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The Quiet Revolution in Agrifood Value Chains in Asia

The Case of Increasing Quality in Rice Markets in Bangladesh

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ABSTRACT

In Bangladesh—one of the poorest countries in Asia, where rice accounts for almost 70 percent of consumers' caloric intake—the share of the less expensive, low-quality coarse rice is shown to be rapidly decreasing in rice markets and the quality premium for the best-quality rice has been consistently on the rise in the last decades. It thus seems that the role of rice as only a cheap staple food is being redefined. The off-farm share in the final consumer price increases from 27 percent to 35 percent to 48 percent for low-, medium-, and high-quality rice, respectively, and the increasing demand for higher quality is thus seemingly associated with a more important off-farm food sector—in particular, milling, retailing, and branding—as well as a transformed milling industry. We further find that the labor rewards for and the technical efficiency of growing different rice qualities are not significantly different, and farmers do not benefit directly from consumers' increased willingness to pay for higher rice quality.

Keywords: Bangladesh, rice, markets, value chains, Asia, quality, milling

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1. INTRODUCTION

Food value chains are being transformed worldwide, given changing consumption patterns and the increasing insistence on food quality and safety (World Bank 2007). These changes are also happening in a number of developing countries (see, for example, Swinnen 2007; Jaffee and Henson 2004; Orden and Roberts 2007; Unnevehr 2007; World Bank 2007; Reardon and Timmer 2007), and more in particular in Asia (Pingali 2007; Minten, Reardon, and Chen 2011; Mergenthaler, Weinberger, and Qaim 2009). However, despite the presumed importance of the transformation of food systems of developing countries, there are currently still relatively few good data and analyses of its magnitude and impacts.

Three strands of research on the transformation of food systems in developing countries can be distinguished in the recent literature. First, new evidence is emerging on the increasing demand for food quality by the poor (for example, Banerjee and Duflo 2011). While economic theory would predict an increase in a demand for the cheapest calories when calorie-insufficient households are given a choice, new research shows that even the poor increasingly seem to prefer food quality and taste over quantity (Jensen and Miller 2008; Deaton and Drèze 2009). This change in preference may be driven by the decline of heavy physical work, improvement in transportation, increasing availability of motorized mills, and better access to water and sanitation, factors that could possibly contribute to lower energy requirements and more modest productivity gains from higher calorie consumption (Banerjee and Duflo 2011).

Second, a number of authors have looked empirically at the influence of new food safety and quality requirements on poor small producers, mostly because of the emergence of new commercial channels such as export agriculture or supermarkets (Reardon et al. 2009; Jaffee, Henson, and Rios 2011). For example, different institutional models are emerging that successfully address these requirements, including contract farming (Miyata, Minot, and Hu 2009; Minten, Randrianarison, and Swinnen 2009) and vertical integration (for example, Swinnen 2007; Birthal, Joshi, and Gulati 2005). A significant body of research now exists that looks at income and welfare effects of these changes on producers (for example, Rao and Qaim 2011; Maertens and Swinnen 2009; Miyata, Minot, and Hu 2009; Neven et al. 2009). A common characteristic of this research is that it has largely focused on nonstaple crops, rather than staples such as rice and wheat, and on the emergence of new market channels.

Third, research has been done on the distribution of the gains within value chains from this transformation because it is not well understood who actually benefits from the higher prices that consumers are willing to pay for safe, high-quality products (for example, Swinnen and Vandeplas 2010). Some argue that midstream companies might extract the surplus through their bargaining power within the chain (for example, Unnevehr 2000; Warning and Key 2002) while others have argued that improved quality standards might actually reduce transaction costs in trade and thus lead to benefits for suppliers (Henson and Jaffee 2007). Research in this area has, however, been largely theoretical (for example, Swinnen and Vandeplas 2010).

In this paper, we contribute to the literature in this area in three ways. First, we analyze data from innovative surveys we implemented at different levels in the rice value chain, from rural producer to urban consumer, in Bangladesh. In these surveys, we make a clear distinction in food quality characteristics throughout the value chain. Such simultaneous surveys at different levels in the value chain have rarely been fielded,[1] and this survey is the first for staples in traditional as well as modern value chains in developing countries. Second, in Bangladesh, one of the poorest countries in Asia, where rice consumption per capita is one of the highest of the world, we find an important change in quality in the rice market. In particular, we note an important decline of the less expensive, lowest-quality rice, coarse rice, in the past decade. We further find a doubling of the quality premium for the best-quality rice over the past three decades. It thus seems that the role of rice as only a cheap staple food is being redefined, even in these poor settings. Third, we find that the producer share in final retail prices drops to

[1] Notable exceptions are Fafchamps, Vargas Hill, and Minten (2008), and Fafchamps and Vargas Hill (2008).

half for the best-quality rice from almost three-quarters for the lower-quality one. Especially retailers and millers seem to capture most of the quality premium between farmers and urban consumers, while there are no large price differences at the farm level. The increasing demand for food quality in these settings thus seems to lead to the emergence of a more important off-farm food sector. Seemingly associated with the rise in quality, we further find significant changes in the milling sector in the areas surveyed.

The structure of the paper is as follows. We first present some background information on the rice sector in Bangladesh in Section 2. Section 3 describes the data and methodology used. In Section 4, basic descriptive statistics from the primary surveys are presented. Section 5 looks at rice quality downstream in urban retail markets while Section 6 studies it upstream, at the farm level. Section 7 then explores who benefits from the increasing willingness to pay for rice quality in the value chain. We finish with conclusions in Section 8.

2. RICE IN BANGLADESH

The agricultural economy of Bangladesh is heavily dependent on rice. It is estimated that almost three-quarters of total cropped land in Bangladesh is devoted to paddy cultivation, and per capita rice consumption is one of the highest in the world. Based on national surveys, foodgrain consumption for an average person in urban and rural areas in Bangladesh is shown to have stabilized over time at about 160 and 180 kilograms per person per year, respectively (Bangladesh, Bureau of Statistics 2005). Rice is the main foodgrain product (wheat makes up only 2 percent of total foodgrain consumption for urban consumers, 6 percent rural), and it is estimated that rice expenditures make up 40 percent of total food expenditures. Rice contributes more than 63 percent and 71 percent of the caloric intake of urban and rural consumers, respectively. It is important in the consumption basket of poor and rich alike: The poorest quintile consumes 139 and 146 kilograms of rice per capita in urban and rural areas, respectively (Bangladesh, Bureau of Statistics 2005).

Significant changes have happened to rice cultivation in Bangladesh over time. While rice acreage has changed little in the past decades, there have, however, been changes in the relative importance of different seasons. Rice is grown in three seasons in Bangladesh: the part rainfed, part dry *aman* season (harvest in December–January); the dry *boro* period, when crops are irrigated (harvest in April–May); and the rainfed *aus* season (harvest in August–September). *Aman* acreage has changed little over time, but *boro* acreage has increased substantially and *aus* acreage has declined accordingly. This has also led to changes in seasonal price patterns of rice (Murshid et al. 2009). Production of rice overall has increased significantly over the last 40 years. Due to the proliferation of shallow tube wells and the development of high-yielding dry-season rice varieties (*boro* rice), rice yields have increased dramatically and the share of dry-season rice has increased from 10 percent of the country's rice production in 1966/67 to 61 percent in 2008 (Hossain 2009).

The success in the increase of rice production is strongly related to the release and wide adoption of different high-yielding varieties (HYV) in recent decades (Hossain, Bose, and Mustafi 2006). In the 1970s and 1980s, these HYV used genetic material from the Philippines and were mostly focused on coarse grains. While the earlier generation lacked disease resistance, this changed with newer varieties released in the 1980s. The second-generation varieties that have been introduced since the mid-1990s have used other international genetic material and focused on shorter plant heights (for example, BRRI dhan 28, BRRI dhan 29). They were rapidly adopted because of high yields, shorter maturity, and relatively good grain quality, causing a shift away from coarse rice varieties (Hossain, Bose, and Mustafi 2006).

An important factor in any food market is quality. While the quality of rice is judged by a number of factors, such as physical appearance (for example, size of the grain as measured by the ratio of length to width), transparency, milling, cooking and processing, and nutritional quality, these are difficult to measure objectively (Rahman 2004). The most widespread distinction used in the rice sector in Bangladesh relates to the shape and size of the kernel. The coarser the grain, the wider or fatter it is (relative to the length). Coarse rice grains used in Bangladesh have a width of more than 2 millimeters. This compares with 1.7 to 2.0 millimeters for medium rice and less than 1.7 millimeters for fine rice (Rahman 2004). This distinction between fine, medium, and coarse rice grains is widely used and well known by farmers as well as traders, and we will therefore use it as a measure for quality throughout this paper. While good statistics are lacking on the economic importance of the three qualities, fine rice is seemingly the least important of the three at the national level. It was estimated in 2002 that fine rice made up about 10 percent of the land allocated to rice cultivation (International Development Enterprises 2002) while the World Bank (2008) evaluated the importance of fine rice in total rice production at 5 percent.

3. DATA AND METHODOLOGY

The purpose of the study is to understand how quality impacts the rice value chain in Bangladesh from rural areas to the capital, Dhaka, which, along with its metropolitan area, is home to approximately13 million people. To get at this information, two types of activities were organized. Interviews were conducted with key informants in the value chain in October 2009. That information was used to design questionnaires for each level in the value chain. These questionnaires were then fielded at the end of 2009 (November and December). The implemented instruments included surveys upstream in the supply chain with rice-producing households and villages, midstream with wholesalers and millers, and downstream with retailers.

Upstream in the supply chain, the district of Noagoan was selected to represent rural production areas because it is an important rice-producing district, supplying rice to the capital. The district is located about 200 kilometers north of Dhaka. The village and household survey was set up as follows. The two most important paddy-producing *thana* (subdistricts) in the district of Noagoan were selected. In each *thana,* the villages were stratified based on total rice produced in the village. Then five villages from each *thana* were randomly selected—two from the stratum of high-producing villages, two from the stratum of medium-producing villages, and one from the stratum of low-producing villages. In each selected village, a village questionnaire was implemented and a census of households was conducted to enumerate the paddy producers. From each of the selected villages, 22 paddy-producing households were then randomly selected, half from the group with the largest farms and half from the group with the smallest farms, reflecting their respective share in the rice value chain. Thus, 220 paddy-farming households were selected in total.[2] A survey focusing on rice production and marketing practices was then implemented.

Midstream in the supply chain, the wholesaler survey was set up as follows. First, interviews were conducted with village traders and other rural off-wholesale-market traders who buy from households in that village or from other traders (17 in total). Second, 43 traders were interviewed from the local rural wholesale market in the selected district. Third, 30 urban wholesale traders were interviewed in Dhaka, half from each of the two most important rice wholesale markets in the city, Badamtoli and Krishi markets. These traders were randomly selected after a census was done.

Also in midstream, a list of all the millers in the district of Noagoan was obtained. A stratified random selection of 20 millers was done (8 with automatic mills, 5 with semiautomatic mills, and 7 with small mills)3 and detailed surveys were conducted, focusing on information related to purchases, sales, and milling patterns. These different technology strata for mills were selected given the presumed importance in the production of better-quality rice by the larger mills, which are usually automatic or semiautomatic. For example, Murshid (2011) found that the increasing availability and affordability of better-quality rice in the market has become possible because of the increasing availability and use of modernized mills.

Downstream in the supply chain, a retail survey was conducted in Dhaka, covering both traditional and modern retailers. First, five *thana* were randomly selected in different parts of Dhaka (north, east, west, south, and central). In each *thana*, a census was done of all retail markets, and two markets were randomly selected. A census of all rice retailers was done for each market, and 12 traders

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[2] While the survey was set up to be representative at the retail level in Dhaka, the necessary resources were lacking to do this at the producer level. Thus, the quantitative results related to the role of the farmer and the structure of the value chain reflect only the situation for production zones similar to the one studied—that is, located about 200 kilometers from Dhaka. Results might be indicative, but will be different in practice, for rice production areas closer to or further away from Dhaka.

[3] Small mills typically first parboil rice and then spread it to dry in the open air. After drying, the rice is transferred to be milled by small Engelberg friction hullers, which remove the husk and polish the rice all in one unit (Chowdhury and Haggblade 2000). Semiautomatic mills are characterized by larger hullers with rubber rollers (Rahman 2004). Large-scale automatic mills emerged in the 1980s, mainly financed by donor money. These mills integrate steam-pressure parboiling, mechanical forced-air dryers, rubber rollers for shelling, and polishing machines in a single conveyer-driven, flow-through facility (Chowdhury and Haggblade 2000).

were then randomly selected and interviewed. A total of 120 traditional retailers were thus interviewed. Second, 20 surveys were conducted with modern retailers. In each *thana* that was selected for the traditional retail survey, a census of modern retail stores was conducted and 4 were randomly selected.[4] A price survey was then also implemented for both types of retailer.

[4] Growth rates in supermarket stores are high, but the growth started from a low base. Our census revealed that at the end of 2009, about 80 supermarket stores, almost all in Dhaka, were active in the country. There were only 4 such stores in 2001.

4. DESCRIPTIVE STATISTICS ON THE RICE VALUE CHAIN

Table 4.1 presents some descriptive statistics of the sample of rice value chain agents.[5] A total of 470 interviews were conducted. The data show large variability within the chain, for example, significant variation in capital requirements at different levels. Retailers are usually significantly smaller than wholesalers, whose working capital and asset value are often 10 times as high. The biggest capital requirements in the value chain, however, occur in midstream processing—that is, in the mills. The product turnover of retailers is about 22 kilograms per day. This compares with 10 tons per day for the wholesalers and up to 50 tons per day per mill (when working at full capacity). To put it in a different perspective, an urban retailer would need on average the sales of 1.5 farmers to assure his rice supplies for the year, whereas a wholesaler would require the sales of 400 farmers and a mill about 2,000 farmers.

Table 4.1—Descriptive statistics

	Unit	Mean	Median
Upstream			
Farmers			
Number of observations	Number	220	
Value of assets	BDT 1,000	2,213	1,550
Paddy land cultivated	Acres	6	5
Paddy production in previous year	Tons/year	10	9
Paddy sales in previous year	Tons/year	7	4
Paddy sales income	BDT 1,000	85	49
Midstream			
Mills			
Number of observations	Number	20	
Capacity of mill	Tons/day	51	37
Value of mill	BDT 1,000	58,790	35,000
Wholesalers			
Number of observations	Number	90	
Quantity procured daily	Tons/day	10	4
Value of assets	BDT 1,000	1,033	49
Working capital	BDT 1,000	2,432	1,000
Downstream			
Traditional retailers			
Number of observations	Number	120	
Quantity procured daily	kgs/day	22	16
Value of assets	BDT 1,000	80	5
Working capital	BDT 1,000	156	60
Modern retailers			
Number of observations	Number	20	

Source: Authors' calculations.

The total paddy area cultivated amounts to almost 6 acres per farming household annually. However, since rice land is cultivated two or even three times over the year, the yearly cultivated rice area

[5] It is important to keep in mind that surveys of value chain actors were set up in a stratified way (with unweighted numbers presented here) and fielded in only one district supplying to the city. Caution is thus needed to extrapolate these numbers to the national level.

is significantly higher than the physical area of 2.6 acres per household. Even though we sampled farmers according to their share in the volume of paddy produced (and thus have a large number of bigger farmers compared with what a simple random selection of farmers would produce), this still relatively small area allocated to rice paddy reflects the overall small farm sizes and high population density in rural Bangladesh. The numbers are consistent with overall statistics in Bangladesh, where it is estimated that almost 90 percent of the farmers cultivate fewer than 2.5 acres (about 1 hectare). The interviewed farmers produced on average about 10 tons of paddy in the year prior to the survey and sold 70 percent of it, accounting for a sales income of about 85,000 Bangladeshi taka (BDT) per household (about US$1,240),[6] or BDT 18,850 per capita (about $275).[7]

Table 4.2 presents information on rice quality handled by the different value chain agents and shows how quality has evolved over time, based on recall questions asked of these different agents. Two observations can be made from the table. First, we see in the past 10 years a large shift away from coarse rice to medium and fine rice in the surveyed production area. The share of coarse paddy in total sales at the producer level declined from 36 percent in 1999 to 17 percent in 2009. Similar trends are seen at the upstream and midstream level, but to a lesser extent, possibly indicating that this change was less pronounced in other production areas than in the area surveyed. For example, urban wholesalers in Dhaka report that coarse rice represented 45 percent of total sales in 1999 and 28 percent in 2009, medium rice 37 percent in 1999 and 44 percent in 2009, and fine rice 18 percent in 1999 and 29 percent in 2009. For all value chain agents, shares of coarse rice have declined significantly as measured by a t-test—between 11 percent and 22 percent over the 10-year period, depending on the value chain agent. The share of medium rice has increased by between 3 percent and 17 percent, and all the changes are significant. While we also see mostly significant positive trends for the share of fine rice, these increases are smaller than those for the rise of medium-quality rice.

Table 4.2—Change in the importance of different rice qualities in the rice value chain in the last decade

	% in sales			t-test difference	
	Year		Mean		
	1999	2009	difference	t-value	Pr(T>t)
Coarse					
Producer	36	17	-19	-10.58	0.00
Rural wholesaler off-market	47	31	-16	-4.55	0.00
Rural wholesaler on-market	55	33	-22	-5.74	0.00
Mill	49	34	-15	-4.16	0.00
Urban wholesaler Dhaka	45	28	-17	-7.39	0.00
Urban retailer Dhaka	34	23	-11	-7.90	0.00
Medium					
Producer	45	62	17	8.52	0.00
Rural wholesaler off-market	41	56	15	5.20	0.00
Rural wholesaler on-market	29	39	10	3.63	0.00
Mill	27	39	12	2.80	0.01
Urban wholesaler Dhaka	37	44	7	3.40	0.00
Urban retailer Dhaka	35	38	3	2.69	0.01
Fine					
Producer	20	22	2	1.72	0.09
Rural wholesaler off-market	12	13	1	0.34	0.73
Rural wholesaler on-market	17	27	10	3.17	0.00
Mill	24	27	3	0.73	0.47
Urban wholesaler Dhaka	18	29	11	4.43	0.00
Urban retailer Dhaka	31	39	8	5.47	0.00

Source: Authors' calculations.

[6] All dollar amounts are in U.S. dollars.

[7] To put this into context, Bangladesh's gross domestic product per capita in 2009 was just below $700.

Second, the share of fine rice is estimated to be significantly higher for Dhaka wholesalers and retailers than for other agents in the value chain.[8] This might reflect two phenomena. First, more fine rice is consumed in Dhaka than in the rest of the country, which is possible because of the relative concentration of better-off consumers there and thus the higher demand for this more expensive rice quality. Second, some of the lower paddy quality is possibly transformed in the value chain into a higher-quality rice, resulting in a relative increase in rice quality from rural traders to urban retailers. Some millers transform lower-quality paddy into a higher-quality rice through extra milling (as well as extra parboiling) and through the use of polishing machines.

The change in quality in the rice market is seemingly associated with a transformation of the milling sector, since automatic and semiautomatic mills are generally perceived to have higher quality standards as well as more reliable weighing and bagging procedures than do small mills (Murshid 2011). The share of the small mills in the trade of both farmers and rice wholesalers has declined, as reported by farmers and wholesalers in our survey, on average for fine rice from 70 percent to 26 percent, for medium rice from 69 percent to 43 percent, and for coarse rice from 68 percent to 40 percent in the past decade. The change exists for all three qualities but is especially stark for fine rice. Murshid (2011) reports similar findings on the decline of the small mill in two other major rice-producing districts (Bogra and Noakhali) in Bangladesh.[9]

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[8] However, Dhaka wholesalers sell significantly less fine rice than do Dhaka retailers. This is possibly partly the case because the former also sell to other parts of the country.

[9] However, the decline of the small mills is not yet reflected in official national statistics, possibly because government statistics are outdated. It was estimated by the Ministry of Food and Disaster Management that in 2006/07 there were 13,329 small mills, 109 major rice mills, and 141 automatic rice mills in Bangladesh, accounting for 550,204 tons, 8,595 tons, and 22,827 tons of milling capacity respectively (FMPU 2009). The growing importance of hybrid rice has reportedly led to the increasing importance of automatic mills because the milling quality of hybrid rice is poor in small and semiautomatic mills. Hybrid rice only started taking off in the middle of the decade from 2000 to 2010 (Murshid 2011). Other reasons might be that small mills might be on the books of the government but not functioning anymore, and that this and Murshid's study have focused on more dynamic districts in Bangladesh and the change might not yet have occurred to the same extent in other parts of the country. The numbers at the national level thus deserve more research.

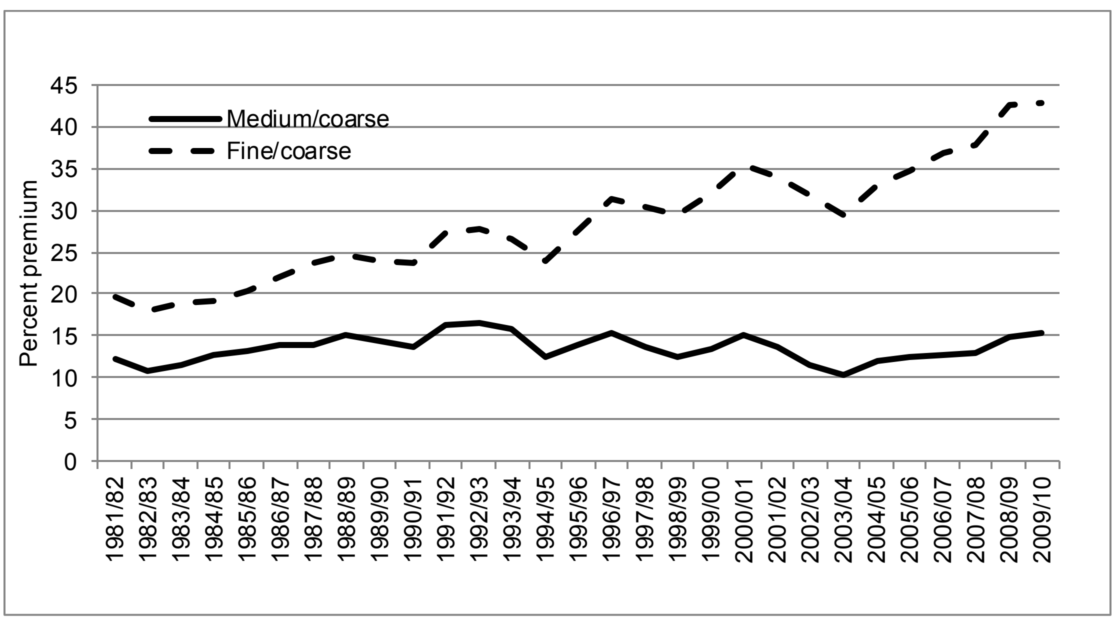
5. RICE QUALITY DOWNSTREAM IN THE VALUE CHAIN

We first want to understand the quality premium downstream before we see how the rewards for quality are transmitted to producers and the rest of the value chain in the next sections. We rely on two sources of information to understand the rewards for rice quality in retail markets in Dhaka. First, we use secondary information on prices that have been collected over the past three decades by the Bangladeshi government. Second, we use price observations of a sample of traditional as well as modern retailers on the day of our primary survey.

The Quality Premium over Time

Figure 5.1 shows the level and the evolution of the rice price quality premium, defined as a percentage ratio of fine and medium rice prices over coarse rice prices, based on prices that are collected monthly in the retail markets of Dhaka. There are three important observations from this graph. First, despite the widespread adoption of medium-quality rice in Bangladesh in the past decade, there are still important quality premiums remaining for that rice quality compared with coarse rice. Second, premiums for fine and medium rice show high correlations over time: When premiums for fine rice are high, those for medium rice are also high. This might illustrate the relatively high substitutability of these rice qualities. Third, the ratios show significant variability over time. The graph shows that price premiums were as high as 12 percent and 20 percent for medium and fine rice, respectively, at the beginning of the 1980s. The level of the fine rice premium was significantly higher by 2009/10, with a price premium of almost 45 percent over coarse rice. While the rise in premiums for medium and fine rice were in sync until the beginning of the 1990s, the gap between them has increased from then on, perhaps because of the increasing availability and widespread adoption of medium rice varieties that has seemingly held down the increase of the premium for medium-quality rice over time.

Figure 5.1—Percent rice quality premium, three-year moving averages



Source: Department of Marketing (DAM).

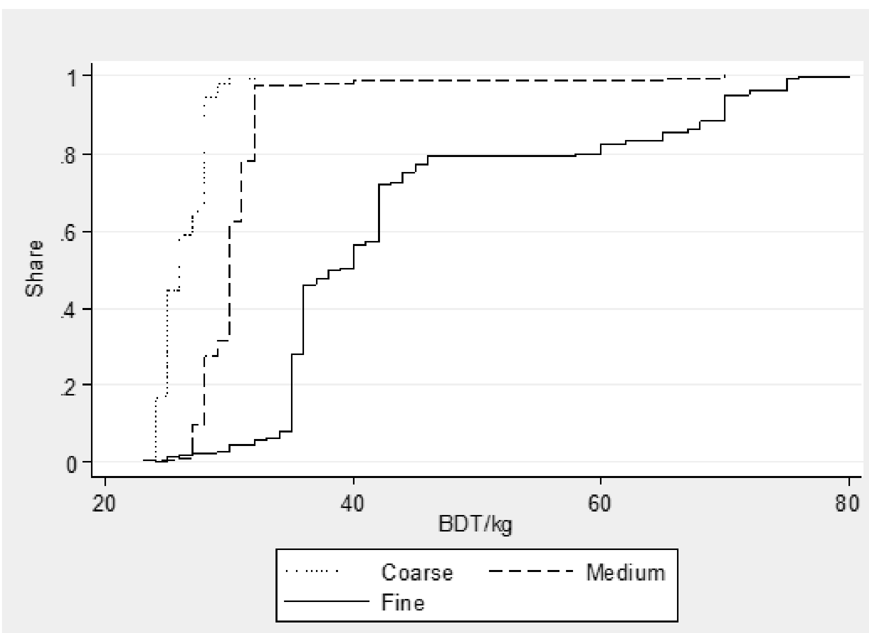
Note: 1 Quintal = 100 Kilogram.

Quality and Traditional Retail

In the fielded primary survey, prices were asked for all the products that the value chain agent was selling at the time of the survey (at the end of 2009). Based on these price data, we find average quality premiums in traditional markets that are similar to the ones reported in the government-collected time series for that period. While the average and median prices of coarse and medium rice were BDT 26 per kilogram and BDT 30 per kilogram, respectively (or a quality premium of 15 percent), the average price for fine rice was as high as BDT 44 per kilogram and the median price was as high as BDT 41 per kilogram at the time of the survey—a quality premium of 69 percent over coarse rice.

We also find that there is significant price variation across retailers at any point in time, but different for the three qualities. This is shown in Figure 5.2, where the price variation of rice is plotted, through a cumulative density function, for each type of rice at the time of the survey. It seems that retail prices vary significantly, with variation primarily depending on quality. Variation for fine rice is significantly higher than for other types of rice, with prices for fine rice varying from BDT 24 per kilogram to more than BDT 80 per kilogram, and more price observations in a broader domain are noted for fine rice, as shown by a less steep slope of the function. The cumulative density distribution functions for coarse and medium rice, on the other hand, are much more tightly centered than that of fine rice (Figure 5.2). We further note that the prices of fine and medium rice dominate stochastically at first order the prices of coarse rice over the whole domain, indicating the unambiguous rewards for rice quality in these markets.

Figure 5.2—Cumulative density functions of traditional retail prices of rice



Source: Authors' calculations.

Quality and Modern Retail

Modern retail is still a niche player in Bangladesh, but its importance is increasing rapidly (the total number of modern retail stores in Dhaka more than tripled from 2006 to 2009), as seen elsewhere in Asia (Reardon, Timmer, and Minten 2010). Modern retail often puts differently structured value chains in place that provide products of different prices and quality (Minten and Reardon 2008). To understand that niche, we compare prices and qualities of rice that are sold by modern and traditional retail (Table 5.1). We asked retailers the different varieties that they were selling at the time of the survey and put them into the three broad categories of coarse, medium, and fine. We also noted their prices. Modern retailers sell mostly a higher quality of rice, since they sell no coarse rice; 2 percent of the rice on offer is medium rice while 98 percent is considered fine rice. For traditional retailers, fine rice makes up only 50 percent of the portfolio of rice they have on offer, while 28 percent is coarse rice and 23 percent is medium rice. The higher share of fine rice in their portfolio compared with their turnover (reported earlier in Table 4.2) seems to indicate higher turnover for coarse grains as well as a lower number of varieties or brands within the lower-quality category—these perceptions were confirmed in key informant interviews. In modern retail, 45 percent of the rice is sold packaged or branded, while this is rarely done in traditional retail (8 percent of the products on offer). These data thus illustrate overall the higher-quality portfolio of the newly emerging supermarket segment.

We further compare prices between these different market segments (bottom of Table 5.1). Average prices are significantly higher in modern versus traditional retail. Prices in modern retail are about BDT 16 per kilogram, or 50 percent, higher and the difference is significant as shown by a t-test. However, this simple comparison does not take into account the differences in quality and other rice characteristics between the different outlets. When we control for these different characteristics—rice quality (coarse, medium, fine), variety, parboiling, packaging, and *thana* (location) dummies—using a hedonic pricing model, this difference largely disappears. Modern retail prices are still significantly higher than those in traditional retail; *ceteris paribus,* it is estimated that rice prices in modern retail are BDT 1.78 per kilogram higher (a price difference of about 4 percent). In an overview of evidence on food price and quality between modern and traditional market formats in a range of developing countries, Minten and Reardon (2008) found that modern retail is usually more expensive in the early supermarket rollout, when the stores tend to focus on the richer segment of the population. This seems to be also the case for rice in Bangladesh. However, the price difference is surprisingly low for this phase of supermarket rollout, and the time savings for households of one-stop shopping at supermarkets versus going into congested traditional retail markets might possibly make up for the price difference.

Table 5.1—Price and quality comparisons of rice between modern and traditional retail

		Outlet			t-test difference	
	Unit	Traditional	Modern	Mean difference	t-value	Pr(T>t)
Number of observations		755	190			
Quality differences						
Coarse	%	28	0	-28		
Medium	%	23	2	-21		
Fine	%	50	98	48		
Parboiled	% parboiled	89	54	-35		
Bagging	% packaged	8	45	37		
Price differences						
Average prices						
- Mean	BDT/kg	36	55	19	16.39	0.00
- Median	BDT/kg	32	44			
Hedonic pricing coefficient*	Modern = 1			1.98	3.75	0.00

Source: Authors' calculations.
Notes: * Controlling for packaging, variety, parboiled dummy, type of rice, location.

We thus find that the quality in rice markets in Bangladesh is changing quickly and that there are significant rewards for quality of this staple, since fine and medium rice were valued at two-thirds and 15 percent higher than coarse rice at the time of the survey. The emerging modern retail sector focuses solely on the sales of the higher-quality rice. Taking into account population and price levels, it can be estimated that because of the price premiums and the higher consumption of higher-quality rice, expenditures in Dhaka for rice have grown in the last decade by $50 million annually. However, it is unclear who benefits from this increased willingness to pay for rice quality by urban consumers. To this question we turn next. We look first at the producers (Section 6) and then at the other agents in the chain (Section 7).

6. RICE QUALITY UPSTREAM IN THE VALUE CHAIN

We start with price information obtained from all commercial rice transactions reported by the interviewed farmers in the year prior to the survey. We first present a parsimonious regression model, wherein paddy prices are explained only by quality indicators (Table 6.1). To explore which other determinants, on top of the rice quality characteristics, are associated with price formation, we also run a long model that includes characteristics of the transactions as well as of the selling household. As could be expected, an important determinant of prices is the period when paddy is sold. Prices of paddy that is sold at the time of harvest of the important *boro* crop are BDT 2 to BDT 4 per kilogram cheaper than paddy sold during the rest of the year.

Table 6.1—Determinants of paddy prices received by farmers

Dependent variable=BDT/kg		Parsimonious model		Long model	
	Unit	Coeff.	t-value	Coeff.	t-value
Quality					
Coarse rice (default)					
Medium rice	yes = 1	-1.232	-1.360	-0.790	-0.860
Fine rice	yes = 1	2.792	2.760	2.017	1.950
Characteristic transaction					
Quantity of paddy sold	log(bags)			-1.039	-2.500
Sold in village	yes = 1			-1.524	-2.710
Sold in January (default)	yes = 1				
Sold in February	yes = 1			0.847	1.200
Sold in April	yes = 1			5.275	4.370
Sold in July	yes = 1			-2.950	-2.750
Sold in August	yes = 1			-3.161	-4.520
Sold in September	yes = 1			-3.325	-3.980
Sold in October	yes = 1			-2.548	-2.900
Sold in November	yes = 1			1.271	0.590
Sold in December	yes = 1			0.002	0.000
Characteristic household					
Household head is illiterate	yes = 1			-0.940	-1.340
Age of head of household	years			0.026	1.260
Size of household	number			0.213	1.050
Value of land owned by household	log(BDT)			-0.147	-0.630
Area of rice cultivated (decimals)	log(dc)			0.131	0.220
Village dummies				included	
Intercept		13.861	16.060	27.652	5.010
Number of observations		314		311	
R-square		0.1412		0.3134	
Root Mean Squared Error		4.4226		4.0887	

Source: Authors' calculations.

Controlling for other confounding factors, farmers who sell in the village itself obtain a significantly lower price (BDT 1.5 per kilogram) than those who travel to wholesale markets or mills, the two other major output channels. This seemingly reflects at least partly the lower transaction costs incurred (Fafchamps and Vargas Hill 2005). None of the household characteristics that were included in the regression turn out to be significant at conventional statistical levels. Finally, fine rice paddy is sold at a significantly higher price (of BDT 2.0 per kilogram and BDT 2.8 per kilogram higher in the long and short models, respectively) while there is no significant difference between coarse and medium rice paddy. The results thus show that there are some small price rewards for rice quality, but they are significantly lower than in urban retail markets.

Because there might be other rewards aside from prices, we would like to further understand how producers benefit from the cultivation of different qualities. We look at labor and land productivity and technical efficiency in particular. The unit of observation for further analysis in this section is the plot in a particular season. Households in our dataset used on average 4.3 plots toward paddy cultivation for at least one season. However, since most households cultivate paddy on the same plot in different seasons, the number of observations is significantly higher: 1,999 plots in total in our dataset, or about 9.1 plots on average per household.

Not all of these paddy plots are as likely to be used for growing the same quality of rice paddy. To explore which factors determine rice paddy quality choice, we run a multinomial regression of different explanatory variables at the plot as well as the household level (Table 6.2). Plots allocated to coarse rice paddy are used as the default value in the regression. The results show that in the area studied, medium rice paddy is much less likely to be planted in the *aman* (rainy) period than in the *boro* (dry) period, while fine rice paddy is more likely to be grown in the *aman* period. Indicators of elevation (such as a land level index and usual flood depth) indicate that coarse rice paddy is more likely to be grown on plots that are more prone to flooding. The characteristics of the households, on the other hand, show little influence on the choice of the quality of rice paddy. The results show that especially the larger households, who are often also poorer, are more likely to cultivate coarse paddy.

Table 6.2—Determinants of plots being used for different qualities of rice (multinomial probit)

Default = coarse rice		Medium		Fine	
Determinants	Unit	Coefficient	z-value	Coefficient	z-value
Irrigated by shallow tube well	yes = 1				
Irrigated by low lift pump	yes = 1	-0.087	-0.330	-0.279	-0.890
Irrigated by deep tube well	yes = 1	-0.624	-5.260	-0.183	-1.390
Irrigated by other	yes = 1	-1.175	-4.360	-0.923	-2.880
Area of plot	Log(decimals)	0.142	1.770	0.236	2.610
Land level	index 1 to 5	0.256	2.370	-0.158	-1.320
Usual flood depth	foot	0.048	1.070	-0.144	-2.780
Head of household is illiterate	yes = 1	0.282	1.890	0.220	1.350
Age of head of household	years	0.003	0.740	-0.005	-1.070
Total area of rice cultivated	Log(decimals)	0.098	0.840	-0.079	-0.600
Household size	number	-0.135	-4.120	-0.071	-1.930
Boro period (default)	yes = 1				
Aus period	yes = 1	-0.038	-0.220	-0.173	-0.830
Aman period	yes = 1	-0.537	-4.710	0.321	2.510
Intercept		0.659	1.070	1.069	1.550
Number of observations		1999			
Wald chi-square (24)		194.30			
Prob > chi-square		0.00			
Log-likelihood		-1,455.95			

Source: Authors' calculations.

Detailed questions were asked for all the rice paddy plots and for each season related to the level of output, input use (seeds, fertilizer, chemicals, irrigation, and manure), use of both family labor and hired labor for different activities (soil preparation, planting, weeding, harvesting, and other activities), as well as technology adoption. All inputs and outputs were divided by the area of the plot, yielding a measure of the intensity of use of inputs and outputs per acre and per unit of labor. The results, distinguished by rice paddy quality, are presented in Table 6.3.

Table 6.3—Production costs and productivity measures, by quality

		Coarse	Medium			Fine		
		Mean	Mean	t-test vs. coarse		Mean	t-test vs. coarse	
	Unit	value	value	t-value	Pr(T>t)	value	t-value	Pr(T>t)
Descriptives and t-tests								
Number of observations		210	1436			353		
Land productivity	kg/acre	1,727	1,864	-1.72	0.08	1,665	0.64	0.52
Expected land productivity (before harvest)	kg/acre	2,011	2,366	-2.23	0.02	1,977	0.27	0.78
Labor productivity	BDT/man-day	318	349	-0.78	0.44	367	-1.27	0.20
Total monetary input costs	BDT/acre	14,560	16,789	-1.07	0.28	13,755	1.06	0.28
Total input costs,* of which…	BDT/acre	36,930	35,940	1.48	0.14	35,669	1.48	0.14
… Ag. inputs (fertilizer, pesticides, manure)	BDT/acre	9,800	8,634	2.93	0.00	9,050	1.21	0.22
… Labor	BDT/acre	8,280	8,455	-0.42	0.67	7,768	1.27	0.20

Nearest-Neighbor Matching (comparing to coarse rice)**		Average treatment effect for the treated (ATT)					
		Medium versus coarse			Fine versus coarse		
		Coeff.	z-value	P>|z|	Coeff.	z-value	P>|z|
Land productivity	kg/acre	164	1.51	0.13	105	0.89	0.37
Expected land productivity (before harvest)	kg/acre	352	1.57	0.12	218	1.25	0.21
Labor productivity	BDT/man-day	44	0.81	0.42	58	1.21	0.22
Total monetary input costs	BDT/acre	3,646	1.22	0.22	66	0.07	0.94
Total input costs,* of which…	BDT/acre	833	0.81	0.42	11	0.01	0.99
… Ag. inputs (fertilizer, pesticides, manure)	BDT/acre	117	0.19	0.85	-249	-0.31	0.75
… Labor	BDT/acre	716	1.16	0.25	260	0.53	0.59

Source: Authors' calculations.

Notes: *: Valuing all inputs (land, labor, inputs) at market prices, excluding tractor and animal use; costs of land fixed at BDT 18,850.

**: Matching variables are type of irrigation, area of plot, land level, usual flood depth, total rice area cultivated, size household, education head of household, household size, period of cultivation, village dummy.

Average rice paddy yields in the surveyed district amount to 1.7 tons for coarse rice paddy, 1.9 tons for medium rice paddy, and 1.7 tons for fine rice paddy. These differences are not significant. All labor use, family as well as hired, was added per plot; labor per plot was then divided by the output per plot and then valued at median prices for the particular quality of paddy. This gave us a measure of labor productivity. Average labor productivity came to BDT 318 per man-day for coarse rice paddy. This compares with BDT 349 and BDT 367 per man-day for medium and fine rice paddy, respectively. None of the differences are significant as measured by a simple t-test. Two cost measures are also presented: total monetary costs as well as total costs valuing all nonpurchased inputs (including family labor).[10] Again, there is little difference between different rice qualities.

Because different varieties, linked to different qualities, are grown in different seasons,11 on different fields, and by different households, a simple comparison between all plots would not be appropriate. We thus implement a nearest-neighbor matching technique, whereby a treated group (the better-quality rice paddy) is compared with a control group (the coarse rice paddy) using matching techniques over a multidimensional set of variables (Abadie et al. 2004). Compared with other matching techniques, this method has the advantage of allowing individual observations to be used as a match more than once and therefore generally lowering the bias (but increasing the variance). Using this technique, we find again no significant differences between intensity of inputs and labor productivity over the sets of varieties of rice paddy that are linked to the three categories of quality. While growing fine rice paddy is slightly beneficial in the level of price received, comparing similar plots and taking into consideration labor requirements and yield levels, it does not lead to higher levels of labor productivity. This finding implies also that shifting to higher-quality rice paddy has no significant implications for input technology (fertilizer use, labor use, pesticides, etc.) and that there is seemingly little costliness in the shift toward higher-quality rice paddy.

We further look at the returns on inputs in a production function, so as to evaluate the impact of quality on technical efficiency.[12] We do so by running a simple Cobb–Douglas production function (Table 6.4). We rely on a fixed-effect model in order to reduce the effect of unobservable household characteristics. Except for wage labor, most of the results turn out to be largely significant at conventional statistical levels. The season of production leads to high productivity impacts, with significantly higher productivity in the boro period, often related to water access and thus production risk. However, controlling for all these inputs and factors, rice paddy quality—as mirrored by variety—does not act as a significant shifter in the production function. A change in the quality of rice paddy grown does not lead to a differential technical efficiency. This lack of any difference in efficiency might explain the joint cultivation of the different qualities as well as the lack of large price differences at the producer level, as would be expected in well-functioning output markets.

[10] The major contributor to input costs is chemical fertilizers. Second comes pesticides and irrigation. Other costs, such as those for seed and manure, are relatively minor. Labor requirements are spread out over different activities. The peak requirements are at the period of transplanting and of harvesting. About 30 percent of the labor used is family labor while 70 percent is wage labor.

[11] Production levels in the *aman* season are significantly lower for all three types of rice; land productivity drops to 60 percent of the level in the *boro* season.

[12] Other authors have looked at this in the Bangladeshi context, such as Balcombe et al. (2007); Hossain, Bose, and Mustafi (2006); and Rahman (2003).

Table 6.4—Returns to inputs (Cobb-Douglas production function; household fixed-effect model)

Determinants	Unit	Coefficient	t-value	Mean level
Production	log(kg)			1,096
Area cultivated	log(decimals)	0.619	6.18	63
Own labor	log(days)	0.028	1.87	15
Wage labor	log(days)	0.045	1.54	40
Seeds	log(kgs)	0.227	8.05	16
Fertilizer	log(kg)	0.110	3.76	103
Pesticides	log(Rs)	0.067	2.92	919
Manure	log(kg)	0.012	2.86	3,720
Tractor use	log(number of hours)	-0.018	-0.30	0.35
Animal use	log(number of hours)	0.070	0.66	12.98
Land level	index from 1 to 5	-0.036	-1.53	2.92
Usual flood depth	foot	0.025	1.58	1.42
Irrigated by shallow tube well	yes = 1			0.43
Irrigated by low lift pump	yes = 1	-0.139	-1.30	0.05
Irrigated by deep tube well	yes = 1	0.007	0.10	0.49
Irrigated by other	yes = 1	-0.004	-0.04	0.03
Fine rice	yes = 1			0.18
Medium rice	yes = 1	0.009	0.23	0.72
Coarse rice	yes = 1	-0.039	-0.67	0.11
Boro period	yes = 1			0.44
Aus period	yes = 1	-0.425	-13.20	0.12
Aman period	yes = 1	-0.395	-18.56	0.43
Intercept		2.661	4.39	

Number of observations = 1,996
R-square: within = 0.7482
between = 0.8466
overall = 0.7880
F(18,1762) = 290.59
Prob > F = 0

Source: Authors' calculations.

7. WHO IN THE VALUE CHAIN BENEFITS FROM THE WILLINGNESS TO PAY FOR RICE QUALITY?

The obvious question is, then, if not the producer, who in the value chain benefits from the quality premium in retail markets? To study this, we rely on sales price information for all rice varieties, paddy varieties, and brands that were for sale at the time of the survey and that were asked for at all levels in the value chain. We do a regression analysis with these sales prices as the dependent variable and with value chain agent dummies interacted with coarse, medium, and fine rice paddy dummies as independent variables. This methodology allows for the estimation of quality-specific margins. The results are reported in Table 7.1. The sales price of coarse rice at the mill is the default value in the regression. Most results come out as expected, with the reported price of (traditional) retailers, urban wholesalers, rural wholesalers in paddy and rice, and millers following their respective place in the rural–urban rice value chain.

Table 7.1—Sales price regression of the paddy/rice value chain

		Results	
	Unit	Coeff.	t-value
Intercept		22.88	13.51
Coarse rice dummy interactions			
Miller in BDT/kg of rice (default)	yes = 1		
Rural paddy trader in BDT/kg of paddy	yes = 1	-9.32	-5.41
Rural rice trader in BDT/kg of rice	yes = 1	-1.71	-1.00
Urban wholesaler in BDT/kg of rice	yes = 1	1.61	0.93
Urban retailer in BDT/kg of rice	yes = 1	3.35	1.97
Medium rice dummy interactions			
Rural paddy trader in BDT/kg of paddy	yes = 1	-10.28	-12.65
Rural rice trader in BDT/kg of rice	yes = 1	0.18	0.20
Urban wholesaler in BDT/kg of rice	yes = 1	2.39	2.83
Urban retailer in BDT/kg of rice	yes = 1	6.16	7.05
Medium rice dummy	yes = 1	1.35	0.72
Fine rice dummy interactions			
Rural paddy trader in BDT/kg of paddy	yes = 1	-19.05	-5.19
Rural rice trader in BDT/kg of rice	yes = 1	-1.99	-0.61
Urban wholesaler in BDT/kg of rice	yes = 1	2.41	0.76
Urban retailer in BDT/kg of rice	yes = 1	9.52	3.04
Fine rice dummy	yes = 1	11.52	3.30
Number of observations		1,064	
F(17,1360)		482.01	
Prob > F		0.00	
R-square		0.56	
Root Mean Square Error		8.60	

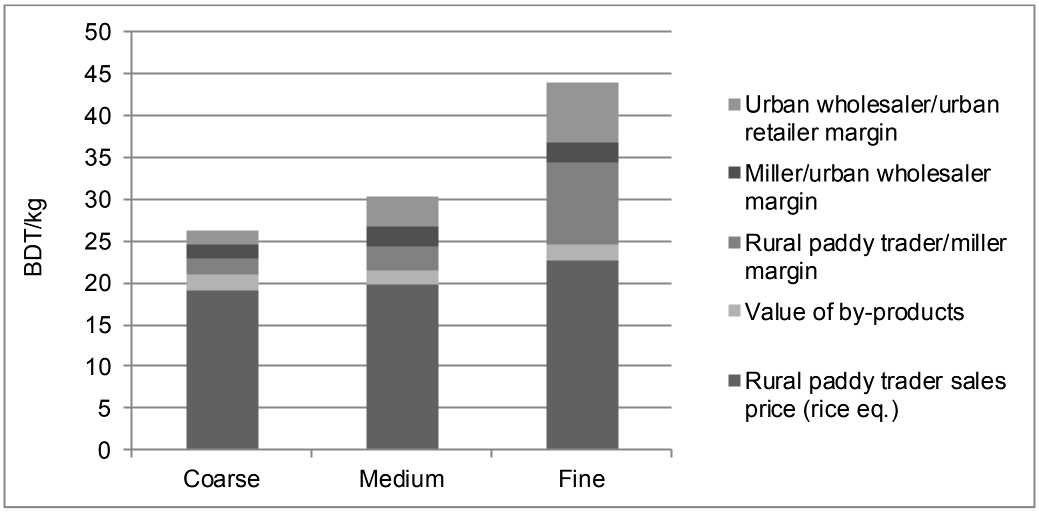
Source: Authors' calculations.

To interpret the coefficient in the regression toward the exact price composition of rice, it is important to convert paddy prices correctly to rice equivalents. To do so, we need to better understand paddy transformation in the country. In the milling process, paddy is separated into rice and by-products (husks).[13] A rice equivalent represents the quantity of rice obtained from the milling of a kilogram of

[13] A first important by-product of paddy milling is *tuss*. For every 100 kilograms of paddy milled, about 20 kilograms of *tuss* is produced. This could be sold at a price of about BDT 2 per kilogram. However, only a small number of mills do sell this by-product, since it is mostly used as a fuel for the parboiling process. A second by-product is *kura*. For every 100 kilograms of paddy, it is estimated that about 15 kilograms of *kura* is produced. This could be sold at about BDT 5 per kilogram at the time of the survey. This product is generally used as feed for fish, cattle, and poultry. Medium and coarse rice are characterized by similar milling ratios (26 kilograms of rice per *maund* [40 kilograms] of paddy, or a conversion rate of 0.65). In the case of fine rice, this conversion rate is slightly lower, at 25 kilograms per *maund,* or a conversion ratio of 0.625.

paddy. Information on these conversion ratios in the Bangladesh setting was collected through key informant interviews.[14] Relying on those estimates, Figure 7.1 shows the price structure at the time of the survey for the three rice qualities. It is important to note that in this graph and in the subsequent price decomposition exercise, we do not directly use the producer prices collected in the farmer survey because they represented prices that farmers obtained for their rice over the course of the year and would thus not be directly comparable to the prices in the value chain at the time of the survey at the end of 2009. As an approximation, we rely on the reported rural paddy trader sales price, which reflects the sales prices for farmers as well a margin for the rural trader.

Figure 7.1—Price structure of rice



Source: Authors' calculations.

While retail prices are lowest for coarse rice, at BDT 26 per kilogram, compared with BDT 30 per kilogram for medium rice and BDT 43 per kilogram for fine rice, rural market prices for these three rice qualities differ much less. Rural paddy trader prices at the time of the survey were evaluated at BDT 13.5 per kilogram, BDT 13.9 per kilogram, and BDT 15.3 per kilogram for coarse, medium, and fine paddy rice, respectively (or, in rice equivalents, BDT 19.1 per kilogram, BDT 19.7 per kilogram, and BDT 22.8 per kilogram).[15] The quality premium is thus seemingly largely explained by post-farmgate activities. When we compare the relative share of the rural paddy trader price—using the rice equivalent price—in final retail, this is as high as 73 percent for coarse rice but drops to 65 percent for medium rice and as low as 52 percent for fine rice. The biggest beneficiaries of this increased price for higher-quality products are mills and (traditional) retailers, as shown in Figure 7.1. The figure shows that urban wholesale contributes relatively little to the final price, 6 percent on average.

While the graph gives us a good indication of the process, we nevertheless want to understand the quality premium better quantitatively. We rely on a decomposition technique to estimate the relative contributions of different components. The retail price of rice quality 1 can be decomposed as follows:

$$P_{r1} = c_1 P_{p1} + B_1 + \sum_{i=1}^{3} M_{i1}, \quad (1)$$

[14] Similar results have been found in other studies in Bangladesh (Murshid 2001).

[15] The differences in the quality premium at the producer level from the previous section are very similar to the quality premiums detected at the rural market level in the value chain regression, and thus they give us further confidence in the magnitudes of these coefficients.

where P_r is the retail price of rice, P_p is the producer price of paddy, c is the conversion ratio, B is the value of by-products, and M_1, M_2, and M_3 are the margins between rural markets and miller, between miller and urban wholesaler, and between urban wholesaler and retailer, respectively. To estimate their respective contributions to the price premium, we subtract the price composition equation of quality 1 from that of quality 2 (meaning, fine minus coarse and medium minus coarse) and then divide that by the retail quality premium:

$$1 = ((c_2 P_{p2} - c_1 P_{p1}) + \Delta B \quad + \sum_{i=1}^{3} \Delta M_i) / \Delta P_r. \qquad (2)$$

Table 7.2 shows the statistical significance of the factors that explain the quality premium. Using an F-statistic, only the retail margin is significantly larger for medium or fine rice compared with coarse rice, while the margin between rural paddy traders and millers is also significantly higher in the case of fine rice compared with coarse rice. Table 7.2 shows further the results of this decomposition exercise. Two decomposition methods are used, one not incorporating the value of by-products (decomposition I), the method commonly used in the literature, and the second incorporating that value (decomposition II). There is little difference between the two methods in explaining the quality premium because of the relatively small change in conversion ratios between qualities.

Table 7.2—Decomposition of the quality premium (using regression results)

	Rice quality premium			
	Medium vs. coarse		Fine vs. coarse	
	F-value	p>F	F-value	p>F
F-test on differences between qualities				
Rural paddy trader price	1.28	0.25	0.76	0.38
Rural paddy trader/miller margin	0.25	0.61	5.76	0.02
Miller-urban wholesaler margin	0.16	0.68	0.05	0.82
Urban wholesaler/urban retailer margin	11.48	0.00	19.47	0.00
	BDT/kg	%	BDT/kg	%
Decomposition I*#				
Rural paddy trader price	0.60	14.4	3.70	20.9
Rural paddy trader/miller margin	0.75	18.0	7.82	44.2
Miller-urban wholesaler margin	0.78	18.8	0.81	4.6
Urban wholesaler/urban retailer margin	2.03	48.8	5.36	30.3
Total	4.16	100.0	17.69	100.0
Decomposition II#**				
Rural paddy trader price	0.60	14.4	3.62	20.5
Value of by-products	0.00	0.0	0.08	0.4
Rural paddy trader/miller margin	0.75	18.0	7.82	44.2
Miller-urban wholesaler margin	0.78	18.8	0.81	4.6
Urban wholesaler/urban retailer margin	2.03	48.8	5.36	30.3
Total	4.16	100.0	17.69	100.0

Source: Authors' calculations.

The analysis illustrates the increasing importance of the off-farm segments with increasing rice quality. The results show that the quality premium (over coarse rice) increases from BDT 4.2 per kilogram to BDT 17.7 per kilogram in the case of medium and fine rice, respectively. The increase in the quality premium is only to a very minor extent explained by increased producer prices (14 percent and 20 percent in the case of medium and fine rice, respectively). The largest explanation is the increase of rural trader–miller margins (44 percent and 18 percent of the premium for medium and fine, respectively) and the urban retail margin (49 percent and 30 percent for medium and fine, respectively).

An important question is why these margins differ significantly between the low- and high-quality rice. First, it can be argued that the milling of higher-quality rice entails higher costs. On the one hand, conversion ratios from fine paddy to fine rice are seemingly lower than the ratios for medium or coarse rice, as indicated by several millers. This then leads to a higher level of lower-valued by-products and higher costs for milling of fine rice. On the other hand, a specific quality of paddy does not lead to a specific quality of rice. Double—or more—milling processes (as well as parboiling) can allow for the production of fine rice out of medium paddy, or of medium rice out of coarse paddy. For example, the widely available Minicate variety in Bangladeshi markets (19 percent of the reported quality in the portfolio for sale by Dhaka retailers) comes mostly not from a fine paddy variety (since fine paddy is rarely produced locally) but from a medium paddy variety that has been double milled so that it becomes fine rice. In this case, the level of by-products is again higher than in the case of single milling. On top of the lower conversion ratio, there is also the extra cost of the milling (and parboiling) operation itself that has to be accounted for. Some millers are willing to bear these extra costs because of the increasing price premium, as was seen in Figure 5.1.

To test whether that process was happening in the zones where our survey was fielded, we compare the importance in the portfolio of the different qualities of rice in procurement and sales, and we test whether the grade millers bought was lower than the grade they sold (Table 7.3). However, no significant difference can be detected, and it seems that this practice is little present in the production areas where the millers were interviewed. Overall, it thus seems the case that the higher milling margins might partly reflect extra costs. In practice, however, we are unable to test for higher costs versus higher profit rates that might be driving the margin.

Table 7.3—Procurement of paddy and sales of rice by mills in the year prior to the survey

	% in portfolio			t-test difference	
	Years Procurement	Sales	Mean difference	t-value	Pr(T>t)
Coarse					
Aman	43.9	44.7	0.8	0.32	0.75
Boro	37.9	42.3	4.4	2.08	0.05
Medium					
Aman	26.3	24.7	-1.6	-0.32	0.75
Boro	36.4	36.7	-0.3	-0.12	0.91
Fine					
Aman	29.7	30.5	0.8	0.14	0.89
Boro	25.4	21.3	-4.2	-1.73	0.10

Source: Authors' calculations.

Second, an important change in retail in Asia is the rapid emergence of brands (Minten, Reardon, and Chen 2011). For example, the mill operators in our sample indicated that the share of packaged rice (sold in bags smaller than 50 kilograms and often reflecting branding) had increased from 5 percent to 36 percent in their portfolio in the last decade. This branding practice is significantly more prevalent for medium and fine rice in Dhaka retail markets than for coarse rice, as shown by the results of a probit model in Table 7.4. The higher prices obtained by rice mills and retailers might thus partly be explained by *brand* values created by the mills (for example, as discussed in general for developing countries by Anholt 2005). The rewards of these brands are captured downstream in the value chain—by the mills as well as possibly by retailers.

Third, there is a much larger diversity of agronomic varieties within the fine and, to a lesser extent, the medium rice category than there is in the category of coarse rice, and millers do not just sell a quality (such as coarse, medium, or fine) but often differentiate further by brand and variety. Given the lower turnover of these products compared with a less differentiated product such as coarse rice (for example, as seen in the larger share of coarse grains in total sales, shown in Table 4.2, compared with their share in the total portfolio of the retailer, shown in Table 5.1), the opportunity costs for retailers (and mills) of holding stocks of better-quality rice might possibly be higher. This might then also partly explain the higher observed retail margins. Since this point was made only in key informant interviews and could not be verified with our data, this explanation deserves further research.

Table 7.4—Branding and rice quality (probit regression of sales of branded rice in Dhaka retail markets)

	Unit	Coefficient	z-value	Marginal effect*
Coarse rice (default)				
Medium rice	yes = 1	0.92	1.97	0.089
Fine rice	yes = 1	1.47	3.29	0.033
Modern retail	yes = 1	2.23	9.13	0.065
Thana dummies	yes = 1		included	
Intercept		-2.18	-4.88	
Number of observations		944		
Likelihood ratio chi-square(11)		274.36		
Prob > chi-square		0		
Pseudo R-square		0.3374		

Source: Authors' calculations.

Note: * Change in the probability for a discrete change in the independent variable.

8. CONCLUSIONS

The impact of the changing demand for food quality and safety on food systems in developing countries is not yet well understood. Most of the existing literature has looked at the impact of modern channels (export markets or modern retail) and has mostly focused on their effects on producers or solely on nonstaple products. While previous research has shown the decline of rice as a staple food in Asian markets (for example, Timmer 2010), little research has been done on the change within the rice sector itself. We look at the case of rice in Bangladesh and study changes in rice quality, based on unique surveys fielded at different levels of the value chain: upstream, midstream, and downstream. Two major findings emerge.

First, the share of higher-quality rice is found in our survey to be rapidly increasing in rice markets. This type of rice is sold in traditional urban retail markets at significantly higher prices than the lower-quality coarse rice. The emerging modern retail sells it at even higher prices. It is interesting that we find such a shift in one of the poorest countries in Asia.

Second, the labor rewards for growing high- and low-quality rice are found not to be significantly different. Farmers thus currently do not benefit directly from these relatively higher retail prices and from consumers' increased willingness to pay for food quality. In a well-functioning agricultural economy, one would expect farmers to be paid for the extra effort to produce quality, but one would expect not to find larger returns on the production of higher-quality versus lower-quality rice if efforts and inputs were similar. The latter seems to be the case in Bangladesh.

The findings point to several implications. First, the availability of higher-yielding varieties of better-quality rice and the increasing demand for quality in rice markets have led to important push and pull factors that have together led to important changes in the rice sector in Bangladesh. This situation illustrates how well-targeted rice variety improvements that respond to needs can have large impacts on agricultural economies in such countries.

Second, the lack of availability of high-yielding varieties of the highest-quality (fine) rice leads to important costs in the rice value chain, resulting from the conversion of low paddy quality to high rice quality. If higher-yielding varieties of fine rice were more readily available, it seems that farmers, if not directly then at least indirectly, should be able to capture a larger share of consumers' increasing willingness to pay for quality, and these varieties would then also become available at lower prices for consumers. The resulting price decreases at the end of the value chain might then also make Bangladesh more competitive in rice export markets.

The research also points to important new areas for research. First, a better understanding of the growing off-farm sector, of the way the availability of new technologies within processing industries leads to a transformation of value chains, and of the rewards of adoption and spread of these new technologies is a fertile area for further research. Second, while the present study is based on relatively small surveys, it would be useful to better understand the implications of the transformation of food value chains based on larger surveys within Bangladesh as well as in other countries. Third, we rely solely on cross-sectional data. It would be beneficial to better grasp changes over seasons and over longer time periods by relying on consistently collected household data over time. Fourth, more research is needed to unravel the exact importance of the different drivers in the transformation of food value chains, such as changing preferences of the poor versus income growth overall.

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