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Food quality in domestic markets of developing economies:
A comparative study of two countries

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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 domestic food markets of developing economies. Based on unique comparable price and trader data in a poor country in Africa (Madagascar) and an emerging economy in Asia (India), we compare food quality and quality's pricing. We find significantly better quality and higher quality premiums (using revealed as well as stated preference methods) in India than in Madagascar. We explain these observed differences through a simple theoretical model, solely based on large average income gaps between the two countries.*

JEL classification: Q12, Q13, L15

Keywords: food quality, quality premiums, development

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1. Introduction

Food quality and safety have become important requirements in food production and markets. This is also increasingly so in developing countries (Swinnen, 2007; Reardon *et al.*, 2003; World Bank, 2007). While private and public regulations on quality and safety have important impacts on developing countries' agricultural production systems through export markets, it has been argued that quality and safety considerations are also becoming increasingly important for domestic markets of developing countries (World Bank, 2005). However, it is often unclear what the demand is for quality and safety in these domestic food markets in developing countries and how much buyers are willing to pay for it.

This topic is important for three reasons, related to technology development policies, market transformation, and analysis of food demand. First, 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 and safer post-harvest technologies (see for example Unnevehr, 1986). 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.

Second, the demand and willingness-to-pay for quality may lead to market transformation, e.g. changing preferences might be important determinants of the potential market opportunities for modern retail chains, which are often focused on products in the higher quality ranges (Reardon *et al.*, 2003). In many countries, it has been observed that the take-off of investments by modern retail chains sparks a much broader sector-wide structural transformation of local agricultural supply chains with important implications for small farmers (e.g. Reardon and Timmer, 2007).

Third, consumers have been shown to switch from low-value to high-value commodities with increasing incomes (e.g. Deaton and Muellbauer, 1980; Gabszewicz and Thisse, 1979; Pingali, 2004). In particular, several empirical studies illustrate that in the process of development, consumers shift from less expensive staple foods such as cereals to more expensive foods such as fruits and vegetables, meat and dairy (e.g. Ye and Taylor, 1995; Sahn, 1988; Joshi *et al.* 2007; Ito *et al.* 1989). There is much less empirical evidence on the demand for different qualities of a particular commodity. However, ignoring these quality issues in empirical food demand analysis and projections might lead to substantial biases (Deaton, 1988; Yu and Abler, 2009).

In this paper, we make three contributions to the (limited) international literature in this area. First, we have collected unique primary data on food quality measures for the same commodity in the domestic markets of two countries (India and Madagascar), both poor but at different stages of development, and we empirically explore the differences between the two. Both markets are unregulated with respect to the (simple) quality indicators that we measure. We find that the food quality[3] on offer and the price premium for food quality differ markedly between these countries. Second, we develop a theoretical model which can potentially explain the differences in food quality solely based on the significant average income differences that exist between these two countries. Our model predicts that market transformation in developing economies due to income increases is driven by these two factors, i.e. increased demand for quality and an increasing price premium for quality. Interestingly, no regulations on quality standards are present in our model as a driver for the transformation of food markets and higher-quality food is just delivered because of the increasing demand and willingness to pay for it. Third, we implement and compare the results of stated and revealed preference methods to get at the value of food quality and of food attributes. This has rarely been done in the setting of developing countries.

The structure of the paper is as follows. In Section 2, we discuss the data collection methods. Section 3 reports and discusses the results of statistical analysis of these data and Section 4 presents a conceptual framework which can explain these results. Section 5 discusses the implications of our results for modern market development in the countries under study and Section 6 concludes.

[3] We focus on the demand for search attributes, and more in particular on value attributes – reflecting organoleptic aspects of quality (in particular appearance and aroma). According to Bowbrick (1982), these are surrogates for flavor.

2. Data collection

As to better understand the demand for food quality in local food markets, a primary survey was organized with traders in traditional market outlets in similar sized cities in a poor country in Africa (Madagascar) and an emerging country in Asia (India).

In Madagascar, we conducted a survey in Antananarivo, the capital of the country. Traditional food retailing is done through different outlets. The most important one is the traditional daily market. Food is sold there by different traders in a designated area. Traders specialize in specific products and often only sell those. Traders of similar products are usually clustered in the same area within the market. Second, micro-retailers or street-sellers also specialize in specific products, sell in micro-quantities, and operate often without formal registration, outside formal markets and outside regular hours. 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 through hawkers here. These can have a permanent shop along the street, but usually rely on push carts, which they use to transport their merchandise from the (mostly public) wholesale markets to a strategically well chosen and semi-permanent spot, close to the consumers' homes. The push carts allow for mobility and many of the hawkers comb the city in the morning, daily delivering fresh fruits and vegetables to people's homes. In the afternoon, they sell at smaller fresh markets where consumers can visit them. In these settings, customers prefer to buy fruits and vegetables daily in relatively small amounts, partly because many households do not own a refrigerator yet.

Staples like rice, being easier to store, are often bought in larger amounts and not on a daily basis. In one particular neighbourhood of Dehradun, close to the public cereals wholesale market, there are many specialized rice and cereal shops, with favourable prices, where a number of households go once a month to buy their rice in bulk. For special occasions, or for some households to meet their daily needs, consumers shop at "mom-and-pop" stores (*kirana* stores), where loose rice is weighed and sold in whichever dose required. Under some conditions, poor households have access to ration cards that allow them to buy rice at below market rates through the Public Distribution System, a safety net subsidized by central as well as state governments.

As to make data collection manageable, it was decided to focus on two major products: on the one hand rice, the main staple in both countries, representing around 50% and 40% of the calories consumed by an average Malagasy and Indian citizen respectively; on the other hand tomato, a major vegetable commonly used in local dishes in both countries. The survey questionnaires included information on basic socio-economic characteristics of traders, purchase and sale practices, perceived price differences of specific quality attributes, current prices charged and paid for their produce together with a list of quality indicators.

The Madagascar survey was conducted during November/December 2006 in several districts of Antananarivo. Almost 450 traders were interviewed in total, of which 233 rice traders and 205 tomato traders. The sampling was set up as follows. Six districts within the city were selected. A census of all the shops, streetsellers and sellers on traditional retail markets 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.[4] About one third of the rice traders were wholesalers. No street sellers of rice could be found in the areas that were surveyed. One quarter of the tomato traders were wholesalers. In the case of tomato traders, no shops (*épiceries*) could be identified that would carry those.

For the India survey, in December 2007, around 300 traders were interviewed in Dehradun, the state capital of Uttarakhand (North India), i.e. 151 rice traders and 157 tomato traders. More specifically, 70 rice traders were interviewed at Hanuman Chowk, the area where most of the rice wholesalers are located. Many of the wholesalers are also retailers. The remainder of the rice traders were selected through geographical stratification. Dehradun counts 60 "wards" (subdivisions of the city), with each having a population of about 10,000. We randomly selected 2 wards in respectively the east, the west, the north and the south of Dehradun – in total 8 wards. In each of these wards, a census was done of all the retailers, and out of this census, 10 rice retailers were randomly chosen. This yielded another 80 rice traders. As for the tomato traders, we interviewed 70 traders on the four major retail markets of the city (*Old Subzi mandi*, *Tehsil* market, *Dharampur* market and the *Niranjanpur mandi*); 80 other retailers were

[4] A dozen wholesalers refused to be interviewed.

selected through geographical stratification in the same wards where the rice traders were selected.

Table 1 gives a description of the sample. There are a few striking differences between the traders of the different commodities. Only one third of the tomato traders are male in Madagascar. This number is significantly higher for rice. A specialization in products by gender has also been observed in other countries (e.g. Harriss-White, 1999). Tomato retailers have less experience in trade than rice retailers. Education levels of retailers are relatively high compared to the average national level, indicating that to be successful as a trader some good notions of accounting and arithmetic, often only taught in schools, are needed. The education level is in both countries higher for rice traders than for tomato traders.

In India, all traders were retailers – but 7% of the rice retailers and 1% of the tomato retailers considered themselves as wholesalers in addition. Nevertheless, there were no significant price differences between wholesalers and retailers in India, neither for rice, nor for tomato. In contrast, in Madagascar, 32% of the rice traders and 25% of the tomato traders were wholesalers, offering significantly lower prices than retailers.

Even after controlling for wholesalers, rice traders seem to run significantly “bigger” businesses than tomato traders, in India as well as in Madagascar: the quantities sold, their storage capacity, the value of business vehicles, as well as their working capital are much higher. In line with results by Minten *et al.* (2010), we find that, while street sellers are important for the distribution of fresh fruits and vegetables, their turnover is often less than the turnover of those traders that operate out of wet markets: in India, the former sell on average 87 kg of tomatoes per week, as compared to 188 kg per week for the latter. In Madagascar, the corresponding figures are 118 kg and 200 kg.

In India, we observe strong differences with respect to the format of retail shops supplying vegetables and of those supplying processed foods such as rice. An overview of the different formats as well as of their relative frequency is presented in Table 1. This confirms earlier findings from a case study done in Delhi (Minten *et al.*, 2010). While tomato sellers in India are often mobile, with a push cart allowing them to go from house to house, most of the tomato sellers in Madagascar are not mobile.

3. Results

3.1. Availability of quality products

To make cross-country comparisons meaningful, we stick to a few simple, easily comparable quality indicators, which came out during pre-testing to be important for quality, 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.[5] 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, where most of the tomatoes 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 whether 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, Madagascar has six significantly lower indicators on food quality: brokenness, impurities by stones and by paddy husks for rice, and degree of rottenness, presence of spots and size for tomatoes. Only in the case of grain length does Madagascar have a higher availability of the highest quality category, i.e. the long grain rice.[6]

3.2. Price premiums for food quality

Marginal prices of specific quality attributes cannot be directly observed from market transactions, as quality attributes are embedded in a product. Hence, in order to get at the value of quality attributes in these traditional market settings, we rely on two distinctive methods. The first is a stated preference method where values of attributes are reported by traders in response to open-ended elicitation questions; the second is a revealed preference method where price

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[5] In the survey setup, we made sure to minimize the leeway for subjective interpretation of the quality attributes and examples of different qualities were shown to the enumerators. For example, the different quality categories for rice grain length were defined as "round", "medium", or "long", which are widely used characteristics of rice in these markets; the categories for degree of brokenness are "high degree (> 15% broken)", "medium degree (5-15% broken)", and "low degree (< 5% broken)."

[6] For a more general discussion of the characteristics of rice varieties available in Madagascar, see Fidelis *et al.* (1990).

premiums for quality attributes are derived from a log-linear hedonic pricing regression model fitted to observed price and attribute variables.

Several authors have compared the usefulness of revealed versus stated preference methods. The general consensus is that revealed preference methods are more valid, as they reflect market discipline, whereas stated preference methods may be more useful for "out of range" predictions, i.e. estimations of values which are not directly observed at the market (Azevedo *et al.*, 2003). Stated preference methods tend to overestimate real valuations, due to the hypothetical bias problem (e.g. Harrison and Rutström, 2008). However, in a review of existing evidence, Murphy *et al.* (2005) find the bias to be less important than commonly assumed, especially for the valuation of private goods. The hypothetical bias is also argued to be lower for respondents who are familiar with the good being valued (Harrison and Rutström, 2008).

(a) Stated values of attributes

In order to reduce hypothetical bias, it was decided to survey traders, rather than consumers, as the former are much better informed about current prices which may fluctuate from day-to-day. Moreover, trader-reported price data are also assumed to be more accurately reflecting real sales prices, less noisy and less dependent on customer-related idiosyncratic errors (e.g. in terms of market information). This is similar to the approach taken by Amegbeto *et al.* (2008). Each trader was asked to evaluate the price difference, ceteris paribus, for each of the quality attributes described in Section 3.1., comparing a better quality to a worse quality (Table 3). For example, we asked "What is the price differential of rice of long grain length compared to rice of medium grain length, everything else being equal?" As to make a cross-country comparison possible, the stated values in local currencies were then converted to dollars per kg using exchange rates at the time of the survey. The analysis was carried out using the relative values of attributes (relative to the mean observed price in each country), but the results are robust (and even more significant) if we use absolute values.

In the case of rice, the stated value of each of these attributes is overall low in Madagascar. None of the better quality attributes would increase the value of rice by more than 10%. The highest values (resp. 8% and 9%) 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 premiums for tomatoes in India are generally larger than in Madagascar (except the quality premium for medium vs. high degree of rottenness), but still mostly of the same order of magnitude, there is a huge difference in the size of quality premiums 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 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, t-tests were conducted on the average stated values (Table 3). The stated values of attributes are higher in India than in Madagascar for 12 out of 13 attributes. Similarly, the differences between averages are significant at a 5% level of confidence for 12 out of 13 attributes. As the stated values of attributes are the local traders' direct estimations of the quality premiums, we thus find that they are, except for 2 out of 13, significantly higher in India.

(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); especially as there may be some correlation between certain quality attributes. This implies that respondents face difficulties in disentangling the separate contributions of single quality attributes which usually come "as a package" (Almond and Hausman, 1994), and is often referred to as a problem of "embeddedness".

We rely on revealed preferences to try to separate the values of attributes that are sold as a package. Traders were asked detailed information on the three most important qualities that they were selling and on the prices that they were charging on the day of the survey. 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:

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

where p_h is the price of the product h, X^k_h is the quantity of attribute k contained in 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), Langyinto *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 in the pricing of food quality between countries. Table 4 shows the results.

Apart from a few coefficients which have an unexpected sign, the coefficients from the hedonic price regression are larger in India than in Madagascar. The differences are only statistically significant (at the 10% level) in the case of rice with a degree of brokenness below 5% (vs. high degree), and in the case of rice with long grain length (vs. medium length). For the former attribute, the absolute value of the premium in India is more than nine times larger than the one in Madagascar. For the latter, the India coefficient is almost 50 times larger than the Madagascar one.

Interestingly, the quality premium calculated through hedonic pricing is similar in size to the stated quality premium in the case of rice with a medium degree of brokenness (a price difference of resp. 23% and 18% for India and 3% for both methods in Madagascar)[7] – and there are more characteristics with relative price differentials of the same size order. Nevertheless, the stated quality premium for long grain length in India is more than ten times the quality premium

[7] Note that the correct interpretation of the coefficient β of a dummy variable in a loglinear regression as a percentage change of the dependent variable is $(e^{\beta} - 1)$*100 – which can be approximated by β*100, especially at lower levels of β.

calculated through hedonic pricing; and likewise for stone and paddy husk impurities. This might be a signal of the embeddedness problem mentioned above.

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 indicate 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 medium degree of rottenness.

Even if the results provided by the hedonic price regression are less supportive than those from the stated values of attributes method, they still suggest that, in the cases where the coefficients are significantly different from each other, it is the Indian coefficient which is highest, i.e. India has a higher quality premium.

4. A tentative explanation

4.1. Income and food demand

(a) Literature review

Existing literature points at the fact that with increasing incomes, consumers switch from low-quality or low-value commodities to high-quality or high-value commodities (e.g. Bils and Klenow, 2001; Gabszewicz and Thisse, 1979; Pingali, 2004). In particular, several empirical studies have shown that with development, consumers shift from less expensive, staple foods such as wheat and rice to more expensive foods such as fruits and vegetables, meat and dairy (see e.g. Ye and Taylor, 1995 for China; Sahn, 1988 for Sri Lanka; Joshi *et al.* 2007 and Ito *et al.* 1989 for several studies on South Asia and Asia respectively).

A related topic is the demand for different qualities (or quality attributes) within a specific commodity. Broadly speaking, the literature distinguishes three categories of quality attributes in a food product (Nelson, 1970; Caswell and Mojduszka, 1996): “search” attributes are quality attributes which are directly observable, as consumers can inspect goods and obtain full information on their quality prior to purchasing them; “experience” attributes are quality attributes which are only observable after purchase, through consumption; finally, “credence” attributes are quality aspects which remain unobserved, even after purchase (e.g. production according to specific environmental or social standards). Several studies have focused on the demand for these attributes, based on different methodologies. They are briefly reviewed below.

A few studies on the demand for "search" attributes use hedonic price analyses (e.g. Amegbeto *et al.*, 2008; Langyintuo *et al.*, 2004), but they do not establish a link to consumer income. Existing studies which take into account consumer income are mostly focusing on "credence attributes", such as organic or environmentally-friendly food (e.g. Blend and van Ravenswaay, 1999) and fair-trade goods (e.g. Howard and Allen, 2008).[8] Contrary to the widely perceived view that higher income leads to a higher willingness-to-pay for quality, Howard and Allen (2008) find that higher income groups are willing to pay less for a "domestic fair trade" label, reflecting better wages and health conditions for domestic workers. In the study by Blend and van Ravenswaay (1999), income does not seem to have a significant effect on the probability of buying eco-labeled products. A possible explanation may be that the direct consumer benefits of these credence attributes are less obvious and more subject to personal beliefs and ideologies.

Yu and Abler (2009) use Chinese panel data to estimate a regression of unit values for specific food groups on household characteristics such as income, assets, household size, and education, echoing a methodology proposed by Deaton (1988). They find that rising household incomes lead to significantly higher unit values for staple foods as well as for high-value foods, suggesting an increased demand for quality. However, both Yu and Abler (2009) and Deaton (1988) lack directly observed unit prices; they use the ratio of expenditures over quantity for each food group as a proxy. Another recent study by Stevens and Winter-Nelson (2008) relate an indirect measure for the income of consumers, in particular the frequency with which they eat meat, to their willingness to trade local white maize varieties for a novel variety of bio-fortified yellow maize. While bio-fortification is clearly a positive "credence" quality attribute, the organoleptic characteristics associated with bio-fortification are usually less preferred than those of traditional white maize varieties. The results of the study show that poorer consumers are more likely to accept bio-fortified maize than richer consumers.

[8] Most of these studies use stated preference methods and hence do not directly observe consumer decisions.

In short, the upshot of the empirical literature is that income is an important driver for food demand differences between households, leading to a change in the type of commodities consumed as well as the quality of commodities.

(b) Income differences between Madagascar and India

While the two surveyed countries are both poor, Madagascar is considerably behind India. 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 163rd 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%. India is a developing economy which is rapidly growing. 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%.

These differences at the national level are also reflected in the income data for the two cities where the survey was fielded. In Antananarivo, the capital of Madagascar, annual per capita consumption expenditures are estimated at 500,693 Ar or 250 US$ in 2006.[9] Though data availability is scarce for Dehradun, the annual per capita consumption expenditure in Dehradun, based on government surveys, is estimated to be around 21,618 Rs, or 546 US $.[10] So, the average income level in Dehradun is estimated to be at least twice as high as in Antananarivo.

Such income differences matter within both countries for food demand - and hence for the demand of the two crops under consideration - as shown by several empirical demand studies. In the case of Madagascar, Ravelosoa *et al.* (1999) show based on national consumption surveys that income elasticities of the demand for rice and vegetables are as high as 0.47 and 1.18 respectively. In the case of India, Mittal (2006) shows income expenditures for the cereals category and for the fruits and vegetables category are 0.17 and 0.72 respectively. These results illustrate two important points of empirical demand analysis in developing countries (e.g.

[9] This estimate for annual per capita consumption expenditure applies to the urban region of Analamanga, which broadly corresponds to Antananarivo, and is provided by INSTAT (2006).

[10] This estimate applies to the city of Dehradun and is provided by the Urban Development Department of the Government of Uttarakhand (2007), whereas the average household size has been inferred from the ratio of income per household to income per capita.

Timmer *et al.*, 1983). First, income is an important determinant of food demand within the country; and a doubling of income leads to increases in demand for these crops between 17% and 118%. Second, there is a significant decline of income elasticities for these food products in the richer country (India) compared to the poorer one (Madagascar). This is consistent with existing literature pointing at the fact that income elasticities of food demand decline with increasing incomes; and that income elasticities of demand for high-value products such as vegetables are higher than for staples such as cereals (e.g. Pinstrup-Andersen and Caicedo, 1978; Park *et al.*, 1996).

4.2. A theoretical model

Given the large income differences between the two cities/countries and given the importance of income in empirical food demand studies, we build a theoretical model with income as a driver for changes in demand for quality between countries as to better understand the underlying economic fundamentals. We draw on Lancaster's (1966) classical approach of considering a product as a bundle of characteristics, which consumers derive utility from. His consumer demand model has been developed further and linked to a supply model in later research work (e.g. Hendler, 1975; Lucas, 1975; Ladd and Suvannunt, 1976; Rosen, 1974). Our framework is a reduced form model in which the availability of quality and its price are endogenously determined. It is close to Lucas' (1975) and Rosen's (1974) model in that it combines a demand and supply model through a market clearing equation. However, it is different from their approach in that it does not assume away spillovers between the production of different qualities. More in line with agricultural production realities, producers choose a level of technology which determines their product mix of varieties with low and high organoleptic quality attributes. Moreover, we establish an explicit link between the income level and the utility which can be derived from higher quality products (which come at a higher price).[11]

[11] This is not a very strong assumption, as it is quite intuitive to assume that the marginal rate of substitution between (remaining) income and quality is higher at low levels of income, if marginal returns to income are decreasing. For reasons of simplicity, we assume that utility is linearly increasing in remaining income; but the same results can be shown to hold for a more general specification of the utility function, such as e.g. the one proposed by Tirole (1988: 97), where for $i = A, B$ and s_i the quality level of the good consumed, with $s_A > s_B$ and $p_A > p_B$, as long as U is increasing and concave in R and Φ increasing in s.

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 at most 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 A is preferred to B; and both are preferred to having no product at all.

A consumer with income R^* will choose to buy 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: $c(\alpha) = C_0 + C\alpha^2$. An important feature of a quadratic cost function is that the marginal cost of increasing α increases with α.[12] This corresponds to Caswell and Mojduszka (1996)'s finding that the supply of food quality is subject to rising marginal costs. 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:[13]

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

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

Proposition 1: 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.

Proposition 2: The quality premium observed in a low income economy is lower than in a high income economy.

Proof:

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[12] 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.

[13] In contrast with the work by Mussa and Rosen (1978) and others on strategic pricing by a monopsonist or strategic behaviour in a duopsony context (e.g. Gabszewicz and Thisse, 1979; Wauthy, 1996), but in line with Rosen (1974), we assume pure competition, which is a more realistic assumption for the markets under study.

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:

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

Hence, not only will consumers in the high-income country buy foods of higher quality and higher prices; our model also predicts that the price differential between high- and low-quality varieties will also increase with income.

As Dehradun (India) has an average income level which is roughly twice the level of Antananarivo (Madagascar), this model thus provides a plausible explanation for the empirical findings of (a) more high-quality varieties on offer in Dehradun than in Antananarivo; and (b) a higher quality premium in Dehradun than in Antananarivo. While other factors such as capital constraints, transaction costs, the agricultural production structure, policies and institutions could also affect the supply of food quality (see e.g. Vandemoortele *et al.*, 2009), these determinants have however received little attention in food demand models, theoretically and empirically (e.g. Deaton and Muellbauer, 1980). Exploring the exact relative contributions of these factors, compared to income, in markets for food quality - and especially in the relative contribution on the supply side - should be fertile ground for future research.

5. Impact of differences in food quality demand on market development

The increasing demand for quality and the increasing premium for food quality might lead to structural market changes in food value chains of emerging economies. Examples include the emergence of modern retail and the increasing importance of branding (Reardon and Timmer, 2007). Especially modern retail has been shown in the last decade to emerge quickly in developing countries, apparently driven by superior logistical operations on the supply side, and by changing consumer preferences on the demand side (Reardon *et al.*, 2003).

Modern retail is also emerging, but from a low base, in both countries under study, but at largely different speeds. In Madagascar, the estimated growth rate of modern retail was as high as 10% over the period 1995–2006 (Minten, 2008). In India, on the other hand, it is shown that modern retail is growing much faster, at an annual compounded growth rate of about 50% in the period 2001-2009 (Reardon *et al.*, 2010).

Two recent studies in Madagascar and India document the importance of quality for rice and tomato in two different market outlets, in particular modern retail and traditional markets. In Madagascar, the product quality on offer in modern supermarkets (and even more so in multinational branches) was found to be higher than the product quality offered in traditional markets (Minten, 2008: Table 2). For example, the supply of local low quality rice (as a share of all rice sold) was 37% in traditional markets, compared to 0% in modern supermarkets. Conversely, the supply of local high quality rice and of imported rice was 49% and 13% respectively for traditional markets, versus 75% and 26% for modern markets. For tomatoes, only 54% of the varieties on offer were free from rotten spots in traditional markets. The corresponding figure for modern markets was 80%. Similar results were found for other quality attributes.

Minten *et al.* (2010) find comparable results for different rice qualities on offer in traditional and modern markets in India. While 93% of the rice qualities on offer in the modern retail markets under study consisted of basmati, which is considered to be the best quality rice in India; in traditional markets only 48% of the offered varieties were of the basmati type. Along the same lines, 88% of the rice qualities on offer in modern retailers were branded, compared to only 31% for traditional retailers. Surprisingly, the results for tomato qualities on offer were not in line with our expectations, as in traditional markets, 56% of the varieties were free from rotten spots; while only 25% were so in modern markets. The lack of quality for vegetables in modern retail in India is linked to the general lack of know-how of perishable food supply chain management given that most modern retailers only recently entered the food business.

Irrespectively of this final, rather surprising, observation, in general these results indicate that modern market outlets are focusing more on products in the higher quality range than traditional channels. The much more rapid emergence of modern retail in India can thus potentially be explained by the higher demand for food quality. Our model predicts that the potential for modern retail will be further enhanced through increasing returns to investment in quality with income growth. Conversely, our findings suggest that the slower growth of modern retail in Madagascar might be due to the lower profit opportunities for modern retail as the latter usually focuses on the distribution of higher quality food products in which it might have a comparative advantage (Reardon *et al.*, 2003). More generally, the findings in this paper might thus help to explain the differences in speed of emergence of modern retail between different countries, as for example documented in Traill (2006).

6. Conclusions

In this paper, we empirically explore for the same commodities the difference in the supply of quality and its pricing between two countries (India and Madagascar), both poor but at different stages of development. Both markets are unregulated with respect to quality. We find that food quality on offer and price premiums for quality are significantly lower in Madagascar. We subsequently present a simple theoretical framework that explains these stylized facts based on important income differentials that exist between both economies: average incomes are at least twice as high in India as in Madagascar. The transformation towards a high-quality food economy is in such a model explained by an endogenous shift because of changing consumer preferences but without any regulations on food quality.

The results have important implications for food market development, public investments and food policy analysis. 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 cost-reducing varieties. This supports current global priorities for agricultural research for the developing world, which focus mainly on maximizing agricultural output and reducing input costs (e.g. Von Braun *et al.* 2008).

Second, the growth of modern retail seems 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 not been able to capture a large share of the food retail market (Minten, 2008). In India, on the other hand, Reardon *et al.* (2010) argue that the fastest food retail revolution has been occurring with annual growth rates of around 50% over the past decade. It seems that the slow growth in poorer countries may be partly explained by the lower profit opportunities for modern retail as the latter usually focuses on the distribution of higher quality food products.

Third, in view of the ongoing debates on food demand projections and their implications for future food prices, a correct estimation of demand systems which takes into account quality differentials within commodities seems important in generating correct food market projections and analysis. The presence of a positive quality elasticity of income seems especially significant for rice, a major staple in both Africa and Asia, but is currently ignored in most of the empirical demand analysis.

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Tables

Table 1: Sample descriptives

	Unit	Madagascar				India			
		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	9.1	32.8	10.6
education	years	9.1	3.0	6.9	2.7	11.9	2.3	5.8	3.9
gender	1=male	42%		29%		100%		100%	
time in this business	years	7.1	6.7	9.0	7.4	13.6	8.7	7.0	6.6
Business information									
quantities sold in a week	ton	1.23	1.94	0.65	1.28	1.92	5.83	0.59	0.30
maximum storage capacity	ton	3.40	5.98	0.96	1.86	3.67	13.24	0.16	0.23
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	6.0	5.6	4.6	4.4	19.0	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 $

Source: Authors' own survey

Table 2: Availability of good quality products

		Availability		Chi2-test*	
		Madagascar	**India**	Chi2	Pr.>chi2
		%	**%**		
Rice					
% broken	a high level (> 15%)	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

Source: Authors' own survey

Table 3: Stated relative values of food attributes (in % of average price level)

		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 (>15%)	3.5	0.3	17.7	1.1	-14.03	**0.000**
low level of broken rice (<5%)	high level broken rice (>15%)	8.0	0.7	45.1	2.8	-14.98	**0.000**
low level impurities of stone	high level impurities of stone	3.4	0.3	17.5	0.9	-16.08	**0.000**
no impurities of stone	high level impurities of stone	9.1	0.8	44.2	3.0	-13.14	**0.000**
low level impurities paddy husk	high level impurities paddy husk	2.6	0.2	17.0	12.2	-16.89	**0.000**
no impurities paddy husk	high level impurities paddy husk	8.9	0.4	39.1	2.7	-14.67	**0.000**
long grain length	medium grain length	2.0	0.1	40.1	3.4	-13.49	**0.000**
Tomato							
low level rotten	high level rotten	26.2	1.1	19.2	1.1	4.44	**0.000**
not rotten	high level rotten	48.7	1.8	49.6	1.0	-0.44	**0.662**
low level of spots	high level of spots	13.3	0.9	16.7	0.9	-2.61	**0.010**
no spots	high level of spots	27.4	1.8	41.3	1.4	-5.95	**0.000**
medium size	small size	10.9	0.8	22.6	0.9	-9.59	**0.000**
large size	small size	30.0	1.3	34.1	1.5	-2.14	**0.033**

Source: Authors' own survey

Table 4: Hedonic price regressions (pooled regressions; dep. var. 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