Emerging Markets after Liberalization: Evidence from the Raw Milk Market in Rural Kenya

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I. Introduction

A well-integrated market system is necessary for an efficient allocation of productive resources, which contributes to regional food security and a reduction of price risks by preventing unnecessary price volatility. It has been widely believed that markets do not function effectively in Sub-Saharan Arica (SSA) due to high transportation costs, high transaction costs, and imperfect contract enforcements (Fafchamps 2004, Poulton et al. 1998), which provided rationale for governments to intervene markets actively since the Independence. The structural adjustment programs withdrew governmental controls and supports on market transactions in many countries, which seemed not to help promoting a well-integrated market system (Badiane and Shively 1998; Osborne 2005).

One reason for unimpressive results of structural adjustment programs is that policy makers and donor agencies might not recognize that institutions supporting market was immature in these countries. Another reason would be that in terms of evaluating the market liberalization programs, existing studies rather focus on comparing the situation before and just after the liberalization. This implies that the authors of these studies believed that markets develop immediately after the regulations and controls were removed. Few studies, however, considered the possibility that markets develop by themselves if supporting institutions are formed so as to allocate resourced efficiently.

In this study, we use panel data of 874 rural households in western and central Kenya

in 1998 and 2004. Before the liberalization, the milk market in the formal sector was monopolized by a parastatal processing company, Kenya Cooperative Creamery (KCC), with coordination of dairy cooperatives. Just after the collapse of KCC, the formal dairy sector in Kenya plunged into a slump. The raw milk market in Kenya, however, seems to have transformed gradually after the crisis of the liberalization.

The rest of the article is structured as follows. The next section describes the market liberalization of the dairy sector in Kenya and explains the institutional changes after the liberalization. Then, we present the panel data used in the study and explain our hypotheses and estimation strategies. Finally we discuss the results and provide conclusions and policy implications.

II. Background

When the liberalization effectively removed the ban on raw milk sales in urban areas, dairy households living close to urban areas started selling raw milk in urban areas. Some of them became small traders (vendors and hawkers) who collected milk from their neighbors and sold it in urban areas. Private processors who newly entered the milk market collected raw milk from dairy households, dairy cooperatives, and traders. Because KCC delayed payments to dairy cooperatives and their members, some of the members have shifted from KCC to

private processing companies and traders. The area where traders buy milk, therefore, has expanded from peri-urban to rural areas.

Replacing the dairy cooperatives with traders and processing companies did not take place without problems. According to the surveys, the frequency of problems related to milk marketing has declined as private traders themselves gained experience, and trust-based and long-term relationships have been established between traders and dairy households and between traders and retailers. What we find in our interviews is that the producer-cum-traders started the business just after the dairy cooperatives and KCC collapsed in order to sell their own milk, but it took some time for large-scale traders connecting towns and urban areas to start their business in the raw milk market. This is because trading raw milk in a larger quantity for a long distance requires pick-up trucks and an established milk marketing chain as well as a brand name to develop a reputation of good quality. In this way, many large-scale traders who gained capital and experience in raw milk marketing have gradually enlarged the scale of their business (Kodhek and Karin 1999). These observations imply that the milk market has emerged gradually during the post-liberalization period.

III. Data and Changes in Milk Marketing among Sampled Households

This article uses panel data of 874 households in rural Kenya. The panel comprises two periods of time. The survey in the first round was conducted by the Smallholder Dairy

Project (SDP), a collaborative team from the Ministry of Livestock Development & Fisheries, the Kenya Agricultural Research Institute (KARI), and the International Livestock Research Institute (ILRI).[1] In 2004, as a part of the Research on Poverty and Environment and Agricultural Technology (REPEAT) Project,[2] 100 sub-locations (the smallest administrative unit in Kenya) were randomly selected from sub-locations where the SDP households resided. In each sub-location, ten SDP households were selected for re-interviews. Although new questions were added in the 2004 REPEAT survey, most of the questions on livestock and dairy production were kept comparable with the SDP surveys. Thus, the panel data can be used for measuring the change in milk marketing between 1998 and 2004.

In Table 1, there are several important findings in this table. First, the proportion of households who produced milk slightly increased from 60% to 64%. Second, there is a large increase in the proportion of households selling milk from 59% to 80% among milk producers from 1998 to 2004. Third, outside of the Nairobi milk shed, the proportion of households who sold milk increased, while the total milk production decreased. These findings suggest

[1] In 1996, SDP first conducted a survey of 334 rural households in Kiambu District (Central Province) near Nairobi. Then, in 1998, the survey was expanded to eight districts in the Central Kenya region, and covered 1,390 additional households (Staal *et al*. 2001). In 2000, they interviewed 1,576 households from seven districts in the Western Kenya region (Waithaka *et al*. 2002). A total of 3,300 rural households were randomly selected according to similar sample selection procedures and interviewed on dairy production and other income generating activities. Thus, the first round of the panel data comprises a series of three household surveys collected in 1996, 1998, or 2000. For the ease of presentation, we indicate the first round as "1998 data."

[2] The REPEAT Project is a collaborative research project of Foundation for Advanced Studies on International Development (FASID), National Graduate Research Institute for Policy Studies (GRIPS), the World Agro-forest Center, and Tegemeo Institute in Kenya. More details on the REPEAT are available in Yamano *et al.* (2005).

that one of the reasons for increasing the participation of selling milk is the increase of milk production between 1998 and 2004. If the amount of milk produced is small, all the milk produced tends to be consumed at home and there is no milk for sales. However, the data show that the amount of milk production declined at least in areas outside of Nairobi milk shed, which suggests that there should be another reason for increasing the participation of selling milk.

In Table 2, we can track how households changed milk buyer between 1998 and 2004. The number of households who identified dairy cooperatives as the largest milk buyer has halved, while the number of households who sold milk to traders has tripled. It seems that private traders have gained the market share which was lost by the dairy cooperatives. Those who started selling milk in 2004 mainly sold milk to individual customers and traders. More than one third of households who sold to individual customers in 1998 shifted to private traders in 2004. It is clear, thus, that the role of traders has become more important during this period.

IV. Development and Efficiency of the Raw Milk Market

A. Hypotheses

The Kenya raw milk market has been in the process of transforming from the KCC-cooperative marketing system to a more competitive marketing system in which traders

and private processors play an important role. As explained in the earlier sections, we postulate that the participation of milk production and milk sales increased in areas where traders and private processors became more active between 1998 and 2004.

With the increasing share of milk going to the informal market in urban areas, transporting milk from production areas to urban areas has increased in Kenya after the liberalization (Karanja 2003). Traders buy milk in milk surplus area and sell in milk deficit area. As the supply of milk in deficit area increases, the price goes down, which decreases the differences between producer price and consumer price and the profit for traders. When the competition becomes harsh, the price difference will decrease until the price difference is declined up to the amount which covers just actual costs such as transportation costs. We call this spatial price arbitrage. Since transportation cost is higher as the distance of transporting milk increases, the price received by producers becomes lower as the production area is farther from the final consumption area. In addition, if market is closed in the locality, the price may be higher where the demand for milk exceeds the supply within the locality, with other things being equal. When the price is arbitraged spatially, such differences in the market condition should not affect the producer prices. Since long-distance traders who connect milk-surplus areas with milk-deficit areas have increased, we postulate that the raw milk price received by producers was determined by factors related with transportation costs, but not by local market conditions such as the excess demand for milk within the local market in 2004.

B. Estimation Model

To estimate impacts of changes in milk marketing on dairy farmers' milk production and sales, we consider following models of the participation to dairy sector and decision of milk production:

(1) $$y_{it} = \beta\ X_{it} + \delta\ M_{jt} + \alpha_i + \varepsilon_{it}, \qquad t = 1, 2$$

where y_{it} refers to either the raw milk production or sales of household *i* at time *t*; X_{it} is a set of household characteristics of household *i* at time *t*; M_{jt} is a set of proportions of households who sold to a specific milk buyer type in community *j* at time *t*; α_i is a set of unobserved characteristics of household *i*; and ε_{it} is the error term. For the decision of whether to produce or sell milk, the dependent variables are dummy variables, while the dependent variables are non-negative continuous variables for the decision of the amount of milk produced and sold. In the estimation models of the decision of milk sales, only the sub-sample of milk producing households is used. Our main estimation concern is that the set of unobserved household characteristics, α_i, is correlated with the independent variables, especially the proportions of households who sold milk to specific milk buyer types, M_{jt}, which can create estimation biases. Thus, we apply the first difference model for eliminating the household fixed effects.

To test the second hypothesis, we estimate the following milk price model at the household level for each survey period:

(2) $$p_{it}^{k} = \alpha_t + \beta_t d_i^N + \delta_t d_i^L + \gamma_t X_{jt} + \varepsilon_{it}, \qquad t = 1, 2$$

where p_{it}^{k} refers to the raw milk price received by household *i* received from milk buyer type *k* in survey year *t*, d_i^N is the distance to Nairobi in kilometers from household *i*, d_i^L is the distance to the nearest urban market (other than Nairobi) of household *i*, X_{jt} is sublocation *j*'s relative milk abundance measured by per capita milk production in community *j*, ε_{it} is the error term. In order to allow non-linear relationship between the distance and the raw milk price, we add the squared terms of distance variables. The dependent variable, p_{it}, raw milk price, is the producer price per liter for the major outlet.[3] As a proxy of transportation costs, we use the distance to Nairobi and the distance to the nearest town both in kilometers. To incorporate the effects of poor quality roads, we also use total traveling time between households and urban towns, instead of the distance.[4] As another explanatory variables, X_{jt}, we use the sublocation-level per capita milk production as a proxy of a local market condition showing whether the sublocation is a milk deficit or surplus area.[5]

C. Results

3 All the data were collected around the month of June which is in major rainy season and the possible price differentials due to seasonality should not be serious. We do not deflate milk producer price since there are no detailed price index. Instead, district dummies are used to control spatial price differences. Since price models are estimated separately in 1998 and 2004, price differences over time do not need to be adjusted to a certain year.

4 These variables were calculated by SDP, not by the authors, using the methods developed in Staal *et al.* (2000) which used GIS information.

5 This is quite a different way to test spatial market efficiency than existing studies which use time-series price data (Fackler and Goodwin 2001). One of the reasons is the fact that time-series data are not available for raw milk prices in Kenya. More importantly, as shown in Baulch (1997), the existence of transaction costs and non-continuous trade flows can make the statistical results from such sophisticated methods flawed. Thus, this study applies the arbitrage condition for prices in spatial competitive equilibrium, similar to Kurosaki (1996).

Table 3 shows the results for the determinants of milk production and marketing decisions. As can be seen in column (1), households tend to start producing milk in areas where there are more milk buyers other than individual customers. The increase in the share of traders by 10 percentage points has an impact on the likelihood of producing milk by 4 percentage points. The amount of milk production, however, does not increase even when the shares of trader and private processor increase (column 2). Rather, the number of household members and age of household head increase the amount of milk production. The positive coefficient of share of KCC indicates that milk production dropped where share of KCC decreased considerably.

As expected, households with larger milk production are more likely to participate in milk sales (column 3). Even after the amount of milk production is controlled for, we can find that the participation of milk sales is likely to increase with the market development. The amount of milk sold is greater if households produced more milk and the education of household head is higher. These finding support our hypothesis that the development of milk market heightens the expected returns to milk production, thereby increasing the participation of milk production and milk sales.

The results from the milk price model in Table 4 indicate that the distances to Nairobi and the nearest urban town are important determinants of the raw milk price in both years. This suggests that even in 1998, milk price received by producers depends on the

transportation cost from the towns. We obtained the qualitatively similar results even when using traveling time instead of distance variables (columns 2 and 4).

V. Conclusions

This article examines how the raw milk market in Kenya has restructured after the market liberalization and how such a change has affected households' decision of milk production and marketing. It is known that the milk marketing channel of KCC accompanied with dairy cooperatives in Kenya have contributed to encourage rural smallholders to adopt dairy cows since such stable milk buyers can decrease the risks associated with milk marketing. According to the panel data of 874 households, however, from 1998 to 2004, the proportions of dairy households who sold milk mainly to KCC and dairy cooperatives have drastically decreased. Instead, the proportions of dairy households who sold milk to traders and private processors have increased. Such a restructuring of the market institution increases the expected returns to milk production, which encourages rural households to start producing and selling milk. The milk price analyses indicate that the local milk market condition no longer determines the milk price in 2004. This is likely because more large-scale traders and private processors who started business in recent years have contributed to connecting rural and urban milk markets.

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Table 1. Milk Production and Sales Status in 1998 and 2004

Province	Number of observations	1998: % of households with positive milk production (A)	1998: % of HHs who sold milk (among milk producers) (B)	1998: Total milk production (liter) Those who sold (C)	1998: Total milk production (liter) Not sold (D)	2004: % of households with positive milk production (E)	2004: % of HHs who sold milk (among milk producers) (F)	2004: Total milk production (liter) Those who sold (G)	2004: Total milk production (liter) Not sold (H)
Eastern	62	53.2	57.6	1381	518	54.8	73.5	1690	515
Central	310	61.9	81.3	2246	1283	71.3	88.2	2614	1425
Rift Valley	222	64.9	66.7	2610	2103	71.2	84.8	2880	1407
Western	111	54.1	28.3	2258	1213	51.4	64.9	1201	508
Nyanza	169	58.6	21.2	1648	1077	53.3	62.2	1532	574
Nairobi milk shed	545	60.6	78.5	2271	1390	68.3	86.6	2701	1203
Outside*	329	60.2	25.3	2244	1456	57.1	66.5	1570	643
Total	874	60.4	58.5	2695	1367	64.1	79.8	2702	1011

* Outside of Nairobi milk shed is defined as Western and Nyanza provinces plus Nandi district.

Table 2. Change in Milk Marketing (Number of Households)

	2004 Individual customer, restaurant	Dairy coop	Trader	Private processor	KCC	Neither sold nor produced	Total
1998							
Individual customer, restaurant	66	3	41	4	3	51	168
Dairy cooperatives	5	54	21	11	9	10	77
Trader	11	2	28	0	2	10	53
Private processor	1	0	6	2	0	0	9
KCC	0	0	5	3	3	3	14
Neither sold nor produced	126	5	51	14	4	353	553
Total	209	31	152	34	21	427	874

Table 3. Milk Production and Marketing Decision and Change in Market, 1998 - 2004 (First Difference Model)

	=1 if Milk Production >0	Milk production (ton liter)	=1 if Milk sold >0	Milk sold (liter)
	(1)	(2)	(3)	(4)
Sublocation level market change				
Δ Share of trader as market outlet	0.387**	0.131	0.304*	-2.988
	(3.62)	(0.30)	(2.55)	(0.80)
Δ Share of private processor	0.739**	-0.221	0.648*	-5.131
	(3.13)	(0.23)	(2.45)	(0.62)
Δ Share of KCC as market outlet	0.521*	5.384**	0.431	4.888
	(2.15)	(5.39)	(1.59)	(0.58)
Δ Share of cooperatives as market outlet	0.403*	-1.007	0.797**	-13.35*
	(2.39)	(1.45)	(4.28)	(2.29)
Δ Number of HH members(100 people)	0.947	4.233*	2.298**	-1.722
	(1.57)	(1.90)	(3.22)	(0.08)
Δ Dummy for female headed household =1	-0.000	-0.052	-0.013	-1.545
	(0.01)	(0.26)	(0.23)	(0.86)
Δ Age of household head (100 years)	0.389*	1.046	-0.164	3.127
	(2.07)	(1.36)	(0.73)	(0.45)
Δ Years of education of household head	0.007	0.038*	0.005	0.616**
	(1.47)	(1.93)	(0.82)	(3.43)
Δ Land size (100 acres)	-0.220	0.101	-0.090	-5.951
	(0.72)	(0.08)	(0.28)	(0.59)
Δ Yearly Milk production (ton)			0.057**	2.603**
			(6.60)	(9.56)
Constant	-0.028	0.283**	0.158**	4.052**
	(1.08)	(2.67)	(5.19)	(4.25)
R-squared	0.03	0.06	0.11	0.17
Number of observations	874	874	670	670

Note: Numbers in parentheses are t-statistics. ** and * indicate significant at 1% and 5%, respectively.

Table 4. Determinants of the Producer Price of Raw Milk (Household Level)

	1998	1998	2004	2004
	(1)	(2)	(3)	(4)
Distance to Nairobi (km)	-0.058**		-0.079**	
	(-3.40)		(-4.42)	
Distance to Nairobi squared (100 km)	0.017		0.023**	
	(3.11)		(4.62)	
Distance to urban town (km)	-0.059*		-0.092**	
	(-1.85)		(-2.67)	
Distance to urban town squared (100 km)	0.047		0.033	
	(1.22)		(0.86)	
Traveling time to Nairobi (hours)		-4.070**		-4.130**
		(-3.10)		(-2.84)
Traveling time to Nairobi squared (hours)		0.924*		1.034**
		(2.93)		(3.25)
Traveling time to urban town (hours)		-5.459**		-8.515**
		(2.93)		(-3.19)
Traveling time to urban town squared (hours)		3.405*		3.135
		(1.85)		(1.61)
Sublocation's per capita milk production (100 liter)	-0.313**	-0.351**	0.073	0.063
	(-3.20)	(-3.47)	(0.97)	(0.84)
Constant	19.96**	20.06**	21.00**	20.17**
	(6.20)	(5.65)	(6.53)	(5.93)
District dummies	Yes	Yes	Yes	Yes
Observations	293	293	494	494
R-squared	0.75	0.76	0.56	0.55

Note: Numbers in parentheses are t-statistics. * and ** indicate 5% and 1% significance levels, respectively.