On food quality in domestic markets of developing economies

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Abstract

Food quality has become an important determinant of success in global food trade and growers for international markets have to continuously adjust to buyers' requirements. It is however not clear to what extent there is a demand for food quality - and how much buyers are willing to pay for it - in the domestic food markets of developing economies. Based on unique price and trader data from domestic food markets in a poor country in Africa (Madagascar) and an emerging economy in Asia (India), we compare quality and quality's pricing. We find significantly better quality and higher quality premia (using revealed as well as stated preference methods) in the richer country, probably leading to an impetus for the development of modern market channels in this economy.

Keywords: food quality, quality premia, development
JEL codes: Q12, Q13, L15

1. Introduction

Food quality and safety have become important requirements in food trade and this also for developing countries (Swinnen, 2007; Reardon et al., 2003; World Bank, 2007). While private and public regulations have already strong impacts on export markets, requirements on quality and safety are also becoming increasingly important for domestic markets of developing countries (World Bank, 2005). However, as there are costs associated with the adjustment to high quality and safe food, it is often unclear what the demand is for quality and safety in food markets in poor countries and how much buyers are willing to pay for it. This topic is important. For example, if demand for quality and safety is high and/or changing, investments should be oriented towards developing varieties that have specific quality characteristics or towards better post-harvest technologies. If customers attach little value to quality or safety, there is little prospect for the adoption of costlier high-quality products or better post-harvesting methods. In such an environment, it seems the highest pay-off for food technology development is then in productivity increasing or input-costs reducing varieties.

In this paper, we try to better understand food quality and its pricing in developing countries. To do so, we rely on food market data from a similar survey that was conducted in two countries (Madagascar and India) in two different continents (Africa and Asia). While the two countries differ in many aspects, they especially differ significantly in economic outlook. Madagascar is a poor economy by any measure. It was estimated to have a nominal per capita GDP of only 392$ in 2007 and it was ranked 163st out of a total of 179 countries by the IMF, based on per capita GDP calculations at purchasing power parity in 2007. Different national household surveys between 1993 and 2005 have evaluated poverty headcount ratios to be around 70%. On the other hand, India is an emerging economy with significantly better economic indicators. It was ranked 129th in the same lists by the IMF and had a nominal per capita GDP of 942$ in 2007. The poverty headcount ratio in India in 2005 was evaluated at 27%.

The contribution of the paper is twofold. First, we develop an appropriate theoretical model and we then test the proposition using innovative similar price and trade surveys, relying on revealed and stated preferences, in two different countries. Such cross-country analyses have rarely been done on this theme before. Second, we find that food quality and the pricing of food quality differ marketed in these countries, most likely driven by important income differences. The structure of the paper is as follows. Section 2 presents a conceptual framework resulting in two propositions on the link between food quality and income. In Section 3, we discuss the data collection methods. In Section 4, we present the empirical tests of our propositions. We finish with the conclusions in Section 5.

2. Conceptual framework

Building on a framework developed by Gabszewicz and Thisse (1982), we assume a population of identical consumers with identical income R^*. When shopping for food, these consumers have the choice between two products: a "high quality" product A with price p_A, and a "low quality" product B, priced at p_B. Every consumer buys only one product and purchases are indivisible. All consumers have identical preferences, defined by the following utility functions:

$$U(0, R) = u_0 R$$
$$U(A, R - p_A) = u_A R - p_A$$
$$U(B, R - p_B) = u_B R - p_B,$$

whereas $u_A > u_B > u_0 > 0$, and $U(0, R)$ is the utility of having neither a unit of A, nor of B, and hence a remaining income R; $U(A, R - p_A)$ is the utility of having a unit of A and a remaining income $R - p_A$, and likewise for $U(B, R - p_B)$. If we keep the remaining income constant, product B is preferred to A; and both are preferred to having no product at all.

A consumer with income R^* will choose for buying no product at all if:
$U(0,R^*) > U(B, R^* - p_B)$, which can be rewritten as $u_0 R^* > u_B R^* - p_B$, and
$U(0,R^*) > U(A, R^* - p_A)$, which can be rewritten as $u_0 R^* > u_A R^* - p_A$, or

a consumer will not buy any of the products if

$$p_A > (u_A - u_0)\, R^* \;\; and \;\; p_B > (u_B - u_0)\, R^*$$

i.e. if the product price of product A (resp. B) is too high, if the extra utility derived from consuming one unit of A (resp. B) is not enough to compensate for its cost, or if the income of the consumer is too low. A consumer will buy a high quality product A rather than a low quality product B if:

$$U(A, R^* - p_A) > U(B, R^* - p_B), \text{ or}$$

$$p_A - p_B < (u_A - u_B)\, R^*$$

Rather than assuming that the product mix at the market is freely determined by consumer demand, we assume that it is determined by the supplier's technology constraints. The supplier can choose between different technologies. A technology T_α results in a product mix with a share α of product A and a share $(1-\alpha)$ of product B. We assume the production cost under a specific technology is a quadratic function of α: $c(\alpha) = C\alpha^2$. An important feature of a quadratic cost function is that the marginal cost of increasing α increases with α.[1] The supplier's profit function under technology T* is $\Pi^* = (\alpha^* p_A + (1-\alpha^*) p_B - c(\alpha^*)) \bullet Q$, whereas Q is total demand.

In order to maximize his profits, the supplier will choose a technology with α* such that:

$$\frac{\partial \Pi}{\partial \alpha} = p_A - p_B - 2\alpha C = 0 \qquad (1)$$

The resulting product mix at the market will be a share α^* of high quality product A, and a share $1 - \alpha^*$ of low quality product B. The market will clear, i.e. both low and high quality products will be bought, if the quality premium ($\theta = p_A - p_B$) exactly adjusts to the difference in utility which consumers derive from consumption of product A and B:

$$p_A - p_B = (u_A - u_B)R^* \qquad (2)$$

Based on equations (1) and (2), we propose two testable hypotheses:

[1] The mere disposal of low quality products could as well (in a broad sense) be seen as a "technology": it decreases the share of low quality items, and increases the production cost of high quality items.

Proposition 1: The quality premium observed in a low income economy is lower than in a high income economy.

Proof:

The higher the additional utility which consumers derive from product A, compared to product B, and the higher the income R^* of the consumers, the higher θ will be:

$$\frac{\partial \theta}{\partial R} = \frac{\partial (p_A - p_B)}{\partial R} = \frac{\partial (u_A - u_B)R}{\partial R} = u_A - u_B > 0$$

Proposition 2: Suppliers in a low income economy will choose to offer a higher share of low quality food products than in a high income economy.

Proof:

$$\frac{\partial \alpha}{\partial R} = \frac{1}{2C}\frac{\partial (p_A - p_B)}{\partial R} = \frac{1}{2C} \cdot (u_A - u_B) > 0$$

Note that the share of high quality products is expected to increase faster with income if the extra utility consumers derive from a high quality product is higher.

3. Data collection

As to better understand quality in local food markets, a primary survey was organized with traders in the traditional market outlets in similar sized cities in a poor country in Africa (Madagascar) and an emerging country in Asia (India). We decided to focus on rice - a major staple in both countries, representing about 50% and 40% of the calory intake by the average Malagasy and Indian citizen respectively – and tomatoes, a major vegetable commonly used in local dishes in both countries.

In Madagascar, we conducted a survey in the capital, Antananarivo. Traditional food retailing is done through different outlets. The most important one is the traditional daily market. Food is there sold by different traders in a designated area. Traders specialize in specific products and often only sell those. Second, micro-retailers or street-sellers also specialize in products and sell in micro-quantities. Third, small shops (*épiceries*) might sell different types of food on top of a variety of other basic products. In India, a survey was conducted in Dehradun, the capital of the northern state of Uttarakhand. Fruits and

vegetables are usually marketed by hawkers. These can have a permanent shop along the street, but usually dispose of push carts. The push carts allow for a great mobility and many of the hawkers comb the city in the morning, daily delivering fresh fruits and vegetables to people's homes. In the evening, they usually sell small wet markets. Rice is often bought in larger amounts. In one particular neighborhood of Dehradun, close to the public cereals wholesale market, there are many specialized rice & cereals shops, with favourable prices, where households go once a month to buy their rice in bulk. For special occasions, or to meet urgent needs, consumers shop at "mom-and-pop" stores (*kirana* stores), where loose rice is weighed and sold in which ever dose required.

A primary survey with traditional retailers and wholesalers was organized. The questionnaires included information on basic socio-economic characteristics of traders, purchase and sale practices, perceived price differences of quality attributes, current prices charged and paid for their produce together with a list of quality indicators. The Antananarivo surveys were conducted during November/December 2006. The sampling was set up as follows. Six districts within the city were selected. A census of all retailers that sold these two products was then done in these districts. About 30 traditional retailers, 5 streetsellers and 5 shops (if they existed) were randomly selected for each district. On top of the retail sellers, all wholesalers in rice and tomatoes in Antananarivo were visited and interviewed.[2] In Dehradun, the survey was conducted in December 2007. We interviewed 70 rice traders in Hanuman Chowk, where most of the rice wholesalers are located. The remainder of the rice traders were selected through geographical stratification. We selected randomly 2 wards[3] in each quarter of Dehradun. In each of these wards, a census was done of all the retailers, out of which 10 rice retailers were randomly chosen.

Table 1 gives a description of the sample. In Madagascar, 235 rice traders and 205 tomato traders were interviewed. About one third of the rice traders and one quarter of the tomato traders were wholesalers. There are few striking differences between the

[2] A dozen wholesalers refused to be interviewed.
[3]Dehradun is subdivided in 60 wards, each with a similar population (around 10 000).

traders of the different commodities. Only one third of the tomato traders are male. A specialization in products by gender has also been observed in other countries (e.g. Harriss-White, 1999). Because of the high number of wholesalers in the sample for rice traders, quantities sold, working capital and the value of trading assets are a bit higher than for the other categories.

In India, 151 rice traders and 157 tomato traders were interviewed. All these were retailers; some (11) of the rice retailers were also wholesalers, but there was no significant difference in prices between the wholesalers and the retailers. Tomato retailers usually had a lower education and a lower experience in trade than rice retailers. Even after controlling for wholesalers, rice traders seem to run "bigger" businesses than tomato traders: the quantities sold, their storage capacity, the value of business vehicles, as well as their working capital are much higher.

Table 1: Sample descriptives

		Madagascar				India			
	Unit	Rice		Tomato		Rice		Tomato	
		Mean	St. dev	Mean	St. dev.	Mean	St. dev	Mean	St. dev.
Socio-economic information									
age	years	35,6	10,1	35,3	11,1	37,5	9,07	32,8	10,57
education	years	9,1	3	6,9	2,7	11,9	2,29	5,8	3,85
gender	1=male	42%		29%		100%		100%	
time in this business	years	7,1	6,7	9	7,4	13,6	8,67	7	6,62
Business information									
quantities sold in a week	ton	392	854	16	12	1,921	5,832	0,592	0,296
maximum storage capacity	ton	10	45	7,5	45,7	3,672	13,235	0,155	0,227
value vehicles in business	US$*	387	3394	44	508	1071	1857	162	305
working capital	US$*	274	558	124	368	208	454	37	73
number of traders known	number	6	5,6	4,6	4,4	19	12,3	15,7	13,3
type of business									
wholesaler	%	32		25					
retailer with table	%	53		61					
streetseller	%	0		14					
shop (epicerie)	%	15		0					
Specialized cereals & pulses store	%					9			
Specialized rice shop	%					3			
Kirana store with multiple products	%					85			
Ration shop (PDS)	%					3			
Retailer fixed location without covered shop	%							8	
Retailer fixed location with covered shop	%							24	
Push cart retailer fixed location	%							50	
Push cart retailer no fixed location	%							17	
observations	number	235		205		151		157	

* 2000 Ariary = 39,4 Rupees = 1 US $

4. Results

4.1. Availability of quality products

To make cross-country comparisons meaningful, we stick to a few simple but important quality indicators, i.e. grain length, brokenness, impurity by stones and by paddy husks in the case of rice, and size, degree of rottenness and the presence of black spots in the case of tomatoes. Table 2 shows the availability of the different qualities at the different retail outlets in the two countries. For most of the characteristics, the bulk of the observations belong to the highest quality category, in India as well as Madagascar. An exception here is the size of tomatoes, as most are of medium size. If we compare the shares of the highest quality categories, India scores best for each of the indicators, except for grain length in rice.

We use a Chi-square test to formally test our proposition 1, i.e. the hypothesis that the availability of different qualities is significantly different between India and Madagascar. The Chi-square test confirms that the frequency distribution of the different qualities is significantly different between the two countries. Out of seven indicators, the poor country has six significantly lower indicators on food quality, hereby supporting our 1st proposition.

Table 2: Availability of good quality products

		Availability		Chi2-test*	
		Madagascar %	**India %**	Chi2	Pr.>chi2
Rice					
% broken	a high level	0,45	2,21		
	a medium level	19,79	17,88		
	broken <5%	79,76	79,91		
Chi2 test				7,62	**0,022**
Impurity by stones	a high level	0,60	0,00		
	a low level	23,41	4,86		
	no impurity	75,98	95,14		
Chi2 test				72,87	**0,000**
Impurity by paddy husks	a high level	0,91	0,22		
	a low level	40,00	6,84		
	no impurity	59,09	92,94		
Chi2 test				155,67	**0,000**
Grain length	round	7,55	0,22		
	medium	32,78	55,19		
	long	59,67	44,59		
Chi2 test				401,03	**0,000**
Tomato					
Level rottenness	a high level	0,82	0,00		
	a low level	37,24	1,77		
	no rotten spots	61,93	98,23		
Chi2 test				188,41	**0,000**
Spots	a high level	1,03	0,22		
	a low level	42,51	6,74		
	no black spots	56,47	93,03		
Chi2 test				161,33	**0,000**
Size	small	27,93	1,55		
	medium	41,89	62,91		
	large	30,18	35,54		
Chi2 test				129,36	**0,000**

*Chi2 test that quality availability is significantly different between Madagascar and India

4.2. Price premia for food quality

As to test our proposition 2 and to get at the value of quality attributes in these traditional market settings, we rely on two distinctive methods, one stated preference method where values of attributes were reported by traders and one revealed preference method where price premia for quality attributes were deducted from a hedonic pricing regression model done with observed price and attribute variables.

(a) Stated values of attributes

Each trader was asked to evaluate the price difference, ceteris paribus, for each of the quality attributes, comparing a better quality to a worse quality (Table 3). As to make a

cross-country comparison possible, the stated values in local currencies were then converted to dollars per kg using current exchange rates at the time of the survey. The analysis was carried out using the absolute values of attributes, but the results are robust if we compare these values with the respective commodity price averages.

In the case of rice, the stated value of each attribute is overall low in Madagascar. None of the attributes would increase the value of rice by more than 10%. The highest values (almost 10%) are attached to a level of broken rice of below 5% and to the absence of small rock particles in the rice. The relative value of different attributes compared to the total value of the crop is significantly higher for tomato than for rice, possibly indicating higher returns to improvements. There is especially a high value attached to tomatoes that are not rotten: traders estimate the quality premium at almost 50% of the average tomato price in Madagascar.

Whereas quality premia for tomatoes are generally larger in India than in Madagascar but still mostly of the same order of magnitude, there is a huge difference in the size of quality premia for rice between India and Madagascar. The average stated values of quality attributes for Indian rice are all well above 10% of the rice price. The highest values (around 45% of the rice price in India) are attached to a level of broken rice of below 5% and to the absence of small rock particles in the rice, exactly as was the case in Madagascar. Also for tomatoes, the highest valued attribute in India is also identical to Madagascar: the highest quality premium is paid for tomatoes that are not rotten and amounts to around 50% of the average tomato price.

To formally test whether the stated values of attributes in India are higher than in Madagascar, we conducted t-tests on the average stated values (Table 3). We find that the stated values of attributes are significantly higher, at the 1% level, in India than in Madagascar for 12 out of 13 attributes. As the stated values of attributes are the local traders' direct estimations of the quality premia, the fact that stated values of attributes (except for 1 out of 13 attributes) are higher in the richest country, in casu India, supports our 2nd proposition.

Table 3: Stated values of food attributes in US¢/kg

		Madagascar		India		T-test	
	compared to (default)	Mean	SE	Mean	SE	t-value	Pr (|T|>|t|)
Rice							
medium level of broken rice	high level broken rice	1,6	0,1	10,9	0,7	-15,43	**0,000**
low level of broken rice (<5%)	high level broken rice	3,7	0,3	28,0	1,8	-16,19	**0,000**
low level impurities of stone	high level impurities of stone	1,6	0,2	10,9	0,6	-17,96	**0,000**
no impurities of stone	high level impurities of stone	4,2	0,4	27,4	1,8	-14,47	**0,000**
low level impurities paddy husk	high level impurities paddy husk	1,2	0,1	10,5	0,6	-18,03	**0,000**
no impurities paddy husk	high level impurities paddy husk	2,7	0,2	24,2	1,7	-15,54	**0,000**
long grain length	medium grain length	0,2	0,0	24,9	2,1	-14,56	**0,000**
Tomato							
low level rotten	high level rotten	6,5	0,3	5,4	0,3	2,86	**0,000**
not rotten	high level rotten	12,2	0,5	13,9	0,3	-3,11	**0,000**
low level of spots	high level of spots	3,3	0,2	46,7	0,3	-3,93	**0,000**
no spots	high level of spots	6,9	0,4	11,6	0,4	-7,78	**0,000**
medium size	small size	2,7	0,2	6,3	0,3	-11,23	**0,000**
large size	small size	7,5	0,3	9,5	0,4	-4,04	**0,000**

(b) Hedonic pricing

Some respondents might have had difficulties to understand the concept of ceteris paribus as often found in the stated preference valuation literature (e.g. Murphy, 2005). We thus also rely on revealed preferences. Traders were asked detailed information on the three most important qualities that they were currently selling and on the prices that they were charging. Since the marginal yield of most characteristics and the implicit price for each attribute can be assumed constant, a hedonic price regression can be estimated where the food price is a function of characteristics of the product, through variety choices or post-harvest technologies. A simple model of the following form can then be run:

$$p_h = \sum_{k=0}^{N} \beta_{kh} X_h^k + \nu$$

where p_h is the price of the product h, X^k_h is the quantity of the attribute k of the product h, β_{kh} the implicit price, and v a stochastic error term. Similar approaches have recently been used in case studies in developed and developing countries alike by e.g. Edmeades (2007), Lambert and Wilson (2003), Dalton (2004), Langyintuo et al. (2004) and Fafchamps et al. (2008).

A hedonic regression of the log of the price per kg was thus run on quality attributes. The obtained coefficients show the rewards for these attributes. We then test through a Chow

test the significance of the difference between the pricing of food quality between countries. Table 4 shows the results. Given the caveat of a low number of observations for some quality attributes, we find that six out of nine coefficients have larger values in India than in Madagascar. However, the differences are only statistically significant (at the 10% level) in the case of rice with a degree of brokenness below 5%, and in the case of rice with long grain length.

Whereas the quality premium calculated through hedonic pricing is similar in size to the stated quality premium in the case of rice with a degree of brokenness below 5% (a price difference of resp. 0.265 and 0.280 US$/kg), the stated quality premium for long grain length in India is almost seven times the quality premium calculated through hedonic pricing. For tomatoes, even if the size of the coefficients is, as expected, higher (often double) in India than in Madagascar, the Chow-test does not reveal any significant differences. This can be largely due to the lack of observations for low quality products in India: for example, there were no observations for tomatoes with high degree of rottenness, and only 8 with a low degree of rottenness.

While the results from the hedonic price regression are less convincing than those obtained from the stated preference method, they however still overall support our 2nd proposition : in the few cases where the coefficients are significantly different from each other, it is the Indian coefficient which is highest, i.e. the richest country has a higher quality premium.

Table 4: Hedonic price regressions (pooled regressions; dep. variables is log(US$ price per kg))

			Madagascar		India		F-test**	
	compared to (default)		coeff.	t-value	coeff.	t-value	F	Prob>F
Rice*								
medium level of broken rice	high level broken rice		0,031	4,09	0,205	1,71	2,11	0,147
low level of broken rice (<5%)	high level broken rice		0,038	5,12	0,265	2,04	3,05	**0,081**
low level impurities of stone	high level impurities of stone		0,000	-0,09	-0,029	-0,41	0,16	0,687
low level impurities paddy husk	high level impurities paddy husk		0,008	3,36	0,038	0,52	0,17	0,681
long grain length	medium grain length		0,001	0,52	0,037	1,71	2,73	**0,099**
R2: overall		0,9813						
Number of observations		1046						
Tomato*								
not rotten	low level rotten		-0,021	-0,48	-0,022	-0,24	0,00	0,994
no spots	low level of spots		0,043	0,84	0,098	4,15	0,98	0,323
medium size	small size		0,125	5,21	0,205	3,57	1,66	0,198
large size	small size		0,281	8,91	0,242	4,2	0,37	0,546
R2: overall		0,9804						
Number of observations		868						

* intercept, variety measures, location dummies, retail characteristics included but not reported

** Chow-test of difference of coefficients between regressions

5. Conclusions

In this paper, we develop a model to explain the difference in the prevalence of low quality food and its pricing between richer and poorer countries. We then test the model based on comparable data between a relatively poorer and richer developing country and we find that food quality on offer and price premiums for quality are significantly lower in the poorest country. This is consistent with existing literature asserting that the demand for variety and the willingness to pay for quality are fairly limited in poor countries (e.g. Behrman and Deolalikar 1989, Antle 1999, Swinnen et al. 2008). As income increases, returns to quality and to variety are expected to go up.

This finding has implications for food market development and public investments. First, returns to public investments might differ and it seems that in the domestic food market, rewards to interventions for adopting high quality varieties or improving post-harvest technologies are significantly higher in richer economies. In poorer economies, it seems that, at least for domestic consumption, the highest pay-off for food technology development is then in productivity increasing or input-costs reducing varieties. This supports current global priorities for agricultural research for the developing world,

which focus mainly on maximizing agricultural output and reducing costs (e.g. Von Braun et al. 2008).

Second, the growth of modern retail is seemingly much slower in poor than in the relatively richer economies (World Bank, 2007). This is also found to be the case when comparing our two countries. While modern retail has been present for over a decade in Madagascar, it has however not captured a large share of the food retail market (Minten, 2008). In India, on the other hand, Reardon et al. (2008) argue that the fastest food retail revolution is occurring with annual growth rates of 75% or even higher. This slow growth in the poorer countries can then potentially be explained by the lower profit opportunities for modern retail as they usually focus on the distribution of higher quality food products in which they might have comparative advantages (Reardon et al., 2003).

Finally, while it is notoriously difficult in empirical cross-country comparisons to assign the differences in outcome to one determining factor, we assume in our study, given that the income difference is so large, that it dwarfs the other factors that might influence the development of a high-quality food industry such as capital constraints, transaction costs, the agricultural production structure, policies and institutions (Swinnen et al., 2008). This assumption without proof is a weakness of the current study and examining the exact contribution of these different factors should be fertile ground for future research.

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