The Role of Market Outlet in Determining Terms for Milk Sales by Smallholders in Kenya

Abstract

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Dairy production is a key small farm strategy for generating income in the Nairobi milk shed. The high perishability of milk under Kenyan conditions appears to be associated with a high frequency of small individual transactions, the terms of which are subject to forced "fire" sales, delayed payments or default. Reliability of outlets in the wet (milk glut) season is also a consideration, and credit sales typically are matched with a commitment to be a steady customer. Two salient phenomena are observed: reported unit milk prices differ widely within the same location and time period, and spot sales for cash tend to be at a higher unit price than sales on monthly credit. We hypothesize that dairy farmers in the Nairobi milk shed choose market outlets and levels of cash sales that reduce transactions costs and help assure reliable future outlets, at the expense of current income. A decomposition of producer milk prices across time, space, and market outlet suggests that reliability of outlet is worth up to 17 % of the spot price, in addition to waiting a month to be paid. Risks of credit default are illustrated by predicted weekly credit prices that are 5 % lower than monthly credit prices. Data from 21 smallholder farms monitored daily over one year are used to estimate a two-limit Tobit model of the role of the characteristics of market outlets and producers in explaining the share of producer output sold for cash rather than credit. Younger, more educated producers, receiving a regular off-farm salary, and near market centres are shown to be more likely to accept sales on credit. Older producers with more experience but less formal education are more likely to sell for cash rather than credit. The power of the model to explain different prices for milk in the same location and week suggests that such price differences viewed unidimensionally are not evidence of lack of market integration as conventionally defined, but an outcome of differential transactions costs and perceptions of risk by different producers.

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Issues and Data

Conceptualisations of buyer-seller relationships in the New Institutional Economics, coupled with a growing number of related empirical works in developing countries, reflect a rising interest in the strategic roles that contractual arrangements can play in conveying non-monetary exchange values that are intrinsically important to exchange-partners (Hayami and Otsuka, 1993; Hoff, Braverman and Stiglitz, 1993). Related to this is the theme that the choice of one contractual form over other forms is a considered decision based on utility differentials (Ganesan, 1994; Heide and John, 1990). Equally significant is the notion that relational transactions are mainly founded on trust (de Janvry, Fafchamps and Sadoulet, 1991; Fafchamps, 1996; Doney and Cannon, 1997 Garbarino and Johnson, 1999) and safeguarded by contracts, which may either be in explicit or implicit forms (Dwyer, Schurr and Oh, 1987).

In this context, trust is conceptualised as the confidence a party in an exchange places on the credibility and reliability of his exchange-partner (Morgan and Hunt, 1994; Moorman, *et al* 1993). Further, Ganesan (1994) argues that participation in a relational transaction demonstrates " an expectancy held by an individual that the partner's word or written statement can be relied on". This implies that it is possible for relational contracts to be potentially useful yet undesirable if a party in an exchange has misgivings about the credibility and reliability of the exchange-partner.

The potential usefulness of the above conceptualisation in revealing the qualitative nature of contractual arrangements involving sale of agricultural commodities by smallholder farmers is apparent. This paper applies the concept in the examination of two peculiar aspects observed in the sale of milk by smallholder dairy farmers in Nairobi milk shed. First, prices differ widely within the same location and time, even though local milk markets otherwise seem to be relatively well-integrated (Staal, Delgado, and Nicholson, 1997). Second, as this paper will demonstrate below, spot sales for cash tend to be at a higher unit price than sales where the producer only gets paid a month later. The aim is to describe and to evaluate milk sales arrangements against the background of three broad categories of

factors hypothesized to be significant determinants of smallholder's choice of market outlet. These are the commodity attributes of milk; the risk factors inherent in market outlets available to the smallholders; and the producer household-specific factors predisposing a household to sell in one or the other market outlet.

The significance of the study is found in the fact that most sub-Saharan African countries have since the mid 1980s embarked on reforms aimed at reducing the role of the state while increasing that of the private sector and of market forces in the co-ordination of food markets. Former systems of market regulations encouraged sale of agricultural commodities through single-channel outlets whose time pattern of payment and mode of transmission of payment to farmers were prescribed by the government. Liberalization of markets has stimulated the emergence of diverse market outlets with corresponding diversity in time patterns of payments. However, as the system develops, it is expected that the long-run market structure will be conditioned by the interacting influences of the contractual aspects of value to producers and the risk factors inherent in the different food commodities and in the emerging market outlets. The role of public policy will then be to address issues of contract enforcement and to facilitate access to communications and transport services within a market context.

The data used in the study were collected in 1998 in a longitudinal survey involving 21 smallholder dairy households in Kiambu district, Kenya. Daily milk production and sales data were collected over a 12 month period, with a recall period of 3 to 4 days. The longitudinal survey was designed to allow appropriate monitoring of changes in flow variables and consequent adjustments in households' milk sale activities. Data collected included detailed measures on milk production, household's characteristics of access to milk market outlets and marketing services, and marketed surpluses sales. Along with these, data was also collected on market outlets, prices obtained in each market outlet used, and organisation of milk collection at the farm level. To capture area-specific factors of importance to market accessibility, the sample was drawn from six sub-locations.

Smallholder Marketing Constraints and Risks: Implications for contractual forms

Raw milk is a highly perishable (non-stock) commodity with a daily flow (once or twice-a-day harvest) of marketable streams that extend for at least a full

lactation period. The frequency of market transaction therefore tends to be very high (Staal, Delgado and Nicholson, 1997). It is reasonable to presume that there is value in contractual forms designed to offer market assurance to producers that streams will be maintained, especially when milk is plentiful on the market during the rainy season and producers face the risk of not being able to sell a non-storable (for them) commodity (Jaffee 1995). It is therefore expected that the farmer does not search for market outlets one transaction at a time. Rather, the farmer is expected to engage in a purposive effort to secure transactions over the horizon of at least one full lactation period (about one year). This suggests that repeat transactions under a contractual arrangement are preferable to many farmers when compared to simple spot transactions.

Another feature of particular significance when discussing smallholder milk marketing is the typically small quantity of individual daily marketable surplus. This coupled with the characteristically high banking transactions costs (resulting from lack of rural banking institutions), and the practice of paying bills and wages at the month's-end, place a great significance on the time-pattern of milk payments. Lump-sum payments may be intrinsically valuable where liquidity flow is required in lumps to match lumpy expenditures e.g., school fees or farm production expenditures and there is little financial intermediation. Furthermore, receiving daily payments in coins for small transactions has obvious disadvantages in any society, especially without banks, over a reliable periodic settlement in larger amounts. It is therefore logical to presume that contractual arrangements that combine repeat transactions with the ability to accumulate daily payments (so as to hand the farmer a lump sum amount at weeks, fortnights' or months-end) are preferable to the receipt of a daily stream of small amounts of money.

Closely associated with the reliability-of-outlet constraint for smallholders is the problem for buyers/market agents of volume unpredictability inherent in procuring large amounts of milk from smallholders. A large buyer must of necessity procure from a large number of smallholders. However, marketable surplus from a smallholder farmer is a residual of home consumption and the production of often only one or two cows; it therefore varies. This coupled with the fact that the farmer can sell in a number of different market outlets means that the aggregate volumes received by the buyer may fluctuate substantially on a daily basis. Added to this is

the fact that production is mainly based on rain-fed pastures and crop residues, with little or no concentrate supplements.

Volume unpredictability suggests that in exchanges between smallholders and large-scale buyers, it might be difficult to define operational volume-based contracts. Further, the small quantities of individual marketable surpluses imply that the cost of drawing up explicit contracts may be high relative to the value of sales. This coupled with the problem of supply fluctuation implies that implicit[1] contracts may be more appropriate as compared to explicit[2].

The above theoretical analysis suggests that, to reflect the utility content of a sales arrangement from the perspective of the smallholder dairy farmer, it is useful to view the problem from three mutually inclusive dimensions:

- The price level
- The presence or absence of a pledge for repeat transactions.
- The time pattern of payments for milk

Based on these three dimensions, the arrangements obtainable in the sale of milk by smallholders logically fall into three categories as illustrated in table 1.

Table 1. Types of farmer-buyer sales arrangements

	Time pattern of payment	Pledge for repeat exchange
On credit sale (OCS)	Lump sums	Yes
Cash-sale single transactions (CSST)	On spot	No
Cash-sale-repeat transactions (CSRT)	On spot	Yes

On-credit-sale contracts are of the type termed by de Jasay (1989) "half-spot half-forward contract". By agreement daily milk payments are deferred to accumulate over a specified unit of contractual period at the end of which the payments are settled in a lump sum. The total length of contractual period may either be definite or open-ended. Such contracts have the advantage of promising a guaranteed market outlet to the farmer for at least one unit of contractual period. However they have certain inherent risks, which suggest that in order to safeguard himself, the farmer will seek

1 Implicit contracts are a non-written form that are defined to occur where both parties in an exchange are clear about the conditions of exchange, but where an explicit contract is not possible or desirable.

on-credit-sales only with buyers who have high stakes in the trade. The risks include delayed payments, non-payments, occasional loss of the entire amount of milk to non-collection of milk by buyer or to undue rejection of milk delivered to the buyer.

Delayed payments: the buyer may delay payments such that the farmer is paid after $t+n$ days instead of the agreed t days. This in effect forces the farmer into a situation where he or she is an involuntary creditor to the buyer. Furthermore, uncertainty can arise if n varies greatly from one contractual time unit to another; the farmer becomes uncertain of the payment date as a result of which planning for the sales proceeds is disrupted.

Non-payment: due to unforeseen circumstances, the buyer may not be able to pay. The buyer may also be tempted to default, unless by defaulting he is likely to worsen his payoff or to fall into disrepute.

Non-collection/undue rejection of milk: repeat transactions with large buyers such as large milk processors are typically not volume-based. They only entail specifications of the following: the party responsible for the functions of milk collection and delivery, minimum specifications of quality, the mode and transmission of payment, and the method of notifying farmers of changes in prices. The difficulties of designing volume-based contracts leaves the farmer vulnerable to the risks of losing entire marketable surplus to non-collection or, to loss from undue rejection of milk as unwholesome[3]. The buyer only pays for milk collected or received subject to the minimum specification of quality. Thus the farmer bears full loss if the buyer fails to collect or if milk is rejected as unwholesome.

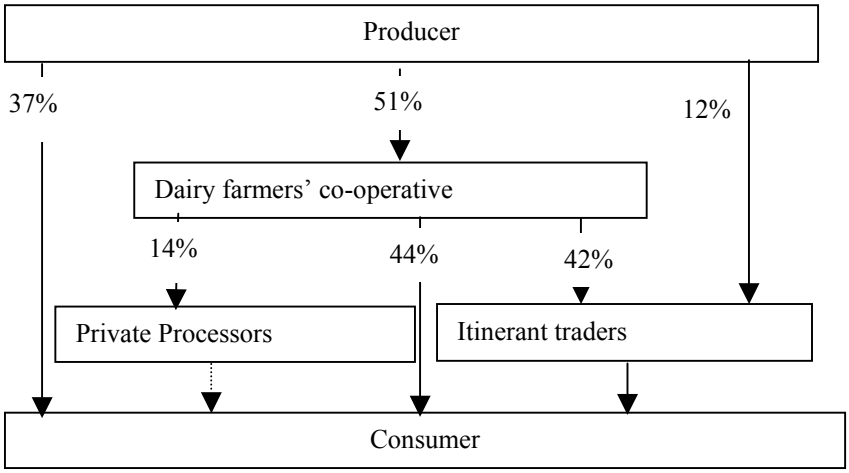
Where risks are relatively high, the farmer may opt for CSST or CSRT. These two contracts are similar in that they both entail the exchange of milk for cash on the spot. But while CSST promises no repeat contracts, CSRT has explicitly specified repeat transactions. It should however be noted that cash-sale payment and OCS are not mutually exclusive. The farmer can apportion his or her marketable surplus to the two markets such that a proportion θ (where $0 \leq \theta \leq 1$) is sold in the cash-sale market and the remaining $1-\theta$ is sold in the credit market.

[2] Explicit contracts are a written specification of terms and conditions agreed upon and voluntarily signed by both parties in an exchange. It is thus easy to verify and enforce legally.

Milk Marketing in The Survey Area

Figure1 depicts the marketing channels operating in the study area. The figure shows the major market outlets available to the smallholder dairy farmers and the relative market shams of volume. It is clear that the set of market outlets available to the producer comprise sales to one's own dairy cooperative (if a member), itinerant raw-milk re-sellers, local resident traders, direct sales to households, sales to stores and kiosks, and milk processors[4].

Figure 1. Milk Marketing Channels: Kiambu, Kenya



Source: Kenya, Ministry of Agriculture, Livestock Development and Marketing. Smallholder Dairy Project (1997). Unpublished results from a survey done to characterise smallholder dairy farmers in Kiambu district, Kenya.

Dairy farmers' co-operative societies constituted the principal market outlet for the farmers in 1997, accounting for over half of all the milk marketed. This was followed by direct sales comprising of 37% while sales to itinerant traders comprised only 12%, as depicted in the figure.

[3] NB the high perishability of milk make verification of quality difficulty

[4] Sales to private processors in fact can and do by-pass coops entirely, although that is not reflected in the 1997 document cited. The chart also lumps together hotels, restaurants, kiosks and households as final consumers.

Major modes of payment

Table 2 details the proportions of different types of farmer-buyer contractual arrangements that obtained in the different market outlets, based on the 1998 survey reported in this paper. The table shows that spot (cash-single) and monthly credit payments were the most common modes of payments. It also suggests that the nature of sales agreements was closely tailored to risk structures of the outlets. For example, compared to the other buyer types, contractual arrangements with itinerant raw-milk resellers were heavily biased towards cash-single exchanges.

Table 2: Nature of Sales Agreements and Modes of Payments

Buyer type	N*	Cash			On credit sales		
		Single	Repeat	In-kind	Weekly	Fortnightly	Monthly
Co-operative/ processor	3927	0	0	0	0	0	100
Itinerant traders	1017	73.2	18	0	4.5	0	4.3
Local-market-based traders	800	3.1	8.5	0	1.5	86.6	0.5
Household consumers	2033	27.1	11.7	.52	2.8	4.5	53.6
General retail shops/kiosks	590	0	11.8	88.2	0	0	0

Note: N is the number of transactions observations under the respective buyer type

Source: survey results

This can be attributed to characteristics of itinerant trade that are important risk factors for producers. Major among these is the ease of entry and exit from itinerant sale of milk. Compared with milk processing, resale of raw milk does not require large capital investments. A raw-milk trader only requires milk-handling cans and a reasonably functioning public transport service or private transport (e.g. a bicycle). Furthermore, itinerant traders may not be resident in the milk producing areas but may live in the nearest major town, in this case the city of Nairobi, in which case they commute to production areas to procure milk. Thus, unlike local-market-based traders, who on account of living among the smallholders and being well-known among the local community have a lot invested in social capital, itinerant traders may have little to lose in terms of reputation. All this coupled with the mobile nature of

the trade implies that itinerant traders have a relatively higher chance of defaulting if milk is sold to them by on-credit-sale.

One issue in trade with traders generally, and itinerant traders in particular, is that they tend not to buy on Sundays and holidays, even though cows produce on those days as well and cold storage on farm is not available.

Contractual arrangements with processors, dairy farmers' co-operative societies, and household consumers mostly involved on-credit-sales, and the unit of contractual period was typically a month. The contract period for local-market-based traders, however, was typically a fortnight. This may be a reflection of relative degree of trust placed on the different market outlets.

Arrangements for direct sale to household consumers offered the widest range of contractual arrangements. This can partly be explained by the relative ease of negotiating customized contracts with neighbouring households and partly by geographical segmentation of household consumers. The household consumer market is likely to be geographically segmented, with sales to neighbouring households being more oriented to credit sales, while sale to households in further away market centres may be more oriented to cash-sale contracts.

Finally, smallholder options for selling to large buyers are likely to be limited to implicit contracts on credit. Large buyers face adulteration risks in pooling milk daily from many small sellers, in addition to market risks of throughput shortfall, and therefore confine themselves to regular trusted sources (Staal, Delgado and Nicholson, 1997). This lenders itself to periodic payment for cost minimization reasons. In addition, dairy cooperatives, another large outlet, have traditionally paid only on a monthly basis.

Observed producer prices

Average producer prices observed during the 1998 survey are presented in Table 3. Since the data are not evenly grouped and are observed over time and across households with different locations and characteristics, their use for analytical purposes is limited. They do suggest the peculiar result, however, that mean credit-sale prices for milk are in several cases lower that spot market cash prices. The next section will seek to establish this point more rigorously by controlling for other possible explanations in an analysis of covariance regression framework.

Table 3. Mean producer price buyer type and mode of payment., Kiambu (Ksh/litre)

	Mode of payment				
	Cash-sale	Credit			In-kind
Market outlet		Weekly	Fortnightly	Monthly	
Co-operative	--	--	--	16.60	--
Itinerant trade	19.10	18.00	--	18.80	--
Local bars/ hotel/restaurant	18.40	19.40	18.40	19.60	--
Household Consumers	23.00	19.70	16.10	20.02	--
Processor	--	--	--	16.00	--
General retail shops/kiosks	24.00	22.60	--	--	23.74

Decomposition of producer prices

To investigate the role of different effects and interactions in producer price formation, we decomposed producer prices by regressing them against fixed effects for sales to different sorts of market outlets, weeks, and locations, and on interactions between market outlets and payment modes. The volume of each transaction varied, but not outside a magnitude where this was thought to unduly influence unit prices within the type of outlet considered.

Prices were in Ksh./litre for transactions ranging from 0.94 to 18 litres/day over the entire data set. However, sales to coops and processors all tended to be in the upper end of the range, sales to traders were tended to be in the intermediate range, and sales to households tended to be at the lower end of the range. In practice, the separate influences of size of transaction and purchaser type were hard to separate statistically, and an insignificant coefficient for a continuous size variable in the producer price model was obtained in the initial run. The size variable was dropped, facilitating but nuancing interpretation of results. The coefficients below can be understood directly in Ksh./litre and are additive, but the difference in prices obtained

from different categories of outlet (coop, trader, household) may also include a small fixed effect for differences in size of transaction.

$$P_{ijkt} = P\ldots. + Outlet_i + Location_k + Week_t + Outlet*Paymentmode_{ij} + e_{ijkt}$$

The dependent variable P_{ijkt} is the unit price observed at market outlet *i* for payment mode *j* at location *k* and time *t.* The constant P…. is the mean market price, collapsed over all four dimensions. The other variables are all fixed effects for the elements identified (1-0 dummy variables).

Results of the price decomposition model are presented in table 4. As hypothesized, inspection of coefficients and error terms reveals that that prices differed significantly across the market outlets. On average, predicted cash prices were highest for direct sales to consumers, with itinerant traders paying the next highest average price, followed by local-market-based traders. For monthly credit sales, the highest predicted price was for direct sales to households, then to local and itinerant traders (few local traders used monthly payment). The lowest predicted prices were for credit sales to processors and dairy coops, which were not significantly different from each other.

Notes: N = 8722 and Adj. R^2 = 0.80

Table 4: Decomposition of Producer Prices for Milk, Kiambu, Kenya

Variable	Coef.	Std. Err.	T	P>|t|	[95% Conf.	Interval]
Size of transaction (KG)	-0.004	0.004	-1.203	0.229	-0.012	0.003
Unit of measure						
Litre	-0.645	0.048	-13.354	0.000	-0.740	-0.551
Bottle (750 ml)	1.554	0.084	18.436	0.000	1.389	1.719
Large cup (500ml)	3.286	0.171	19.198	0.000	2.951	3.622
Small cup (350ml)	0.205	0.113	1.823	0.068	-0.015	0.426
Buyer-types						
Itinerant trader	2.591	0.051	50.595	0.000	2.491	2.691
Local-market-based trader	0.152	0.106	1.439	0.150	-0.055	0.359
Household Consumer	1.333	0.068	19.546	0.000	1.199	1.466
Processor	-0.266	0.072	-3.712	0.000	-0.407	-0.126
General shop/kiosk	0.557	0.117	4.741	0.000	0.326	0.787
*Buyer-type*mode of payment*						
Itinerant trader*weekly	-1.682	0.200	-8.431	0.000	-2.073	-1.291
Itinerant trader*monthly	0.186	0.104	1.785	0.074	-0.018	0.391
Itinerant trader*in-kind	-2.416	0.432	-5.586	0.000	-3.263	-1.568
Local-market-based trader*in-kind	0.631	0.169	3.745	0.000	0.301	0.962

Local-market-based trader*weekly	2.235	0.325	6.879	0.000	1.598	2.872
Local-market-based trader*monthly	1.796	0.578	3.106	0.002	0.663	2.930
Household Consumer*cash	0.959	0.078	12.230	0.000	0.805	1.112
Household Consumer*weekly	-0.005	0.095	-0.052	0.959	-0.192	0.182
Household Consumer*fortnightly	-0.956	0.154	-6.220	0.000	-1.257	-0.655
Household Consumer*in-kind	-1.601	0.393	-4.077	0.000	-2.371	-0.831
General shop/kiosk*cash	0.597	0.159	3.762	0.000	0.286	0.908
General shop/kiosk*weekly	-0.711	0.287	-2.482	0.013	-1.273	-0.150
Sub-locations						
Gitaru	6.189	0.104	59.380	0.000	5.985	6.393
Kanjai	0.060	0.058	1.040	0.298	-0.053	0.173
Kimathi	1.767	0.110	16.104	0.000	1.552	1.982
Ngecha	1.132	0.074	15.214	0.000	0.986	1.278
Karuri	0.904	0.064	14.124	0.000	0.778	1.029
H	-0.047	0.034	-1.409	0.159	-0.113	0.018

Fixed effects for weeks and locations were also included (not shown)

Significantly, weekly contract prices predicted for household consumers were significantly lower than those for monthly credit sales to households, although both were lower than spot price paid by direct consumers. This reflects the fact that reliable, local consumers typically took regular, daily, deliveries from the same producer and paid up weekly, which reduced payment transaction costs while also being of limited risk to the producer. Predicted cash prices for locally-based traders were not statistically significantly different from fortnightly cash payments by locally-based traders, which suggests that this was a low risk outlet for sales, and that the producer discount rate for credit payments was approximately equal to the value of the reduced transactions costs in getting paid once a fortnight, the two balancing each other.

Determinants of the household share of marketed milk sold on the spot market

The second objective entails an assessment of factors influencing the allocation by producers of their household milk sales between spot cash and on-credit markets. To investigate this, the following assumptions are modelled. On a typical day, the farmer has q litres of marketable milk surplus. Available to the farmer are two different contractual arrangements differentiated according to the flow of payment; the farmer can sell milk on markets that offer lump-sum payments coming regularly after a predetermined period of delivery of milk on credit or he/she can sell in markets that exchange milk for cash on the spot. The farmer can sell the entire

marketable surplus (sold daily) to one or the other market, or apportion it between them such that a proportion θ (where $0 \leq \theta \leq 1$) is sold in the cash-sale market and the remaining 1- θ is sold in the credit market. The proportion θ serves as a good proxy for measuring the degree of participation in the cash-sale market and, conversely, the proportion 1-θ serves as a proxy for measuring participation in the sale-on-credit credit markets.

Model

We define a variable Y that takes on a value of one if the parameter θ is greater than zero (i.e., some proportion of *q* is sold in the cash-sale market) and a value of zero if *q* is exclusively sold to the credit market). The proportion, θ, which the farmer can sell through the cash-sale markets, ranges from 0 to 1. Hence, market apportionment (Y) is doubly censored at 0 (all milk is sold to the credit market) and at 1 (all milk is sold to the cash sale market). Under this structure, the payment mode comprises a decision of not only whether to sell to the cash-sale or to the credit markets, but also of the share of marketable surplus to sell to each. The determinants of producer's choice between the spot and credit sale markets are modelled with a two-limit Tobit specification given by:

$$Y_{it} = \begin{cases} 0 & \text{if } 0 \geq \mathbf{X}_{it}\boldsymbol{\beta} + e_{it} \\ \mathbf{X}_{it}\boldsymbol{\beta} + e & \text{if } 0 < \mathbf{X}_{it}\boldsymbol{\beta} + e_{it} < 1 \\ 1 & \text{if } 1 \leq \mathbf{X}_{it}\boldsymbol{\beta} + e_{it} \end{cases}$$

The dependent variable $\mathbf{Y}_{it}$ is the proportion of the total milk that is sold to the cash-sale markets by household *i* on day *t*. Vector $\mathbf{X_{it}}$ comprises the explanatory variables of which marketable surplus, measured as the absolute volume of milk sold by household *i* on day *t,* and household-specific socio-economic characteristics affecting marketing comprised the primary explanatory variables of interest. Vector $\boldsymbol{\beta}$ comprises of unknown parameters while e_{it} is a residual error assumed to be normally distributed with mean zero and a constant variance.

Specific hypotheses

- The relationship between the proportion (θ) of marketed surplus sold through cash-sale market and the amount of marketed surplus (q) is expected to be negative. This follows from the perishability and the daily production flow of milk, which implies that the larger the amounts of marketable surplus, the less attractive markets that do not promise a guaranteed market for marketable streams of milk and the greater the investments in market outlets that offer such guarantees.
- The relationship between θ and age is expected to be positive. Younger farmers are more likely to be open to new forms of exchange and more aggressive in seeking new markets and taking risks. They are also likely to in a stage where they are making investments on their farms and are therefore may also prefer a lump-sum liquidity flow in the absence of a local banking system. Older farmers may also still be influenced by the expectations created by the regulated formal markets of the 70s and 80s, which might overvalue in market terms the positive elements of selling through dairy farmers' co-operatives.
- Similarly, higher educational levels are expected to increase willingness to engage in credit-based contracts, *ceteris paribus.*
- As distance from market centre increases, smallholders are expected to use cash-sale markets more, since the enforcement of credit based sales becomes more problematic.

Choice of payment mode, once an outlet is chosen, is expected to vary with the structure and size of family size. Producer households with school-age children are more likely to prefer lump-sum liquidity flow to facilitate payment of school-fees and similar payments. On the other hand milk consumption in producer households with younger children and infants is more likely to be sold in the higher return cash market. Since the penalty for not being able to sell milk is to consume it one's self, such households may be relatively less concerned about the risk of not having a market outlet available in the glut season.

Specification and estimation

Table 5 presents the variables used and summary statistics. As discussed earlier, there are three groups of factors, viz., outlet-specific factors, area-specific factors and producer household-specific factors that are presumed to be antecedent variables for payment mode choice. On a particular day, *t,* however, outlet-specific factors (e.g., market outlet(s), price(s), time spent on milk sale/delivery and the distance to selling point) are determined within the payment mode choice decision and are thus endogenous to the choice. Outlet-specific factors thus vary with variations in the parameter θ; they therefore do not enter the right-hand side of the model specified above. Area-specific factors, on the other hand, are exogenous to the choice but are constant across smallholder dairy farmers living in a given area and across market-outlets available in the area. Area-specific factors are thus appropriately captured in the model through a set of binary categorical control variables coded 0/1 to identify households with their area locality. Household-specific factors vary across household but pre-exists observations on the response variable θ; they thus comprised the major group of predictor variables. To control for seasonal factors, a set of binary categorical variables identifying observation on marketed surplus with the week in which they were observed were used.

Table 5. Variable and summary statistics

Variable	Mean	Std. Dev.	Min	Max
Proportion of total marketed milk that is sold in cash-sale market	0.23	0.40	0	1
Marketed surplus in litres	7.45	4.76	0.94	18.06
Age of head of household in years	55.99	11.27	34	75
Distance to market centre in kilometres	2.01	1.53	0.1	7
Years of experience in dairying in number of years	22.88	11.90	4	40
Number of years of school completed	7.40	4.40	0	13
Number of children aged below 9years	0.95	0.89	0	2.64
Number of children aged below between 9 and 15years	0.70	1.01	0	3
Number of children aged below between 9 and 22years	1.75	1.38	0	4.34
Number of household members aged above 22years	3.18	1.11	2	5
Flow of off-farm income (1 if regular 0 otherwise)				
Holiday (1 if day t falls on a Sunday or a public holiday, 0 otherwise)	0.14	0.35		

Results and discussion

Parameter estimates for the model are shown in table 6. The overall model fit was good (Wald chi2=1996.12 prob>chi2=0.000). The likelihood ratio test indicates that panel-level variance component was significantly different form zero (chi2=1773.81 prob>chi2>0.000). Overall, the model shows reasonable support for the hypothesis regarding payment mode choice and the allocation of milk between cash-sale and on-credit markets were supported by the data. As expected, the size of marketable surplus (β=-0.076 *p*=0.000), years of school completed (β=0.19 *p*=0.000), and the number of children aged between 9 and 14 years (β=-0.63 *p*=0.000) had significant negative effects on the proportion of milk sold in the cash-sale markets. Also as expected, age of the head of household (β=0.017 *p*=0.000), distance to the nearest market center (β=0.44 *p*=0.000), and the number of children below 9 years of age had a significant positive effect on the proportion of milk sold in the cash-sale markets. However, holiday (Sundays and public holidays) (β=-0.01 *p*=0.604) were not significantly related to payment mode choice.

Estimates suggest that the role of physical market accessibility, as measured by the distance to the nearest market centre, is very important in deciding the kind of market outlet and hence the mode of payment available to smallholder dairy farmers; a unit increase in the distance from nearest market centre increases the proportion of milk sold to cash-sale markets by 9.1% and the probability of selling in this market by 30.3%. This can be explained by the fact that further away a household is from a major market centre, the more inaccessible it is for the local-market-based trader. Moreover, the centres designated as milk collection centres by Dairy Farmers' Co-operative Societies are mostly located at market centres or along main roads. Thus farmers located far away from market centre and main roads are likely to depend on itinerant raw-milk traders calling at the farm-gate to sell their marketed surplus.

Table 6. Tobit Model of Participation in Cash-sale Market

Variable	Coef.	Std. Err.	δEProbability (Y)/δ(X)[5]Uncensored

[5] conditional on being uncensored

Marketed surplus	-0.076	0.006	-0.016	-0.052
Age of head of household	0.017	0.003	0.003	0.012
Distance to market centre	0.444	0.254	0.091	0.303
Years of experience in dairying	0.022	0.004	0.004	0.015
Education	-0.027	0.014	-0.005	-0.018
Children aged below 9 years	0.151	0.025	0.031	0.103
Children aged >9yrs ≤14years	-0.626	0.043	-0.129	-0.427
Children aged >14years ≤22	0.143	0.016	0.029	0.097
Household members > 22years	0.085	0.013	0.018	0.0580
Regular salary	-1.338	0.089	-0.275	-0.912
Holidays	-0.013*	0.024	-0.003	-0.009
Constant	-2.731	0.256	-0.561	-1.862
sigma_u	0.629	0.030		
sigma_e	0.374	0.009		
Rho	0.739	0.017		

Notes: N = 6492
Wald chi2 (71) 1996.12 prob>chi2=0.000,
Likelihood ratio test of sigma_u=0: Likelihood ratio test of sigma_u=0: chi2(1) =1773.81 prob > chi2=0.000
Fixed effects for weeks and locations were also included (not shown)
not significant at 5%

Structure and size of producer family also played an important role. A unit increase in the number of children aged below 9 years of age increases the proportion of sales in the cash-sale markets by 3.1% and the probability by 10.3%. On the other hand, a unit increase in the number of children aged between 9 and 14 year decreases the proportion by 12.9% and the probability by 42.7%. The flow of off-farm income and the fixed area-specific factors are also important. Households receiving regular off-farm incomes are less likely to sell in cash-sale market.

Conclusions

The major objective of the study was to describe the contractual arrangements employed by smallholder dairy farmers and to test empirically the relationship between choice of payment mode (cash versus credit) and various factors presumed to contribute significantly to market outlet risks and transaction costs in the sale of milk by smallholder dairy farmers. The results show that farmers have multiple outlets, and suggest strongly that the decision to sell on credit is linked to the risk structure of the market outlets, both in terms of reliability throughout the year and the likelihood of being paid at the end of the contract.

The statistical decomposition of producer prices shows that the predicted average price received traders as a market outlet, once other factors have been controlled for, is about the same for cash or credit. However, it differs greatly for direct sales to households. Direct consumers that producers are willing to sell to on weekly credit pay nearly 7 % less per unit than cash customers, but monthly credit customers pay only 2 % less than cash customers. Since producers are rarely traders, going door to door, it is likely that the only direct household sales that they actively seek are on a regular basis.

Good credit risks and steady customers are supplied for less, and settle weekly. Bad credit risks or only occasional customers need to pay cash, and higher per unit prices. Large purchasers, such as coops and processors, pay the lowest per unit prices (about 17 percent below prices paid by household consumers). This is due to the fact that they can consistently buy the whole daily household product and purchase in glut times as well as during the dry season. If all these dimensions of price are collapsed to the price of milk per week and location, it is not surprising that there is quite a bit of apparent lack of market integration. The conclusion is not the markets per se are not integrated, but that producing households face different transactions costs and may have differential perceptions of risks.

Household-specific transactions costs result from asymmetries in access to information and assets, and frequently are proxied by observable household characteristics such as demographics, education, income streams and assets that are exogenous to the decision being modelled. We find that with regard to the household-level decision to sell to higher-priced spot markets or lower priced credit markets, these household characteristic proxy variables work well. Younger, more educated producers are shown to be more likely to accept sales on credit; they are more aggressive and apparently more tolerant of risks. All producers are more likely to sell to persons that have a regular monthly salary income and are located close by. Older producers with more experience but less formal education are more likely to sell for cash rather than credit, *ceteris paribus*.

Direct policy conclusions from this phase of the work are hard to assess, since the cost of interventions to alleviate the transaction costs affecting smaller producers in particular are hard to assess. However, some broad line of relevant further inquiry are apparent. The lack of viable rural banks in the area surveyed leads to purchasers of smallholder products serving as both outlet and bank for the smallholder producers,

a situation that cannot be in the producer's interest. The lack of formal contract enforcement also surely discourages profitable contracts over longer distances. The roughly 17 percent lower producer prices paid on the market by cooperatives and processors, with monthly payments only, suggest that producers greatly value the convenience and reliability of having one large repeat customer.

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