Research Proposal on Measuring Oligopsony Power in Mexico's Raw Milk Industry

1 Academic Bases and Significance

Milk plays a fundamental social and economic role in Mexico and is becoming an increasingly important focus of foreign and domestic agricultural policy. Milk is one of the most important products of the family shopping basket, a main source of animal protein, and a strong contributor to the economy (Carranza-Trinidad et al, 2007). Since 2004, annual milk production is approximately 10,000 million liters, and contributes about 6.3% of investments and 8.6% of employment in the entire food industry (Alvarez, 2004). However, national production of fluid milk does not satisfy domestic demand, making Mexico one of the world's largest importers of dry and powdered milk[1] (Lara-Covarrubias et al, 2003).

The goals of this research project are to (i) empirically test whether local raw milk markets are competitive in Mexico and (ii) determine factors that are associated with competitive and non-competitive market outcomes. Our first goal will be achieved by estimating the market power of milk processors' in each state using traditional and conventional techniques. Our second goal will be accomplished by analyzing how these estimates vary across states and over time, which will allow us to determine whether certain factors (such as seasonality, average processor size, cost of transportation, and/or local farm production technologies) are associated with high levels of market power. By estimating local market power and determining influencing factors, this project represents a necessary first step in a larger research agenda that investigates optimal policy instrumentation for the raw milk industry.

[1]Total imports of fluid milk are an insignificant component of total consumption (less than 1 percent) as opportunities for sales beyond the northern border cities are limited by the high cost of transportation (Nawn and Trejo, 2007).

1.1 Why Mexico?

The undertaking of this project is important given the emergence of evidence suggesting that Mexican raw milk producers could be suffering from anticompetitive pricing behavior on the part of local processors. During the nineties, big transnational corporations entered the Mexican milk sector and the milk price was liberalized. Three firms (Lala, Alpura, and Parmalat) have steadily increased their grip on the industry and currently control 75% of milk distribution[2] (Alvarez, 2004). Additionally, in October 2000, the price of pasteurized milk rose nationwide with an increase ranging between 6.7 to 7.3 percent depending on the brand. The Federal Competition Commission deemed the potential existence of horizontal anticompetitive practices in the production, distribution and trading of industrialized milk. An ex officio investigation was initiated regarding presumed horizontal anticompetitive practices, concerning a collusion among economic agents participating in the processed milk market to fix sale prices (OECD, 2008).

Determining the existence of market power in state-level Mexican raw milk markets warrants further understanding of the underlying causes of this anticompetitive behavior. Two possible factors that may be correlated with the existence of and use of market power. First, there is a large amount of intra-annual variation of production across months and this seasonality persists over time (Gallardo et al, 2005). Second, the regional characteristics of milk production systems are not homogeneous, as evidenced in several important ways including production, delivery to the processor, and capacity of the processing firm (Losada et al, 2001). These spatial and temporal heterogeneities will be embraced in our empirical analysis and present a rich area for exploration into the cause of (and possible solutions to) the exploitation of market power.

This evidence, combined with the fact that market power is a traditional source of anticompetitive pricing in raw agricultural commodity markets (discussed below), suggests that

[2]The same study finds similar evidence exists in other dairy sectors as three firms (Danone, Nestle and Sigma) control 80% of yogurt distribution and six firms (La Esmeralda, Nestle, Noche Buena, Chalet, Caperucita y Volcanes) control 70% of cheese distribution.

empirical work aimed at identifying the competitive structure of the Mexican raw milk industry is warranted. Indeed, Lara-Covarrubias et al (2003) notes that, due to free trade and non governmental intervention in markets, it is necessary to know the competitiveness and comparative advantages of milk production systems, as well as the effects that sectorial and macroeconomic policies have on these systems, in order to place development perspectives of this activity under the new conditions.

1.2 Why Market Power?

Research on market power is an important tool for policy makers. It provides evidence that can be used to improve local and regional regulatory standards, and formulate effective antitrust and merger laws. It is often used in court cases, and presumably will be increasingly employed in the future.

The justification of markets being able to provide a socially optimal allocation of resources is based on the assumption that firms consider the prices they face as given. Situations in which firms can manipulate prices create market distortions that generate welfare losses and affect other agents interacting in the markets. In the case of the milk industry, these distortions will affect the economic activities of the raw milk producers, culminating in a direct impact on labor and wages in one of the most important sectors in the Mexican economy.

Recent contributions in the field of agricultural economics suggest that food processing sectors generally have significantly greater size economies than the farm sector; hence, the number of buyers (the processing firms) is small relative to the number of sellers (the farmers). If the buyers in a market are able to manipulate the price received by the sellers, then they are flexing a type of market power called oligopsony power. This type of market power is a concern in food product industries since raw agricultural products are often perishable, bulky, and costly to transport. These characteristics often inhibit competition, with typical consequences including lower prices and profits for farmers as well as deadweight welfare

losses for society. (Durham and Sexton, 1992; Huck et al, 2006).

Academic research and government policy has begun to focus on identifying and punishing firms that are engaging in this anticompetitive behavior. The presence of oligopsony power in tomato and meat processing industries is well documented (Pritchett and Liu, 1999; Koontz and Garcia, 1997; Durham and Sexton, 1992). More generally, a study by Rogers and Sexton (1994) found evidence of buyer power in more than 50 food processing industries in the United States. In the milk industry, evidence of oligopsonistic power is region/country specific. Tiffin (2006) finds no evidence of market power in the U.K. milk market, while Alvarez et al (2000) and Huck et al (2006) find evidence of oligopsonistic power in the milk processing industries of Spain and Germany, respectively. Additionally, the South African federal Competition Commission initiated an investigation into anticompetitive behavior in the milk industry in February 2005 and found evidence of price fixing for raw and retail milk (FLEXNEWS, 2008).

2 Methodology

The previous section described why the identification of market power is important for the Mexican raw milk industry. However, establishing credible evidence of its existence requires empirical support. Many techniques have been developed to estimate the degree of market power (Perloff et al., 2007). Our identification strategy uses the insight that, if an industry for a homogenous good has competitive prices, then the price processors pay producers for raw milk should equal the marginal benefit they obtain from processing and selling the milk. If we were able to observe a processor's marginal value of raw milk, we could directly determine whether that firm is able to set price below marginal benefit (i.e., flex market power). Unfortunately, we usually observe only price and factors that are associated with some costs and benefits to the firms; we do not have explicit information on both costs and benefits.

The proposed approach to overcoming this problem is to infer market power from the firm's observed behavior using a structural model. This approach has two key advantages. It provides a direct way to estimate market power, and the estimated model can be used to simulate the effects of changes in the market, which can be used for future work relating to public policy impact assessments (discussed below). The main disadvantage of the structural approach is that the results depend on a variety of assumptions concerning functional form, distributions, and other facts that are not generally known to the econometrician. Therefore, several robustness checks for the model that utilize recent technical advances (e.g., the nonparametric estimator in Raper and Love, 1997) may be included in the analysis.

2.1 Modelling Strategy

The objective of this presentation is to describe the main characteristics of the approach and to emphasize the data requirements necessary to estimate the model. In practice this model will be modified to better capture the details of the industry.

Assume that a representative firm maximizes profit received from processing and selling milk. Define the price the firm receives for y units of processed milk by p_y and the effective cost it pays to acquire x units of raw milk by $p_x^d = w(x)$.[3] The firm's ability to transform x units of raw milk into processed milk is given by the function $y = f(x; \mathbf{Z}_y)$, where the vector $\mathbf{Z}_y$ contains other factors needed for production (such as labor and capital). The firm's optimization problem is represented by

$$\max_x \Pi(x) = p_y f(x; \mathbf{Z}_y) - w(x)x, \tag{1}$$

which implies the necessary first order condition

$$p_y f_x(x; Z_y) - p_x^d - x w_x(x) = 0 \tag{2}$$

[3]In absence of market power this cost will be constant across x, but if the firm has market power then this expression will be an explicit function of x. We will discuss how the identification of this function allows us to measure the existence of market power.

where subscripts on functions denote derivatives. The first term on the left defines the marginal benefit obtained from processing and selling an additional unit of raw milk and the next two terms define the processor's effective marginal cost of acquiring an additional unit of raw milk. The first order condition then implies that a processor will continue to demand raw milk until marginal benefit equals effective marginal cost.

The supply side of the raw milk industry, determined by the behavior of raw milk producers, is assumed to be competitive and the market supply function is given by

$$p_x^s = s(X; Z_x), \tag{3}$$

where X represents the total quantity of milk sold in the market and the vector Z_x reflects other factors that affect the price of raw milk.

These concepts allow us to introduce a testable measure of market power. To test this measure, we determine if the firm considers the effect its decisions have on market price. The key insight is that if the market is competitive and the firms cannot affect price, then $w_x(x) = 0$; however, if the firm considers the effect its decisions have on price then $w_x(x) > 0$. A convenient way of nesting these mutually exclusive possibilities is by introducing a parameter λ, and expressing the firm's effect on equilibrium price by

$$w_x(x) = \lambda s_x(X; Z_x). \tag{4}$$

This procedure allows us to express the optimality condition (2) as

$$p_y f_x(x; Z_y) - p_x^d - \lambda s_x(x; Z_x)x = 0, \tag{5}$$

which nests different market structures through the market power parameter λ. In particular, if the market is competitive and the firm cannot influence price then $\lambda = 0$, but if the firm is a monopsony or the industry is characterized by a cartel under perfect collusion then $\lambda = 1$.

Intermediate values between $\lambda = 0$ and $\lambda = 1$ represent a market less competitive than perfect competition but more competitive than a perfect monopsony; this outcome would suggest the presence of market power in the form of an oligopsony.

The parameter λ has been given different interpretations in the literature. One of them has been that of a *conjectural variation* representing the way firms think competitors will react to their decisions. This interpretation has been widely criticized in the economic literature. Therefore, we interpret λ as a nesting behavioral parameter that allows us to identify if firms take into account their effect on price when making decisions.

This simple static framework presented here does not take into account whether firms form strategic pricing schemes that dynamically evolve over time. The proposed model can be extended to a dynamic model, but at a cost; the information requirements and the econometric techniques necessary to identify market power increase. During the execution of this proposal we will explore different models, both static and dynamic, to represent in the best possible way the particular characteristics of the Mexican milk industry.

2.2 Identification and Estimation of the Model

In this subsection we present an example of the identification and estimation of the nesting parameter λ under particular functional forms for the production and supply functions.

Let the production function of the milk processor be Cobb-Douglas

$$y = f(x, L, K, \varepsilon_y) = Ax^{\alpha} L^{\beta} K^{\gamma} e^{\varepsilon_y}, \tag{6}$$

where L is labor, K is capital, and ε_y is a mean zero random variable. Additionally, let the raw milk supply function be log-linear

$$\ln p_x^s = \delta_0 + (\delta_1 + \delta_2 Z) \ln x + \varepsilon_s \tag{7}$$

where Z is a variable that moves the slope of the supply function. Under these functional

forms the optimality conditions for raw milk, labor, and capital are

$$p_y f_x(x, L, K, \varepsilon_y) - p_x^d - \lambda s_x(x; Z_x)x = 0 \tag{8}$$

$$p_y f_L(x, L, K, \varepsilon_y) - w = 0 \tag{9}$$

$$p_y f_K(x, L, K, \varepsilon_y) - r = 0 \tag{10}$$

where w and r represent the unitary cost of labor and capital.

The goal is to identify the parameters of the production function, the supply function, and the market power parameter λ by estimating jointly the equations (6)-(10). There are several econometric methods that can be used for this task. One of them is to solve equations (6), (9) and (10) for y, L and K and then replace these variables in equation (8). This approach yields following demand equation for raw milk:

$$\ln p_x^d = \theta_0 + \theta_1 \ln p_y + \theta_2 \ln w + \theta_3 \ln r + \theta_4 \ln x - \ln(\theta_5 + \theta_6 Z) + \varepsilon_d \tag{11}$$

where

$$\theta_0 = \ln \alpha + \frac{1}{1-\beta-\gamma}\left(\ln A - \beta \ln \beta - \gamma \ln\right), \theta_1 = \frac{1}{1-\beta-\gamma}$$
$$\theta_2 = -\frac{\beta}{1-\beta-\gamma}, \theta_3 = -\frac{\gamma}{1-\beta-\gamma}, \theta_4 = -\frac{1-\alpha-\beta-\gamma}{1-\beta-\gamma}$$
$$\theta_5 = 1 + \lambda\delta_1, \theta_6 = \delta_2, \text{ and } \varepsilon_d = \frac{1}{1-\beta-\gamma}\varepsilon_Q.$$

The system of demand and supply equations given by (11) and (7) can then be estimated together. Notice that the demand equation is linear in the parameters $\theta_0 - \theta_4$ and that all the parameters of the production function can be identified from them. However, the demand equation is non-linear in Z, the determinants of the supply slope, which makes it impossible to estimate this system using traditional ordinary least squares estimators. Thus, we will

estimate the supply and demand equations using more general methods like non-linear least squares or the generalized method of moments. In addition, we will consider alternative Bayesian and maximum entropy estimators.

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Research Proposal on Measuring Oligopsony Power Budget

ITEM	AMOUNT	COMMENTS
Research Assistant Salaries	$13,050	2 students at $725/month for 9 months
Research Assistant Benefits	$260	UC required benefits
Supplies and Expenses	$190	Occasional payment for research assitance
Travel	$1,500	3 plane tickets to Mexico City