536 [0.245]**	0.609 [0.226]**	0.579 [0.222]**	-0.690 [0.401]*	-0.413 [0.396]	-0.477 [0.406]
Cost of carrying rice back to market <sub>it</sub>		0.702 [0.229]**	0.720 [0.276]**	0.663 [0.274]**	-2.426 [1.350]*	-2.340 [1.289]*	-2.753 [1.457]*
Total rice inventory at retailer (100 kg) <sub>it</sub>		0.007 [0.007]	-0.009 [0.007]	-0.009 [0.007]	0.067 [0.045]	0.061 [0.044]	0.067 [0.045]
Time-invariant control variables		No	No	Yes	No	No	Yes
Week dummies/Survey round dummies <sup>3</sup>		Yes	Yes	Yes	Yes	Yes	Yes
Retailer's fixed effect		Yes	Yes	No	Yes	Yes	No
Constant		3.945 [0.652]**	4.890 [0.522]**	5.288 [0.641]**	0.715 [1.935]	0.159 [0.592]	3.447 [2.092]*
F test of excluded instruments <sup>2</sup>		NA	21.26***	21.23***	NA	21.26***	11.13***
Number of retailers x weeks		80 x 23	80 x 23	80 x 23	80 x 23	80 x 23	80 x 23

Notes: 1) Standard errors are clustered at retailer level and shown in brackets. <sup>\*</sup>  $p < 0.1$ , <sup>\*\*</sup>  $p < 0.05$ , and <sup>\*\*\*</sup>  $p < 0.01$ .

2) Purchase of premium rice is endogenous, and hence it is instrumented by the quality standardization dummy in the case of IV-fixed effect model and IV-random effect model. Test statistics of the F test exceeds 10 in all the models, indicating that the IV is relevant. As for exclusion restriction, Hansen J statistics cannot be applied because we have only one IV. However, as discussed in footnote 6, it is reasonable to consider that the quality standardization cannot influence directly on the dependent variables. Also note that even if we add "total rice inventory at retailer" as the second IV, the regression results are almost the same and Hansen J statistics indicates the exclusion restriction is likely to be satisfied in all the models.

3) Due to collinearity with IV, week dummies cannot be used in IV models. Instead, survey round dummies are used. These dummies correspond each period between surveys to capture time effect in the absence of week dummies.

Table 2. Descriptive statistics<sup>1</sup>

Variable	Control markets	Treatment markets
<b>Retailer's performance (<math>V_{imt}</math> and <math>P_{imt}</math>)</b>		
Local rice price per kilogram (GHS/kg)	( $n=39$ ) 4.13	( $n=41$ ) 4.58***
Shop share in the industry (%)	1.06	1.04
Purchase of premium rice (dummy)	0.04	0.10***
<b>Time-variant control variables (<math>X_{imt}</math>)</b>		
Our wholesale price of ordinary rice (GHS/kg)	3.20	3.20
Weight of milled rice per margarine cup (kg)	0.45	0.44***
Transportation cost for buying rice (GHS/kg)	0.03	0.02***
Cost of carrying rice back to market (GHS/kg)	0.07	0.06***
Total rice inventory at a retailer (100 kg)	6.11	4.64***
<b>Time-invariant control variables (<math>Z_{im}</math>)</b>		
Retailer's characteristics:		
Years in Education	7.51	7.34
Age of retailer	41.92	39.39
Years of trading at site	6.10	3.55**
Frequency of operations (binary dummies)		
Operates weekdays only	0.79	0.66*
Operates market days only	0.10	0.27**
Type of store (binary dummies)		
Fixed structure (shared)	0.74	0.71
Table, shed, hawk, floor parasol	0.21	0.27
Separate fixed structure	0.05	0.02
Location of store (binary dummies)		
In the market	0.31	0.41
Around the market	0.08	0.12
In residential area near the market	0.54	0.37*
Other places	0.08	0.10

Note: Means are displayed. <sup>\*</sup>, <sup>\*\*</sup>, and <sup>\*\*\*</sup> indicate two means are statistically different at 1%, 5%, and 10% level respectively.

The first column of each dependent variable is the estimation result of retailer's fixed effect model including the quality standardization dummy (1 after 10<sup>th</sup> sales week) and its interaction with treated market dummy (1 for M<sub>1</sub> and M<sub>3</sub>). Difference-in-differences estimator for ITT of quality standardization is obtained from the coefficients of the interaction of treatment and standardization.<sup>7)</sup> The results indicate that quality standardization has no ITT impact on the selling price or the market share. Since only some retailers bought our premium rice and the other retailers did not buy it even in the treated markets, it is natural that quality standardization has no impact on the two outcomes.

The second and third columns are instrumental variable fixed effect model and instrumental variable random effect model respectively. The impact of standardization at the retailer level (TOT) is captured by the coefficients for the endogenous dummy variable of the purchase of our premium rice.<sup>7)</sup> The results show that the purchase of our premium rice has significant positive effects both on the selling price and the share in the industry. It increases the average selling price of local rice by about 0.35 GHS/kg<sup>8)</sup> and the share in the industry by about 1.4%. The results suggest that rice quality standardization promotes the establishment of the price-quality connection and that retailers with such connection are performing better than those without the connection.

As for retailer's specific costs such as transportation costs (both human transport and goods transport) and the weight of margarine cup, we find significant effects on the retailer's selling price of local rice. With respect to the weight of margarine cup, a heavier cup tends to give a lower selling price per kg. It is interpreted by the practice observed in our study markets; that is, their transactions are based on the volume and the price is given per cup.

## 5. Conclusions

This study provides empirical evidence that price-quality connection, which is a necessary condition for an efficient market and is generally missing in the markets of locally produced rice in SSA including Ghana, can be established by constant supply of standardized premium quality rice. This

study also suggests that connecting price and quality potentially unleashes and internalizes gains from quality-upgrade.

Our findings due to premium purchases imply that good quality local rice stands a chance to survive in the competition with imports, if it comes with standardized quality information. A few limitations, however, remain in this study. 1) Demand information: Although consumer demand information is central to the evolution of retail prices, this study fails to capture the effects of within community variation in preference and quality premiums since it uses retailer level data alone. 2) Mechanisms: We recognize that the behavioral basis for quality-sensitive pricing - such as brand substitution (or expansion) mechanism and the priming effects of access to quality information - is not analysed and discussed in this paper. Such additional detailed assessments will certainly clarify and strengthen the findings.

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7) ITT is to see if we can observe any impact among retailers in the treated markets relative to those in the control markets although even in the treated markets some retailers do not respond to our intervention. TOT is to see if we can observe any impact among retailers who respond to our intervention relative to those who do not. Because of the inclusion of the non-respondents in ITT, ITT can be insignificant while TOT is significant.

8) Note that this increase is the average of all kinds of local rice the

retailers sold, including not only our premium and ordinary rice but rice from other sources. On the other hand, as shown in Table 1, our wholesale price of ordinary rice during the period we sold our premium rice was about 100 GHS/bag or 3.33 GHS/kg. Thus, our quality premium (15% of the price of ordinary rice) is about 0.5 GHS/kg. Considering that the estimated price increase is of the mixture of all kinds of rice, the magnitude of the estimated increase (0.35 GHS/kg) is quite reasonable.