Marketing, Co-operatives and Price Heterogeneity:

Evidence from the CIS Dairy Sector

Johannes Sauer
Department of Economics, University of Manchester, Manchester, UK

Matthew Gorton
Newcastle University Business School, Newcastle University, Newcastle upon Tyne, UK

John White
School of Management, University of Plymouth Business School, Plymouth, UK

Abstract

Drawing on survey data, this paper identifies the determinants of variations in farm gate milk prices for three CIS countries (Armenia, Moldova and Ukraine). We apply a multi-level modeling approach, specifically a bootstrapped and selectivity bias corrected mixed-effects linear regression model. The analysis suggests three main strategies for farmers to improve the price received for their output: *consolidation*, *cooperation* and *stable supply chain relationships*. While selling through a marketing cooperative has a significant and positive effect on farm gate milk prices, the majority of non-members are reluctant to join. The size of dairy operations, trust and contracting also impact positively on the prices received by farmers. Policy implications are drawn.

Key Words: price heterogeneity, milk, cooperatives, Armenia, Moldova, Ukraine
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1. Introduction

Farmers' welfare will depend mostly on the price received for their output in environments of minimal agricultural policy support, the absence of social safety nets, and a weak non-farm rural economy which limits agricultural diversification. These features characterize much of the Commonwealth of Independent States (CIS)[1], where rural poverty is widespread. The price received by farmers for their output is thus of considerable concern. Yet evidence to date for the CIS indicates that since the break-up of the USSR farm gate prices have often been significantly below international prices (Striewe, 1999; von Cramon-Taubadel *et al.* 2001; World Bank, 2005; von Cramon-Taubadel *et al.* 2007; Liefert and Liefert, 2007) and vary considerably between producers (Keyser, 2004). The latter has been attributed to uneven competition (Kazmer and Konrad, 2004) caused by weak physical and commercial infrastructure. Poor physical and commercial / institutional infrastructure raise transport and transaction costs (Striewe, 1999; Gow and Swinnen, 2001) and increase the likelihood of incomplete price information (Swinnen, 2005; Liefert and Liefert, 2007). Where physical and commercial infrastructure is weak, farmers are less likely to be aware of the prices received by others, and processors / other purchasers may act as local monopsonies (Cochrane, 2007). Erratic and rent seeking government intervention may reinforce these problems (von Cramon-Taubadel *et al.* 2007). While case studies (Striewe, 1999; Cocks et al. 2005; Gorton *et al.* 2006) and aggregate market analysis (von Cramon-Taubadel *et al.* 2007; Liefert and Liefert, 2007) identify these difficulties in the CIS, there is an absence of cross-sectional data analysis on the prices received by farmers in CIS markets.

This paper analyses data for three CIS countries (Armenia, Moldova and Ukraine), seeking to identify the determinants of variations in farm gate milk prices. Several studies identify severe problems affecting milk marketing in the CIS (Cocks et al. 2005; Engels and Sardaryan, 2006; Gorton *et al.* 2006). Some of the problems faced are common to other branches of agriculture – a fragmented and typically poorly capitalized production base, with weak rural infrastructure and high levels of opportunistic behavior. However the perishable nature of milk coupled with its production pattern (milking twice a day) and the counter cyclical nature of supply and demand between summer and winter aggravate marketing difficulties (Engels and Sardayan, 2006). In the immediate post-Soviet period many dairy supply chains collapsed and rebuilding the sector has proved more difficult than some initially envisaged (Cochrane, 2007). Low farm gate prices,

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[1] The CIS comprises countries that were formerly Soviet Republics, excluding Estonia, Georgia, Latvia and Lithuania. Ukraine is regarded as only a *de facto* CIS state, as despite being one of the founding states it did not ratify the CIS charter.

substantially below international / border prices, limit the viability of private investment and encourage a deeper consideration of price determination. In doing so the paper contributes to a wider literature on price heterogeneity in developing and transitional economies. We specifically investigate whether marketing cooperatives raise farm gate prices for their members. The latter is of substantial policy interest given a desire to assist small-scale farmers to improve value added (Reardon *et al.* 2009) and the dependence of rural areas in the CIS on agriculture (World Bank, 2005).

A wide array of farms, ranging from rural households with 1 or 2 cows up to large corporate enterprises with herds of 10,000 milking cows, characterizes the CIS dairy sector. Small-scale dairy farming is prevalent in much of the rural CIS. For example, Dumitrashko (2003) estimated that more than 40 per cent of rural Moldovan households kept at least one cow and the majority of one cow units sold at least some of their output. However, less than 6 per cent of households possessed three or more cows. Such small-scale production is often discounted, but in an environment of low incomes and weak social safety nets, it may have a significant effect on rural welfare. To illustrate, Keyser (2004) calculated that a two cow herd in 2003, produced an average profit of €90 per annum in Moldova. While this may appear modest, compared against an average monthly salary in agriculture and pension of €32 and €15 respectively for the same year (*Biroul Național de Statistică al Republicii Moldova*, 2007) it is apparent that dairy farming can represent an important source of rural income. No government in any of the countries studied, during the period of data analysis (2005-6), imposed a minimum or set price for milk.

In recent years average rural incomes increased in the CIS but remain very low by European standards. For example, the average *gross* monthly salary in Ukrainian agriculture in 2009 was equivalent to €117 (State Statistics Committee of Ukraine, 2009), with agriculture recording the lowest mean wage out of the 12 sectors for which statistics are compiled. In Moldova, the average gross monthly wage in agriculture in 2009 equated to €92 (*Biroul Național de Statistică al Republicii Moldova*, 2010), with the comparable figure for Armenia in 2008 being €121 (ARMSTAT, 2009). Throughout the region, state pensions fail to provide an adequate level of income to meet reasonable basic needs (UNDP, 2009; World Bank, 2006). In this context, fairly small changes in agricultural output prices, even for those marketing small quantities, may impact significantly on welfare. Hence the factors that determine price heterogeneity are worthy of study.

The paper consists of six sections. The next section reviews the literature on price heterogeneity. This is followed by a presentation of the econometric analysis and dataset. Results relate to the

determinants of the marketing channel utilized and the price received by farmers for their milk. Drawing on the analysis, the conclusion details three strategies for dairy farmers to improve the prices received for their output: consolidation, cooperation and stable supply chain relationships.

2. Price Heterogeneity

In keeping with Varian's (2000, p.187) oft quoted remark that the law of one price is 'no law at all', several empirical studies uncover significant price dispersion even after controlling for product heterogeneity (Lewis, 2008; Sorensen, 2000). In other words, firms in the same market sell 'identical goods for different prices (at the same time)' (Lewis, 2008, p.654). To explain price dispersion, economists tend to assume that some form of heterogeneity holds (Besancenot and Vranceanu, 2004). These assumptions can be grouped into three categories, relating to imperfect information, transaction costs and spatially uneven competition, which are discussed in turn.

Imperfect information

Search models posit that price dispersion can arise as a stable equilibrium outcome where consumers possess imperfect information and the search costs of price shopping are positive. Consumers vary in terms of the information they possess and search costs. A firm may be able to charge a higher price for the same good as a competitor, if there is some probability that a randomly arriving consumer is unaware of the competitor's lower price and chooses to purchase rather than incur the cost of seeking additional price quotations (Sorensen, 2000). Similarly a producer may sell at a lower price if s/he is unaware of other actors willing to pay more. A mass of small-scale, often isolated, producers characterize most markets in developing and transitional economies, particularly in rural areas (IFAD, 2001). As small-scale rural market systems lack publically announced prices or detailed market information systems, imperfect information on prices is likely to be severe (Brooks, 2010).

Transaction Costs

Transaction costs refer to the 'pecuniary and non-pecuniary costs associated with arranging and carrying out an exchange of goods or services' (Holloway *et al.* 2000, p. 281). The main forms are search, bargaining, monitoring, enforcement, maladaptation and transport costs (Williamson, 1985). The poor state of rural infrastructure in the CIS raises transaction costs considerably, particularly for a perishable product such as milk. This problem is compounded by the sparsely populated and remote nature, and low local purchasing power, of most rural areas in the region. Unofficial fees and shipping hazards (damaged or stolen goods during transit) are also relatively

high in the CIS (Porto, 2005). Goetz (1992) demonstrates that transaction costs lower the prices received by farmers as sellers of agricultural output and raise their input prices. In general for a buyer the transaction costs of sourcing a given quality of raw materials from a small number of larger suppliers will be less than procuring from a mass of small-scale producers. Transaction costs therefore tend to favor larger farms (Swinnen, 2005) and a buyer may pass on some of the saved costs to larger producers, in the form of a higher relative price, in an attempt to secure their output, particularly in a market characterized by growing demand.

Transaction costs may be reduced by cutting the number of exchange relationships through the creation of cooperative / intermediary institutions (Sykuta and Cook, 2001). For example a milk marketing cooperative may provide a bulking and bargaining service so that a processor need not deal directly with small farms (Holloway *et al.* 2000). A marketing cooperative / intermediary may also improve the flow of information to farmers, so that production better meets the requirements of a market, and increases the bargaining power of members. This bargaining power may lead to members receiving higher prices relative to non-members (Morgan, 2008). Staatz (1987) argues that establishing such countervailing power is critical as individually farmers are weak compared to concentrated input and processing industries. A marketing cooperative may also decrease the likelihood of opportunism by buyers, as losing the supply of a collective of farmers would be more damaging than terminating a relationship with a single, small-scale producer. Reducing opportunism may encourage investment and hence increase productivity (Gow *et al.* 2000, Sauer and Balint 2008). However while the theoretical arguments in favor of marketing cooperatives are well known, in practice their performance in developing countries has been patchy (Glover, 1987). In Eastern Europe, farmers have been reluctant to join such arrangements, a tendency often linked to a legacy of distrust of collective arrangements stemming from experiences under communist regimes (Gardner and Lerman, 2006).

An important characteristic of CIS markets, particularly in the early years of transition, was a high level of opportunistic behavior on the part of buyers, sellers and regulatory agencies (Safavian *et al.* 2001). Weak and ineffective systems of legal redress compounded this problem so that firms turned to internal or purely private enforcement mechanisms based on constructed mutual dependence or trust (Hendley *et al.* 2000). This included attempts to establish self-enforcing contracts (Gow *et al.* 2000) and rewarding loyal buyers / suppliers. As Hendley *et al.* (2000, p.649) remark 'in the chaotic world of the transition, strategies that use trust - both personal and calculative - emerge as critical.' Interviews with food processors revealed that while larger suppliers are preferred in general, trust, stable relationships and willingness to learn were as, if not more, important (Gorton and White, 2007).

Spatially uneven competition

Models of monopolistic competition suggest that increased competition is associated with lower average output prices and a lower level of price dispersion (Barron *et al.* 2004). In supply chains, more competition should lead to more equal rent sharing, evidenced by higher producer prices and more services for farmers (Swinnen and Maertens, 2006). There is empirical evidence to support these notions. Data for retail gasoline markets consistently indicate that average prices and price dispersion are negatively related to the number of stations within a particular geographic market area (Barron *et al.* 2004; Eckert and West, 2006). Evidence for the Bulgarian (Noev *et al.* 2009) and Polish (Dries and Swinnen, 2004) dairy sector reveals that competition encourages processors to match or offer enhanced supplier assistance programs in order to protect their supply base. Case study evidence suggests that farmers are worst placed when faced with a privately owned or government controlled monopsony (Gorton and White, 2007; Sadler, 2006). Wegren (1996) argues that local monopsonies are common in the CIS as Soviet planners built food processing plants (mills, dairies etc.) on a one for each *oblast* (region) basis, with no direct competition between them for raw materials. During the early years of transition these local monopsonies often remained in place because of transport and logistical difficulties and the political connections of established firms, which 'insulated lone buyers within each region from competition with buyers outside the region' (Kazmer and Konrad, 2004, p.54).

3. Econometric Analysis

The econometric analysis consisted of two stages. First, a probit model is estimated to assess the factors which determine the marketing channel utilized, specifically whether farmers sell only to a commercial buyer or sell to final consumers. For an analysis of price heterogeneity it is important to separate out those farmers that sell also to final consumers from those that supply only commercial buyers. In the second stage we investigate the determinants of farm gate milk prices focusing on those that sell only to commercial buyers.

The analysis is linked in that it is likely that the characteristics of farmers that sell only to commercial buyers differ from those that sell also to final consumers. Unobservable characteristics affecting the decision to sell only to commercial buyers will be correlated with the milk price received by the farmer. Selectivity bias would be present, therefore, if we were to draw inferences about the determinants of milk prices for all farmers based on the observed milk

prices of the subset of farmers that sell only to commercial buyers. Heckman's (1979) two-stage sample selection model copes with such a selection problem and is based on two latent dependent variable models, where the level of the milk price received by the farmer is modeled in a second stage as a mixed-effects linear regression model. The estimates obtained in the first stage are used to generate the inverse Mill's ratio (*MR*). This ratio is required to account for possible sample selection bias in the second stage of the model (Heckman 1979; Greene 2003). While the paper presents the results of both stages the principal focus of the analysis lies with the second step. The remainder of this section outlines the two stages in greater detail.

Probit Model of Determinants of Marketing Channel Utilized

It is expected that a farmer's decision to use a commercial marketing channel or not is influenced by a multitude of factors, related to farm characteristics (*fc*), collaboration with other farmers (*cb*), herd characteristics (*h*) and locational information (s = {Armenia, Ukraine}, where Moldova is used as the reference category). Previous research on farming in Central and Eastern Europe (Lerman, 2001; Mathijs and Noev, 2004) and developing countries (Barrett, 2008; Nwigwe *et al.* 2009) identify these factors as important determinants of the marketing channel utilized. To capture farm characteristics the following variables are included: total land owned, total land rented, pasture land used, common pasture land used, and the number of full- and part-time employees. Collaboration behavior records if farmers cooperate with others in the processing of milk, purchasing of inputs, lobbying, milk storage or in any other manner (e.g. machinery ring). Herd characteristics cover the number of milking cows, number of heifers, number of calves and average milk yield per cow.

The final estimation model is described by:

$$P_i = \begin{cases} 1 \text{ if } \alpha + \sum_j \beta_j fc_{ij} + \sum_k \gamma_k cb_{ik} + \sum_l \delta_l h_{il} + \sum_m \theta_m s_{im} + u > 0 \\ 0 \text{ otherwise} \end{cases}$$

(1)

where P_i is a binary variable which takes the value one if the farmer is selling to commercial buyers only and zero if the farmer decided to sell also to final consumers, α, β, γ, δ, and θ are the parameters to estimate, and *u* is the error term.

Mixed-Effects Linear Regression of Determinants of Milk Price

Secondly, we investigate the determinants of variations in farm gate milk prices for those that sell to commercial buyers only. Here, the dependent variable is the actual price of milk in Euros per liter received by farmers. Data were collected in national currencies and converted to Euros using average exchange rates for the period in question. Milk price data covered three periods, with respondents providing an average price received in winter 2005/6, summer 2005 and the 2004/5 winter season.

As some of the covariates are grouped according to one or more characteristics (i.e. representing clustered, and therefore dependent data with respect to space and other characteristics) we apply a multi-level modeling approach commonly referred to as mixed-effects or hierarchical model (Fox, 2002; Bryk and Raudenbush, 2002). Such a mixed model is characterized as containing both fixed and random effects.[2] The Laird and Ward (1982) form of the milk price model is:

$$P_{im} = \alpha + \Box P_{imt-1} + \Box op_{im} + \sum_j \mu_j\, ms_{ijm} + \sum_k \rho_k\, tr_{ikm} + \sum_l \tau_l\, s_{ilm} + \varphi MR_{im} + \sum_n b_n\, z_{inm}$$

$$+ u_{im}$$

(2)

with $b_n \sim$iid $N(0, \xi_b^2)$, cov$(b_n, b_{n-1})= \xi_{n,n-1}$, $u \sim$iid $N(0, \sigma^2\lambda_{im})$, cov$(u_{im}, u_{i-1,m})= \sigma^2\lambda_{imi-1}$. P_{im} as the value of the response variable for the i-th observation in the m-th group of clusters; ε, υ, μ, ρ, τ, φ are the fixed-effect coefficients which are identical for all groups m; P_{imt-1}, op_{im}, ms_{im}, tr_{im}, s_{im} are the fixed-effect regressors for observation i in group m (where P_{t-1} is the milk price in 2005; *op* is the size of operation [number of milking cows]; *ms* refers to a vector of milk marketing characteristics [number of potential commercial buyers, % of milk output sold on contract, % of milk output sold through a marketing cooperative, milk sold via collecting station]; *tr* is a vector of trust related variables [trust in seller, a cross effect between trust and % of milk output sold on contract]; *s* refers again to the country the farm is located in, i.e. Armenia, Ukraine where Moldova is again the reference category; and *MR* is the inverse Mill's ratio obtained from the first stage regression controlling for potential selection bias). b_n are the random-effect coefficients for group m, assumed to be multivariately normally distributed and varying by group; b_n are designed as random variables and are hence similar to the errors *u*; z_n are the

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[2] The fixed effects are analogous to standard regression coefficients and are estimated directly. The random effects are not directly estimated but are summarized according to their estimated variances and covariances. Random effects may take the form of either random intercepts or random coefficients, and the grouping structure of the data may consist of multiple levels of nested groups (here related to country and trust). The error distribution of the linear mixed model is assumed to be Gaussian.

random-effect regressors; ξ_b^2 and $\xi_{n,n-1}$ are variances and covariances among the random effects assumed to be constant across groups; u_{im} is the error for observation i in group m assumed to be multivariately normally distributed; $\sigma^2\lambda_{imi-1}$ are the covariances between errors in group m.[3] The model in (2) is estimated by maximum restricted (or residual) likelihood (REML) (Harville, 1977).[4]

The analysis therefore includes as independent variables factors identified in the literature discussed above as potentially causing price heterogeneity. Regarding market competitiveness, surveyed farmers estimated the total number of potential commercial buyers for their milk. This captures the degree of switching power farmers have in marketing milk and the degree to which markets are characterized by monopsony. Four measures relate to transaction / marketing characteristics. To test the notion that marketing cooperatives can reduce transaction costs and / or may provide countervailing power to oligopsonistic and monopsonistic buyers, translating into higher prices for members, the analysis includes as a variable the percentage of a farm's total output that is sold via a marketing cooperative. Farmers may sell their output on contract rather than via spot markets. Contracts should provide a greater degree of certainty for buyers regarding the availability of supply, for which a buyer may pay a premium (Gow *et al.* 2000). The study therefore includes the percentage of a farm's total output sold on contract as an independent variable. To capture the reliability of buyers, a measure of trust was included: farmers responded to a 5 point Likert scale to the statement "My main buyer keeps the promises it makes to us" where 1 = strongly disagree, 5 = strongly agree. Doney and Cannon (1997) developed this measure of trust and it has been successfully incorporated into several subsequent studies on supply chain relationships (Pavlou, 2004, Johnston *et al.* 2004). Finally regarding marketing characteristics, a dummy variable captures whether the farm sells via a village collecting station. Village milk collecting stations are common in the CIS, but quality testing has often been rudimentary (Gorton *et al.* 2006). Where quality testing is weak, asymmetric information may lead, following Akerlof's (1970) market for lemons, to good milk being crowded out and prices depressed.

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[3] In our case, observations are sampled independently within groups and are assumed to have constant error variance ($\lambda_{imi}=\sigma^2$, $\lambda_{imi-1}=0$), and thus the only free parameter to estimate is the common error variance, σ^2.

[4] We also tested for other groupings with respect to the random effects specification, however, none of these showed to be of satisfactory significance.

Finally, we investigate the robustness of our estimates obtained by (1), and (2) by applying a simple stochastic re-sampling procedure based on bootstrapping techniques (Efron and Tibshirani, 1993).

4. Data Set

Given the objective of identifying the determinants of variations in farm-gate prices, the population of interest was defined as primary producers who sell cows' milk to another supply chain actor. Therefore farmers without dairy cows, those who did not sell any of the milk produced or who processed all milk themselves (i.e. did not sell any raw milk) were excluded from the study. While given the focus of this research these restrictions are justified, it means that our sample cannot be directly compared to official data on the structure of milk production. For data collection, a quota of 300 responses was set per country with the intention of including a representative cross-section of commercial dairy farms, including both household producers that sold milk and agricultural companies.

From the 3 countries in total 916 responses were obtained, 300 each from Armenia and Moldova and 316 from Ukraine. The Moldovan sample includes farms from all regions of the country excluding the breakaway Pridnestrovian Moldavian Republic. Excluding the latter territory, which does not recognize the laws of the Republic of Moldova, farms were sampled from the northern, central and southern regions of the country in line with each region's contribution to total milk production. In Ukraine, data collection concentrated on the Dnepropetrovsk region.[5] Dnepropetrovsk, the country's third largest city is the administrative centre of the region. The region's mean wage and standard of living is close to the Ukrainian average. Within this region, sampling was weighted to five districts (*rayons)* that have significant commercial dairy production. The Armenian sample comprises farms from all regions (*marzes*) that have significant commercial milk production. The weighting given to each region was in accordance with that area's contribution to Armenia's total milk production. National statistical agencies, local and regional authorities, village majors, local livestock experts and agricultural agencies aided the identification of individual farms. A single source could not be used as most 1-2 cow farm units are unregistered.

The sample is divided into two groups: (i) those who sell directly to *final* consumers via local markets and informal sales and (ii) those that *only* sell milk to a commercial buyer (milk

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[5] As Ukraine is geographically the largest country solely within Europe, it was not possible to survey all regions within the framework of this project.

processor, logistics firm or other intermediary actor). Table 1 outlines the characteristics of the two sub-samples.

Table 1 about here

Overall, the median herd size is low (2 milking cows). The mean is higher (17.2) due to a small number of much larger operations in Ukraine with 1,000-1,500 milking cows. In the entire sample there are only six farms with 500 or more cows. In contrast, 219 operators only possess one milking cow (23.9% of the sample) and 290 farmers own two cows (31.7% of the sample). The majority of farmers surveyed therefore possess two or fewer cows and this is in line with other studies for the CIS (Dumitrashko, 2003; Keyser, 2004). There are however significant differences in the distribution of farms across countries. Ukraine has a bi-modal distribution with a large number of very small units (1-2 cows) but also a group of relatively large corporate farms, each with 200 cows or more. Many of the corporate dairy farms in Ukraine originate from the state and collective farms of the Soviet era. However their management style is now, in general, radically different and many received significant investment from entrepreneurs and business groups that accumulated wealth in other sectors of the economy (Skripnik *et al.* 2005). In Moldova, 2 cow units predominate, with only a handful of farms with 50 or more cows. This extreme fragmentation follows Moldova's radical decollectivization where the assets and land of former state and collective farms were divided up between members (Lerman *et al.* 2004). A unimodal distribution characterizes Armenia, with the mode being between 6 and 9 cows. Only 1 farm in the sample with 20 or more cows sells to final consumers, the vast majority of relatively large operators therefore deal only with commercial buyers. Considering the micro-producers, approximately 15% and 20% of one and two cow units sell to final consumers respectively. Selling to final consumers is most common amongst the farms with 3 and 4 cows.

5. **Results**

Table 2 presents summary statistics on milk prices for those farms selling solely to commercial buyers. In 2006, the average price actually received by farms was €0.1754 per liter. The respective figures for Armenia, Moldova and Ukraine were €0.175, €0.153 and €0.193. These farm gate prices are low by international standards and in line with earlier estimates (Venema, 2002; Perekhozhuk, 2007). The order of farm gate prices across countries, however, varies over time. In 2005, the average farm gate prices in Armenia, Moldova and Ukraine were €0.131, €0.151 and €0.140 respectively. In 2004, prices were higher in Ukraine (€0.1740) relative to Armenia (€0.133) and Moldova ((€0.132).

Table 2 about here

Tables 3 and 4 summarize the results for the estimated models. According to the different diagnosis tests performed all estimated model specifications show a statistical significance at a satisfactory level and no severe signs of misspecification (see model quality measures). These conclusions are supported by the bootstrapped bias-corrected standard errors. The linear hypotheses tests conducted with respect to the significance of groups of explanatory variables indicate the relevance of the final specifications. We further tested for potential endogeneity of some of the explanatory variables as well as collinearity between different regressors.

Table 3 presents the bootstrapped probit model for determinants of marketing channel utilized. Overall, farmers that sell only to commercial buyers operate on a larger scale. This is evident from the significant positive relationships with total land owned, number of full time employees and number of milking cows.

Table 3 about here

The partial productivity (average yield per cow) of those farms that sell only to commercial buyers is higher. Those selling only to commercial buyers are significantly more likely to have used extension services and cooperate with other farmers in the marketing of milk and milk storage. These findings on scale, use of extension services and cooperation are consistent with previous findings on factors affecting market participation and involvement in formal supply chains (Mathijs and Noev, 2004; Barrett, 2008; Nwigwe *et al.* 2009). Those supplying commercial buyers only are significantly less likely to cooperate with farmers on 'other matters', which largely relates to the use of common pasture land by small-scale farmers in Moldova. 91 per cent of the Moldovan farmers surveyed utilized common pasture land in 2005. Farmers in Armenia and Ukraine are significantly more likely to sell only to commercial buyers (Moldova is the reference category).

Table 4 presents the results of the bootstrapped mixed-effects linear regression model for the determinants of farm-gate milk prices. Even after other factors are controlled for, farmers operating on a larger scale receive a better price for their milk. This is in accordance with the theory that transaction costs for buyers will be lower when procuring from fewer, larger dairy farms (Reardon *et al.* 2009) and that in general transaction costs favor larger suppliers (Swinnen,

2005). Processors are willing to share with larger farms some of the benefits of lower transaction costs to secure their output.

Table 4 about here

Selling through a marketing cooperative also has a significant and positive effect on farm gate milk prices. This suggests, in accordance with cooperative theory, that farmers can improve the price received for their output by selling via marketing cooperatives. Given that farm gate prices are often substantially below international prices in the CIS, this result gives credence to the notion that marketing cooperatives can usefully 'fill a gap in the economic institutions' of the rural CIS (Gardner and Lerman, 2006, p.1). Of those sampled that sell only to commercial buyers, 24.6 per cent currently cooperate with other farmers in the marketing of raw milk. Of those that do not currently cooperate in marketing raw milk, only 16 per cent are willing to collaborate with other farmers in future. Thus the majority of farmers do not wish to collaborate with other farmers despite the potentially useful role that marketing cooperatives can play. Collaboration in other regards is also fairly low: in 2006 1.5, 0.6, 10.6, 3.5 and 19.2 per cent of those selling exclusively to commercial buyers reported that they collaborated with other farmers regarding milk processing, marketing processed dairy products, input purchasing, lobbying and milk storage respectively. In each case, the majority of those not collaborating were not willing to do so in future. The first step in expanding the role of marketing cooperatives should therefore be persuading farmers of their merits and addressing directly their reservations.

The use of contracting is also significant. Contracts give buyers greater certainty in supply and they are willing to pay a premium for this, particularly during a period of growing demand as witnessed at the time of study. Those farmers that sell via marketing cooperatives sell almost exclusively on contract but for other buyers (processors, intermediaries) the picture is more mixed. For those farmers that have signed a contract, a major motivating factor was the prospect of a higher milk price - only 7.8 per cent reported that a higher milk price was of no importance in influencing them to sign a contract.

Trust in supply relationships is also positively related to the milk price actually received by farmers. Again buyers appear willing to pay a premium to farmers that they trust and forsake opportunistic behavior. The interaction effect of trust and contracting suggest that these are mutually reinforcing, with buyers valuing certainty in supply. This is particularly important in the CIS where supply chain disruption and high levels of opportunistic behavior hindered the viability of the whole supply chain (Gorton *et al.* 2006). After controlling for other factors, farm

gate milk prices are significantly higher in Armenia. Armenia is a landlocked, relatively remote and modestly populated country which limits the transmission of international prices on to the domestic market.

The sign for the competition coefficient is negative, suggesting, given the rest of the independent variables that farm gate milk prices fall as the number of potential buyers increases. This is not consistent with the notion that greater competition should lead to more equal rent sharing. However, the number of potential buyers may not be an effective measure of competition if there is collusion between processors as has been reported in Ukraine (Perekhozhuk, 2007). Capturing collusion is however very difficult in survey research and further work on the relationship between farm gate prices and competition is required. Just over one quarter of those selling only to commercial buyers report that they realistically have only one buyer for their milk, implying that local monopsonies persist in the CIS.

6. **Conclusion**

A weak non-farm economy, the absence of effective social safety nets and a dependence on agriculture characterize rural areas in the CIS. The welfare of farmers therefore depends greatly on the prices received by farmers for their output. This justifies the examination of the determinants of variations in farm gate prices and we examine milk prices in Armenia, Moldova and Ukraine for a sample of 918 operators.

The analysis suggests three main strategies for dairy farmers to improve the prices received for their output: *consolidation*, *cooperation* and *stable supply chain relationships*. Farmers with larger operations secure higher prices for their output. The transaction costs of dealing with a smaller number of larger suppliers are less and the analysis presents empirical evidence which confirms larger scale producers are favored by buyers. Selling via marketing cooperatives improves the price received by farmers and pooling output in this manner can overcome some of the size disadvantages of small-scale producers. The empirical evidence thus supports strategies to encourage farmers' involvement in marketing cooperatives. However, the majority of nonmembers are currently unwilling to join. Marketing cooperatives will play a limited role until these farmers are convinced of their merits. Nevertheless, developing intermediary institutions such as marketing cooperatives are critical to avoid small-scale farms being further marginalized or excluded from formal supply chains. Finally, buyers value the security in supply which comes

from trusted relationships and contracts. Establishing such relationships is in the long-term interest of farmers.

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Table 1: Number of milking cows per farm unit sampled by type of marketing channel

Number of milking cows	Sell only to commercial buyer(s)	Sell to final consumers as well as commercial buyer(s)	Total
1	187	32	219
2	232	58	290
3	30	13	43
4	23	6	29
5	50	7	57
6 to 9	105	13	118
10 to 19	76	4	80
20 to 49	34	0	34
50 to 99	11	0	11
100 to 199	15	1	16
200 to 499	13	0	13
500+	6	0	6
Total	780	136	916

Source: survey data

Table 2: Summary Statistics for milk prices, farms selling solely to commercial buyers

	Mean (Euros per liter)	Std. Deviation
All countries		
Average milk price actually received (2006)	0.1754	.03890
Average milk price actually received (2005)s	0.1397	.03115
Average milk price actually received (2004)	0.1472	.03903
By country (2006)		
Average milk price actually received (Armenia)	0.1750	.04122
Average milk price actually received (Moldova)	0.1532	.04624
Average milk price actually received (Ukraine)	0.1929	.01280

Table 3: Bootstrapped Probit Model (Stage 1) – Marketing Channel Utilised

Marketing Channel Decision		
(n = 916)	coefficient[1]	bootstrapped bias-corrected se[2]
index function for probability of selling to commercial buyers only (mean probability)		
Farm characteristics		
Total land owned	0.031**	0.011
Total land rented	7.06e-04	0.001
Pasture land used	2.85e-04	0.004
Common pasture land used	0.001**	6.40e-04
Full-time employees	0.086***	0.006
Part-time employees	-0.051	0.035
Extension services		
Use technical assistance	0.439**	0.214
Collaboration with other farmers		
Marketing of raw milk	0.686***	0.217
Processing of milk	0.208	0.491
Marketing of processed milk	0.386***	0.069
Purchasing of inputs	0.124	0.338
Lobbying	-0.462	0.458
Milk storage	0.667***	0.257
Other	-1.431***	0.348
Herd characteristics		
Number of milking cows	0.033***	0.006
Number of heifers	9.27e-04	0.002
Number of calves	0.002	0.008
Average yield per cow	6.94e-05***	1.19e-05
Country [3]		
Armenia	1.245***	0.456
Ukraine	1.610***	0.221
Constant	3.612***	0.498
log-likelihood (LogL)	-291.016	
LR chi2(20)	180.48***	
Pseudo R2	0.732	
McFadden's Adj. R2	0.520	
McKelvey&Zavoina's R2	0.999	
Count R2	0.872	
linear hypotheses tests in model specification ($chi^2(x)$)		
H_0: farm characteristics have no significant effect ($chi^2(6)$)		19.80*** (rejected)
H_0: collaboration related regressors have no significant effect ($chi^2(7)$)		52.42*** (rejected)
H_0: herd characteristics have no significant effect ($chi^2(4)$)		20.82*** (rejected)
H_0: farm location has no significant effect ($chi^2(2)$)		49.30*** (rejected)

1: * - 10%-, ** - 5%-, *** - 1%-level of significance.

2: Bootstrapped and bias-corrected standard errors (based on 10,000 bootstrap replications).

3: Moldova is the reference category.

Table 4: Bootstrapped Mixed-Effects Linear Regression Model for Determinants of the Farm gate Milk Price(Stage 2)

Milk Price in 2006		
(n = 768)	coefficient[1]	bootstrapped bias-corrected se[2]
fixed effects		
Past milk price		
Milk price 2005	0.897***	0.019
Size of operation		
Number of milking cows	6.94e-05***	6.83e-06
Milk marketing characteristics		
number of potential commercial buyers	-4.09e-04*	2.31e-04
% of milk output sold on contract	0.018**	0.008
% of milk output sold through marketing cooperative	3.27e-05***	0.34e-05
milk sold via collecting station	-9.25e05	0.002
Trust		
Trust (Likert scale based)	0.024***	0.001
Trust x % of milk output sold on contract	0.005***	0.002
Country [3]		
Armenia	0.013***	0.003
Ukraine	-0.004	0.003
Probability of sample selection		
inverse Mill's ratio	0.003**	0.001
constant	0.033***	0.006
random effects		
Country		
standard deviation (constant)	0.006**	0.003
Trust		
standard deviation (contract)	0.006***	0.002
standard deviation (% of milk output sold through marketing cooperative)	7.06e-05*	4.94e-05
standard deviation (milk sold via collecting station)	0.002	0.003
standard deviation (constant)	0.003***	0.001
LR test vs. linear regression (chi2(5))	47.79***	
Log-restricted Likelihood	1999.901	
Wald chi2(9)	2546.69***	

linear hypotheses tests in model specification ($chi^2(x)$)

H_0: milk selling characteristics have no significant effect ($chi^2(4)$)   72.20*** (rejected)

H_0: trust related regressors have no significant effect ($chi^2(2)$)   12.93*** (rejected)

H_0: farm location has no significant effect ($chi^2(2)$)   9.51** (rejected)

1: * - 10%-, ** - 5%-, *** - 1%-level of significance.

2: Bootstrapped and bias-corrected standard errors (based on 10,000 bootstrap replications).

3: Moldova is the reference category.