TITLE:

Marketing, cooperatives and price heterogeneity: evidence from the CIS dairy sector

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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 mixed-effects linear regression model. The analysis suggests three main strategies to improve the price received by farmers for their output: *consolidation*, *competition for output* and *stable supply chain relationships*. In Armenia and Ukraine selling through a marketing cooperative has a significant, positive, albeit modest, effect on farm gate milk prices. In all three countries studied, the size of dairy operations, trust and contracting also affect positively the prices received by farmers.

Key words: price heterogeneity, milk, cooperatives, Armenia, Moldova, Ukraine

JEL Codes: O13, P32, Q13

Milk marketing, cooperatives and price heterogeneity: evidence from the CIS dairy sector

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, Zorya and Striewe, 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 monoponsies (Cochrane, 2007). Erratic / rent seeking government intervention may reinforce these problems (von Cramon-Taubadel *et al.* 2007). While case studies (Striewe, 1999; Cocks, Gow and Westgren, 2005; Gorton, Dumitrashko, and White, 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 document severe problems affecting milk marketing in the CIS (Cocks, Gow and Westgren, 2005; Engels and Sardaryan, 2006; Gorton, Dumitrashko, and White, 2006). Some of the problems faced are

[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.

common to other branches of agriculture – a fragmented and typically poorly capitalized production base, 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, 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.[2] 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 Naţional de Statistică al Republicii Moldova*, 2007) it is apparent that dairy farming can represent an important source of rural income. 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.

[2] No government in any the countries studied, during the period of data analysis (2005-6), imposed a minimum or set price for milk.

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 improving the prices received by farmers for their output: consolidation, stimulating competition for output and stable supply chain relationships.

1. 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, 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 increase 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, Streeter, and Swinnen, 2000). 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, Graham, and Gonzalez-Vega, 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, Murrell, and Ryterman, 2000). This included attempts to establish self-enforcing contracts (Gow, Streeter, and Swinnen, 2000) and rewarding loyal buyers / suppliers. As Hendley, Murrell, and Ryterman (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, Taylor, and Umbeck, 2004). In supply chains, greater competition should lead to more equal rent sharing, evidenced by higher producer prices and more services for farmers (Swinnen and Maertens, 2007). 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, Taylor, and Umbeck, 2004; Eckert and West, 2006). Evidence for the Bulgarian (Noev, Dries, and Swinnen, 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).

2. 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 two stages of the analysis are 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 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*) and herd characteristics (*h*). 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:

$$\text{Pi}=1 \text{ if } \alpha+j\beta jfcij+k\gamma kcbik+l\delta lhil+u>0 \text{ otherwise} \quad (1)$$

where P_i is a binary variable which takes the value one if the farmer sells 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. Separate models are constructed for each country (Armenia, Moldova and Ukraine). 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. 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.[3] The Laird and Ware (1982) form of the milk price model is:

$$Pim=\alpha+\epsilon Pimt-1+\vartheta opim+j\mu jmsijm+k\rho ktrikm+\varphi MRim+nbnzinm+uim \quad (2)$$

with b_n ~iid N(0, ξ_b^2), cov(b_n, b_{n-1})= $\xi_{n,n-1}$, u~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; 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]; 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 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; $\sigma^2\lambda_{imi-1}$

[3] The error distribution of the linear mixed model is assumed to be Gaussian.

are the covariances between errors in group m.[4] The model in (2) is estimated by maximum restricted (or residual) likelihood (REML) (Harville, 1977).[5]

The analysis 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 improve the prices received by farmers for their output, the analysis includes as a variable the percentage of a farm's total output that is sold via a marketing cooperative. While cooperative membership may deliver other benefits to farmers, in Eastern Europe farmers perceive low output prices to be their main problem (Mathijs and Noev, 2002) and the success of cooperation in marketing is assessed in terms of improving output prices.

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, Streeter, and Swinnen, 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, 2003, 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, Dumitrashko, and White, 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.

[4] 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.

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

Appendix 1 describes the dependent and independent variables included in the models, and presents summary statistics.

We model the random effects variables around the group variable 'trust'. Hence 'trust' (based on the Likert type scale) is estimated as random effects regressed on milk selling characteristics (% of milk sold on contract', % of milk output sold through marketing cooperative and whether milk is sold via a collecting station). The rationale for this is that the definition and interpretation of 'trust' in this context is to a considerable extent randomly determined based on non-observable individual experiences in the past. Hence, it is necessary to estimate the variance around the different Likert scale based 'trust' levels as a function of variables that potentially approximate these (unobservable) experiences. As the structure and processes related to selling via contracts, marketing cooperatives, and collecting stations most likely follow specific patterns across countries and regions, it seems reasonable to assume that this unobservable randomness related to the interpretation/experience of 'trust' can be approximated by these selling and cooperation characterizing features. However, a certain part of this effect must be observable and 'fixed' across observations; hence we also include a fixed effect with respect to the 'trust' variable.

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).

3. 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 three 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.[6] 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 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 possess only

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

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. The Ukrainian sample includes both small-scale units and corporate farms. Many of the latter 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 a lot received significant investment from entrepreneurs and business groups that accumulated wealth in other sectors of the economy (Skripnik, Chernyshova and Vinichenko, 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, Csaki, and Feder, 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.

4. Results

Descriptive Statistics

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

Econometric Analysis

Tables 3 to 8 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.

Tables 3, 4 and 5 present the bootstrapped probit models for determinants of marketing channel utilized for Armenia, Moldova and Ukraine respectively. Overall, farmers that sell only to commercial buyers operate on a larger scale - in each country there are significant positive relationships with the number of full-time employees, total land owned and number of milking cows.

Tables 3, 4 and 5 about here

The partial productivity (average yield per cow) of those farms that sell only to commercial buyers is higher in each of the countries studied. Those selling only to commercial buyers are significantly more likely to have used extension services and cooperate with other farmers in the marketing of raw and processed milk. In Armenia and Ukraine, those selling only to commercial buyers are also significantly more likely to cooperate with other farmers in 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' in Armenia and Moldova,

but significantly more likely to cooperate with fellow farmers on 'other matters' in Ukraine. In Armenia and Moldova, 'other matters' relates largely to the use of common pasture land, where it is ubiquitous. 90 and 91 per cent of the Armenian and Moldovan farmers surveyed utilized common pasture land in 2005 respectively. In Ukraine, cooperation on other matters is far less common (11.7 per cent of sampled farmers) and relates principally to veterinary and transportation services.

Tables 6, 7 and 8 present the results of the bootstrapped mixed-effects linear regression models for the determinants of farm gate milk prices in Armenia, Ukraine and Moldova respectively. Even after other factors are controlled for, Armenian and Moldovan farmers operating on a larger scale receive a better price for their milk. In these countries, the production base is more fragmented and processors appear to place a greater premium on securing suppliers from the relatively small number of larger producers (Gorton, Dumitrashko, and White, 2006). 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). Interviews with dairy processors suggest that they are willing to share with larger farms some of the benefits of lower transaction costs to secure their output (White and Gorton, 2004). In Ukraine no such relationship between farm gate prices and herd size is apparent. Ukraine did not witness during transition such a dramatic fragmentation in the structure of dairy farming and it appears that in this market, size alone does not guarantee favorable terms.

Tables 6, 7 and 8 about here

Selling through a marketing cooperative has a significant and positive, albeit modest, effect on farm gate milk prices in Armenia and Ukraine. No such relationship is apparent in Moldova. In Armenia and Ukraine, less than 6 per cent of farms sampled sold milk through a marketing cooperative, while in Moldova 58 per cent reported sales through cooperation with other farmers. This suggests a possible first mover advantage. Where marketing cooperatives are absent, processors may welcome the development more, and farmers improve their relative position slightly. However, where marketing cooperatives are ubiquitous, joining such an organization may not generate such an advantage.

For all three countries, the use of contracting is 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 of the whole sample reported that a higher milk price was of no importance in influencing them to sign a contract.

In all three countries, trust in supply relationships is also positively and significantly related to the milk price actually received by farmers. Buyers appear willing to pay a premium to farmers that they trust and forsake opportunistic behavior. The interaction effect of trust and contracting suggests 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, Dumitrashko, and White, 2006). In all cases there are significant positive relationships between current and previous years' milk prices. The analysis also incorporates an interaction effect (price 2005 x trust) to further account for the strong influence of the previous year's price, assuming that successful and stable buying relationships (i.e. a relatively high previous price and significant trust in buyer) manifest in a non-linear effect. The significance of this interaction effect implies that there are increasing returns with respect to positive business experiences in previous periods if the trading relationship is characterised by significant trust.

In all three countries, there is a significant, positive relationship between the milk price and the number of potential commercial buyers. This is consistent with the notion that greater competition leads to more equal rent sharing (Barron, Taylor, and Umbeck, 2004). Farmers' welfare can be improved by stimulating competition for their output. Competition is not fully developed in the region - just over one quarter of those selling only to commercial buyers reported that they realistically had only one buyer for their milk, implying that local monopsonies persist in the CIS.

Finally, the models for Armenia and Ukraine indicate a significant, negative relationship between the prices received by farmers and selling via a collecting station. The results for these countries are consistent with notions that prices are depressed where the ability to accurately measure quality, such as at village collecting stations, is weak (Akerlof, 1970). Yet in Moldova, a positive relationship between milk prices and selling via a collecting station is evident. The latter result appears inconsistent with theory. In assessing the difference in results it is important to note however that village collecting stations remain far more prominent in Moldova. In Armenia and Ukraine only 30 and 28 per cent of sampled farmers reported selling via collecting stations respectively. The comparable figure for Moldova was 71 per cent. It maybe where they remain the norm, farmers are not penalized solely for selling via village collecting stations.

5. 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 to improve the prices received by farmers for their output: *consolidation*, *stimulating competition for output* and *stable supply chain relationships*. In the Armenian and Moldovan cases, farmers with larger operations secured 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 receive more favorable prices. In all cases, competition, as measured by the number of potential buyers, stimulated higher farm gate prices. Despite the number of years that have passed since the end of central planning, effective competition remains absent from some local markets - over a quarter of farmers sampled reported that they confronted a local monopsony with only one potential buyer for their output. Finally, buyers value the security in supply which comes from trusted

relationships and contracts. Given the significant and consistent linkages with milk prices, establishing such relationships is in the long-term interest of farmers.

The evidence on marketing cooperatives is mixed. In Armenia and Ukraine, selling via marketing cooperatives improves significantly, albeit modestly, the price received by farmers while there are significant negative relationships with selling via village collecting stations. These findings are consistent with theory (Akerlof, 1970; Morgan, 2008). However, these relationships do not hold for Moldova where marketing cooperatives and village collecting stations are relatively more common. This suggests that buyers are pragmatic, they may support the development of marketing cooperatives, through higher prices, more where they are initially absent and discriminate against village collecting stations only where feasible alternatives exist.

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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 - Armenia

Marketing Channel Decision		
(n = 300)	coefficient[1]	bootstrapped bias-corrected se[2]
index function for probability of selling to commercial buyers only (mean probability)		
Farm characteristics		
Total land owned	0.078**	0.036
Total land rented	0.001	0.004
Pasture land used	-0.009	0.011
Common pasture land used	0.001**	6.18e-04
Full-time employees	0.221***	0.086
Part-time employees	-0.116**	0.057
Extension services		
Technical assistance	0.365*	0.204
Collaboration with other farmers		
Marketing of raw milk	0.363*	0.214
Processing of milk	0.269	0.476
Marketing of processed milk	0.384***	0.067
Purchasing of inputs	0.192	0.345
Lobbying	-0.564	0.495
Milk storage	0.910***	0.265
Other	-1.232***	0.326
Herd characteristics		
Number of milking cows	0.015***	0.001
Number of heifers	0.002	0.021
Number of calves	0.012	0.017
Average yield per cow	3.03e-04*	1.77e-04
Constant	1.846***	0.393
log-likelihood (LogL)	-191.435	
LR chi2(20)	145.55***	
Pseudo R2	0.754	
McFadden's Adj. R2	0.921	
McKelvey&Zavoina's R2	0.980	
Count R2	0.853	
linear hypotheses tests on model specification ($chi^2(x)$)		
H_0: farm characteristics have no significant effect ($chi^2(6)$)		22.89*** (rejected)
H_0: collaboration related regressors have no significant effect ($chi^2(7)$)		20.56*** (rejected)
H_0: herd characteristics have no significant effect ($chi^2(4)$)		33.44*** (rejected)

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

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

Table 4: Bootstrapped Probit Model (Stage 1) – Marketing Channel Utilised - Moldova

Marketing Channel Decision		
(n = 316)	coefficient[1]	bootstrapped bias-corrected se[2]
index function for probability of selling to commercial buyers only (mean probability)		
Farm characteristics		
Total land owned	0.042***	0.003
Total land rented	1.68e-03	0.002
Pasture land used	4.44e-03	0.005
Common pasture land used	0.006**	5.72e-04
Full-time employees	0.081***	0.009
Part-time employees	-0.055	0.056
Extension services		
Technical assistance	0.505**	0.055
Collaboration with other farmers		
Marketing of raw milk	0.122**	0.052
Processing of milk	-0.502	0.603
Marketing of processed milk	0.313***	0.052
Purchasing of inputs	-0.149	0.486
Lobbying	0.164	0.739
Milk storage	-0.276	0.471
Other	-1.139***	0.321
Herd characteristics		
Number of milking cows	0.007***	0.002
Number of heifers	0.034*	0.014
Number of calves	0.021	0.024
Average yield per cow	0.009**	0.003
Constant	1.169***	0.363
log-likelihood (LogL)	-148.112	
LR chi2(20)	50.05***	
Pseudo R2	0.741	
McFadden's Adj. R2	0.710	
McKelvey&Zavoina's R2	0.999	
Count R2	0.918	
linear hypotheses tests in model specification ($chi^2(x)$)		
H_0: farm characteristics have no significant effect ($chi^2(6)$)		64.40*** (rejected)
H_0: collaboration related regressors have no significant effect ($chi^2(7)$)		9.82** (rejected)
H_0: herd characteristics have no significant effect ($chi^2(4)$)		10.71** (rejected)

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

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

Table 5: Bootstrapped Probit Model (Stage 1) – Marketing Channel Utilised - Ukraine

Marketing Channel Decision		
(n = 298)	coefficient[1]	bootstrapped bias-corrected se[2]
index function for probability of selling to commercial buyers only (mean probability)		
Farm characteristics		
Total land owned	0.042**	0.019
Total land rented	8.48e-04	0.001
Pasture land used	1.96e-04	0.003
Common pasture land used	4.57e-04	0.001
Full-time employees	0.031***	0.003
Part-time employees	-0.027	0.054
Extension services		
Technical assistance	0.354**	0.118
Collaboration with other farmers		
Marketing of raw milk	0.816***	0.259
Processing of milk	0.215	0.921
Marketing of processed milk	0.413***	0.077
Purchasing of inputs	0.211	0.323
Lobbying	-0.733	0.750
Milk storage	0.767***	0.318
Other	0.922***	0.203
Herd characteristics		
Number of milking cows	0.015***	0.003
Number of heifers	0.017	0.051
Number of calves	0.003	0.038
Average yield per cow	5.45-05***	1.35e-05
Constant	-0.378	0.333
log-likelihood (LogL)	-233.292	
LR chi2(20)	110.34***	
Pseudo R2	0.912	
McFadden's Adj. R2	0.521	
McKelvey&Zavoina's R2	0.999	
Count R2	0.805	
linear hypotheses tests in model specification ($chi^2(x)$)		
H_0: farm characteristics have no significant effect ($chi^2(6)$)		16.76*** (rejected)
H_0: collaboration related regressors have no significant effect ($chi^2(7)$)		14.05*** (rejected)
H_0: herd characteristics have no significant effect ($chi^2(4)$)		41.61*** (rejected)

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

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

Table 6: Estimates Bootstrapped ME REML Regression (Stage 2) – Armenia

Milk Price in 2006		
(n = 252)	coefficient[1]	bootstrapped bias-corrected se[2]
fixed effects		
past milk price		
milk price 2005	0.701***	0.089
size of operation		
number of milking cows	4.49e-05***	1.07e-05
milk selling characteristics		
number of potential commercial buyers	0.007***	8.81e-04
% of milk output sold on contract	0.039**	0.015
% of milk output sold through marketing cooperative	8.76e-05***	4.78e-05
milk sold via collecting station	-0.049**	0.022
trust in seller		
trust (Likert scale based)	0.023*	0.010
trust x % of milk output sold on contract	0.003**	0.001
trust x milk price 2005	0.181***	0.006
probability of sample selection		
inverse Mill's ratio	0.004**	0.002
constant	0.187***	0.008
random effects		
trust		
standard deviation (contract)	0.006***	0.001
standard deviation (% of milk output sold through marketing cooperative)	3.36e-05*	1.46e-05
standard deviation (milk sold via collecting station)	0.047***	0.018
standard deviation (constant)	0.033***	0.015
LR test vs. linear regression (chi2(5))	49.05***	
Log-restricted Likelihood	1017.288	
Wald chi2(10)	2017.09***	
linear hypotheses tests on model specification (chi^2(x))		
H_0: previous price has no significant effect (chi^2(2))	1102.13*** (rejected)	
H_0: selling characteristics have no significant effect (chi^2(4))	38.76*** (rejected)	
H_0: trust related regressors have no significant effect (chi^2(3))	16.22*** (rejected)	
H_0: cooperation characteristics have no significant effect (chi^2(2))	9.54*** (rejected)	

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

2: Bootstrapped and bias-corrected standard errors (based on 10.000 bootstrap replications).

Table 7: Estimates Bootstrapped ME REML Regression (Stage 2) – Moldova

Milk Price in 2006		
(n = 265)	coefficient[1]	bootstrapped bias-corrected se[2]
fixed effects		
past milk price		
milk price 2005	0.814***	0.027
size of operation		
number of milking cows	5.85e-05***	1.14e-05
milk selling characteristics		
number of potential commercial buyers	0.002***	7.63e-04
% of milk output sold on contract	0.025*	0.014
% of milk output sold through marketing cooperative	-5.91e-04	5.14e-04
milk sold via collecting station	0.011**	0.004
trust in seller		
trust (Likert scale based)	0.033***	0.005
trust x % of milk output sold on contract	0.087***	0.025
trust x milk price 2005	0.211***	0.008
probability of sample selection		
inverse Mill's ratio	0.016**	0.008
constant	0.156***	0.009
random effects		
trust		
standard deviation (contract)	0.008***	0.004
standard deviation (% of milk output sold through marketing cooperative)	8.02e-04***	3.48e-04
standard deviation (milk sold via collecting station)	0.006*	0.004
standard deviation (constant)	0.004	0.003
LR test vs. linear regression (chi2(5))	63.00***	
Log-restricted Likelihood	1370.092	
Wald chi2(10)	769.60***	
linear hypotheses tests on model specification ($chi^2(x)$)		
H_0: previous price has no significant effect ($chi^2(2)$)	1094.13*** (rejected)	
H_0: selling characteristics have no significant effect ($chi^2(4)$)	40.01** (rejected)	
H_0: trust related regressors have no significant effect ($chi^2(3)$)	658.31*** (rejected)	
H_0: cooperation characteristics have no significant effect ($chi^2(2)$)	13.31*** (rejected)	

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

2: Bootstrapped and bias-corrected standard errors (based on 10.000 bootstrap replications).

Table 8: Estimates Bootstrapped ME REML Regression (Stage 2) – Ukraine

Milk Price in 2006		
(n = 250)	coefficient[1]	bootstrapped bias-corrected se[2]
fixed effects		
past milk price		
milk price 2005	0.983***	0.021
size of operation		
number of milking cows	7.27e-05	8.55e-05
milk selling characteristics		
number of potential commercial buyers	0.005***	9.70e-04
% of milk output sold on contract	0.019**	0.008
% of milk output sold through marketing cooperative	8.15e-05*	4.65e-05
milk sold via collecting station	-0.058***	0.018
trust in seller		
trust (Likert scale based)	0.033***	0.005
trust x % of milk output sold on contract	0.008*	0.004
trust x milk price 2005	0.234***	0.007
probability of sample selection		
inverse Mill's ratio	0.016**	0.008
constant	0.158***	0.018
random effects		
trust		
standard deviation (contract)	0.012**	0.005
standard deviation (% of milk output sold through marketing cooperative)	3.46e-04***	1.24e-04
standard deviation (milk sold via collecting station)	0.022***	0.007
standard deviation (constant)	0.019***	0.006
LR test vs. linear regression (chi2(5))	64.30***	
Log-restricted Likelihood	1174.888	
Wald chi2(10)	1258.05***	
linear hypotheses tests on model specification (chi^2(x))		
H_0: previous price has no significant effect (chi^2(2))	2259.63*** (rejected)	
H_0: selling characteristics have no significant effect (chi^2(4))	16.96*** (rejected)	
H_0: trust related regressors have no significant effect (chi^2(3))	52.51*** (rejected)	
H_0: cooperation characteristics have no significant effect (chi^2(2))	11.36*** (rejected)	

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

2: Bootstrapped and bias-corrected standard errors (based on 10.000 bootstrap replications).

Appendix 1: Description of Variables and Summary Statistics

Variables	Description	Mean	Minimum	Maximum
Dependent				
Marketing Channel Decision	1 = sell only to commercial buyer, 0= sell to final consumers as well	85.2% sell only to commercial buyer		
Milk price	Average milk price received per litre, Euros (only commercial buyers)	0.175	0.05	0.43
Independent				
Total land owned	Measured in hectares (ha)	74.2	0	14000
Total land rented	ha	87.1	0	8300
Pasture land used	Owned or rented, ha	7.7	0	450
Common pasture land used	ha	45.0	0	6140
Full-time employees	Number of full time employees	3.6	0	319
Part-time employees	Number of part-time employees	1.5	0	87
Technical assistance	Received technical assistance = 1, not receive = 0	0.29	0	1
Marketing of raw milk	Collaborate with other farmers = 1, 0 if not	0.23	0	1
Processing of milk	Collaborate with other farmers = 1, 0 if not	0.02	0	1
Marketing of processing milk	Collaborate with other farmers = 1, 0 if not	0.09	0	1
Lobbying	Collaborate with other farmers = 1, 0 if not	0.03	0	1
Milk storage	Collaborate with other farmers = 1, 0 if not	0.17	0	1
Average yield per cow	Average number of litres per cow, per day	11.5	2	32
Number of potential commercial buyers	Estimated number of potential commercial buyers for farmers' milk	2.3	1	20
% of milk sold on contract	% of milk sold on contract, those selling to commercial buyers only	29.4	0	100
% of milk sold via marketing cooperative	% of milk sold via marketing cooperative, those selling to commercial buyers only	43.8	0	100
Milk sold via collecting station	1 = milk sold via collecting station, 0 if not	0.42	0	1
Trust	5 point Likert scale – 'my main buyer keeps the promises it makes us' 1 =strongly disagree, 5 = strongly agree	3.7	1	5