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Agroindustrialization through institutional innovation Transaction costs, cooperatives and milk-market development in the east-African highlands

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Abstract

Some small-holders are able to generate reliable and substantial income flows through small-scale dairy production for the local market; for others, a set of unique transaction costs hinders participation. Cooperative selling institutions are potential catalysts for mitigating these costs, stimulating entry into the market, and promoting growth in rural communities. Trends in cooperative organization in east-African dairy are evaluated. Empirical work focuses on alternative techniques for effecting participation among a representative sample of peri-urban milk producers in the Ethiopian highlands. The variables considered are a modern production practice (cross-bred cow use), a traditional production practice (indigenous-cow use), three intellectual-capital-forming variables (experience, education, and extension), and the provision of infrastructure (as measured by time to transport milk to market). A Tobit analysis of marketable surplus generates precise estimates of non-participants' 'distances' to market and their reservation levels of the covariates — measures of the inputs necessary to sustain and enhance the market. Policy implications focus on the availability of cross-bred stock and the level of market infrastructure, both of which have marked effects on participation, the velocity of transactions in the local community and, inevitably, the social returns to agroindustrialization. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

This paper considers one recent trend in the commercialization of subsistence agriculture that has potential to catalyze market participation, enhance the velocity of transactions and sustain economic growth in rural communities. The topic is the emergence of cooperative sales organizations among resource-poor dairy producers in peri-urban settings.

Small-scale dairy production is an important source of cash income for subsistence farmers in the east-African highlands. Dairy products are a traditional consumption item with strong demand, and the temperate climate allows the cross-breeding of local cows with European dairy breeds to raise productivity. Particularly where infrastructure and expertise in dairy processing exist, such markets

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allow small-holders to participate in the agroindustrial sub-sector and potentially in regional export markets and beyond. Moreover, growth in demand for dairy products in sub-Saharan Africa (SSA) is projected to increase over the next 20 years due to expected population and income growth. Milk production and dairy product consumption are expected to grow in the region of 3.8–4% annually between 1993 and 2020 (Delgado, 1999). Increased domestic dairy production has the potential in most parts of SSA to generate additional income and employment and thereby improve the welfare of rural populations (Delgado, 1995, 1996; Staal et al., 1997). However, there are concerns that the benefits of this expected growth may bypass resource-poor livestock producers unless specific policy actions are taken.

Barriers to small-holder participation in dairy production range from the availability and cost of animals to the labor needed to bring the products to market. Despite the potential, small-holder participation in market-led dairy development has not been widespread in SSA outside of Kenya. Even in regions with favorable climates for livestock development, such as the Ethiopian highlands, participation in fluid milk markets by rural small-holders has been limited. Changes in sectoral and macroeconomic policies are frequently necessary, but not sufficient, to provide the requisite incentives for small-holders to participate in markets.

Small-scale milk producers face many hidden costs that make it difficult for them to gain access to markets and productive assets (Staal et al., 1997). Among the barriers that may be influenced by policy are transaction costs — the pecuniary and non-pecuniary costs associated with arranging and carrying out an exchange of goods or services. The relatively high marketing costs for fluid milk in Africa, the scattered nature of fluid milk markets and the risk attached to marketing of perishables in the tropics suggest that transaction costs play a central role in dairy production and marketing. Under such conditions, producer marketing cooperatives that effectively reduce transaction costs may enhance participation. Hence, it is vital to know what governments can do to better support these organizations and their emergence, and determine whether alternative institutions should be encouraged.

This paper explores the impact of household-level transaction costs and the choice of production technique on the decision of farmers to sell fluid milk to marketing cooperatives using a detailed sample of observations from the Ethiopian highlands (Nicholson, 1997). Covariates representing factors affecting production, consumption and marketable surplus are examined in order to determine the extent to which they influence the milk-marketing decision.

In the conceptual framework we employ, transaction costs include not only the costs of exchange, but also the complete set of costs implied when households must reorganize and reallocate labor in order to generate a marketable surplus. These costs may be substantial, may dominate other, observable (pecuniary) costs and, therefore, are scrutinized. We focus on a parsimonious set of factors conjectured to affect them, namely a modern production practice (cross-bred cow use), a traditional production practice (indigenous-cow use), three intellectual-capital-forming variables (experience, education, and extension), and the provision of infrastructure (as measured by time to transport milk to market). We compute estimates from a Tobit specification of marketable surplus and use the estimates to draw policy conclusions.

2. Transaction costs, cooperatives and milk-market participation

Transaction costs are the embodiment of barriers to market participation by resource-poor small-holders. They include the costs of searching for a partner with whom to exchange, screening potential trading partners to ascertain their trustworthiness, bargaining with potential trading partners (and officials) to reach an agreement, transferring the product, monitoring the agreement to see that its conditions are fulfilled, and enforcing the exchange agreement.

The nature of milk and its derivatives in part explains the high transaction costs associated with exchanges of fluid milk. Raw milk is highly perishable and, thus, requires rapid transportation to consumption centers or for processing into less perishable forms. Further, bulking of milk from multiple suppliers increases the potential level of losses due to spoiling. These losses limit marketing options for small and remote dairy producers, raise transport costs, and imply greater losses due to spoilage than for commodities such as grains. Because milk production typically is

a year-round activity, dairy producers often must be concerned with maintaining outlets for their production.

The search for stable market outlets by producers is complicated by significant seasonal variation in milk production and dairy product consumption (Debrah and Anteneh, 1991; Jaffee, 1994). In part due to high perishability, but also due to natural variation, milk quality is variable. Some of its properties (e.g., bacterial counts) are also not easily ascertained. Although not a perfect proxy, we conjecture that distance between production and purchasing points is highly correlated with quality, which declines rapidly after milking. The lack of easily measurable quality standards may also allow agents purchasing raw milk from producers to reject milk without just cause when they have contracted to purchase more milk than can be profitably sold.

Differential transaction costs among households stem from asymmetries in access to assets, information, services and remunerative markets (Delgado, 1999). Handling these access problems requires institutional innovation. First, the asset-deficit problem of resource-poor small-holders is often so great that a net transfer (such as a heifer) is necessary to induce entry. Second, technical and market information for new commercial items is more likely to be useful to individuals with higher levels of schooling, greater work experience, better access to management and technical advice, and better knowledge of market opportunities. Small-holders may require particular support in information and management. Third, access to services is often unequally distributed within communities. Poor infrastructure, low population density, and low effective demand make it necessary to have institutions for risk-sharing and economies of scale in provision of agricultural services, especially in remote areas. Fourth, better access to remunerative markets for high-value to weight items is necessary for promoting growth of small-holder agriculture.

3. Cooperatives as catalysts

A common form of collective action to address access problems of this type is a participatory, farmer-led cooperative that handles input purchasing and distribution and output marketing, usually after some form of bulking or processing. Farmers gain the benefit of assured supplies of the right inputs at the right time, frequently, on credit against output deliveries, and an assured market for the output at a price that is not always known in advance, but applied equally to all farmers in a given location and time period. Extension is sometimes part of the services provided, typically at higher rates (and quality) than state extension services. Cooperatives, by providing bulking and bargaining services, increase outlet market access and help farmers avoid the hazards of being encumbered with a perishable crop with no rural demand. In short, participatory cooperatives are very helpful in overcoming access barriers to assets, information, services, and indeed, the markets within which small-holders wish to sell high-value items.

Like contract farming, producer cooperatives can offer processors/marketers the advantage of an assured supply of the commodity at known intervals at a fixed price and a controlled quality. They can also provide the option of making collateralized loans to farmers. For processors or marketers, such arrangements eliminate the principal-agent issues faced by collectives and outgrower schemes in monitoring effort by the individual producer, providing better relations with local communities than large-scale farms, avoiding the expense and risk of investing in such enterprises, sharing production risk with the farmer, and helping ensure that farmers provide produce of a consistent quality (Grosh, 1994; Delgado, 1999).

Producer cooperatives are, however, unlike contract farming schemes with respect to negotiations among different partners. If the issue in contract farming revolves around the power of farmers to negotiate with processors, in producer cooperatives, the members themselves, collectively, have the power to hold management accountable. Producer cooperatives in Africa have had a generally unhappy history, because of difficulties in holding management accountable to the members (i.e., shirking), leading to inappropriate political activities or financial irregularities in management (de Janvry et al., 1993; Akwabi-Ameyaw, 1997), and also due to over-ambitious investment beyond management's capability in terms of scale and enterprises. The degree of moral hazard seems to be greater if cooperatives are general in their orientations rather than created for specific purposes, such as farmer-run local milk marketing cooperatives in

Uganda and Kenya (Staal et al., 1997). In Ethiopia, on the other hand, the perception exists (Nicholson, 1997) that there may be enormous potential for their role, in concert with production innovations, as market precipitators.

4. Experience in Ethiopia

The traditional system of milk production in Ethiopia, comprising small rural and peri-urban farmers, uses local breeds, which produce about 400–680 kg of milk per cow per lactation period (Debrah and Anteneh, 1991). More recently, intensive systems as diverse as state enterprises and small and large private farms use exotic breeds and their crosses, which have the potential to produce 1120–2500 over a 279-day lactation period (Debrah and Anteneh, 1991). Fresh milk marketing is channeled through both formal and informal outlets, with informal markets supplying some 85% of total fresh milk in the Addis Ababa area (Staal, 1995). The major formal outlets are dominated by a government enterprise called the Dairy Development Enterprise (DDE), which has established numerous collection centers that buy milk at a uniform government controlled price that requires no minimum delivery. In 1992/1993, the DDE supplied 12% of total fresh milk sales in Addis Ababa (Staal, 1995). The DDE is concerned primarily with fluid milk marketing, although it does make some cheese and yogurt in its Addis Ababa processing facilities.

The informal fresh milk-market involves direct delivery of raw milk by producers to consumers in the immediate neighborhood and sales to itinerant traders or individuals in nearby towns. Milk is transported to towns on foot, by donkey, by horse or public transport and frequently commands a higher price than in the originating locale (Debrah and Anteneh, 1991). In Ethiopia, fresh milk sales by small-holder farmers are important only when they are close to formal milk marketing facilities such as government enterprises or milk groups. A sample survey of farmers in northern Shewa in 1986 estimated that 96% of the marketable milk was sold to the DDE (Debrah and Anteneh, 1991). Farmers far from such formal marketing outlets prefer to produce other dairy products instead, such as cooking butter and cottage cheese. In fact, the vast majority of milk produced outside urban centers in Ethiopia is processed into products by the farm household, and sold to traders or other households in local markets.

The other principal outlets for milk are 'milk groups', which are milk marketing cooperatives recently established by the Ethiopian Ministry of Agriculture's Small-holder Dairy Development Project (SDDP) with the support of the Finnish International Development Association. The milk groups buy milk from both members and non-members, process it, and sell the derivative products to traders and local consumers. Although the milk groups sometimes sell fluid milk products such as sour milk, skim milk, or buttermilk, most of their revenue is generated by sales of processed dairy products, butter and cottage cheese (Nicholson et al., 1998). The groups do not presently represent a significant source of fresh milk for either rural or urban markets.

5. Background to the empirical application

The SDDP milk groups purchase raw milk from farmers, then use hand-operated equipment to process the milk into butter, local cottage-type cheese (ayib), and yogurt-like sour milk (ergo). These dairy products are sold to local households, to traders who market them, in turn, to major urban centers, and local restauranteurs. Typically, the value-added from processing the fluid milk into products (less funds retained for maintenance of the groups' facilities) is returned as a semi-annual, lump-sum payment to group members and others who have supplied milk to the group during the period since the previous payment.

At the time of data collection, four of these milk groups existed, two in the Shewa region north of Addis Ababa and two in the Arsi region near the regional center Asela. The activities of these groups are focused exclusively on the processing and selling of dairy products. They provide no additional services (i.e., no credit, feeds, veterinary services, etc.) to farmers nor to buyers and, therefore, represent the simpler end of the sequence of activities that cooperative organizations might undertake.

Although the number of farmers and the amount of milk received at each group is not a large proportion of regional totals, the formation of these groups has created a new outlet for sales of fluid milk by producers. Prior to the formation of the groups, nearly all locally

produced milk was processed into butter and ayib (a local form of cottage cheese) by the households. Even now, most milk produced in these areas is marketed as home-processed dairy products and sold to traders or other households in local markets. Thus, the milk groups can be considered organizational innovations that increase the number of marketing options available to small-holder dairy farmers and mitigate some of the principal transaction costs that retard entry. We now turn to the identification of the remaining factors (technology, infrastructure and household capital accumulation) that may forestall entry.

6. Data collection procedures

Data were collected from four rural communities called 'Peasant Associations' (PAs) which are state-designated partitions of rural districts near two of the four milk groups formed by the SDDP. Preliminary surveys were undertaken in December 1996 and January 1997 to ascertain the extent of cross-bred cow ownership. On the basis of the preliminary surveys, the Mirti and Ashebaka PAs in the area of the Lemu Ariya milk group were selected from Arsi region, and the Ilu-Kura and Archo PAs were selected near the Edoro milk group in Shewa region. One PA in each region was close enough to the milk group where cooperative selling occurred; the other was distant enough that sales were precluded. None of the households in the Ashebaka and Archo PAs participated in the milk groups, whereas a proportion of the households in Mirti and Ilu-Kura PAs delivered milk to the groups.

A census of households in these four PAs was conducted for the purpose of developing a sampling frame. Using the census results, a sample of 36 households was selected in each of the PAs, stratified on the basis of whether the household owned cross-bred cows, participated in the group, and their distance to the group or to another local market where dairy products could be sold. During June 1997, baseline surveys of household characteristics and current cattle management practices were administered to 144 households. From June to October 1997, data on milk allocation and marketing, significant events occurring in the cattle herd (births, deaths, purchases, sales, illness, etc.), and cow feeding practices were collected every two to three weeks.

From the survey, we focussed on the 68 households in the Mirti and Ilu-Kura PAs for which samples were observed on milk sales in the seven days prior to three consecutive visits, yielding a total of $1428=68\times7\times3$ observations. Importantly, only 15% of the observations correspond to participating households. Table 1 summarizes the data by market participation status.

7. Estimation

Having established two important features of the survey environment (namely, that milk-selling is affected significantly by transaction costs and that the presence of cooperatives has the potential to significantly reduce these costs), the question remains as to why there exists such a low rate of participation (15% of the total observations). In order to answer this question a Tobit specification of marketable surplus is

Table 1
Selected characteristics of survey households, by market participation status[a]

Effect of the characteristic on milk yield	Sample means (S.E.)	
	Sold to the milk group	Did not sell to the milk group
Unit increase in the number of cross-bred cows (t=15.32)	1.41 (0.99)	0.49 (0.69)
Unit increase in the number of local cows (t=−1.81)	1.26 (1.03)	1.42 (1.12)
Time (min) to the milk group (t=−4.37)	35.16 (18.76)	45.53 (29.94)
Farm experience (years) of household head (t=−1.22)	23.20 (12.58)	24.79 (16.21)
Formal schooling (years) of household head (t=0.22)	1.96 (4.01)	1.90 (3.24)
No. of visits by an extension agent during past year (t=14.74)	3.19 (3.59)	0.78 (1.66)

[a] Statistics t (1426 d.f.) reported for difference between means.

employed and estimation is executed using Markov-chain Monte Carlo (MCMC) methods. The procedure is motivated in three steps. First, household maximization is formalized. Second, relaxing the non-negativity restriction on marketable surplus, a set of latent values are implied for the nonparticipating households. Third, because we observe the value zero for these households rather than the latent quantities, the data are censored and Tobit estimation is relevant.

Although relatively new, MCMC methods are now widely used in Bayesian inference. However, applications in development economics have thus far been few. Details of the procedure are presented in Chib (1992). His approach combines Gibbs sampling with data augmentation. Seminal contributions in these two areas are Gelfand and Smith (1990) and Tanner and Wong (1987), but very readable introductions are Casella and George (1993), Tanner (1993) and Chib and Greenberg (1993).

Let $\Phi_i(\cdot)$ denote the level of a maximand of interest in household "i" (say, the level of expected utility); let $\varphi_i(\cdot)$ denote its first-order partial derivative with respect to variable, v_i (the level of marketable surplus from the household); and let $\mathbf{x}_i \equiv (x_{1i}, x_{2i}, \ldots, x_{mi})$ denote a vector of factors affecting the choice of v_i (the composition of the physical capital in the household, the physical distance that it resides from the market, and the stocks of intellectual capital that the household has accumulated). Then, across each of the households $i=1, 2, \ldots, N$, we are concerned with the problem:

$$\max_{v_i} \Phi_i(v_i, \mathbf{x}_i) \quad \text{subject to} \quad v_i \geq 0; \tag{1}$$

the derivative condition on the objective function,

$$\varphi_i(v_i, \mathbf{x}_i) \leq 0; \tag{2}$$

the non-negativity restriction on marketable surplus,

$$v_i \geq 0; \tag{3}$$

and the complementary-slackness condition,

$$\varphi_i(v_i, \mathbf{x}_i) v_i = 0. \tag{4}$$

Ignoring the restriction in (3) for the moment and assuming strict equality in (2), a first-order MacLaurin-series expansion in the left-hand side yields

$$\varphi_i + \varphi_{v_i} v_i + \sum_{k=1}^{m} \varphi_{x_{ki}} x_{ki} = 0, \tag{5}$$

where the function φ_i and the partial derivatives φ_{v_i} and $\varphi_{x_{ki}}$, $k=1, 2, \ldots, m$, are evaluated at the point $v_i=0$, $\mathbf{x}_i=0$. Accordingly, we have a (locally) valid expression relating the household's choice of v_i to the levels of the covariates, x_{ki}, $k=1, 2, \ldots, m$, in the linear equation

$$v_i = \beta_0 + \sum_{k=1}^{m} \beta_k x_{ki}, \quad i = 1, 2, \ldots, N; \tag{6}$$

$\beta_0 \equiv -\varphi_i \varphi_{v_i}^{-1}$ and $\beta_k \equiv -\varphi_{x_{ki}} \varphi_{v_i}^{-1}$, $k = 1, 2, \ldots, m$. But, when v_i is negative we actually observe zero and, therefore, the relevant statistical framework is the censored regression model

$$z_i = \beta_0 + \sum_{k=1}^{m} \beta_k x_{ki} + \varepsilon_i, \quad i = 1, 2, \ldots, N; \tag{7}$$

$\varepsilon_i \sim N(0, \sigma^2)$ and we observe $y_i = \max\{z_i, 0\}$.

Although some interest resides with the parameters in (7), our fundamental concern lies with the levels of the covariates that are required for participation in the market, i.e., the measures beyond which positive marketable surplus is implied for the non-participants in the (censor) set $c \equiv \{i: z_i \leq 0\}$. The quantities of interest follow naturally from setting marketable surplus to zero in (7); solving for each of the covariates,

$$\hat{x}_{ki} = \frac{\beta_0 + \sum_{j \neq k}^{m} \beta_j x_{ji} + \varepsilon_i}{-\beta_k}, \quad k = 1, 2, \ldots, m, \quad i \in c; \tag{8}$$

and computing means across the set of non-participating households, say n in total,

$$\bar{\hat{x}}_k = \frac{1}{n} \sum_{i \in c} \hat{x}_{ki}, \quad k = 1, 2, \ldots, m. \tag{9}$$

The covariates upon which we focus attention include a modern production practice (cross-bred cow use), a traditional production practice (indigenous-cow use), three intellectual-capital-forming variables (experience, education, and extension), and the provision

of infrastructure (as measured by time to transport milk to market). [1,2]

8. Results

Table 2 reports results of the estimation. All but one of the covariates (experience) is significant at the 5% level. Thus, each of the other covariates has a significant impact on marketable surplus and, therefore, entry into the milk-market. Focusing on the parameter estimates themselves, the addition of one cross-bred cow raises surplus by about 4.4 l of milk per day and the addition of one local cow increases surplus by about 1.8 l — a clear and obvious difference between the modern and the traditional production techniques. Distance-to-market on the other hand causes surplus to decline, and we estimate that for each one-hour reduction in return time to walk to the milk group, marketable surplus increases by about 3.5 l. Of the capital-forming variables (experience, education, and extension) education and visits by an extension agent are significant, but surplus is unresponsive to farm experience. The estimates of the responses to education and extension are, perhaps, more important for our study because these variables are potentially more likely to be directly affected by policy. For each additional year of formal schooling of the farm decision-maker, daily marketable surplus increases by about 0.30 l and, for each additional visit by an extension agent, increases by almost 1.0 l. The summary statistics suggest a reasonable fit given the high proportion of censoring in the sample — approximately 85% are non-participants.

Table 2
Marketable-surplus Tobit-equation estimates

Regressor	Estimate (S.E.)
Unit increase in number of cross-bred cows	4.43 (0.38)
Unit increase in the number of local cows	1.81 (0.26)
Time (min) to the milk group	−0.06 (0.01)
Farm experience (years) of household head	0.0027 (0.0233)
Formal schooling (years) of household head	0.28 (0.10)
No. of visits by extension agent during the past year	0.94 (0.11)
Constant	−12.40 (1.39)
Square root of the variance	27.47 (3.98)
Summary statistics	
Uncensored observations	
R^2	0.35
Positive predicted values	63
Negative predicted values	105
Censored observations	
R^2	0.98
Positive predicted values	21
Negative predicted values	1239

Turning to the distance measures, Table 3 reports point estimates of the 'distance' statistics (Eq. (9)). In order to effect entry, the representative non-participant must increase surplus by 9.8 l of milk per day. Such an increase, it appears, could be effected by a variety of techniques, including additions to the milking herd of 2.5 cross-bred animals or, instead, by 6.4 local cows, a feasible but nonetheless substantial increase in

[1] As two reviewers correctly pointed out, some concern exists about the assumed exogeneity of cow numbers as determinants of marketable surplus. We agree, but acknowledge two motivating factors that engender their categorization as exogenous. The first is that exogeneity is credibly motivated by interpreting cow numbers as stock variables, relative to the primary flow variable, marketable surplus (recall that the periodicity of the surplus measures is daily). The second motivation is the desire for simplicity and the related desire to focus the paper on conceptual rather than technical issues (to our knowledge, multivariate count-data models with Gaussian, Tobit components have not yet been successfully estimated). Notwithstanding these motivations, endogenizing cow numbers offers a potentially fruitful area of secondary research. In this regard, the current estimates provide a useful platform to investigate the magnitudes and directions of any biases arising from the simplifying assumption that cow numbers are exogenous.

[2] Related to the issue of exogeneity of cow numbers is the issue of identification of structural parameters from the system of reduced-form equations. In situations in which prior information exists, there arise additional opportunities for identification (Drèze, 1974) compared to the usual, classical rules for likelihood identification (Fisher, 1966). For example, in the present setting, when cow-numbers are endogenous, likelihood identification requires that one exogenous variable in the (simultaneous) system be omitted from the Tobit equation. In short, we must identify an instrument that affects marketable surplus, but not cow numbers. Selecting such an instrument is an empirical matter that lies beyond the scope of our present focus. Leaving open the question of any bias arising in this neglect, we note one particular situation in which the issue is moot. This situation is where the coefficients in the Tobit equation are biased symmetrically; because the distance estimates depend on *ratios* of coefficients in the structural equation, estimates of covariate 'distances' will be unbiased.

Table 3
Distance estimates

Regressor	Estimate (S.E.)
Marketable Surplus	−9.81 (5.63)
Unit increase in the number of cross-bred cows	2.52 (0.13)
Unit increase in the number of indigenous cows	6.45 (0.67)
Time (min) to the milk group	−114.26 (33.50)
Farm experience (years) of household head	−757.12 (58289.48)
Formal schooling (years) of household head	45.26 (444.96)
No. of visits by extension agent during the past year	10.43 (0.91)

productive assets. Of the remaining covariates for which the distance estimates are significant, entry could also be effected by reducing transport time by almost 2 h or by increasing the frequency of extension visits to around 10 per household per year.

9. Discussion

The policy-relevant variables having the greatest impact on participation in fluid-milk markets are number of cows, time to the milk group, and visits by an extension agent. The number of cows kept affects marketable surplus through both total production and the marginal costs of production. An increase in total milk production by the household decreases the marginal utility of milk consumption and, thus, should increase marketable surplus. In the case where additional cows lower marginal costs of production, this also increases marketable surplus because the household is assumed to equate marginal costs of production and milk price net of transaction costs. Finally, a higher marketable surplus per farm potentially reduces the farm's average costs of milk transfer to the group, as well as lowering average production costs on the farm. Thus, the action of pooling, especially pooling of milk collection and transport activities, has potential to mitigate costs. However, problems of coordinating and monitoring agreements between participants and the costs engendered by such ventures are likely to dissipate any potential gains from exploiting scale economies.

Our empirical analysis does not distinguish among possible scale effects, but this does not appear to be particularly crucial for policy purposes given the net positive impacts of cow numbers (of both breeds) on marketable surplus.[3] The difference between the impacts of local and cross-bred cows on marketable surplus and fluid milk-market participation has more relevance for policy. In theory, the marginal costs of milk production are equated for cross-bred and local cows if the household owns both types. However, not all households own both types of cows, and other market imperfections (e.g., feed and services availability) may imply higher marginal costs for cross-bred animals. Higher marginal costs for cross-bred cows imply a negative gross effect (despite the positive net impact of crossbreds) on marketable surplus compared to local cows. The magnitude of this effect can be approximated using annualized milk yield per day for crossbreds and local cows and multiplying these by the 'distance' estimates from Table 3.

Annualized milk yields per day from a farm survey in the peri-urban area of Addis Ababa are 3.9 l for cross-bred cows and 1.2 l for local cows. Multiplying these milk yields by the Tobit distance estimates of daily milk production implied for market entry are 9.8 l for cross-bred cows and 7.7 l for local cows. If the

[3] Although the estimation of the fixed costs remains an empirical matter that is impeded by lack of available data, some reflection on their impacts is relevant. The issue is identified by an anonymous reviewer as a potentially important source of bias in the present work. The impacts of fixed costs are explicated cogently in a recent paper by Goetz (1992). There, scale-effect impacts on marketable surplus are modeled sequentially by assuming that households first decide whether or not to participate in the market (i.e., decide whether their surplus is sufficient to overcome fixed costs) and, subsequently, decide on how much surplus to contribute (i.e., deduce the profit maximizing quantities conditionally on the entry decision). But this extension affects Tobit-equation and distance-parameter estimates only slightly. Therefore, at least in terms of the current application, fixed-costs effects do not appear to be an important source of bias. Whether this finding is robust to alternative applications remains to be seen.

estimates reflected only the transaction costs related to the level of marketable surplus, we would expect these figures to be equal. Further, since milk prices paid to farmers in this sample do not distinguish between milk from local and cross-bred cows, milk quality can be safely assumed not to contribute to this difference. The difference can thus be presumed to relate to differences in technology (including scale effects). Thus the higher milk level needed from cross-bred cows suggests that some 27% more 'milk production potential' (capacity) is needed in the form of cross-bred cows compared to local cows in order to effect entry. Whether this is related to downside risk of disease, different feed requirements, or differential scale effects on unit production and transfer costs, is uncertain. However, the relatively small difference suggests that although transaction costs related to technological obstacles are evident, they are not insurmountable. Further, to the extent that policy and other interventions can reduce this difference in marginal costs, cross-bred cows will have a larger impact on marketable surplus of fluid milk.

The Tobit estimate of time to milk group shows that sales to the milk group could be effected by reducing the milk delivery time from farm to collection point by an average of 114 min. This is clearly related to the transaction costs of reallocating family labor to milk delivery. Given the current limited number of milk groups in Ethiopia, and the very large number of rural households with cattle, this result suggests a potentially simple policy intervention. Currently, many potential fluid milk-marketing households are hours distant from any milk group. Setting up new groups would clearly reduce the time to group for a number of households close to the group. Of course, the actual number of households that would benefit depends on local population densities.

Any policy support to raise small-holder participation in milk marketing based on our analysis of factors influencing fluid milk sales would necessarily have to weigh public costs against the expected gains by small-holder households. The existing milk groups were established by a development project at an estimated cost of EB 44 350 each, or about US$ 5350. Given the prices at the time of group formation, the cost of a milk group is roughly equivalent in market value to some 10 cross-bred cows. Given the density of households in many parts of rural Ethiopia, one such investment is likely to bring about market entry of more than four households, the number implied by the yield of 10 cows. Further, the availability of cross-bred cows for purchase by small-holders is limited. Policies to promote expansion of cross-bred numbers — currently less than 100 000 in Ethiopia — rely on expansion of the domestic herd, largely at government-owned facilities. Imports of cross-bred cattle are severely restricted (particularly from Kenya) due to fears of disease risk. The resulting slow growth of the domestic herd of cross-bred animals also provides support for the formation of cooperatives, with or without the provision of additional cross-bred animals.

The ultimate benefits of participation in fluid milk sales — and the survival of the milk groups themselves — will depend on their continued ability to capture value-added in dairy processing and return that value-added to their members. This, in turn, relies on the groups' abilities to offer producers a higher return net of transactions cost than alternative market outlets. Whether they will continue to do so remains to be seen, but first impressions from our two sample sites are positive.

10. Conclusions

The ideas developed here are simple and so is the message that we are advancing: Institutional innovations by themselves are insufficient to catalyze entry; they must be accompanied by a mix of other inputs including infrastructure, knowledge and asset accumulation in the household. Although it is not surprising that milk groups increase the participation of small-holders in fluid milk markets in Ethiopia's highlands, our empirical results provide insights about how to promote further market participation by small-holder producers. Locating groups so as to minimize the time required to market milk increases the number of participating producers and the level of marketable surplus. Given the difficulty and cost of providing cross-bred animals (as experienced by such heifer-loan schemes as Heifer Project International in other parts of Africa), investment in infrastructure such as the milk groups provides a low cost mechanism for increasing small-holder participation and furthering the integration of traditional

producers into agro-industrial systems. These results are likely to hold relevance for other perishable and time-constrained agricultural products, such as winter vegetables, cut flowers, and the like and, perhaps, a wide and broader set of circumstances.

Milk groups are a simple example of an agroindustrialization innovation, but they appear to be a necessary first step in the process of developing more sophisticated cooperative organizations. Costs of milk production in Ethiopia are low compared to world prices (Staal, 1995) but high transaction costs for households and processors alike prevent dairy exports. Thus, derivative impacts of the innovation in effecting globalization are precluded at present. Time will tell whether the experience obtained from the milk groups may serve as a basis for the development of producer-oriented processing that better integrates small-holder producers with global agroindustry.

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