Milking the milkers: a study on buyer power in the dairy market of Peru

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Abstract

The literature on imperfect competition suggests two conditions facilitating the exercise of buyer market power: the existence of an inelastic and upward-sloping supply, and the existence of high concentration in purchases. In this study, we use monthly aggregate data (from 1999-2014) of the raw milk market in Peru. We test whether those conditions hold, by analyzing the market and estimating the supply elasticity. The results suggests the existence of buyer power in raw milk market since an inelastic raw milk supply and a highly concentrated market is verified. Our assessment is reinforced with the role played by the existing market power of the firms at the downstream segment and the existence of entry barriers to that market segment.

Keywords: Buyer Power, Monopsony, Monempory, Dairy Industry, Milk Supply, Milk Demand, Raw Milk, Evaporated Milk, Upstream Market, Downstream Market

JEL Codes: L11, L12, L13, L41, L42

1 Introduction

Buyer power (monopsony in the extreme case) is present in intermediary markets where there is a concentrated final producer market and a competitive supplier market. Monopsonies can lead to bigger welfare losses when the monopsonist also enjoys monopoly power in the downstream market; the literature has defined these situations as monempories. Following the economic theory behind monopsonies and monemporists, we analyze the Peruvian dairy market and estimate the supply of raw milk to test whether the raw milk market has the conditions for buyer power to arise - market power and an inelastic convex supply.

The results indicate that there exist buyer power from the concentrated firms, which would be exacerbated by the market power they have in the downstream market: the market structure would be closer to an oligoempory one. From the estimates, we find the supply to be very inelastic and upward sloping (it has strictly convex costs). These results may provide empirical support for the use of antitrust policies against abusive practices such as exploitative pricing; although we consider these results as part of larger research agenda that we need to build to

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improve our understanding how markets work in Peru.
In general, imperfect competition literature has analyzed buyer market power as a topic of increasing interest, mainly due to the increasing concentration in the retail sector (such as groceries) in the last two decades, as well as in the manufacturing and food markets. We focus in the dairy industry, which is relevant not only for its impact in economic production, but also for its importance as a basic component of households' consumption basket. Particularly, we focus on the Peruvian dairy market, where a dual market power exist and which have been worsening social welfare due to reduced supplied quantities of industrial milk at high prices. In fact, Peru's per capita milk consumption (65 kg) ranks far below the minimum (120kg) recommended by the Food and Agriculture Organization of the United Nations (FAO), which indicates an important gap for market expansion.[1]

Prices have shown very steady behavior in the long run and above $1.2 per liter, which exceeds the average $0.92 per liter that Americans pay. [2] [3] Only one firm collects around 80% of the national raw milk production sold to the dairy industry, this firm also has more than 80% of dairy products' market share, more particularly in the leading product of evaporated milk. In November of 2007 the Peruvian Milk Farmers Association (AGALEP due to its Spanish name) and the National Fund of Dairy Farming (FONGAL Lima) brought an antitrust case against Gloria S.A. – the largest dairy company in the industry– to the Peruvian Competition Authority for abuse of its dominant position. Even though the case was dismissed by the Free Competition Commission, the discussion about abusive pricing and its effects on economic social welfare continued. Indeed, the fact that the Peruvian dairy industry has been heavily concentrated in only three firms for a long time, and that they mostly collect raw milk in separate geographical regions, where they face atomistic suppliers, sparked discussions about the exercise of buyer power in this sector. [4]

The following section reviews the relevant literature on buyer power. Section 3 reviews the main theoretical framework related to monopsonies and monempories, with special focus in the latter that is predicted to be significantly detrimental for social welfare. A brief description of the Peruvian dairy market, focusing on the characteristics that may explain the presence or lack of buyer power is presented in section 4. The methodology and data are described and the estimation results are presented in the following section 5. The main findings and conclusions are given in the last section.

2 Literature Review

Buyer power has caught attention of researchers and competition authorities, particularly in Europe due to the increasing concentration of distribution and retailing markets, and also in

[1] The per capita milk consumption in 2012 in Chile was 146 kg; in Brazil, 161 kg; and in Argentina, 205 kg; according to the National Institute of Statistics of Chile and the FAO.

[2] This calculation is made with the price of evaporated milk per an equivalent liter of whole milk (at October 2013, the price of an equivalent liter was approx. 3.43 PEN, which is about $ 1.29 (price obtained from the National Institute of Information and Statistics of Peru).

[3] Calculation made once we converted the price of a gallon of whole milk (3.5 litters approx.) that reached 3.499 dollars by October of 2013; this gave me around $ 0.92 (price obtained at `http://future.aae.wisc.edu/data/monthly_values/by_area/301?area=US`, accessed on November, 2013).

[4] In 2008, the Free Competition Commission refused the motives of the lawsuit. According to their decision, the alleged misbehavior would be related to exploitative prices (excessively low prices), a practice that is not condemned by the current Peruvian Competition Law. In 2011, the Competition Tribunal confirmed the previous decision of the Competition Commission. The investigation report concluded that such phenomena would exist due to the atomistic raw milk production, inefficient production and low bargaining power of the suppliers.

manufacturing and food production sector, where firms increased in size organically and also through horizontal mergers. Although, it can be argued that concentration in sectors related to agricultural products relies on efficiency gains due to the existence of economies of scale and scope (Dobson et al., 1998, 2001), it is also true that in certain cases, the combined buyer and seller power of firms call into question its effect on economic welfare.

The existence of buyer power has been applied to case studies generally focused on the retail sector. The dairy industry has been included in some analyses Rozanski and Thompson (2011), but not in detail. The various analysis and studies are developed through either a theoretical approach (Inderst and Wey, 2007; Chambolle and Villas-Boas, 2008) or an empirical and applied work (Dobson, 2005; Bonnet and Dubois, 2010; Rozanski and Thompson, 2011) with the purpose of explaining and finding conditions that allow buyer power to arise and its consequences on social welfare.

From a descriptive approach, (Noll, 2005) analyzes the implications of buyer power in economic policy. He defends symmetric antitrust treatment of practices exercised due to market power, either from a monopoly or a monopsony since both lead to economic welfare losses. Actually, a more favorable treatment of monopsonies (and oligopsonies) wrongly assumes that lower input prices (as a result of buyer power at the upstream market) are passed on as lower output prices (downstream market), which could finally benefit consumers. In reality, however, output prices are expected to go up (Dobson et al., 2001; Noll, 2005). Even in the cases where lower output prices might happen, Noll (2005) affirms that the input sellers' losses would be greater than consumers' gain in the downstream segment.

Bilateral bargaining models are often used to analyze markets (Chipty and Snyder, 1999; Inderst and Wey, 2003, 2007; Rozanski and Thompson, 2011). Inderst and Wey (2003) find that downstream mergers are more likely to happen when there is an increasing unit cost of upstream firms, whereas upstream mergers would be more likely to happen when downstream firms' products are substitutes. The structure of the downstream market influences the technology choice of upstream firms, so downstream firms would strategically merge to induce supplier to choose more efficient technology.

In a later study, Inderst and Wey (2007) present a theoretical model to explain the origin of buyer power where the sole determinant is the number of buyers. They associate the existence of bargaining power to the shape of the cost function for suppliers and capacity availability. The authors show that the presence of constrained capacity and strictly increasing convex costs to suppliers plus concave revenue of downstream firms are sufficient conditions for buyer power to arise and be sustained. The main result of this study – unlike Noll (2005) and Dobson (2005) –is that buyer power would increase the suppliers' incentive to innovate product or processes due to the weight suppliers give to reduced incremental costs (Inderst and Wey, 2007; Inderst and Mazzarotto, 2008). Notwithstanding, it is also stated that welfare can be adversely affected when suppliers innovate products instead of processes, mainly because of the existence of inefficiently high incentives to innovate.

Chipty and Snyder (1999) study buyer merger effect using a bilateral bargaining model between a supplier and various buyers; they allow buyer size to be endogenously determined before negotiations start. Buyers' bargaining position is improved as long as the supplier's surplus function is concave, which implies a convex cost function. In the particular case of Cable TV market, they conclude that due to the concavity of program supplier' cost, mergers follow efficiency reasons instead of any attempt to improve their bargaining position.

Not only is an upward sloping supply required for buyer power to be exercised, but also buyers should account for an important portion of purchases, and entry barriers to buyer market should be present to have more inelastic supply. Inelastic supply relates to low levels of substitutability of buyers and few or no possibility of asset usage for alternative outputs (Dobson et al., 1998; Rozanski and Thompson, 2011). Following a game theoretical model applied to the retailing sector, Chambolle and Villas-Boas (2008) show upstream differentiation practices may be another source of retailers' buyer power. When producers or suppliers differentiate products based on quality, retailers may tend to trade with low-quality goods producers in order to keep bargaining power when they negotiate. This result leads to welfare loss since consumers face higher prices and lower quality products.

Empirical studies on retailing and agricultural markets are given by Dobson (2005), Bonnet and Dubois (2010) and Rozanski and Thompson (2011). Concerned about the high concentration in the grocery retailing market in the UK, Dobson (2005) analyzes that sector and argues that buyer power position is strengthened by the exploitation of retailers' three roles: as consumers (retailing activity), as competitors (against retailers' own-label products) and as suppliers (of shelf-space); the latter would reinforce retailers' bargaining position when trading with suppliers. On the other hand, Dobson (2005) finds that the high level of consumer loyalty and habit formation on one-stop-shopping practices in the UK are the main factors that explain the advantageous purchasing position of UK retailers in comparison to their foreign counterparts. He warns about the adverse effect of buyer power on upstream markets, distorting supplier and retailer competition. In particular, this would be basically related to the erosion of investment incentives in suppliers, and moreover to the consequent breakdown of many small suppliers that would be forced to exit the market, implying an overall damage to economic welfare.

In agricultural markets, any factor that reduces the outside-of-agreement payoff ("outside option") of suppliers and/or increases those of buyers', makes suppliers worse off (Snyder, 2005; Inderst and Mazzarotto, 2008; Rozanski and Thompson, 2011). According to Snyder (1996), mergers of large buyers in the downstream segment increases profits of all the buyers at expenses of sellers. Rozanski and Thompson (2011) also highlight the supply inelasticity as a key factor for buyer power exercise. Although many agricultural markets appear to have characteristic conditions for exercising buyer power, in evaluating sectors such as poultry, cattle, dairy and grains, the authors find no conclusive evidence of the effect of buyer power on farm income. They find an increasing spread between farm-to-retail price, which might not be necessarily associated to buyer power exercise, but would be associated to increasing non-farm cost (further processes and distribution costs) instead.

The size of the effect of buyer power on social welfare depends on the existing relationship between buyer power in upstream market, but also on the existence of seller power in the downstream market (Dobson et al., 1998, 2001). In cases where both powers are exerted by one firm, the agent with dual power is identified as a "monemporist" (Nichol, 1943). Thus, although some markets may allow natural monopsonies (such as milk and some agricultural markets), the final welfare effect is influenced by the presence of downstream competition in the final product. The presence of monemporists (or oligoemporists) would lead to important welfare losses, damaging not only consumers but also the long-term viability of upstream markets and therefore the market dynamic due to distortions on the commitment of future investment or the innovation of product or processes (Dobson et al., 1998, 2001). By examining the food sector in four European countries, Dobson et al. (2001) find significant market

concentration in the sector and also evidence of discounts received by large buyers or retailers.

Although many researchers agree in the negative welfare impact of buyer power, there is not a consensus. A relevant aspect that should be noticed is that most of the empirical studies have been applied to markets in developed countries, where market concentration has been consolidated. The characteristics of agricultural markets seem to justify the presence of concentrated downstream markets based on efficiency gains. In order to find if current market structure in less developed countries relies on efficiency gains and whether the presence of oligopsonies (or oligoemporists) are not detrimental of social welfare, this paper examines the Peruvian Dairy Industry case under the analysis of buyer power.

3 Theoretical framework: Buyer power economics

Monopsony is a situation where market power is exerted by one buyer over its sellers or suppliers. This situation can be seen in intermediate or input markets, where many suppliers compete to sell their product to one buyer. When there are a few buyers this situation becomes an oligopsony. The buyers hold an important market power and therefore pay lower for the inputs than under competition.

The analysis of monopsony is totally analogous to the monopoly case. The equilibrium is given when the marginal factor cost (MFC) meets the derived demand (which equals to the Value Marginal Product of factor). However, things turn out to be interesting when the monopsonist also has seller power in the downstream market. In such cases, the literature refers to a monempory. Particularly in upstream markets, factor suppliers may have jeopardized their long term viability. From the consumer side, the impact may be ambiguous in terms of price, but clearly they would be affected by the smaller quantity supplied.

Assuming an output $y = f(x)$, a monemporist's profit maximization problem is set as the following:

$$max_x \ \pi(x) = p(f(x)) \ f(x) - w(x)x$$

Where $f(x)$ is the production function of the final good, and $w(x)$ is the inverse supply curve of the factor or input x (intermediate good). Then, from the first order conditions we have the following:

$$\frac{\partial p(f(x))f(x)}{\partial x} = w(x) + x\frac{\partial w(x)}{\partial x}$$

$$p(f(x))f'(x) + f(x)p'(f(x))f'(x) = w(x) + w'(x)x$$

$$[p(y) + yp'(y)]f'(x) = w(x) + w'(x)x \tag{1}$$

$$MR_y MP_x = w(x) + w'(x)x \tag{2}$$

Therefore, the equilibrium price is reached when the Marginal Revenue Product MRP (the product of the marginal revenue of output and the marginal product of the factor in the left hand side of the last equation) equals the Marginal Factor Cost MFC (the right hand side of equation 2). The monempory equilibrium quantity and price (x_{MM}, p_{MM}) lies below the monopsony's case (x_M, p_M), as shown in Figure 1.[5]

[5] In the case where the buyer is price-taker in the downstream market, as happens in the simple monopsonist case, the MRP is just the Value of the Marginal Product of the factor, pMP_x, which also equals the derived demand.

From this equilibrium, it is also possible to get the relationship between mark-up and the elasticity of supply curve of the input (ϵ_s):

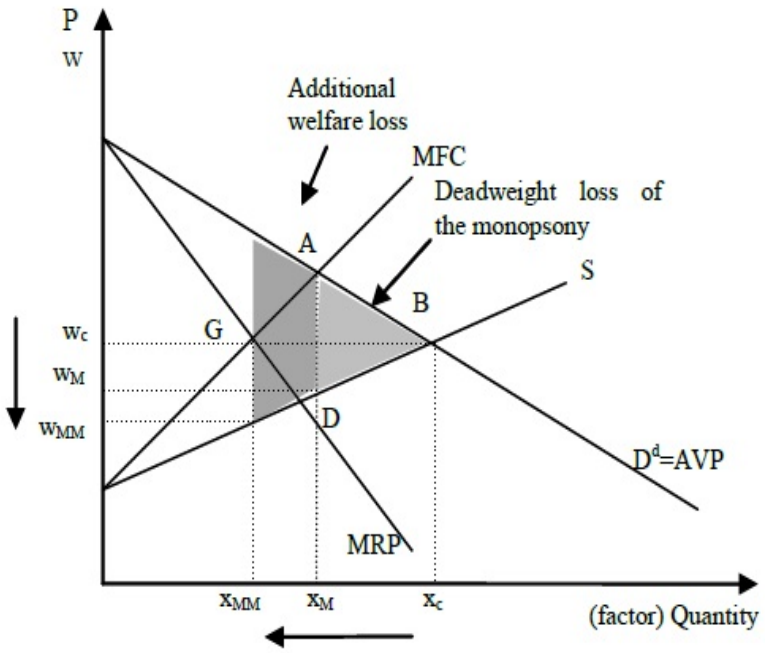
$$MRP_x = w(x)(1 + \frac{1}{\epsilon_s})$$

$$\frac{MRP_x - w(x)}{w(x)} = \frac{1}{\epsilon_s} \tag{3}$$

Reordering the equation, we can also get the following:

$$p(y)f'(x)[1 + \frac{1}{\epsilon_{d_y}}] = w(x)[1 + \frac{1}{\epsilon_{s_x}}] \tag{4}$$

Equation 3 shows that there is inverse relationship between the mark up and the supply elasticity: the more inelastic is the supply, the higher the mark-up received by the monempory and larger the distance from the competitive prices. Equation 4 shows the marginal revenue product increases with the inelasticity of demand of the final product. Thus, a monemporist will also increase its mark-up when the output demand is more inelastic. For instance, monemporists causes greater welfare loss.



Note: D^drefers to a derived demand of inputs, which equals to the average value product of factor AVP in this case. Competitive equilibrium is signalled by x_c and w_c. Likewise, x_M and w_M show the monoposonist equilibrium points, and x_{MM} and w_{MM} the monemporist equilibrium outcomes.

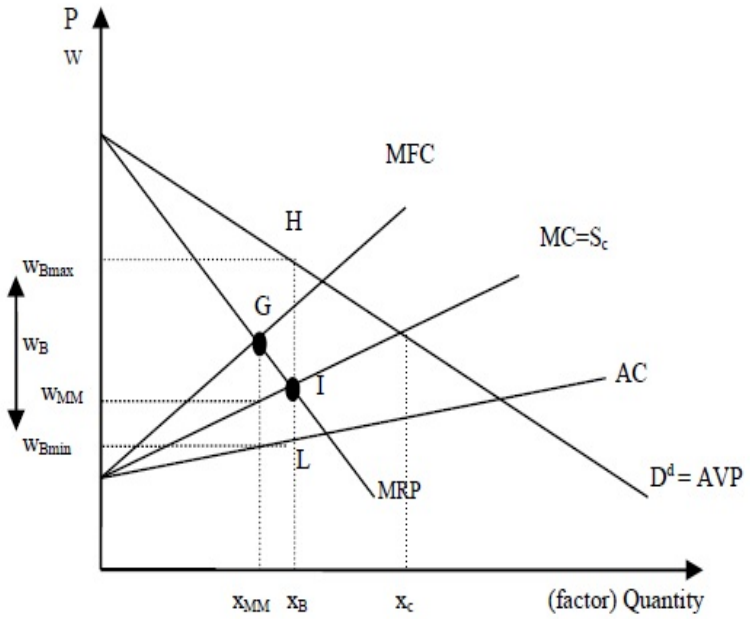
Source: Taken from Dobson et al. (2001).

Figure 1: Welfare loss in monemporist case

Figure 1 graphically shows the monemporist and monopsonist situation in an intermediate good market. The shaded area ABD represents the monopsony's welfare loss, while the darker shaded trapezoid area is the additional welfare loss due to the monopoly power of

the monopsonist in the downstream market. Monempories have higher detrimental effect of social welfare.[6] In upstream markets, factor suppliers may have jeopardized their long term viability. In downstream markets, and from the consumer side, the impact may be ambiguous in terms of price, but clearly they would be affected by the smaller quantity supplied.

The sole existence of buyer power in a market may not be necessarily negative. Collective purchases from groups or alliances may result in efficiency gains from organizational economics, improved coordination, reduced transaction costs of negotiations (administrative costs), as long as buyers compete each other in the downstream market. However, if entry barriers exist in the downstream market, then buyer power may intensify the concentration process leading towards seller power. Occasionally, buyer power may arise from economies of scale; where the presence of network economies — in input collection activities for example — leads one or few buyers to be the most efficient structure. This may be particularly true in agricultural markets(Dobson et al., 1998, 2001).



Note: AC is the average cost, and AVP, the average value product of factor. (x_B, w_B) in point I indicates the bilateral monopoly equilibrium, while (x_{MM}, w_{MM}) in point G gives the monemporist equilibrium.

Source: Taken from Dobson et al. (2001).

Figure 2: Monopemporist vs Bilateral Monopoly

From a different viewpoint, monopsony can be thought as an effective response to seller

[6]Buyer power facing powerless suppliers (competitive market) may compromise the long run viability of the upstream market and therefore for society; furthermore the variety and quality of input may be jeopardized due to less investment incentives of suppliers to innovate (Smith and Thanassoulis, 2009). According to Inderst and Wey (2007), the incentives to innovate may not be reduced, but enhanced in order to reduce incremental costs and being able to sell larger quantities to buyers. In this scenario welfare is improved only if processes, rather than products, are innovated. However, this may not be applicable for upstream markets of raw materials with atomistic suppliers (such as farmers) that face several constraints and where switching to more efficient processes may be highly difficult or even less feasible relative to their size.

power, therefore, buyer power arises as a countervailing force; thus we would have a bilateral monopoly (monopolist supplier vs. monopsonist buyer). Under this scenario, and assuming that the seller cannot vertically integrate backwards, the input quantity, $x*$, is greater than when power of only one side is exercised. Thence, the countervailing power would lead to some social welfare gain. The quantity is set where the supply (marginal cost) equals the marginal revenues (MRP), and the price is negotiated and would lay in some point within the segment $\overline{HL}$ in Figure 2.

The welfare effects of buyer power varies according to the structure of both the upstream and downstream markets: as mentioned before, buyer power paired with downstream competition may be beneficial, in such cases lower input prices may also be passed to consumers as price reductions. On the other hand, seller power in the upstream market and powerless buyers implies adverse welfare effects. Buyer power may be desirable when the buyer has no monopoly power in the downstream market, and the supplier has seller power.

Taking into account all the above, three conditions are necessary to exercise buyer power:

(i) buyers account for a significant proportion of the purchases – high concentration in purchases

(ii) there are entry barriers in the downstream market, which add to the market concentration; and

(iii) the supply curve is inelastic and upward sloping, which means that suppliers should have increasing marginal costs (or strictly convex cost functions).

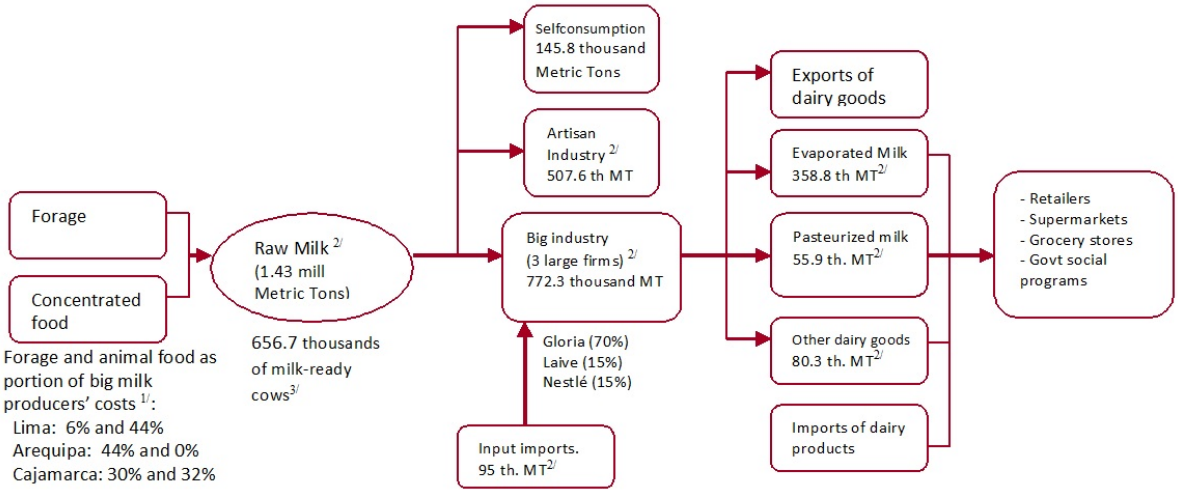
This upward sloping supply curve condition is not difficult to find in real world, where many industries are likely to show decreasing returns to scale; indeed it is a common feature of most of the agricultural markets that are vulnerable to stronger counterparts (retailers, manufacturers, etc.). [7] Rozanski and Thompson (2011) highlights inelastic supply as the key determinant of the exercise of buyer power; this due to the lower bargaining position that suppliers have in the absence of an "outside option", which may lead them to worse situations such as "take it or leave it" negotiations or any contract imposition (exclusivity agreements) that favor buyer's dominant position in the market of the final good (Dobson et al., 1998, 2001; Noll, 2005).[8]

4 Diary Industry in Peru: market description

The dairy industry is characterized for its vertical structure, which starts from the raw milk production and ends with the production of processed fluid milk and other milk-based products (dairy goods). Many agents are involved in the entire value chain: raw milk producers, milk cooperatives (in certain cases), artisan firms, big dairy firms and retailers (see Figure 3). The value chain of dairy industry incorporates relevant activities as raw milk production, raw milk collection, milk transformation and retailing and distribution. Thus three vertical markets are distinguishable: raw milk market, processed milk products market and retailing and distribution market.

[7] Only 3 of 26 studied industries presented a downward sloping supply curve (prepared feeds, construction equipment and aircrafts); the others presented either flat or upward sloping curves (Dobson et al., 2001).

[8] In agricultural markets, many suppliers may face important infrastructure constraints that would hinder their ability to sell their product to other markets due to higher transport costs and perishability of their goods (milk for example), which diminish their outside options (Rozanski and Thompson, 2011).



Notes: Based on information by 2006; (1/) Information by 2004, it considers production from Cajamarca.
Sources: MAXIMIXE (2006), 1/ Gil (2004), 2/ Rebosio (2007), 3/ Dataset from the Ministry of Agriculture (MINAG) and the National Institute of Statistics (INEI). Based on INDECOPI (2007)

Figure 3: Value chain of dairy industry

Raw milk is the essential input for any dairy final good. It is highly perishable, which makes transporting it to long distances difficult and expensive. For this reason raw milk production requires specific investments in refrigeration equipment. These extra investments increase provision costs and makes distance-to-markets an important barrier for expanding the geographic relevant market. For instance, raw milk sales are limited to the local or regional market.

Unlike main agricultural commodities, the price of milk is determined within the domestic market rather than international markets. Price levels depends on the quality level of raw milk, percentage of solids and proteins, absence of any bacterial content (diseases), and distance to the collection center. Additionally, bonuses may be applied according to the supplied quantity and refrigeration (Carrera, 2008).

An important characteristic of the Peruvian market of raw milk is the composition of the upstream market (supply). The raw milk supply is provided by thousands of small farmers, who mostly produce less than 100 kg/day — around 80% of milk farmers are small size producers with scarce or non-economies of scale. They are dispersed and weakly organized, and face different constraints (transport and energy infrastructure) according to the region they are located (INDECOPI, 2007; Zavala, 2010). [9]

Three large firms remain as producers of industrialized milk products: Gloria S.A., Nestlé

[9]The most relevant organizations are those that provide services to milk production and distribution, which mainly comprises the National Fund of Dairy Farming (FONGAL – *Fondo Nacional de Ganaderia Lechera*) and the Milk Collection Centers (CALE-*Centros de Acopio Lechero*). The first operates in the main milk producing regions and provides milk collection, refrigeration, processing and distribution services. Within FONGAL, in Lima, the strongest organization is the Milk Farmers National Association (AGALEP – *Asociacion de Ganaderos Lecheros*) that is led by medium and large milk producers. The second, CALE, is comprised by producers of Arequipa, and also provides collection, refrigeration and distribution services; this organization has helped many producers to get higher prices for collective and refrigerated milk supply by allowing producers to gain bargain power against the largest buyers such as Gloria (Carrera, 2008).

and Laive. These three firms are the big purchasers of raw milk, but practically, each firm buys its input in different geographical zones: North, Center and South. It is important to highlight that only Gloria's purchases account for around 70% of the raw milk used for the big industry, making this firm the dominant one.[10] The three big firms produce mainly evaporated milk (most popular among Peruvians) and pasteurized milk (UHT fluid milk). [11] Gloria is the largest producer of evaporated (canned) milk, and it has been also the largest provider of milk to the Government's purchases of milk for the social programs. Gloria has kept the leadership in the market overtime.

The profitability of the raw milk production depends on the production costs, which are affected by the technology used for milk extraction (manually or by machine), genetic improvement, herd size and the methods of feeding cattle (using only concentrate food, only forage or a combination of both), farm size (small or big farm, or large raw milk producer), productivity and raw milk quality (heavily influence by sanitary control of production processes).

4.1 Milk production

The production of evaporated milk shows an increasing trend since 2002, as opposed to the UHT milk that shows a flatter production trend and far below the evaporated milk production levels. From 2000 to 2013 the production increased by 120.2%, with an average growth rate of 6.4% per year. This growth is related to the rise in raw milk production of around 51.6% during the same period, showing an average rate of 4.2% (see Figure 4). Domestic raw milk has been used more intensively by the industry in the last decade. Imported products, such as powdered milk, which is used as complementary input for industrialized fluid milk has shown a fluctuating trend that averages 174 metric tons per year between 2002 and 2013, showing an important peak in 2012.

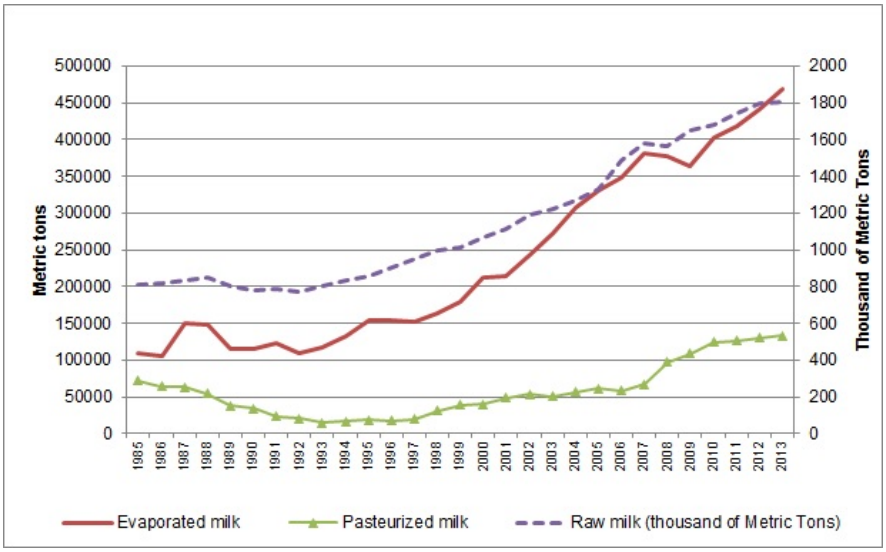
As mentioned before, three regions are distinguished as the main producers of raw milk. particularly the South and North regions account for almost 50% of the national raw milk production (as shown in Table 7 in the appendix). Gloria is the main buyer in the southern region, where it collects almost 80% of the raw milk, while Nestlé is the leading purchaser of the Northern region with around 75% of raw milk purchases. The Central region provides mostly to Gloria (85% of the purchases), and the remainder is evenly shared between Nestlé and Laive. Given that the market of raw milk is constrained to local markets, these firms may behave as local monopsonies.

Peruvian production of raw milk is, on average, constrained by transport facilities, technology access, lack of organization and therefore almost no economies of scale to produce large quantities. In the two largest zones of production (Cajamarca in the North and Arequipa in the South), small producers comprises 95% and 85% of the total producers, respectively, as shown in Table 1.

Small producers rely on traditional methods of cattle care and milk extraction, using forage and low or no genetic improvements of their herds. These characteristics may vary across regions, which determine different production cost structure. Cattle food constitutes the

[10] Around 54% of total raw milk production is sold to the industry.

[11] Unlike other countries, Peruvian demand for milk is mainly focused on evaporated milk (canned milk). This is justified for its advantages of of conservation and quality, given that still many Peruvian families (especially so of rural areas) do not have refrigerators.



Source:Ministry of Agriculture Peru

Figure 4: Fluid milk production (1985-2013)

most important cost for Peruvian milk farmers; equipment and sanitation are also a relevant part of the cost, their importance decreases with producer size but increases with the distance to the largest market (Lima city). This is shown in Table 2, which prersents the estimated cost structure that milk producers face according to their production size of producer in specific regions.[12]

4.2 Downstream market concentration

Raw milk purchases are highly concentrated in three industrial firms, which also keep the downstream market (evaporated milk and Dairy products in general) highly concentrated. The Hirsch-Herfindahl Index (HHI) is above 5000 in the case of raw milk collection and above 7000 in the case of evaporated milk (see Table 3). [13]

Although the available information is not complete, the trend has not changed. The high Gloria's market shares –around 80% of market share in the relevant dairy products (fluid milk, evaporated milk and yoghurt)– implies that the market concentration remained at least the same after 2006 (see Table 4).[14] This also would imply that Peru would be facing a structure close to an oligoempory.

4.3 Supply bargaining power

The scarce organization of milk producers, coupled with the characteristic geographic dispersion of them, makes difficult for them to get favorable negotiated prices. As an example, Gloria collects milks from more than 15000 producers, while Laive does the same from a smaller, but still large, number of 1085 producers (A&A, 2011; LAIVE, 2010).

[12]The portion of the costs explained by forage (mainly comprised by alfalfa) is consistent with Santa Cruz et al. (2006) and a more recent analysis made by DRSAU (2012)

[13]By convention, an HHI greater than 1800 indicates a high market concentration.

[14] The market share information is found in GLORIA (2009, 2011, 2014), however there is no such detailed information form the rival firms, Nestle and Laive.

Producer's size	Range of production (Kg./day)	Arequipa	Cajamarca	Lima
Small size	0-30	42.99%	68.95%	23.61%
	31-100	41.88%	28.23%	34.74%
Medium size	101-200	11.93%	2.80%	10.47%
	201-500	2.47%	1.22%	11.36%
Large size	501-1000	0.41%	0.50%	7.80%
	1001-5000	0.24%	0.29%	9.13%
	More than 5000	0.09%	0.00%	2.90%
	Total	100.00%	100.00%	100.00%

Source: Gil (2004)

Table 1: Market structure of raw milk production by region

	South (Arequipa)		North (Cajamarca*)		Center (Lima)	
Caracteristics	**Small Producer**	**Large Producer**	**Small Producer**	**Large Producer**	**Small Producer**	**Large Producer**
Milk sales per day (lt)	63	907	10	43	78	3860
Milk production per cow (lt)	9.7	11.6	4.2	3.7	7.8	14.2
Revenue for milk sales(USD/day)	11	216	2	8	21	1042
Milk production costs (USD cents/lt)	17.4	18.6	31.2	28.9	30.6	21.5
Concentrated food purchases	0%	0%	17%	32%	57%	44%
Forage production	60%	44%	33%	30%	0%	6%
Water cost	1%	35%	0%	0%	0%	0%
Equipment or machinery, sanitation	14%	21%	19%	20%	14%	9%
Labor	18%	9%	29%	16%	22%	14%
Investment	7%	7%	2%	3%	7%	11%
Administrative expenses	0%	16%	0%	0%	0%	17%
Profit per liter of milk (USD cents)	4	8.9	-2.9	3.9	0	9.8

Note: (*)Information that corresponds to producers located in the highland's villages and valleys.
Source: Tomas Bernet (2000) cited in p. 17 of Gil (2004)

Table 2: Cost structure by producer type and region

Another factor that strengthens bargaining position of industrial firms is associated with quality assessment of raw milk. In Peru, the milk quality is tested by the firms themselves, and because prices are set based on quality, firms have incentives to cheat and downgrade

Market segment (Num. of firms)	Firms with largest market share		HHI	
	1%	2%	2001	2006
Diary Industry [1/] (3 firms/companies)	Gloria (68%)	Nestlé(13%)	4000	4900
Raw Milk collection [2/] (3 big buyers/firms)	Gloria (70%)	Laive(15%)	NA	5350
Industrializes products [3/] (Evaporated milk (3 firms)	Gloria (83.2%)	Nestlé(12.7%)	NA	7100

Note: [1/] Jan-Sep.2006, [2/] Dec. 2006, [3/] Jun2006, NA=not available
HHI >1000 market not concentrated, 1000<HHI<1800 moderate concentration and HHI>1800 high concentration.
Source: GLORIA (2009), A&A (2006), MAXIMIXE (2006)(cited in INDECOPI (2007))

Table 3: Market concentration of milk purchases and industrialized milk market in Peru

	2004	2005	2006	2008	2010	2013
Fluid milk (pasteurized UHT milk)						
Gloria	73.7%	76.9%	79.6%	72.2%	76.8%	75.9%
Nestlé	14.6%	13.8%	12.2%	n.a	n.a	n.a
Laive	7.3%	6.1%	5.9%	n.a	n.a	n.a
Otras	4.4%	3.2%	2.3%	n.a	n.a	n.a
Evaporated milk						
Gloria	79.0%	81.2%	83.2%	82.1%	83.2%	81.8%
Nestlé	15.7%	15.0%	12.9%	n.a	n.a	n.a
Laive	53.0%	3.8%	3.9%	n.a	n.a	n.a
Yoghurt						
Gloria	68.3%	74.9%	78.4%	81.6%	81.5%	81.0%
Laive	21.0%	18.5%	14.9%	n.a	n.a	n.a
Otras	10.7%	6.6%	6.7%	n.a	n.a	n.a

Source: A&A (2007) and Gloria's Annual Reports (2009, 2010, 2013)

Table 4: Market share of main dairy products in Peru

milk quality to push down even more input prices.[15]

The more inelastic the supply, the less bargaining power raw milk producers have. Situation

[15]Usually, industrial firms take a sample from the milk they purchase, and after analyzing it in their own labs, they pay the corresponding price once the discounts and/or bonuses for refrigerated milk are applied. During an interview held on 2007 to Javier Valera and Bernardo Mountauban (members of AGALEP), they mentioned a previous experience of a mismatch on quality analysis made to the same sample of milk, from the purchaser's own lab and an independent laboratory (a university's lab); the differences were detrimental for the farmers

that is worsened under highly concentrated industrial demand. In Peru, raw milk producers tend to be vulnerable to accepting low-price offers when negotiating with big firms. Usually small producers do not have an "outside choice" that could increase their negotiation power, and also are subject to exclusive contracts with one of the industrial firms. [16]

4.4 Entry barriers in the downstream market

As mentioned earlier, raw milk supply in Peru is comprised by mostly small milk farmers dispersed in location. Therefore, given the atomization of the raw milk supply, in addition to the scarce or non-existent investment on refrigeration systems of these farmers, the big players of the market have implemented collection systems (collection route and installation of collection and refrigeration centers) paired to exclusive contracts. This existing collection network and system arises as an important barrier to potential entrants, who are expected to incur in additional high investments to implement similar collection systems.

Additionally, it is worth mentioning that the production of evaporated milk is more expensive than of the pasteurized milk (UHT fluid milk) mainly due to the cost of cans used for its production. Thus, the high production cost of canned milk, paired to the high preference of the demand for this type of milk, hinder the entry of smaller producers that are less able to handle specific investments to produce canned milk. Although this may not be properly considered as entry barrier, it influences on higher entry costs.

Until now, the presumed inelastic supply, the high concentration of purchases, the downstream market concentration, and the important entry barriers in the Peruvian raw milk market depict a scenario that create the necessary conditions for an adverse exercise of buyer power, but most important of buyers with seller power (a oligoempory).

4.5 Price behavior

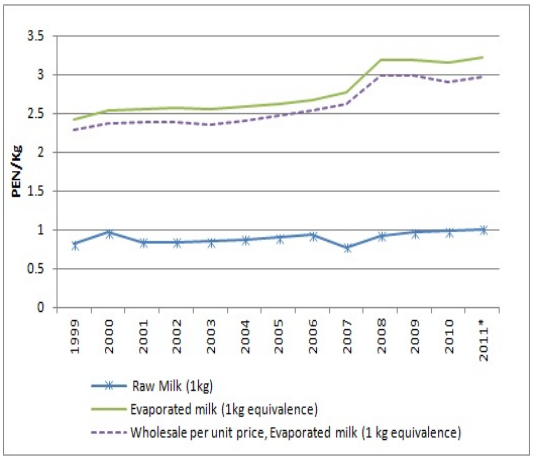
The analysis of price behavior and price spreads may help to better understand the market dynamics. Under some degree of competition, unless price already hit the marginal cost, it is logical to expect price variability as a result of dynamic interaction among competitors. For instance, price stability may suggest lack of competition, among industrial firms (as buyers) in the upstream market and (as sellers) in the downstream market.[17]

As shown in Figure 5a during last decade, the raw milk average price (paid to raw milk producers) per kilogram of milk has maintained a steady trend, showing a slightly increase after 2008. This change is associated to several complaints from milk farmers during 2006 and 2007 made to the Competition Agency for suspected abuse of dominant position. On the other hand, wholesale and consumer average prices of evaporated milk show an overall increasing trend, with a big jump in 2008 to reach a steady level after. This jump would be also related to the milk farmers' complaints. [18]

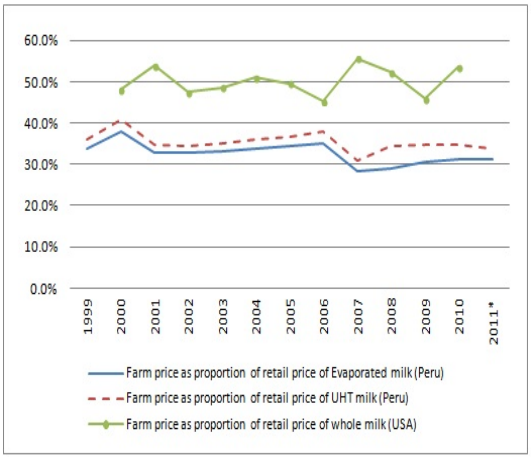
[16] According to Bernardo Montauban – a large milk farmer in the Lima region –, it is usual that big industries ask for exclusive contracts to provide milk to them. Thus, farmers do not have other buyers to sell their production, and lose bargaining position in price setting (Interview held on June, 28th 2007).

[17] Let's recall that the three industrial firms belong to a strong organization, called Industrialized Producers Association (ADIL-*Asociacion de Industriales lecheros*).

[18] Prices of evaporated milk are found by per can unit. Since, this type of milk must be mixed with same amount of water to obtain an equivalent of fluid milk, we used the conversion rate found by the Peruvian competition agency – 1.28 units of canned milk are needed to get 1 litter (1 kg) of milk– to get the equivalent price of 1 litter of fluid milk from evaporated milk.



(a) Average price of raw milk and processed milk (1999-2011)

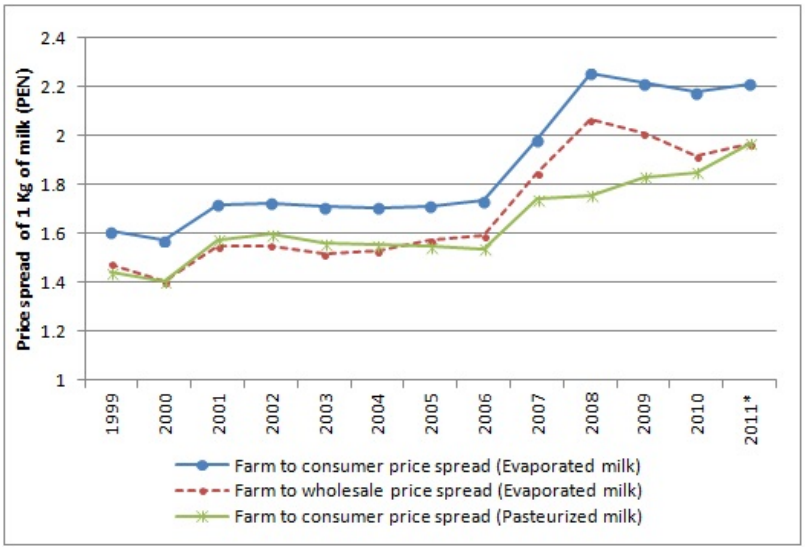


(b) Farm price as proportion of retail price (Peru v.s. USA)

(*) Information up to July 2011

Source: Ministry of Agriculture of Peru and USDA.

Figure 5: Average prices and farm price as proportion of retail prices



(*) Information up to July 2011

Source:Ministry of Agriculture Peru

Figure 6: Price spread between raw and processed milk prices (1999-2011)

By comparing the final product price and input price, we can observe an increasing gap. Figure 5b shows the ratio farm price to consumer price (retail price) for Peruvian industrialized milk and USA whole milk. Not only is the proportion of final price that comes from farm price below the ratio observed in USA's market, but also there is a decreasing trend of such proportion.

As expected, UHT or pasteurized milk's final price accounts for a larger proportion from farm price than evaporated milk does. This might show an increasing added value that firms give

to the industrialized milk (as well as the extra costs incurred due to the atomistic structure of milk producers) and may also include the distribution costs and increasing participation of retailers in this market segment. Americans, unlike Peruvian milk producers, may account for a larger proportion of the final price due to gains in efficiency (in economics of scale) and value added to their product (supply structure might not be atomized), thanks to technology, transport and market accessibility. Also, under the assumption of a more competitive downstream American milk market, the significant differences in input-output price ratios might be associated with the exercise of buyer power of the concentrated dairy industry in Peru.

In more detail, Figure 6 shows the evolution of price spreads between wholesale and consumer prices and input prices (raw milk) during last decade. An increasing trend is remarkably notorious. Two important details are noticed from this figure: (i) the farm-to-consumer price spread has been increasing, especially after 2006. This would suggest increasing buyer power of industrial firms; and (ii) the spread between consumer and wholesale prices (in case of evaporated milk) has remained almost constant over the period 1999-2008. A rise in that spread is recently evidenced since 2009, which would suggest a greater role of bargaining power of retailers.

5 Supply Estimation

To complete the analysis about the conditions of the existence of buyer power, we need to verify the supply is indeed inelastic. For that purpose, we estimate a simple structural model of supply and demand.

5.1 Specification of the Model

In this model, the supply and demand are defined as functions of selected variables based on the description of the market.

The supply is defined as a function of inputs (cattle, credit, transport costs, technology) and other factors that affects it:

$$Q_t^s = f(P_t, S_t, IC_t, Tech_t, TC_t, ES_t) \tag{5}$$

in which

Q^s : quantity produced of raw milk

P : raw milk price

S : size of producer

IC : investment cost

$Tech$: technology level

TC : transport costs

ES : sectoral economic situation

With the exception of IC and TC, all the other variables are expected to have a positive relationship with supply. IC and TC would have a negative effect on Q^s. Particularly,

- the size of the producer would be directly related to the supply, the bigger the size of the raw milk producer, the more raw milk it can produce.
- investment cost would be inversely related to the supply.
- technology level would be directly related to supply, the higher the technology level, the greater the productivity of inputs and the more the supplier can produce.
- transport cost, add to the cost and makes difficult to produce, for that reason this cost would be inversely related to supply.
- general economic situation of market or economic sector, would influence in expectation of the production, if the sector is having a boom, more suppliers will have incentive to produce more raw milk. The relationship will be positive.

Although, the demand estimation is not the main concern of this study, we include it in order to estimate a three stage least square model. Thus we briefly define the demand for raw milk, which is actually a derived demand of the output (we only consider evaporated milk as output since it is the most consumed dairy product). The demand function for raw milk is defined as a function of quantity supplied and prices of the final good (evaporated milk) – this following equation 1 – and other factors such income level, transport costs, and dairy imports. Thus, the demand function is defined as follows:

$$Q_t^d = f(P_t, q_{t-1}^{evap}, p_t^{evap}, Y_t, TC_t, M_t) \tag{6}$$

in which

q^{evap} : quantity level of evaporated milk

p^{evap} : price of of evaporated milk

Y : income level

M : dairy products imports

Taking raw milk as normal good in consumption and a normal input in production, we should expect Y to have a positive impact on demand. Also, following the derivations of equation 1, we expect a positive impact of prices of evaporated milk on the demand for raw milk The impact of quantity produced/demanded of evaporated milk and of dairy imports are unclear, and are explained below.

- production level of evaporated milk affects demand for raw milk in the form of expectations. Since raw milk faces a derived demand from industrialized milk, the expected demand of industrialized (mainly evaporated) milk affects decision of factor demand. Taking into account that evaporated milk can be stored, we assume farmers are more affected by previous period demand for evaporated milk than by current demand. So, industrial firms (buyers) demand their input according to their expected demand in the output market, which is at least as much as the previous period production level. The expected relationship of q_{t-1}^{evap} and supply depends on the existence of an inventory system: under the case of high presence of inventories, high production of evaporated milk in the previous period may discourage the current production of processed milk, and therefore discourage the current demand for raw milk. Whereas in the case where inventories are small or non-existing, then a high production of evaporated milk in the previous period may encourage high current production and therefore increase the current demand of raw milk. So if inventories exist then a negative relationship is expected, while if they are absent, a positive relationship between q^{evap} and demand is expected.

- income will be positively related to demand of raw milk. We take raw milk as a normal good and normal factor (let's recall that is the key input for evaporated milk).
- transportation costs, since industrial firms in Peru collect the milk directly from each producer, higher transport costs discourage firms to buy milk from those producers.
- dairy and related components imports, this affects the demand through two channels: final good imports – that reduces demand for domestic industrialized production and therefore for raw milk –; milk powder (or any other dairy component) imports that industrial firms may use to substitute, to some extent, raw milk.

5.2 Data

We use monthly data obtained from the Ministry of Agriculture of Peru (MINAG), the National Institute of Statistics and Information of Peru (INEI) and the Central Bank of Peru (BCRP) for the period between January 1999 to December 2014. The data are aggregate at nationwide level.

The dataset includes monthly national aggregate information about raw milk production and evaporated milk production, average prices of both products, specific input (forage) for the raw milk production and several indexes of prices that serve as indicators of the model's variables. The indicators selected for each variables are summarized below:

- demand of milk: one-month lagged evaporated milk production.
- price of evaporated milk: average retail price of canned milk for an equivalent amount of 1 liter of fluid milk.
- size of the producer, which is directly related with the size of cattle (more cows, higher milk quantity), therefore we use the total national number of cows as indicator.
- investment cost, which is directly related with access to credit; we use the domestic interest rate level.
- technology: (i) per cow productivity (kg of milk per cow), and (ii) the production of alfalfa (given the extensive use of forage as way for feeding cattle).
- transport cost: the average price of gasoline (diesel type, which is the more common) that is the most representative indicator. This is relevant for producers that transport their small amount of milk to cooperatives collection and cooling centers, and for industrial firms that have to collect milk from the producers in their collection network.
- sectoral economic situation: the livestock production index (index based on 2007 prices) is used as an indicator. We use the livestock sector index because it captures seasonal effects and common features on similar activities.
- income: (i) the GDP index (index based on 2007 prices) lagged by one period, which may indicate also the overall situation of the economy and private sector situation, and (ii) the index of real minimum wages (index based also on 2007 prices) as indicator of individuals' income (higher wages increase the likelihood to buy industrialized evaporated milk, which also derives in higher input demand).
- imports of dairy and related products: value of total imports of dairy and related components.

Variable	Mean	Median	Maximum	Minimum	Standard Deviation	Nobs
Production of raw milk(Metric Tons)	90838.79	70950	169440.9	46726.08	34968.37	382
Price of raw milk(PEN/kg)	.896	.894	1.045	.816	.041	204
Production of evaporated milk	18925.7	13766.5	44147.2	5697	10327.1	418
Price of evaporated milk (PEN/kg)	2.93	2.69	3.76	2.34	.430	192
Sales of evaporated milk(Metric Tons)	18869.5	13854	43827.6	4550	10264.1	419
Diary imports (USD million)	1.9	1.51	10.97	.11	1.58	204
Number of cows ready to milk	715525	728574	950278	516971	119726	192
Cow productivity (kg/cow)	5.56	5.61	6.16	5.06	.259	192
Production of alfalfa-forage (thousands of Metric Tons)	450.93	440.00	763.62	253.8	86.84	298
Average credit interest rate in national currency(%)	33.87	24.34	185.95	15.53	27.81	275
Average price of Diesel gasoline (PEN/gallon)	8.371	8.617	10.632	3.885	1.670	180
Real minimum wage index(2007=100)	111.5	98.1	308.8	26	59.8	420
GDP index(2007=100)	91.72	81.00	159.33	53.17	28.36	252
Livestock sector production index (1994=100)	4.42	4.36	4.95	3.84	.292	299

Source: Data collected from the Ministry of Agriculture of Peru (MINAG), the National Institute of Statistics and Information of Peru (INEI) and the Central Bank of Peru (BCRP).

Table 5: Summary statistics of the variables

Table 5 shows the summary statistics of the variables that is used in the estimation. As observed the average final price of evaporated milk almost triples the farmer price for raw milk. The production of raw milk is far larger than the production of evaporated milk, which is reasonable considering that raw milk is also used for the production of other dairy products (butter, cheese, yoghurt, etc.).

Another interesting observation from Table 5 is the evident presence of inventories in the evaporated milk industry. On average, the production of evaporated milk is larger than the sales by about fifty metric tons. Therefore, following the specification of the model, and given the existence of inventories, a higher production of evaporated milk in the past period may have a negative impact on the demand and supply of raw milk.

As noted, we have times series data, with information for 180 to 381 months depending on the variable. Given our model specification, and considering the variables and selected indicator, our sample size is compressed to 180 time periods.

5.3 Identification strategy and estimation of the model

For the empirical estimation, both equations (5) and (6) are defined as log linear functions:

$$q_t^s = \alpha_0 + \alpha_1 p_t + \alpha_2 S_t + \alpha_3 IC_t + \alpha_4 Tech_t + \alpha_5 TC_t + \alpha_6 ES_t + \epsilon_t \tag{7}$$

$$q_t^d = \beta_0 + \beta_1 p_t + \beta_2 q_{t-1}^{evap} + \beta_3 p_t^{evap} + \beta_4 Y_t + \beta_5 TC_t + \beta_6 M_t + v_t \tag{8}$$

where v_t and ϵ_t are the disturbances of the demand and supply equation, respectively.

Solving the problem of demand and supply, the equilibrium condition is $q_t^d = q_t^s$, therefore we have a system of equations to solve. (8) and (7) are given in their structural form, and we cannot estimate them by running a simple OLS technique due the violation to the exogeneity condition: price and quantity are simultaneously determined, so price carries some endogeneity.

We address the endogeneity problem by using excluded exogenous regressors from each equation as instruments for the right-hand-side endogenous variable. We rely on the use of instrumental variables as identification technique. For instance, the variables Y, q^{evap}, p^{evap} and M are used as instruments of price in the supply equation (7), and the variables S, IC, $Tech$ and ES are used as instruments for price in the demand equation (8). Thus, these two equations are overidentified and can be consistently estimated by using two-statge-least squares (2SLS), and also can be jointly estimated by using three-stage-least squares (3SLS) simultaneous system of equations regression. With the equation-by-equation 2SLS estimation, We only focus in the reduced form relationships between the endogenous and exogenous regressors. On the other hand, assuming the model is well specified, the joint estimation of the system of equations allow us to focus in the structural equations and get more efficient estimates for the parameters.

3SLS estimator has the advantage to exploit the correlation of disturbances across the simultaneous equations, giving a gain in asymptotic efficiency over the 2SLS. Among the estimation techniques, we also use a two stage generalized method of moments (GMM) that have an advantage because it allows for correlation overtime among disturbances, and relaxes the assumption of linear regression.

Given the times series data we have, variables were treated so they are stationary. Thus, all variables are detrended and seasonally adjusted, and pass the Augmented Dickey Fuller unit root test (variables are integrated of degree zero). We estimated the model under various techniques, and checked for the endogeneity tests and validity of the instruments. In both cases – the demand and supply specification – the model passes the validity test (Hansen J test).[19] Additionally, in both cases, the model passes the underidentification tests (Kleibergen-Paap rk LM statistic), by rejecting the null hypothesis of underidentification, therefore the model is identified.

To account for heteroskedasticity and autocorrelation, we use robust standard errors. Despite the relative good fit of the model, a potential difficulty of the estimation is related to the weak instruments problem. The model does not perform as well as desired in the weak instruments tests, nonetheless this may be overcome with longer data series and with more specific data and less aggregated data.[20] [21] The following section present the results of the estimation,

[19] In performing the Hansen J test, we fail to reject the null that the instruments are valid.

[20] By estimating a GMM 2-step model on equation 5, the partial R^2 is only 0.172, and the $F(3, 168)$-statistic is 3.01 significant at 95% confidence level; likewise, in the case of the estimation of equation 6, partial R^2 is 0.301 and the $F(5, 168)$-statistic is 18.42 significant at 99% confidence level.

[21] Lets recall that the estimation is given with national aggregated data, the results may severally improved if data are at firm level.

which still give some useful insights about the initial suspicion of the exercise of buyer power in the raw milk market.

5.4 Estimation results

As shown in Table 6, by using the two stage least square estimator (in column (1)) and the 3SLS estimator (in column (2)), the estimated supply elasticity is found to be positive and inelastic (below 1), although insignificant. Which implies that the coefficient is not significantly different than zero, meaning that indeed the supply elasticity may in fact be very inelastic. However, by using a GMM 2-step estimator (column (3)), the supply elasticity shows to be positive 0.63 (inelastic), significant at the 5% level. As expected, the estimated elasticities using the 3SLS technique are more efficient (present lower variances).

The responsiveness of supply to the interest rate –indicator of investment cost variable– is found to be significant and negative, confirming the role of credit access. On the other hand, technology appears to significantly explain supply, all the variables show the expected positive sign. In the case of cow productivity, the significance level is kept across techniques, but forage (or alfalfa) remain insignificant.

Size of the cattle matters. It has a highly significant positive impact on supply. This results would, somehow, suggest the importance of scale for efficiency gains. Gasoline (indicator of transport costs) shows to be statistically significant, but has an unexpected sign (positive). This could reflect the switch on small farmers' decision to sell their product to big firms that directly collect milk from each farm, rather than carry the milk on their own to some collection center, which might be directed to artisan dairy production or to small industry.

Even though the demand estimation is not the main focus of this study, the estimation results, shown in Table 9 (in the appendix), evidence a demand elasticity around -2.0 significant at 1% statistical level across estimation methods. This suggests that the raw milk farmers would face an elastic demand curve. The results also show that the effect of price of evaporated milk on raw milk supply is positive and strongly significant, as expected. On the other hand, (expected) production/demand of industrialized/evaporated milk and transport costs show to have a small negative effect on raw milk supply (statistically significant at 5% level). The negative relationship between expected evaporated milk production and raw milk current demand suggests that the inventory system is existent and important in the industrialized milk market, so industrial firms would buy less the current period if they produced more in the previous one. Higher transport costs would reduce industrial firms demand due to the collection system implemented by these firms, where they internalize the transport costs of milk collection.

Even though dairy imports show an insignificant impact of demand, they have the expected sign. This result suggests that dairy import products are used as complements of raw milk for the production of evaporated milk. Finally, unexpectedly the income elasticity is found to be negative. This is surprising,it may indicate that raw milk is an inferior good for consumers (indeed, the higher the income, Peruvian people would be more willing to buy evaporated milk rather than raw milk, which is highly perishable). Since the data are aggregated, then it is plausible that the effect from consumer behavior surpasses the producers'.

The estimates obtained by using different econometric techniques are reasonable in the way that a downward sloping demand curve and an upward sloping supply curve are found. Fo-

	Supply(Q^s)		
Variables (Detrended and seasonally Adjusted)	**2SLS (1)**	**SE 3SLS (2)**	**GMM (3)**
Log of Price of raw milk	0.473	0.469	0.626**
	(0.294)	(0.294)	(0.309)
Log of Interest rate in domestic currency	-0.103***	-0.103***	-0.112**
	(0.034)	(0.033)	(0.045)
Log of Cow productivity	1.051***	1.049***	1.111***
	(0.161)	(0.157)	(0.231)
Log of Number of cows	0.658***	0.625***	0.765***
	(0.139)	(0.135)	(0.208)
Log of Production alfalfa	0.051	0.042	0.038
	(0.061)	(0.059)	(0.052)
Log of Livestock production index	-0.429***	-0.410***	-0.347
	(0.125)	(0.121)	(0.285)
Log of Gasoline average price (diesel)	0.227***	0.226***	0.263***
	(0.055)	(0.054)	(0.036)
Constant	0.002	0.002	0.001
	(0.002)	(0.002)	(0.003)
R^2	0.381	0.382	0.308
Adjusted R^2	-	-	0.280
Root mean squared error (RMSE)	0.033	0.033	0.035
Nobs	180	180	180

[a] ***, **, * denotes statistic significance at 1%, 5% and 10% level respectively.
[b] Columns (1) shows 2SLS Instrumental Variables estimates, (2) shows the 3SLS simultaneous equations estimates; and (3) shows the GMM estimates.
[c] Robust errors are given in parentheses for all columns.

Table 6: Supply estimation: log of quantity produced of raw milk as dependent variable

cusing in the elasticities, and taking the 3SLS and GMM estimates as the best ones because of its advantages on asymptotic efficiency and flexibility, we found an inelastic supply and elastic demand of raw milk. The elasticity of the supply is of our primary interest and given the fit of the model we take the result as relevant.

Given this result, our model confirms that industrial firms indeed would have a higher bargaining position than milk farmers do, given the inelasticity of the supply. Therefore, we should expect high mark-ups obtained by industrial firms. From the theoretical framework shown in section 3, we show that this mark-up is also inversely related to the price-elasticity of demand of the output in the downstream market. Driven by the observation of a high market concentration in the industrialized milk market in Peru and the existence of entry barriers in that downstream market, we also look for the price-elasticity of the demand of evaporated

milk, we borrow the rsult of INEI (1997) that found that the demand for evaporated milk is elastic. [22]. A elastic demand of evaporated milk reduces the industrial firms mark-up, and this added to the evidence of an inelastic raw milk supply would suggest that industrial firms would have even higher incentives to exercise pressure to lower raw milk prices.

6 Conclusions

There is a direct relationship between the mark up and the supply elasticity: the more inelastic is the supply, the higher mark-up the monopsony gets and larger the distance from the competitive prices; this also implies greater welfare loss.

According to the literature and theory, two conditions are necessary to exercise buyer power: (i) buyer accounts for a significant proportion of the purchases, and (ii) the supply curve is inelastic and the supplier has convex cost function, which means upward sloping supply curve (increasing marginal costs). Dobson et al. (2001) add a third condition associated to the existence of entry barriers. Supply inelasticity is stressed as key determinant of the exercise of buyer power, since it lowers supliers' bargaining position and may lead them to "take it or leave it" situations.

This study shows evidence of an inelastic supply in the Peruvian raw milk market, the estimated supply elasticity is 0.66, which also evidence its upward slope. From the dairy market analysis, there is evidence of the high concentration of purchases by the industrial firms (high HHI indexes).Likewise, not only industrial firms show market power in the upstream market, but also in the the downstream market, where the concentration indexes are very high, and where the dominant presence of one firm (Gloria) is highlighting.

Only three large firms in Peru produce industrialized milk products, from which one firm (Gloria) is the bigger not only in the purchases (70% of raw milk sold to the industry), but also in the production of evaporated milk (most popular among Peruvians), pasteurized milk (UHT fluid milk) and yoghurt.

Raw milk is highly perishable, which makes it difficult and expensive to transport at long distances; specific investments in refrigeration equipment are required, but these cannot be afforded by the average farmer that is small in size, heavily relies on low technology use (forage to feed the cattle) and is therefore located in remote rural areas. Thus, raw milk sales are limited to the local or regional market. Additionally, the poor organization of milk producers worsens their bargaining position against the big industry.

An important market characteristic and a great difficulty in the production of industrialized milk is given by the high preference for canned milk, which increases the production cost and requires higher investment. Likewise, given the atomization of the raw milk supply, the collection system already implemented by the big industries (collection route and installation of collection and cooling centers) arises as an important entry barrier to potential entrants, who would have to make a significant investment to implement similar collection systems.

From the analysis of the Peruvian market structure of raw milk –atomized and powerless upstream market, and a high concentrated downstream market–, the existence of entry bar-

[22]INEI (1997) finds that the absolute value of the demand elasticity ranged from 1.04 for high income families, 1.17 for medium income families, to 1.45 for low income families

riers in the market of industrialized milk and the empirical evidence of an inelastic supply curve of raw milk suggest that there are conditions in this particular market that makes highly likely the exercise of buyer power.

In conclusion, our analysis shows that the power of industrial firms would be greater since these firms would be behaving as an oligoempory, and this feature needs to be addressed in the analysis of the anticompetitive cases that are viewed by the Competition Agency in Peru, INDECOPI.

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Appendix

Appendix A

Region	2000		2005		2010	
	Thousand of Tons	**%**	**Thousand of Tons**	**%**	**Thousand of Tons**	**%**
South region	**285.80**	**26.8%**	**335.06**	**25.2%**	**396.50**	**23.6%**
Arequipa	254.26	23.0%	296.83	22.3%	355.01	21.2%
Moquepgua	15.06	1.4%	16.36	1.2%	15.26	0.9%
Taccna	25.47	2.4%	21.87	1.6%	26.22	1.6%
North region	**208.73**	**19.61%**	**299.16**	**22.5%**	**404.07**	**24.1%**
Cajamarca	153.60	14.4%	219.46	16.5%	303.45	18.1%
La Libertad	55.13	5.2%	79.70	6.0%	100.62	6.0%
Central region	**186.73**	**17.5%**	**258.28**	**19.4%**	**368.27**	**21.9%**
Lima	153.78	14.4%	222.55	16.7%	306.88	18.3%
Junin	17.97	1.7%	18.61	1.4%	31.11	1.9%
Ica	14.98	1.4%	17.11	1.3%	30.28	1.8%
Other regions	**383.93**	**36.0%**	**436.84**	**32.9%**	**509.54**	**30.4%**
National total	**1065.18**	**100.0%**	**1329.33**	**100.0%**	**1678.37**	**100.0%**

Source: Data collected from the Ministry of Agriculture of Peru (MTC), the National Institute of Statistics and Information of Peru (INEI) and the Central Bank of Peru (BCRP).

Table 7: Milk production by region

Appendix B

Dairy Market description by regions

Peruvian raw milk production is concentrated in three specific geographical regions, which, for practical purposes, are identified as south, north and central regions (in order of importance). Figure 7 and Table 7 show not only a increasing trend in the production of raw milk, but overall the prevalence of the south region as main producer of such input.

The supply structure of raw milk, which is disperse and atomized: many raw milk producers are small families that provide less than 30 kg/day of raw milk, and usually they live in disperse places in rural areas, where transport infrastructure is barely present. In the two largest zones of production (Cajamarca and Arequipa), small producers comprises 95% and 85% of the total producers, respectively.

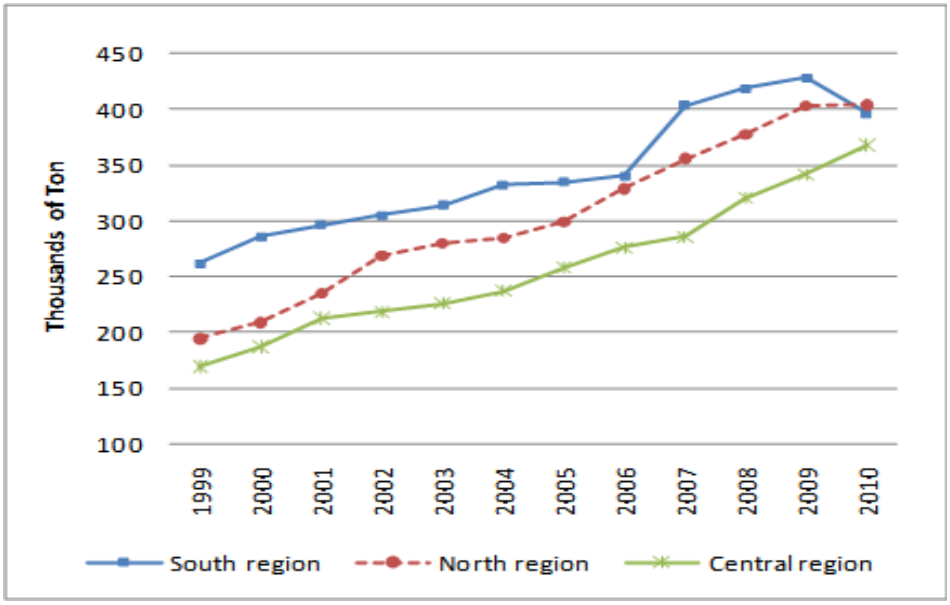


Figure 7: Raw milk production by region(1999-2010)

Source: Ministry of Agriculture Peru

Southern region

The southern region is basically formed by Arequipa, Moquegua and Tacna. Arequipa is the largest producer of the group, but most importantly, of the entire nation contributing one fifth of total production. The production has grown at an average annual rate of 4% during the period 2000-2010, which reached 396.5 thousand tons in 2010 (39% greater than in 2000) (see Figure 7 and Table 7.). However this region's share in the total national production has been decreasing mainly due to improved performance of the Central region.

In this zone, where the production is semi-intensive, the cattle are fed by forage and traditional technology (manual milk extraction) is still used. Around 80% of the producers are small (see Table 1 and geographically disperse, and the big industry is their main purchaser. Gloria and Laive each have two production plants in this region; however, Gloria collects almost the 80%

of the milk in this zone (Carrera, 2008) due to the fact that its largest evaporated milk plants are located in this region (see Table 8). [23]

	Gloria		Nestle		Laive	
	N° of production plants	Purpose	N° of production plants	Purpose	N° of production plants	Purpose
Arequipa	2	Evaporated milk prod., and collection and milk pre-process	-	-	2	Cheese and butter, and evaporated milk
Cajamarca	1	Other dairy products (cheese, butter, yoghurt)	1	Pre-condensed milk prod.	-	-
La Libertad	1	Collection and pre-processed milk	-	-	-	-
Lima	1	Evaporated milk and other dairy products	1	Evaporated milk prod.	1	Evaporated and other dairy
Total	5		2		4	

Source: Gil (2004), Carrera (2008) and Gloria, Nestlé and Laive's annual reports.

Table 8: Processed milk plants' location by firm

Central region

The central region comprises Lima (Peru's capital and largest city), Ica and Junin, with Lima being the largest producer. The milk production of this zone has shown a dynamic growth, increasing at an average annual rate of 7% during the period 2000-2010. Its production reached a total production of 368.3 thousand tons in 2010, a figure that almost double the amount produced at the beginning of the decade (see Figure 7 and Table 7).

In contrast with the other regions, the central zone is characterized for using more technology(extraction techniques and genetic technology for the cattle to improve their productivity), for being more capital intensive (using specialized machineries for milk extraction for example), forage is not extensively used, and cattle is mainly fed by using concentrated food. Although small producers account for more than half, a larger portion of the producers can be classified as medium to large size (41% of the milk producers produce above 101kg/day); therefore economies of scale are more likely to help in undertaking investment, and also production may be favored for its closeness to the major market (Lima) and the benefits of more accessible infrastructure.

Also, all the industrial firms have their principal production plants in this zone. Once again, Gloria is the leading purchaser, accounting for over 85% of the milk sold to the industry (Carrera, 2008). The remaining amount is almost evenly shared by Nestleànd Laive.

[23] Gloria has implemented a collection route to directly purchase the milk from more than 15000 producers that are geographically dispersed; thus incurring additional costs to collect milk. By 2005, Gloria collected milk from 8960 producers in the south, 3530 in the central and 1240 in the north region (GLORIA, 2005).

Northern region

The northern region is mainly comprised by Cajamarca and La Libertad, with Cajamarca being the largest producer. Similar to the central region, milk production in 2010 within this region almost double the amount reached in 2000. Indeed, the production in this zone grew at an average annual rate of 7% during the last decade (see Figure 7 and Table 7). Its good performance has led this region to increase its production share to almost one fourth of the total national production.

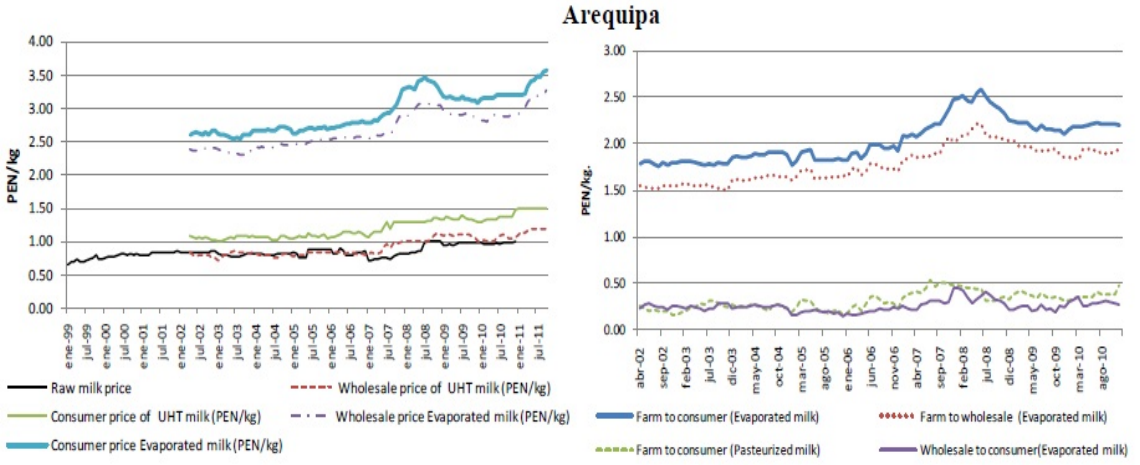
Very similar to the southern region, the North uses traditional technology, cattle are fed with forage and the production is semi-intensive. Raw milk producers are mostly small and disperse (around 97% of the total produced less than 100kg/day by 2004). Gloria and Nestlé have their production plants in this zone; Nestlé is the largest purchaser accounting for around 74% of the milk sold to the big industry, the remainder is purchased by Gloria (Carrera, 2008).

Price spreads by region

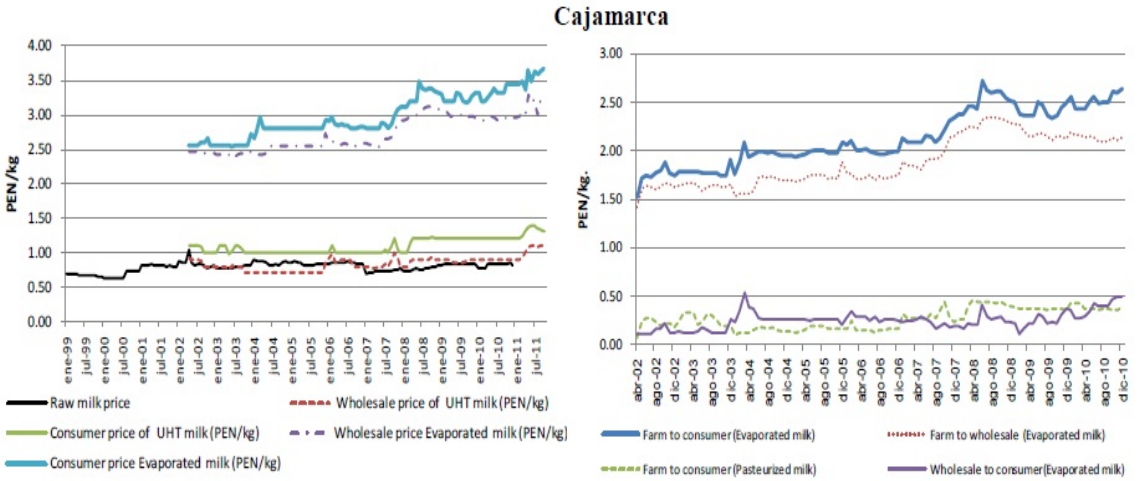
Given the distinctiveness of three production zones, each with different characteristics and large buyers (mainly Gloria in the South and Center, and Nestle in the North), average prices and prices spreads by region are depicted in Figure 8. In general, raw milk price (farm price) seems to remain stable over time in all the regions, actually the coefficient of variation are small in all three representative regions and at national level. Another remarkable observation is that average prices vary across region: on average, producers in Lima are paid the highest (1.04 PEN/kg in 2010), followed by Arequipa (0.98 PEN/kg in 2010) and Cajamarca (0.82 PEN/kg in the same year), differentiation that might be related to the differences in technology, productivity and closeness to big industry and the largest market.

Another observation is the clear gap between UHT and evaporated milk, which suggests that UHT milk, is more affordable (and therefore might be preferred) in regions outside of Lima, since the evaporated milk price is a little bit higher in these regions. According to the graph, retailers (still comprised of many small stores) might not be playing a big role in overpricing the industrialized milk but potentially they would as they acquire more buyer power.

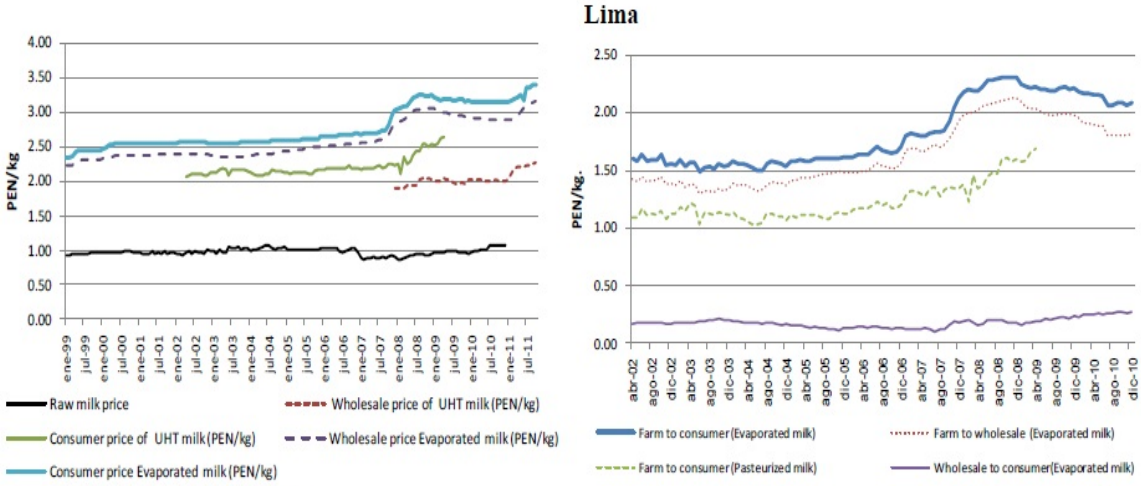
From the price spreads graphs, it is observed that the spread gets larger in regions outside of Lima, which shows an increasing trend particularly in Cajamarca. The farm-to-consumer spread was in average 2.52 PEN/kg in Cajamarca, 2.2 PEN/kg in Arequipa and 2.11 PEN/kg in Lima.



Source: Ministry of Agriculture of Peru



Source: Ministry of Agriculture of Peru



Source: Ministry of Agriculture of Peru

Figure 8: Prices evolution (left) and price spreads evolution (right) per region

Appendix C

	Demand(Q^d)		
Variables (detrended and seasonally adjusted)	**2SLS (1)**	**SE 3SLS (2)**	**GMM (3)**
Log of price of raw milk	-2.027***	-2.021***	-1.974***
	(0.245)	(0.239)	(0.225)
Log of evaporated milk prod. lagged one month	-0.073*	-0.072*	-0.089**
	(0.039)	(0.037)	(0.032)
Log of price of evaporated milk	0.635***	0.620***	0.636***
	(0.126)	(0.122)	(0.141)
Log of gasoline average price(diesel)	-0.088*	-0.088*	-0.034
	(0.051)	(0.050)	(0.057)
Log of GDP index lagged one month	-0.717***	-0.713***	-0.665***
	(0.135)	(0.131)	(0.085)
Log of real minimum wages index	-0.103	-0.118	1.248
	(0.078)	(0075)	(0.872)
Log of dairy imports	0.007	0.008	0.002
	(0.007)	(0.006)	(0.006)
Constant	0.004	0.004	0.002
	(0.003)	(0.003)	(0.003)
R^2	0.155	0.157	0.172
Adjusted R^2	-	-	0.138
Root mean	0.039	0.038	0.038
Nobs	180	180	180

[a] ***, **, * denotes statistic significance at 1%, 5% and 10% level respectively.
[b] Columns (1) shows two-stage Least Squares estimates, (2) shows the 3SLS simultaneous equations estimates; and (3) shows the GMM estimates.
[c] Robust errors are given in parentheses for all columns.

Table 9: Demand estimation: Log of quantity produced of raw milk as dependent variable