Small scale farmers in the market and the role of processing and marketing cooperatives: A case study of Italian dairy farmers

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Declaration

I hereby declare that this thesis has not been, and will not be, submitted in whole or in part to another University for the award of any other degree.

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SUMMARY

Agricultural markets are often characterised by imperfect competition between buyers of farm produce. Cooperatives are often regarded as one possible way to enhance welfare for small producers, while others view them as an inefficient historical relic.

My thesis investigates empirically the coexistence of cooperative and capitalistic processing and marketing firms in the market for raw milk in three Italian provinces, using a dataset I collected via a survey of dairy farmers.

First, I analyse what accounts for variation in market structure within each province and what drives coop membership when choice is available. Geography is found to influence both number and nature of processing firms operating at a given location. Where farms are more isolated and scale of production is smaller, cooperatives have – historically – tended to prevail, and often remain the only buyer today. Where both coops and capitalistic processors are available, parental membership status is more important for the decision of a farmer to join the cooperative, suggesting some degree of inertia.

Second, I investigate whether there is any evidence that selling through a cooperative makes a difference for farmers, with respect to both price and non-price characteristics of the relationship. With respect to non-price characteristics, results show that cooperatives draw less complex contracts with members compared to capitalistic processors with their suppliers, are less likely to pay a lower price than agreed, and more likely to offer technical assistance. Members and non-members do not appear to differ in their perceived net benefits from the exchange relationship, but benefits from membership appear to be larger for smaller than larger farmers.

As regards whether cooperative membership, *per se*, has any effect on price paid to farmers, the theoretical literature suggests that asymmetric price competition between two firms with different objective functions, in a spatial market, under different spatial pricing policies, can lead to price differences between the two. This prediction is tested by estimating the effect of coop membership on prices paid using four different non-experimental evaluation methods. The results show a positive and significant effect of membership, driven by more remote farmers with smaller scale of production, located in areas of cooperative monopsony.

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Acronyms

IV-2SLS	Two-stages least squares with instrumental variables
AGEA	Agenzia per le Erogazioni in Agricoltura
ATE	Average treatment effect
ATNT	Average treatment effect on the non-treated
ATT	Average treatment effect on the treated
CF	Control function method
CIA	Conditional independence assumption
EC	European Commission
EU	European Union
EU15	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom
EU27	Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom
FADN	Farm Accountancy Data Network
FILM	Fully interacted linear model
FOB	Free-on-board price
ICA	International Cooperative Alliance
IMR	Inverse Mills Ratio
IOF	Investor-oriented firm
ISTAT	Istituto Nazionale di Statistica
IV	Instrumental variable
LATE	Local average treatment effect
MIPAAF	Ministero delle Politiche Agricole Alimentari e Forestali
MRP	Marginal revenue product
NARP	Net average revenue product
NEM	Non-experimental evaluation method
NGC	New generation cooperative
NRP	Net revenue product
OECD	Organisation for Economic Co-operation and Development

OLS	Ordinary least squares
PD	Price differential
PDO	Protected designation of origin label
PF	Pinzolo Fiavè
PSM	Propensity score matching
RP	Reservation price
SUTVA	Stable unit treatment value assumption
TA	Technical assistance
UD	Uniform delivered price
UK	United Kingdom
US	United States
WMW	Wilcoxon-Mann-Whitney

Chapter 1 – Introduction

1.1. Research questions and evidence base

The characteristics of agricultural markets, including the perishable and bulky nature of many farm products, the spatially dispersed character of farm production versus spatial concentration at the processing and marketing stages, specialisation of processors' needs for agricultural products, and farmers' specialised investment for the supply of particular commodities, are conducive to imperfect competition among buyers of farm produce. In recent years, consolidation in upstream and downstream industries in the agricultural sector has further intensified challenges for farmers, by increasing the disparity in size and bargaining power between them and other actors in the agricultural value chain.

Cooperatives are often regarded as one possible way to increase competition among buyers and enhance welfare for farmers, particularly smaller ones, by improving the terms of trade for both members and non-members and contributing to better livelihoods in rural areas (Sexton 1990; Hussi and Murphy 1993; Carletto, de Janvry et al. 1999; Birchall 2003; Page and Slater 2003). However, cooperatives are also sometimes viewed as a transitory institutional arrangement typical of the early stages of economic development, to be supplanted by capitalistic firms as the market economy develops. In this view, cooperatives are inherently inefficient due to high costs of collective action, and their survival at later stages of development is seen as a distortion resulting from state involvement via subsidies or favourable legislation (Ward 1958; Alchian and Demsetz 1972; Jensen and Meckling 1979; Porter and Scully 1987).

In fact, agricultural markets in higher income countries with developed market economies are still today characterised by the coexistence of both cooperative and capitalistic processing and marketing firms (Sexton and Lavoie 2001; International Cooperative Alliance 2010; USDA 2011). A motivating concern of this thesis is to shed some light on the reasons and implications of such coexistence. The focus is on the interaction between cooperative and capitalistic firms in a given area. A number of questions were on my mind when I embarked on this project. Why do some farmers, but not others, sell through cooperatives? What benefits do they expect and what do they actually obtain, and how does this compare with the experience of similar farmers selling through capitalistic firms? Ultimately, does selling through cooperatives make any difference for members and in particular for smaller producers, with respect to the price and non-price characteristics of the transaction? More specifically, the thesis does not provide any new analytical results, but instead investigates empirically the following questions:

(1) What accounts for the variation in number and organisational form of milk processing and marketing enterprises, namely the fact that in some areas only capitalistic processing firms operate, in others only cooperative firms operate, and in yet others both are observed?

(2) When farmers can choose between buyers with different organisational forms, what drives the decision to join a cooperative?

(3) Do cooperatives provide farmers with a significantly different kind of exchange relationship compared to capitalistic processors with respect to non-price characteristics of the transaction, namely contract content, compliance with the agreement, provision of technical assistance services, and overall net benefits as perceived by farmers?

(4) What accounts for the variation in price received by farmers; in particular is there any evidence that organisational form of the buyer *as such* has any effect on farmgate price?

These questions are analysed using an original data set on dairy farms which I collected via a survey in three Italian provinces (that is, intermediate administrative units between a region and a municipality), characterised by the coexistence of cooperative and capitalistic processing firms. The data set combines information on production and socio-economic characteristics of dairy farms with detailed information on the relationship between farmers and their milk buyer, and allows comparing farmers who are members of and sell milk to a dairy processing and marketing cooperative with farmers selling to a capitalistic processor.

The remainder of this chapter is organised as follows. Section 1.2 introduces the basic definition of cooperative firm adopted in the thesis, and provides an overview of heterogeneities among cooperatives and key differences from capitalistic firms. Section 1.3 outlines key potential costs and benefits that farmers can expect when dealing with a cooperative or with a capitalistic buyer. Section 1.4 presents two alternative scenarios on the possible role that cooperatives can play for their members. Section 1.5 discusses the choice of sector and geographical focus of this research. Section 1.6 outlines the structure of the thesis.

1.2. Dairy processing and marketing cooperatives: basic definition, institutional heterogeneity and key differences compared to capitalistic firms

A dairy processing and marketing cooperative is defined in this thesis as an organisation that is owned, controlled and financed by its member-farmers, who benefit from its services and share the profits it earns in proportion to the volume of milk they sell through the cooperative.

The distinctive features of a cooperative were stated in the original Rochdale Principles designed in 1844 by the Rochdale Society of Equitable Pioneers in Rochdale, England, later recognised and endorsed by the International Cooperative Alliance.[1] These include open membership, the principle of one-member one-vote, limited returns on equity capital, operation at cost, and a duty to educate in the principles and techniques of cooperation (Cotterill 1987). The operation at cost principle means that any net margins made by the cooperative should be returned to members in proportion to patronage, that is, their sales through the coop. These principles stem from the social and economic circumstances in which early cooperatives where formed in the 19th century, and which contributed to defining the values that, at least in principle, inspire their operations, including “self-help, self-responsibility, democracy, equality, equity and solidarity” as well as “honesty, openness, social responsibility and caring for others” (International Cooperative Alliance 1995). Cooperative values and principles reflect the attempt by cooperatives to address market failures and avoid the exercise of market power by other actors located up- or downstream from the farm, but also a wider concern and engagement for better social and economic conditions, especially for the welfare of smaller scale producers and lower income consumers (Zamagni 2005). Legally recognised cooperatives still today make at least a formal endorsement of these principles.

[1] The Rochdale Society of Equitable Pioneers was an early consumer cooperative and considered to be the model for the subsequent development of the cooperative movement. The International Cooperative Alliance (ICA) is a federation of cooperatives founded in 1895 and representing cooperatives and the cooperative movement worldwide.

In practice, however, cooperative firms are a heterogeneous category, adopting a variety of different organisational forms and operational rules that sometimes deviate from one or more of these original principles and are often modified over time in response to changes in market structure and in the socio-economic and political context. "Traditional" cooperatives, characterised by ownership rights, benefits and returns restricted only to members, open membership, and the "one-member, one-vote" principle, often coexist with coops that have introduced a number of organisational innovations, including so called "new-generation cooperatives", partnerships with limited liability companies, and equity seeking joint-ventures (Cook and Chaddad 2004). The purpose of these innovations is to address potential weaknesses of the traditional coop model, where vaguely defined property rights, resulting from the combination of open membership, lack of a market for ownership rights and equally distributed voting rights among members, may discourage members from investing in their cooperative, leading to capitalisation problems for the coop, and may foster decision making inefficiencies, slowing down the cooperative's ability to react to market changes and investment opportunities (Cook 1995).

Vaguely defined property rights create inefficiencies because the decision maker is not bearing the full impact of her actions. Open membership may impede capital accumulation by exacerbating free-rider problems: existing members cannot appropriate the full value of the benefits deriving from the investments which they have funded, but instead must share these with any new members (Iliopoulos 2005). Meanwhile, because members' ownership rights do not vary over time to take into account changes in the profitability of the cooperative, and sales of these rights are typically restricted, members may lack incentives to invest in long term projects which generate returns over a period which is longer than the investor's own time horizon (Furubotn and Pejovich 1970). Capital mobilisation from members is further discouraged because larger-scale investors cannot expect to exert proportionally greater influence on their cooperative's investment decisions.

Lack of a market for ownership rights and equally distributed voting rights among members can also lead to decision-making inefficiencies. First, because most cooperatives do not float their shares in the stock market, and because the secondary market for cooperative shares is limited or nonexistent, members cannot rely on fluctuations in the stock prices of their cooperative as an indicator of management performance or an instrument to discipline managers, generating a control problem

(Vitaliano 1983). This often results in the board of directors having to play a much more activist role in cooperatives than in capitalistic firms, generating a more cumbersome and potentially slower decision-making process and governance system (Staatz 1989). Second, an influence cost problem may arise because lack of a market for members' ownership rights reduces their exit options and may instead encourage them to try to influence decision-making to their own advantage (Porter and Scully 1987; Hart and Moore 1996).

Among the alternative institutional arrangements developed in order to cope with these problems, the model of new generation cooperatives (NGCs) has been expanding fast since the 1980s from North America, to Australia, to parts of northern Europe.[2] NGCs are closed-membership cooperatives, with a system of fixed, binding and transferable output delivery rights and capital subscriptions that are proportional to usage, marketable and appreciable. In other countries, including Italy, cooperatives tend to maintain a traditional structure, and partnerships with limited liability companies or equity seeking joint-ventures have been preferred in order to address capitalisation problems.

Despite heterogeneity among cooperatives with respect to organisational forms and operational rules, two features distinguish them clearly from capitalistic, or "investor-oriented", firms (IOFs).

First, a cooperative is primarily an association of persons and not of capital: the size of an individual's capital holdings in a cooperative is not a determinant of her influence, in terms of voting power, within the organisation. Changes to the one-member-one-vote rule usually lead to a system where voting power is proportional to patronage, not to capital. When capital subscriptions from non-member shareholders are allowed in order to raise capital for investment, as in Italy, the amount that can be subscribed and the attached voting power are tightly regulated by law. This configuration may favour the capital accumulation problems discussed above, which may place cooperatives at a relative disadvantage compared to capitalistic firms. However, such a system based on principles of equality and democracy may also foster an environment of trust and

[2] Between 1983 and 1987 a severe agricultural depression struck US farmers, due to global excess supply, slow growing domestic markets and highly leveraged producers. When the depression finally eased, US agricultural cooperatives found themselves with reduced market shares and a disappointed membership who had become sceptical about cooperation due to its perceived ineffectiveness in helping members during that difficult time. This pushed cooperative leaders and scholars to look for alternative institutional arrangements that could improve coops' ability to serve members' interests. New generation cooperatives are the main organisational innovation that emerged from this period of crisis.

collaboration, lowering transactions costs within the cooperative (Hendrikse and Bijman 2002).

Second, users of the cooperative are its owners and residual claimants: members are entitled to the net income generated by the firm, and are the residual risk bearers of the firm's net cash flows. As a reward for being residual claimants, any net margins made by the cooperative belong to members. In addition to the price received for the product marketed through the coop, unlike suppliers of a capitalistic firm, member-farmers also receive a dividend, that is, a share of the cooperative profit (if any) in proportion to the value of business done with their society, in accordance to the principle of operation at cost. Members, directly or indirectly through the board of directors, decide how to implement this principle and what share of the net margins of the cooperative, if any, to allocate to dividends, retained earnings for capital accumulation, and provision of common services.[3]

From the difference in ownership structure between cooperatives and capitalistic firms stems the difference in their objectives. Capitalistic firms are typically assumed to maximise profits. Conversely, a variety of objectives may be adopted by cooperatives and the one that is chosen is seen as the outcome of an internal bargaining process, reflecting the relative strength of different agents, including groups of members, managers and board of directors (Staatz 1983; Sexton 1986b; Staatz 1987c; Zusman 1992; Vercammen, Fulton et al. 1996; Bourgeon and Chambers 1999). A coop may, in theory, pursue a profit maximising objective, especially when managers have a strong influence and their performance is assessed on the basis of accounting profits (Bateman, Edwards et al. 1979). More commonly, however, cooperatives are seen as either maximising welfare, that is joint cooperative and member profit; or maximising price paid to members, subject to a break even constraint (LeVay 1983a; Cotterill 1987). The scant empirical evidence on the objective actually pursued by cooperatives finds results consistent with either the objective of price maximisation (Sexton, Brooks et al. 1989) or welfare maximisation (Boyle 2004). Pursuing either of these objectives means that cooperatives take into account the surplus generated for members when they take decisions with respect to price and quantity purchased, while capitalistic firms do not.

[3] It is of course possible that farmers would buy shares of a capitalistic processing and marketing firm, thus becoming its owners. Decision rights in these two organisational forms would however differ, as voting rights for farmer-shareholders within a capitalistic firm would be proportional to their capital subscriptions, not to their patronage, as in a cooperative. In practice, in capitalistic firms few investors have any other business ties to their organisation than their equity investment, and farmers tend to perform only the role of input suppliers (Sykuta and Cook 2001).

1.3. Costs and benefits from joining a cooperative vis-à-vis supplying a capitalistic processor

There are a number of quantifiable and non-quantifiable relative costs and benefits for farmers that are, at least in principle, associated with cooperative membership vis-à-vis trading with a capitalistic processor.

Costs of cooperative membership include the membership fee required for joining; the opportunity cost of capital invested in the cooperative; the opportunity cost of time spent in attending compulsory meetings and negotiating decisions with other farmers; the entrepreneurial risk entailed in being the residual risk bearers of the cooperative's net cash flows; the risk that influential members may hijack the cooperative for their own benefit, exploiting the rest; and a delay in receiving the full value of the product marketed through the cooperative, because payment is typically made in partial instalments each month and the full value is only paid at the end of the financial year.

Possible benefits of cooperative membership include a price that is, potentially, at least as high as that paid by a capitalistic processor, and may be higher if the cooperative makes a profit and distributes part of it as dividend; a commitment by the cooperative to supporting the technological development of members' farms; satisfaction for being part, albeit to a varying degree, of the decision-taking process; satisfaction derived from the relationship with a firm that appeals to values of equity, equality, solidarity and social responsibility; and security, possibly pride and sense of belonging, as well as social benefits, that come from group membership.

Farmers supplying a capitalistic processor face a different set of potential costs. The perishability and high transport costs of many agricultural products, including milk, facilitate imperfect competition among a limited number of local buyers and their exercise of market power. Disadvantages that arise when supplying a capitalistic processor that enjoys some degree of market power include the possibility of being paid a monopsonistic price; confronting the risk of opportunistic behaviour by the processor who, once the contract has been agreed, may have incentives to renege on its terms, for instance buying or paying less than agreed; and the risk that the processor may unilaterally decide to terminate the exchange relationship.

Compared to cooperative membership, however, supplying a capitalistic processor offers a number of benefits, including the opportunity to focus on milk production, without being involved in decision making on processing or marketing, or in the governance of the milk buyer. Being just suppliers, and not owners, also means that farmers are not required to invest in the processing firm and are not its residual claimants: they forego having a share in the net income generated by the processing firm, but also avoid being the residual risk bearers of its net cash flows, thus limiting their entrepreneurial risk to their own farm. At least in principle, suppliers also receive each month the full value of their trade with the processor.

The net benefit from cooperative membership depends on how people value the different monetary and non-monetary costs and benefits associated with joining a cooperative. This may differ across individuals and particular groups. For instance, the net benefit from membership may be larger for smaller farmers who may be more vulnerable to the potential exercise of market power by capitalistic processors. I do not have full information on the net utility farmers receive from dealing with either organisational form, but I do observe the outcome: provided farmers can choose between buyers with different organisational forms, membership status can be interpreted as an indication of which organisational form provides that particular farmer with benefits that outweigh its costs.

1.4. Two scenarios on the possible role of processing and marketing cooperatives

From the characteristics of cooperative firms discussed in the previous two sections it is possible to envisage two stylised, opposite scenarios on the role of processing and marketing cooperatives and their effects on members.

An emblematic picture of "things gone wrong" in cooperatives is provided by Banerjee et al. (2001) for the case of sugar cooperatives in Maharashtra, India (Banerjee, Mookherjee et al. 2001). By government regulation, each cooperative is given local monopsony power over a 'command area' which covers a fixed radius around the cooperative factory, and entry of new cooperatives is tightly regulated. The law forbids cooperatives from distributing profits to members, but this can be accomplished, *de facto*, by adjusting the sugar cane price paid or by reinvesting the profits in the cooperative. The choice of pricing policy thus becomes crucial. The authors find that wealthier members use their influence on their cooperative to depress the unit sugar cane price paid to all members, in order to accumulate a surplus which is only partly reinvested in the cooperative. Instead, a large share of it is used by the cooperative to build local public goods such as schools and hospitals, through construction firms typically owned by wealthier members, who thus benefit disproportionately from these activities, which provide them with political advantage and material benefits. Wealthier members extract a rent from lower-income members, who are essentially captive due to lack of alternatives.

This scenario results, in part, from the particular implications of such extensive government intervention in both the functioning of the market and cooperative regulations. However, heterogeneity among members and coexistence of different interest groups are common in cooperatives and may give rise to negative outcomes for some or all members (Hart and Moore 1996; Legros and Newman 1996). Different interest groups may compete over pricing and investment decisions in order to extract rents. If cooperatives are unable to design suitable operational rules in order to counter possible free-riding, capitalisation and control problems, this may lead to a loss in efficiency and underinvestment, with adverse potential consequences, both in the short run with respect to price paid and in the long-run with respect to cooperative survival. If some groups have a significantly stronger bargaining power than others, less influential members with no alternative options may end up being worse-off than if supplying a capitalistic processor.

An alternative scenario is one in which cooperatives are no less efficient than capitalistic processors and through institutional design manage to solve potential conflicts of interest and collective action problems in a way that allows them to pay farmers a price that is at least as high as that paid by capitalistic processors, and possibly higher because of profit distribution to members. In this scenario, cooperative also provide a distinctive set of non-pecuniary benefits like the ones discussed in section 1.3 above, which, for some people, outweigh membership costs. There is in fact no conclusive evidence on whether or not capitalistic processors outperform cooperatives: results tend to depend on how well the analysis takes into account differences in objectives between capitalistic and cooperative firms (Sexton and Iskow 1993; Soboh, Oude Lansink et al. 2012). The potential positive outcome of cooperative presence may also extend beyond members. This is the so-called "competitive yardstick effect" of cooperatives: by entering a monopsonistic or oligopsonistic market, coops have the effect of increasing competition and making their rival "more honest" (Nourse 1922). An open-membership cooperative that does not engage in exploitation of its members pushes capitalistic rivals who do not want to be driven out of the market to modify their behaviour and reduces their scope for engaging in oligopsonistic exploitation or *ex-post* opportunistic behaviour towards farmers.

In practice, cooperatives are likely to be a heterogeneous category also with respect to their efficiency, profitability and ability to deliver pecuniary and non-pecuniary benefits to members. They also potentially face a conflict between the short and the long run: the short-run concern for improving members' welfare by paying prices that are as high as possible and distributing dividends may affect the long-run objective of ensuring cooperative survival and viability, which may require retaining at least part of the profits and/or mobilising capital for investment from members. Moreover, the non-pecuniary benefits of membership may vary depending on the size of the cooperative: as membership size increases, it may become increasingly difficult for members to take an active role in the governance of the cooperative and the sense of group belonging may become diluted (Birchall 2004). The findings of this thesis, which deals with a sample that, on aggregate, belongs to different dairy processing and marketing cooperatives, represent an averaging out of such potential heterogeneity.

1.5. Choice of the case study: the dairy sector, Italy and the three provinces

The dairy sector has been chosen as a case study because it presents a number of characteristics, related to the perishable and bulky nature of raw milk, that are conducive to processors' exercise of local market power, and which have historically provided incentives for the formation of cooperatives, but is nonetheless still characterised by the coexistence of both cooperative and capitalistic processors, producing substantially similar final products. This makes it an interesting ground for investigating the interaction between capitalistic and cooperative firms in a market characterised by high transportation costs, and for analysing in what respects selling milk through a cooperative makes a difference, if any, for members.

The data set used in this research allows me to observe a particular market structure configuration at one point in time, in which a given number of processing firms, based at a given location, compete over milk supply within a given area. Such configuration is likely to result from a number of factors, including historical and political ones. This thesis however focuses on observable characteristics and in particular on the role of geography. The observed market configuration could be conceived as a Nash equilibrium resulting from processors' strategic choice of location, organisational form, price and market areas, given heterogeneous local geographical and farmer characteristics. The high degree of heterogeneity in geographical and farmer characteristics, however, greatly complicates matters and the thesis does not develop this kind of modelling. Instead, the three core chapters explore empirically variation in processors' presence within a given area, prices paid, and non-price characteristics of the transaction, with respect to which processors may also compete in addition to prices.

Italy is a useful case study for a number of reasons. First, the cooperative sector plays an important role in Italian agriculture, involving almost 800,000 farmers in about 12,000 agro-food cooperatives, producing about 35% of the total value added of the sector (MIPAAF 2009).[4] Italian agricultural cooperatives also play a significant role in the European co-operative movement, being fourth in terms of turnover and second in terms of employees (MIPAAF 2009). However, cooperatives are not the only actor in agricultural markets, where they typically coexist with capitalistic processing firms. In 2006, cooperative members contributed 28% of the volume of agricultural commodities produced at national level, and 46% of those produced in the north of the country. In the dairy sector, 63% of Italian farmers sell milk to a cooperative firm (Pieri and Del Bravo 2008), but this share is higher in the north. This reflects historical regional differences in initial cooperative diffusion and political support to the movement, which have persisted over time. The south, in particular, is characterised by a more limited presence of cooperatives, which is often attributed in part to an overall lower degree of trust and social capital in this part of the country (Putnam 1993; Menzani and Zamagni 2010).
Second, the Italian agricultural cooperative sector is interesting because it is characterised by organisational heterogeneity, where large firms with a complex business organisation – still cooperative dominated in principle, but with a strong private enterprise component – coexist with cooperatives with a much smaller turnover, membership size and area of operation, and a much less articulated business structure. For instance, about a third of Italian cooperatives do not employ specialised personnel to perform the key tasks of overseeing supplies and production, marketing, sales and R&D (MIPAAF 2009). The cooperatives represented in the sample exemplify such organisational heterogeneity. They include both the largest Italian dairy cooperative,

[4] It is not possible to calculate the exact number of farmers that are members of agro-food cooperatives due to multiple memberships. Data refer to 2007.

Granlatte, which is based in Bologna, operates on a national scale and has evolved over time into a business group that established and controls an investor-oriented subsidiary; and small scale cooperatives, with a strongly local identity and limited geographical reach.[5]

Third, compared to the rest of Europe, small- and medium-scale family farms are still the predominant agricultural form in Italy. About 80% of total farms are managed exclusively by household members and a further 10% employs fewer hired labourers than household members. With respect to farm size, in 2000, 57% of farms were smaller than 2 hectares and 77% did not reach 5 hectares. Focussing on dairy farms, herd size was less than 6 cows for 34% of farms, and less than 10 for 50% of farms (ISTAT 2001). Over the past ten years, Italian agriculture has undergone a process of fast change towards increased consolidation, and this has been even more marked in the dairy sector, with the exit of a large number of marginal and small farmers, especially in areas less suited to dairy farming, and a substantial increase in size of operations. However, farm size in this sector remains smaller than the average in most other European countries. For instance, In 2007, average herd size was of 30 dairy cows in Italy, against 33 in the EU27 and 41 in the EU15; 44% of Italian dairy farms still had a herd size smaller than 10 in 2007, against 47% in EU27 but only 25% in EU15.[6] This heterogeneity in farm scale of production enriches the analysis because it allows exploring whether the role of cooperatives is different for different groups of people, and in particular for smaller farmers.

The provinces studied in the thesis were not chosen randomly. Primary data collection was necessary in order to answer the research questions, due to lack of suitable existing sources. At the initial stages of this research I was advised that, given the type of questions I was planning to ask, the south of Italy was likely to be a difficult research environment, due to cultural reluctance to sharing information on private businesses. I thus decided to focus on the north. I was also advised that, in order to increase response rates, it was important to gain the support and endorsement of local livestock farmers'

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[5] Hunt and Cazzuffi (2009) use two case studies to provide a comparative overview of the historical evolution and of the main determinants and consequences of institutional changes in both Granlatte, and in a smaller scale, strongly local cooperative, operating in the mountainous province of Bolzano, in the north of Italy (Hunt and Cazzuffi 2009).

[6] EU27 comprises the 27 current member countries in the European Union, while EU15 refers to the number of member countries prior to the accession of ten candidate countries on 1 May 2004. EU15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and United Kingdom.

organisations. I thus sought provinces in the north of Italy where such associations had a large membership among dairy farmers, which made them, at least, a well-known actor in the local rural community. After a number of unsuccessful contacts, I finally obtained the support of farmers' associations in the provinces of Trento, Piacenza and Bologna. These represent, respectively, 1.2%, 2.3% and 0.8% of total Italian milk output, and 1.4%, 2.8% and 1% of milk output in the north. The details and limitations of this choice of geographical focus are discussed more fully in Chapter 3.

1.6. Structure of the thesis

The three core chapters of the thesis, 4 to 6, are interconnected and complementary to each other. They are organised in the sequence described below, but their relationship with each other is more circular than linear. The thesis is organised as follows.

Chapter 2 reviews the existing theoretical and empirical literature on the research questions, focussing on studies of processing and marketing cooperatives. With respect to the theoretical literature, the chapter first draws from existing studies to present a framework for understanding drivers of cooperative formation and membership and of coexistence of cooperative and capitalistic firms in the same market. Second, the chapter reviews the theoretical justification for expecting differences between cooperative and capitalistic processors with respect to the non-price observable characteristics of the relationship with farmers, including contract content, compliance with the agreement and provision of additional services. Third, the chapter reviews in detail an analytical contribution that deals with the complexities of asymmetric price competition between two firms with different objective functions in a spatial market under different spatial pricing policies. This work provides the theoretical justification for expecting differences in prices paid to farmers between cooperative and capitalistic processors, even when they compete directly. Predictions on price differences will then be tested in Chapter 6.

The review of the empirical literature highlights a few limitations of existing studies, which this thesis seeks to address. First, existing studies of cooperative membership typically assume that membership is the result of a choice and that alternatives with different organisational forms are available to farmers. However, this may not always be the case. If the possibility of lack of choice is ignored, the analysis may mix up the determinants of market structure (that is, of the presence of one or more available outlets, and of their organisational form) with the determinants of cooperative membership given the availability of choice, with possibly confounding effects. Second, to the best of my knowledge no empirical studies exist that analyse quantitatively differences between cooperative and capitalistic processors with respect to observable non-price characteristics of the relationship, such as contract content, compliance with the agreement, and provision of other services. Third, the little empirical evidence on producer price heterogeneity that takes into account the organisational form of the processor does not address potential problems of endogeneity between price paid and farmers' selection into cooperative membership, and this can lead to biased results.

Chapter 3 presents the survey methodology and the data collected. It justifies the decision of undertaking primary data collection by assessing the suitability of existing data sources; it explains the choice of survey areas and method and describes the main steps of the data collection process, which involved a mail survey of all dairy farmers operating in the three provinces under study; it then presents the survey instrument used and the additional data collected on the areas under study and on the population of dairy farmers, and assesses data quality and limitations. Finally, it provides an overview of the characteristics of the areas under study, of the sample and of the dairy processing and marketing firms observed to operate in the three provinces, in order to give a flavour of the various levels of heterogeneity that characterise this study. The main limitations of the data that the thesis has to deal with arise from the use of a cross-section sample, which has not been drawn randomly, which makes it difficult to make generalisations of the findings to other regions than just the provinces under study. The data is also composed by a large sub-sample of members and a smaller sub-sample of non-members, with distinct characteristics that limit comparability between them and the suitability of the group of non-members as a control group for estimating the effects of coop membership on particular outcomes.

Chapter 4 analyses variation in market structure within the three provinces and the correlates of cooperative membership when farmers perceive that both capitalistic and cooperative buyers are available to them. While the three provinces are each characterised, at the aggregate level, by coexistence of cooperative and capitalistic processors, analysis of market structure within each province at a more disaggregated spatial level, using municipalities and data on the population of dairy farmers, shows that areas where only one processor appears to operate (that is, to collect milk from farmers at that location) coexist next to areas of overlap between processors; and areas where processor(s) with only one organisational form, typically cooperative, operate coexist next to areas where both cooperative and capitalistic buyers appear to overlap. Analysis of sample data with respect to farmers' perceptions of what is available to them also shows that one third of the sample perceives their current buyer is the only one available to them and less than half of the sample perceives both organisational forms are available buyers.

The chapter first analyses empirically factors that favour the emergence of only one buyer at a given location, using both population and sample data, focussing on geographical characteristics which, in a spatial market where transport costs are non-trivial, are expected to influence the degree of competition between firms. Second, the chapter provides a historical overview of the evolution of the milk market structure in the areas under study into its current configuration, focussing on how local agro-ecological characteristics influenced the interplay between distribution and heterogeneity of farm size and transportation costs, and how this in turn created incentives for the initial organisation of milk processing and marketing into one particular form – cooperative or capitalistic – and incentives for both path dependence and change in the choice of organisational form by subsequent entrants, leading to the current observation of coexistence of areas where only one organisational form operates with areas of overlap between the two. Third, the chapter analyses differences in characteristics between cooperative members and non-members and correlates of cooperative membership. The picture that emerges from the full sample, which includes farmers who perceive only one buyer or only one organisational form is available to them, is compared with that provided by the sub-sample of individuals who perceive both organisational forms are available. This is done in the attempt to separate, at least to some extent, correlates of farmers' choice of buyer when such a choice is available from correlates of a particular market structure configuration. The chapter adopts a reduced form approach to cooperative membership, ignoring for the moment potentially endogenous prices paid, which are analysed in detail in their relationship with membership in Chapter 6.

Chapter 5 analyses differences between cooperative and capitalistic processors with respect to non-price aspects of their relationship with farmers, which can influence farmers' net benefits from cooperative membership. The chapter first presents farmers' self-reported motivations for trading with their current buyer. Second, it examines three observable non-price characteristics of the relationship, namely (a) contract content and complexity and farmers' experience of difficulties during the negotiation of the terms of the agreement, which provide an indication of differences between cooperatives and private processors in the overall level of trust and perceived information asymmetry between them and their members or suppliers; (b) processor's compliance with the exchange agreement with respect to timeliness of payment, milk rejection for reasons unrelated to its quality, and adherence to the agreed price (if any such agreement had been reached); (c) processors' provision, and farmers' use, of technical assistance services.

Third, the chapter analyses farmers' valuation of their net benefit from trading with a buyer with a particular organisational form, using farmers' self-reported reservation prices, that is, the price that a buyer with a different organisational form would have to pay for them to leave their current buyer. This is expected to capture a wider range of relative costs and benefits for farmers, including those that remain unobserved to the researcher. Differences in reservation price between members and non-members, and how net benefits from membership vary across different groups of people depending on their individual characteristics, including scale of production, household dependence on dairy farming and farm manager's age, are investigated.

Chapter 6 investigates what accounts for the variation in producer prices paid, and in particular whether the organisational form of the processor, *per se*, has any effect on prices paid. The key problem studied in this chapter is the evaluation of the causal effect of being in a cooperative, relative to supplying a capitalistic processor, on the price a farmer receives. Ideally, one would like to compare the price an individual would receive in a cooperative with the price that the same individual would receive when selling to a private processor. For each individual, however, only one 'state' is observed: the other remains an unobserved counterfactual, and has to be estimated in a way that provides as close a representation as possible of the potential outcome for actual cooperative members had they been supplying a private processor instead. A complicating factor is that, when more than one option is available, self-selection into cooperative membership can occur on the basis of both observed and unobserved characteristics. Ignoring selection on unobserved characteristics that are correlated with prices paid, and possible differences between members and non-members in the distribution of observable characteristics, would lead to biased and inconsistent estimates of the cooperative effect on prices paid.

This chapter contributes to the existing empirical literature by carefully constructing a counterfactual using and comparing four different non-experimental methods (least squares, instrumental variables, control function and propensity score matching), which address both possible selection bias and non-comparability between members and non-members (albeit at the cost of possible sample selection bias from dropping uncomparable individuals). The purpose of this methodology is to be reasonably confident that a counterfactual is obtained that is as good a representation as possible of the price current coop members would have received had they not joined a cooperative, in order to reach a meaningful estimate of the coop effect on prices paid.

Chapter 7 concludes.

Chapter 2 – Literature review

This chapter examines, without developing any new analytical results, existing theoretical contributions which provide the underlying theoretical motivation for the empirical analysis in the thesis, and reviews the existing empirical analyses on the research questions. The literature on cooperatives is vast and this chapter only focuses on studies of agricultural processing and marketing cooperatives. The chapter is divided into three main sections.

Section 2.1 presents a conceptual framework for explaining cooperative formation and membership decision and analyses empirical contributions on the determinants of cooperative membership. Section 2.2 examines the theoretical justification for expecting differences between cooperative and capitalistic processors in the non-price aspects of their relationship with farmers, and then examines the existing empirical evidence. Section 2.3 analyses first the theoretical justifications offered in the literature for expecting a difference in prices paid between a cooperative and a private processor, even when they compete with each other, focusing on contributions that deal with the complexities of asymmetric price competition in a spatial market under different spatial pricing policies assumptions; and second reviews the existing empirical evidence on the relationship between cooperative membership and producer prices paid. Section 2.4 concludes.

2.1. Cooperative formation and membership

This section is organised as follows: Section 2.1.1 reviews the existing theoretical literature on cooperative formation and membership and Section 2.1.2 discusses the existing empirical contributions on the determinants of cooperative membership

2.1.1. Theoretical contributions on cooperative formation and membership

One of the main arguments used to explain cooperative formation is avoidance of processors' market power (Sexton 1986a; Staatz 1989). Two sources of market power are especially relevant for the case of raw milk. One is the spatial nature of this market, due to the physical characteristics of the product; the other is barriers to entry of new processing firms. Because raw milk is bulky and perishable and its shipping costs are high relative to its unit value, its geographical mobility is often limited. This facilitates buyers' exercise of market power: a processor can lower the price it pays and still be able to source from some suppliers for whom the transportation cost of shipping to another buyer is too high. Due to the importance of space and transportation costs, competition between processing firms is then localised in space and each firm can be considered as competing directly with only a limited number of rivals, even when the number of firms in the market is large (Saccomandi 1998). Thus, each firm operating in a given area enjoys some degree of market power.

In addition to the importance of space, other factors tend to favour imperfect competition in the raw milk market by generating barriers to entry of new processing firms. These include possible technical economies of scale in processing and high fixed costs, influencing firms' minimum efficient size of operations; the high cost to the entrant for creating a reputation and acquiring the necessary technology and know-how; and advertising costs. Moreover, large investments in specialised processing facilities and other assets which have no alternative use create barriers to exit for processors, and serve to deter entry even when positive profits could be earned (Sexton and Lavoie 2001).

The importance of these factors is compounded by potential problems of imperfect information for both farmers and processors and by bounded rationality of agents, implying a limited capacity to analyse available information (Simon 1955). This results in transactions that are characterised by search and negotiation costs, which include the time and monetary costs of discovering potential trading partners (for instance, for farmers, the time and monitoring cost of discovering price and non-price characteristics of the relationship with each prospective buyer and of negotiating the terms of the agreement); as well as contract monitoring and enforcement costs (Goetz 1992; Holloway, Nicholson et al. 2000; Key, Sadoulet et al. 2000). Farmers who incur positive search costs for discovering alternative buyers and offered terms of the transaction may not leave their current buyer immediately following a cut in price paid. Lack of seller 'arbitrage' further weakens competition among buyers.

These conditions can favour processors' exercise of market power towards farmers. This may take the form of payment of a monopsonistic or oligopsonistic price that is lower than the marginal revenue product of milk.

Another way in which a processor can exercise market power is by engaging in opportunistic behaviour once it has entered an exchange relationship with farmers who have become locked into transacting with that particular processor due to lack of alternatives. Opportunism, defined by Williamson (p.234) as "self-interest seeking with guile", means that a buyer has incentives to strategically violate the terms of the agreement with farmers (Williamson 1979). Farmers' lock-in, favouring processor's exercise of opportunistic behaviour, can arise for instance if only one or very few processors are available locally, and if farmers are required to undertake highly specific investments in order to enter into or comply with the exchange relationship with their milk buyer, for instance a highly specialised milk parlour or cooling tank, which cannot be converted to an alternative use. Asset specificity gives processors an incentive to engage in opportunistic behaviour, for instance by paying less than agreed, because the high specialisation of farmers' investment makes it too costly for them to convert the farm and exit milk production even in case the processor reneges on the agreement, making their supply relatively inelastic (Hendrikse and Bijman 2002). In turn, if a farmer foresees this, the specialised investment may not take place, potentially leading to an inefficient outcome (Staatz 1987a).

The vulnerability of farmers, more than other agents, to market power and lock-in problems arises from their weaker bargaining power vis-à-vis capitalistic processing firms, which in turn stems from the difference in size between these two actors (Valentinov 2007). Specific characteristics of agriculture at the production stage, such as uncertainty of outcome and supervision problems when employing hired labour, have favoured the organisation of agriculture around family farms, whose size is constrained by household size given available technology (Binswanger and Rosenzweig 1986; Schmitt 1993). In some cases, mechanisation allows small households to manage very large farms, but capitalistic processing firms, which are often hierarchically organised and face lower monitoring and supervision constraints, face a much weaker constraint on firm expansion, and tend to have a significantly larger size than family farms (Johnson and Ruttan 1994).

These factors provide an incentive for farmers to establish their own firm. By forming their own processing and marketing cooperative, as opposed to just a milk collection cooperative, farmers can simultaneously avoid selling raw produce to private buyers, and establish bargaining power vis-à-vis final purchasers of processed product, including large retailers.[7] Incentives for coop formation may however be stronger for some groups of farmers than for others. For instance, while there is evidence that small farms may be more efficient than large ones with respect to the agricultural production process (among others, (Heltberg 1998)), they may be prevented from realising external economies of scale, whereas larger farms experience advantages in terms of access to inputs, credit, services, marketing and distribution channels. A cooperative pooling and handling members' produce may thus provide farmers, especially smaller-scale ones, with an opportunity to combine the advantages of family based organisation of production, with economies of scale in processing and marketing.

For cooperative formation to occur, however, the incentive for taking collective action must outweigh the costs entailed in cooperative membership. Thus, the actual extent of cooperative presence depends not only on its potential benefits, but also on its costs, and in particular on the internal costs of its governance (Hansmann 1996). The first of these costs is the cost of monitoring managers and inducing them to pursue the objective that members chose. This cost is likely to be smaller, relative to the value of members' transactions with the firm, when members are few, live close to each other and to the coop headquarters, and transact regularly and repeatedly with each other and their cooperative over a prolonged period of time.

The second, and potentially larger, cost is the cost of collective decision making, which typically involves a voting system as a means of aggregating members' preferences. One of the most important determinants of the cost of collective decision making is the extent to which members have different interests and preferences regarding business conduct (Hart and Moore 1996). Where members have very similar interests, for instance because they are all transacting under similar circumstances for similar quantities of a single homogeneous product, decision making costs are likely to be very low. However, as heterogeneity in member characteristics increases, for instance with respect to output scale and quality, time horizon and discount rates, so potentially does

[7] Provided that institutions for contract enforcement are sufficiently developed, the lock-in problems entailed by asset specificity may however be solved effectively not just by a cooperative, but also by using long term contracts with private buyers, which negotiate transaction terms before production (or investment) decisions are made and by committing not to renegotiate (Bogetoft and Olesen 2003). However, if the relationship between farmers and capitalistic processor is characterised by lower levels of trust, processor's commitment to comply with the contract may lack credibility and may not be sufficient to discourage cooperative formation.

heterogeneity in their interests and preferences on cooperative investment, allocation of net earnings, pricing and marketing policies. In turn this is likely to increase decision making costs (Markelova, Meinzen-Dick et al. 2009). Thus, the cost of cooperative membership is expected to be higher and the probability of forming a cooperative to be lower, the higher is local heterogeneity among farmers.

The factors conducive to cooperative membership once a cooperative is established are similar to those leading to cooperative formation. Farmers will join a cooperative if their expected utility from being members exceeds their expected utility from supplying a private processor. The net benefits from membership are expected to be larger, and the likelihood of joining a cooperative higher, for those who are more vulnerable to potential exercise of market power by capitalistic buyers. These are expected to be smaller and more isolated farmers, who have invested in highly specific assets for milk production and/or who rely heavily on dairy farming for their livelihoods (Staatz 1987a). In addition to these observable characteristics, unobservable individual traits influencing farmers' preference for the values and ideals to which cooperatives, at least in theory, appeal, can also play a role (Zamagni 2005). This is however less easily amenable to empirical testing, because of the difficulty of finding an adequate objective measure for *ex-ante* individual preferences for cooperative values.

Overall, this framework helps explaining why cooperatives are a widespread organisational form in agriculture, and why more than one organisational form may coexist in equilibrium as a response to different relative costs and advantages of cooperation for different farmers, depending on their individual characteristics and preferences for the monetary and non-monetary aspects of the relationship with a cooperative.

2.1.2. Empirical contributions on the determinants of cooperative membership

Empirical studies typically model cooperative membership as the result of farmer's choice, as a function of farm and socio-economic characteristics and characteristics of the transaction (Bravo Ureta and Lee 1988; Jensen 1990; Fulton and Adamowicz 1993; Klein, Richards et al. 1997; Pascucci, Gardebroek et al. 2011). Farmers' ability to choose between alternative buyers with different organisational forms is assumed, but usually no evidence is provided to show that this is indeed the case. Klein et al. (1997) is the only study that explicitly recognises the potential problems that arise if this assumption is violated: if the sample includes farmers whose current buyer is their only available outlet, the analysis mixes the determinants of market structure (that is, of the presence of one or more available outlets, and of their organisational form) with the determinants of cooperative membership given the availability of choice, with possibly confounding effects.

Given the assumption that choice is available, a farmer is assumed to choose between different alternatives on the basis of the expected utility yielded by her choice: the *i*-th farmer has an incentive to join the cooperative only if the present value of her expected utility from joining the cooperative is greater than that of not joining. Expected utility is a function of economic and non-economic benefits and costs associated with each alternative and is typically modelled using a random utility framework of the form $U_{ij} = V_{ij} + e_{ij}$. This accounts for the fact that the utility for individual i of each potential outcome j (joining the cooperative or supplying a capitalistic processor), U_{ij}, is the result of both a known (to the researcher) component of utility, V_{ij}, and a random element e_{ij} which depends on unobserved (to the researcher) characteristics, measurement error, as well as information constraints, errors or misperception on the part of each farmer about the true values of her returns to the transaction with each alternative, following (McFadden 1974). V_{ij} depends on observed individual characteristics and attributes of the transaction, $a_{ij}X$. Assuming a linear relationship between U_{ij} and $a_{ij}X$, the net utility from joining a cooperative, U_{iC}, and from selling to a private processor, U_{iP}, can be expressed as

$U_{iC} = \alpha_{iC}X + e_{iC}$

$U_{iP} = \alpha_{iP}X + e_{iP}$

The vector X includes attributes associated with the organisational form of the processor (for instance prices offered, services, and non-monetary characteristics that can be a source of utility or costs for farmers, such as participation in decision making), and farmers' characteristics, which affect both individual-specific gains and costs from choosing either type of processor (Masten and Saussier 2002). An element of X that has an effect α_{iC} on the utility of membership which exceeds the effect α_{iP} on the utility of non-membership, increases the probability that coop membership is chosen.

Formulating the membership decision as a random utility model allows making probabilistic statements about farmer behaviour and choice, which are typically estimated empirically via a logit or probit model. In practice, there are a few potential problems with this way of treating membership decision. First, as already mentioned, when only one buyer is available, it is misleading to formulate the problem as a matter of ‘choice’, and there is a potential endogeneity problem between the attributes of the transaction, observed individual characteristics (for instance quantity of output sold) and membership status, which needs to be investigated and, if necessary, addressed empirically. Second, the relevant transaction characteristics influencing individual choice (if such choice is available) are likely to be the *relative* characteristics of the transaction, that is, for instance, offered price and services relative to what would be offered by the next best available alternative. Such unobserved counterfactual would have to be estimated empirically.

Early empirical contributions on the determinants of cooperative membership mostly provide results that can be interpreted more confidently as correlations rather than causally. Bravo Ureta et al. (1988) compare the socio-economic characteristics of dairy cooperative members and non-members based on a cross-section of 537 US dairy farmers, 82% of which are coop members. In a logit analysis for the probability of membership, the authors find that this varies by region, and that it is positively related to the number of extension contacts which the farmer had, and negatively related to yield per cow and farm size, measured as number of cows on farm. Possible reverse causality between membership and extension contacts, and concerns of possible endogeneity between yield per cow, farm size and cooperative membership, are not investigated. Jensen (1990) analyses reasons that influence choice of cooperative versus capitalistic processing firm for a cross-section of 594 Tennessee dairy farmers and finds that larger farmers are more likely than smaller ones to decide on outlet type on the basis of price paid and timing of payment, while smaller farmers are more likely than larger ones to choose the buyer that fellow farmers recommend, or to perceive that their current buyer is their only available choice. The latter finding suggests smaller farmers may have lower bargaining power compared to larger ones.

Fulton and Adamowicz (1993) consider membership and patronage decisions as separate and use a random utility model to analyse farmers’ decision to patronise a cooperative. This study is an empirical contribution to the analysis of the problem of cooperative loyalty: a farmer may join a cooperative, but may then decide to free ride and sell her output to another processor, taking advantage of the potential competitive yardstick effect of the cooperative in the industry. However, if enough members are disloyal, the cooperative may cease to exist. The analysis is based on a cross-section of 403 members of a large open membership grain cooperative in Alberta. The authors find that those farmers who i) have a larger percentage of income coming from grain farming, suggesting a higher degree of asset specificity, ii) attribute high importance to the possibility of sharing in the profits of the cooperative, and iii) attribute high importance to the availability of additional services (such as technical assistance and market information), are more likely to patronise the cooperative.

The question of patronage for cooperative members in Alberta is also investigated by Klein et al. (1997), who find that the share of business conducted with coops increases with farm size (measured as total value of farm sales), farmers' age and positive perception of coops. The attribution of explanatory power to farmers' perception of the cooperative, by both Fulton & Adamowicz and Klein et al, is however problematic: the direction of causality is unclear and may in fact go from patronage to perceptions, and unobserved characteristics may be influencing both perceptions and patronage decisions, thus biasing the results. Potential endogeneity is briefly acknowledged, but not dealt with empirically. Also the total value of farm sales, which is a function of prices paid, may suffer from endogeneity with respect to patronage decisions. For these reasons it is difficult to interpret these results causally.

Pascucci et al. (2011) model jointly farmers' decision to join and patronise a processing and marketing cooperative via a bivariate probit model, identifying four groups: members who sell via the coop (strong membership); members who do not sell via the coop (soft membership); non-members who sell via the coop (shadow membership); and non members. They use a large cross-section of Italian farmers with different specialisations (including dairy, horticulture, grains and meat). The paper assumes that membership and delivery decisions are closely related and a function of similar observed and unobserved characteristics. The two decisions are modelled as a function of the same explanatory variables, except for age of farm manager and participation in networking activities (such as membership of producer associations) that are assumed to influence membership but not delivery decisions; and for a cooperative dummy included in the model of delivery decision. Explanatory variables include individual characteristics (operated land area, productive specialisation, and socio-economic characteristics of the farm manager) and local characteristics (including dummies for agro-ecological conditions; a dummy for farm location in the south of Italy, where cooperative presence is historically lower; agricultural labour as share of total labour in the region; total number of processors in the region; cooperative processors as share of total processors; and the share of coop processors by product specialisation).

They find that a larger number of processing firms, both cooperative and private, decreases the likelihood of both joining and patronising a coop, suggesting that preference for cooperatives may decrease as more options become available. Farm size in terms of acreage has no significant effect on either membership or deliveries, but farm size in terms of total assets does: farms with more assets are more inclined to deliver to a co-op, a finding consistent with the asset specificity hypothesis of coop membership. Farms specialised in dairy are significantly more likely than others to both join and deliver to a coop. Older and more experienced farmers who work on their farm and have a successor already working on farm are more likely to join a coop but not systematically more likely to deliver to a coop. Being located in the south of the country increases the probability of membership but decreases the probability that coop members will deliver to the cooperative. Being located in a mountainous or hilly area decreases the probability of membership but has no effect on deliveries. The latter two are surprising findings, contrasting with the expectation of a weaker cooperative presence in the south and the hypothesis that farmers' vulnerability to potential exercise of market power increases with farm isolation, which in turn is likely to be higher in hilly and mountainous areas due to higher transportation costs. However, these results may be partly driven by the great heterogeneity in sectors, agro-ecological and institutional characteristics of the areas under study, and may reflect heterogeneity in the relative strength and presence of different cooperatives in different parts of the country.

Overall, these studies find weak supporting evidence for the theoretical prediction that smaller farms (where farm size is often defined as value of output sales) are more likely to participate in cooperatives because gains from economies of scale in inputs purchase or output processing, and vulnerability to market power, are higher for them. On the other hand, the asset-specificity and lock-in argument is not at odds with the finding that larger farmers, who are likely to be more specialised and thus, *ceteris paribus*, may have more to lose from *ex-post* opportunistic behaviour of processors, are more likely to patronise cooperatives.

The analysis in this thesis confronts the limitation that membership and patronage decisions are assumed to be equivalent, that is, it is assumed that, in the sample, only cooperative members sell to a cooperative, and no cooperative member sells to a capitalistic processor, based on the answers given by farmers to questions on membership status and on the name of their main milk buyer. Pascucci et al. find evidence that this is not always the case in their sample. However, they also find that this is most likely to happen in the south of Italy and among members of cooperatives specialised in olive oil production, while membership and delivery to the same cooperative are most likely in dairy processing and marketing cooperatives and when the owner of the farm enterprise also works in her farm. Given that my sample is entirely composed of dairy farmers, who own and work in their own farm, on balance this suggests that the assumption of identity between membership and patronage decision is not particularly problematic in this particular application.

The reviewed empirical studies also confront a number of limitations. Cooperative membership is assumed to be the result of a choice, but the relationship between the geographical characteristics of a given area, farm characteristics, cooperative presence and availability of alternatives is not explicitly considered. The potential endogeneity of cooperative membership and total value of output sold is not investigated. In some cases (Fulton and Adamowicz 1993; Klein, Richards et al. 1997) farmers' subjective perceptions about coops are attributed explanatory power without recognising the possibility that the direction of causality may go from patronage to perception; that cooperative 'socialisation' may bias *ex-post* the self-reported importance that members' attribute to cooperative related values and activities; and that subjective perceptions may differ among individuals. Pascucci et al. (2011) address several problems that characterise the previous empirical literature, by controlling more extensively for local geographical characteristics and market structure, but deal with a potentially very heterogeneous sample, where cooperatives and farmers operating in different sectors may have very different characteristics. Moreover, a definition of market structure in terms of total number of processors and relative share of coops does not necessarily capture whether alternatives actually exist for an individual farmer.

2.2. Expected differences between cooperatives and capitalistic processors in the non-price characteristics of the exchange relationship with farmers

This section is organised as follows. Section 2.2.1 reviews theoretical contributions which justify why differences between cooperative and capitalistic processors can be expected in the non-price aspects of their relationship with farmers. Section 2.2.2 examines the existing empirical evidence.

2.2.1 Theoretical contributions on differences between cooperatives and capitalistic processors in the non-price characteristics of the relationship

The difference in ownership structure between cooperative and capitalistic firms is expected to influence the observable price and non-price characteristics of their exchange relationship with farmers because it results, at least in principle, in a different alignment in objectives and incentives across agents within each organisational form. In a capitalistic firm, where farmers are just suppliers and not owners, any increase in payment for the produce supplied by farmers (e.g., milk), and/or provision of other services free of charge, represents a decrease in the residual income for its owners. Conversely, provided members are relatively homogeneous and the cooperative does not extensively engage in redistribution of welfare among members, the producer-owned and producer-governed nature of cooperatives makes this organisational form, at least in theory, more likely to be producer-oriented, since producers are involved in both sides of the transaction (Sykuta and Cook 2001).

Objectives and incentives may thus be better aligned across stakeholders in a cooperative than in a capitalistic firm. As a result, the processor-supplier relationship in capitalistic firms is expected to be characterised by lower levels of trust and higher levels of perceived information asymmetry compared to the relationship between a cooperative and its members (Bogetoft 2005; Bontems and Fulton 2009). This is supported by a growing body of empirical evidence (Balbach 1998; Casadesus-Masanell and Khanna 2003; James and Sykuta 2005; James and Sykuta 2006).

The different alignment in objectives and incentives and the ensuing expected differences with respect to trust are hypothesised to have implications for a number of observable non-price characteristics of the relationship.

First, they can influence contract content and complexity and the ease of reaching an agreement between different parties. Sykuta and Cook (2001) hypothesise that contracts between capitalistic firms and their suppliers will be more detailed and more complete than contracts between cooperatives and their members, and more likely to specify clearly the final product price, in order to compensate for the lower level of trust and stronger need for coordination and harmonisation of incentives in capitalistic firms. In turn, more complex contracts can entail substantial costs: they are less flexible in accommodating for unforeseen circumstances and are likely to require more costly negotiation, monitoring and enforcement costs. According to James and Sykuta (2005:

548), “organizations exhibiting greater levels of trust among members are likely to operate more efficiently or [sic] have lower costs of production than organizations manifesting lower levels of trust, other things being equal” (James and Sykuta 2005).

Second, the different ownership structure and ensuing different alignment in incentives and objectives is expected to influence processors’ behaviour towards farmers once an agreement has been reached. Cooperatives are not, in principle, expected to engage in the kind of *ex-post* opportunistic behaviour capitalistic firms may be prone to, discussed in Section 2.1.1 above. However, this may happen if members’ ownership and control is diluted due to a disproportionate importance of the management or board of directors, or of an influential group of members that somehow stands to benefit from such behaviour, and if the cooperative enjoys some degree of local monopsony power. For instance, if managers’ payment is tied to the profits made by the cooperative, and if members’ active involvement in the cooperative is weak, managers may succeed to, for instance, lower price paid in a given year vis-à-vis the agreement. This incentive however would have to be weighed by managers against possible punishment in the following period and long term consequences on the survival of the cooperative itself. On the other hand, where firms face at least potential competition for milk suppliers from other buyers, *ex-post* opportunistic behaviour is expected to be less likely regardless of the organisational form of the processor, since it can result in loss of suppliers.

Third, cooperatives are expected to be more likely to offer additional services, such as free technical assistance. This stems in part from the producer-oriented nature of cooperative firms, and in part from operational rules regulating members’ exit. Staatz argues that private processors may be less likely to provide such services because farmers can potentially use their new skills to sell to other firms. On the other hand, cooperative members’ returns on their investment in the cooperative are typically contingent on their continued patronage, and for this reason they may be less inclined to act opportunistically toward the cooperative after receiving assistance and training (Staatz 1987a). The greater loyalty to the cooperative shown by its members would in turn increase the cooperative’s incentive to train farmers in improving existing production techniques or adopt new ones. The characteristics of the market however also shape processors’ provision of additional services, which is expected to become more likely regardless of processors’ organisational form when they compete for a common pool of suppliers.

2.2.2 Empirical contributions on differences between cooperatives and capitalistic processors in the non-price characteristics of the relationship

To the best of my knowledge, there are no empirical studies investigating differences between cooperative and capitalistic processors with respect to contract complexity and processor compliance with the agreement. There is however a body of empirical literature investigating the transaction costs entailed in different forms of organisation of economic interactions between different interdependent agents in agriculture. This literature, and in particular its empirical definitions of *ex-post* transaction costs, that is, those costs entailed in monitoring and enforcing the terms of the transaction once the exchange relationship has been established, as well as any costs that either party may have to sustain following contract non-compliance by the other party, was useful both for questionnaire design and for orienting the empirical investigation of processor's behaviour vis-à-vis the exchange relationship towards the analysis of violations of contract terms with respect to purchased quantity, timeliness of payment and prices paid. Ex-post transaction costs may also result from farmers' behaviour towards buyers, if, for instance, farmers commit to deliver a certain quality or quantity prior to a specific investment by a processor, and then strategically fail to honour that commitment. The main concern of this thesis, however, is with processors' behaviour.

Hobbs (1997) provides one of the first comprehensive empirical analyses of transaction costs, on which much of the subsequent work on the subject is based (Hobbs 1997). Studying choice of cattle marketing channel between live-weight auctions and direct sales to a packer, in the UK, she develops proxies for transaction costs and for other characteristics of the exchange relationship, including time spent by farmers in discovering price information, uncertainty with respect to quality grading, and time it takes for a farmer to get paid after the sale.

Boger (2001) builds on this work and studies the relationship between quality, transaction costs and different marketing arrangements (local slaughterhouse, traders or large processor) in the Polish hog market (Boger 2001). Transactions costs associated with each marketing channel are studied using proxy variables, including timeliness of payment, farmers' perceived bargaining power towards buyers (measured on a scale from one to five where one means the farmer is always accepting the offered price and five means the farmer is always negotiating the offered price); and farm asset specificity (measured with a qualitative variable indicating the extent of farmers' investment in hog production and a variable indicating whether farmers felt an increased dependence on their current buyer as a result of their investment). Results suggest that the exchange relationship is more likely to be regulated by a written contract and to specify price and quality requirements when the buyer is a large processor than when it is a local slaughterhouse or trader. Farmers' perceived bargaining power tends to be higher, and perceived dependency from the buyer tends to be lower, when selling to a local slaughterhouse compared to a large processor. Local slaughterhouses typically serve a relatively small geographical area and manage smaller volumes compared to large processors, suggesting a smaller relative size difference between farmer and buyer in this case compared to the interaction with a large processor. This could be driving both the relative need for more sophisticated coordination mechanisms (i.e. more detailed contracts) and farmers' perception of bargaining power. With respect to timeliness of payment, results suggest that farmers are more likely to experience a delay when selling to a local slaughterhouses or large processor, compared to selling to a trader, which seems to suggest that traders face more competition in the hog market compared to the other two channels.

Vakis et al (2003) explore similar factors when investigating the relationship between transaction costs and channel of sales in Peru, and also include a variable indicating whether farmers experienced any difficulties in agreeing on the exchange relationship with their buyer (Vakis, Sadoulet et al. 2003). They find that farmers selling in a local market tend to experience fewer problems in agreeing on quality and fewer delays in payment compared to farmers selling to traders at the farm gate. Competition between alternative buyers is likely to be higher at the market place than at the farm gate, and these results suggest that, as expected, the likelihood of buyers' opportunistic behaviour increases with their monopsony power, which makes farmers more likely to be locked into that particular transaction for lack of available alternatives.

Royer (2011) quantifies and compares transaction costs for dairy farmers in marketing boards versus direct, bilateral contracting with private processors in Canada and in the UK (Royer 2011). Milk marketing boards share some similarities with milk collection cooperatives, in that individual farmers delegate all their marketing activities to a board of elected producers and professional staff, in charge of conducting all the steps of the transaction (from price negotiation to contract enforcement) between farmers and milk processors. Royer measures *ex-post* transaction costs as cost of contract enforcement, including time and money spent on litigation to deal with disagreement on the interpretation of contract clauses or with processors' breach of contracts. Results show that *ex-post* transaction costs are much lower in a marketing board setting than under bilateral contracting, but, as a percentage of average dairy farm revenues, their magnitude remains quite small with both arrangements: 0.0017% when using marketing boards and 0.04% when using bilateral contracting. However, there is substantial heterogeneity in *ex-post* transactions costs across farmers using bilateral contracting, which for some of them represent a much larger share of dairy revenues. It would be important to know whether such high variation in *ex-post* transactions costs is systematically related to particular farm and socio-economic characteristics, but this issue is not pursued due to the small size of the sub-sample (62 farmers). Conversely, marketing boards, being a collective negotiation tool, allow farmers to pool transaction costs, providing a sort of insurance mechanism, and no differences in *ex-post* transactions costs across farmers are observed here.

Overall, these studies suggest that some differences in the non-price characteristics of the transaction can be expected across different channels. However, such differences tend to decrease with increased competition among buyers, and when the broader institutional context and legal framework governing economic transactions is more developed, as suggested by the case of the UK and Canada. With respect to the latter, contract enforcement is one of the weakest aspects of the Italian legal and institutional framework: 39 months, versus an OECD average of 16, are required on average to solve a dispute, and the average cost of litigation is 50% higher than the OECD average (World Bank 2012), providing a conducive environment for processors' potential exercise of opportunistic behaviour.

2.3. Expected differences between cooperatives and capitalistic processors in producer prices paid

This section is organised as follows: Section 2.3.1 reviews the key theoretical contribution on price competition between cooperative and capitalistic firms which provides the justification for the empirical analysis of differences in prices paid between coop members and non-members in Chapter 6. Section 2.3.2 discusses the limited existing empirical literature on producer price heterogeneity that takes organisational form of the buyer into account.

2.3.1. Theoretical contributions on price competition between cooperative and capitalistic processors

This section discusses theoretical reasons why price differences between cooperative and private processors competing for milk supply in the same market can be expected.
A well known result from short-run duopoly analysis of identical private firms under zero transportation costs is the Bertrand paradox: price competition between just two firms is sufficient to bring price down to competitive levels, unlike under Cournot competition. With Bertrand competition, each firm knows that, by just underbidding the other, it will capture the whole market area, and the only stable equilibrium is one where both are charging at marginal cost and, by symmetry, share the market equally. Similarly, in the case of a duopsony, the only stable equilibrium is one where both firms pay a price that is equal to marginal revenue product. If one overbids the other, it captures the whole market area.[8] This outcome also characterises asymmetric price competition in non-spatial markets, that is, where two firms with different objective functions (capitalistic and cooperative) coexist, transportation costs are trivial and farmers are in charge of shipping milk to the plant gate (Cotterill 1987).[9]
When competition for milk supply between processing firms is spatial, that is, transportation costs are non trivial, as is likely to be the case for a bulky and perishable product like raw milk, the interaction between firms becomes more complex. Depending on how important transportation costs are in a given area, relative to the net value of firms' processed product, firms may a) not interact with each other at all; b) *just* make geographic contact but no economic contact, meaning that they do not compete over the market boundary in order to encroach on the market area of the rival; or c) actively compete over the market boundary in order to defend or increase their market area at the expense of the rival.

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[8] There are a number of reasons why the one-off Bertrand competition outcome may not arise. For instance, if a temporal dimension, and the possibility for firms to react, are introduced to the game, so that firms are playing a repeated game, each firm will have to compare the short run gain, i.e. the increase in its market share, with the long run losses of engaging in a price war, which will eventually erode its market power by bidding up the price paid to milk producers. Realising the potential cost of a price war, firms may thus adopt some form of cooperative behaviour. In reality, firms are likely to interact repeatedly, and the set of competitors is likely to be relatively stable over time, because of a number of reasons including barriers to entry of new firms and capacity constraints, or, more generally, decreasing returns to scale technology, where marginal costs increase with output.

[9] In Karantininis & Zago (2001) and Albaek and Schultz (1998) models, the cooperative and private processors compete à la Cournot instead, and the result is that quantity processed by the cooperative is larger than that processed by the private firm (Albaek and Schultz 1998; Karantininis and Zago 2001).

When operating in a spatial market, processors can choose between two different spatial pricing policies for milk procurement: free-on-board (FOB) or uniform delivered pricing (UD), which have different implications for milk price paid and market area served. With FOB, a processor pays all farmers the same price at the plant gate, and farmers pay the transportation cost for milk shipment. With UD, a processor absorbs transportation costs fully and pays all farmers a fixed price regardless of their distance from the plant, effectively discriminating in favour of the more distant suppliers. FOB pricing is often implicitly assumed in theoretical and empirical analyses of competition. There is however some evidence that UD pricing is often adopted by processors in practice (Alvarez 2000; Gallagher, Wisner et al. 2005; Graubner 2011).[10]

An additional element of interest and complexity is provided by the different implications of the asymmetric nature of price competition when two firms with different objective functions, cooperative and capitalistic, interact in a spatial market using different spatial pricing policy combinations. These implications are laid out analytically in a paper by Fousekis (2011), which develops a two-stage game between a cooperative and a private processor, where in the first stage firms choose their optimal spatial pricing policy, and in the second stage they choose simultaneously their optimal price and market area. This section analyses this paper in detail, without providing any new analytical results, because it provides the theoretical justification for expecting differences in price paid between cooperative and capitalistic firms, a prediction which is tested in the empirical analysis in Chapter 6.

The paper makes the following assumptions. A group of identical farmers is distributed with uniform density along a line with length equal to 1 and processor(s) are exogenously located at the end(s) of the line. Processors buy primary produce (hereafter milk) from farmers, and process it into a final product (hereafter cheese). There are no fixed costs in processing and average (and marginal) processing cost c is constant. Cheese is sold in a perfectly competitive market at price p per unit. Farmers are assumed to have a linear supply function of the form $x=w(r)$, where x is quantity of milk sold, r is the distance between farm and processor's plant, and $w(r)$ is the price farmers receive, net of transportation costs – if any – for hauling milk to the processor. Transportation costs per unit of distance are assumed to be constant. The cost for the

[10] In theory, instead of making this kind of 0-1 choice between pricing policies, processors may choose to absorb just a fraction of transportation costs, and/or pay each farmer a different price according to her distance from the plant. However, this would be costly to administer and would possibly conflict with legal restrictions on price discrimination, leading to a choice between either FOB or UD pricing.

processor to buy one unit of milk from a farmer located at distance r is w when FOB pricing is adopted, and $w + \gamma r$, when UD pricing is adopted, where γ is the transportation cost per unit of distance travelled. Hereafter, FOB pricing is denoted with m and UD pricing with u.

In a spatial market, the crucial determinant of the degree of interaction – and competition – between firms is the relative importance of space, that is, how large transportation costs are relative to the net cheese price received by processors (net of processing costs), $s = \gamma/(p - c)$. Fousekis sets $(p - c) = 1$ for normalisation, so that in this paper $s = \gamma$. As the relative importance of space decreases, for instance, because of a decrease in transportation costs, the area of overlap and direct competition between firms increases.

The remainder of this section first analyses Fousekis' results on processors' behaviour under different spatial pricing policies when they each operate as a spatially isolated monopsony; and then analyses his results on the four possible combinations of pricing policies in asymmetric spatial duopsony.

2.3.1.1. Fousekis' results on spatial monopsony

This section analyses Fousekis' results on the behaviour of capitalistic and cooperative monopsonists under different spatial pricing policies.

A private processor using FOB pricing maximises the following profit function:

$$\pi^I_{FOB} = (1 - m^I)\int_0^{R^I_{FOB}} (m^I - sr)\,dr \qquad (1)$$

where m^I and R are the endogenous FOB price and market radius respectively, $(1\text{-}m^I)$ is the processor's profit per unit of processed milk, and the integral represents total milk supply over the processor's market area. Given the optimum price, the market boundary is determined by the farmer who is indifferent between selling and not selling, that is, the farmer for whom the FOB price net of her transport costs to the processor's plant is zero. Given the optimum price, the boundary is $R = m^I/s$, so that (1) becomes a function of m^I alone, substituting for R:

$$\pi^{I}_{FOB} = (1 - m^{I})\int_{0}^{R^{I}_{FOB}} (m^{I} - sr)\,dr$$
$$= (1 - m^{I})\left[m^{I} r - \frac{1}{2} sr^{2} \right]_{0}^{m^{I}/s}$$
$$= \frac{1}{2s}(m^{I2} - m^{I3})$$

Differentiating yields m^I = 2/3 at the optimum. The optimal market area is $R^I{}_{FOB}$ = 2/(3s). Profit is 2/(27s). Price is independent of transportation costs, but market area is not. As the relative importance of space decreases, the processor's market radius expands.

A private processor using UD pricing maximises the following profit function:

$$\pi^{I}_{UD} = u^{I}\int_{0}^{R^{I}_{UD}} (1 - u^{I} - sr)\,dr \qquad (2)$$

where u^I and R are the endogenous UD price and market area respectively. Because of the form of the supply function, u^I is also the supply of an individual farmer. The integral represents processor's profit from purchasing one unit of milk from a farmer located r distance away. Given the optimum price, a processor expands its market radius up to the point where the marginal revenue and marginal cost from buying from that farmer are equal. Given the optimum price, the market radius of a UD pricing private processor is $R^I{}_{UD} = (1 - u^I)/s$. Maximising this profit function with respect to u^I yields a UD price of 1/3, a market area of 2/(3s) and a profit of 2/(27s). Profit and market area are the same as in the FOB case, but price paid is half the FOB price because the processor is absorbing the transport costs. Also in this case, market radius expands as transportation costs fall. Farmers located along the extra market distance 1/(3s) beyond the monopsonist boundary of 2/(3s) can, if they so wish, transport their milk at their own expense up to the IOF boundary. The IOF is indifferent to this extra supply appearing at the boundary, because it makes no profit from them. Thus, the range of suppliers for the private processor, and its *effective* market boundary R^E as a monopsonist, is 2/(3s) + 1/(3s) = 1/s.

Although the outcome is the same in certain respects between FOB and UD pricing, it is not the same at farmer level: farmers located close to the processing plant are better off with FOB than with UD, while those further away are better off with UD than FOB.

With respect to the behaviour of the cooperative monopsonist, Fousekis assumes that its objective is welfare maximisation, that is, joint maximisation of cooperative profits from processing and selling cheese, and member profits (producer surplus).

A cooperative paying FOB prices maximises the following welfare function:

$$W_{FOB}^{C} = (1 - m^{C})\int_{0}^{R_{FOB}^{C}} (m^{C} - sr)\,dr + 0.5\int_{0}^{R_{FOB}^{C}} (m^{C} - sr)^{2}\,dr \qquad (3)$$

where m^C and R are the endogenous FOB price and market radius respectively. The first part of this function represents the cooperative profit from processing and is identical to that of a private monopsonist. The second part represents member profit. As in the case of a private monopsonist, given the optimal price, the market boundary is determined by $R^{C}_{FOB} = m^C/s$. Maximising with respect to m^C yields a price of 1, a market radius of $1/s$ and a welfare of $1/(6s)$. Price is higher and market radius is larger than those of a private processor. Also for the coop, market radius decreases as transportation costs increase.

Intuitively, it is not surprising that the coop will pay a higher price than the private processor, because a welfare maximising cooperative is taking into account the surplus generated for the farmer in its pricing decisions. When $m^C = 1$, the cooperative makes no profit from processing. This is consistent with the coop objective of maximisation of price paid to members subject to a break even constraint. The maximum amount that the cooperative can pay for total milk supply, without incurring in any deficits, is given by the net revenue product (NRP), that is, revenue from selling cheese minus processing and transportation costs (if any): $NRP^{FOB} = 1\int_{0}^{R_{FOB}^{C}} (m^{C} - sr)\,dr$. The maximum price per unit of milk it can pay is the net average revenue product (NARP), a concept introduced by (Helmberger and Hoos 1962), which in this case is given by

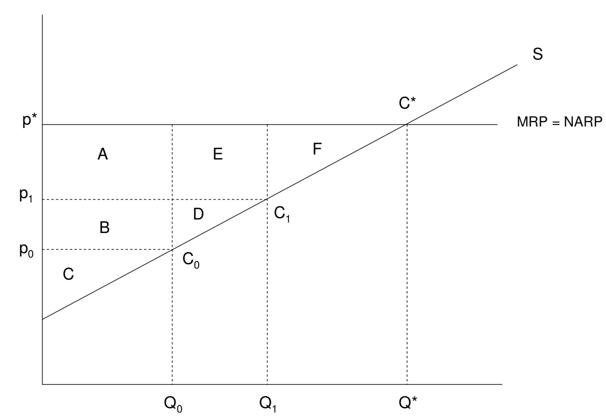
$$NARP^{FOB} = (1\int_{0}^{R_{FOB}^{C}} (m^{C} - sr)\,dr) / (\int_{0}^{R_{FOB}^{C}} (m^{C} - sr)\,dr) = 1$$

This implies that a welfare maximising coop operating in a perfectly competitive cheese market pays members according to NARP, that is, the maximum possible price subject to a break even constraint. This is shown as point C^* in Figure 2.1. Because of the constant processing costs and the assumption of a perfectly competitive cheese market, marginal revenue product (MRP) and NARP are flat and equal to each other. The supply curve S is assumed to be the marginal cost of milk.[11]

[11] This assumption may not hold in duopsony if one processor is bidding suppliers away from its competitor.

To see why in this case a welfare maximising cooperative is NARP pricing, suppose that it didn't and instead operated at point C_0, paying price p_0 and purchasing quantity Q_0. The coop profit from selling cheese is the area A + B. Member surplus is the area C. Should the coop raise its price up from p_0? Suppose the coop pays p_1 and operates at C_1, processing quantity Q_1. Coop profit is now A + E and member surplus is B + C + D. Area B is redistributed from cooperative to members. Area D is additional surplus resulting from the increase in supply from existing members and the entry of new members following the price increase. A welfare maximising cooperative would not be pricing at p_0 given that pricing at p_1 yields higher welfare. In fact, a welfare maximising cooperative will price at p^* and operate at C^*: at this point, all the coop profit A + E has been redistributed to members and the additional surplus F (from increase in supply from existing and/or new members) is generated. Thus, a welfare maximising cooperative in a perfectly competitive cheese market sets a price that is the highest possible price it can pay, subject to breaking even, that is, is NARP pricing.

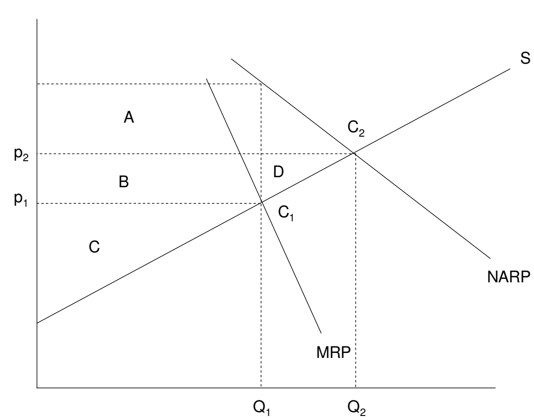
Figure 2.1: Price-quantity equilibrium for a welfare maximising cooperative in a perfectly competitive cheese market



However, if the cooperative had some degree of monopoly power in the cheese market, facing a downward sloping demand curve, marginal revenue product and average revenue product would no longer be the same and a welfare maximising cooperative would not be also maximising price paid to members. This is illustrated in Figure 2.2. A welfare maximising coop is operating at point C_1, at the intersection between marginal revenue and the supply curve. Profit accruing to the coop is area A+B and member surplus is area C. If the coop maximises milk price paid, it operates at the intersection of the NARP and the supply curve at point C_2. The cooperative now makes no profit. Member surplus is area B+C+D. Overall, welfare is lower in a price maximising cooperative than in a profit maximising one. Point C_2 is however considered to be the only stable long-run equilibrium (Helmberger and Hoos 1962; Helmberger 1964; Cotterill 1987). A cooperative operating at C_1 redistributes its profit A+B to members at the end of the year in the form of a dividend. Members base their milk production decisions on the basis of their expected milk price, which in this case is the transaction price p_1 received at the time of sale, plus the dividend at the end of the year. Each member is thus expecting a price that is higher than p_1, and overproduces relative to the welfare maximising optimum quantity. This will continue up to the point where the cooperative simply pays according to NARP and retains no profit. The question for the cooperative then becomes how to control supply in such a way as to achieve the higher welfare equilibrium C_1. For instance, restrictions to membership or to maximum delivery per member may be used (LeVay 1983b; Lopez and Spreen 1985).

Fousekis' analysis and findings may not necessarily hold if the cooperative has market power in the cheese market. In the remainder of this section however I will continue to follow this paper in the assumption of a perfectly competitive cheese market and in its implication that a welfare maximising cooperative is NARP-pricing.

Figure 2.2: Price-quantity equilibria for a welfare maximising and for a price maximising cooperative with market power in the cheese market



A cooperative paying UD prices maximises the following:

$$W_{UD}^{C} = u^{C}\int_{0}^{R_{UD}^{C}}(1-u^{C}-sr)\,dr + \frac{1}{2}\int_{0}^{R_{UD}^{C}}(u^{C})^{2}\,dr = u^{C}\int_{0}^{R_{UD}^{C}}(1-\frac{1}{2}u^{C}-sr)\,dr \qquad (4)$$

where u^C and R are the endogenous UD price and market area respectively. Because of the form of the supply function, u^C is also the supply of the individual member. Cooperative profit from selling cheese is expressed in the same way as for the private monopsonist. The cooperative however differs in the way it defines its market boundary. Given the optimum price, the cooperative collects milk up to point where surplus to the last farmer from selling, $1/2\ u^C$, equals loss from processing for the cooperative at that quantity, $u^C(sR^C{}_{UD} - 1 + u^C)$. Thus, $R^C{}_{UD} = (1 - 1/2\ u^C)/s$.

Maximisation yields a price of 2/3, a market radius of 2/(3*s*) and a welfare of 4/(27*s*). Market radius (as a function of transportation costs) is the same as for the UD pricing private monopsonist, but price paid is double. Price paid, market radius and welfare are however lower in a UD pricing cooperative than in an FOB pricing coop. Fousekis shows that a UD pricing cooperative in a competitive cheese market is also NARP pricing. The net revenue product associated with equation *(4)* is $NRP^{UD} = u^{C}\int_{0}^{R_{UD}^{C}}(1-sr)\,dr = u^{C}R_{UD}^{C}(1-\frac{1}{2}sR_{UD}^{C})$. Because of the assumption that farmers are uniformly distributed in space, $u^{C}R_{UD}^{C}$ is total milk supplied and thus $NARP^{UD} = (1-\frac{1}{2}sR_{UD}^{C})$. With R_{UD}^{C}=2/3(s), $NARP^{UD}$ is equal to 2/3, which is the coop UD price

A UD pricing cooperative cross-subsides between members located closer and further away from its plant. It is making a loss from processing at the market boundary which is exactly compensated by profit earned through members located at its gate. Because of this, however, a UD pricing coop, unlike a UD private monopsonist, is not indifferent to extra supply appearing at its boundary, transported there by non-members at their own expense. If it accepts it, it will incur an additional loss in processing that is not compensated by any additional profit from farmers closer to its gate. Thus, the UD pricing cooperative does not accept any supply from beyond its market boundary and effectively operates as a closed membership cooperative.

The next section now turns to the analysis of asymmetric price competition between a cooperative and a capitalistic processor.

2.3.1.2. Fousekis' results on asymmetric price competition in spatial duopsony

When both firms are in the market, each located at the end point of a line (the cooperative at point zero and the private processor at point one), Fousekis assumes they adopt Bertrand-Hotelling conjectures, each setting its price taking the price of the rival as given. The cooperative is assumed to always price according to NARP, which facilitates the analysis. The problem for the private processor is now to choose the price that maximises its profit within its share of the market area. Four scenarios can arise, depending on the spatial pricing policy adopted by each processor: both use FOB; the coop uses FOB and the private processor uses UD; the coop uses UD and the private processor uses FOB; and both use UD.

In all cases, unlike in monopsony, the optimum price for the private processor is a function of the parameter *s*. This is not surprising: *s*, i.e. the relative importance of space, determines the effective distance between the two competitors, whether or not they interact, and the behaviour of the private processor. This means that observing firms' coexistence in a given area, for instance within a province, does not necessarily mean that they are actively competing with each other. Depending on the relative importance of space, each firm may continue to behave as a spatially isolated monopsony. With all combinations of spatial pricing policy but one, economic interaction and price competition begin only when *s* decreases to the point where firms' market areas begin to overlap. Conversely, when both firms adopt UD pricing, overlap in market areas in not observed even at low values of *s*.

When both firms adopt FOB pricing, their market boundary $\overline{R}$ is determined by the equality of their net prices, so that

$$m^C - s\overline{R} = m^I - s(1-\overline{R}) \Rightarrow \overline{R} = \frac{m^C - m^I + s}{2s} \Rightarrow \overline{R} = \frac{1 - m^I + s}{2s} \qquad (5)$$

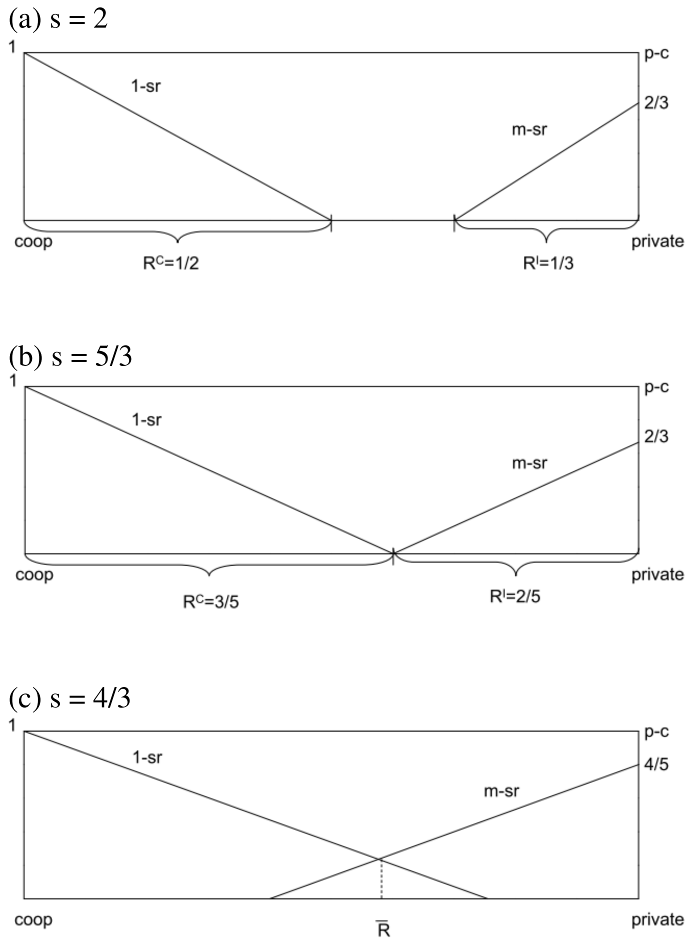
where the last implication follows because of the assumption that the coop is NARP pricing ($\text{NARP}^{\text{FOB}} = m^C = 1$).

The maximisation problem for the private processor is now to choose the price that maximises its profit within its share of the market area:

$$\pi_{FOB,FOB} = (1 - m^I)\int_{\overline{R}}^{1} (m^I - s(1-r))\,dr \qquad (6)$$

The optimum price obtained by maximising this function is a function of the parameter *s*.[12] For high values of *s*, for instance when $s = 2$, the market areas of the two processors are separate and each behaves as a spatially isolated monopsonist with respect to both price and market area, as illustrated in Panel (a) of Figure 2.3.

Figure 2.3: Interaction between FOB coop and FOB private processor for different values of *s*



As the value of *s* decreases, the market boundaries of the two rivals will get closer to each other. The two firms *just* meet at the market boundary, but have no economic interaction, when $s = 5/3$. This is the value of *s* for which the sum of the coop monopsonist market area plus the private monopsonist market area equals one ($1/s + 2/(3s) = 1$). In this case, shown in Panel (b) of figure 2.3, each firm continues to behave

[12] Maximisation of (6) with respect to price yields the equilibrium FOB price

$$m^I = \frac{(-2s+5)+\sqrt{(-s+2.5)^2+9(s^2-1)}}{9}$$

as an isolated monopsonist. As the value of s decreases further, the firms begin to make economic contact. The coop encroaching on to the market area of the private monopsonist pushes it to raise its price to defend its procurement area, as shown in Panel (c) of Figure 2.3 for s = 4/3. For values of s approaching zero, m^I is pushed towards one.

When the coop uses FOB and the private processor uses UD and transport costs are low, the market boundary $\overline{R}$ between the two firms is again determined by the equality of their net prices:

$$m^C - s\overline{R} = u^I \Rightarrow \overline{R} = \frac{1-u^I}{s} \qquad (7)$$

The private processor chooses u^I in order to maximise its profit in the area between its location and the market boundary:

$$\pi^I_{FOB,UD} = u^I \int_{\overline{R}}^{1} (1-u^I - s(1-r))\,dr \qquad (8)$$

Also in this case, the optimal UD price for the private processor is a function of the parameter s, and the nature of interaction between the two firms changes with the relative importance of space.[13]

For sufficiently high values of s, they operate as isolated spatial monopsonists. The coop pays m^C = 1 and its market boundary is $R^C_{FOB}=1/s$. The private processor pays its monopsony UD price of 1/3 and its market boundary is $R^I_{UD}=2/(3s)$. However, as noted for the case of a UD pricing private monopsonist, the private processor also has an *effective* market boundary of $R^E = 2/(3s) + 1/(3s) = 1/s$. This is because farmers located in the remaining market distance $1/(3s)$ can, if they so wish, transport the milk at their own expense up to its monopsony boundary.

The cooperative and the private processor *just* meet, with no economic interaction, at the effective market boundary of the private monopsonist, R^E, (that is, $1/s + 1/s = 1$) when s=2, that is, when transport costs are relatively high, as shown in Figure 2.4. What happens here is that the cooperative is unable to extend its market area all the way to the private monopsony boundary $R^I_{UD}=2/(3s)$, because for farmers in the interval between R^E and R^I_{UD} the net price they get from transporting milk to the monopsony boundary of

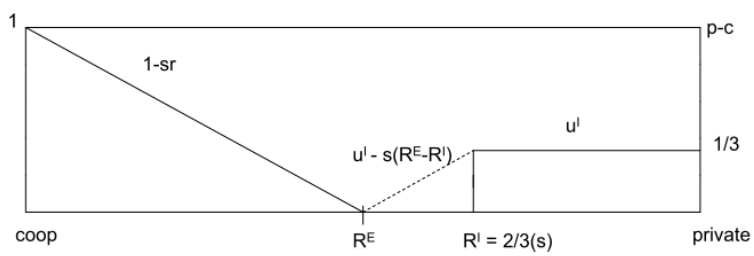
[13] Maximisation of (8) with respect to price yields the equilibrium UD price

$$u^I = \frac{(-4s+6)+\sqrt{(-2s+3)^2+9(-s^2+4s-3)}}{9}$$

the private processor is higher than what they would get if travelling to the cooperative plant. When the market areas of the private and cooperative processors *just* meet at R^E, the private processor continues to pay its monopsony price.

As transportation costs decline further, the coop moves to progressively capture the interval between R^E and R^I_{UD}. The two firms *just* meet at the private monopsonist boundary when $s = 4/3$. The cooperative's expansion between R^E and R^I_{UD}, that is, up to the private monopsonist boundary, has no impact on the private processor and does not push it to change its behaviour: up to its monopsonist boundary, the private firm's optimal market area is not under threat, because the processor is not making any profits from farmers located in the interval R^E - R^I_{UD}. However, for values of s lower than 4/3, the cooperative begins encroaching on that monopsony market area. Economic interaction now begins and the two firms compete for market boundary, with the UD price paid by the private firm approaching 1 as competition is made fiercer by transportation costs approaching zero.

Figure 2.4: Interaction between FOB coop and UD private processor for *s* = 2



When the coop uses UD and the private processor uses FOB and transport costs are low, the market boundary $\overline{R}$ between the two firms is determined by the equality of their net prices:

$$m^I - s(1-\overline{R}) = u^C \tag{9}$$

The coop is pricing according to NARP, so that $u^C = 1 - \frac{1}{2}s\overline{R}$. Substituting this into equation (10) gives the market boundary

$$\overline{R} = \frac{2(1-m^I+s)}{3s} \tag{10}$$

The private processor chooses the price that maximises its profit in the area between the market boundary and its location, maximising

$$\pi_{UD,FOB} = (1-m^I)\int_{\bar{R}}^{1}(m^I - s(1-r))\,dr \qquad (11)$$

Again, the optimal FOB price for the private processor is a function of the relative importance of space.[14]

For high values of *s*, firms are separated and each behaves as an isolated monopsonist. The coop pays $u^C = 2/3$ and its market boundary is $R^C{}_{UD} = 2/(3s)$. The private processor pays $m^I = 2/3$ and its market boundary is $R^I{}_{FOB} = 2/(3s)$. Unlike the UD pricing private monopsony, the UD pricing cooperative monopsony does not accept any irregular supply appearing at its market boundary, because at that point it is already operating at a loss from processing. Thus, the cooperative effectively has a closed membership.

The firms just meet with no overlap when $2/(3s) + 2/(3s)=1$. This happens when $s=4/3$. For intermediate values of *s* lower than 4/3, the UD pricing cooperative, which does not behave strategically, continues to behave as an isolated spatial monopsonist, collecting milk up to its UD monopsony boundary $2/(3s)$. This constrains the market area of the private processor, which operates as a monopsonist with restricted area $R^R = 1\text{-}2/(3s)$ and chooses the price that maximises its profit given R^R. Within this restricted market area, the private processor does not fear loss of suppliers to the cooperative, which does not accept any suppliers beyond $2/(3s)$. Thus, for intermediate values of *s*, the private processor can strategically lower its price below its monopsony price. Supply from all the restricted area $R^R = 1/(3s)$ is ensured as long as, for the farmer at the boundary, $m^I=sR^R$, and this requires a lower price than in monopsony, given that R^R is smaller than the private monopsony area.

Thus, for intermediate values of transportation costs, before they become low enough to start price competition at the market boundary, presence of a UD cooperative in the market when the private processor adopts FOB pricing makes private firm suppliers worse off than under an FOB pricing private monopsony.

The last possible combination of spatial pricing policies is adoption of UD pricing by both firms. Models of price competition between two UD pricing private firms

[14] Maximisation of (11) with respect to price yields the equilibrium FOB price

$$m^I = \frac{(-2s+12)+\sqrt{(-s+6)^2 + 24(s^2-2s)}}{24}$$

interacting with each other present the problem of discontinuity in profit functions as either processor moves from just below to just above the rival's price. Equilibria only exist in mixed strategies, a problem that would not arise in the other cases of competition between two private processors under different combinations of pricing policies (Zhang and Sexton 2001). However, when a UD-pricing private processor competes with a UD-pricing cooperative, Fousekis shows that there is no discontinuity, each player uses pure strategies, and the private processor finds it optimal to concede, paying a lower price than the coop and serving a smaller market area.

Intuitively, one would expect the private processor to concede, because, for any market radius, the NARP price paid by the coop, $u^C = 1 - \frac{1}{2} sR$ exceeds the maximum price the private processor is willing to pay, $u^I = 1 - sR$, because the coop takes member surplus into account in its pricing decisions.

If the coop were to concede, the private processor would behave as a UD-pricing spatially isolated monopsony; the cooperative would serve the area up to the *effective* boundary of the private processor and choose the price that maximises welfare within its restricted market area. The effective boundary, R^E, is relevant because, with a UD pricing private processor, additional suppliers beyond the private processor's optimal market boundary R^I_{UD} can transport their milk at their own expense up to R^I_{UD}. The effective boundary is determined by the farmer for whom the UD price she would receive from the cooperative equals the monopsony UD price she would get from selling to the private firm minus the transport cost she incurs to cover the distance between her location and the private monopsony boundary.

If the coop were to overbid, it would set its market area as a spatially isolated monopsonist and find its optimal NARP price accordingly. Fousekis shows that, for low values of relative transport costs, the same price maximises coop welfare under conceding and under overbidding, suggesting that the objective function of the cooperative is not discontinuous and pure strategies are used.

Fousekis then shows that, given the pure strategy of the coop, profit for the private processor is always lower under overbidding than under conceding, suggesting that also the private processor uses pure strategies and concedes, as expected intuitively.

Given that the private processor concedes and the coop is the overbidder, the coop always behaves as a spatially isolated monopsony and the private processor always confronts a restricted market area even at low values of *s*. The two firms never overlap.

The area served by the coop is always larger, and the price paid higher, than for the private processor. The latter does not need to raise its price close to that paid by the cooperative in order to defend its market area, because the UD-pricing coop operates with a closed membership. The private processor however raises its price above monopsony level in order to increase supply from its restricted market area (given the assumed supply function $x = u$). It can afford to do so, because its transport costs within the restricted market area are now lower than in the monopsony case.

Summing up, the analytical results obtained by Fousekis show that price differences between cooperative and private competitors can be expected when the relative importance of space is high, which progressively weakens interaction between firms towards isolated monopsony behaviour. Differences can be expected also at very low values of s when both adopt UD pricing. With the other spatial pricing policy combinations, no difference is expected when the relative importance of space is very low and firms are competing over the market boundary. In all cases except one, when a cooperative interacts with a private processor either by competing directly for the market boundary or by restricting the market area of the private processor, the difference in the objective functions between the two firms gives the cooperative a positive competitive yardstick effect, that is, the ability to push the private processor to raise its price above monopsony level. The exception is the case of competition between a UD-pricing coop and a FOB-pricing private processor at intermediate values of s, where the coop operates with closed membership and the private firm can lower its price below monopsony level without fear of losing suppliers to the coop.

With respect to the first stage of the game, where firms choose their optimal spatial pricing policies given the choice of equilibrium milk price and market area in the second stage, Fousekis finds that (a) mutual UD spatial pricing is the optimal strategy when transportation costs are low; (b) mixed strategies (with the coop using FOB and the private processor using UD) are optimal for intermediate values of s; and (c) FOB for the coop and, equivalently, UD or FOB for the private processor are optimal when each is operating as an isolated monopsonist.

In order to make the analysis more tractable, the world painted by Fousekis is of course a simplified metaphor of what in the real world, including the provinces studied in the thesis, is a more complex market characterised by several levels of heterogeneity which are likely to impact on price and market area equilibria, and on price differentials between firms. The description of the three provinces, of farm characteristics and of the processors operating there, provided in Chapter 3, will give a flavour of the heterogeneities this thesis is dealing with.

First, geography varies, between and within provinces, and this has implications for transportation costs per unit of distance, which are likely to vary with topography, for instance increasing at higher altitudes where roads become steeper and more winding. Second, farmers differ with respect to quality and quantity produced, and this may be partly related to location-specific agro-ecological characteristics. Third, transport costs may not be the only cost processors face for sourcing milk from farmers, but other transaction costs may be relevant. These refer to the monetary and time costs of arranging and carrying out an exchange of goods or services and include the costs of bargaining over the terms of the transaction as well as of monitoring and enforcing compliance with the agreement (Holloway, Nicholson et al. 2000). Presence of transaction costs and farmers' heterogeneity with respect to quantity produced may combine and lead to differential payment of different farmers. If costs for contract negotiation and management with individual farmers are fixed regardless of volume of milk sold, so that, *ceteris paribus*, the transaction costs per unit of milk that a buyer has to incur in order to source raw milk from a small number of large farmers is lower than procuring from a mass of small scale producers, processors may reward larger producers with a higher unit price in order to secure their supply (Swinnen and Maertens 2007). However, processors with different objective functions may deal differently with farmer heterogeneity with respect to both quantity and quality: for instance, cooperatives may confront more resistance from members against introduction of pricing policies that differentiate between farmers, because of the principle of equality that, in theory, guides their operations.

Fourth, processors may not be identical with respect to processing and marketing costs and managerial quality. If, for whatever reason, cooperatives face higher costs than private processors, their ability to exert a competitive yardstick effect is reduced. Fifth, processors may also engage in product differentiation, for instance producing different types of cheese or different qualities of the same cheese. If this is the case, then the assumption of a perfectly competitive cheese market, where marginal revenue product is equal to net average revenue product and a welfare maximising cooperative is also maximising price paid to farmers subject to a break even constraint, would not hold.

This adds a further element of complexity: the coop would have to determine its objective function (welfare or price maximisation) and the private processor would have to choose its best response under different possible cooperative objectives. The processors investigated in the thesis seem to adopt some degree of product differentiation: they all produce the same type of hard cheese, marketed at national and international level, but some of them also produce niche cheeses strongly related to the geographical area where they operate. There is also some evidence, discussed in Chapter 3, Section 3.6.3, that some coops pay dividends, a scenario consistent with welfare maximisation when coops enjoy some degree of market power.

Sixth, processor location is treated as exogenous by Fousekis, an assumption that may not be particularly problematic in his world of identical geography and farmers. However, in a heterogeneous world, both processor location and the nature of the firm choosing a particular location (cooperative or capitalistic) is itself likely to be related to local characteristics of farmers, geography and, for new entrants, the nature and location of existing firms.

Finally, when farmers are free to decide where to sell milk and processors adopt FOB pricing, Fousekis assumes that farmers decide between buyers only on the basis of the price they receive, net of transportation costs. However, the different nature of processing firms and the heterogeneity of farmers' preferences for the different combination of costs and benefits associated with dealing with either processor, may also play a role in determining farmers' allocation between processors. In turn, this may have an impact on pricing decisions by firms and lead to price differences even when competing directly for the market boundary. Firm differentiation by organisational form, farmers' perception that firms are, indeed, different, and their heterogeneous preferences for such difference, compound spatial differentiation, that is, the effect of the parameter s, and can further reduce the range of firms' economic interaction, even when low transportation costs push towards firm's competition over the market boundary and equality of prices (Fulton 1999; Fulton and Giannakas 2001; Bhaskar, Manning et al. 2002).

Nonetheless, the paper by Fousekis is very useful in the thesis for a number of reasons. It provides a clear framework for understanding the nature of interaction between two firms with different objective functions in a spatial market under different spatial pricing policies. It characterises the interaction of a private processor with an aggressive competitor, the coop, which, in its pricing decisions, takes into account not just its own profit from processing and marketing, but also the surplus generated for member-farmers, which the private processor does not consider. It shows how coexistence of two firms within the same market does not necessarily mean that they are competing with each other. It explains why, in the case of asymmetric price competition under different spatial pricing policies, price differences between cooperative and capitalistic firms can be observed. The analysis of firms' interaction when both adopt UD pricing is particularly useful because I have some evidence, both anecdotal and empirical, that this is the spatial pricing policy adopted in the areas under study, as will be discussed in Chapter 3 and Chapter 6.

The next section reviews the existing empirical literature on producer price heterogeneity that takes into account differences in the organisational form of the processor.

2.3.2. Empirical literature on differences in price paid between cooperatives and capitalistic processors

There is relatively little empirical literature on variation in producer prices paid which takes organisational form of processor and spatial pricing policy into account.

Milford (2012) analyses the relationship between coffee prices paid and cooperative presence at the level of municipalities in Chiapas, Mexico, in order to test whether coops have any competitive yardstick effect on local prices (Milford 2012). The dependent variable is measured as the difference between the log of the average price received by coffee producers per municipality and the log of international coffee price. Cooperative presence is measured as the number of processing coops per 100 coffee producers in each municipality. Additional controls include local agro-ecological characteristics, average farm size per municipality, and share of Spanish-speaking farmers in the municipality.

Concerns about endogeneity between cooperative presence and prices paid, for instance the possibility that farmers with sufficient organisational skills to establish a cooperative may also be better negotiators, and thus receive higher prices not because of cooperative presence but because of their unobserved characteristics, are discarded, but not entirely convincingly. The argument used is that cooperatives were formed following the initiative of benevolent external actors who focussed on relatively disadvantaged areas, where farmers can be expected to be relatively uninformed about the functioning of the coffee market and less effective negotiators with intermediaries. Because of this, Milford argues that the potential correlation between coop presence and prices paid should not be a concern, because it is expected to be negative unless the coop has a pro-competitive effect.

Results from least squares estimation on a cross-section of 75 municipalities show that municipalities located in the North of Chiapas and those where there is a larger share of the population that does not speak Spanish receive on average a lower local coffee price. A positive relationship between coop presence in the municipality and local prices paid is also found, and this is interpreted as evidence that cooperative presence exerts a competitive yardstick effect, leading to higher prices for all local farmers, both members and non-members. However, it is difficult to attribute causality to this finding, given the unresolved concern about endogeneity. Moreover, it is unclear to what extent different alternative buyers are available at municipal level, and what share of farmers per municipality are cooperative members: if coffee producers in a given municipality are entirely served by a cooperative, this result may be more meaningful for drawing inferences on the relationship between membership and prices received by members only, rather than on the effect of coop presence on both members and non-members.

The closest study to the approach adopted in the thesis for the analysis of the effect of coop membership on prices paid is a paper by Sauer et al. (2012) on the determinants of variation in producer price for milk in Armenia, Moldova and Ukraine. The paper explicitly investigates the role of cooperatives, which, in this case, are milk collection cooperatives, bulking up members' raw milk and then selling it to processors (Sauer, Gorton et al. 2012). Using survey data on about 300 farmers from each country, the authors use a Heckman two-stage sample selection model. In the first stage, a probit model is estimated to explain what determines the marketing channel utilised, that is, whether farmers sell only to a commercial buyer (which includes cooperatives) or sell also to final consumers. The explanatory variables include herd characteristics (number of milking cows), farm characteristics, use of extension services and variables indicating whether the farmer is collaborating with other farmers for milk storage, processing or marketing. In the second stage, the determinants of producer price heterogeneity are investigated, focussing only on farmers selling to commercial buyers and correcting for selection bias that arises because farmers who sell only to commercial buyers may differ from those selling also to final consumers with respect to unobservable characteristics which may be correlated with milk price received.

Producer price paid is modelled as a function of lagged price, number of milking cows, number of potential buyers, share of output sold on contract, share of output sold via cooperatives, and farmers' trust in their buyer.

The authors find that farmers selling only to commercial buyers operate on a larger scale (with respect to land, herd size and number of employees).[15] With respect to producer price variation, even after other factors are controlled for, farmers operating on a larger scale receive a higher price for their milk, at least in Armenia and Moldova. This can be explained by a scenario in which processors face positive transaction costs when dealing with farmers and larger farmers are rewarded because they provide processors with a saving in the transaction cost per litre of negotiating and monitoring the agreement compared to smaller farmers. Presence of a contract between farmer and buyer, and farmers' self-reported number of potential buyers (a proxy for competition) are both positively related to prices paid. Selling milk through a cooperative has a positive and statistically significant, albeit economically modest, effect in Armenia and Ukraine, while it is not significant in Moldova. Sauer et al. attribute this result to the different diffusion of cooperatives in these countries: while 58% of Moldovan farmers reported selling milk through cooperatives, in Armenia and Ukraine less than 6% did. The authors suggest this gives Armenian and Ukrainian coops a sort of first mover advantage: when the coop moves into the market it is a welcome institutional innovation for processors, because it allows them to save on dealing with each farmer individually; processors may thus reward cooperative members in a similar way to how they reward large farmers. However, as presence of milk collection cooperatives increases, the need for processors to reward them with higher prices in order to secure their output declines.

This paper is an interesting empirical contribution, because it simultaneously controls for several factors theoretically expected to influence producer price heterogeneity. The characteristics of the market for raw milk are however not discussed in detail, and it is unclear to what extent different types of commercial buyers, including cooperatives, are available anywhere on the territory, or whether they only serve particular areas. Another limitation of this study is that it controls for possible selection bias just in the decision to sell to commercial buyers or to final consumers – provided it is indeed a decision and not a result of the absence of commercial buyers in a particular area – but not also in

[15] The herd size range in the sample is very small, with a mean of 17 cows, driven by very few large outliers with a herd size larger than 500, and a median of two cows.

farmers' choice of type of commercial buyer, i.e. cooperative versus other buyers, provided, again, that there is a choice.

2.4. Conclusions

This chapter reviewed the existing theoretical and empirical literature on the research questions. The framework for cooperative formation and membership as avoidance of market power, and as the result of balancing of relative costs and benefits from collective action, underlies the analysis in this thesis, in particular the empirical investigation of the correlates of cooperative membership, and is also useful to explain why both cooperative and capitalistic firms can coexist in a market characterised by heterogeneous farmer characteristics and preferences for the relative costs and benefits associated with either organisational form. The different nature of ownership and objective between cooperatives and capitalistic firms drive the expected differences between them with respect to both non-price characteristics of the transaction and prices paid. With respect to the latter, the analytical framework developed by Fousekis provides the theoretical justification for the empirical analysis of differences in prices paid between members and non-members in Chapter 6.

With respect to the empirical literature reviewed, a few limitations have been identified in the existing contributions. First, analyses of the determinants of cooperative membership model this as the result of individual choice, without checking the implicit assumption that farmers have available alternatives. If that assumption is violated, the analysis conflates determinants of individual choice with determinants of the evolution into a particular market structure configuration where only one buyer and only one organisational form has prevailed, with possible confounding effects. Second, there are no quantitative studies comparing cooperatives and capitalistic firms with respect to the non-price characteristics of the exchange relationship, such as contract content and processors' compliance with the agreement. Third, the literature on producer price heterogeneity that takes into account organisational form of the processor is limited, and does not deal with the potential endogeneity between membership status and prices paid. The analysis in the thesis seeks to contribute to the empirical literature on cooperatives by addressing these points.

Chapter 3 – The data

3.1. Introduction

Two data sources are used in the thesis: my own survey of dairy farms in the three provinces and data on the population of dairy farms in two of the three provinces, Trento and Piacenza. In order to answer the research questions, data on farm and farm household characteristics, as well as on the relationship between farmers and their milk buyers, are required. To date, no such dataset exists for Italy and for this reason I collected primary data. An exploratory fieldwork consisting of semi-structured interviews with dairy farmers and with personnel of local livestock farmers' associations guided the development of the questionnaire and the choice of data collection method. A questionnaire addressed to the farm household head or to the person primarily responsible for managing the farm (hereafter: farm manager) was designed, piloted and mailed to *all* dairy farms in the provinces of Trento, Piacenza and Bologna. This chapter outlines the various steps of the data collection process and is organised as follows: Section 3.2 explains the rationale for carrying out a survey by assessing the suitability of existing data sources for answering the research questions; Section 3.3 describes the main steps of the data collection process: choice of survey areas, choice of data collection method, exploratory fieldwork and piloting; Section 3.4 presents the questionnaire and the additional data collected at the level of municipalities; Section 3.5 reports on response rates, quality and limitations of the data; Section 3.6 provides a descriptive overview of geographical characteristics of the provinces under study, of the farm-level data collected, and of the dairy processing and marketing firms operating in the three provinces; Section 3.7 concludes.

3.2. Available data and rationale for the survey

There are two official data sources on Italian farm households which include data on cooperative membership: the Agricultural Census, carried out every ten years by the National Institute for Statistics (ISTAT), which covers all farms and was available for the year 2000; and the Farm Accountancy Data Network (FADN), which is a harmonised yearly data collection system at the level of the European Union, maintained in Italy by the Italian Agency for Agricultural Payments (AGEA), with the purpose of monitoring income of farm households and the effects of the Common Agricultural Policy. FADN collects data on a representative sample of farms, stratified by farm typology (on the basis of production specialisation); in Italy it covers 44% of farms. Both data sources include a question asking what type of cooperative a farmer is member of, if any (e.g. supply or processing cooperative). With respect to dairy farming, both data sources record whether milk was sold to a private processing firm, to a trader, or to a cooperative.

On several occasions I requested ISTAT and AGEA access to their anonymised micro-data, but I never received a reply. These data would be useful in some respects, but not sufficient, alone, for addressing all the research questions, and also for this reason primary data collection was necessary. Existing data could be used to identify individual socio-economic and farm characteristics correlated with cooperative membership. However, they would not allow distinguishing between farms with more than one available buyer and farms which have no alternatives, hence they would not allow addressing most of research questions 1 and 2 on the variation of outlet presence within each province and on the differences between cooperative members and non-members when farmers can choose between joining a cooperative or selling to a private processor. Existing data also do not provide any information on the different objective and subjective characteristics of the exchange relationship between farmer and milk buyer, needed in order to address research question 3. Furthermore, the existing price information is not sufficient for addressing research question 4 on variation in producer prices and the effect of organisational form *per se*: the agricultural census collects information on output value just as an overall figure for all output sold by the farm and in the form of broad classes of value, which does not allow a calculation of the unit price per litre of milk sold; and FADN data does not ask separate questions on quantity sold and value of output sold for each of the buyers used by farmers, and there is the possibility that farmers sell a particular output (e.g., milk) to more than one buyer.

In sum, given the difficulties in accessing existing data and their limited usefulness for addressing the research questions, collecting new primary data was necessary, and the different steps of this process are outlined in the next section.

3.3. The data collection process

This section describes the data collection process and how some issues that emerged in the initial phases of exploratory fieldwork and interviews with dairy farmers led to the choice of data collection method and of survey areas.

3.3.1. Exploratory fieldwork

In order to gather a sense of what were the relevant issues for farmers in the relationship with their milk buyer, as well as to refine the research questions and to begin to develop the questionnaire, the first step of the data collection process was to arrange a number of semi-structured interviews with dairy farmers and with personnel of local livestock farmers' associations.

Between June and August 2006 I interviewed twelve dairy farmers. Of these, half were cooperative members in the province of Bolzano (distributed equally between two relatively small-scale cooperatives) and the others were farmers from Bologna, of which four were members of the large dairy cooperative Granlatte and two supplied milk to a small scale private processor. At this stage I had not yet decided in which areas to conduct the survey. The initial interest in Bologna was driven by the coexistence, within this province, of several small-scale cooperative and private processors with the large coop Granlatte. Bolzano was of interest because, as an entirely mountainous province in the Alps, its agro-ecological conditions are conducive to farmers' relative isolation and potential exercise of market power by milk buyers.

The sample for these exploratory interviews was drawn partly randomly and partly using snowballing. In each province, three farmers were drawn randomly from a list of dairy farms published by the local administration, and each was then asked to refer me to an acquaintance in the area, to generate the additional subjects. The priority at this stage was to identify farmers who were willing to spare some time to discuss their productive activity, their relationship with the milk buyer and the main challenges they encountered in the process of selling their milk. Interviews were purposely left only loosely structured around a set of broad questions on key farm and production characteristics, motivations which led farmers to choose their current milk outlet and the overall characteristics and quality of the relationship. Meetings were arranged on farm at a convenient time for farmers, who seemed happy and keen to engage in conversation regarding their productive activity.

However, in several cases and especially in Bologna, farmers reported concerns about disclosing information on their relationship with the buyer. Such concerns were mitigated to some extent by reassurance of confidentiality and that the information was being collected purely for independent research purposes with no connections with their milk buyer. Overall, however, farmers still revealed substantial reluctance to disclose what clearly appeared to be sensitive information.

The main outputs of this first stage of interviews were the first version of the questionnaire, some initial thoughts about possible data collection methods and steps that could be taken in order to reassure farmers about the purpose of the research and thereby encourage response, and two main qualitative findings. With respect to data collection methods, I began considering a completely anonymous mail survey, being aware of the risks it entails and which will be discussed in section 3.3.3, as a promising way to encourage response to sensitive questions compared to a personal interview.

With respect to the main qualitative findings, the first was that farmers' perception of the quality of their relationship with their cooperative varied substantially with the size of the coop itself. This seemed to be directly related to farmers' perceived ability to interact with and influence decision-makers within their cooperative. For instance, Granlatte's members all remarked that they perceived little difference between the behaviour of Granlatte towards its members and the behaviour of a private processor towards its suppliers, both with respect to pricing policies and governance system. Granlatte's members reported a perceived lack of ability to interact with and influence management's decisions. Suppliers of the small scale private processor in Bologna, in contrast, seemed to find it much easier to at least establish a dialogue with the owner. In Bolzano, cooperative members had a much more positive view of their cooperatives, which were perceived as being an integral part of farmers' productive activity and not, as among Granlatte's members, simply a buyer of farmers' milk. There was no reference to cooperative managers among Bolzano's members, but rather to a process of collective decision-making. History of the cooperatives, their choices with respect to expansion and marketing policies, their current membership size and cohesiveness, probably all played a role in these different perceptions, suggesting cooperatives are a heterogeneous category.

A second qualitative finding was a tendency for relationships between farmers and buyers to last for a long time, often crossing generations. All the farmers I interviewed were currently transacting with the same buyer as their parents' and none of them had ever traded with any other. This was explained by some farmers, both members and non-members, in terms of a relationship of mutual trust that was built over time, and it was suggested that it would take a long time to build a similar relationship with an alternative buyer. Some regarded this continuity as something of which they were proud. Even in case the relationship was not considered to be satisfactory from time to time, cooperative members in Bologna mentioned a commitment to maintaining their membership "in good times and in bad." Social sanctions and reputation also appeared to play an important role for maintaining membership and commitment to the cooperative: members in both provinces said that they would not like to be seen by other farmers and by prospective buyers as changing buyer frequently. In particular, the behaviour of opting in and out of the cooperative following short-term price fluctuations between buyers was seen as highly frowned upon by fellow members and managers. In Bolzano, a few farmers mentioned that this could potentially lead to permanent exclusion from the cooperative as untrustworthy, undesirable member. Overall, this seemed to suggest a substantial degree of inertia in the relationship between farmers and their milk buyer.

Between February and April 2007 I then conducted exploratory interviews with personnel of local livestock farmer organisations in Bologna and Bolzano. The purpose of these interviews was to gain a better understanding of the relationship between milk buyer and farmers, in particular with respect to contract terms and requirements. Feedback on the questionnaire was also provided. Interviewees remarked that cooperatives and private processor tend to adopt similar pricing, contract terms and requirements. Two main differences remain, in their view. The first is the way they distribute their profits, as expected, with cooperatives distributing dividends to its member farmers. The second is the higher security of the exchange relationship provided by cooperatives, which commit to buying all members' output and guarantee continuity in the relationship over time. In Bologna, smaller scale private processors were considered unable to commit to buying the whole output of their suppliers, because of constraints in processing capacity, while larger private processor were considered increasingly less willing to procure from Italian farmers, in favour of cheaper milk imported from Eastern Europe.

Some differences in perceptions and assessment of the role of cooperative firms were found also in this case. In Bolzano, cooperatives' policy of focussing on high quality and niche products was praised as remunerative and beneficial for farmers. In Bologna prevailed a feeling of disappointment, mainly towards the most important local actor, Granlatte, which did not diversify into niche markets and was seen to be following the pricing policy of private processors. Cooperatives were seen here as a very important actor for farm development and modernisation between the 1950s and 1970s, but somehow having lost their "mission" today.[16]

These exploratory interviews with farmers and personnel of livestock farmers' associations, together with comments and suggestions from my supervisors and from faculty of various Agricultural Economics departments in Italy, and relevant questions already adopted in the literature, informed the iterative process of questionnaire development.[17]

Between September and November 2007 I then piloted the questionnaire among ten farmers from Bologna. This sample was chosen to include a variety of buyer types: three members of Granlatte, two members of a small-scale cooperative in the mountains, three selling to the largest private processor operating there, and two selling to another, smaller-scale private processor. None of these farmers had participated to the exploratory interviews and their names were provided by the livestock farmers' association. Some of the interviews were conducted on farm and some at the headquarters of the association. The main purpose of the piloting was to check for clarity, possible ambiguities, and relevance of the questions and no substantial changes to the questionnaire appeared to be necessary as a result. Farmers were particularly happy to discuss matters following open questions.

However, this process again revealed a substantial reluctance to answering specific questions about prices received and relationship with the milk buyer, which appeared stronger than I had encountered during previous interviews. Only under the assurance of strict confidentiality would farmers disclose such sensitive matters at all, and the majority of them stated that they would find it easier to answer those questions in the

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[16] Findings from these interviews with associations' personnel and with farmers were used elsewhere as case study material to inform research on institutional and governance structure of Italian cooperative firms (Hunt and Cazzuffi 2009).

[17] Comments and suggestions from faculty in the Departments of Agricultural Economics at the Università Cattolica del Sacro Cuore (in particular Prof. Renato Pieri and Dr. Claudio Soregaroli), Università di Perugia (in particular Dr. Gaetano Martino) and Università di Napoli Federico II (Dr. Stefano Pascucci) were also very important in the final stages of questionnaire design, and are gratefully acknowledged.

absence of an interviewer and in a format that guaranteed complete anonymity. This stressed further the potential advantage of collecting data via an anonymous mail survey, which for this reason became the data collection method I used in this research, as discussed in more detail in section 3.3.3.

3.3.2. Choice of survey areas

The first step for thinking about the geographical reach of the survey was to decide on a suitable geographical survey unit. A province (that is, the administrative unit between a region and a municipality) seemed to be a promising and manageable level of analysis because of its smaller size and relatively more homogeneous agro-ecological and production characteristics compared to a region.

The selection of research areas was not random. Because I was concerned about obtaining a sufficiently large sample size, I focussed on provinces with a relatively large number of dairy farms. This pointed to most areas in the north of Italy, as well as to the southern regions of Sicily and Puglia.[18] At the early stages of this research, I was however advised that, given the sort of questions I was planning to ask in the survey, the south of Italy would be a difficult research environment due to cultural reluctance to share information on private businesses. For this reason, I decided to focus on the North. At these early stages I was also advised that it would be of primary importance to obtain the support of local livestock farmers associations in order to increase response rate to the survey, and the importance of this as a way to provide reassurance to farmers that the survey had research purposes only and no connections with dairy processing and marketing firms became more evident during initial interviews with farmers.

I thus sought provinces in the north of Italy where such associations had a large membership among dairy farmers, which made them, at least, a well-known actor in the local rural community.[19] After a few initial contacts which were not successful[20], I

[18] It is customary to consider as part of the north the regions of Trentino Alto Adige (where Trento is located), Emilia Romagna (where Bologna and Piacenza are located), Valle d'Aosta, Piemonte, Liguria, Lombardia, Veneto, Friuli Venezia Giulia. The regions of Abruzzo, Molise, Basilicata, Campania, Calabria, Puglia, Sicilia and Sardegna are considered to be part of the south. The remaining regions are defined as centre.

[19] Livestock farmers' associations primarily function as sources of information (on market conditions and farming practices) and technical assistance for farmers, and occasionally also engage in political lobbying. The variation in the share of farmers participating in these associations, about 45% in the north of Italy against 28% in the rest of the country, already provides some evidence of variation in the degree

finally obtained the support of farmers' associations in Trento, Piacenza and Bologna, who were willing to endorse the survey and present it to farmers by means of a letter encouraging participation. For this reason, these provinces became the research areas.

The process of selection of research areas raises questions of external validity. First, concerns about the willingness to participate of farmers in the south of Italy brings to mind Putnam's findings that this part of the country is characterised by an overall lower degree of social capital, trust and propensity to associate than the rest of the country (Putnam 1993). This suggests that, by focussing on the North, my research is dealing with people who, *a priori*, may be considered more open and willing to 'cooperate'.

Second, even though all farmers operating in the three provinces, and not just members of the local livestock association, were included in the survey, focussing the research on areas where farmers' associations play an important role may also imply that farmers in these areas are more likely to be 'association minded' to begin with. Historically, in the north of Italy the formation of the first cooperatives usually started long before livestock associations were established.[21] However, today, unobserved characteristics correlated with membership in such associations may also be correlated with the likelihood of joining a cooperative and may influence both expected and actual gains from coop membership itself. For instance, it cannot be ruled out that membership in farmers associations may foster trust and willingness to collaborate among fellow farmers. In turn, this may reduce management costs for cooperatives, improve coop performance and increase farmers' returns from membership. If this is the case, results on both price and non-price characteristics of the relationship between farmers and buyers may be driven by both an 'association effect' and a true 'cooperative effect'. However, unfortunately I can only observe a combination of the two without being able to separate them empirically.

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of cooperation among farmers, which is consistent with the north-south variation of cooperative membership in dairy farming discussed in Chapter 1.

[20] The decision of local associations not to endorse the research was explained to me only in one case, in the province of Bolzano, where the director told me farmers were too busy to spend time on the questionnaire, and the association did not wish to be seen by farmers as taking up their time with a survey.

[21] While the establishment of formal and informal cooperative associations dates back to the second half of the 19th century in most of the north of Italy, the livestock farmer associations were typically established from the 1960s onwards, a move related to modernisation of livestock farming and cattle reproduction techniques.

3.3.3. Advantages and disadvantages of collecting data via a mail survey

The data was collected via an anonymous mail survey. A questionnaire was mailed in February 2008 to *all* farmers operating in the three provinces, together with a short presentation of the survey, instructions for completion and a cover letter from the local livestock farmers' association endorsing the survey and encouraging farmers' collaboration. Two reminders were sent one and two months after the original questionnaire, respectively. A pre-stamped addressed envelope for returning the questionnaire was also always included, and a replacement, identical questionnaire was mailed together with the second reminder. A total of 3194 farmers were contacted, of which 1894 in Trento, 1130 in Piacenza and 170 in Bologna. Responses continued to arrive until July 2008.

A mail survey was chosen for four reasons. First, as revealed in the exploratory interviews with farmers, an anonymous, self-administered questionnaire seemed to be more effective in eliciting a response to sensitive questions compared to face-to-face interviews. Second, it appeared to be a faster and more cost effective way of reaching the whole of each province compared to personal interviews, in order to try to increase the sample size as much as possible. Third, part of the questionnaire involves 'recall' questions about price paid, quantity of milk sold and farm characteristics in the financial year 2006-2007 (the most recently completed financial year at the time when the survey begun), as well as questions about the decision-making process that led the farmer to choose her current outlet. A mailed questionnaire was chosen in the attempt to increase the accuracy of the data collected, by giving farmers sufficient time to recall, collect or verify the relevant information, avoiding the pressure and possible measurement error associated with the presence of an interviewer at the moment of completion of the questionnaire (Moser and Kalton 1971). Fourth, being aware that I was asking for farmers' time in return for nothing more than the opportunity to anonymously say something about their productive activity and relationship with their milk buyer, a mail survey seemed to be a less obtrusive way of asking for their help, allowing them to complete it in the time and manner they found most convenient.

A mail survey, however, raises a number of problems. Low response rates are documented in the literature (Moser and Kalton 1971; Tourangerau, Rips et al. 2000; De Leeuw, Hox et al. 2008). The researcher has no control over who actually completes the questionnaire, and has no chance of encouraging respondents to answer particular questions they may seem inclined to avoid, which may lead to the problem of return of incomplete questionnaires. Because respondents can read the questionnaire in full before beginning to respond, replies are not spontaneous and independent from each other. Checking for validity of responses also becomes very difficult, for instance because it is not possible to detect non-verbal signs of incomplete or deliberately false information being provided by respondents.

I took several measures in the attempt to address these problems as best as I could. I chose to survey the whole population of dairy farmers in order to increase the chances that even a low response rate would not compromise the research and yield a sufficient number of responses to allow quantitative analysis. The questionnaire was kept as short as possible, and a long time was invested in checking wording, meaning, order and relevance of questions as carefully as possible, including during interviews with local farmer associations' personnel and through piloting. Presentation and endorsement of the survey by the local livestock farmers' association, i.e. an organisation that farmers know, as well as reminders, were used in order to encourage response. The role of local livestock farmers' associations was particularly important, because they provided additional reassurance that the information I was collecting would just be used for independent research purposes and would not be disclosed to milk buyers.

In addition to these measures, respondents were never asked to provide their name or full address anywhere in the questionnaire, just their municipality. Anonymity was ensured not only to encourage response, but also to increase the willingness of farmers to respond accurately to questions about their relationship with the milk buyer. Anonymity entailed two significant costs: first, it did not allow me to identify non-respondents in order to target them with additional follow-ups or with a shorter survey collecting some basic information that would have been useful for investigating possible response bias; second, it prevented me from identifying precisely the geographical location of respondents. These costs were accepted because I was repeatedly advised, both by farmers' associations and by farmers who participated in the piloting, that anonymity would be very important for encouraging response and accuracy.

In order to mail the questionnaires, I obtained a list with name and address of all dairy farmers operating in the three provinces in 2006 (the most recent available year). The source of this information is lists of suppliers compiled by each dairy processing firm for the year 2006-2007 and submitted to AGEA, the government body in charge of managing agricultural subsidies within the framework of the Common Agricultural

Policy. This list was then passed to me by the Osservatorio Latte of the Università Cattolica del Sacro Cuore, Milano, which maintains the database of Italian dairy farmers on behalf of AGEA and whose help I gratefully acknowledge. The list excludes farmers not selling to a processing firm, for instance because selling to a trader. Sales to milk traders are however not common in the North of Italy, estimated to account for less than 1% of total volume sold (Pieri and Del Bravo 2008), so the exclusion of these farms is not considered a reason for particular concern. No individuals, provided they were included in this list, were purposefully or systematically excluded from the survey.

3.4. Description of the questionnaire and other data collected

The final version of the questionnaire contains 38 questions and is included in Appendix B translated into English. The questionnaire was addressed to the household head or to the person mainly responsible for farm management. It was anonymous, as discussed above, but asked farmers to indicate their province and municipality. The type of questions asked include closed questions, lists where respondents can select more than one response, and five open questions in which respondents are asked to explain their answer to the previous question. The questionnaire is divided into two sections: the first on farm and household characteristics, and the second on the relationship with the milk buyer.

In order to benefit from validated, already tested questions, some of questions on farm and household characteristics closely resemble relevant ones from the Italian Agricultural Census of 2001.[22] Similarly, some of the questions on the characteristics of the exchange relationship with the buyer follow closely similar ones used in the empirical literature on transaction costs in agricultural marketing, in particular (Staal 1996; Hobbs 1997; Boger 2001; Vakis, Sadoulet et al. 2003; Escobal D'Angelo 2005).

Questions on the relationship with the milk buyer are referred to the buyer farmers sold most of their milk to. It is possible, in principle, for farmers to sell to more than one buyer, but evidence collected during the preliminary fieldwork and piloting suggest this is unlikely. Farmers were asked to indicate both their membership status and the name of their current main milk buyer. No discrepancies between membership status and

[22] Available online at http://censagr.istat.it/questionario.htm (last access July 18th, 2012).

organisational form of the buyer were found. Thus, the thesis is effectively dealing with a situation where, at least according to what revealed by farmers, only members sell to cooperatives, and no members sell to a private processor. Potential incentives for being untruthful in this answer, not disclosing disloyalty to the current buyer, are discussed in Section 3.5.2 below. Even though the focus of the thesis is on the comparison between cooperative and private processors, for completeness the possibility of sales to a milk trader instead were also considered, but no respondents reported this as their marketing channel.

The information collected in the survey includes:

(a) Farm characteristics: This includes herd size, milk quantities produced and sold, land area and land ownership status, type of stalling facilities, and family and hired labour working on farm.

(b) Household characteristics: The definition of household I adopted is the one used by ISTAT, encompassing people related by marriage, blood or legal status and living under the same roof. The information collected includes demographic characteristics of farm manager and other household members (age, gender, highest level of schooling completed and engagement in off-farm employment) and contribution of dairy farming to total farm and household income.

(c) In order to study the determinants of cooperative membership and availability of alternatives, I collected the following information: name and organisational form of current main milk buyer; membership status of parents of person mainly responsible for managing the farm; number of changes in milk buyers since the farmer had become farm manager, and organisational form of previous buyer, if any; availability and organisational form of other potential buyers; motivations for choice of current buyer.

(d) In order to analyse the characteristics of farmers' exchange relationship with their milk buyer, I collected the following information:

(d.1) Objective characteristics of the exchange relationship: This includes type of contractual agreement with milk buyer (written or verbal); number and type of contract items agreed upon (including prices and quality criteria); buyer's compliance with the terms of the agreement with respect to price paid, punctuality of payment and quantity collected; frequency and location of milk collection (whether at the farmgate, at the processing plant gate or at an intermediate collection point); farm to plant distance; provision of technical assistance by the buyer; and changes in productive activity required by the buyer. The latter was collected due to an initial interest in exploring patterns of on-farm innovation. However, this was not pursued further because a full analysis of innovation behaviour over time would have required greatly lengthening the questionnaire, increasing the risk of non-response.

(d.2) Farmers' subjective perception of the exchange relationship: This includes whether farmers experienced difficulties in agreeing on the terms of the exchange relationship; how much the farmer felt able to influence decisions on the terms of the agreement; and whether she felt more tied to her buyer following some required specific investments. In order to analyse farmers' preference for a particular type of organisational form, I also collected data on farmers' self-reported reservation price for trading with a buyer with a particular organisational form, that is, the price that a buyer with a different organisational form would have to pay for them to leave their current buyer. Farmers were also asked to indicate whether a higher price alone would be enough to switch, and what else would be required if not.

(e) In order to investigate variation in producer prices paid, I collected the following price data for raw milk sold to processors, expressed in per litre terms: base price, quality and quantity premia, and final price, which includes the premia-adjusted price plus any end-of-year bonus paid by the processor. A more detailed discussion on the typical price structure for raw milk is left for Section 3.6.3 below.

Survey data were later combined with data on the municipality where each farm is located, including:

(a) Geographical characteristics: Mean altitude; minimum and maximum altitude points; agro-ecological classification (lowland, hill or mountain); physical area and population of the municipality in 2007.

(b) Average farm characteristics: Average farm herd size (available from public access ISTAT data for 2007); breed composition, computed as the share of each breed of dairy cows over total number of dairy cows in each municipality (information on cattle disaggregated by breed was obtained from provincial administrations).

(c) Local market structure: The list of the population of dairy farmers which I used as sampling frame to run the survey was used to gather additional information on market structure by municipality in Piacenza and Trento. In addition to the name and address of all farmers, the lists I obtained for these two provinces also contained the name of the processor each farmer was selling to in 2006. Unfortunately, this information was not available for Bologna: for this province, I only received a list with address and name of farmer, but not the name of the processor to whom farmers were selling; my efforts to obtain this information were not successful and an explanation was not offered. For Piacenza and Trento, however, from the processor's name it was then possible to identify whether it was a cooperative or a private processor. This information was used to map within each Trento and Piacenza the number and organisational form of processors buying milk from each municipality. Chapter 4 discusses this in more detail, together with the limitations of analysing variation in market structure using municipalities as the unit of analysis.

3.5. Response rate and quality of the data

This section first presents the response rate to the survey and then discusses quality and limitations of the data with respect to their representativeness of the characteristics of different populations and non-response bias (Section 3.5.1), and in terms of accuracy and non-response to individual questions (Section 3.5.2).

The overall response rate to the survey was low, just above 10% (10% of farmers in Trento, 8% in Piacenza and 24% in Bologna). This resulted in a sample of 313 farmers, of which 182 in Trento, 91 in Piacenza and 40 in Bologna. Cooperative members are 81% of the sample: 95% in Trento, 64% in Piacenza and 60% in Bologna. In spite of the low response rate, sample size is still large enough to allow quantitative investigation of the research questions. Figures 3.1 and 3.2 show, respectively, the distribution of responses and of cooperative members by municipality within each province.

Figure 3.1: Number of survey respondents by municipality

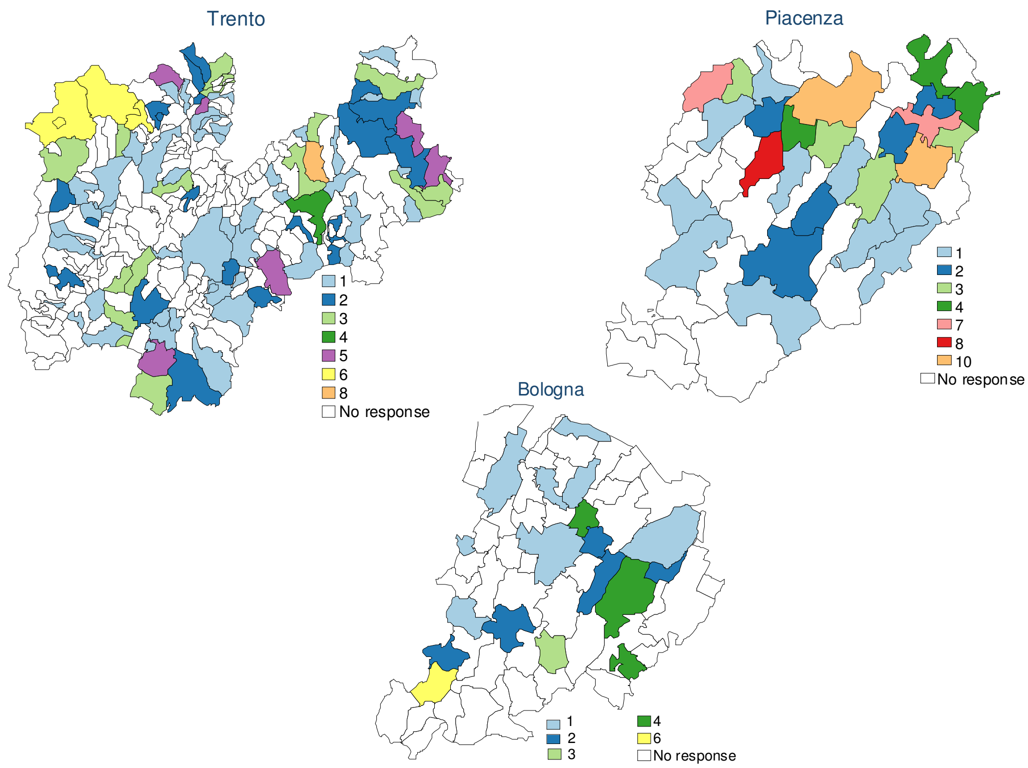
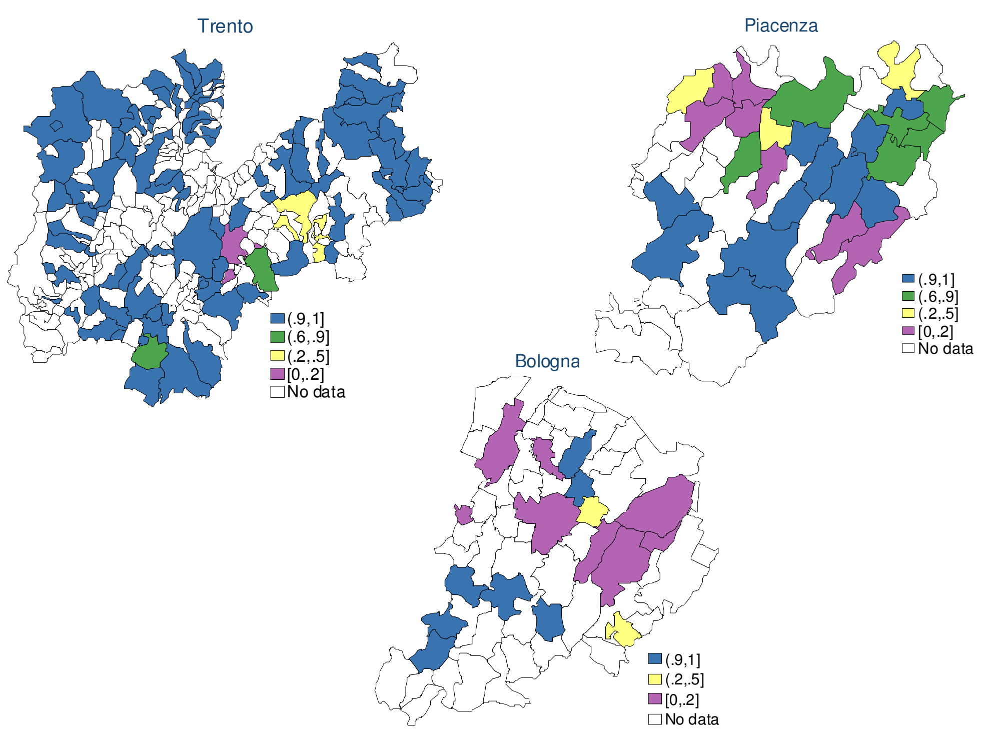


Figure 3.2: Share of cooperative members by municipality



3.5.1. Sample representativeness and non-response bias

In this section, sample characteristics are compared to available characteristics of the population of cattle dairy farmers in the whole of Italy, in the North of Italy, and in each of the three provinces. Available data for comparison include some measures of farm size, share of cooperative members, age and gender of the farm manager.

The sample is constituted by farms that are significantly larger than dairy farms in either the whole of Italy or in the north of the country. Annual farm milk output is 241 tons in the whole of Italy, and 233 tons in the north, against a sample mean of 378 tons. These differences are statistically significant at 1% level (t-stats = 5.66 and 5.98 respectively). This pattern is confirmed when looking at mean farm herd size, which is 29 in the whole of Italy and 27 in the north, against a sample mean of 47 (t-stats = 6.83 and 7.58 for the whole and north of Italy respectively). Looking at the population of dairy farms within each province, Table 3.1 shows that respondents in Piacenza have significantly smaller herds, but not output, than the population. Conversely, respondents in Trento and Bologna produce a significantly larger output than the population in each province, but do not differ from it with respect to herd size.

The share of cooperative members in the sample is also larger than in the population in the whole country and in the north: 63% and 74% in Italy and in the north, respectively, compared to a sample mean of 81%. These differences are statistically significant at 1% level (t-stat = 8.2 and 3.2 for Italy and for the north, respectively). Looking at the population within each province, Table 3.1 shows that cooperative members are over-represented in Trento and Piacenza, but not in Bologna.

With respect to demographic characteristics of the farm manager, data on age and gender are only available as a national aggregate. The proportion of female farm managers is significantly smaller in the sample compared to the population (10.4% against 16.5%, t-stat = -3.45), while mean age is the same, fifty, for both population and sample.

The sample overall appears to be too different from the wider population of dairy farms to provide grounds for meaningful inferences for the whole country or for its northern regions. However, the analysis can still provide some significant results for the provinces under study, which can be suggestive of broader trends and tendencies for areas with similar agro-ecological characteristics and market structure, provided non-response bias is taken into account. Because the survey basically consists of a census of the population of dairy farms in each province, the comparison of sample characteristics disaggregated by province with population characteristics in each province provides an indication of whether the data is likely to suffer from non-response bias. Non-response bias occurs as a function of how correlated response propensity is to the key attributes of interest, and can arise if non-respondents differ from respondents in observable or unobservable characteristics that also influence the variables under study (Whitehead, Groothuis et al. 1993; De Leeuw, Hox et al. 2008). One of the main hypotheses of this thesis is that smaller farms, which are more vulnerable to the potential exercise of market power by processors, are more likely to join a coop and benefit more from membership than larger farms. Because farm size of respondents in Trento and Bologna tends to be larger than in the population, results on coop effect on prices paid for these two provinces are likely to provide a downward biased estimate for their population. Conversely, because herd size of respondents in Piacenza tends to be smaller than in the population, results for this group are likely to provide an upward biased estimate for the underlying population.

Table 3.1: Mean sample and population characteristics (2007)

	Sample	Population	t-stat
Annual farm milk output (ton)			
Trento	211.46	143	3.41
Piacenza	689.83	582	1.86
Bologna	429.56	312	2.72
Farm herd size			
Trento	29.02	26	1.46
Piacenza	81.88	135	-7.95
Bologna	54.55	53	0.30
% of coop members			
Trento	94.5%	91%	2.06
Piacenza	63.74%	48%	3.10
Bologna	60%	67%	-0.89

Source for population data: Pieri and Del Bravo (2008) using ISTAT data

3.5.2. Accuracy of responses and non-response to individual questions

Potential problems with the quality of survey data also need to be recognised: respondents may not give accurate information, or may not answer particular questions.

Question ambiguity, or farmers' subjective valuation of certain concepts, may lead to differences among respondents in their interpretation of the wording or of how a variable should be calculated, and this may cause non-response or dispersion in responses. Piloting the questionnaire was helpful in the attempt to reduce this problem as much as possible, by identifying questions that needed more clarity and additional instructions. However, questions asking farmers about their subjective perceptions of quality of the exchange relationship remain the item with the largest number of non-responses, suggesting that ambiguity had not been fully addressed with piloting.[23] Respondents' concerns about privacy and disclosure may also affect willingness to respond or the answer given. Ensuring anonymity sought to minimise response error resulting from confidentiality problems.

The potential for strategic misrepresentations should also be considered: respondents may have incentives to be untruthful in their answer. The survey does not have any direct linkage to subsequent economic outcomes which are of interest to the farmers and which they may feel they can influence with their response. However, non-pecuniary, 'warm-glow' incentives may exist for farmers to be untruthful in order to project a positive self-image (Hurd, McFadden et al. 1998). These incentives may be more serious for cooperative members. For instance, members may have an incentive to report that their main buyer is a cooperative even in case they are selling to a private processor, in order not to disclose their disloyalty to the cooperative. They may also have an incentive to overestimate their reservation price for leaving the coop and switching to a private buyer, in order to project themselves as committed to the cooperative. Possible implications of these measurement errors will be discussed in Chapters 6 and 5 respectively. Overall, ensuring anonymity should also help to reduce incentives for this kind of response behaviour.

Imperfect knowledge is another reason to be cautious about survey data. Respondents may not have readily available all the information they need to answer a certain question and this may lead to item non-response or to the construction of an estimate.[24] This appears to have happened to some extent with price data: 4% of the sample did not

[23] Seventeen percent of respondents did not answer the question on their own perceived influence on the exchange relationship, and 14% did not answer the question of whether they felt more tied to their current buyer following a request for specialised investment. There do not appear to be any significant differences with respect to age, gender, years of schooling, scale of production and membership status between respondents and non-respondents to these questions.

[24] An example of this is so called 'focal effects', whereby information is stored or reported categorically, with a tendency to rounding numbers off, for instance reporting distance at 5 kilometres intervals or milk produced at 10 quintals intervals.

provide information on final price, while 17% and 19% did not provide information on price disaggregation into base price and premia respectively. Farmers not providing information on base price and premia do not appear to differ from farmers providing this information with respect to age, gender, highest completed level of schooling, scale of production or membership status. However, the scale of production of the 14 farmers not reporting final prices is double that of farmers providing this information (t-stat = -3.22).

3.6. Background and data description: geography, sample farms and processors

This section provides, first, a brief description of the geography of the provinces under study, second, a summary of the characteristics of the sample, as a whole and disaggregated by province, and, third, a description of the characteristics of the processors operating in the three provinces, with the aim of providing a picture of the various levels of heterogeneity that characterise the case under study. A map of where the three provinces are located in Italy is provided in Figure 1-A in the Appendix.

3.6.1. Geography

The three provinces differ by geography and farm characteristics. Trento is the largest (6207 km^2) and entirely mountainous. Mean altitude of its municipalities is 709 m above sea level, ranging from 73 to 1842 m, and mean minimum altitude is 539 m, ranging from 65 to 1418 m. Average herd size per farm for the population of dairy farms is 30, ranging from 2 to 173. Almost 80% of dairy cows in this province are of a breed, (Alpine Brown), which provides lower unit yields in terms of quantity, but higher quality in terms of milk nutrients, compared to the dominant breed in the rest of northern Italy (Friesian), as shown in Table 3.2. The choice of different breeds in different provinces is partly due to different agro-ecological conditions. Because of their biological characteristics, Friesians have a more fragile structure and are less suited for extensive farming (grazing) which is more common at higher altitudes.

The territory of Piacenza is less than half that of Trento (2589 km^2) and is 23% mountainous, 37% hilly and the remainder are lowlands. Mean altitude of its municipalities is 225 metres, ranging from 39 to 906 m, and mean minimum altitude is

109 m, ranging from 34 to 399 m. Average herd size per farm is 139, ranging from 14 to 538. Bologna is larger than Piacenza (3702 km^2) but has similar agro-ecological characteristics: it is 22% mountainous, 35% hilly, and the remainder are lowlands. Dairy farming is however concentrated mostly in hilly and mountainous areas. Mean altitude in this province is 194 m, ranging from 8 to 841 m, and mean minimum altitude is 97 m, ranging from 3 to 394 m. Average herd size per farm is 44, ranging from 6 to 174. In both provinces 98% of dairy cows are of Friesian breed.

Table 3.2: Output quantity and quality for the two main breeds in the provinces

Breed	Milk yield	Quality per unit of milk	
	Lt/cow/day	% fat	% proteins
Freisian	23	3.8	3.35
Alpine brown	19	4	3.52

Source: National Livestock Register (last access July 18th, 2012)
http://statistiche.izs.it/portal/page?_pageid=73,12918&_dad=portal&_schema=PORTAL

A total of 1894, 1130 and 170 dairy farms produce raw milk in Trento, Piacenza and Bologna respectively. Farms in these provinces, like all Italian farms, are subject to milk quotas, a regulation set in 1984 by the European Union which limits the maximum amount of milk that each farm can sell.[25] Farms can trade quotas between themselves from one year to the next, with some geographical and quantity restrictions. In the provinces under study, transactions in quotas (sales or lease) from 2006 to 2007, the year under study, accounted for between 5 and 6% of total quantities of milk sold in 2007, suggesting that, overall, individual milk supply can be regarded as relatively inelastic (Pieri and Del Bravo 2008).[26]

[25] European authorities established the quota system with the objective to curb the increasing over-production of milk, especially high in northern member countries; and to stabilise milk supply and producer prices. The law does not prevent any citizen from producing as much milk as s/he wants, but selling any quantity in excess of the allowed ceiling is subject to a 'super levy', which renders revenue from excess milk practically null. Member states were initially allocated national reference quantities based on national data on milk production for the year 1983. Reference quantities were subsequently adjusted and increased for several countries (including Italy) following negotiations. National reference quotas were then assigned to individual farmers based on their historical production levels (Boussard 1985).

[26] If land is rented or sold, the attached milk quotas are also transferred. Transfers of milk quotas without land are allowed, under certain restrictions. For instance, farms located in lowlands cannot rent nor purchase quotas from farms located in mountain areas. Conversely, farms located in mountain areas and wishing to rent or buy more quotas face no geographical restrictions. However, a farm will lose its quota if it leases it for more than two consecutive years.

Heterogeneity in province characteristics is reflected in heterogeneity across sampled farms. The next section presents mean farm and socio-economic characteristics of the sample and their variation across provinces.

3.6.2. Sample farms

Tables 3.3 and 3.4 summarise farm characteristics for the full sample and by province respectively. Sample mean farm herd size (defined as the average number of lactating cows on farm in the year under study) is 47, ranging from 3 to 400. Mean annual farm milk output is 378 tons, ranging from 6 to 3000 tons, most of which is sold to processing and marketing firms. Only 1% of output is sold directly to consumers. The distribution of sample farms by herd size and milk output is shown in Figure 3.3. The majority of farms have a herd size that is smaller than 40 and an output smaller than 120 tons per year. Mean yield per cow per day is 19 litres. About 46% of farms have modern stalling facilities, where cattle are not chained to a fixed position, but free to move within stalls. Mean total operated land area is 42 hectares (ranging from 2 to 550 ha), 46% of which is owned. About 19% of farms own all the land they farm, while 9% rent it all. On average, 2.5 household members are employed on farm and 25% of farms also hire labour. Each household member works on farm an average of 9 hours per day.

Farm characteristics are significantly different across provinces, as shown in Table 3.4. Farms in Trento are consistently the smallest, whether this is measured by herd size, annual milk output or land area. Yield per cow is lowest here, 16 litres per day against 22 for the rest of the sample. This difference is likely to be partly due to the differences in breed composition among provinces shown in Table 3.2 above. Farms in Trento also have the lowest share of modern stalling facilities; in this province, however, the practice of open grazing onto common fields, especially in the summer, is widespread. Land area is smallest here, and the share of owned land, and of farms owning all their land, is also lowest. Both the number of hours per day worked on farm by household members and the share of households hiring labour are the lowest in this province.

Farms in Piacenza are the largest, with a herd size almost three times as large as in Trento and 1.5 times as large as in Bologna. Annual milk output is three times as large as in Trento. Almost 70% of farms have modern stalling facilities, and both land area and the share of farms owning all their land are largest here. The number of household members working on farm is the lowest of the three provinces, and the share of farms hiring labour is the highest. Farms in Bologna present similar characteristics to Piacenza, with the exception of herd size, annual milk output, and share of farms hiring labour, which are all smaller than in Piacenza.

Table 3.3: Farm characteristics: full sample

	Sample		
	N	Mean	St. dev
Farm altitude (m)	300	522.61	407.48
Herd size (n lactating cows)	308	47.44	47.34
Annual milk output (ton)	308	378.01	426.12
Yield/cow/day (lt)	303	18.71	6.46
% farms with modern stalling	310	45.81%	49.9
Total land area (ha)	304	42.49	52.58
% land owned	305	46%	35
% farms owning all land	305	19.02%	39.3
% farms renting all land	305	8.85%	28.4
N hh membes working on farm	296	2.54	1.05
Hours/day per hh member	298	9.13	2.99
% farms hiring labour	313	25.24%	43.5

Figure 3.3: Distribution of sample farms by herd size and annual milk output

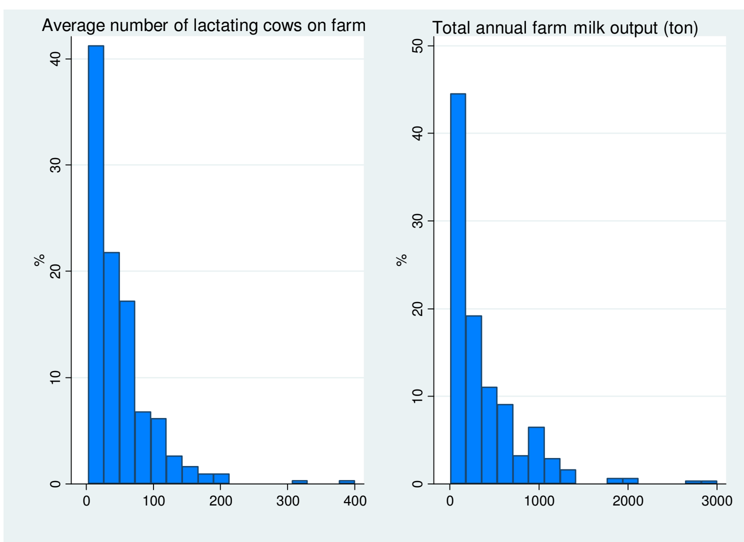


Table 3.4: Farm characteristics by province

	Trento			Piacenza			Bologna			Chi2
	N	Mean	St. dev	N	Mean	St. dev	N	Mean	St. dev	
Farm altitude (m)	175	786.98	300.47	86	105.78	87.41	39	255.54	296.16	177.52***
Herd size (n lactating cows)	180	29.02	27.80	88	81.88	62.68	40	54.55	32.21	93.24***
Annual milk output (ton)	179	211.46	270.06	89	689.83	545.15	40	429.56	272.05	92.78***
Yield/cow/day (lt)	177	16.29	5.88	86	22.46	6.01	40	21.33	4.92	63.48***
% farms with modern stalling	180	30%	45.9	90	67.78%	47	40	67.50%	47.4	43.20***
Total land area (ha)	174	23.98	22.13	90	68.79	76.57	40	63.82	48.35	95.04***
% land owned	175	31%	27	90	68%	34	40	60%	35	67.09***
% farms owning all land	175	4.57%	20.9	90	41.11%	49.4	40	32.50%	47.4	56.96***
% farms renting all land	175	10.29%	30.5	90	6.67%	25.1	40	7.50%	26.7	1.07
N hh membes working on farm	173	2.55	1.08	85	2.34	0.97	38	2.92	0.97	7.80**
Hours/day per hh member	174	8.71	3.26	85	9.64	2.57	39	9.92	2.17	12.01***
% farms hiring labour	182	18.68%	39.1	91	41.76%	49.5	40	17.50%	38.4	18.57***

Test statistic is non-parametric Kruskal-Wallis χ^2; *** p<0.01, ** p<0.05, * p<0.1

Table 3.5 shows sample mean characteristics of the farm manager, defined as the person primarily responsible for managing the farm. Mean age of the farm manager is 50 and 23% of them are younger than 40. Female farm managers are 10% of the sample. With respect to the highest completed educational attainment, 25% of the sample stopped schooling after completing primary school and 37% stopped after completing secondary school. Another 36% completed post-secondary education and the remaining 2% has a university degree. Twelve percent of the sample has a specialised post-secondary agricultural education. Current farm managers have been primarily responsible for managing the farm for a long time, 22 years on average. They work about 10 hours per day on farm, and 8% of them are also employed off-farm.

Table 3.5: Farm manager characteristics: full sample

	Sample		
	N	Mean	St. dev
Age	283	50.37	13.25
% younger than 40	282	23.40%	42.42
% women farm manager	306	10.46%	30.65
N years of experience as farm manager	311	22.12	12.38
Hours a day worked on farm	298	10.48	3.30
% farm mangers also working off-farm	301	8.31%	27.64
Highest completed educational attainment			
Primary	300	25.33%	43.56
Secondary	300	37.33%	48.45
Post-secondary agricultural education	300	12.33%	32.94
Post-secondary technical education	300	13.33%	34.05
Other post-secondary education	300	11.67%	32.16
University degree	300	2.00%	14.02

Differences across provinces are less marked with respect to farm manager characteristics than they were with respect to farm characteristics, as shown in Table

3.6. Farm managers in Trento are the youngest (49 years), and those in Bologna are the oldest (56). They are most likely to be women in Trento (15%) and least likely to be so in Piacenza. Farm managers in Bologna are significantly more likely than elsewhere to have stopped schooling after secondary school, while in Piacenza they are least likely to have done so. Conversely, post-secondary agricultural education is most frequent in Piacenza, 23% of farmers, compared to just about 8% of farm managers in Bologna and Trento.

Table 3.6: Farm manager characteristics by province

	Trento			Piacenza			Bologna			Chi2
	N	Mean	St. dev	N	Mean	St. dev	N	Mean	St. dev	
Age	171	48.93	13.47	75	50.95	11.97	37	55.86	13.49	7.52**
% younger than 40	171	28.07%	45.07	74	18.92%	39.43	37	10.81%	31.48	6.18**
% women farm manager	178	15.17%	35.97	89	2.25%	14.91	39	7.69%	27.00	10.94***
N years of experience as farm manager	182	22.68	12.8	89	19.92	11.45	40	24.43	11.80	5.85*
Hours a day worked on farm	174	10.43	3.79	85	10.54	2.38	39	10.56	2.67	0.57
% farm mangers also working off-farm	175	10.86%	31.20	87	4.60%	21.06	39	5.13%	22.35	3.58
Highest completed educational attainment										
Primary	173	24.28%	43.00	88	27.27%	44.79	39	25.64%	44.24	0.28
Secondary	173	42.20%	49.53	88	21.59%	41.38	39	51.28%	50.64	14.31***
Post-secondary agricultural	173	8.09%	27.35	88	22.73%	42.15	39	7.69%	27.00	12.45***
Post-secondary technical	173	15.03%	35.84	88	13.64%	34.51	39	5.13%	22.35	2.71
Other post-secondary	173	10.40%	30.62	88	14.77%	35.69	39	10.26%	30.74	1.17
University degree	173	0.58%	7.60	88	3.41%	18.25	39	5.13%	22.35	4.62

Test statistic is non-parametric Kruskal-Wallis χ^2; *** p<0.01, ** p<0.05, * p<0.1

With respect to household characteristics, summarised in Table 3.7, sample households have on average 3 members and 34% of them have at least one member working off-farm. Dairy farming contributes on average to 67% of total household income and 75% of total farm income. About 20% of farms are fully specialised in dairy, that is, all of their farm income comes from dairy farming. These characteristics vary by province, as shown in Table 3.8. Household size is largest in Bologna and smallest in Piacenza. Households in Trento tend to diversify their income more than elsewhere: 43% of them have at least one member working off farm, compared to 21% and 23% in Piacenza and Bologna respectively; dairy farming represents 58% of household income and 70% of farm income in Trento, compared to 85% of both in Piacenza and 70% and 77% respectively in Bologna. Only 16% of farms in Trento and 17% in Bologna are fully specialised in dairy farming, compared to 29% in Piacenza.

Table 3.7: Household characteristics: full sample

	Sample		
	N	Mean	St. dev
Household size	306	2.98	1.23
% of household with at least one member working off farm	302	34.11%	47.49
Dairy farming as share of hh income	301	67.51%	30.42
Dairy farming as share of farm income	301	75.55%	26.04
% of households specialised in dairy	299	20.07%	40.12

Table 3.8: Household characteristics by province

	Trento			Piacenza			Bologna			Chi2
	N	Mean	St. dev	N	Mean	St. dev	N	Mean	St. dev	
Household size	179	2.97	1.24	88	2.83	1.27	39	3.38	1.02	7.31***
% of household with at least one member working off farm	176	43.18%	49.67	87	20.69%	40.74	39	23.08%	42.6	15.53***
Dairy farming as share of hh income	174	58.20%	32.16	87	84.79%	19.25	40	70.45%	25.53	42.46***
Dairy farming as share of farm income	174	70.26%	28.97	87	85.62%	16.79	40	76.70%	22.78	17.57***
% of households specialised in dairy	172	16.28%	37.03	87	28.74%	45.52	40	17.50%	38.48	5.78*

Test statistic is non-parametric Kruskal-Wallis χ^2; *** p<0.01, ** p<0.05, * p<0.1

With respect to current, past and alternative buyers, again the sample shows substantial heterogeneity, summarised in Tables 3.9 and 3.10. The sample is predominantly composed by cooperative members (81%). Farmers have been selling to the same buyer for almost 17 years on average and only a third of them had changed buyer at least once since she became the farm manager. Mean number of changes for those who changed at least once is two. A substantial portion of the sample, about a third, perceives that no alternative buyer is available. Less than 50% of the sample knows the milk price paid by other buyers.

Cooperative members are significantly more predominant in Trento (94%) compared to 64% in Piacenza and 60% in Bologna. Duration of the exchange relationship with the current buyer is longest in Trento (19 years), followed by Bologna (17 years), and shortest in Piacenza (11 years). The share of farmers who changed buyer at least once is largest in Piacenza (65%) followed by Bologna (50%), compared to only 15% in Trento. Among those who changed at least once, farmers in Piacenza changed on average 2.3 buyers, compared to 1.8 in Bologna and Trento each. The share of farmers perceiving alternative buyers are available also differs significantly across provinces. It is largest in Piacenza (86%), followed by Bologna (78%), but is only 56% in Trento.

Overall, this preliminary descriptive evidence indicates substantial variation within the sample and across provinces in both farm characteristics and market structure, which will be investigated in more detail in the next chapters. The next section presents some characteristics of the dairy processing and marketing firms operating in the three provinces.

Table 3.9: Current, past and alternative buyers: full sample

	Sample		
	N	Mean	St. dev
% coop members	313	81.15%	39.17
N of years with current buyer	299	16.59	11.05
% farmers who changed buyer at least once	304	33.55%	47.30
N changes in buyer if at least one	102	2.01	1.22
% farmers perceiving other buyers are available	304	67.43%	46.94
% farmers knowing price paid by other buyers	251	49.40%	50.10

Table 3.10: Current, past and alternative buyers by province

	Trento			Piacenza			Bologna			Chi2
	N	Mean	St. dev	N	Mean	St. dev	N	Mean	St. dev	
% coop members	182	94.51%	22.85	91	63.74%	48.34	40	60.00%	49.61	50.96***
N of years with current buyer	179	18.93	11.45	84	11.48	8.42	36	16.86	10.62	24.46***
% farmers who changed buyer at least once	180	15.00%	35.81	86	65.12%	47.94	38	50.00%	50.67	70.83***
N changes in buyer if at least one	27	1.81	0.83	56	2.28	1.34	19	1.84	1.26	2.845
% farmers perceiving other buyers available	178	55.62%	49.82	89	86.52%	34.35	37	78.38%	41.73	28.09***
% farmers knowing price paid by other buyers	137	43.80%	49.80	83	55.42%	50.01	31	58.06%	50.16	3.86

Test statistic is non-parametric Kruskal-Wallis χ^2; *** p<0.01, ** p<0.05, * p<0.1

3.6.3. Dairy processing and marketing firms in the three provinces

A total of 21, 36 and 17 dairy processing and marketing firms operated in Trento, Piacenza and Bologna respectively in 2007. All processors operating in Trento, half of those operating in Piacenza and 60% of those operating in Bologna are represented in the sample. Figure 3.4 provides a map of the location and organisational form of processing plants of milk buyers across agro-ecological regions within each province and Table 3.11 summarises some characteristics of the milk market in each province. The majority of processors operating in each province are local, i.e. have their processing plant and administrative headquarters within the province. This share is lowest in Piacenza (26 out of 36 processors) and highest in Trento (20 out of 21).

The few buyers that are based outside are usually located in neighbouring provinces. In both Trento and Piacenza (the only provinces for which I have this information) the vast majority of dairy farmers conduct business with local processors only (99% in Trento and 95% in Piacenza). In turn, most local processors tend to do business with local farmers only (95% of processors in Trento and 72% in Piacenza).

Cooperatives and private processors coexist in all provinces, but with different shares: 20 out of the 21 processors operating in Trento are cooperatives, against 50% of those in Piacenza and 47% of those operating in Bologna.

Figure 3.4: Processor location and organisational form and agro-ecological regions by province

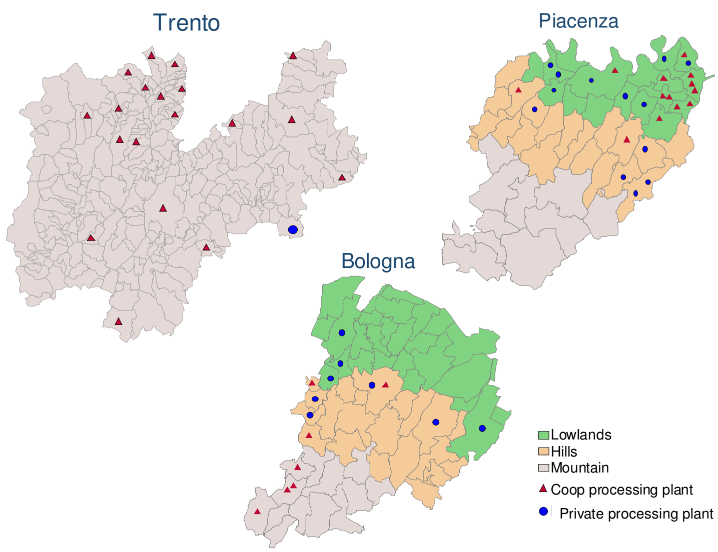


Table 3.11: The raw milk market in the three provinces

	Trento	Piacenza	Bologna[1]
Area of the province (km^2)	6207	2589	3702
% of province that is mountainous	100%	23%	22%
N of dairy farmers in the province	1894	1130	170
N of processors buying milk within the province	21	36	17
N of processors with processing plant in the province	20	26	15
% farmers only trading with local processors	99%	95%	
% processors only trading with local farmers	95%	72%	
N of cooperative processors	20	18	8
N of private processors	1	18	9
Mean N of suppliers per local processor	103	49	
Mean dairy farm size (population)	30	139	44
Min – max dairy farm size (population)	2 – 173	14 – 538	6 – 174

[1] The missing information on Bologna is due to lack of data on the population of dairy farms in this province.

Cooperatives formally have an open membership policy, but often introduce restrictions on geographical grounds; the most common one is the requirement that members are located within the provincial borders. Processors vary with respect to the size of their pool of suppliers, ranging from over a thousand members (scattered over the national territory) for one cooperative in Bologna, to ten members for some cooperatives in Piacenza. Processors vary in number of suppliers and geographical reach also within each province.

In Trento, the average number of suppliers per processor is 103, ranging from 314 to 21. Only five cooperatives have more than 100 suppliers, however. The processing plants of cooperative firms are scattered across the province, but the majority of them are located in the north-western tip of the province. The private processor is located in a south-eastern municipality at the border with the province of Vicenza and very close to a highway. With respect to geographical reach, the private processor operating in Trento has a large procurement area which develops south into neighbouring provinces, while most cooperatives have a smaller and well defined core procurement area, i.e. a cluster of contiguous municipalities within provincial borders, which includes the municipality where the processing plant is located. Most cooperatives however also reach out to a few municipalities that are scattered in other parts of the province.

In Piacenza, the average number of suppliers per processor, only considering processors with their headquarters in the province, is 49, ranging from 10 to 374. Only five processors have more than 50 suppliers. The smaller number of suppliers per processor in Piacenza compared to Trento does not necessarily mean smaller mean size of milk throughput per processor in Piacenza compared to Trento, given the larger mean herd size per farm in the former. Most processors are concentrated in the north-east part of the province. The pattern of geographical reach of procurement areas tends to be more closely clustered around neighbouring municipalities here than in Trento. The largest cooperative reaches all municipalities in the province. Comparable information on Bologna is not available due to lack of data on the population of dairy farms in this province.

Considering only the processors with which sample farms trade, all processors in Trento and Piacenza and some in Bologna produce the same type of hard cheese as their core finished product. This type of cheese has a limited area of production, restricted to fifteen provinces in the North-East of the country[27], and a protected designation of origin label (PDO), which means that only these areas within the national border are allowed to produce it. The cheese output produced in Trento represents 2% of the total produced in the 15 provinces, while the output produced in Piacenza and Bologna is 12% of the total, most of which is Piacenza's.[28] The cheese is then sold in national and international markets. Very similar cheeses, without the PDO label, are produced nationally and internationally, suggesting that these processors face substantial competition in both markets.

All processors in Trento, but not those in Piacenza, also produce other products, which however represent a much smaller part of their business: the two largest cooperatives also produce liquid processed milk, yogurt and soft cheese, marketed within the region; while the smaller cooperatives each produce a different type of niche, speciality cheese associated with a specific valley or village, which are also mostly marketed within the region; and the private processor produces another type of PDO cheese then sold on national and international markets. In Bologna, the few processors that do not produce hard cheese produce liquid milk and fresh products (the largest cooperative), sold on the national market, or soft cheeses, most of them marketed within the region.

With respect to other sources of heterogeneity among processors, in addition to product differentiation, unfortunately I do not have information on their costs and technology of production, which however may vary among them depending, among other things, on the extent to which their geographical location allows them to exploit scale economies in processing. On the other hand, there is some anecdotal evidence that managerial quality of processing firms, in particular cooperative ones, varies. This has been the case for the largest cooperative in Bologna, Granlatte, throughout its evolution.[29] More recently, the second largest cooperative in Trento has also been going through several years of managerial and financial difficulties which eventually led, in 2010, to its

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[27] These fifteen provinces are concentrated in the five regions of Lombardy, Piedmont, Veneto, Trentino Alto Adige (where Trento is located) and Emilia Romagna (where Piacenza and Bologna are located).

[28] Data available from http://www.clal.it/index.php?section=produzioni_grana_provinciale (last access September 12th, 2012).

[29] Evidence on the evolution of Granlatte and how changes in its managerial quality related to performance has been provided elsewhere (Hunt and Cazzuffi 2009).

merger with the largest coop in Trento, in order to avoid bankruptcy.[30] Smaller cooperatives, on the other hand, seem to present fewer managerial problems.[31]

Networks of processors play a role in all provinces. Firms producing hard cheese belong to a national consortium in charge of label protection from counterfeit, research and development activities, advertising and exports. Cooperatives also often belong to second-tier cooperative networks. The role of networks is especially important in Trento, where a second-tier cooperative associates all local processing cooperatives producing hard cheese and provides them with technical assistance, research and development, and storage facilities for maturing the cheese.

For the period under study, there was no intra-industry negotiation of either producer or wholesale prices in the Italian dairy sector.[32] Pricing schemes for raw milk are similar across processing firms and include a base price, premia and discounts for milk constituents and bacterial quality and an optional end-of-year bonus. Some processors may also pay premia for large quantities sold. In the sample, 28% of processors, which are predominantly cooperatives in Trento, do so. Quality premia and discounts are each organised into three bands, defined by progressively higher (lower) values of nutrients and bacterial count. No premia (discounts) apply to farmers in the baseline band. For milk whose quality is above (below) the upper (lower) threshold of the baseline band, premia (discounts) apply, in two bands, each representing progressively better (worse) milk characteristics. The magnitude of the premium or discount per unit is the same within each band, but premia (discounts) in band 1 are smaller than those in band 2.

The bonus is occasionally paid at the end of the year by private processors if the market price for milk over the year is systematically higher than the base price the processor set at the beginning of the year. For cooperatives, the bonus is the dividend, i.e. a share of the profit made by the cooperative which is redistributed to its member-shareholders in proportion to the quantity marketed through the cooperative. Each cooperative is

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[30] Evidence on the evolution of the crisis of the second largest cooperative in Trento is available from local newspapers, including reports by L'Adige (for instance, http://www.ladige.it/articoli/2010/10/17/fiave-caseificio-socialesta-andando-chiusura).

[31] For instance, from the local newspaper L'Adige, http://www.ladige.it/articoli/2011/05/25/caseificio-cercenfatturato-4-milioni.

[32] Until 2002 base price paid to milk producers in Italy was negotiated through a national contract between representatives of producers and milk processors. Since 2002, national level negotiations over milk prices systematically failed, effectively leaving each processor to set prices individually with its suppliers. A regional agreement was reached in 2006 in Piedmont. This was not binding for the rest of Italy, but processing firms could use the agreement as reference when setting prices for their suppliers (Pieri and Del Bravo 2008). The base price per litre defined in this agreement was 32.85 eurocents per litre.

required by law to keep a fixed share of its profit as reserves, and decides with a majority vote by its members over the allocation of the remaining profits between retained earnings for capital investment and distributed dividend. In the sample, only farmers supplying the private processor in Trento received a bonus. With respect to cooperative members, the data suggest that all cooperatives in Trento, except two, 30% of coops in Piacenza and 50% of coops in Bologna paid a dividend in 2007.

This finding that at least some cooperatives make a profit and redistribute it to members is at odds with Fousekis' assumption of perfect competition in the cheese market, where welfare maximising cooperatives are also NARP pricing, that is, paying the maximum possible price without making any cooperative profit and thus without paying dividends. It is however consistent with a scenario in which welfare maximising cooperatives have some degree of monopoly power in the cheese market. The finding that almost all coops in Trento, where niche cheeses are produced in addition to hard cheese, pay a dividend reinforces this interpretation. Another interpretation for this finding is that cooperative networks and second tier cooperatives, particularly active in Trento as noted above, provide some cost savings to individual affiliated coops, which are then passed on to members. Such cost savings may result from provision by second tier coops of common storage facilities and from their R&D and advertising activities to the benefit of affiliated coops. The finding of dividend payment by at least some cooperatives also suggests that these coops have found a way to control members' supply in such a way as to avoid members' overproduction in response to the dividend compared to what would be optimal for the objective of welfare maximisation; presence of milk quotas probably aided the achievement of this objective.

With respect to spatial pricing policy used, whether UD or FOB, anecdotal evidence collected during initial interviews and piloting of the questionnaire suggests that, when processors are in charge of milk shipment, they bear the transportation cost and pay farmers a price that is not affected by the distance between farm and processor, consistent with uniform delivered pricing. Restriction of cooperative membership on geographical grounds, noted earlier, is also consistent with adoption of UD pricing, which, for a cooperative, implies that neither additional members nor extra supplies from non-members are accepted beyond the optimal market boundary.

Sample data show that, for all farmers in Piacenza and Bologna and for 70% of those in Trento, milk collection occurs at the farmgate. As for the remaining farmers in Trento, all cooperative members, 16% of them transport the milk to a nearby collection point (located on average 1 km from the farmgate), where it is then collected by the processor, and 14% of them transport it all the way to the processing plant gate, which is usually located fairly close to them (at a distance of 6 km on average for this group, against a mean distance of 14 km for Trento farms with collection at the farmgate). It is plausible to assume that the price received by farmers who undertake all or part of the transport is gross of their own transportation costs.

In order to investigate whether processors pay UD or FOB prices when collecting at the farmgate, I look at correlations between farm-to-plant distance and base and final price (that is, base price plus premia and dividend) received by those sample farmers who supply the same processor, reported in Table 3.12. Unfortunately this is possible only for a few buyers (4 out of 20 processors in Trento, 2 out of 17 in Piacenza and 1 out of 10 in Bologna, all cooperatives except one), because sample size for the rest is too small.

Table 3.12: Spearman correlation coefficients between farm-plant distance and price paid

Processor	Province	Org. form	N	Spearman correlation coefficient between distance and			
				Base price		Final price	
				rho	p-value	rho	p-value
Latte Trento	Trento	Coop	16	-0.045	0.872	0.298	0.262
Pinzolo Fiavè	Trento	Coop	29	-0.088	0.663	0.039	0.841
Primiero	Trento	Coop	10	0.210	0.589	-0.355	0.314
Cercen	Trento	Coop	12	-0.349	0.293	-0.157	0.626
APL	Piacenza	Coop	23	0.472**	0.031	0.248	0.253
Colla	Piacenza	Private	11	-0.236	0.485	-0.222	0.511
Granlatte	Bologna	Coop	15	-0.035	0.909	0.219	0.430

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

With one exception, there is no significant correlation between distance and prices paid, suggesting that, at least when collecting at the farmgate, these processors pay a UD price. The exception is the largest cooperative in Piacenza, where base price paid seems to increase with farm-to-plant distance. This seems to be counterintuitive, but might be a spurious correlation related to other characteristics hidden by a bivariate analysis. Chapter 6 will investigate the question of spatial pricing policy more fully in the multivariate analysis of producer price variation.

The data presented in this section sought to provide a picture of the heterogeneity that characterises the case under study, with respect to geographical areas, sampled farms and processors. Such heterogeneity implies that any differences between cooperatives and private processors found in the subsequent analysis with respect to both price and non-price characteristics of their relationship with farmers represent an average of potentially heterogeneous processors.

3.7. Conclusions

The main contribution of the long process of data collection described in this chapter was to provide the first dataset on Italian dairy farms combining information on farmers' socio-economic and productive characteristics with detailed information on the objective and subjective characteristics of the exchange relationship with the milk buyer and on availability of alternative buyers. The extent to which the data can be used to draw inferences and conclusions on the overall population of dairy farmers in Italy, however, is limited in a number of ways. Results are considered in this thesis as relating primarily to the provinces under study, but may also be suggestive of trends and tendencies that can be relevant for other areas with similar characteristics. A larger sample from a broader geographical area would be needed to assess the robustness of the findings of the thesis to different farm and agro-ecological characteristics and market structure configurations.

Nevertheless, this dataset allows the thesis to contribute to the limited empirical literature on cooperatives as follows.

First, it allows conducting a detailed study of variation in market structure within each province and a comparison of the picture of variation in market structure offered by population data with that provided by farmers' perception of the alternative buyers available to them. Second, the analysis of the correlates of coop membership can benefit from the distinction between farmers who don't have an alternative buyer and those who perceive both organisational forms (cooperative and private) are available, which allows separating, at least to some extent, correlates of farmers' choice of buyer when such a choice is available from correlates of a particular market structure configuration. Third, data on non-price characteristics of the exchange relationship between farmers and buyers allow investigating differences between cooperative and private processors with respect to contract complexity, services provided and processors' compliance with the exchange agreement with farmers. Fourth, data on the overall subjective value attributed by farmers to transacting with a buyer with a particular organisational form allow exploring whether this varies systematically between members and non-members, and among different groups of members, providing an indication of the variation in perceived net benefits of membership for people with different characteristics. Fifth, in spite of the limited comparability in characteristics between members and non-members, which will be discussed in detail in Chapters 4 and 6, the price data collected allow estimating the effect of coop membership on prices paid, that is, the difference between the price current members obtain in the coop and what they would have received had they supplied a private processor.

The remainder of the thesis now turns to these issues. The next chapter investigates the apparent contradiction between coexistence of several buyers within each province, and the finding that one third of the sample perceives that no alternative buyer is available to them.

Chapter 4 – Variation in presence and organisational form of dairy processing and marketing firms within the three provinces

4.1. Introduction

The description of sample data and of the processors operating in the three provinces, provided in the previous chapter, presents a puzzle: the three provinces are each characterised by the coexistence of cooperative and private processing firms, yet one third of sample farms perceive that their current buyer is their only available buyer and no alternatives exist. Are farmers *wrong*, that is, do they face very high search costs giving rise to a problem of imperfect information? Or is the observation of coexistence at the aggregate spatial level of a province misleading and hiding variation in processor presence within a given territory? This chapter examines the coexistence of private and cooperative processing firms *within* each province, comparing sample responses with processors' presence according to data on the population of dairy farms. It finds that when market structure, that is, number and organisational form of processing firms, is analysed at a more disaggregate spatial level, areas where more than one milk buyer operates (i.e. where more than one processor buys milk from local farmers) coexist next to areas where only one buyer operates, and areas where both cooperatives and private processors operate coexist next to areas where one organisational form, usually cooperative, operates. The chapter investigates what accounts for this variation.

Understanding variation in market structure is relevant because the price and non-price characteristics of the relationship between farmers and milk buyers can vary depending on the nature of market structure and competition between buyers. It is also useful for understanding why farmers join a processing and marketing cooperative or sell milk to a capitalistic processor. The framework typically used in the literature in order to analyse this question, a random utility model where coop membership is the outcome of individual choice, is problematic whenever farmers transact with a particular outlet because that is the only one operating in a given area. In this case there is no outlet 'choice' to speak of, and the emergence of that particular market configuration needs to be investigated first.

The observed market configuration at any given time is likely to be the result of a number of factors, including policies and historical events. The approach of this chapter is to relate empirically the variation in market structure to observable characteristics, and in particular to geographical characteristics, and to provide a historical account of the evolution of the milk market structure in the three provinces to its current configuration, in order to address the following questions:

(1) What are the observable conditions that favour the presence of only one buyer in a given area?

(2) What are the observable conditions that favour the prevalence of cooperative forms of organisation of milk processing and marketing in a given area?

(3) When more than one alternative is available and their organisational form differs, in what respects do cooperative members differ from farmers selling to a private processor?

Relating these questions to geography is relevant because space plays an important role in the market for raw milk, a product that is bulky and perishable, and which has high transport costs relative to its unit value. This restricts its geographical mobility, limiting farmers' access only to those buyers located relatively close. The relevant geographic market for the purchase of raw agricultural products is thus often narrower, and concentration among processors higher, than in the associated market for finished products (Sexton and Lavoie 2001). This scenario is potentially conducive to processors' exercise of market power towards farmers. In turn, this may have an impact on the actions farmers take in order to avoid such market power, chiefly by organising themselves into a processing and marketing cooperative.

Geography, for instance altitude above sea level, plays a role because it influences transportation costs. It is plausible to assume that the higher the altitude of a given area, the higher are transportation costs for milk shipment, because of sloping, narrower and winding roads. No direct data on transportation costs within provinces are available, and thus this section relies on altitude as a proxy for transportation costs. In turn, the magnitude of transportation costs influences the degree of competition between processors in a given area, as shown analytically by Fousekis (2011). Processor presence and farm characteristics may both be a function of the geographical characteristics of that particular area. For instance, altitude above sea-level affects agro-ecological characteristics, and thus farmers' decisions about optimal herd size and composition with respect to breeds, and about farming methods, which affect output quantity and quality. In turn, processors may (or may not) be established or operate in a particular area as a response to prevailing local characteristics, for instance relative farm isolation, output scale and herd composition. Thus, exogenous and heterogeneous geographical characteristics, affecting both farmer characteristics and outlet presence, may lead to a milk market structure where areas of direct competition between several buyers with different organisational forms coexist next to areas where only one buyer operates.

This chapter analyses these issues by combining two data sources: sample data and data on the population of dairy farms in two of the three provinces, Trento and Piacenza, namely the location of all farms in the population and the name of the processor to which each of them is selling raw milk. As explained in Chapter 3, unfortunately information on milk buyer for the population was not available for Bologna. Data on the population of dairy farms in Trento and Piacenza are used to analyse variation in the number and organisational form of processing firms within provincial borders, by disaggregating space into municipalities, the administrative level below a province and a much smaller and agro-ecologically homogeneous spatial unit. In Trento, which has an area of 6707 km^2, there are 215 municipalities and their size ranges from 1.7 to 160 km^2. The average size of municipalities is 28 km^2, or 0.4% of the size of the whole province, and 87% of municipalities each have an area that is less than 1% of the size of the province. In Piacenza, which has an area of 2589 km^2, there are 41 municipalities and their size ranges from 24 to 123 km^2. The average size of municipalities is 53 km^2 (2% of the size of the whole province), and 76% of municipalities each have an area that is less than this. The area of a municipality is itself likely to be related to geographical characteristics, population density and transportation costs. However, unfortunately, official guidelines on the rules that determine the definition of municipal administrative borders are not publicly available.

For each municipality in Trento and Piacenza, I am able to identify the number of dairy farms located there and the number and organisational form of processors buying milk from farmers located in that municipality. This allows me to cluster municipalities into five possible outcomes: municipalities where a] only one cooperative operates; b] more than one cooperative operates, but no private processor does; c] only one private processor operates; d] more than one private processor operates, but no cooperative processor does; e] both cooperative and private processors operate. In fact, I do not observe any municipality where more than one private processor operates but cooperatives are absent, and I only observe three where only one private processor operates.

Disaggregating space into municipalities is however potentially problematic, because it introduces an artificial border and an arbitrary definition of market area as unit of analysis. For instance, a farmer living in a municipality where only one buyer operates, but located close to the boundary with a municipality where another buyer operates, may in fact have more than one available outlet even though, from this particular way of slicing up space, she appears to only have one. Conversely, a municipality apparently characterised by the presence of more than one buyer may actually be split between processors along a clear spatial divide, with no actual overlap between them.

A preferable approach, given the availability of an address for each farm, may be to plot farms into space, map procurement areas of each processor and identify areas of overlap, if any. This approach was attempted, but was not successful: in several cases, especially for the province of Trento, the address is not complete, but only contains the name of the farm and of a sub-area of the municipality, with no house number. While this information was probably sufficient for a postman to reach the farms in question, it is not sufficient to plot farms with precision into space. An alternative approach could have been to disaggregate space using postcodes. However, given the small size of all these municipalities, municipalities and postcodes have exactly the same boundaries in all cases. Moreover, disaggregating space into municipalities has the advantage that this is the lowest administrative level for which characteristics of the population of dairy farms, for instance herd size and breed composition, as well as average local geographical characteristics, including altitude points, are publicly available.

Sample data on farmers' perceptions on availability and nature of alternatives are also used in the empirical analysis as an alternative way of investigating variation in market structure and to check robustness of the findings, given these concerns about potential aggregation bias when using municipalities as the unit of analysis. Sample data are used to construct the same clustering for market structure as done for the population, using the following information: a] organisational form of current buyer; b] self-reported availability of alternative buyers; c] organisational form of available alternatives.

The chapter is organised as follows. Section 4.2 describes variation in market structure within provinces using both population and sample data, and compares the picture provided by using municipalities as the unit of analysis with that resulting from farmers' perception of buyers' availability. Section 4.3 investigates empirically, using both population and sample data, the first puzzle posed by variation in market structure, namely the coexistence, within each province, of locations where only one buyer operates with locations where more than one buyer appear to overlap. Section 4.4 presents a historical analysis of the emergence and subsequent prevalence of a particular form of organisation of milk processing and marketing, whether cooperative or capitalistic, in the areas under study, in order to investigate the second puzzle posed by variation in market structure, namely the coexistence of areas where only one organisational form, typically cooperative, operates, with areas where both cooperative and capitalistic processors appear to overlap. Section 4.5 then examines in more detail areas of overlap between cooperative and capitalistic processors, by analysing correlates of cooperative membership when farmers perceive that buyers with both organisational forms are available to them. Section 4.6 concludes.

4.2. Variation in market structure within provinces: descriptive evidence from population and sample data

This section describes variation in market structure within provinces according to population and sample data, and then compares the pictures provided by the two data sources for Trento and Piacenza, for which population data are available, in order to investigate possible reasons of discrepancy between "actual" (according to population data) and "perceived" (according to sample data) market structures.

4.2.1 Variation in market structure within Trento and Piacenza: population data

Figure 4.1 shows variation in market structure within Trento and Piacenza respectively according to population data and includes the location of processing plants. Only taking into account municipalities where more than one dairy farmer operates (i.e. all 41 municipalities in Piacenza and 173 out of 215 in Trento), in 49% of municipalities in Trento only one cooperative operates (cooperative monopsony), in 25% more than one cooperative operate, but no private buyer (cooperative oligopsony), in 3% only one private buyer operates (private monopsony), and in 23% both private and cooperative buyers operate (mixed oligopsony). In Piacenza, in 10% of municipalities only one cooperative operates, and in the rest both cooperative and private processors do. The terms 'monopsony' and 'oligopsony' are used here as descriptive, without implying that processors are exercising market power. The two provinces differ not just with respect to relative presence of mixed areas, which, *prima facie*, suggests more competition among processors in Piacenza, but also with respect to the number of buyers per municipality, which ranges from 1 to 6 in Trento and from 1 to 14 in Piacenza, as shown in Figure 4.2. Mean number of buyers per municipality in areas of overlap, that is, where more than one buyer operates, is 2.3 in Trento and 6.8 in Piacenza, and this difference is highly statistically significant ($t = -11.37$).

The approach of this chapter is to relate variation in market structure to observables, and in particular to geographical characteristics. As a first step, Figure 4.3 maps municipalities in Trento and Piacenza according to classes of minimum altitude. Comparing the distribution of altitude classes with the distribution of market structures, it appears that, in both provinces, mixed areas tend to be concentrated at lower altitudes. If municipalities at lower altitudes are larger, possibly because of lower transportation costs, observing overlap between processors in these areas may simply result from the larger size of the unit of analysis. However, in Trento there is no significant correlation between altitude and size of the municipality (correlation coefficient = 0.03, p-value = 0.622). Size of municipality tends to be slightly larger where more than one buyer operates (32 km^2, compared to 28 km^2 in monopsony municipalities), but this difference is not statistically significant ($t = 0.762$). In Piacenza, on the other hand, size of municipality is actually positively correlated with altitude (correlation coefficient = 0.506, p-value = 0.001), which probably depends on the lower population density at higher altitudes (correlation coefficient = -0.406, p-value = 0.01). Size of municipality is larger in areas of monopsony (79 km^2 versus 50 km^2 in oligopsony areas), but the small sample size of monopsony areas (4) does not allow testing for statistical significance. Finding that average area of municipality is not significantly larger in areas of overlap suggests that the *prima facie* inverse relationship between altitude and areas of overlap is not driven by the larger size of the unit of analysis at lower altitudes, but seems to be related to transport costs, which are expected to be lower at lower altitudes.

Figure 4.1: Variation in market structure within Trento and Piacenza

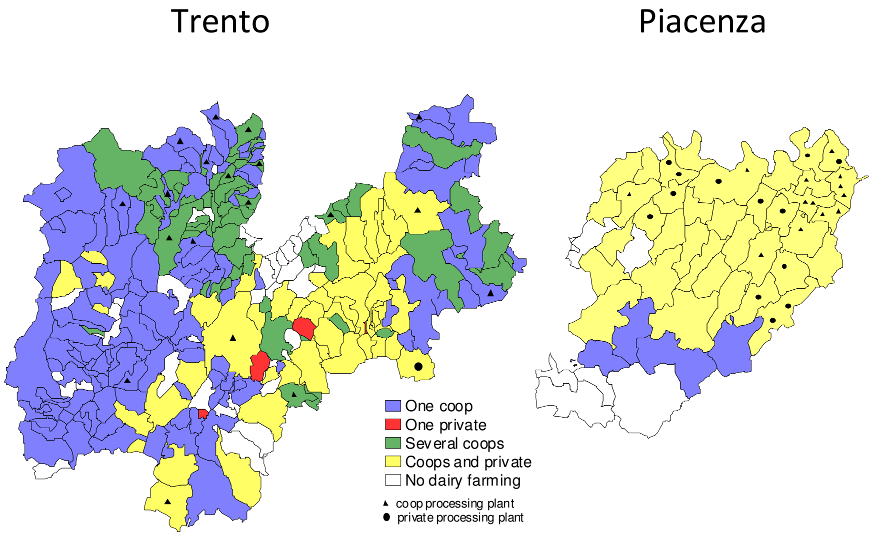

Figure 4.2: Number of buyers per municipality, Trento and Piacenza

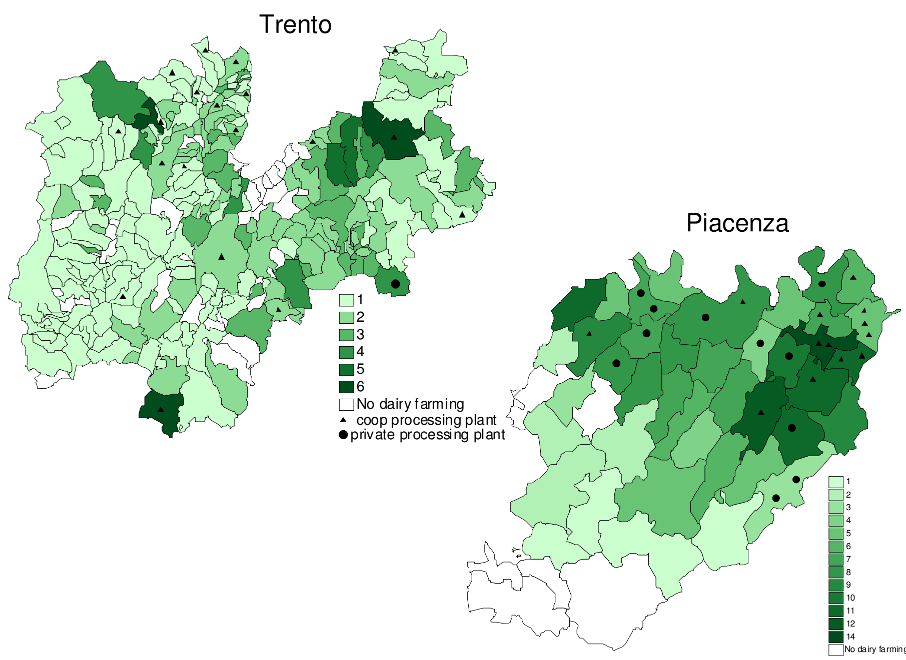

Figure 4.3: Minimum altitude by municipality, Trento and Piacenza

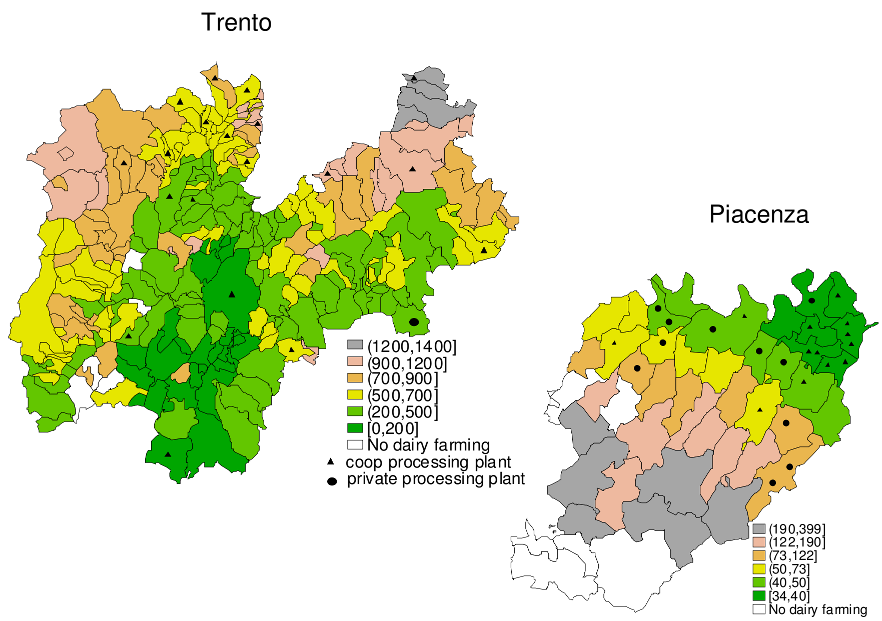

Table 4.1 summarises some characteristics of municipalities in Trento by market structure. Local agro-ecological characteristics, proxied with altitude of the municipality, are likely to be correlated both with processor presence and organisational form, and with local farm characteristics. Mean altitude of municipality is significantly lower in mixed areas or where only one private buyer operates. Number of dairy farms is significantly smaller in areas of monopsony, regardless of the organisational form of the buyer. There are no significant differences across types of market structure with respect to average herd size per municipality. However, Friesian breeds are significantly more prevalent in mixed areas and this suggests that milk supply per farm is likely to be larger here: as noted in Chapter 3, Friesian breeds tend to produce higher yields per day compared to other breeds, even though the quality of their output is lower in terms of fat and protein content. Where cooperatives (whether one or more) are the only buyer in a municipality, mean altitude is higher, suggesting these areas are characterised by higher transportation costs and greater relative isolation of farmers; number of local suppliers is smaller; and the share of cattle producing higher quality milk is larger, which however itself tends to depend on altitude, as noted in Chapter 3.

Table 4.2 presents the same characteristics for Piacenza. Also in this case, mixed areas tend to concentrate where altitude is lower and number of suppliers is larger. There are no differences with respect to breed composition across the province, but mean farm herd size is substantially larger in mixed areas than in cooperative monopsony ones. Given the small sample size for the cooperative monopsony category, however, it is not possible to test for the significance of these differences.

The next section analyses how the picture on variation in market structure provided by population data compares to farmers' perceptions on the availability of alternative buyers.

Table 4.1: Descriptive statistics: municipalities by market structure in Trento

		Mean altitude		N dairy farmers		Farm herd size		% Friesian breed	
	N	Mean	St. dev	Mean	St. dev	Mean	St. dev	Mean	St. dev
One coop	85	765.56	311.8	7.59	6.97	29.06	27.07	21.38	25.28
One private	3	670	214.85	7.34	7.57	15.65	23.65	38.33	54.21
> one coop	44	752.57	302.06	12.36	12.17	32.34	34.55	18.72	22.18
Mixed area	41	616.02	317.44	16.56	13.07	31.93	20.61	32.08	24.08
χ^2		6.678*		23.26***		4.649		10.67**	
Only coops	129	761.13	307.39	9.22	9.32	30.18	29.74	20.49	24.23
Private are present	44	619.70	309.95	15.93	12.93	30.82	20.94	32.37	24.98
χ^2		6.546**		15.052***		1.998		10.405***	

χ^2: non-parametric Kruskal-Wallis equality of populations rank test; *** p<0.01, ** p<0.05, * p<0.1

Table 4.2: Descriptive statistics: municipalities by market structure in Piacenza

		Mean altitude		N dairy farmers		Farm herd size		% Friesian breed	
	N	Mean	St. dev	Mean	St. dev	Mean	St. dev	Mean	St. dev
One coop	4	510.75	146.08	18.25	16.78	30.34	19.55	98	-
Mixed area	37	142.94	111.58	29.46	19.02	147.94	96	98	-

4.2.2. Variation in market structure: sample data

Combining sample data on organisational form of current buyer and perceived existence and organisational form of available alternatives, if any, five types of market structure for the sample (including Bologna) are identified and summarised in Table 4.3.

The relative majority of respondents, 43%, and the absolute majority in Piacenza and Bologna, report both cooperative and private processors are available buyers. This sub-sample of 131 farmers will be analysed in more detail in Section 4.5. With respect to the remainder of the sample, 32% perceive their current cooperative is the only available buyer, and 22% perceive their current cooperative plus one or more other cooperatives are available, but no private processor. Less than 2% of respondents report having their current private buyer as the only alternative, and about 2% perceive their current private buyer plus one or more other private firms, but no cooperatives, are available. The latter are all concentrated in Piacenza.

Table 4.3: Types of market structure in the sample

	Sample		Trento		Piacenza		Bologna	
	N	%	N	%	N	%	N	%
One coop	95	31.56	79	44.38	10	11.49	6	16.67
One private	4	1.33			2	2.30	2	5.56
More than 1 coop	65	21.59	45	25.28	12	13.79	8	22.22
More than 1 private	6	1.99			6	6.90		
Mixed area	131	43.52	54	30.34	57	65.52	20	55.56

Focussing on Trento and Piacenza only, it is possible to compare individual sample responses on perceived availability of alternatives with the picture on market structure provided by population data. The perception of 72% of the sample is consistent with population data, but this share is lower in Trento (66% of consistent responses, versus 84% in Piacenza).

Among farmers whose perception is not consistent with population data, those who perceive that no other buyer is available to them, while population data show that more than one operate in their municipality, are 59% in Trento and 92% in Piacenza. The remaining 41% and 8%, respectively, perceive other buyers are available, while the municipality is a monopsony according to population data. Is such discrepancy the result of inaccuracies arising from using municipalities as the unit of analysis, or are farmers making ‘mistakes’? The probability of making ‘mistakes’ may be higher for farmers with higher information and search costs, for instance older farmers with fewer years of schooling. Tables 4.4 and 4.5 compare characteristics of sample farmers between the group with perceptions that tally with population data and the group whose perceptions are not consistent with population data. Overall, there is no *prima facie* evidence that discrepancies between farmers’ perceptions and population data are driven by high information costs. Instead, it appears that the representation of local market structure provided by municipalities tends to become less accurate at higher altitudes and in larger municipalities. Higher transportation costs at higher altitudes may play a role in defining market areas that do not coincide with administrative borders. Area of municipality tends to be larger for farmers who perceive more than one alternative buyer is available when population data show only one operates, compared to that of farmers whose perception is consistent with population data. In larger municipalities, farmers may be more dispersed, which would result in them observing an alternative across the border even though none appears to be there according to population data.

Table 4.4: Mean characteristics by consistency of farmers' perceptions with population data when more than one buyer operates in municipality according to population data

	More than one buyer according to population data							
	Trento				Piacenza			
Sample response is:	Consistent: more than one perceived buyer	Not consistent: only one perceived buyer	Test stat	p-value	Consistent: more than one perceived buyer	Not consistent: only one perceived buyer	z	p-value
Area of municipality (km^2)	43.46	53.18	-1.285	0.199	52.34	56.27	-0.784	0.433
Farm altitude (m)	713.40	831.70	-2.831***	0.005	71.52	76.26	-0.810	0.411
Years of schooling of farm hh head	9.17	8.85	0.624	0.533	10.45	9.75	0.790	0.429
Age of farm hh head	50.19	50.09	0.014	0.989	49.33	51.12	-0.468	0.639

z-score from non-parametric Wilcoxon-Mann-Whitney ranksum test. *** p<0.01, ** p<0.05, * p<0.1

Table 4.5: Mean characteristics by consistency of farmers' perceptions with population data when only one buyer operates in municipality according to population data

Trento	Only one buyer according to population data			
Sample response is:	Consistent: only one perceived buyer	Not consistent: more than one perceived buyer	z	p-value
Area of municipality (km^2)	33.18	70.04	-2.172**	0.030
Farm altitude (m)	703.00	979.73	-3.486***	0.000
Years of schooling of farm hh head	8.78	8.42	0.356	0.722
Age of farm hh head	47.20	47.83	-0.171	0.864

z-score from non-parametric Wilcoxon-Mann-Whitney ranksum test. *** p<0.01, ** p<0.05, * p<0.1

Overall, however, both population and sample data indicate substantial variation in market structure within each province and coexistence of areas of monopsony with areas of overlap between more than one processors, as well as coexistence of areas where only one organisational form operates, usually cooperative, with areas of overlap between both organisational forms. The next two sections analyse each of these aspects of variation in turn.

4.3. Empirical analysis: monopsony areas versus areas of overlap

What factors are conducive to the presence of only one buyer in a given area? This section analyses this question empirically. The data give me two ways of investigating the amount of competition – that is, whether one or more processors operate – at any location. First, they allow me to ask whether one or more buyers operate at a given municipality according to the information provided by population data. This methodology is questionable because of the arbitrary aggregation entailed by taking municipalities as the unit of analysis: administrative boundaries may not be relevant in processors' definitions of procurement areas and therefore may not be an accurate representation of the degree of overlap and competition between processors and of the extent to which farmers have available alternatives. The second available way of investigating the level of competition is, at the sample level, to ask whether a farmer perceives one or more buyers are available. This shifts the analysis to the subjective perception of farmers, and needs to take into account possible differences in information and search costs among farmers, which may influence their knowledge and perception of what is available.

In the literature on spatial competition, including the paper by Fousekis (2011) reviewed in Chapter 2, Section 2.3.1, the degree of competition between exogenously located firms, and whether an area is characterised by monopsony or by overlap in market areas between rivals, is the result of the relative importance of space in a given area. In Fousekis' paper, the relative importance of space is defined as $s = \gamma/(\rho - c)$, that is, unit transport costs in a given area, γ, divided by the net value of the processed product (cheese), i.e. wholesale cheese price ρ minus processing costs c. As the relative importance of space decreases, the effective distance between firms shrinks, and their market areas progressively overlap.

The degree of competition between firms, and in particular whether an area is served by one milk buyer or more, may also result from technical economies of scale in processing due to lumpy capital and high fixed costs: if the minimum efficient scale of operations represents a significant proportion of local supply, the market can sustain only a small number of firms, or even just one. This may happen, for instance, in areas with only a few dairy farmers. A monopsonist processing firm may also be able to deter entry of additional firms by manipulating its scale of operations, for instance by accumulating capital beyond what would be the optimal level in a monopsony, or with efforts to increase suppliers' loyalty in order to reduce available supply to the entrant. Fousekis, and in general the literature on spatial markets, is silent on economies of scale, because of the assumptions of zero fixed costs in processing and uniform distribution of farmers.

This section is organised as follows. Section 4.3.1 analyses whether a municipality is characterised by monopsony or by overlap between processors, using population data. Section 4.3.2 then analyses farmers' perceived availability of one or more buyers.

4.3.1. Municipalities: monopsony versus overlap between processors

The empirical analysis in this section estimates the probability that only one processor buys milk at a given municipality using population data. The analysis is conducted on the 214 municipalities in Trento and Piacenza where more than one dairy farmer is located. Pooling of municipalities across provinces was necessary due to their small number in Piacenza (41). The focus is on the role of geography. Investigating the role of economies of scale would also be desirable, but unfortunately I do not have any information on the technology used by processors. Size of local supply is controlled for by using two alternative measures: number of dairy farmers in the municipality, and average herd size per farm in the municipality. For a given processor's technology, the probability that only one buyer is observed in a municipality is expected to increase as the number of local suppliers decreases.

With respect to the role of geography, the variable of interest is the relative importance of space. The literature on spatial input markets offers two alternative conceptual definitions of this variable. The first, adopted, among others, by Fousekis (2011) and noted above, is $s = \gamma/(\rho - c)$, that is, transport costs in a given area relative to the net value of the processed product. The second, adopted by Alvarez et al (2000), is $s = \gamma d/(\rho - c)$, where d represents distance between competing firms, which in this model is relevant because the two rivals are exogenously located at *intermediate* points along a line and not, as in Fousekis' model, at the end-points of a line. When processors are located at intermediate rather than end points, the area of competition between them can extend beyond their location: firm A's procurement area can go all the way to and beyond firm B's processing plant, while, when firms are located at the end-points of a line, competition can obviously only occur in the space between them.

The analytical implications for prices paid and market area of these two different assumptions on firm location and definitions of relative importance of space are not immediately comparable quantitatively, because Fousekis' and Alvarez's models are different: Fousekis studies the case of Bertrand-Hotelling price competition between a coop and a private processor under alternative spatial pricing policies, while Alvarez analyses collusive price matching between two UD-pricing capitalistic firms. Qualitatively, however, the effect of the relative importance of space is the same in both models: as s increases, economic interaction between the two rivals decreases, to the point where each becomes an isolated spatial monopsony, thus predicting a direct relationship between the relative importance of space and the probability that a given area is characterised by presence of only one buyer. At intermediate and low values of s, Alvarez shows that market areas of the two symmetric rivals can overlap, while Fousekis shows that, under asymmetric competition and adoption of UD prices, the two rivals will coexist in a given market area, but their procurement areas will not overlap.[33]

A scenario where the area of competition between firms can envelope and extend beyond processors' locations seems to be a more accurate picture of many real world situations and therefore Alvarez's definition would be a desirable one to use empirically. It is however also problematic because of the assumption of exogenous location of processors that underlies d. Processor location in space can itself be the choice variable in a higher stage location game where each firm chooses the location

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[33] The analytical results on price obtained by Alvarez et al. show that UD-pricing, price matching capitalistic processors located at intermediate points along a line don't have strong incentives to increase price paid to farmers above monopsony levels when the relative importance of space is low, for instance if they are located close to each other, because their market areas overlap almost completely: the additional suppliers gained from one firm to the other by offering a higher price are not very valuable because they are not located close to the firm that is gaining them. Thus, price remains at monopsony level, unlike Fousekis' result for asymmetric price competition when both firms are using UD pricing, where at low values of s the private processor raises price paid well above monopsony level. However, in Alvarez's model, as the relative importance of space, and economic distance between firms, increases, each firm has an incentive to raise its price above monopsony level and consequently reduce its market area, freeing up some suppliers that are located further away from its plant and closer to the plant of the rival. Because of the assumption of price matching, each firm expects the rival will behave in the same way, so that each competitor will lose some distant suppliers and gain more valuable, closer ones. Thus, their model predicts a non-monotonic, inverted-U relationship between the relative importance of space and price paid, while Fousekis' model of asymmetric competition predicts an inverse relationship between s and price paid by the private processor.

that maximises its profit given the location decision of the rival, in a similar way to Hotelling's duopoly location-price game between symmetric firms (1929). In Hotelling's model, minimal spatial differentiation is optimal, because each firm realises that it can maximise its market area and profits if it locates near or at the middle of the market. If transportation costs and distribution of both suppliers and customers are not uniform in space, processors will also take into account local geographical characteristics influencing transport costs, as well as rival's location, in choosing their location. Alvarez et al. and Fousekis are silent on these matters.

Alvarez et al. offer guidance on constructing an empirical measure for the concept of relative importance of space. However, due to lack of available data, in their application they end up using a measure of the *absolute* importance of space instead. The dependent variable in their model is monthly observations of price paid to farmers by 13 dairy processors for eleven years in the mountainous region of Asturias, in the north of Spain. Data on firm processing costs and on wholesale cheese price, which are needed to construct a measure of the relative importance of space, are not available. Their empirical measure of the absolute importance of space, $s_A = \gamma d$, is constructed as follows. The monthly price per litre of diesel fuel is used to approximate transportation costs γ. This however does not take into account possible differences in transportation costs across areas with heterogeneous geographical characteristics. Distance between rivals d is measured as the sum of distances between each processing firm i and its nearest rivals, such that the combined processed volume of the rivals at least equalled the volume of firm i.

In this section I adopt both the definition of s used by Fousekis and the one used by Alvarez et al. However, I confront the same data limitations as Alvarez et al: I do not have information on wholesale price for cheese produced by processors or on their processing costs, and I, too, work with the *absolute* importance of space.

I proxy transportation costs γ using the minimum altitude point of each municipality, *minalt*, available from official ISTAT data. It is reasonable to assume that geographical characteristics in a given area influence transportation costs, and in particular, the higher the altitude, the higher are transportation costs for milk shipment from farm to processing plant, because of steeper roads. Use of minimum altitude can hide some variation in geographical characteristics within municipalities, which may create differences in the transportation cost of reaching different farms. As discussed in the introduction, however, the area of municipalities tends to be very small, thus reducing the likelihood of very large differences in geographical characteristics within them. Use of minimum altitude point is preferred to use of mean altitude of the municipality, because it is considered a cautionary measure in order to reduce the risk of over-emphasising the importance of transportation costs when mean altitude is used. For each municipality, also data on maximum altitude, and on the difference between maximum and minimum altitude points, are available. However, these two measures are considered to be less informative and are not used because maximum altitude often refers to a mountain peak with no human settlement, irrelevant for milk transportation costs.

With respect to the empirical counterpart of *d*, Alvarez is conducting the analysis at the level of processors and thus uses distances between processing firms. My analysis is at the level of municipalities and I use two measures of distance between municipalities and processing firms, which capture relative isolation of each municipality with respect to processors' location. The first, *avdist*, is the average geodesic distance (that is, shortest distance), mid-point to mid-point, between each municipality and all the municipalities where processors' processing plants are located. In the sample of municipalities, this ranges from 19 to 118 km, with a mean of 64 km. Use of this variable may however be misleading, because a processor may not necessarily be a relevant actual or potential buyer equally at all locations. For this reason, and also following inspection of the map of plant distribution presented in figure 4.1, I also use a second measure, *avdist3*, which focuses on the average geodesic distance between each municipality and the municipalities where the three closest processors are located. In the sample of municipalities, this ranges from zero to 63 km, with a mean of 23 km. With either measure, in some cases distance of municipality *i* from one or more processors is zero because their processing plant is located in municipality *i* itself. In theory, distance from processors located in neighbouring provinces is also relevant. In practice, as noted in Chapter 3, 95% of dairy farmers in Piacenza and 99% in Trento only trade with milk buyers with processing plant within the provincial administrative border. Thus, relative isolation of each municipality with respect to processors' location is measured only taking into account processors with their headquarters in the province.

Because of the use of geodesic or "as the crow flies" distance, neither *avdist* or *avdist3* takes into account potentially heterogeneous geographical characteristics that can affect economic distance between municipalities and processing firms. Data on travel time between geographic points, which would be a better measure in presence of heterogeneous geography, are available at province but not at municipal level and thus could not be used. Proxies for economic distance between municipality *i* and processors' headquarters, similar to Alvarez's measure of the absolute importance of space, *γd*, are obtained with interaction terms between each distance variable and the minimum altitude point of municipality *i*.

However, historically, processors' decision with respect to their location and therefore current distance between competitors is likely to have been influenced by geographic factors such as altitude, which would influence transportation costs to the processor for reaching both customers and suppliers. In Trento and Piacenza each there is a positive correlation between minimum altitude point of the municipality and average distance between municipalities and processors. This is weaker in Trento: correlation between minimum altitude of the municipality and *avdist* is only significant at 10% level (correlation coefficient = 0.14, p-value = 0.07), while the correlation between minimum altitude and *avdist3* is not statistically significant (and actually negative: correlation coefficient = -0.09, p-value = 0.24). The latter point is supported by visual inspection of the map of processor location in Figure 4.3, which shows that, at least in the north-west part of the province, processors are located very close to each other. In Piacenza, on the other hand, correlations between minimum altitude point and each distance variables are both positive and significant at 1 % level (correlation coefficient = 0.72 for *avidst* and 0.84 for *avidst3*).

Both a model using altitude as the proxy for the absolute importance of space, following the conceptual definition by Fousekis, and a model using the interaction term between minimum altitude point and average distances between processors, following the conceptual and empirical definitions by Alvarez, are estimated. In both cases, however, altitude is likely to affect the outcome both via its effect on transportation costs, and via its likely effect on processors' past decisions with respect to their location, which resulted in current distance between processors. Because the correlation between minimum altitude and average distance variables may have confounding effects, the model using only minimum altitude as a proxy for transportation costs is preferred.

To sum up, the basic specification used in the probit model estimated in this section is[34]

$prob[monopsony_i=1] = \Phi(\alpha + \beta_1 s_{Ai} + \beta_2 supply_i + e_i)$

where i = 1, …, 214 municipalities in Trento and Piacenza where more than one dairy farmer is located and *monopsony* is a dummy equal to 1 if only one processor is observed to collect milk in a municipality, and zero otherwise. The absolute importance of space, s_A, is proxied alternatively with (a) *log(minalt)*; (b) *log(minalt*avdist)*; and (c) *log(minalt*avdist3)*. The size of local milk supply, *supply*, is proxied alternatively with (a) the log of the number of dairy farmers in the municipality; and (b) the log of average herd size on farm per municipality. A province dummy is also included in order to control for unobserved differences between provinces. Coefficients and marginal effects at the mean of the characteristics are reported in Table 4.6. Reported standard errors are based on the Huber–White estimator of variance, and are robust against many types of misspecification of the model. The model correctly predicts between 65% and 71% of observations.

Results show that the probability that only one buyer operates in a municipality decreases as local supply increases, as expected. The number of dairy farmers located in the municipality seems to be the important factor: a 10% increase in the number of local suppliers (at the mean of 13) is associated with a decrease of between 2 and 1.8 percentage points in the probability that a municipality is a monopsony, on average and *ceteris paribus*. Instead, average herd size per farm, a proxy for size of average farm milk output, is not statistically significant (column 2, Table 4.6).

The relationship between absolute importance of space and the probability that a municipality is a monopsony is consistently positive and significant, as expected, regardless of the proxy used to capture s_A. A 10% increase in minimum altitude of the municipality (column 1, Table 4.6), at the sample mean of 473 m, is associated with an increase in the probability that a municipality is a monopsony by 2.2 percentage points, on average and everything else equal. A 10% increase in the economic distance between each municipality and all the processors operating in the province (proxied with log(*minalt*avdist*)) is associated with an increase in the probability that a municipality

[34] Parameters of a non-linear probability model can be estimated in a probit model using maximum likelihood techniques. For each observation, the probability of observing y conditional on x can be written as $\Pr(y \mid x) = \{\Phi(x_i'\beta)\}^{y_i}\{1-\Phi(x_i'\beta)\}^{1-y_i}$, $y_i = 0, 1$ and the log likelihood function for the probit model can be written as $L = \sum_{i=1}^{n} y_i \log\{\Phi(x_i'\beta)\} + \sum_{i=1}^{n}(1-y_i)\log\{1-\Phi(x_i'\beta)\}$.

is a monopsony by 2.5 percentage points (column 3, Table 4.6). When the economic distance of interest is restricted to that between the municipality and the three closest processors (column 4, Table 4.6), the magnitude of the relationship becomes smaller: a 10% increase in such distance is associated with an increase in the probability of observing a monopsony by 1.5 percentage points.

The dummy for Trento is not statistically significant.

The data suggest that, as expected, the degree of competition at a given location, namely whether an area is characterised by monopsony or by overlap between processors, depends on availability of local supply and on geographical factors affecting transportation costs, a result consistent with the theoretical predictions of models of spatial inputs markets. Overall, more competition is found where local supply is larger and transport costs are lower, and the importance of availability of local supply for processors' decisions on their procurement area is likely to increase when transportation costs are higher. The next section investigates to what extent these correlates of the actual configuration of market structure (at least according to population data) are relevant to explain farmers' perceptions on processors' availability.

Table 4.6: Probit model for the probability that only one buyer operates in a municipality

Dependent variable: Only one buyer operates in municipality (1 = yes)	(1) Coeff.	(1) Mg.effect	(2) Coeff.	(2) Mg.effect	(3) Coeff.	(3) Mg.effect	(4) Coeff.	(4) Mg.effect
Ln(minalt)	0.571***	0.218***	0.491***	0.188***				
	(0.180)	(0.069)	(0.175)	(0.067)				
Ln(minalt*avdist)					0.675***	0.254***		
					(0.154)	(0.058)		
Ln(minalt*avdist3)							0.405***	0.154***
							(0.112)	(0.042)
Ln(n dairy farmers)	-0.524***	-0.200***			-0.519***	-0.195***	-0.473***	-0.180***
	(0.109)	(0.042)			(0.111)	(0.042)	(0.111)	(0.042)
Ln(average farm herd size)			-0.171	-0.065				
			(0.110)	(0.042)				
Trento	0.033	0.013	0.536	0.191	-0.363	-0.140	0.175	0.065
	(0.434)	(0.165)	(0.444)	(0.158)	(0.444)	(0.172)	(0.383)	(0.143)
Constant	-2.521***		-3.034***		-5.622***		-2.962***	
	(0.875)		(0.992)		(1.343)		(0.882)	
Observations	214		210		214		214	
Pseudo R^2	0.209		0.144		0.243		0.216	
χ^2	55.48		47.46		54.06		50.16	
% correctly predicted	69%		65%		71%		71%	

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

4.3.2. Sample data: perceived availability of alternative buyers

This section shifts the focus of the analysis to farmers' perceptions on the availability of one or more alternative buyers. The analysis is conducted on the sub-sample of farms from Trento and Piacenza only, in order to facilitate comparability of results with those on municipalities obtained in the previous section. The dependent variable is a dummy equal to 1 if the farmer perceives her current processing firm is her only available buyer and zero if she perceives alternatives are available. Farmers' perceptions are expected to depend both on the actual market configuration and on farmers' costs of discovering alternative options.

Local geography and milk supply are expected to influence farmers' perception of available alternatives because they influence actual market configuration (at least according to population data). These variables are measured again at municipal level, as in the previous section, because the only available information on geographical location of survey respondents is their municipality, due to anonymity of the questionnaire. Absolute importance of space is proxied, as in the previous section, with minimum altitude of the municipality and with the interaction term between altitude and average distance between municipality and processors' (all, and nearest three) locations.

Farmers' information and search costs can also influence their knowledge and perception of available alternatives. Farmers for whom these costs are sufficiently high may be discouraged from looking for alternatives and therefore may be more likely to perceive that their current buyer is the only available one. Information and search costs for the farm manager are expected to be higher when her level of schooling is lower and when she does not only work on farm but is also employed off-farm, as this increases her time constraints. Information costs may also increase as farm manager's age increases. However, due to the significant negative correlation between age and number of years of schooling in the sample (correlation coefficient = -0.59, significant at 1% level), age of farm manager is omitted in order to avoid confounding effects.[35]

Estimated coefficients and marginal effects for a probit model for the probability that a farmer perceives no alternative buyer is available are reported in Table 4.7. The model correctly predicts between 64% and 61% of observations. As expected, the likelihood of

[35] The model was re-estimated excluding the number of years of education of the farm manager and including her age. This variable is not statistically significant and the other results remain substantially unchanged compared to those presented in Table 4.7.

perceiving that more than one option is available increases as local transportation costs decrease, and when farmers are located in municipalities that are less isolated relative to processing plants. The relationship is stronger and its magnitude larger when minimum altitude of the municipality, proxying transport costs, is used: a 10% increase in altitude (from a sample mean of 415 m) increases the probability of perceiving the current buyer as the only available alternative by 2.1 percentage points, on average and ceteris paribus (column 1, Table 4.7). This decreases to 1.8 percentage points when the effect considered is that of the interaction between altitude and distance from all processors (column 2, Table 4.7), and to 0.6 percentage points when focussing on the interaction between altitude and distance from the three closest processors (column 3, Table 4.7). This difference in the estimated relationship across measures may depend in part on the confounding effects resulting from the correlation between altitude and distance between municipality and processors.

Information and search costs also appear to play a significant role in farmers' perceptions. First, a 10% increase in the number of years of schooling of the farm manager is consistently associated with a decrease in the probability of perceiving only one buyer is available by about 2 percentage points, on average and holding everything else equal. Second, compared to farm managers employed full time on farm, those also working off-farm are about 19% more likely to perceive their current buyer is their only alternative, suggesting that time constraints affect farmers' ability to find out about alternatives.

None of the other variables is statistically significant.

Both the analysis at the level of municipalities using population data and that at farm level using sample data yield similar results with respect to the relationship between geography, in particular transportation costs, and presence of areas of overlap. This relationship is consistent with the theoretical prediction that as transportation costs and the economic distance between rival processors increases, the probability of overlap between them decreases. High transportation costs thus favour the emergence of monopsony areas. In regions with heterogeneous geographical characteristics such as Trento and Piacenza, this leads to the coexistence of areas of monopsony with areas of overlap between more than one processor. Results yielded by the analysis at sample level are consistent with those provided by population data with respect to the role of geography. They also suggest that information and search costs have an important role in farmers' perceptions of what is available to them.

Table 4.7: Probit model for the probability that the farmer perceives only one buyer is available

Dependent variable: Farmer has only one available buyer (1 = yes)	(1) Coeff.	(1) Mg. effect	(2) Coeff.	(2) Mg. effect	(3) Coeff.	(3) Mg. effect
Ln(minalt)	0.581***	0.208***				
	(0.167)	(0.060)				
Ln(minalt*avdist)			0.508***	0.182***		
			(0.143)	(0.051)		
Ln(minalt*avdist3)					0.180*	0.065*
					(0.101)	(0.037)
Ln(n dairy farmers in municipality)	0.060	0.021	0.087	0.031	0.104	0.038
	(0.126)	(0.045)	(0.125)	(0.045)	(0.125)	(0.045)
Ln(n years schooling of farm manager)	-0.585**	-0.210**	-0.608***	-0.218***	-0.566**	-0.206**
	(0.236)	(0.085)	(0.236)	(0.085)	(0.235)	(0.085)
Farm manager employed off-farm (1 = yes)	0.511*	0.196*	0.506*	0.194*	0.495*	0.191*
	(0.298)	(0.114)	(0.300)	(0.115)	(0.297)	(0.114)
Trento	-0.320	-0.117	-0.572	-0.211	0.353	0.124
	(0.413)	(0.151)	(0.451)	(0.166)	(0.387)	(0.136)
Constant	-2.417**		-3.885***		-1.259	
	(1.056)		(1.371)		(0.987)	
Observations	239		239		239	
Pseudo R^2	0.139		0.141		0.108	
χ^2	42.02		39.26		32.59	
% correctly predicted	64%		63%		61%	

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Coexistence of monopsony areas with areas of overlap within the same province is just one of the questions posed by the current configuration of market structure in Trento and Piacenza illustrated in Figure 4.1. The other question is what drives the coexistence, within the same province, of areas where cooperatives are the only buyer (especially widespread in Trento) with areas where both cooperatives and private processors (appear to) overlap. The next section analyses the factors that favour the prevalence of cooperative firms as the mode of organisation of milk processing and marketing in a given area. Section 4.5 then explores in more detail areas of overlap between buyers with different organisational forms, by investigating differences in characteristics between members and non-members, and the observable characteristics that are associated with farmers' self-selection into cooperative membership when alternative options are available.

4.4. Prevalence of cooperative forms of organisation of milk processing and marketing in a given area: a historical analysis

What accounts for the variation within the areas under study in the organisational form adopted by processors, namely the fact that in some areas only cooperatives operate and in others both cooperative and private firms appear to coexist? The literature indicates that cooperative formation and membership is more likely when farmers are more vulnerable to the potential exercise of market power. This suggests that cooperative formation and presence is more likely when farms are relatively more isolated, as this increases their transport costs for delivering to an alternative buyer; when their scale of production is smaller, because the discrepancy in bargaining power towards processors is even larger for them than for larger farms; and when, in order to enter a transaction, they have made substantial investments in specific assets with no alternative use, which make their supply more inelastic. The likelihood of cooperative formation however also depends on the costs of collective action which, according to Hansmann's argument reviewed in Chapter 2, Section 2.1.1, tend to be lower the more homogeneous farmers are.

In this section I analyse patterns of prevalence of cooperative presence with a historical account of the evolution of the milk market structure in Trento and Piacenza into its current configuration. No primary historical data on the relationship between farm characteristics, geography, and emergence of the first organisational forms of milk processing and marketing are readily available, and the analysis in this section rests on secondary data.

The first question this section asks is what factors favour the organisation of milk processing and marketing at the early stages of agricultural commercialisation into either a cooperative or a capitalistic organisational form. The hypothesis is that this initial form of organisation is influenced by the interplay between distribution and heterogeneity of farm size and transportation costs in a given area, both influenced by local agro-ecological characteristics.

The second question this section asks is about choice of organisational form by subsequent firms entering the market. The organisational form of the incumbent creates incentives both for replication and diffusion of the existing organisational form, and for differentiation by new entrants into alternative organisational forms: while there may be increasing returns from adopting the same organisational form as the incumbent, it may also be profitable for the new entrant to differentiate in order to enjoy some degree of local monopsony power. Both incentives for path dependence and change exist and the one that prevails is influenced also by the organisational nature of the first mover.

The concept of path dependence can be defined as “the set of dynamic processes where small events have long-lasting consequences that economic action at each moment can modify yet only to a limited extent” (Antonelli 1997):643. Thus, early decisions reverberate through history, reinforcing and validating a particular path, such as, for instance, the technological lock-in into the QWERTY keyboard (David 1985). Path dependence however does not mean historical determinism or ‘past dependence’: rather, it is a probabilistic process where, given past states of the world, some possible paths are more probable than others (Martin and Sunley 2006). Historically given structures thus influence, but do not determine, the behaviour of individuals in the present by setting an initial distribution of resources and vested interests. Processes of change and creation of new paths are always latent in the process of path dependence.

An important source of path dependence is increasing returns, in which various externalities and learning mechanisms operate to produce positive feedback effects, thereby reinforcing existing development paths (Arthur 1989). Types of increasing returns include large fixed, initial, set-up costs (which give the advantage of falling unit costs as output increases); dynamic learning effects (such as learning by doing and learning from others); and coordination effects (‘going along’ with other agents taking similar actions). North (1990) also attributed the tendency for formal and informal institutions and social arrangements to be self-reproducing over time, partly through the same system of socio-economic actions they serve to support and stabilise (North 1990). Individual decisions, whether coordinated or not, give rise to the path and to its potential reproduction. At the individual level, reproduction of the path may take the form of some sort of inertia or resistance to change or *status quo* bias, whereby the current, known circumstance is preferred to a new situation. Some of the information I collected for this research suggests that some form of inertia potentially related to path dependence may be in place with respect to farmers’ transaction with milk buyers. Three points may serve as illustration. First, the parents of 84% of cooperative members had themselves been members of a processing and marketing cooperative in the past. Second, 39% of respondents (52% in Trento) reported transacting with their current outlet *because* it was the same outlet with which their parents were transacting. Third, only 32% of the sample had changed milk buyer at least once in the past, while the rest never had. Among those who did, 61% of them changed buyer but not organisational form: 34% changed from one cooperative to another and 27% changed from one private buyer to another. This suggests that, to some extent, decisions taken in the past, by the same farmer or within the household, have an impact on the present by increasing the probability that a similar action will be taken again in the present.

With respect to the establishment of the path itself, the likelihood of a cooperative to emerge as the first mover is hypothesised to be higher the smaller and more homogeneous the farm size in a given area. In turn, once a cooperative is in place, new entrants are hypothesised to be more likely to adopt the same organisational form, as this represents a readily available example which facilitates learning and imitation by other agents. Moreover, the development of cooperative forms of organisation may have an impact on the local framework of formal and informal institutions, generating some sort of locally specific social capital, social infrastructures and traditions, all of which embed economic activity into a local trajectory (Granovetter 1985). How can change occur in such a scenario? My hypothesis is that, as the heterogeneity in characteristics across agents increases, the costs of cooperative membership also increase, at least for some, giving them an incentive to deliberately look for an alternative path. On the other hand, where the initial distribution of farm size is heterogeneous, for instance characterised by a substantial number of large farms and a smaller number of smaller farms, my hypothesis is that the initial organisation of milk processing and marketing is more likely to take the form of a capitalistic firm. The path can be changed if the conditions of land distribution change.

Transportation costs are important in these initial stages of organisation because they define the area of interactions among agents: the lower the transport costs, the larger the area of possible interaction and potentially the stronger the degree of heterogeneity in the characteristics of the agents. Conversely, the higher the transport costs, the smaller the area of close-knit interaction between agents; because key characteristics, like farm size, are also likely to depend on geographical characteristics (e.g. slope), and geographical characteristics are more likely to be homogeneous in smaller areas, farmers' characteristics are also more likely to be homogeneous in smaller areas.

Trento and Piacenza presented very different characteristics at the early stages of the process of commercialisation of livestock products, and followed two distinct patterns of evolution in milk processing and marketing arrangements.

Trento, in the mid 19th century, was characterised by a small-scale peasant farming system with homogeneous farm size, where milk was produced for home consumption (Felice 2004). In the second half of the 1800s 'rotating dairies' were formed in several valleys in order to process into cheese the surplus milk produced by local farmers (Santoro Lezzi 1993; Trentini 2008). Rotating dairies were informal village-level cooperative arrangements where a small scale plant – usually beginning with nothing more than a shed with some rudimentary tools – was jointly managed by villagers producing surplus milk; each member would take it in turns to process all members' milk into cheese or butter; at regular intervals (e.g. when the process of cheese maturing was completed) members would share the output proportionally to the quantity of milk they had delivered to the rotating dairy. In 1897 there were 240 such dairies throughout the province of Trento (Federation of Trento Cooperatives, personal communication, September 2007). Over time, rotating dairies transformed into 'social dairies', still informal arrangements, which however began hiring professional cheese-makers to carry out milk processing, thus reducing the risk that lack of processing skills of one or more members might compromise the outcome for all members. Merging of social dairies to achieve economies of scale was rare in this first period of informal cooperative development, and overall social dairies maintained a strongly local and small-scale character, mostly operating just at village level (Felice 2004).

The process of cooperative development started to change in the first two decades of the 20th century, and more markedly after the Second World War, as national and local agricultural policy began providing access to grants and subsidised credit for investment only to those farmers formally organised into cooperatives and producer organisations. As a response to this, over time social dairies formalised their status into that of processing and marketing dairy cooperatives. Alongside this process of formalisation, from the 1950s onwards also began a slow process of mergers between neighbouring cooperative dairies in pursuit of economies of scale in processing and marketing. This followed a period of intense investment in transport infrastructure in the region, which meant that the importance of transportation costs began to decline relative to potential economies of scale in processing and marketing.

A partial change to the path of cooperative predominance occurred when the only private buyer currently operating in this province began its operations in the 1930s, after the initial waves of cooperative development: one large dairy farmer located in the lower altitude south-east of the province installed processing equipment on farm and started buying milk from neighbouring farmers to cover its processing capacity, and then progressively expanded scale of operations over time.

In Piacenza the evolution of the milk market took a different form. At the end of the 19th century, the local agrarian structure was characterised by a system where large scale, capital intensive, specialised farms with tenants or hired labour coexisted with small scale family farms with a diversified production system, scattered in the plains and more frequently in hilly areas, as well as with a large number of landless labourers (Procacci 1964; Elazar 1996). Given its predominantly lowland character, the province presents low geographical constraints, both to farm size and with respect to transport costs. The initial development of milk processing and marketing took the form of the establishment of processing plants on farm by large farms specialised in milk production (D'Antone 1981). Over time, as specialisation increased further, processing plants were established as separate from the farm itself, but still owned by the initial owner. Large farmers would tend to make agreements among themselves with respect to sales, i.e. agreeing to sell to neighbouring large farms with processing plant facilities. Smaller farms producing surplus milk could sell to a large farm with on-farm processing facilities, but would often face a less favourable treatment than larger ones (Menzani 2007). Initially, smaller farms were too few and dispersed in space for collective action in the form of cooperative formation to take place.

Three events contributed to a qualitative change in this process of historical development. The first was the land reform of 1950, which redistributed land away from large landholdings and increased the number of small and medium size properties (Monti 1998), thus potentially giving small scale farms the critical mass necessary to realise the potential gains from collective action in the form of a cooperative. Second, the urban cooperative movement had an explicit focus of encouraging the establishment of processing and marketing cooperatives in rural areas (Menzani 2007). Third, the initiative of the cooperative movement was favoured by the aforementioned national policy of granting subsidised credit to farmers organised in cooperatives and producer organisations. The influence of the initial path is however still visible in the fact that about half of dairy farms continue to supply private processors today.

A few points can be highlighted from these accounts. The first concerns the relationship between distribution of farm size and the costs of setting up processing and marketing facilities. In Piacenza, scale of production of large, capitalistic farms was often large enough for each of them to be able to meet those costs individually and set up an on-farm processing plant. Conversely, Trento was characterised by small family farms, itself likely to be an outcome of agro-ecological conditions and topographical constraints. The size of the initial surplus in milk production was probably relatively homogeneous across farms, and small, making it too costly for an individual farm to incur the fixed cost of setting up processing facilities on farm. However, the evidence suggests that at some point the value of the surplus produced by neighbours or village members became sufficient to offset the shared fixed cost of establishing joint processing facilities. This cost includes some initial capital (building, including storage for hard cheese; tools); but also the cost of negotiating an agreement, designing the formal or informal rules of collective action, and monitoring compliance with those rules. In the case of Trento, there are reasons to expect these costs to be small. First, relative homogeneity in farm characteristics is likely to reflect in relatively homogeneous interests. Second, most villages had prior experience in collective action, in the form of formal and informal cooperative institutions for joint management of common resources (forests and pastures), which had already been in place for centuries within most villages (Casari 2007). Third, the mountainous nature of the region, coupled with little transport infrastructure, resulted in high transport costs which limited the geographical reach of these first dairy cooperative arrangements, thus maintaining group size within relatively small numbers and group members within close geographical proximity, lowering the costs of monitoring compliance with the rules, and defining a sort of closed community where social sanctions could be a strong enough enforcement mechanism if needed.

With respect to the key change in the path in Trento, i.e. entry of the capitalistic processor, this occurred at a time when transport costs were beginning to decline. This processor could exploit the high quality milk produced in the area. At least initially, it may have competed with existing coops by paying farmers a higher price; however, my sample evidence suggests that, at least today, this buyer actually pays less than cooperative firms in the area. One possible evolutionary path leading to the current outcome is that, as a result of evolution in land structure, over time heterogeneity between farms has increased, although still checked by geographical constraints. As members' heterogeneity increased, the costs of cooperative membership also increased, especially for larger farms, for who the benefits from collective action are likely to be smaller compared to smaller farms, who in turn tend to be more vulnerable to the potential exercise of market power by processors. Larger farms may thus accept a lower price paid by the private processor because this still compensates them for the higher costs of cooperative membership they would have to face.

In Piacenza, the change in the path with entry of cooperative firms took the familiar form of cooperative formation as countervailing power and avoidance of market power, which was favoured by a change in the distribution of farm size via the land reform. In both Trento and Piacenza, however, the importance of strategic agency and the deliberate deviation of agents from established paths should also be recognised. In Trento, an example of this was the decision of one farmer to establish a processing plant on farm. In Piacenza, an example was the support and encouragement of the urban cooperative movement to the establishment of agricultural cooperatives in rural areas.

4.5. Cooperative members and non-members in the full sample and in areas of overlap

The influence of the initial path of development of commercialised milk processing and marketing organisation is still visible today in Trento in the predominance of cooperatives especially in higher altitude areas where transport costs are higher, and in Piacenza in the fact that about half of dairy farms continue supplying private processors. In areas where both cooperative and capitalistic firms overlap, and assuming that farmers can choose between either types of buyer, what are the characteristics that make them more likely to choose a cooperative? Models of spatial input markets, including the model by Fousekis, assume that price net of transport cost is the only variable farmers are interested in when deciding whether to supply to a cooperative or to a private processor. When the two firms overlap, the assumption is that identical farmers will choose randomly between processors (Iozzi 2004). In the real world, however, heterogeneous farmers may have heterogeneous preferences for the different set of costs and benefits associated with joining a cooperative or supplying a private processor. Thus, farmers' distribution between buyers with different organisational forms in areas of overlap may not be random, and instead may depend on their individual characteristics. In particular, more isolated, smaller farmers with higher levels of asset specificity, who are more vulnerable to the potential exercise of market power from private processors, are expected to be more likely to join a cooperative.

This section investigates differences in characteristics between cooperative members and non-members, and compares the results that emerge when looking at the full sample, which includes farmers who perceive only one buyer, or only one organisational form, is available to them, with those provided by the sub-sample of individuals who perceives both organisational forms are available buyers, in the attempt to separate, at least to some extent, correlates of farmers' choice of buyer when such a choice is available from correlates of a particular market structure configuration. The section is organised as follows. Section 4.5.1 presents a descriptive overview of the differences in characteristics between members and non-members (a) in the full sample, (b) within provinces, and (c) in the sub-sample who perceives both organisational forms are available. Section 4.5.2 then presents the results of a multivariate analysis of the correlates of cooperative membership both for the full sample and for the sub-sample perceiving both organisational forms are available. The objective of this analysis is to understand what observable characteristics differentiate members and non-members and drive farmers' selection into cooperative membership. Selection into membership will depend also on the expected gains from joining, including the relative price gain from membership compared to selling to a private processor. This relative price gain, which contains a counterfactual price outcome for each individual, that is, the price members would have obtained had they supplied a private processor, is (for the moment) unobserved. In this section I adopt a reduced form approach, where cooperative membership is a function of observable individual and market characteristics, ignoring prices paid. Prices paid are endogenous and many of the observable characteristics hypothesised to influence the membership decision also affect prices. This section however identifies one variable, parental membership status, which is important for farmers' decision on whether or not to join a cooperative, but which is expected to have no influence on current prices received by members (this will be discussed in more detail in Chapter 6, Section 6.4.4.), and thus allows to discern the effect of cooperative membership on prices paid, namely the difference between the price current members receive compared to what they would obtain had they been supplying a private processor, given their individual characteristics. This section will focus on the reduced form estimation of the correlates of coop members, while estimation of the counterfactual price outcome for members, and of the cooperative effect on prices paid, taking into account farmers' self-selection into cooperative membership, will be the subject of Chapter 6.

4.5.1. Members versus non-members: a descriptive overview

A Wilcoxon-Mann-Whitney (WMW) test is used to test for statistically significant differences in the means of continuous variables between members and non-members, without assuming that these variables are normally distributed, and a Chi^2 test is used to test for the statistical significance of the relationship between membership status and categorical variables.

Table 4.8 compares characteristics of members and non-members in the full sample. Cooperative members are located at significantly higher altitude compared to non-members and are significantly more distant from processors' locations. Their farm size is significantly smaller, whether it is measured with total annual farm milk output, herd size or operated land area. Members tend to be located in areas characterised by the prevalence of cattle producing higher quality milk (which is itself related to altitude) and where the share of cooperative members is higher. Current cooperative members are significantly more likely to have parents who had themselves been cooperative members in the past. There are no significant differences between members and non-members in the relative importance of dairy income in farm or household income, but cooperative members tend to employ more household members on farm and are significantly less likely to hire labour. The share of female farm managers is higher among members than non-members and coop members have completed fewer years of schooling compared to non-members, while differences in age and number of years of experience as farm manager between the two groups are not statistically significant. Cooperative members are more likely to have stopped schooling at the end of secondary school, while non-members are significantly more likely to have completed post secondary agricultural education or a university degree.

Table 4.8: Mean characteristics by membership status, full sample

	Non-member		Member		Test statistic	p-value
	Mean	St. dev	Mean	St. dev		
Minimum altitude of municipality (m) †	126.44	152.28	436.58	313.82	-7.316***	0.000
Avdist (km) †	44.97	17.63	60.20	23.62	-4.373***	0.000
Avdist3 (km) †	12.84	10.18	18.91	12.33	-3.284***	0.000
Annual farm milk output (ton) †	654.47	592.53	312.51	346.67	5.406***	0.000
Herd size†	82.19	71.42	39.55	35.66	5.688***	0.000
Total operated land area (ha) †	81.62	93.43	33.26	30.67	5.411***	0.000
% of cattle in municipality producing higher quality milk †	13.64%	26.38	54.02%	39.99	-6.945***	0.000
% of dairy coop members in municipality†	41.76%	21	83.56%	25	-8.344***	0.000
Parents were coop members (%)‡	50%	50	84.19%	37	31.974***	0.000
Dairy income as share of household income †	72.19%	28.38	66.42%	30.83	1.378	0.168
Dairy income as share of farm income †	76.49%	24.31	75.34%	26.47	0.127	0.899
% of farms for which dairy income is 100% of farm income†	25%	44	18.93%	39	1.045	0.307
N of household members working on farm †	2.27	1.10	2.63	1.02	-2.338**	0.019
N of hours/day worked on farm by hh members†	9.53	12.32	9.05	10.61	-1.109	0.268
% of farms hiring labour ‡	44%	50	21%	41	13.659***	0.000
Age of farm manager†	52.27	13.54	50.01	13.19	0.685	0.494
N of years of experience as farm manager †	20.82	11.16	22.41	12.64	-0.842	0.399
% of women farm manager ‡	3.70%	19	11.90%	32	3.194*	0.074
N of years of schooling of farm manager †	10.06	4.01	8.90	3.28	1.981**	0.047
Highest level of schooling completed (%):						
Primary ‡	24.53%	43	25.51%	44	0.022	0.882
Secondary ‡	22.64%	42	40.49%	49	5.939**	0.015
Post-secondary agricultural education ‡	22.64%	42	10.12%	30	6.326**	0.012
Post-secondary technical education ‡	13.21%	34	13.36%	34	0.001	0.976
Other post-secondary education ‡	16.98%	38	10.53%	31	1.764	0.184
University degree ‡	7.55%	27	0.81%	9	10.106***	0.001
N	59		254			

†: Wilcoxon-Mann-Whitney ranksum test. Test statistic is z-score
‡: Pearson Chi^2 test
*** p<0.01, ** p<0.05, * p<0.1

These sample level differences between members and non-members become less marked when analysed within each province, as shown in Tables 4.9 to 4.11. The only difference between members and non-members that is consistent – and highly significant – across provinces is with respect to parental membership status: cooperative members are significantly more likely than non-members to have parents who themselves had been members of a coop. With respect to other characteristics, cooperative members are located at higher altitudes than non-members in Trento and Bologna. Contrary to what appears when looking at the full sample, members are closer than non-members to the three nearest processors in Trento and to all processors in Piacenza. Cooperative members have smaller herds and operated land area in Piacenza and Bologna, while these differences are not significant in Trento. They also tend to cluster in municipalities where the majority of dairy farmers is in a coop (this information is not available for Bologna because it is based on population data). While in Piacenza cooperative members are significantly less likely than non-members to be specialised in dairy farming (where a farm is defined as specialised if all farm income comes from dairy farming), in Bologna they depend on dairy farming more than non-members for both total farm and total household income. In both Trento and Piacenza cooperative members are significantly less likely to hire labour. In Piacenza they also tend to employ more household members on farm, who tend to work more hours per day on farm than among non-members. There are no observed differences in socio-economic characteristics between the two groups, with the exception that non-members in Bologna are significantly more likely to have completed a university degree.

Table 4.9: Mean characteristics by membership status, Trento

	Non-member		Member		Test statistic	p-value
	Mean	St. dev	Mean	St. dev		
Minimum altitude of municipality (m) †	425.80	110.08	596.81	249.06	-2.674***	0.001
Avdist (km) †	68.37	8.48	71.51	17.73	-0.323	0.746
Avdist3 (km) †	29.53	3.73	22.66	11.51	2.071**	0.038
Annual farm milk output (ton) †	311.52	367.29	205.54	263.47	0.688	0.491
Herd size†	42	44.58	28.26	26.50	0.969	0.333
Total operated land area (ha) †	36.40	48.47	23.22	19.50	0.252	0.801
% of cattle in municipality producing higher quality milk †	70.69%	11.49	78.82%	21.20	-2.359**	0.018
% of dairy coop members in municipality†	53.53%	23	93.73%	15	-5.670***	0.000
Parents were coop members (%)‡	60%	52	87.13%	34	5.655**	0.017
Dairy income as share of household income †	54.44%	27.44	58.40%	32.46	-0.416	0.677
Dairy income as share of farm income †	60%	28.61	70.82%	28.97	-1.516	0.129
% of farms for which dairy income is 100% of farm income†	-	-	17.07%	38	1.631	0.202
N of household members working on farm †	2.25	1.28	2.6	1.05	-1.18	0.238
N of hours/day worked on farm by hh members†	10.2	13.08	8.65	10.10	-0.107	0.914
% of farms hiring labour ‡	40%	52	17%	38	3.166**	0.075
Age of farm manager†	53.86	11.51	48.72	13.54	0.979	0.328
N of years of experience as farm manager †	27.4	11.66	22.4	12.88	1.218	0.223
% of women farm manager ‡	-	-	15.79%	37	1.303	0.254
N of years of schooling of farm manager †	8.67	5.39	8.86	3.24	0.154	0.878
Highest level of schooling completed (%):						
Primary ‡	33.33%	52	23.95%	43	0.277	0.598
Secondary ‡	16.67%	41	43.11%	50	1.661	0.197
Post-secondary agricultural education ‡	16.67%	41	7.78%	27	0.614	0.433
Post-secondary technical education ‡	33.33%	52	14.37%	35	1.631	0.202
Other post-secondary education ‡	-	-	10.78%	31	0.722	0.396
University degree ‡	-	-	0.60%	8	0.036	0.849
N	10		172			

†: Wilcoxon-Mann-Whitney ranksum test. Test statistic is z-score
‡: Pearson Chi^2 test
*** p<0.01, ** p<0.05, * p<0.1

Table 4.10: Mean characteristics by membership status, Piacenza

	Non-member		Member		Test statistic	p-value
	Mean	St. dev	Mean	St. dev		
Minimum altitude of municipality (m) †	61.78	26.19	77.30	66.84	0.083	0.934
Avdist (km) †	32.25	7.84	29.26	10.63	2.267**	0.023
Avdist3 (km) †	6.06	3.37	8.40	8.85	-0.405	0.685
Annual farm milk output (ton) †	831.44	692.77	606.37	420.88	1.249	0.212
Herd size†	103.71	84.88	70	42.87	1.873*	0.061
Total operated land area (ha) †	95.88	113.50	53.84	38.85	1.720*	0.085
% of cattle in municipality producing higher quality milk †	2%	-	2%	-		
% of dairy coop members in municipality†	38.09%	19	52.47%	23	-0.315***	0.002
Parents were coop members (%)‡	56.25%	50	82.76%	38	7.410***	0.006
Dairy income as share of household income †	83.13%	25.04	85.76%	15.09	0.930	0.352
Dairy income as share of farm income †	85.63%	19.50	85.62%	15.19	0.916	0.359
% of farms for which dairy income is 100% of farm income†	40.63%	50	21.82%	42	3.494*	0.062
N of household members working on farm †	2.13	0.96	2.53	0.95	-1.887*	0.059
N of hours/day worked on farm by hh members†	8.76	10.08	10.11	10.94	-3.014***	0.003
% of farms hiring labour ‡	57.6%	50	33%	47	5.326**	0.021
Age of farm manager†	48.43	12.03	52.06	11.89	-1.236	0.216
N of years of experience as farm manager †	17.5	8.02	21.28	12.85	-0.962	0.336
% of women farm manager ‡	-	-	3.45%	18	1.093	0.296
N of years of schooling of farm manager †	10.55	3.91	9.48	3.56	1.228	0.219
Highest level of schooling completed (%):						
Primary ‡	25.81%	44	28.07%	45	0.052	0.820
Secondary ‡	12.90%	34	26.32%	44	2.134	0.144
Post-secondary agricultural education ‡	29.03%	46	19.30%	40	1.083	0.298
Post-secondary technical education ‡	12.90%	34	14.04%	35	0.022	0.883
Other post-secondary education ‡	19.35%	40	12.28%	33	0.798	0.372
University degree ‡	6.45%	25	1.75%	13	1.345	0.246
N	33		58			

†: Wilcoxon-Mann-Whitney ranksum test. Test statistic is z-score
‡: Pearson Chi^2 test
*** p<0.01, ** p<0.05, * p<0.1

Before comparing characteristics between members and non-members in the sub-sample of farmers who perceive both organisational forms are available, Table 4.12 presents differences between the sub-sample who perceives only one organisational form is available and the sub-sample who perceives both organisational forms are available (131 farmers, i.e. 42% of the sample). The distribution by province and membership status between the two groups is different. The group that perceives both coops and private processors are available is composed for 64% by cooperative members, who represent instead 94% of the group of farmers who perceive only one organisational form is available. The latter is predominantly composed by farmers located in Trento (73%), followed by Piacenza (18%). Instead, farmers perceiving both organisational forms are available are mostly located in Piacenza (44%) and Trento

(41%). Farmers perceiving only one organisational form is available are located at higher altitudes and are relatively more remote with respect to processor location. Their farm size is smaller, both with respect to output volume and herd size, and they are located in municipalities where breeds producing higher quality milk are prevalent. There are no significant differences in socio-economic characteristics between the two groups.

Table 4.11: Mean characteristics by membership status, Bologna

	Non-member		Member		Test statistic	p-value
	Mean	St. dev	Mean	St. dev		
Minimum altitude of municipality (m) †	72.69	94.39	156.46	107.99	-1.683*	0.092
Avdist (km) †	55.79	13.24	52.21	10.79	0.127	0.202
Avdist3 (km) †	16.38	8.26	17.62	10.32	-0.319	0.750
Annual farm milk output (ton) †	503.81	284.98	380.06	257.18	1.505	0.132
Herd size†	65.63	33.42	47.17	29.82	1.826*	0.068
Total operated land area (ha) †	81.36	57.82	52.13	37.78	1.881*	0.060
% of cattle in municipality producing higher quality milk †	2%	-	2%	-		
Parents were coop members (%)‡	31.25%	48	66.67%	48	4.829**	0.028
Dairy income as share of household income †	60.31	26.74	77.21	22.80	-2.058**	0.039
Dairy income as share of farm income †	67.50	23.59	82.83	20.46	-2.336**	0.019
% of farms for which dairy income is 100% of farm income†	6.25%	25	25%	44	2.338	0.126
N of household members working on farm †	2.56	1.26	3.09	0.85	-1.400	0.161
N of hours/day worked on farm by hh members†	10.74	14.16	9.38	10.49	-0.157	0.875
% of farms hiring labour ‡	19%	40	17%	38	0.029	0.865
Age of farm manager†	57.40	15.42	54.82	12.27	0.418	0.676
N of years of experience as farm manager †	23.4	14.11	25.1	10.23	-0.761	0.446
% of women farm manager ‡	12.50%	34	4.35%	21	0.883	0.347
N of years of schooling of farm manager †	9.63	3.74	7.74	2.49	1604	0.108
Highest level of schooling completed (%):						
Primary ‡	18.75%	40	30.43%	47	0.676	0.411
Secondary ‡	43.75%	51	56.52%	51	0.616	0.433
Post-secondary agricultural education ‡	12.50%	34	4.35%	21	0.883	0.347
Post-secondary technical education ‡	6.25%	25	4.35%	21	0.070	0.791
Other post-secondary education ‡	18.75%	40	4.35%	21	2.126	0.145
University degree ‡	12.50%	34	-	-	3.030*	0.082
N	16		24			

†: Wilcoxon-Mann-Whitney ranksum test. Test statistic is z-score
‡: Pearson Chi^2 test
*** p<0.01, ** p<0.05, * p<0.1

Table 4.12: Mean characteristics by perceived availability of alternative: one type or both types of organisational forms (coop and private)

	One		Both		Test statistic	p-value
	Mean	St. dev	Mean	St. dev		
Minimum altitude of municipality (m) †	503.52	310.62	226.17	243.51	7.589***	0.000
Annual farm milk output (ton) †	278.75	299.81	498.93	483.43	-4.478***	0.000
Herd size (number of lactating cows) †	36.14	31.76	60.78	55.35	-4.600***	0.000
% of cattle in municipality producing higher quality milk †	60.66%	38.75	29.45%	36.63	6.628***	0.000
Avdist (km) †	61.80	22.93	51.52	22.54	3.294***	0.000
Avdist3 (km) †	17.84	12.18	17.57	12.46	-0.015	0.988
Age of farm manager†	50.59	13.25	50	13.37	0.524	0.601
N of years of schooling of farm manager†	8.76	3.39	9.56	3.48	-1.951	0.051
% of women farm manager ‡	12.50%	33	7.87%	27	1.646	0.200
N	169		131			

†: Wilcoxon-Mann-Whitney ranksum test. Test statistic is z-score
‡: Pearson Chi^2 test
*** p<0.01, ** p<0.05, * p<0.1

Focussing now on differences between members and non-members within the group of 131 farmers who perceive both organisational forms are available, comparing the characteristics of cooperative members for whom both organisational forms are available with those of members for whom only cooperatives are available (not shown in the table), it appears that the former tend to be located at lower altitudes (z = 6.098), where production of high quality milk is less predominant (z = 5.052), and their scale of production is larger (z = -3.143 for annual farm milk output). There are no statistically significant differences between the two groups of non-members.

Table 4.13 shows differences in mean characteristics between members and non-members within the sub-sample that perceives both alternatives are available. The magnitude of the differences between the two groups is now smaller compared to the full sample, but the same characteristics, with the exception of gender and years of schooling of the farm manager, remain significantly different between members and non-members, and especially altitude, scale of output and parental membership status.

Table 4.13: Mean characteristics by membership status where both cooperatives and private processors are available

	Non-member		Member		Test statistic	p-value
	Mean	St. dev	Mean	St. dev		
Minimum altitude of municipality (m) †	145.52	165.72	271.81	267.74	-2.991**	0.003
Avdist (km) †	46.44	18.18	54.48	24.36	-1.718*	0.086
Avdist3 (km) †	13.87	10.36	19.64	13.10	-2.340**	0.019
Annual farm milk output (ton) †	608.95	542.15	434.29	436.07	2.225**	0.026
Herd size†	77.67	70.20	51.73	43.29	2.549**	0.011
Total operated land area (ha) †	83.85	102.50	42.92	34.09	2.272**	0.023
% of cattle in municipality producing higher quality milk †	16.61%	28.87	36.63%	38.66	-3.465***	0.000
% of dairy coop members in municipality†	45.33%	22	68.37%	29	-3.969***	0.000
Parents were coop members (%)‡	55.32%	50	85.71%	35	14.775***	0.000
Dairy income as share of household income †	70.11%	28.59	67.60%	32.05	0.240	0.810
Dairy income as share of farm income †	75.22%	24.01	74.05%	27.98	-0.109	0.913
% of farms for which dairy income is 100% of farm income†	20%	40	15%	36	0.515	0.473
N of household members working on farm†	2.29	1.17	2.67	1.09	-1.806*	0.074
N of hours/day worked on farm by hh members†	9.55	13.20	9.32	10.05	-1.324	0.185
% of farms hiring labour ‡	40%	50	33%	47	0.659	0.417
Age of farm manager†	52.23	14.05	49.02	13.02	0.833	0.405
N of years of experience as farm manager †	21.1	11.57	20.6	11.72	0.171	0.864
% of women farm manager ‡	4.65%	21	9.52%	30	0.931	0.335
N of years of schooling of farm manager †	9.98	4.11	9.36	3.13	0.842	0.399
Highest level of schooling completed (%):						
Primary ‡	23.81%	43	17.86%	39	0.624	0.430
Secondary ‡	26.19%	45	45.24%	50	4.275**	0.039
Post-secondary agricultural education ‡	21.43%	42	9.52%	30	3.399*	0.065
Post-secondary technical education ‡	9.52%	30	16.67%	37	1.167	0.280
Other post-secondary education ‡	9.52%	40	9.52%	31	1.667	0.197
University degree ‡	9.52%	30	1.19%	11	5.102**	0.024
N	47		84			

†: Wilcoxon-Mann-Whitney ranksum test. Test statistic is z-score
‡: Pearson Chi^2 test
*** p<0.01, ** p<0.05, * p<0.1

4.5.2. Multivariate analysis of the correlates of cooperative membership

The correlation between geography and farm characteristics underlies the need for multivariate analysis in order to understand what drives cooperative membership. The probability that a farmer is a member of a cooperative is estimated using a probit model. Results for the full sample and for the sub-sample of individuals who perceive both organisational forms are available to them are compared, in the attempt to separate, at least to some extent, correlates of farmers' choice of buyer when such a choice is available from correlates of a particular market structure configuration. Ninety-four percent of farmers who perceive only one organisational form is available to them are cooperative members. Cooperative membership when farmers do not have an available alternative is not, strictly speaking, the result of an individual 'choice', but rather the outcome of a collective process of organisation of milk processing and marketing into a particular configuration, including both number and organisational form of local processors.

For farmers who perceive cooperatives and capitalistic processors are available, however, the use of a binary dependent variable model can be underpinned by referring to a latent variable, that is, an unobserved continuous variable y^*_i, linearly related to a set of factors $\boldsymbol{x}$ and a disturbance term u, such that $y^*_i = \boldsymbol{x'}_i\boldsymbol{\beta} + u_i$. In this case, y^*_i can be thought of as the net benefit to individual i from joining a cooperative. A farmer joins the cooperative if her net benefits from membership exceed a certain threshold. Net benefits are unobserved, but I observe the outcome for each individual, which is assumed to be governed by the decision rule

$y_i = 0 \quad if \qquad y^*_i < 0$

$y_i = 1 \quad if \qquad y^*_i \geq 0$

The relationship between the latent and the observed discrete variable is given by

$Pr(y^* > 0 \mid \boldsymbol{x}) = Pr(u > -\boldsymbol{x\beta} \mid \boldsymbol{x}) = Pr(u < \boldsymbol{x\beta} \mid \boldsymbol{x}) = Pr(y = 1 \mid \boldsymbol{x}) = \Phi(y^*_i)$

where $\Phi(.)$ is a cumulative distribution function. Parameters are estimated using maximum likelihood. For each observation, the probability of observing y conditional on x can be written as $\Pr(y \mid x) = \{\Phi(x_i'\beta)\}^{y_i}\{1-\Phi(x_i'\beta)\}^{1-y_i}$, $y_i = 0,1$ and the log likelihood function for the probit model can be written as $L = \sum_{i=1}^{n} y_i \log\{\Phi(x_i'\beta)\} + \sum_{i=1}^{n}(1-y_i)\log\{1-\Phi(x_i'\beta)\}$.

Notwithstanding the conceptual difference between observed membership status in the full sample and in the sub-sample with both (perceived) alternatives, the theory suggests that factors favouring organisation of milk processing and marketing in a cooperative form, and the characteristics favouring individual cooperative membership are broadly similar and revolve around vulnerability to market power. Cooperative membership is thus modelled as a function of the following observable characteristics:

(a) Relative farm isolation, proxied with the minimum altitude of the municipality where the farm is located, expected to increase the likelihood of membership;

(b) Farm scale of production, measured with herd size on farm, defined as the average number of lactating cows on farm over the year under study; smaller farms are expected to be more likely to join a cooperative (concerns about the potential endogeneity of scale of production and membership status will be addressed below);
(c) Asset specificity, which may be proxied with the share of cattle producing higher quality milk in the municipality. The likelihood of joining is expected to increase as the degree of farm asset specificity increases;
(d) Individual demographic characteristics of the farm manager which may influence both milk quality and farmers' bargaining power vis-à-vis the processor, and thus their vulnerability to the potential exercise of market power, including number of years of schooling, number of years of experience as farm manager and gender of the household head; and average age of household farm labour and highest number of years of schooling completed by any other household member;
(e) Local market conditions, including proxies for the degree of competition between processors (farmer's perceived availability of alternative buyers and average distance between the municipality where the farm is located and the municipalities of the closest three processing firms) and controlling for total number of suppliers (dairy farmers) in the municipality;
(f) Inter-generational transmission of membership status, measured with a dummy equal to 1 if the parents of the current farm manager have ever in their life been member of a dairy processing and marketing cooperative, and 0 otherwise. Parental membership is expected to be relevant for current membership status if 'choice' of milk buyer is characterised by some degree of inertia or *status quo* bias of current farm managers; and/or if preference for the cooperative form of organisation *per se* has been transmitted from parents to children through education.
With respect to the potential concern of endogeneity between membership status and farm output scale, both members and non-members tend to sell all their output to their main milk buyer, but the channel through which they sell may influence farm output scale via prices paid, rewards for quantity sold, requirements in terms of feeds use and other production practices, and possibly overall processors' support to farm production practices and provision of technical assistance services. There are, however, reasons to expect relatively low elasticity of farm output, at least in the short run, even in case prices paid are agreed at the beginning of the year. First, as discussed in Chapter 3, section 3.6.1, individual milk supply is governed by milk quotas and transactions in

quotas between farmers are relatively infrequent. Second, maximum cattle density per hectare is also governed by EU regulations (EC regulation 1804/99); supposing a farm is already operating at the maximum, herd size cannot be increased without purchasing or renting more land, a transaction that may be relatively slow and unlikely to be completed within the year period between the price agreement and the end of the contract. Moreover, milk production is characterised by time lags: quantity sold depends on number of lactating cows and on feeds; feeds can be varied in the short run, even on a daily basis, but there is a 9-months delay between reproduction decisions and increase in number of lactating cows. The hypothesis that membership status does not influence farm milk output is tested by estimating farm milk supply, measured as the log of total annual farm milk output, as a function of membership status, milk price paid, variable inputs (family and hired labour), fixed inputs (land and type of stalling facilities), human capital proxies, and a control for agro-ecological characteristics. Results, reported in Table 1-A in the Appendix, show no significant effect of cooperative membership or of price paid on quantity sold.

Results (coefficients, marginal effects and robust standard errors, in parenthesis) of a probit model estimating the probability that a farmer is member of a dairy processing and marketing cooperative are reported in Table 4.14. Column 1, Table 4.14 reports results for the full sample; columns 2 and 3 report results for the sub-sample with both organisational forms as perceived alternatives.

The model for the full sample correctly predicts 85% of observations. Results (column 1, Table 4.14) show that, in the sample, the probability of being in a cooperative is higher when farmers are more isolated, when their scale of production is smaller, when alternatives are not available and when parents had themselves been coop members. The magnitude of the effect is however relatively small for altitude and scale of production. A 10% increase in the minimum altitude of the municipality, from the sample mean of 378 m, is associated with an increase in the probability of membership by half a percentage point, on average and *ceteris paribus*. A 10% increase in farm herd size, from the sample mean of 47 lactating cows, is associated with a decrease in the probability of membership by 0.4 percentage points. Farmers who perceive no alternative buyer is available are 8% more likely to be in a cooperative. Finally, farmers whose parents had been cooperative members in the past are 17% more likely to be in a cooperative themselves, on average and *ceteris paribus*.

The model is then re-estimated on the sub-sample of farmers who perceive both organisational forms are available (column 2, Table 4.14). This means excluding farmers who perceive their available buyers (if more than one) all have the same organisational form, a group that is predominantly composed by coop members with no alternative buyers than coops. Results show that the role of altitude and scale of production is no longer statistically significant. This suggests that these variables influence membership status primarily by affecting the options farmers have available, and in particular the prevalence of cooperative presence in given area. In fact, when options are available, results suggest that observable farm and socioeconomic characteristics do not play a significant role in the decision to join a cooperative. The only statistically significant variables in this case are the number of dairy farmers in the municipality and parental membership status. A 10% increase in the number of dairy farmers in the municipality is associated with an increase in the probability of being a coop member, when both alternatives are available, by 0.9 percentage points, on average and *ceteris paribus*. A larger number of local dairy farmers may decrease the costs of cooperative membership and increase the gains from economies of scale in pooling farm output, thereby encouraging membership.

The strongest correlate of membership, however, even when both alternatives are perceived as available, remains parental membership status: farmers whose parents had been in a cooperative are themselves 26% more likely to be in a cooperative, on average and *ceteris paribus*. This variable may in part pick up some of the constraints, for instance in terms of relative isolation, confronted by current farmers, because current farmers typically remain in the same farm as their parents. Column (3) in Table 4.14 re-estimates the model for the sub-sample excluding the parental membership dummy, but results do not seem to support this interpretation, because the statistical significance of the other covariates does not change. The importance of parental membership suggests some degree of inertia in cooperative membership and *status quo* bias of farmers in favour of an arrangement that is known. It also suggests that a preference for the overall set of relative benefits, monetary and non-monetary, offered by coop membership is transmitted from parents to children, for instance through learning, and such preference is relevant in guiding membership choice. Lack of evidence that other individual characteristics matter, in particular the variables usually associated to vulnerability to market power, when both alternatives are perceived as available is consistent with a scenario in which the ability of private processors to exercise market power is constrained when they coexist with cooperative firms, which suggests that widespread coop presence in the areas under study has a competitive yardstick effect on private buyers.

Table 4.14: Probit model for the probability that a farmer is a cooperative member

Dependent variable: farmer is coop member (1 = yes)	Full sample		Sub-sample			
	(1)		(2)		(3)	
	Coeff.	Mg effect	Coeff.	Mg effect	Coeff.	Mg effect
Ln(minimum altitude municipality)	0.376***	0.051***	0.154	0.052	0.151	0.051
	(0.134)	(0.018)	(0.169)	(0.057)	(0.172)	(0.058)
Ln(herd size on farm)	-0.288*	-0.039*	-0.224	-0.076	-0.178	-0.061
	(0.152)	(0.021)	(0.194)	(0.066)	(0.198)	(0.067)
% cattle producing high quality milk in municipality	0.005	0.001	0.004	0.001	0.007	0.002
	(0.004)	(0.001)	(0.006)	(0.002)	(0.006)	(0.002)
N yrs experience as farm manager	-0.007	-0.001	-0.007	-0.003	-0.012	-0.004
	(0.009)	(0.001)	(0.012)	(0.004)	(0.012)	(0.004)
N yrs schooling of hh head	-0.005	-0.001	0.023	0.008	0.018	0.006
	(0.045)	(0.006)	(0.055)	(0.019)	(0.052)	(0.018)
Gender hh head (1 = female)	0.737	0.066	0.733	0.199	0.596	0.170
	(0.566)	(0.051)	(0.595)	(0.162)	(0.535)	(0.153)
Highest number of years of schooling in hh	-0.037	-0.005	-0.072	-0.024	-0.078	-0.027
	(0.039)	(0.005)	(0.050)	(0.017)	(0.049)	(0.017)
Average age of hh members working on farm	0.007	0.001	0.004	0.001	0.002	0.001
	(0.004)	(0.001)	(0.005)	(0.002)	(0.005)	(0.002)
Farmer perceives other buyers available (1 = yes)	-0.699**	-0.082**				
	(0.305)	(0.036)				
Ln(average distance from 3 closest processors)	-0.035	-0.005	0.100	0.034	0.051	0.017
	(0.141)	(0.019)	(0.195)	(0.066)	(0.190)	(0.065)
Ln(N dairy farms in municipality)	0.162	0.022	0.257*	0.087*	0.278*	0.095*
	(0.128)	(0.017)	(0.154)	(0.052)	(0.146)	(0.050)
Parents were coop members (1 = yes)	0.876***	0.170***	0.707**	0.259**		
	(0.240)	(0.047)	(0.320)	(0.117)		
Constant	-0.144		-0.425			
	(1.179)		(1.254)			
Observations	271		116		116	
Pseudo R^2	0.356		0.190		0.159	
χ^2	77.38		29.22		21.14	
% correctly predicted	85%		72%		68%	

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

4.6. Conclusions

This chapter investigated variation in market structure within the provinces under study, focussing on observable characteristics and in particular on the role of geography, and combining the picture provided by population data on buyers' presence in municipalities with that provided by sample data on farmers' perceptions of what is available to them. Both data sources show that there is substantial variation in market structure within the areas under study. First, locations where only one buyer is observed to operate coexist next to locations where overlap among more than one buyer is observed. Second, areas served by processor(s) with only one organisational form, mostly cooperative, coexist next to areas where coops and capitalistic processors appear to overlap.

The chapter first analysed empirically the factors that favour the presence of only one buyer at a given location, using both population data, which focus the analysis on buyers' presence in municipalities, and sample data, which focus on farmers' perceived availability of alternatives. In both cases, results are consistent with the theoretical prediction that, as the relative importance of space increases, economic interaction between competing firms is progressively reduced, to the point where each is an isolated spatial monopsony. High transportation costs and a large economic distance from processors increase both the probability that only one buyer is observed in a municipality, and that a farmer perceives only one buyer is available. Thus, geography is an important factor in explaining emergence of monopsony areas in the provinces under study. Buyers' presence at a given municipality is also related to availability of local supply: a larger pool of local dairy farmers increases the probability of observing overlap between buyers at a given location. Results also suggest that information and search costs have an important role in farmers' perceptions of what is available to them.

Second, the chapter analysed historically the evolution of milk market structure in the areas under study into its current configuration, in order to investigate factors that are conducive to the prevalence of one organisational form in a given area. The analysis finds a pattern that is consistent with the hypotheses that the initial form of organisation of milk processing and marketing is influenced by the interplay between distribution and heterogeneity of farm size and transportation costs in a given area, both influenced by local agro-ecological characteristics, and that this in turn influences choice of organisational form by subsequent firms entering the market, creating incentives for both path dependence and change. The influence of the initial path of development of commercialised milk processing and marketing organisation is still visible today in Trento in the predominance of cooperatives especially in higher altitude areas where transport costs are higher, and in Piacenza in the fact that about half of dairy farms continue supplying private processors.

Third, the chapter analysed differences in characteristics between cooperative members and non-members, comparing the picture that emerges when looking at the full sample, which includes farmers who perceive only one buyer, or only one organisational form, is available to them, with that provided by the sub-sample of individuals who perceives both organisational forms are available buyers, in the attempt to separate, at least to some extent, correlates of farmers' choice of buyer when such a choice is available from correlates of a particular market structure configuration. The chapter adopts a reduced form approach to cooperative membership, ignoring for the moment potentially endogenous prices paid, which will be analysed in detail in their relationship with membership in Chapter 6. Results show that, in the three provinces, the traditional explanation of cooperative membership as avoidance of market power is relevant for the full sample but not when farmers have both available alternatives. This suggests that these variables, such as relative farm isolation and scale of production, influence membership status primarily by affecting the options farmers have available, and in particular the prevalence of cooperative presence in given area. Conversely, when options are available, results suggest that observable farm and socioeconomic characteristics do not play a significant role in the decision to join a cooperative. The only significant correlates of membership in this case are number of local milk suppliers and parental membership status. The importance of the latter seems to suggest a combination of inertia in favour of an arrangement that is known, and preference for the nature of a cooperative firm, which may have been transmitted across generations. Lack of evidence that variables related to vulnerability to market power matter for selection into a coop when both types of buyers are perceived to coexist also suggests that the ability of private processors to exercise market power is limited by presence of cooperative firms.

The next two chapters now turn to investigating whether there is any evidence that selling through a cooperative makes any difference for farmers, with respect to the price and non-price characteristics of the transaction. The effect of cooperative membership on prices paid will be analysed in Chapter 6. The next chapter turns to exploring non-price characteristics of the exchange relationship between farmers and their milk buyer: contract content and complexity, processors' compliance with the exchange agreement, provision and use of technical assistance services, and farmers' overall valuation of their net benefits from trading with a buyer with a particular organisational form.

Chapter 5 – Non-price characteristics of the exchange relationship with farmers: differences between cooperative and capitalistic processors

5.1. Introduction

What benefits do people expect to get when they join a cooperative and what do they actually get, in terms of both prices paid and other, non-price characteristics of the relationship? Even though theoretical models of spatial competition assume that (net) prices paid are the only relevant variable for farmers, in reality a range of other factors and net benefits beyond price paid, some easier to quantify than others, are also important for farmers in their relationship with the milk buyer, including trust, security of the endurance of the relationship, and preference for a particular ownership structure. The expectation of differences in the nature of the relationship between a cooperative and its members compared to that between a private processor with its suppliers stems from the different ownership structure between these two organisations, which in turn leads to potential differences in the alignment of interests and objectives between different agents within each organisational form. This chapter first presents farmers' self-reported motivations for starting to trade with their current buyer (Section 5.2), which paints a picture of what they expect from the exchange relationship. Lack of available alternatives, discussed in the previous chapter, is an important factor, but not the only relevant one. The remainder of the chapter then focuses on the non-price characteristics of the exchange relationship. Both observable non-price characteristics (Section 5.3), and farmers' overall valuation of their net benefits from trading with a buyer with a particular organisational form (Section 5.4), are investigated.

The focus of Section 5.3 is on three observable non-price aspects of the exchange relationship. First, Section 5.3.1 analyses contract duration and complexity, and farmers' experience of difficulties during the negotiation of the terms of the agreement. This provides an indication of differences between cooperatives and private processors in the overall level of trust and perceived information asymmetry between them and their members or suppliers, as hypothesised by Sykuta and Cook (2001) and discussed in Chapter 2, Section 2.2.2. Trust, a potentially elusive concept with many meanings, is defined in this chapter as the belief by one party that the other will not engage in an action that is detrimental to her (Gambetta 1990). Section 5.3.1 tests the hypothesis that contracts between suppliers and private processors are overall more detailed than contracts between members and their cooperative, in order to compensate for the lower degree of trust between private processors and suppliers compared to the relationship between members and their cooperative.

Second, Section 5.3.2 investigates processors' compliance with the terms of the agreement, namely whether there is any evidence that either cooperatives, or capitalistic processors, or both engage in opportunistic behaviour towards farmers, reneging on aspects of the agreement once the agreement has been made. The focus of this section is on timeliness of payment, milk rejection for reasons unrelated to its quality, and adherence to the agreed price (if any such agreement had been reached). The hypothesis is that cooperatives are less likely to engage in *ex-post* opportunistic behaviour towards their members compared to private processors with their suppliers.

Third, Section 5.3.3 examines processor's provision and farmer's use of technical assistance services and tests the hypothesis that cooperatives provide a more conducive environment for farmers' improvement of their production practices and techniques, controlling for possible selection bias arising from unobserved characteristics influencing both members' decision to join a cooperative and their use of technical assistance services.

Section 5.4 then analyses farmers' self-reported reservation price (RP) for dealing with a buyer with a particular organisational form. Cooperative members were asked how much per litre a private processor would have to pay for them to leave the cooperative and become its suppliers. Non-members were asked how much per litre a cooperative would have to pay for them to become members. RP is used as a measure of farmers' perceived net benefit from trading with a buyer with a particular organisational form, which includes also those aspects of the relationship that remain unobserved by the researcher, such as farmers' preference for involvement in decision-making by the processor or for collaboration with fellow farmers. Differences in perceived net benefits between members and non-members, and how net benefits from membership vary across different groups of people depending on their individual characteristics, including scale of production, household dependence on dairy farming and farm manager's age, are investigated. In order to understand how important milk price paid is for farmers relative to other characteristics of the exchange relationship, farmers' self-reported reasons for staying with the current buyer even when another buyer offers a higher price are also analysed. Section 5.5 concludes.

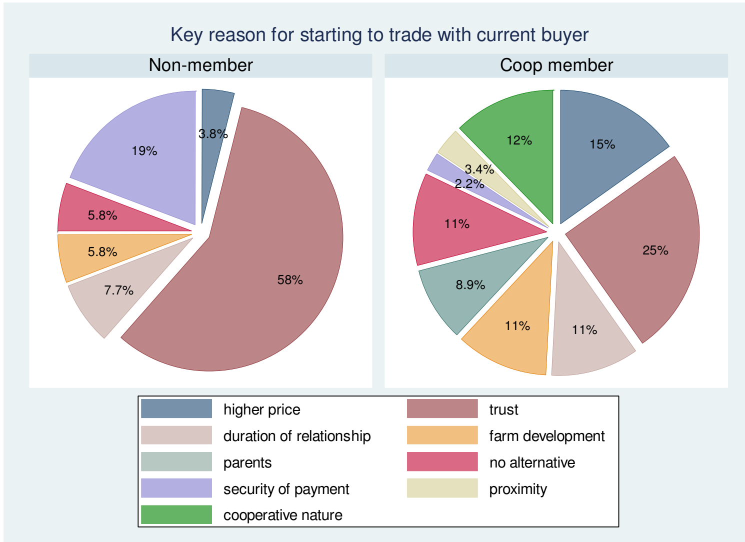
5.2. Reasons for starting the exchange relationship with the current buyer

In order to understand what farmers expected form the exchange relationship with their current buyer, the survey asked them to identify the key reason which was most important for them to decide to start the relationship. The question provided six alternatives plus the option of indicating any other reason not initially provided. The six alternatives represent the reasons that emerged most frequently when discussing outlet choice during initial interviews, and were then verified during piloting of the questionnaire. These are:

1. The price paid by the current buyer was higher than the price paid by the closest alternative buyer
2. Trust in the buyer
3. Security that the exchange relationship with the current buyer could last for a long time
4. The current outlet represented the best option for the development of the farm
5. The current outlet was the same outlet as that of respondent's parents
6. Other outlets did not represent a feasible alternative (in which case farmers were asked to explain why).

Farmers themselves defined the meaning that potentially ambiguous concepts such as trust and farm development had for them. In addition to these six reasons, respondents mentioned geographical proximity and security that the buyer will pay the amount due and on time. A few farmers, all of them cooperative members, also referred to other reasons directly related to the organisational form and ownership structure of a cooperative, with statements such as "I chose a cooperative because I want to participate in the decisions regarding the processing and marketing of my milk" and "I chose a cooperative because it allows me to discuss with other farmers future plans for common development". Farmers' motivations for trading with the current buyer, disaggregated by membership status, are summarised in Figure 5.1.

Figure 5.1: Key reason for starting to trade with current buyer, by membership status



Trading with a trustworthy buyer and security that the amount due will be paid on time appear to be the paramount concerns of non-members when choosing their milk buyer, as indicated by 58% and 19% of non-members respectively. These elements have a much lower relative importance for coop members, and are indicated as key reason for outlet choice by 25% and 2.2% of them, respectively. Both issues are likely to be implicit and taken for granted by members when considering what they expect from dealing with a cooperative, given its ownership structure.

Coop members are more likely than non-members to have chosen their current buyer because it paid a higher price compared to available alternatives (15% versus 3.8% respectively). Members are also more likely than non members to chose on the basis of the security that the relationship with the buyer would last for a long time (11% versus 7.7%), and the perception that the buyer would offer the best environment for farm development (11% versus 5.8%). Lack of feasible alternatives is more likely to be a motive for members than for non-members (11% versus 5.8%). Respondents who explained why other buyers would not be feasible stated that, when they started selling to the current buyer, this was the only processing firm buying milk from the area where they are located.

Continuity with the membership choice of parents and geographical proximity between farm and buyer are relevant motives for some members (8.9% and 3.4% respectively) but not for non-members. Finally, 12% of members, most of them located in Trento, referred to reasons that can be directly related to the nature of the cooperative firm, such as ability to participate in decision-making and to collaborate with other farmers, and a desire to deal with a firm that endorses the cooperative values of equity, equality, mutual help and solidarity.

On aggregate, it appears that non-members primarily look for a buyer they can trust and who complies with the agreement with respect to price paid and timeliness of payment. In contrast, cooperative members expect their relationship with the buyer to satisfy a variety of characteristics: trust is important, but so are prices paid, being in an environment that is conducive to farm development, and dealing with a buyer that offers opportunities for participation and collaboration with other farmers.

The next section examines some observable non-price outcomes of the relationship which are related to issues of trust (contract content and complexity), of processor's compliance with the agreement, and of provision of an environment that is conducive to farm development (processor provision and farmers' use of technical assistance services). Section 5.4 then investigates farmers' overall perception of their net benefits from the relationship, a valuation that encompasses also aspects that are unobserved or not easily measured by a researcher, including preference for participation and collaboration with fellow farmers.

5.3. Observable non-price outcomes of the relationship between farmer and milk buyer

This section is organised as follows. Section 5.3.1 analyses contract content and complexity; Section 5.3.2 investigates processors' compliance with the terms of the agreement with farmers; Section 5.3.3 examines processor's provision, and farmers' use, of technical assistance services.

5.3.1. Contract content and complexity

The survey collected information on contract content and duration and on whether the contract is written or verbal. With respect to contract content, regardless of whether the agreement was written or verbal, the survey asked whether each of the following six provisions was included (for each provision farmers were asked to answer with "yes" or "no" as appropriate): base price paid; frequency of payment; quantity of milk traded; party responsible for milk transfer from the farmgate to the processing plant; milk quality criteria; and other specific production requirements, for instance use of a particular type or composition of feeds. These six provisions emerged from initial interviews as the most common ones included in the agreement between farmer and milk buyer, and were verified during piloting. They are used to get a measure of contract complexity, ranging from 0 to 6, depending on the number of provisions included, which are each given equal weight. Contract complexity is considered to increase with the number of provisions.

Among the sample, all contracts with private processors are annual and can be renewed at the end of the year. For cooperative members, there is typically a membership agreement, signed upon farmer's entry in the cooperative, which remains valid until exit; and there is a yearly agreement regulating quantity and quality of milk sold to the cooperative. Written contracts are prevalent in the sample: only 3% of farmers have a verbal contract with their buyer. These are nine non-members, six located in Trento and supplying to the only capitalistic processor operating there, and the other three located in Piacenza, each supplying to a different processor. I do not have any information on the reasons why, in these cases, a verbal contract was adopted, or whether a written contract was offered at all and at what conditions.

It could be hypothesised that non-written contracts are more likely when farmer and processor are located at closer proximity, which decreases the cost of informal coordination, and when farm scale of production is smaller, which increases processor's cost per litre of negotiating the agreement and drawing the contract. Sample size is too small to test this hypothesis. A simple comparison of farm-processor distance and total annual farm milk output between non-members with a written contract and those with a verbal contract shows that, in Piacenza, farmers with a verbal contract are smaller and closer to the processor compared to their counterpart. Mean total annual milk output is 313 tons/year for them compared to 883 tons for non-members with a written contract, while mean farm-processor distance is 5 km against 9 km for suppliers with a written contract. In Trento, however, farm scale of production and distance are both larger for farmers with a verbal contract, 375 tons/ year and 40 km compared to 216 tons and 18 km for farmers with a written contract.[36] Given the small numbers, however, these data could be nothing more than suggestive, and the lack of consistency in results between Trento and Piacenza makes it difficult to draw any conclusions.

Sample variation with respect to contract content and complexity is summarised in Figure 5.2. About 21% of the sample has a contract that includes only one of the six provisions, while contracts for 8% of respondents include all six. Production practices, quality requirements and, to a lesser extent, prices paid appear to be the aspects of the relationship where the need for coordination is stronger: when only one provision is included, this is requirements on production practices in 41% of cases, milk quality criteria in 30% of cases, and prices paid in 17% of cases; when two provisions are included, the most frequent combination (39% of respondents) is production practices requirements and quality criteria, followed by quality criteria and prices paid.

Figure 5.2: Sample variation in contract content and complexity

The comparison between members and non-members is conducted both with respect to the inclusion of individual provisions, and with respect to overall contract complexity. Table 5.1 compares the share of contracts with cooperatives versus the share of

[36] One supplier with verbal contract in Trento has a very large scale of production (800 tons/year) and is located at very large distance (90 km). The mean scale of production and distance for the group with verbal contract remain, however, larger than those for the group with written contract even when this outlier is excluded (mean output is 289 tons/year and distance is 30 km).

contracts with private processors including each individual provision. Contracts with private processors are always more likely than those with cooperatives to include each of the examined provisions, with the exception of specific production requirements, and these differences are always statistically significant. For instance, base price is set by contract for 92% of non-members, against less than 30% of members. Quality criteria are set by contract for 87% of non-members, against 66% of members. Conversely, specific production requirements, such as regulations on the use of feeds, are set by contract for 60% of members against 30% of non-members, suggesting that cooperatives pose overall more stringent conditions on the milk quality produced by farmers.

Table 5.1: Percentage of respondents who report that each item is included in their contract, by organisational form of the buyer

	Private	Cooperative	z	p-value
Base price paid	92%	29%	8.36***	0.000
Frequency of payment	87%	48%	5.01***	0.000
Quantity of milk traded	34%	19%	2.03**	0.043
Mode of milk collection	67%	40%	3.27***	0.001
Quality criteria	87%	66%	2.77***	0.006
Other production practices	30%	60%	-4.47***	0.000

z-score from a two-sample test of proportions; *** p<0.01, ** p<0.05, * p<0.1

Figure 5.3: Contract complexity: Number of provisions included in the contract, by membership status

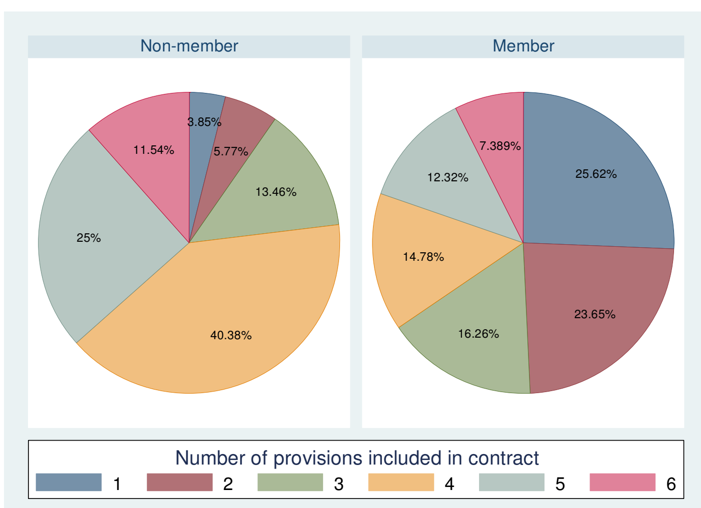


Figure 5.3 shows variation in contract complexity between members and non-members. Members' contracts include on average 2.6 provisions, compared to 4 for non-members. This difference is statistically significant at 1% level (t-stat = 5.256). Overall, the data show that contracts between private processors and suppliers are more detailed than contracts between cooperatives and members, supporting the Sykuta and Cook hypothesis.

Contract complexity, however, may also be driven by the number of suppliers of a given processor, a hypothesis not discussed by Sykuta and Cook. As the number of suppliers increases, also the need for formal and more detailed coordination between processor and suppliers is expected to increase, and even more so when the larger number of suppliers is associated with a larger geographical procurement area, which potentially increases the time and monetary costs of informal coordination.

Table 5.2 summarises inclusion of each provision by membership status and distinguishes between larger and smaller processors, where relative 'size' is defined as the number of suppliers. Smaller cooperatives are defined as those with a membership size smaller than 41, which is the median for the coops included in the sample (compared to a mean of 110). Smaller private processors are defined as those with less than 69 suppliers (again the sample median, against a mean of 114). Contracts with smaller cooperatives contain on average 2.2 provisions, against 2.74 for larger cooperatives. This difference is barely significant at 10% level (t-stat = 1.534). There are two statistically significant differences between these two groups: larger cooperatives are much more likely than smaller ones to specify milk price in the contract (even though they remain less likely to do so than private processors); and smaller coops are – slightly – more likely to specify production requirements. These results are consistent with a scenario in which trust and information exchange among members and between members and managers tend to weaken as membership size increases. In turn, smaller cooperatives may need to rely on high quality final products in order to carve a niche and survive in the market, and this may result in more stringent quality requirements for members.

Contracts with smaller private processors contain on average 3.9 provisions, against 4.2 for larger ones, but this difference is not statistically significant (t-stat = -0.715). The only statistically significant difference between these two groups is with respect to frequency of payment, which contracts with smaller private processors are slightly more likely to include.

Table 5.2: Larger versus smaller processors: Percentage of respondents who report that each item is included in their contract, by membership status

	% of contracts including each provision					
	Coop			Private processor		
	Larger	Smaller	z-score	Larger	Smaller	z-score
Base price paid	38%	5%	3.93***	94%	100%	-1.12
Frequency of payment	56%	45%	1.29	84%	100%	-1.83*
Quantity of milk traded	20%	24%	-0.43	30%	39%	-0.63
Mode of milk collection	46%	39%	0.74	70%	67%	0.24
Quality criteria	74%	66%	0.98	90%	89%	0.12
Other production practices	63%	76%	-1.57*	30%	28%	0.16

z-score from a two-sample test of proportions; *** p<0.01, ** p<0.05, * p<0.1

A Poisson count data model is used to test the Sykuta and Cook hypothesis on the role of organisational form on contract complexity, while simultaneously controlling for number of suppliers to the processor. The dependent variable is the number of provisions included in the contract, assumed to be drawn from a Poisson distribution with parameter λ, if it takes integer values y = 0, 1, 2… with probability $Pr\{Y = y\} = e^{-\lambda}\lambda^{y} / y!$ for $\lambda > 0$.[37] The mean and variance of this distribution can be shown to be $E(Y) = var(Y) = \lambda$. Since the mean is equal to the variance, any factor that affects one will also affect the other. Thus, the usual assumption of homoscedasticity would not be appropriate for Poisson data.[38] The relationship between λ and the regressors can be expressed as $log(\lambda_i) = \boldsymbol{x_i}'\boldsymbol{\beta}$. Because the dependent variable is truncated at one (all respondents indicated that at least one provision was included in the contract), a zero-truncated Poisson model is estimated. Estimated coefficients represent the change in the logs of the expected number of included provisions for a unit change in the explanatory variable.

[37] Alternatively, given that the number of provisions included in the contract is used to indicate contract complexity, the dependent variable may also be considered as ordered from low (one provision) to high complexity (six provisions). A logit or probit ordinal regression model would be an appropriate model for ordinal data. However, these models may not necessarily be appropriate when the dependent variable is not unambiguously ordinal and could be ordered in a different way for a different purpose, as may be the case with the index of contract complexity (Long and Freese 2006): p 138. Moreover, ordinal regression models rest on the theory of random utility and are usually applied to individual choices, which would make them an uncomfortable application in this case. For these reasons, a Poisson count data model is preferred.

[38] If variance exceeds the mean, this leads to overdispersion in the distribution of the dependent variable. In this case, a negative binomial regression model should be preferred. Overdispersion does not seem to be a problem here, however: mean number of provisions is 3.58 and its variance is 2.58.

Table 5.3 reports the results. Model (1) estimates the number of provisions included in the contract as a function of the coop membership dummy and of the total number of suppliers to the processor. Both explanatory variables are highly significant at 1% level and their sign is consistent with what expected. Being in a cooperative decreases the expected log count by a factor of 0.54, that is, being in a cooperative decreases the expected number of provisions by 42%, holding all other variables constant. For every additional supplier to the processor, the expected number of provisions increases by 0.1%. Province dummies are not significant. Model (2) adds an interaction term between the coop membership dummy and the total number of suppliers to the processor, in order to check how contract complexity changes as membership size increases. Being in a cooperative is now associated with an even stronger decrease by 54% in the expected number of provisions. However, the effect of number of suppliers on contract complexity now appears to be driven by larger cooperatives: the interaction term is significant at 5% level and implies that for every additional member to the coop, number of contract provisions increases by 0.2%, holding other variables constant. Province dummies are not significant.

Table 5.3: Zero-truncated Poisson model for the number of provisions included in the contract

	(1)	(2)
Dependent variable: n of provisions included in contract		
Coop member (1 = yes)	-0.538***	-0.768***
	(0.090)	(0.131)
Total number of suppliers to farmer's processor	0.001***	-0.001
	(0.000)	(0.001)
Coop*N suppliers		0.002**
		(0.001)
Trento	0.094	0.163
	(0.091)	(0.102)
Bologna	-0.173	-0.112
	(0.119)	(0.123)
Constant	1.343***	1.511***
	(0.052)	(0.076)
Observations	242	242
χ^2	48.16	61.36

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

These results support the Sykuta and Cook hypothesis that contracts with capitalistic processors are significantly more detailed, also when simultaneously controlling for number of suppliers. There is some evidence that contract complexity increases in cooperatives as membership size increases, but the degree of such complexity still remains substantially lower than for private processors. Drawing and agreeing to a more detailed contract can make the negotiation process longer and more difficult. The survey asked farmers whether they experienced difficulties in reaching an agreement with their buyer over the terms of the exchange relationship, and differences between members and non-members are found also in this case, and are consistent with a scenario where negotiations with a private processor are overall more difficult than between members and their cooperative. Just under half of non-members (47%), compared to only 6% of members, reported having experienced difficulties, a marked difference that is statistically significant at 1% level (t = 8.56). The share of farmers experiencing difficulties is not significantly different between suppliers of smaller and larger private processors (47% and 48% respectively), or between members of smaller and larger cooperatives (5% and 7% respectively). Among private firm suppliers, larger farms (defined as those having an annual milk output larger than the sample median of 210 tons) are more likely to have experienced difficulties compared to smaller scale suppliers (52% against 22% among smaller farms, t = 1.66), suggesting that their higher bargaining power may have increased conflict during negotiations. There is no significant difference in difficulties between cooperative members with smaller and larger scale of output.

In order to gather some information on farmers' (perceived) own bargaining power in dealing with the processor, the survey also asked to what extent farmers felt able to influence the definition of the terms of the agreement during contract negotiation, on a scale from zero (lowest) to 10 (highest). Mean perceived influence of cooperative members is significantly lower than that of private suppliers, but is significantly higher for members of smaller coops than for members of larger ones. Larger farmers perceive they have significantly more influence than smaller ones, and this result is driven by larger cooperative members, while among non-members there is no significant difference between smaller and larger scale suppliers.

Taken on its own, the result that non-members feel more influential in the definition of the exchange agreement compared to members (with a score of 3.98 versus 2.97, respectively; t-stat = 2.39) suggests that private firms are more prone to adopting differential treatment among suppliers, while in cooperatives an individual member cannot do much, on her own, to change the terms of trade to her advantage, because decisions are taken jointly. This seems to imply greater equality of treatment in cooperatives, but this interpretation is challenged by the finding that coop members with larger scale of production perceive they have significantly more influence than smaller ones (t-stat = 1.99). This may suggest a potentially dangerous scenario where a particular group of members is able to exert more influence than the rest on the decisions of the cooperative, with the risk of potentially adverse consequences for less influential members. It is unclear however to what extent this is the case. Disproportionate influence of particular groups of members never emerged as a concern during initial interviews and piloting, or in answers to open-ended questions in the questionnaire, in contrast to a concern with what is perceived as excessive importance and decision-making powers of managers as membership size increases. The finding that members' perceived influence is higher in smaller than larger cooperatives (4.17 versus 2.69; t-stat -2.90) is consistent with the latter point, suggesting that members' ability to take an active role in the governance of the cooperative and in the definition of the exchange relationship weakens as membership size increases and the balance of power shifts towards managers, in order to coordinate more complex organisations. Homogeneity of members' characteristics and interests may also be higher in smaller than larger cooperatives, thus giving farmers the impression that their individual preferences are accommodated while in fact decisions reflect the preferences of a wider group with similar characteristics.

Overall, the evidence on contract complexity and difficulties in the negotiation process is suggestive of lower trust and higher perceived information asymmetry in the capitalistic firm-supplier relationship, compared to the relationship between a cooperative and its members. Private processors would then use more detailed contracts in order to compensate for a lower level of organisational trust and achieve a better alignment of objectives and interests. This can have implications for the actual, direct monetary costs of negotiating, monitoring and enforcing a contract, both for the processor and for farmers. However, since the survey did not collect information on such costs, I cannot draw any conclusions on whether these are significantly higher in capitalistic firms, or in larger coops compared to smaller ones, or on their implications for processor efficiency as suggested by James and Sykuta (2005). Nonetheless, while more detailed contracts may be more costly, they may also be beneficial for farmers, by representing a legal safeguard against cheating by the processor.

Trust appears to decrease and the level of perceived information asymmetry to increase also in cooperatives as membership size increases, requiring more detailed contracts to smooth coordination between agents, in particular with respect to price paid. While very few members experienced difficulties in the negotiation process with the cooperative, overall they also felt a lower bargaining power, and this seems to be the case especially for smaller farmers in larger cooperatives. In contrast, private firm suppliers felt better able to influence the terms of the agreement, something that may counterbalance, at least in part, their higher likelihood of experiencing difficulties in the negotiation process.

How do processors behave with respect to the exchange agreement once it has been drawn? The next section investigates this question with respect to timeliness of payment, quantity purchased, and adherence to a formally or informally agreed price.

5.3.2. Processor's compliance with the terms of its agreement with farmers

Processors' behaviour towards farmers once an agreement over the transaction has been made is expected to be influenced by its organisational form and by the characteristics of the local market structure, namely to what extent a processor enjoys local market power. Cooperatives are expected to be less likely to engage in opportunistic behaviour towards members, provided they are not hijacked by a particular group (for instance managers or a group of influential members) that would stand to benefit from such behaviour. Opportunistic behaviour is also expected to be less likely regardless of ownership structure when processors face competition from rivals for a given pool of suppliers, given that it would be easy for a farmer to leave the current processor and sell to another buyer; and when the available pool of local suppliers is smaller.

In order to capture processors' compliance with the agreement, the survey asked questions on timeliness of payment, milk rejection for reasons unrelated to its quality, and adherence to the price that had been agreed or disclosed in advance of the transaction. With respect to the latter, Section 5.3.1 showed that price paid is formally included in the contract for only 41% of the sample. However, it is possible that processor and farmer reach an informal agreement on price paid, or that farmers are informed by processors at the beginning of the transaction period on the price they will receive, even though such price is not formally included in the contract. This was found during all initial interviews and piloting of the questionnaire.

Only three farmers reported a delay in payment. One is a cooperative member in Trento, and is the only one, among the 41 members of this cooperative that are included in the sample, who reports a delay in payment. The other two farmers are suppliers to the same private buyer in Piacenza; the other supplier to this firm that is included in the sample does not report a late payment. Given the very small number, nothing meaningful can be said about these three farmers. Overall, timeliness of payment does not appear to be a problem in the sample. With respect to milk quantity to be traded, the survey asked whether the buyer refused to buy part, or all, of the agreed quantity of milk for reasons other than inadequate quality. No respondents reported that this happened, again providing evidence that processors' strategic behaviour with respect to milk quantity is not a problem in the sample.

With respect to payment of the agreed price, respondents were asked the following question: "The price you received in 2007 was, on average and compared to the price agreed formally or informally with your buyer, (a) higher; (b) lower; (c) about the same". The sample provides a varied picture, summarised in Table 5.4. Cooperative members are slightly less likely than non-members to receive a price that is lower or the same as agreed and slightly more likely to receive a higher price than agreed. These differences, however, are not statistically significant. There are also no significant differences between members of smaller and larger cooperatives, or between suppliers of larger or smaller processors. The share of farmers who report receiving a price that is lower than agreed is however substantial, about a third of the sample, and the remainder of this section investigates this issue further.

Table 5.4: Actual versus agreed price, members versus non-members (percentage)

Compared to the agreement, price received was:	Full sample	Members	Non-members	t-stat
About the same	56%	56%	60%	0.129
Lower	34%	34%	35%	0.608
Higher	10%	11%	5%	-1.22

Eighty percent of farmers reporting they received a lower than agreed price are cooperative members. About a third of them belong to the same cooperative, Pinzolo Fiavè (PF), located in Trento, which had been going through managerial and financial difficulties since 2002. These problems eventually led, in 2010, to a merger with the largest cooperative in Trento (Latte Trento), in order to avoid bankruptcy. PF members who report a lower than agreed price are 61% of all PF members included in the sample. Their response may in part reflect the particular situation of their cooperative, but this does not explain why not all PF members reported receiving a lower price than agreed.

The probability that a farmer receives a lower than agreed price is estimated as a function of the following characteristics:

(a) The coop membership dummy, to test the hypothesis that cooperatives are less likely than private firms to engage in opportunistic behaviour towards their members, once other characteristics are controlled for.

(b) Market structure, proxied with a dummy equal to one if the farmer perceives she has at least one other available alternative buyer and zero otherwise; with the log of the minimum altitude of the municipality, expected to decrease competition between buyers because of higher transport costs; and with the number of dairy farmers in the municipality. More competition between buyers for local supply and lower availability of local supply are expected to decrease the probability of opportunistic behaviour.

(c) Farm asset specificity, which decreases farm elasticity of supply and is hypothesised to increase the likelihood of opportunistic behaviour by the processor. The share of cattle in the municipality producing higher quality milk, used in the previous chapter as a proxy for asset specificity, is included but expected to play a different role in this application: processors may have lower incentives to pay a lower-than-agreed price to farmers producing higher quality milk. In order to capture farm asset specificity, a dummy equal to 1 if all farm income comes from dairy, and zero otherwise, is used instead.

(d) A dummy equal to one if price paid was defined and included in the contract, which is expected to make it more difficult for processors to renege on the agreement. Formal inclusion of price in the contract cannot however be attributed a causal effect on payment of the agreed price, because unobserved processor characteristics may influence both their likelihood of committing by contract to a given price, and of complying.

(e) Farm scale of production, measured with the log of total annual milk output, expected to decrease the probability that a farmer is paid less than agreed. This may happen if trading with larger scale producers lowers fixed transaction costs per litre for processors (e.g. the cost of negotiating and monitoring compliance with the agreement), thus making larger scale suppliers more valuable and lowering incentives for opportunistic behaviour towards them.

(f) Human capital of the farm manager, proxied with the number of years of schooling and number of years of experience of the farm manager. This is expected to decrease the probability of receiving a lower than agreed price, for two reasons: because better human capital is likely to be positively related to farmers' bargaining power, by lowering their negotiation, monitoring and enforcement costs; and because it is also likely to be positively related to quality produced, lowering the buyer's incentives to behave opportunistically towards farmers supplying better quality milk.

Province dummies are included to control for unobserved local characteristics.

Table 5.5 reports coefficients, with robust standard errors in parentheses, and marginal effects from probit model estimation. Column (1) estimates the model for the full sample, and column (2) re-estimates it on a sub-sample which excludes members of PF, in order to avoid possible confounding effects resulting from the particular circumstances of that cooperative.

Considering the full sample first (column (1) in Table 5.5), the model correctly predicts 63% of the observations. Most statistical relationships are significant at the 10% confidence level, with the exception of milk quality. Cooperative members have a 17% lower probability of receiving a lower than agreed price, on average and *ceteris paribus*. Contrary to what hypothesised, being in a municipality with larger local supply is also associated with a decrease in the likelihood of receiving a lower than agreed price: a 10% increase in the number of dairy farmers in the municipality is associated with a 0.9 percentage points lower probability of receiving a lower than agreed price. Farmers who are fully specialised in dairy are 14.5% more likely to receive a lower than agreed price, suggesting buyers may be more likely to behave opportunistically towards farmers whose elasticity of supply is lower. Formal inclusion of price in the contract is associated with a 14% lower probability of receiving a lower than agreed price, although, as noted above, no causal relationship can be attributed to this. A 10% increase in herd size on farm is associated with a lower likelihood of receiving a lower price than agreed by 0.6 percentage points. This is consistent with a scenario in which transaction costs for processors make larger farmers more valuable to them and lower their incentives to strategically pay a lower than agreed price. Similarly, also farmers producing higher quality milk appear to be relatively more valuable for processors: a 1% increase in the share of dairy cattle in the municipality producing higher quality milk, and in the number of years of experience as farm manager, are each associated with a decrease in the probability of receiving a lower than agreed price by 0.5 percentage points. Farmers located in Bologna are also less likely to receive a lower than agreed price. This may be due to the smaller number of dairy farmers in this province compared to Trento and Piacenza, making local supply scarcer and therefore more valuable.

Results from the estimation of the same model on the sub-sample excluding PF members (column (2) in Table 5.5) show that the model again correctly predicts 63% of observations. Being in a cooperative is now associated with a 30% lower probability of receiving a lower than agreed price. This stronger effect, now significant at 1% level, was expected, given that members of a problematic cooperative are dropped. There is now some evidence that competition between buyers has a positive effect on processor's compliance with the agreement: farmers who perceive they have at least one alternative buyer are 16% less likely to receive a lower than agreed price. Formal inclusion of price in the contract is again associated with a lower probability of receiving a lower price than agreed, by 22%. Also in this case, processors appear to be less likely to behave strategically towards farmers producing higher quality milk: a 1% increase in the share of dairy cattle in the municipality producing higher quality milk, in the number of years of schooling, or in the number of years of experience of the farm manager are each associated with, respectively, a 0.7, 2.3 and 0.9 percentage points lower probability of receiving a lower price than agreed.

These results are consistent with the hypothesised scenario of processors being less likely to comply with the agreement when competition for local supply is lower, when farm supply is more inelastic, and when supply from individual farmers is relatively less valuable to processors, because of either volume, or quality, or both. As expected due to the different nature of ownership between cooperatives and private processors, cooperatives are significantly less likely to engage in opportunistic behaviour towards their members, once other characteristics are controlled for, and this is confirmed also when including members of a cooperative going through serious performance difficulties due to managerial problems. The next section turns to the third observable non-price outcome of the exchange relationship examined in this chapter: processors' provision and farmers' use of technical assistance services.

Table 5.5: Probit model for the probability that a farmer receives a lower than agreed price

Dependent variable:	(1)		(2)	
price received is lower than agreed (1 = yes)	Coeff.	Mg. Effect	Coeff.	Mg. Effect
Coop member (1 = yes)	-0.449*	-0.171*	-0.812***	-0.298***
	(0.262)	(0.100)	(0.281)	(0.103)
Other buyers are available (1 = yes)	-0.160	-0.059	-0.459*	-0.164*
	(0.219)	(0.081)	(0.261)	(0.093)
Ln(minimum altitude of municipality)	0.064	0.023	0.117	0.040
	(0.135)	(0.049)	(0.154)	(0.053)
Ln(N of dairy farmers in municipality)	-0.248*	-0.091*	-0.038	-0.013
	(0.136)	(0.050)	(0.164)	(0.056)
All farm income from dairy (1 = yes)	0.382*	0.145*	0.349	0.125
	(0.212)	(0.080)	(0.222)	(0.080)
Price included in contract (1 = yes)	-0.393*	-0.141*	-0.655***	-0.216***
	(0.225)	(0.081)	(0.253)	(0.084)
Ln(annual farm milk output)	-0.168*	-0.061*	-0.173	-0.059
	(0.089)	(0.033)	(0.109)	(0.037)
% of higher quality cattle in municipality	-0.015**	-0.005**	-0.020*	-0.007*
	(0.006)	(0.002)	(0.011)	(0.004)
N years schooling of hh head	-0.032	-0.012	-0.067**	-0.023**
	(0.028)	(0.010)	(0.031)	(0.011)
N years experience as farm manager	-0.014*	-0.005*	-0.025***	-0.009***
	(0.008)	(0.003)	(0.009)	(0.003)
Trento	0.478	0.171	0.693	0.236
	(0.548)	(0.197)	(0.900)	(0.306)
Bologna	-1.034**	-0.297**	-0.728	-0.209
	(0.404)	(0.116)	(0.454)	(0.130)
Constant	2.540**		2.817**	
	(1.039)		(1.201)	
Observations	234		200	
Pseudo R^2	0.0826		0.124	
χ^2	23.75		30.53	
% correctly predicted	63%		63%	

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

5.3.3. Processor's provision and farmers' use of technical assistance services

Cooperative firms can be expected, in theory, to be more likely than capitalistic processors to offer technical assistance services free of charge to their members. This stems from the different ownership nature of the two firms, which, in principle, makes cooperatives more producer-oriented than private processors. Private firms may be reluctant to provide such services for fear that farmers would use their improved skills to sell to other buyers (Staatz 1987b). On the other hand, loyalty and exit rules in coops, according to which members' returns on investment are typically contingent on their continued patronage, can discourage this behaviour by members and favour service provision by the coop. Provision of such services can in turn be interpreted as evidence of processor's engagement for the improvement of production practices of farmers. Information on whether or not processors *provided* technical assistance services (TA), regardless of whether or not farmers used them, is unfortunately not available, because I only collected information on whether or not farmers *used* such services at least once during the year under study, the outcome of both TA supply by the processor and demand by the farmers.

Forty-seven percent of farmers received TA from their buyer. Just over half of cooperative members, 52%, received it, against 25% of non-members and this difference is statistically significant at 1% level (t = -3.636). There is no significant difference between members of small and large coops (t = -1.012), while suppliers of smaller private processors are slightly more likely to receive TA compared to suppliers of larger private processors (t = -1.56). There are also no significant differences in TA use between smaller and larger farms (t = -0.943). Only focusing on those processors for whom the sample includes more than one supplier, 94% of cooperatives provided TA to at least one of their members, against 54% of private processors. The latter result suggests that cooperatives are more likely to provide TA, but, because it is derived using information on farmers' actions, it may in fact be driven by farmer characteristics that influence both their decision to join a cooperative and their use of TA. Private processors may appear to be less likely to offer TA, while in fact it may just be that their suppliers are less likely to request it compared to coop members.

The data allows me to investigate what drives the decision of a farmer to use TA. This can be modelled as the probability that a farmer used TA at least once during the year under study, as a function of factors that favour TA supply by the processor and conditions that influence TA demand by farmers, and estimated using a probit model. The role of coop membership can be explored in this framework: a positive and significant relationship between membership and TA use may be considered as evidence that coops provide a more conducive environment for farmers' improvement of production practices and techniques, provided that the potential correlation between membership decision and TA use is not biasing the results.

One approach for dealing with the potential endogeneity of membership and TA use is to instrument the problematic coop dummy and estimate a linear probability model using two-stages least squares (IV-2SLS). Use of IV-2SLS also when both dependent variable and endogenous regressor are discrete is justified by Angrist & Pischke (2009), who argue that this method can provide consistent estimates without requiring stringent assumptions, provided a valid instrument is used.[39] For an instrument to be valid, it has to satisfy the properties of relevance and orthogonality: it has to be highly correlated with the endogenous membership dummy but uncorrelated with TA use, once other covariates are controlled for. IV-2SLS then estimates a 'reduced form' equation in the first stage and the 'structural' relationship of primary interest (use of TA) in the second stage. In the reduced form equation, cooperative membership is specified as a function of all the exogenous variables in the structural equation and the set of instrumental variables. The predicted values from this reduced form equation are then included in the structural equation (the TA equation) in place of the problematic membership dummy. Given a valid instrument, exogeneity of the problematic regressor can then be tested using a Wu-Hausman test.

The available instrument for cooperative membership is the membership status of parents. This is measured with a dummy equal to one if the parents of the current farm manager had ever in their life been members of a dairy processing and marketing cooperative, and 0 otherwise. This is not necessarily the same cooperative of which current farmers are members. Parental membership status appears to be a relevant instrument. The parents of 84% of cooperative members were themselves members of a processing and marketing cooperative. Chapter 4, Section 4.5.2, showed that, even for those farmers who do have a choice between organisational forms, membership decision of the parents is the strongest correlate of their own membership. This suggests that the membership decision of current farmers depends in a non-trivial manner on the membership decision of parents. Instrument orthogonality, that is, its exogeneity with respect to TA use once other covariates are controlled for has to be assumed and cannot be tested, because there is only one instrument. However, once other covariates are controlled for, there is no strong *a priori* reason to expect parents' membership status to be correlated with current farmers' decisions on TA use.

With a dummy endogenous variable, the coefficient on the instrumented membership dummy should not be interpreted as the average effect of coop membership on the probability of using technical assistance, but rather as the effect of membership on TA use for those farmers whose membership behaviour is affected by the instrument, known in the literature as 'compliers'. That is, it estimates the effect of membership on

[39] An alternative approach would be to estimate a bivariate probit model (Heckman 1978) for the related membership decision and TA use decision. This model however requires the strong assumption that both decisions are jointly distributed with a bivariate normal distribution and is not necessarily superior to IV-2SLS if such assumption is violated (Angrist and Pischke 2009).

TA use for those farmers who are coop members because their parents had been coop members, or who would have been members had their parent been in a coop. This is known as local average treatment effect (LATE) (Angrist, 2001).

A farmer's use of TA is the result of both processor's supply and farmer's demand for this service. The likelihood that a processor will supply TA is expected to increase (a) if the processor is a cooperative, for the reasons noted above; (b) with competition from other buyers for local suppliers, proxied with a dummy equal to 1 if the farmer perceives other buyers are available and with the log of minimum altitude of the municipality where the farm is located; (c) with the size of available local supply, measured with the number of dairy farmers in the municipality, because the cost per unit of milk supplied for setting up technical assistance facilities is likely to be lower the larger the potential pool of suppliers; and (d) when a farmer is located closer to the processor's headquarters, as this reduces the cost of reaching the farm.

The likelihood that a farmer will use TA is expected to be positively related to her number of years of schooling, and non-linearly with number of years of experience as farm manager, hypothesised to first increase and then decrease the probability of using TA over time. These variables are used to proxy quality of human capital. The likelihood of using TA is also expected to increase as dependence on dairy farming for household income increases, proxied with a dummy equal to 1 if all farm income comes from dairy farming, and zero if not. Province dummies are included to control for unobserved local characteristics.

Results are reported in Table 5.6. Columns (1) and (2) report coefficients and marginal effects from the estimation of a probit model and column (3) reports coefficients for the second stage of an IV-2SLS model. The first stage results are reported in Table 2-A in the Appendix. The dependent variable in both cases is a dummy equal to one if a farmer used the TA services provided by the processor at least once in the year under study. Reported standard errors are based on the Huber-White variance-covariance matrix. The probit model correctly predicts 63% of observations and results indicate that the probability of using TA increases by 42% when the farmer is a cooperative member, on average and *ceteris paribus* (column (2) Table 5.6). This result may however be driven by correlation between unobserved characteristics influencing both membership decision and TA use. Estimation of IV-2SLS deals with this type of selection bias. The instrument appears to be strong, with an F-statistic of 19.9 (reported in the second-to-last row of column (3) Table 5.6), above the rule of thumb of 10 suggested in the literature (Staiger and Stock 1997).

Table 5.6: Probit and IV-2SLS regression results for farmer's use of TA services

Dependent variable: farmer used TA provided by processor at least once during year under study (1 = yes)	Probit (1) Coeff.	Probit (2) Mg. Effect	IV-2SLS (3) Coeff.
Farmer is coop member (1 = yes)	1.195***	0.416***	0.257
	(0.257)	(0.090)	(0.288)
Farmer perceives other buyers available (1=yes)	-0.089	-0.036	-0.047
	(0.202)	(0.081)	(0.080)
Ln(N dairy farms in municipality)	0.100	0.040	0.050
	(0.125)	(0.050)	(0.051)
Ln(minimum altitude of municipality)	-0.134	-0.053	-0.033
	(0.127)	(0.051)	(0.048)
Ln(farm-plant distance)	-0.108	-0.043	-0.033
	(0.076)	(0.030)	(0.027)
All farm income from dairy (1 = yes)	0.107	0.042	0.029
	(0.222)	(0.089)	(0.079)
Ln(N years of schooling hh head)	0.533**	0.212**	0.187**
	(0.268)	(0.107)	(0.094)
N of years of experience as farm manager	0.020	0.008	0.007
	(0.022)	(0.009)	(0.008)
Experience squared	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)
Trento	-0.379	-0.150	-0.100
	(0.381)	(0.151)	(0.158)
Bologna	0.396	0.157	0.147
	(0.361)	(0.142)	(0.128)
Constant	-1.670		-0.102
	(1.019)		(0.361)
Observations	240		240
χ^2	31.25		0.119
(Pseudo) R^2	0.102		0.119
Wald F-stat			19.90
Durbin-Wu-Hausman stat (p-value)			0.564

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The IV-2SLS estimate for the effect of coop membership on TA use has the same sign and a lower magnitude compared to the probit marginal effect, and is not statistically significant (column (3) Table 5.6), suggesting the probit model may be overestimating the importance of coop membership for the probability of TA use. However, a Wu-Hausman test of exogeneity on the IV-2SLS model (p-value reported in the last row of column (3) Table 5.6) indicates that the hypothesis of exogeneity between membership decision and TA use cannot be rejected in this case. Probit model results on the relationship between membership and TA use may thus be interpreted as suggestive that cooperatives provide a more conducive environment for farmer's improvement of their production practices and techniques.

With respect to the other covariates, the probit model indicates that farmers with more years of schooling are more likely to use TA, as expected. A 10% increase in the number of years of schooling of the farm manager is associated with a 2 percentage point higher probability of using TA. None of the other covariates is statistically significant.

Overall, section 5.3 showed some evidence that is consistent with a scenario where cooperatives provide members with higher benefits in terms of trust, lower likelihood of opportunistic behaviour and support to farm development. However, these observed outcomes of the exchange relationship are only a part of the wider range of potential benefits that trading with a buyer with a particular type of organisational form may deliver, some of which are not easily observed. Moreover, what matters is how farmers value such benefits relative to the specific costs entailed in dealing with either type of buyer. The next section analyses farmers' own valuation of their net benefits from trading with a particular type of buyer, which encompasses both observable and unobservable relative costs and benefits.

5.4. Farmers' own valuation of their net benefits from trading with a particular type of buyer

This section analyses farmers' valuation of their net benefits from trading with a particular type of buyer, i.e. a cooperative or private firm. Costs and benefits associated with each type of buyer were noted in Chapter 1, Section 1.3. When joining a coop, possible benefits include a price potentially higher than that paid by a capitalistic processor; a commitment by the cooperative to supporting the technological development of members' farms; and satisfaction derived from being part of a group and of its decision-taking process, and from the relationship with a firm that appeals to values of equity and solidarity. Costs include a membership fee, the opportunity cost of capital invested in the cooperative and of time spent attending meetings and negotiating decisions, the entrepreneurial risk ensuing from being the owner and residual claimant of the coop, the risk that a group of influential members may exploit others, and the delay in receiving the full value of the milk marketed through the cooperative. Conversely, when supplying a private processor, a farmer receives payment in full each month and is free to focus on dairy farming without being directly involved in processor's operations. When farmers trade with a private processor that enjoys some degree of market power, however, their costs include potential payment of a monopsonistic price, processor's exercise of *ex-post* opportunistic behaviour with respect to payment of the agreed price, and the risk that the processor may decide to unilaterally terminate the exchange relationship.

The net benefit derived from dealing with a particular type of buyer depends on how people value the different monetary and non-monetary costs and benefits delivered by that buyer. This may differ across individuals and particular groups, depending on their individual characteristics. I measure farmers' own valuation of their net benefits with a self-reported reservation price (RP) from trading with a buyer with a particular organisational form. Cooperative members were asked how much per litre a private processor would have to pay for them to leave the cooperative and become its suppliers. Non-members were asked how much per litre a cooperative would have to pay for them to become members. The object of the analysis in this section is not the absolute RP reported by farmers, but the difference between RP and actual unit milk price received from the current buyer, in order to take into account differences in prices paid across farmers, and because, when thinking about the price they would require in order to switch buyer, farmers are likely to keep the current price they receive as a reference point (Kahnemann and Tversky 1979).

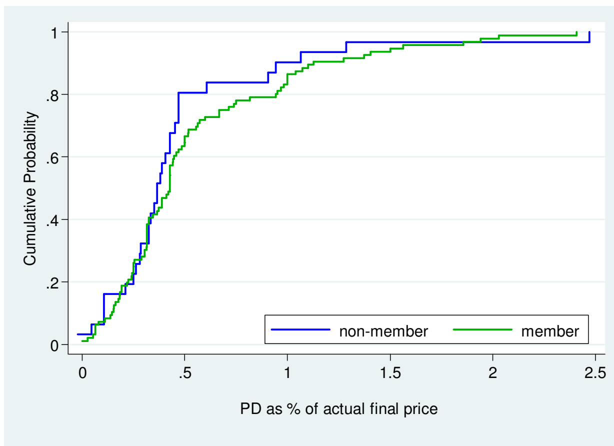
Interpreting a high reported reservation price as farmer's perception of a high net benefit from trading with a particular type of buyer requires caution. First, farmers considering whether or not to change buyer face imperfect information and uncertainty on what dealing with an alternative buyer would actually entail. Loss aversion is expected to play an important role here, leading farmers to increase the value they attribute to their current relationship because they are confronted with an uncertain alternative that may entail losses compared to the *status quo* (Kahnemann, Knetsch et al. 1991). Self-reported reservation prices may therefore provide an upwards biased estimate of the net benefits farmers receive from trading with a buyer with a particular organisational form. Second, warm-glow effects may play a role: farmers may have an incentive to overestimate their reservation price for switching to an alternative buyer in order to project a positive self-image of commitment to the current buyer. This problem could potentially be more serious among cooperative members. However, the complete anonymity of the survey instrument, and the fact that the interview was not conducted face-to-face, should have helped to reduce this kind of incentive (Hurd, McFadden et al. 1998).

Previous work using self-reported reservation prices includes Porcheddu's analysis of the value farmers attribute to trading with their current milk buyer and of members' commitment to their cooperative in the dairy sector of Sardinia (Italy) (Porcheddu 2005; Porcheddu 2006). Porcheddu uses a different sample and definition of reservation price from the ones used here. His sample only includes cooperative members, whereas I am able to compare members and non-members. His reservation price is the price that any other buyer, regardless of its organisational form, would have to pay for members to leave their current cooperative. Instead, the reservation price I collected enables investigating farmers' preference for one organisational form *versus* the other. Porcheddu analyses the relationship between individual farmer characteristics and their *absolute* reservation price, while I work with *relative* reservation price, that is, the difference between RP and actual unit milk price received, for the reasons noted above. Porcheddu finds that self-reported reservation price, which he interprets as the extent of member commitment to their coop, increases with herd size and presence of a household member that will continue working on farm after the current manager retires; and decreases with current manager's number of years of schooling.

The remainder of this section analyses the data collected. First, the price differential (PD) between RP and actual price received by cooperative members is compared with that of non-members. Second, the relationship between PD and individual characteristics of cooperative members is analysed, in order to explore how different groups of people value net benefits from cooperative membership. Third, farmers' perception of the relative importance of price, compared to other characteristics, in the relationship with the milk buyer is analysed by examining answers to the questions (a) whether a higher offered price would be enough to switch buyer; and (b) what other factors would need to be considered.

In order to switch to a private processor, cooperative members would require a price differential of 22 eurocents per litre, compared to 17 eurocents/lt for non members. In both cases PD exceeds actual price, but the excess is greater for coop members. Compared to the actual final price received by each group, 41 eurocents/lt for members and 36 eurocents/lt for non-members, the price required in order to switch buyer is 54% higher for coop members and 47% higher for non-members. This suggests that members tend to value the relationship with their cooperative more than non-members value their relationship with the private processor. However, the difference is not statistically significant (t-stat = -0.76). The distribution of the price differential expressed as a percentage of the actual price, by membership status, is shown in Figure 5.4.

Figure 5.4: Price differential for changing buyer as percentage of actual price, by membership status



Members of larger cooperatives require a price that is 59% higher than their current price in order to switch, while members of smaller coops would accept a 45% higher price. This finding is surprising given the frequent suggestion both in the literature and among farmers themselves that smaller cooperatives are better able to deliver non-monetary benefits to farmers by facilitating closer interaction and collaboration among members and more active participation in decision-making. The difference is however not statistically significant (t = 1.09). Conversely, it is suppliers of smaller private processors who would require a higher differential price in order to switch, 54% higher than current price, compared to suppliers of larger private processors, who would switch for a 37% higher price. This suggests that the costs of dealing with a private buyer, such as its potential exercise of market power, are mitigated when dealing with a smaller firm, as the difference in bargaining power between farmer and processor is reduced. Again, however, these differences are not statistically significant (t = -0.93).

It is possible that different groups of coop members attribute different importance to the relative costs and benefits of membership, depending on their individual characteristics, and thus perceive different net benefits from coop membership. The main hypotheses are as follows:

(a) Farmers with smaller scale of production perceive higher net benefits from coop membership because they would be more vulnerable to the potential exercise of market power if they were to deal with a private buyer;

(b) For the same reason, also farmers with a higher degree of asset specificity are expected to perceive higher net benefits from coop membership.

(c) With respect to age of the farm manager, the direction of the relationship needs to be estimated empirically. Older farmers are more likely to have participated in the founding or early years of the cooperative, and thus may be more likely to attach greater importance to the non-quantifiable benefits of membership, which would increase their perceived net-benefits. Younger farmers, who may be more heavily leveraged from starting their own farm, may attribute more importance to milk prices paid, and be readier to switch buyer following short-run price fluctuations. However, their longer horizon may make them value more than older farmers some of the potential long run benefits of coop membership, such as the stability of the exchange relationship over time and coop's support to the improvement of farm production practices.

Table 5.7 reports results (coefficients and standard errors in parenthesis) for a least squares estimation of the relationship between the log of differential price (expressed as an absolute value and not as a percentage of actual price) and farm scale of production, asset specificity (proxied with the share of cattle in municipality producing higher quality milk) and age of the farm manager, controlling for perceived availability of alternatives, which can also influence farmers' perception of net benefits, and for parental membership status, which may influence both the degree of preference for the cooperative form of organisation *per se* and the *status quo* bias of the farmer. Province dummies are included to control for unobserved local heterogeneity. Column (1) in Table 5.7 reports estimation results for a specification that measures farm scale of production with the log of herd size, while column (2) uses the log of total annual farm milk output.

Results show a negative and significant relationship between differential price and farm scale of production, indicating that the perceived net benefits from cooperative membership are larger for smaller farmers. A 10% increase in farm herd size is associated with a 2.8% decrease in differential price, significant at 5% level, on average and *ceteris paribus* (column 1, Table 5.7), while a 10% increase in annual farm milk output is associated with 2.7% decrease in differential price, significant at 1% level (column 2, Table 5.7). This suggests that smaller, more vulnerable farms attach more importance to the benefits of coop membership. There are various factors which may contribute to lowering perceived benefits from membership, or increasing its perceived costs, for larger farmers. They are more likely to have to meet monthly production costs, for instance wages for hired labour, which would increase the cost for them of the holding back of final payment in coops. They may also see less favourably than smaller farmers the democratic decision-making process in cooperatives, where a larger scale of production is not reflected in stronger decision making power. This, however, may be mitigated by their higher perceived influence in negotiations with the coop, noted in section 5.3.1.

None of the other covariates is statistically significant.

Table 5.7: Least squares regression results for price differential, coop members only

Dependent variable: Ln(reservation price – actual price)	(1)	(2)
Ln(herd size)	-0.280**	
	(0.140)	
Ln(annual farm milk output)		-0.266***
		(0.097)
% of higher quality cattle in municipality	0.006	0.006
	(0.006)	(0.006)
Ln(Age of farm manager)	-0.435	-0.489
	(0.321)	(0.315)
Farmer perceives other buyers available (1=yes)	0.075	0.063
	(0.188)	(0.187)
Parents were coop members (1 = yes)	-0.070	-0.009
	(0.237)	(0.236)
Trento	-0.516	-0.533
	(0.619)	(0.606)
Bologna	0.273	0.294
	(0.250)	(0.238)
Constant	5.395***	6.053***
	(1.699)	(1.672)
Observations	86	85
R^2	0.138	0.166

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Together with providing an estimate of farmers' perceived net benefits from membership, the price differential can also be regarded as a proxy for farmers' commitment to trading with a buyer with a particular organisational form. The lower the differential price, the higher is the importance attributed to the mere monetary aspects of the transaction, and the lower the perception of the distinctiveness of one type of buyer from the other. A substantial share of the sample, 59%, indicated that offer of a higher price would not be enough to induce a switch in buyer. This share is significantly higher among cooperative members than non members: 64% against 43%, respectively ($t = -2.71$). There are no significant differences between members of smaller and larger coops ($t = -0.27$), or between suppliers of smaller and larger private processors ($t = 0.44$). There are also no significant differences between smaller and larger farms in either the full sample ($t = -0.85$), or among coop members only ($t = 0.44$), suggesting that, even though larger farmers perceive lower net benefits from cooperative membership, they would not be systematically more likely than smaller farmers to opportunistically switch buyers following short run price fluctuations.

When asked to explain why a higher price alone would not be sufficient to induce a change in buyer, trust in buyer and security that the buyer would pay the amount due and on time were indicated by 24% and 30% of respondents, respectively. The remaining farmers mentioned reasons that refer to the particular nature of cooperative versus capitalistic buyers and associated relative costs and benefits. Non-members mention two disadvantages they perceive in cooperative membership: the payment system, with monthly instalments and full payment only at the end of the financial year; and a fear that the decision making process in cooperatives may be too slow to respond quickly to market opportunities. Cooperative members refer to the possibility in cooperatives, unlike capitalistic firms, to follow all the stages of production up to the sale of the final product in collaboration with other farmers; and to how "being in a cooperative gives a better sense of protection for the future, especially for small farms bypassed by big commercial networks". Some members also refer to a sense of ownership of the cooperative so strong that makes the distinction between "farm" and "milk buyer" seem inappropriate: "This cooperative is as important for me as my own farm, I feel responsible for it, and I want to give my contribution for it to function in the best possible way".

5.5. Conclusions

This chapter explored differences between capitalistic and cooperative firms with respect to non-price characteristics of the exchange relationship with farmers. Evidence provided in this chapter suggests that the non-price aspects of the relationship are, for farmers, at least as important as prices paid. Differences in behaviour between cooperatives and private processors with respect to non-price characteristics of the relationship are expected to emerge because of their different ownership structure, which results in a different alignment in objectives and incentives between agents. The chapter first presented the key motivations that led farmers to choose their current buyer, which give an indication of what they expected from the exchange relationship. It then focussed on three observable non-price outcomes of the relationship: contract content and complexity, processors' compliance with the terms of the agreement, and processors' provision and farmers' use of technical assistance services. Finally, the chapter investigated farmers' perceived net benefits from trading with a buyer with a particular organisational form, and how they vary between members and non-members and across members with different characteristics.

Trust and timely payment of the amount due are the two paramount concerns for non-members when choosing their milk buyer, while a variety of issues, including prices paid and support to farm development, are important for cooperative members. There is some evidence that trust between farmers and buyers is lower in private firms than in cooperatives: contracts with private processors are more detailed compared to those with coops, and this can be interpreted as evidence that more sophisticated coordination mechanisms are necessary here to achieve the desired alignment in objectives between farmers and processor. Even though non-members tend to feel more able than coop members to influence decisions on the terms of the agreement, they are also significantly more likely to experience difficulties during the negotiation process. Moreover, non-members appear to be significantly more vulnerable to *ex-post* opportunistic behaviour from buyers: private firm suppliers are significantly more likely than coop members to be paid a price that is lower than agreed. Processors' provision and farmers' use of technical assistance services are also less likely when supplying a private processor.

Cooperatives seem to provide higher benefits with respect to these observable outcomes. When comparing overall relative costs and benefits for trading with a buyer with a particular organisational form, members' perceived net benefits from being in a coop are larger than those of farmers supplying a private processor, but the difference is not statistically significant. Certain costs of cooperative membership, especially the delay in payment of the full value of milk sold, and what is perceived as a slower and inefficient decision-making process, appear to be crucial for explaining why some farmers would not join a cooperative even if it offered a higher price than their current private buyer.

There is, however, some heterogeneity across cooperatives and across members in both the non-price characteristics of the relationship and in perceived net benefits. Contract complexity increases in cooperatives as membership size increases, albeit remaining at a lower level compared to private processors. Members tend to feel a lower bargaining power in larger than in smaller cooperatives, suggesting a shift in the balance of power towards managers in the former. Farmers' perception of net benefits from cooperation is not, however, significantly different between members of larger and smaller cooperatives. Members with larger scale of production tend to feel more influential, a finding that contrasts with cooperative values of equity and equality, but which is consistent with a scenario in which a way needs to be found in order to reward larger farmers for being strategically important for cooperatives in order to compensate for the large transport and transactions costs per litre that may derive from a predominantly smaller scale membership. Even though larger farmers do not appear to be more likely to change buyer just following short-run price fluctuations, their net benefits from membership appear to be significantly smaller than for smaller farmers, a group that is more likely to be vulnerable to the potential exercise of market power from capitalistic processors, and who for this reason may attach higher value to the benefits of cooperative membership.

The next chapter turns to the analysis of variation in milk prices paid across the sample, and investigates whether being in a cooperative, *per se*, has any effect on prices paid.

Chapter 6 – Variation in producer prices paid and the role of organisational form *per se*

6.1. Introduction

This chapter investigates empirically what accounts for the variation in producer prices found in the sample, and in particular whether organisational form of the processor, *per se*, has any effect on prices paid. Depending on the nature of competition between cooperative and capitalistic processors, and on the spatial pricing policy they use (FOB or UD), their different objective function (profit maximisation in capitalistic firms versus, for instance, welfare maximisation in cooperatives), which stems from their different ownership structure, can result in different price-output equilibria for these two firms. When they each operate as isolated monopsonists, cooperatives are predicted to pay higher prices than capitalistic firms, and closer to what would obtain in perfect competition. When they compete directly for a given market area, the competitive pressure provided by the presence of a cooperative firm behaving non-cooperatively towards its rival pushes the private processor to raise its price above monopsony level and close to the competitive price (Sexton 1990). The expected difference in price paid between cooperative and private processor is least marked when low transportation costs facilitate firms' overlap and direct competition over a given market area. However, it is expected to persist even when transport costs are low when both firms adopt UD pricing, because the competitive effect of a UD-pricing cooperative only comes from restriction of the market area of the private processor. Even though it does not fear loss of suppliers to the closed-membership UD-pricing coop, the capitalistic processor would increase price paid in order to increase supply from its restricted market area (assuming a linear supply function). Thus, as discussed in detail in Chapter 2, Section 2.3.1, when transportation costs are relatively high, price differences between cooperative and private processors are expected under all possible combinations of spatial pricing policies, with cooperatives paying higher prices. When transportation costs are very low, price differences are expected to tend to zero under all price combinations except one, that is, when both firms pay UD pricing, in which case cooperatives are expected to pay a higher price than private processors (Fousekis 2011).

The UD-pricing case is especially relevant here because I have both anecdotal and empirical evidence that this is the spatial pricing policy adopted in the areas under study.

From the point of view of cooperative members, asking whether there is an effect of cooperative membership on prices paid amounts to asking whether, given their characteristics, they would receive a lower or higher price had they sold milk to a capitalistic processor. The *prima facie*, descriptive evidence provided by the data is that cooperative members receive on average a higher price than non-members. However, a straightforward comparison in price paid between members and non-members cannot be interpreted causally, because these two groups may differ in a number of observed and unobserved characteristics which also influence the price they receive.

The problem of measuring the impact of cooperative membership on prices paid bears some similarities with the core issue addressed by the evaluation literature: the measurement of the causal impact of a generic 'treatment' on an outcome of interest (for instance, (Heckman, LaLonde et al. 1999)). In fact, the problem studied in this chapter could be thought of as the evaluation of the causal effect of being member of a cooperative, C_1, relative to selling milk to a private processor, C_0, on the outcome y considered, in this case prices paid measured at one point in time. What is of interest is to retrieve quantities of the form $y_{1i} - y_{0i}$ (that is, price received in the coop minus price received from a private processor), averaged over some population of interest. Ideally, I would like to compare the price that individual *i* would receive in a cooperative with the price that the same individual *i* would receive when selling to a private processor. Each individual, however, receives only one of the "treatments": the other remains an unobserved counterfactual. Thus, the key challenge is to estimate missing data, that is, the unobserved counterfactual. In order to recover the counterfactual, in this research I have to rely on non-experimental evaluation methods (NEM) and on a cross-section estimator, comparing outcomes of different individuals – members and non-members – at the same point in time. One of the key issues in this case is to what extent the outcome of non-members is a good representation of prices members would have received had they not been in a cooperative.

A complicating factor is that, at least where more than one buyer is available and available buyers have different organisational forms, cooperative membership is the result of self-selection, which may occur on the basis of both observed and unobserved (by the researcher) characteristics. No given NEM is uniformly superior to all others (Blundell, Dearden et al. 2005). In fact, what is the most appropriate estimator largely depends on what governs the selection process (whether observed or unobserved characteristics) and on the relationship between the membership decision and the outcome (prices paid), and in particular on whether there is a correlation between the error terms in the two equations. The approach adopted in this chapter is to explore the relationship between the selection and outcome process empirically, comparing four different NEM estimators.

The obvious starting point, especially given the relatively small sample size, is a least-squares estimation of prices paid as a function of the coop dummy and other covariates. Least squares, however, assumes that individuals select into cooperatives only on the basis of observed characteristics, such as scale of production and location. Unobserved characteristics, which may be correlated with prices paid, may also guide the selection process. In the case of endogeneity of cooperative membership and prices paid, OLS will generate biased estimates. Two possible solutions to this problem adopted in this chapter, which also allow testing for whether selection into cooperative membership does, in fact, occur on the basis of unobserved characteristics, are instrumental variables and control function methods. Even in case of no selection on unobservables, a least squares estimate would be biased if the distribution of characteristics between members and non-members is substantially different, which, in the extreme, would lead to comparing uncomparable individuals (Heckman, Ichimura et al. 1996). In order to gather some insights on the extent to which the OLS estimates suffer from this kind of bias, I also implement matching methods, being well aware, however, of their limited suitability to my data, for reasons discussed in more detail in section 6.4.4.

Another complicating factor in this research concerns the definition of the population of interest over which one averages the retrieved cooperative impact $y_{1i} - y_{0i}$. In the evaluation literature, the 'population of interest' is composed by all the 'eligible' individuals, i.e. all the units who could be exposed to *both* treatment 1 (coop membership) and treatment 0 (selling to a private processor). Who are the "eligibles" in this research? This is not a trivial question in the light of what discussed in Chapter 4 about presence and distribution of cooperatives and private processors within each province. The answer ultimately depends on the assumptions one is prepared to make about the nature of market structure in the provinces under study, which has implications for the extent to which individuals are exposed to both treatments.

Recall that Chapter 4 showed that each province is, on aggregate, characterised by the coexistence of cooperatives and private processors. However, when using population data and municipalities to disaggregate space into smaller units of analysis in Trento and Piacenza, it appears that cooperatives are present in all municipalities, whereas private processors are not observed to operate in 76% of municipalities in Trento and in 10% of municipalities in Piacenza. Using individual farmers as the unit of analysis, sample data show that approximately a third of the sample believes they have no available alternative buyer. Moreover, 56% of the sample (most of them cooperative members) does not perceive that both cooperatives and private processors are available buyers; thus, only 44% of the sample *perceives* being exposed to both treatments. Of course, as discussed in Chapter 4, presence of buyers is itself not exogenous. Moreover, independently of questions on the population of interest, outcomes (prices in this case) are expected to differ as a function of local market structure. On balance, even though in these provinces areas of pure local monopsony and oligopsony (i.e. with one or more buyer having the same organisational form) appear to coexist, with no overlap, with mixed oligopsony areas, the relatively small territory of these provinces, where a relatively large number of processors with both organisational forms operate, farmers are not concentrated and the main processed product (cheese) is standardised, suggest that these provinces are characterised by at least *potential* competition among buyers with both organisational forms. A further complication is that the data only allow me to observe presence and distribution of buyers at one point in time. However, if one introduces a dynamic component to the story, then it is clear that, over time, there is the possibility of entry of new processors, of either organisational form, which again would change conclusions about whether or not there is at least potential competition among processors and between both organisational forms, and consequently about who are the farmers who could be exposed to both "treatments".[40]

The approach adopted in this chapter is to perform the empirical analysis both on the full sample and on the sub-sample of individuals who perceive both organisational

[40] One could try to glean some information on the extent to which farmers may be exposed to both treatments by looking at sample data on farmers' mobility between different organisational forms in the past. However, this is not very informative. Among cooperative members who today perceive they only have cooperatives as available alternative buyers, there are only 7 who in the past had been supplying a private processor. The other members who joined a cooperative after having supplied a private processor are 16, and all currently believe they still have both organisational forms as available buyers.

forms as available buyers. Differences in the estimates for these two different populations of interest are expected to depend on whether there are any systematic differences between farmers who are exposed to both organisational forms and farmers who are only exposed to one (mostly cooperative). These differences were noted in Chapter 4, Section 4.5.1, and will be briefly recalled in the next section.

'Treatments' may also be heterogeneous, i.e. cooperatives may differ from each other in terms of scale, efficiency, profitability and rules (to some extent). Unfortunately, no information is available on this kind of cooperative characteristics; thus, the average cooperative effect I am recovering is in fact expected to be averaging out treatment heterogeneity.

The analysis of the cooperative effect in this chapter focuses on individual impacts of cooperative membership. This means focussing solely on the private impact of cooperative membership at one point in time, taking market structure as exogenous and fixed and ignoring possible externalities of cooperative membership that might affect the economy as a whole. If cooperatives are performing a competition enhancing role in the raw milk market, by pushing private processors to raise prices paid to a level closer to what would emerge in competition, then part of the "cooperative effect" in the milk market would actually be the higher price paid by private processors compared to what they would pay in the absence of a coop. I am, however, unable to estimate this given the available data. Such a competition enhancing effect of cooperatives, if present, would lead to a smaller, if any, difference in prices paid between the two types of firm.

A full analysis of the impact, or 'returns' of coop membership should also balance the individual cost of coop membership (including, among others, membership fee, opportunity cost of investing in the cooperative, time and monetary cost of attending meetings) against the flow of returns over her working life. I do not observe either element, and the analysis conducted here is thus only one part of the full return to coop membership.

This chapter is also concerned with investigating other reasons why producer prices may vary across farmers; even though a substantial part explores the role of cooperative membership, other hypotheses will be tested, including the role of milk quality, transaction costs and market structure. Exploration and estimation of the cooperative effect is considered first, because if endogeneity of cooperative membership is present, then all the parameters, including those on the other covariates, will be biased.

This chapter is organised as follows. Section 6.2 discusses the price data used and provides some descriptive evidence on variation in prices paid within the sample. Section 6.3 reviews the four non-experimental methods used in the estimations. Section 6.4 presents the empirical specifications for the price equation and for the cooperative membership equation, discusses possible relationships between the error terms in the two equations, and the validity of the available instrument used to address potential endogeneity of prices and coop membership. Section 6.5 presents the results of the estimations of the effect of cooperative membership on prices paid, while section 6.6 presents results on the other covariates. Section 6.7 concludes.

6.2. Data used and some descriptive evidence on variation in prices paid

The price data analysed in this chapter are self-reported producer prices. The survey asked respondents to indicate the base price, quality and quantity premia, and final price per litre they were paid for raw milk in 2007. This price disaggregation is consistent with the pricing scheme that is adopted by Italian dairy processors, explained in Chapter 3, Section 3.6.3. The final price is the sum of base price, premia, and any end-of-year bonus paid by the processor. The empirical analysis in Sections 6.5 and 6.6 is conducted on base price, premia-adjusted price and final price.[41] The rationale for analysing the three prices is that it may provide some insights on the source of the difference in prices, if any, between members and non members. In this sample it is usually the case that coop members receive a higher price. Do cooperatives set a base price that is altogether different from capitalistic firms, or does a difference in final prices arise because members receive higher quality and/or quantity premia? The latter may mean that either cooperatives set higher premia, or members produce higher quality milk on farm, or both. Or, still, does the difference in price arise only because cooperatives redistribute a share of the profits, if any, among members at the end of the financial year?

The survey was not explicit on whether the requested price data were net or gross of transportation costs. Information on the location of milk transfer from farmer to

[41] While base and final price were self-reported by farmers, I calculated premia-adjusted price by adding base price and any quality and quantity premia reported by respondents. Out of a sample of 313, 299 respondents provided a final price, but only 269 reported a base price and premia. A comparison in characteristics between farmers reporting a final price but not a base price with farmers reporting both prices does not reveal any significant difference between the two groups, as noted in Chapter 3, Section 3.5.2.

processor, however, allows me to make some assumptions on whether reported prices are net or gross of transportation costs. As noted in Chapter 3, Section 3.6.3, dairy processors are in charge of milk collection at the farmgate for all farmers in the Piacenza and Bologna sub-samples, and for 70% of farmers in the Trento sub-sample. Anecdotal evidence collected during initial interviews and piloting of the questionnaire suggests that, when processors are in charge of milk shipment, they bear the transportation cost and pay farmers according to UD pricing, that is, a price that does not depend on the distance between farm and processor. It is plausible to assume that prices reported by farmers when collection occurs at the farmgate are net of transportation costs.

The remaining farmers, all cooperative members in Trento, either transport milk to a collection point, or all the way to the processing plant gate. Farmers transporting milk to a collection point are 29. Compared to those selling at the farmgate in Trento, they produce a significantly smaller output (50 tons/year versus 223 tons/yr, t = 3.653); on average, they are also located closer to the processing plant of their buyer and at a higher altitude, but these differences are not statistically significant. Farmers transporting milk all the way to the processing plant are 25. They produce significantly larger quantities than Trento farmers selling at the farmgate (328 tons/yr versus 223 tons/yr, t = -1.717), are located at significantly shorter distance (t = 2.88) and at significantly higher altitude (938 m versus 747 m, t = -3.042). It is plausible to assume that the price reported by farmers who undertake all or part of the transport is gross of their transportation costs. Variation in location of milk transfer and its implications for whether reported price is net or gross of transportation costs is controlled for in the empirical analysis of prices paid by including a dummy equal to 1 if milk collection occurs at the farmgate, and zero otherwise.

Part of the analysis in this chapter will be conducted on the sub-sample of farmers who perceive having both organisational forms as available alternatives. Recall from Chapter 4, Section 4.5.1, that this group of 131 farmers (42% of the sample) is composed for 64% by cooperative members, who represent instead 94% of the group who perceives only one organisational form is available. Cooperative members who perceive both organisational forms are available, compared to members who perceive only cooperatives are available, tend to be located at lower altitudes, where production of high quality milk is less predominant, and their scale of production is larger. There are no statistically significant differences between the two groups of non-members.

Differences between members and non-members in the group who perceives both alternatives are available are less marked than in the full sample, but persist in several characteristics, including altitude and scale of production, respectively higher and smaller for members.

Table 6.1 summarises prices paid for the full sample and for the sub-sample of farmers who perceives both organisational forms are available alternatives, by province and membership status. The first three rows of the table do not take into account location of milk transfer from farm to plant (i.e. whether the processor collects at the farmgate or whether the farmer transports milk to the plant gate). The remainder of the table only focuses on those farmers for whom milk collection occurs at the farmgate.

Without considering location of milk transfer, mean base price per litre is 37.5 eurocents, premia-adjusted price is 39.5 eurocents and final price is 40 eurocents. For the sub-sample with both types of alternatives, mean prices are 35, 37 and 38 eurocents per litre for base, premia-adjusted and final price respectively. There is wide variation in prices in both samples,[42] which is somewhat reduced when focussing only on farmgate prices, although more so for the sub-sample than for the full sample. Mean farmgate prices for the full sample are 36.7, 38.7 and 39.6 eurocents/lt for base, premia-adjusted and final prices respectively, while for the sub-sample they are 34.3, 36.3 and 37.3 respectively. A visual summary of variation in farmgate prices is provided in Figure 6.1 for the full sample and in Figure 6.2 for the sub-sample. Prices overall appear to be lower where both organisational forms are available. This seems paradoxical, because one would expect price paid to increase with competition between buyers. However, as noted above, the group of farmers with both available alternatives also tends to be located al lower altitudes and where milk quality is lower. This is likely to drive the observed price difference, and underlines the need for a multivariate analysis of prices.

Disaggregating by provinces, prices paid are consistently highest in Trento and lowest in Piacenza, although the difference is less marked for the sub-sample with both types of alternatives. Again, given the different agro-ecological characteristics between the two provinces, this may be driven mainly by milk quality differences. With respect to membership status, mean prices paid to cooperative members in the full sample are

[42] The minimum premia adjusted price reported in Table 1 for the sub-sample is lower than minimum base price. This is likely to be due to penalties charged for insufficient nutrient or sanitary quality of milk. The minimum final price reported for the sub-sample is lower than the minimum reported base and premia-adjusted price. This is due to the missing values in base and premia-adjusted prices discussed in footnote 3.

higher than those paid to non-members: 37.5, 39.5 and 40.5 eurocents/lt for base, premia-adjusted and final prices respectively, versus 34.3, 36.2 and 36.2 for non-members. The difference becomes much smaller when looking only at the sub-sample; for instance, mean final prices for cooperative members are now 37.78 eurocents, against 36.54 for non-members. Prevalence of different buyers at different locations is itself in part related to agro-ecological characteristics, and again these price differences may reflect, in part, quality differences.

Table 6.1: Descriptive statistics on prices paid

	Full sample					Both organisational forms are available				
	N	Mean	St.dev.	Min	Max	N	Mean	St.dev.	Min	Max
Base	269	37.49	6.53	24	65	117	34.76	3.53	30	48.5
Premia	268	39.51	6.71	24	65	117	36.81	4.23	29.5	50
Final	299	40.26	6.84	24	65	125	37.84	4.73	29	53
Farmgate										
Base	224	36.66	5.98	24	63	105	34.30	2.91	30	43.08
Premia	223	38.67	6.32	24	63.26	105	36.27	3.75	29.5	46
Final	247	39.55	6.53	24	64.73	111	37.27	4.28	29	52
Farmgate by province										
Trento										
Base	113	38.83	7.02	29	63	37	34.80	3.21	30	43.08
Premia	112	41.01	7.14	30	63.26	37	37.00	4.07	30	45.5
Final	126	42.38	7.09	30	64.73	39	38.91	4.98	30	52
Piacenza										
Base	76	33.70	3.16	24	42	49	33.70	2.98	30	42
Premia	76	35.49	4.32	24	47	49	35.50	3.96	29.5	46
Final	83	35.82	4.34	24	47	52	36.06	4.04	29	46
Bologna										
Base	35	36.04	3.83	31.5	46	19	34.85	1.66	32.7	39
Premia	35	38.11	3.56	32.89	46	19	36.83	1.79	33.5	40
Final	38	38.30	3.34	32.89	46	20	37.21	1.70	34	40.38
Farmgate by membership status										
Member										
Base	168	37.46	6.54	24	63	59	34.17	2.95	30	43.08
Premia	167	39.50	6.79	24	63.26	59	36.09	3.76	30	44.93
Final	191	40.52	6.85	24	64.73	65	37.78	4.54	30	52
Non-member										
Base	56	34.26	2.73	30	42	46	34.46	2.87	30	42
Premia	56	36.19	3.69	28	46	46	36.50	3.76	29.5	46
Final	56	36.23	3.73	28	46	46	36.54	3.81	29	46

Figure 6.1: Farmgate price distribution by province and membership status, full sample

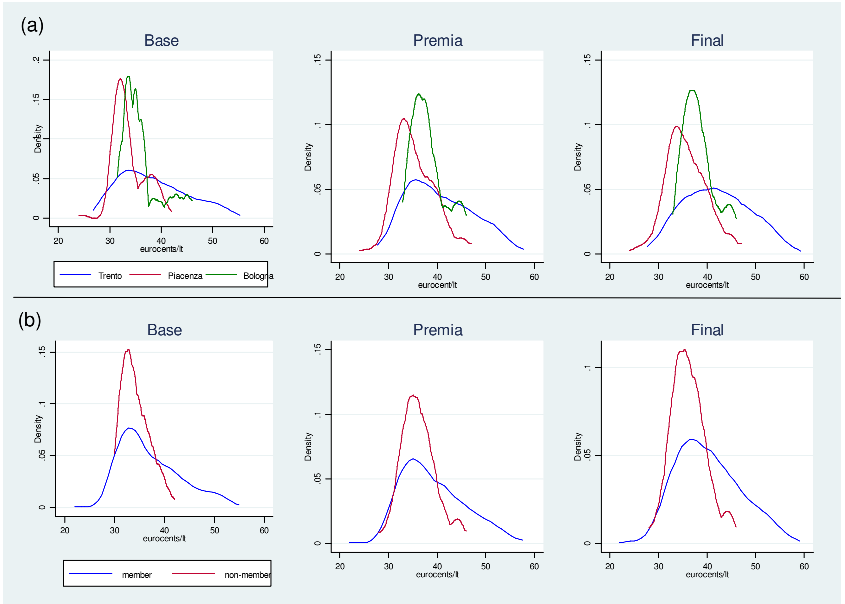
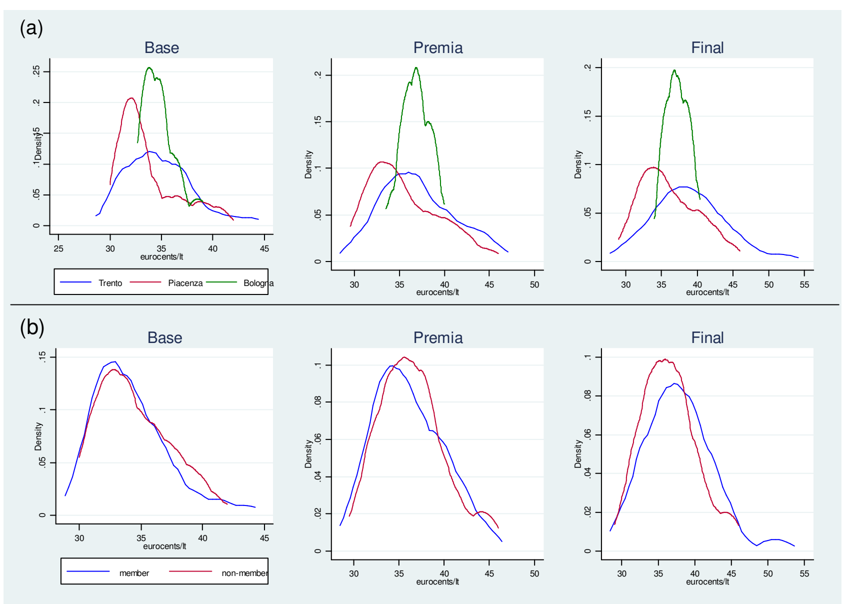


Figure 6.2: Farmgate price distribution by province and membership status, sub-sample with both organisational forms available



In order to begin to investigate the relationship between price distribution and other observable characteristics, Figure 6.3 combines, for Trento and Piacenza each, a map of the distribution of final farmgate prices paid by municipality with a map of minimum altitude and one of the distribution of market structure by municipality. For Trento and Piacenza, the latter two are the same maps presented in Chapter 4 in Figures 4.1 and 4.3. Milk quality is expected to be higher at higher altitudes and so are transport costs. In Trento, the lowest prices paid (in dark blue in the top part of panel (a)) tend to be found in areas of lower altitude and where both cooperatives and private processors operate, while the highest prices paid (in red) tend to be found in areas of higher altitude, especially in the eastern tip of the province. *Prima facie*, the positive effect of altitude on quality appears here to outweigh any negative influence of transportation costs on prices. Instead, in Piacenza the picture is less clear cut and, if anything, prices seem to be lower at relatively higher altitudes, which are comparable to the lower altitude range in Trento, and may not be sufficient to generate any sizeable positive effect on milk quality. This seems to suggest that in Piacenza higher transportation costs at higher altitudes outweigh the positive effect of higher quality. With respect to Bologna, for which data on market structure based on the population of dairy farms are not available, Figure 6.4 presents the distribution of final prices and minimum altitude only. Partly due to the relatively few data, also here the *prima facie* relationship between geographical characteristics and prices paid is not very clear, even though the lowest prices paid tend to be concentrated at lower altitudes.

The next section now turns to examining the theoretical underpinning and empirical relevance in this context of the non-experimental evaluation methods used in this chapter in order to carry out the multivariate analysis of prices paid and the estimation of the coop membership effect.

Figure 6.3: Distribution of final farmgate prices, minimum altitude and market structure by municipality, Trento and Piacenza

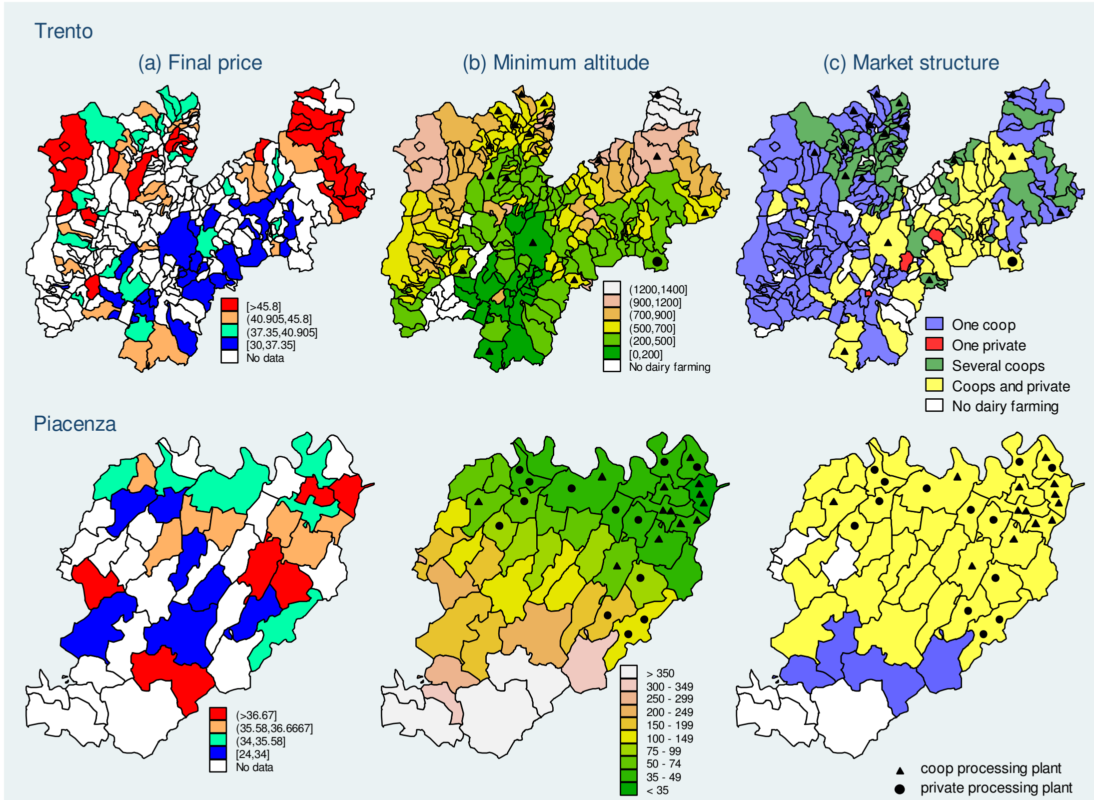
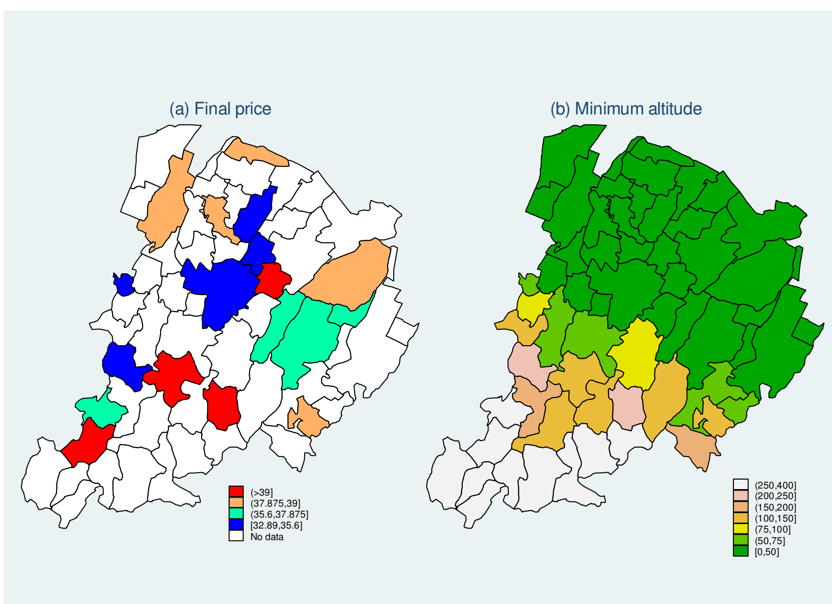


Figure 6.4: Distribution of final farmgate prices and minimum altitude by municipality, Bologna



6.3. Overview of the non-experimental evaluation methods used to estimate the cooperative effect on price paid

This section reviews the four non experimental evaluation methods used to estimate the coop effect on prices paid and broadly follows the approach and notation by Blundell et al. (2005) in estimating the returns to higher education.

6.3.1. A general framework for the relationship between price paid and cooperative membership

The observed relationship between price paid and membership status for individual *i* can be written as

$$y_i = y_{0i} + (y_{1i} - y_{0i})C_i \equiv y_{0i} + \beta_i C_i \qquad (1)$$

where y_{1i} is price paid if individual *i* is a cooperative member and y_{0i} is price paid if individual *i* sells milk to a private processor. $C_i \in \{0,1\}$ is the membership status of each individual *i*, equal to 1 if *i* is a cooperative member, and 0 if she sells to a private processor. The 'coop effect' I want to estimate is β_i. y_{0i} and y_{1i} are the two potential outcomes for each individual. Individual *i* can either join or not join a coop, thus only one of these potential outcomes can be realised (and observed). Prior to the membership decision, however, both prices are potentially observable (hence the label 'potential outcomes') (Imbens and Wooldridge 2009: 9). The potential outcome, i.e. prices paid, for individual *i*, depends both on observed covariates X_i, and unobserved factors u_i:

$$y_i = f\,(X_i, u_i) \qquad (2)$$

This representation, and all the non-experimental evaluation methods I use in this chapter, presuppose the so-called stable unit-treatment value assumption, or SUTVA (Rubin 1980; Rubin 1986). This assumption requires that an individual's potential outcomes and membership status are independent of the membership status of other individuals in the population and do not affect outcomes for another individual, thus ruling out spillover, peer or general equilibrium effects. This assumption is convenient, but seems difficult to justify in the case of cooperative membership. First, peer effects may be important in guiding the membership decision of an individual. Second, the membership size of a cooperative, resulting from individual membership decisions, may affect the price it pays because it affects the balance between economies of scale in processing and potential diseconomies of scale from transportation costs and collective action costs as group size increases. Third, the cooperative yardstick of competition hypothesis suggests that the presence of an open membership cooperative increases prices paid also for non-members, i.e. has an externality on the rest of the economy. Miguel and Kremer (2004) discuss the implications of violation of the SUTVA for the case of spillover effects from treated to non-treated in an experimental set-up of randomised medical treatment. In their case, ignoring spillover effects doubly underestimates the benefits of treatment, because it misses externality benefits to the control group from reduced disease transmission, and underestimates benefits for treated individuals from reduced risk of contagion from non-treated ones (Miguel and Kremer 2004). More generally, violations of the SUTVA may produce biased estimates, but the direction and magnitude of the bias depend on how treatment effects spill over across individuals, which is difficult to know a priori, also because the intensity of interactions potentially leading to spillovers may decline in importance depending on some distance metric, either geographical or proximity in some other socio-economic metric (Imbens and Wooldridge 2009).

Equation (2) requires the observable *Xs* to be exogenous: their potential values must not depend on membership status. The included covariates and their exogeneity assumptions will be discussed in Section 6.4.1.

Assuming additive separability between observables and unobservables, the potential outcome can be written more explicitly as the two counterfactual outcomes y_{0i} if individual *i* is not a cooperative member and y_{1i} if she is member, each decomposed into their mean and a stochastic part with zero mean:

$$y_{0i} = m_0(X_i) + u_{0i}, \qquad E(u_{0i}) = 0$$

$$y_{1i} = m_1(X_i) + u_{1i}, \qquad E(u_{1i}) = 0$$

with $E[y_i \mid X_i] = m(X_i)$, i.e. assuming that the observable regressors *X* are unrelated to the unobservable *u*.

The state-specific unobservable components of producer prices, *u*, (which will be discussed in more detail in section 6.4.3) include:

a] some unobservable individual trait α_i, such as ability, which affects price paid for any given membership status;

b] individual-specific unobserved gains in terms of price which derive directly from cooperative membership, b_{1i}, relative to selling to a private processor, b_{0i}; for convenience, b_{0i} can be normalised to zero;

c] a residual ε_i, unrelated to membership status, possibly capturing, among other things measurement error in price paid and membership status.

The effect of cooperative membership on prices paid can be modelled as having homogeneous or heterogeneous impacts across individuals. In turn, heterogeneous impacts could be observed or unobserved.

A general specification of the price equation can be written as the non-members' outcome plus, for members, the difference between the price obtained in the cooperative and the price that individual *i* would have obtained had she supplied a private processor, plus the state-specific unobservables:

$$\begin{aligned} y_i &= m_0(X_i) + C_i(m_1(X_i) - m_0(X_i)) + C_i(b_{1i} - b_{0i}) + \alpha_i + \varepsilon_i \\ &= m_0(X_i) + C_i b(X_i) + C_i b_i + \alpha_i + \varepsilon_i \qquad (3) \\ &= m_0(X_i) + \beta_i C_i + \alpha_i + \varepsilon_i \end{aligned}$$

with $\beta_i \equiv b(X_i) + b_i$.

In this way, the individual effect of cooperative membership on prices paid is allowed to vary across individuals in both observable and unobservable dimensions. $b(X_i)$ represents the common effect for all individuals with characteristics X_i, thus capturing observable heterogeneity in impacts; b_i represents the unobserved individual-specific impact of cooperative membership for individual *i*, thus capturing unobserved heterogeneity in impacts. In the case of homogeneous impacts, the cooperative effect is the same for each individual with characteristics *X*, so that $\beta_i = m_1(X_i) - m_0(X_i) = b(X_i)$ for all *i*.

Once the effect of cooperative membership on prices is allowed to vary across individuals, the parameter of interest, that is, the average of the individual impacts, could be:

a] The average in the population regardless of their membership status, i.e. the average treatment effect (ATE): $\beta_{ATE} \equiv E[b(X_i)] + b_0$

b] The average among individuals actually observed to be cooperative members, i.e. the average treatment effect on the treated (ATT): $\beta_{ATT} \equiv E[b(X_i) + b_i \mid C_i = 1]$

c] The average among individuals observed to be selling to a private processor, i.e. the average treatment effect on the non treated (ATNT): $\beta_{ATNT} \equiv E[b(X_i) + b_i \mid C_i = 0]$

d] A local average treatment effect (LATE), measuring the impact of cooperative membership for an even more specific sub-group of individuals who are induced to become members by some "exogenous" event. This will be discussed in more detail when the IV estimator is discussed.

The main focus of this chapter will be on the average treatment effect and on the average treatment effect on cooperative members.

6.3.2. The naïve estimator

In the general framework (3), a naïve estimator of the impact of cooperative membership (relative to selling to a private processor) on price paid, for individuals actually observed to be cooperative members, would be the simple difference between the observed average price received by cooperative members and the observed average price received by non-members. To illustrate the problems arising from this, the observed difference in conditional means can be rewritten in terms of the ATT parameter and the bias potentially arising when the earnings of non-members ($y_{0i} \mid C_i = 0$) are used to represent the unobserved counterfactual ($y_{0i} \mid C_i = 1$), i.e. the price current members would have obtained had they not joined a cooperative. Thus,

Naïve estimator: $\equiv E[y_i \mid C=1] - E[y_i \mid C=0]$

$$= E[y_{1i} - y_{0i} \mid C=1] + \{E[y_{0i} \mid C=1] - E[y_{0i} \mid C=0]\}$$

$$= \text{ATT} \qquad + \text{[bias]}$$

Heckman et al. (1998) provide a useful decomposition of this bias term (Heckman, Ichimura et al. 1998):

$$bias \equiv E[y_{0i} \mid C=1] - E[y_{0i} \mid C=0] = B_1 + B_2 + B_3 \qquad (4)$$

The first two sources of bias arise from differences in the distribution of observed characteristics X between the two groups. B_1 represents the bias due to lack of common support in observable characteristics, which leads to comparing uncomparable individuals, that is, using non-members with characteristics that are not representative of cooperative members as the control group from which to recover the coop effect. For instance, in this sample there are 85 cooperative members but no non-members who are located at an altitude higher than 600 m; thus, at least with respect to altitude, there is no comparable non-member for this group of members. B_2 is the bias due to mis-weighting of individuals in the common support, which may arise because the distributions of observable *Xs* are not necessarily the same between the two groups even when restricted to the group with comparable characteristics. For instance, there may be much fewer large farmers among cooperative members than among non-members, so that larger non-members should be weighted down in order to be representative of the few large members, but the naïve estimator simply attaches the same weight to all observations regardless of their distribution. B_1 and B_2 in the context of this sample will be illustrated in more detail in section 6.5.1.

The third source of bias, B_3, is the classic econometric 'selection bias', arising from selection into cooperative membership due to unobservables, and leading to correlation between the error term in the price equation and the membership dummy. This may arise if:

a] Selection into cooperative membership occurs on the basis of observable characteristics which also influence prices paid but are omitted from the model;

b] Individuals select into a cooperative on the basis of unobserved characteristics which also influence prices paid, e.g. unobserved ability;

c] Selection occurs on the basis of unobserved individual impacts, i.e. if an individual is somehow able to anticipate her individual specific price gain from becoming a cooperative member and makes her choice, at least in part, on the basis of that.

Because of these three potential sources of bias, the non-member outcome may not be an accurate representation of the price cooperative members would have received had they not become members. Each non-experimental method used in this chapter makes different identifying (that is, non testable) assumptions in order to recover the missing counterfactual and estimate the impact of cooperative membership in the presence of selection decisions by individuals, which will be discussed in the remainder of this section. Implicitly, each method thus provides a different approach to constructing the counterfactual. Estimates from the different methods may differ because they rely on different assumptions, deal with different sources of bias, and to some extent answer different questions on the population of interest, as is the case with LATE.

6.3.3. Least squares

The identifying assumption of OLS is that selection into cooperative membership occurs only on the basis of observable characteristics. The additional assumption of the classical dummy variable regression model is that observed characteristics affect potential outcomes linearly and in the same way: the treatment effect is represented by an intercept shift of two linear functions, one for members and one for non-members, that are, otherwise, the same, and membership has the same impact for all individuals, so that $ATT = ATNT = ATE = b$.

OLS has the obvious advantage of precision without needing much data, which makes it attractive in this application. It can also be made more flexible in the specification of functional form by using a fully interacted linear model (FILM). This consists in including as additional regressors a set of interaction terms between each explanatory variable and the membership dummy. This is also informative because it allows testing for the actual presence of observably heterogeneous effects with respect to individual *Xs*.

However, OLS suffers from essentially the same potential sources of bias that characterise the naïve estimator: it does not restrict the analysis only to comparable individuals and in practice extrapolates into regions outside the common support, if any (B_1); it weighs observations without taking into account the potential difference in distribution of observed characteristics between members and non-members (B_2); and it ignores possible selection on unobservables (B_3). If any of these problems are present, the least squares estimate of the cooperative effect will be biased. Matching methods share the same identifying assumption of no selection on unobservables, but can address B_1 and B_2 in a superior way to OLS, albeit at the potential cost of sample selection bias, as will be discussed in the next section.

6.3.4. Propensity score matching

Propensity score matching (PSM) is a semi-parametric method which seeks to *ex-post* mimic an experiment, by choosing a comparison group among non-members that is as similar as possible to coop members with respect to their observed characteristics (Imbens 2004). PSM constructs a statistical comparison group by modelling the probability of cooperative membership on the basis of observed characteristics unaffected by membership itself. Members are then matched on the basis of this probability, or propensity score, to non-members with comparable propensity scores (Rosenbaum and Rubin 1983). Individuals for which no match is found are dropped because no basis exists for comparison. There are several available approaches to define the counterfactual and match members and non-members on the basis of their propensity score. The discussion of the method I use in this chapter, and of what guides my decision to use a many-to-one, kernel based method instead of a one-to-one, nearest neighbour method, is left for the empirical discussion in section 6.5.4. The average effect of coop membership is then calculated as the mean difference in prices across these two matched groups.[43]

The key identifying assumption of matching is the Conditional Independence Assumption (CIA), that is, the assumption that, conditioning on the relevant set of *Xs*, the distribution of prices paid is the same for members and non-members. If the CIA holds, then the average price paid of the matched non-members represents the correct counterfactual for the missing information on the price members would have received on average, had they not joined a cooperative.

Overall, matching deals with B_1 and B_2 in a superior way to OLS, because its comparison of outcomes (prices) is non-parametric and thus avoids functional form specifications, and because it chooses and appropriately weights observations within the region of overlapping support of members and non-members. If the data present regions where overlapping support fails, however, as is the case with my data, matching is implemented by restricting the analysis only to those observations falling within the region of common support, and the parameter has to be redefined accordingly. If the

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[43] In practice, matching recovers the ATT by estimating non-parametrically the conditional expectation function for non-members, $E[y_i \mid C_i = 0, X]$, and averaging it over the propensity score distribution of members within the region of common support (if this restriction is needed). Matching pairs to each member *i* some group (or even just one) of 'comparable' non-members, and associates to the price received by member *i*, y_i, a matched price $\hat{y}_i$, given by a weighted average of comparable non-members. The general form of the matching estimator for the average coop effect on members (within the common support) is given by $\beta_{ATT} = \frac{1}{N_1^*} \sum_{i \in \{C_i = 1 \cap S^*\}} \{ y_i - \hat{y}_i \}$, where N_1^* is the number of members within the common support S*. $1/N_1^* \sum \hat{y}_i$ is the estimate of the average non-membership counterfactual price for members. The general form of the counterfactual to be matched to member *i*'s price is $\hat{y}_i = \sum_{j \in S^0(\tilde{X}_i)} W_{ij} y_j$, where $S^0(\tilde{X}_i)$ defines member *i*'s neighbours in the comparison group; and W_{ij} is the weight attributed to non-member(s) *j* in order to form a comparison with member *i*.

impact of membership differs across members, restricting to the common support may generate a sampling bias in the membership effect. Moreover, matching suffers from the same drawbacks as OLS with respect to selection on unobservables.

In addition to this, in the particular case of this research, the small sample size, and having a smaller group of non-members than of cooperative members, may also be a problem: it would be highly desirable to have a large sample size for the 'control' group, in order to have a wider choice as to which non-member(s) are the closest match for each member. Because of the small number of non-members, paired non-members may actually be quite far from their matched member; moreover, the same non-member will have to be used many times, leading to an increase in the standard error and a loss of precision in the estimated parameter. Nevertheless, matching is used in this analysis in a comparative way in order to gather some additional information as to the extent to which OLS estimates of the coop effect may be biased due to B_1 and B_2.

I now turn to discussing the methods used to deal with potential selection on unobserved characteristics: instrumental variables and control function methods.

6.3.5. Instrumental variables

If individuals select into a cooperative on the basis of their unobserved characteristics, the error in the price equation will have non-zero expectations. If an instrument can be found which is correlated with membership status and uncorrelated with the unobservables in the price equation, then IV methods provide a solution to the bias due to selection on unobservables (B_3). The IV estimator of the impact of cooperative membership is consistent in the homogeneous returns case, while its interpretation needs to be changed if heterogeneous returns are allowed for; this will be discussed in more detail below. For an instrument Z to be valid, it must satisfy the orthogonality condition and it must be relevant for predicting coop membership. Orthogonality means that $E[u \mid X, Z] = E[u \mid X]$, that is, once other covariates are controlled for, the instrument is exogenous and affects prices solely via its impact on the membership decision. Relevance means that $P(C = 1 \mid X, Z)$, that is, that the probability of being a cooperative member depends in a non-trivial way on Z.

Once a valid instrument has been found, IV can be implemented using a two-stages least squares estimator (IV-2SLS). The first stage estimates a 'reduced form' relationship, and the second stage estimates the 'structural' relationship of primary interest. In the reduced form equation, the coop membership dummy is specified as a function of all the exogenous variables in the structural equation and the set of instrumental variables. The *predicted values* from this OLS reduced form equation are then included in the structural equation (the price equation) in place of the problematic membership dummy.

Given the binary nature of the membership variable, the first stage regression could be estimated using a nonlinear method such as logit or probit. However, Angrist (2001) and Angrist and Pischke (2009) argue that the second-stage estimates will be inconsistent if the first stage model is incorrectly specified. Instead, a standard 2SLS procedure is always safe, because it gives consistent estimates regardless of the non-linearity of the first stage, and thus should be preferred.[44]

The coop effect estimate recovered by IV-2SLS is essentially the change in prices paid induced by a change in the instrument, averaged out by the change in cooperative membership induced by a change in the instrument. However, if price gains from coop membership are allowed to be heterogeneous, the meaning of the parameter needs to change to an estimate of a local average treatment effect (LATE) (Angrist 2001; Angrist and Pischke 2009), that is, the average coop effect (conditional on *X*) among those individuals who are induced to change their membership status because of a change in the instrument, known in the literature as 'compliers'. The concept of compliers can be explained by supposing that, for each chosen instrument, there are four groups of people: those who would always join a cooperative regardless of the value of the instrument ('always-takers'); those who would never join regardless of the value of the instrument ('never-takers'); and those who are *induced* by the instrument to change their behaviour, either in a discordant way, i.e. joining the cooperative if the instrument is unfavourable ('defiers'); or in line with the instrument, i.e. join the cooperative if the instrument is favourable ('compliers'). LATE makes an assumption of monotonicity: the instrument has the same directional effect on all individuals whose behaviour it changes, *de facto* excluding the possibility of either defiers or compliers. If Z favours

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[44] A complicating factor is the possible presence of heteroskedasticity of unknown form, which could result in inconsistent estimates of the standard errors, preventing valid inference. An alternative may be to use the generalised method of moments (GMM-IV). In the case of exactly identified equations, however, the method of moments gives a solution that is equivalent to the standard IV estimator (Baum, Schaffer et al. 2007).

participation, this amounts to excluding the possibility of defiers. In order to identify the ATT, one would have to assume that the individual gain would be the same for the always-takers and for the compliers, i.e. for all cooperative members.

LATE can be controversial. It is essentially defined for an unobservable sub-population and will also typically vary according to the instrument used, because different instruments may induce different people to modify their behaviour. Moreover, when heterogeneity in unobserved individual gains is important, LATE could vary widely according to the local average it recovers, because compliers could be a group with very high or very low gains from membership.

Overall, is IV always to be preferred to OLS? As long as the two key instrument's properties (relevance and orthogonality) are satisfied, the IV estimator is consistent. However, it is not an unbiased estimator, because, just like OLS, still needs to deal with functional form specifications and is thus subject to the same potential misspecification biases B_1 and B_2 which matching avoids. Moreover, the precision of IV estimates is lower than that of OLS estimates (Baum, Schaffer et al. 2007). Assuming a relevant and exogenous instrument has been found, it is then possible to test for the exogeneity of the problematic regressor, using a Wu-Hausman test. The null hypothesis in this case is that cooperative membership is exogenous. The test compares OLS and IV estimates and explores whether the differences in the estimates are systematic. If they are, then the null is rejected, suggesting a bias of OLS, and IV should be preferred. Otherwise, OLS estimates should be preferred, because they are more precise and because they avoid the controversial LATE interpretation. The power of the test is however contingent on having valid instruments. If the instruments are weak and/or non-exogenous, the power of the test is poor.

6.3.6. Control function method

The control function method recovers the average coop effect by controlling directly for the correlation of the error term in the price equation with the membership dummy. For this, an explicit model of the membership selection process is required. The control function approach augments the price regression with an additional equation determining membership choice. In a similar way to IV, an exclusion restriction is required in order to identify the equation determining the membership probability, i.e. a determinant of the membership decision that can be omitted from the price equation. Assuming a joint distribution for the errors in the price and membership equation (usually, joint normality is assumed), an estimate for the part of the *error term* in the price equation that is correlated with coop membership is constructed. This estimate of the non-zero conditional mean of the unobservables in the price equation is then included in the price equation itself in the form of standard inverse Mills ratios (IMR), which fully control for the relationship between the unobservable determinants of prices paid and the selection into a cooperative.[45] The IMR can be consistently estimated from a binary response model, in a similar way to the standard selection model.

The control function method recovers the ATT even when individuals select into cooperative membership based on their unobserved individual gains from it, unlike IV, which would only be able to recover a LATE. The distributional assumptions made allow the control function method to recover also ATE and ATNT. Moreover, the estimated coefficient on the IMR is informative on the presence of selection on unobservables and on the direction of the selection process. The control function

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[45] Suppose that in the general heterogeneous returns model (3)

$$y_i = m_0(X_i) + (b(X_i) + b_0)C_i + (b_1 - b_0)C_i + \alpha_i + \varepsilon_i$$

cooperative membership C_i is determined according to the binary response model

$$C_i = 1(m_C(Z_i, X_i) + v_i \geq 0) \qquad \text{where } v_i \text{ is distributed independently of Z and X.}$$

Assuming joint normality of the distribution of the error terms in the membership and in the price equation, the unobserved ability term α_i and the unobserved individual returns b_i can be decomposed in the following way:

$$\alpha_1 - \alpha_0 = r_{\alpha v} v_i + \xi_{\alpha i} \qquad with \quad v_i \perp \xi_{\alpha i}$$

$$b_1 - b_0 = r_{bv} v_i + \xi_{bi} \qquad with \quad v_i \perp \xi_{bi}$$

Given this, the conditional mean of the unobservables can be written as:

$$E[(\alpha_1 - \alpha_0) \mid Z_i, X_i, C_i = 1] = r_{\alpha v} \lambda_{1i}(X_i, Z_i)$$

$$E[(\alpha_1 - \alpha_0) \mid Z_i, X_i, C_i = 0] = r_{\alpha v} \lambda_{0i}(X_i, Z_i)$$

$$E[(b_1 - b_0) \mid Z_i, X_i, C_i = 1] = r_{bv} \lambda_{1i}(X_i, Z_i)$$

where λ_{0i} and λ_{1i} are the conditional mean terms, or 'control functions' that fully control for the dependence of the unobservables of prices paid on the selection into a cooperative. The price equation can now be written as

$$y_i = \alpha_0 + m_0(X_i) + (b(X_i) + b_0)C_i + r_{\alpha v}(1 - C_i)\lambda_{0i} + (r_{\alpha v} + r_{bv})C_i \lambda_{1i} + \omega_i$$

where the conditional mean of ω_i is now zero, because the additional terms $(1 - C_i)\lambda_{0i}$ and $C_i \lambda_{1i}$ eliminate the bias introduced by the endogeneity of cooperative membership. These control function terms depend on the unknown reduced form $m_C(\cdot)$ and on the distribution of the unobservables, and under the joint normality assumption they take the form of the standard inverse Mills ratios from a selection model (Heckman 1979), that is

$$\lambda_{0i} \equiv -\frac{\varphi(m_C(Z_i, X_i))}{1 - \Phi(m_C(Z_i, X_i))} \qquad and \qquad \lambda_{1i} \equiv \frac{\varphi(m_C(Z_i, X_i))}{\Phi(m_C(Z_i, X_i))}$$

method in facts allows testing *separately* for presence of either selection on unobserved characteristics or selection on individual unobserved gains from membership, whereas IV only allows testing for a joint hypothesis of presence of either kind of selection on unobservables. These tests can be very informative *per se*, on the reliability of the conditional independence assumption of OLS and matching methods.

6.3.7. Summary on the recovered cooperative effect using the different methods

Ignoring selection on unobservables for a moment, matching dominates over OLS if common support is a problem in the data and if the distribution of *Xs* varies widely between members and non-members and also within the region of common support, provided that restriction of the analysis to the region of common support does not result in sampling bias from, for instance, exclusion of members with no comparable characteristics to non-members. If there is selection on unobservables, both OLS and matching will be biased. If, for instance, individuals with higher unobserved ability are more likely to join a cooperative, matching and OLS estimates will be upward biased, because this selection component is ignored. Assuming that the exclusion restriction for the instrument used by IV and control function methods is valid, if there is selection into cooperative membership on the basis of unobserved characteristics and gains from membership are homogeneous across individuals, both IV and control function methods should recover the average membership effect on members. If gains from membership are heterogeneous across individuals, the control function method recovers the ATT directly, while IV recovers an instrument-related local average, which could be very different from the average coop effect for a random individual in the population.

The adequacy and implications of each of these estimation methods ultimately rest on a conceptual framework of the determinants of producer price variation, of the drivers of the membership decision, and of the relationship between the two. The next section gives empirical content to this framework.

6.4. Empirical specifications

This section is organised as follows. Section 6.4.1 discusses the main specification used for the estimation of variation in milk producer prices, and the robustness checks performed. In order to get an idea of whether the error term of the price equation is likely to be correlated with the unobservables of the process of self-selection into cooperative membership, Section 6.4.2 briefly recalls this process and the explanatory variables of the cooperative membership equation, from Chapter 4. Section 6.4.3 then discusses how the unobservables of the two equations may be correlated. If such correlation exists, instrumental variable or control function approaches can be used, but both rely on the satisfaction of the exclusion restriction, that is, on the availability of a valid instrument. Section 6.4.4 discusses the validity of the instrument used with respect to its relevance and exogeneity to prices paid.

6.4.1. The price equation

The basic empirical specification for the estimated price equation is the following:

$Ln(price)_i = \alpha + \beta_1 coop_i + \boldsymbol{X'_i\beta} + e_i$

Where $ln(price)_i$ is the log of self-reported producer price. Three different equations are estimated separately, one for base price, one for premia-adjusted price, and one for final price (which includes the base price, the premia, and any end-of-year bonus or cooperative dividend). $coop_i$ is a dummy equal to 1 if the respondent is a cooperative member and zero otherwise. $\boldsymbol{X'_i\beta}$ is a set of covariates which economic theory suggests may be related to producer price variation. These can be grouped into three broad groups: raw milk quality, local market conditions and transaction costs for processors.

Milk quality is the first obvious reason why prices paid may vary across farmers. Milk quality can vary with respect to milk nutrients (fat and protein content) and bacterial count, partly because of location-specific agro-ecological characteristics. Raw milk quality at the farm is controlled for by including four characteristics: cattle breed, stalling facilities, human capital and agro-ecological characteristics. Cattle breed in the farm is proxied with the share of cattle in the municipality which is of a breed that produces milk with a higher fat and protein content (i.e. with higher quality). Stalling facilities are measured with a dummy equal to 1 if the farm has modern stalling facilities and zero otherwise. Modern stalling facilities are defined as any stalling facility where cattle are not kept chained to a fixed position when inside the cowshed, but are rather free to move around, which improves cattle health and milk quality (Cook 2002). The human capital contribution to milk quality is captured with the inclusion of farm manager characteristics (gender, number of years of experience as farm manager and number of years of schooling), the highest number of years of schooling completed by any other household member older than 18, except the head, and average age of all the household members working on farm.

Agro-ecological characteristics are proxied with the minimum altitude (i.e. the lowest altitude point) of the municipality where the farm is located. Yields per cow tend to be lower at higher altitudes, but the fat and protein content tends to be higher, leading to higher quality at higher altitudes (Pieri and Del Bravo 2008). It is important to note, however, that altitude may influence prices paid also via other channels, as discussed in Chapter 4: by influencing transportation costs, local geographical characteristics may influence (a) the nature of market structure in a given area, i.e. both number and organisational form of competitor(s); and (b) farmers' relative isolation and thereby their vulnerability to the potential exercise of market power by private processors, and therefore farmers' propensity to join a cooperative. The reason why altitude is interpreted here mainly as a proxy for milk quality is that both farm's relative isolation and the degree of competition between processors are already to some extent reflected in the correlates capturing local market characteristics (discussed below). Another interpretation of altitude, which I however am unable to disentangle from quality, is that costs of production may be higher at higher altitudes.

Endogeneity of price and raw milk quality at the farm may be a concern. A farmer may try to adjust milk quality to respond to quality premia paid by the processor. This could be done by changing quantity and composition of feeds, breed composition of the herd, type of stalling, or other unobserved farming practices. However, this problem may not be too serious here, even though use of feeds is unobserved. Altitude and human capital proxies are exogenous; changing stalling facilities is costly and often requires lengthy administrative permits, which makes it relatively unlikely to respond quickly to changes in quality premia in a given year; and aggregate herd composition with respect to breed in a municipality is expected to be less responsive to the changes in quality premia experienced by any individual farmer *i* than herd composition at farm *i* itself.

The degree of competition between firms (in this case, processors) is sometimes measured in the literature with the number of such firms operating in a given area (Barron, Taylor et al. 2004; Sauer, Gorton et al. 2012). The number of processors operating in each municipality is only available for Trento and Piacenza and will be used only in the robustness checks so as not to reduce sample size. The measures used in the main specifications are: (a) a dummy equal to one if the farmer perceives she has at least one available alternative buyer, and zero otherwise, which is expected to capture farmers' perceived level of competition and which also avoids the problem of arbitrarily defining a market area as a municipality; and (b) the average distance (mid-point to mid-point) between the municipality where the farm is located and the municipalities of the closest three processing firms operating in the province; competition between firms at a given location is expected to increase as the distance between them decreases. Local market conditions are further controlled for by including the total number of dairy farmers operating in the municipality where the farm is located. With respect to possible endogeneity between the degree of competition and prices paid, in the long run, when entry and exit of processing firms is possible, one can expect local milk prices to influence local market structure, i.e. both number and nature of processing firms. However, for the purpose of this research, which looks at one point in time, local market structure may be reasonably considered as exogenous.

Farm scale of production is relevant for prices paid if processors face transaction costs when dealing with farmers. Scale of production could be measured in various ways, including quantity of milk sold, quantity of milk produced and farm herd size. There may be concerns regarding the potential endogeneity of quantity sold and price paid: a farmer may choose the quantity produced and sold in response to the price offered. However, there are various reasons to suspect relatively low – or slow – responsiveness of farmers to milk prices paid, even in case the base price and premia scheme for the whole year is agreed upon at the beginning of the year, as noted in Chapter 4, Section 4.5.2. Estimation of farm milk supply as a function of milk price paid, variable inputs (family and hired labour), fixed inputs (land and type of stalling facilities), human capital proxies, the coop membership dummy and a control for agro-ecological characteristics shows no significant effect of price paid on quantity sold (results reported in Table 1-A in the Appendix). The log of annual farm milk output is used in the estimation of price paid in all the main estimations, while the log of milk sold and that of farm herd size are used as an additional robustness check.

The log of farm-to-plant distance is included in order to test empirically for use of FOB or UD spatial pricing policy by processors, controlling for location of milk transfer with a dummy equal to 1 if processor collects milk at the farm gate, and zero otherwise. Province dummies are included in all specifications to control for unobserved local characteristics.

The robustness of the base OLS specification is checked by comparing its results with those obtained with different specifications to account for possible different measures of farm scale of production (herd size and output sold) and of competition (adding to the other measures also the number of processors buying milk from the municipality where the farm is located, available for Trento and Piacenza); base OLS results are also compared to those obtained when standard errors are clustered by provinces or municipalities, to control for the fact that individual farmers' prices within the same geographical unit may not be independent from each other.

Before discussing what is likely to be included in the error term of the price equation, and how this may relate to the unobservables of the process of self-selection into a cooperative, the next section briefly recalls the determinants of selection into cooperative membership, discussed in Chapter 4.

6.4.2. The cooperative membership equation

Pooling together cooperative members located where cooperatives are the only available buyer with farmers who have some alternatives and select one may mean mixing together individual characteristics influencing farmers' propensity to join a cooperative, and local conditions influencing the nature of the available alternatives, with possible confounding effects. However, the theory suggests that factors favouring organisation of milk processing and marketing in a cooperative form, and the characteristics favouring individual cooperative membership are broadly similar and revolve around vulnerability to market power (Staatz 1987a). As in Chapter 4, cooperative membership is modelled, for both the full sample and the sub-sample who perceives both organisational forms are available, as a function of the following characteristics:

(a) Relative farm isolation, proxied with the minimum altitude of the municipality where the farm is located, expected to increase the likelihood of membership;

(b) Farm scale of production, measured with herd size on farm, expected to decrease the likelihood of membership as farm size increases;

(c) Asset specificity, proxied with the municipal share of cattle producing higher quality milk;

(d) Individual demographic characteristics of the household and of the farm manager, which may influence vulnerability to potential exercise of market power;

(e) Local market conditions, proxied with the degree of competition between processors (farmer's perceived availability of alternative buyers and average distance between the municipality where the farm is located and the three closest processing firms) and total number of suppliers (dairy farmers) in the municipality;

(f) Parental membership status, measured with a dummy equal to 1 if the parents of the current farm manager have ever in their life been members of a dairy processing and marketing cooperative, and 0 otherwise.

This is the selection model used in the control function approach. Most of these characteristics, in fact, with the exception of the membership status of parents, are expected to simultaneously influence cooperative membership and prices paid. The membership status of parents is the excluded instrument used in this analysis and will be discussed in Section 6.4.4. The next section discusses how the error term in the price equation may be related to the unobservables in the membership equation.

6.4.3. The error term in the price equation

The error term in the price equation is likely to capture, among other things, measurement error in the dependent and explanatory variables, unobserved individual gains from membership and unobserved individual characteristics, such as unobserved ability. The latter two may also influence the membership decision.

Measurement error in the dependent variable (i.e. the log of producer prices paid) is not unlikely in this case, but only impacts on the efficiency of the estimates.

The possibility of measurement error in the cooperative dummy is of greater concern. This would happen if, for instance, a cooperative member is disloyal to her cooperative and sells milk to a private buyer, does not disclose this information in the survey, and reports the price paid by the private buyer.[46] If this measurement error is correlated with membership status, then estimates may be biased, and it is not possible to know *a-priori* the direction or magnitude of the bias (Kane, Rouse et al. 1999).

Unfortunately, it is not possible to gauge the extent to which this may be a problem here. While throughout the thesis it is assumed that only cooperative members sell to a cooperative, and no cooperative member sells to a capitalistic processor, Pascucci et al., in an analysis for the whole of Italy and across all sectors in agriculture, showed that this is often not the case: they found that 24% of farmers selling to capitalistic processors are formally cooperative members and that 29% of farmers selling to cooperatives are non-members (which however does not mean that the latter have a contract with a capitalistic processor and are being disloyal, as they may simply have not entered into any contractual arrangement) (Pascucci, Gardebroek et al. 2011). It is also not possible to have an *a priori* idea of the direction of the resulting potential bias in the cooperative effect on prices paid, because the characteristics of this hypothetical group of 'disloyals' in my sample are not known. However, one of the reasons why I adopted a completely anonymous survey instrument was in the attempt to reduce as much as possible this type of incentives (Hurd, McFadden et al. 1998). Moreover, considering only formal cooperative members who do not sell to their cooperative, Pascucci et al. found that this is most likely to happen in the south of Italy and among members of cooperatives specialised in olive oil production, while membership and delivery to the same cooperative are most likely in dairy processing and marketing cooperatives and when the owner of the farm enterprise also works in her farm. Given that my sample is entirely composed of dairy farmers, who own and work in their own farm, on balance I do not consider measurement error in the membership dummy of particular concern in this case.

A farmer may join a cooperative at least in part on the basis of her expected gains from membership, which may vary across individuals on the basis of both observed and unobserved characteristics. An example could be a farmer who knows that the quality of her production will improve especially in the situation of collaboration and information sharing fostered by a cooperative, knows that this higher quality is likely to result in

[46] The survey asked respondents to indicate both whether they were members of a processing and marketing cooperative, and the name of the main buyer of their milk. There were no cases in which a cooperative was named as main buyer by a non-member, or an IOF by a member, but this may, of course, be a biased response if farmers choose not to disclose their disloyalty to their buyer in order to project a positive self-image.

higher prices paid, and selects into a cooperative because of this higher expected gain. If this is uncontrolled for, it will lead to a positive correlation between the error terms of the price and membership equation, and to an upward bias in the least squares estimate of the coop effect on prices paid.

Another potential source of correlation between the error terms in the two equations is unobserved ability, i.e., in the notation of section 6.3.1, the correlation between α_i and C_i. While one can reasonably expect unobserved ability to be positively correlated with prices paid, its relationship with cooperative membership may go either way and it is difficult to determine *a priori* which mechanism may prevail in practice and the direction of the resulting potential bias. One may expect that cooperative members are individuals with systematically higher ability, because they simultaneously have to manage their own farm *plus* a jointly owned enterprise, while non-members only have to manage their own farm. If this is the case, α_i and C_i will be positively correlated, inducing an upward bias in the least squares estimate of the coop effect. Alternatively, one may suspect that individuals with lower ability are more likely to join a cooperative because of the pooling component of this arrangement, looking for some form of redistribution from higher- to lower-ability members: a farmer is paid individually for the quality of her product; however, the final price she receives, which includes the dividend, that is, a share of the cooperative profit, depends, among other things, not only on the quality she produced, but also on the quality produced by all the other members. If lower-ability farmers are more likely to join, α_i and C_i will be negatively correlated and the estimated least-squares parameter will be downward biased.

Instrumental variable and control function approaches can deal with the potential endogeneity of price and coop membership, but both depend on the availability of a valid instrument. This is discussed in the next section.

6.4.4. The available instrument: membership status of parents

The excluded instrument for cooperative membership used in this analysis is the membership status of parents. This, to recall, is measured with a dummy equal to one if the parents of the current farm manager had ever in their life been members of a dairy processing and marketing cooperative, and 0 otherwise. This is not necessarily the same cooperative of which current farmers are members. How good a solution to the problem of selection on unobservables is provided by the instrument depends on whether the instrument is relevant and orthogonal (that is, exogenous): a good instrument, z_i, must be highly correlated with the endogenous explanatory variable $coop_i$, but uncorrelated with the outcome variable $ln(price)_i$, once other covariates are controlled for.

With respect to relevance of the instrument, as discussed in Chapter 5, Section 5.3.3, there is evidence that the membership decision of current farmers depends in a non-trivial manner on the membership decision of parents. Intergenerational transmission of membership status may also reflect, in part, a market structure that has remained essentially unchanged over time, providing the same kind of options from parents to children, but inclusion of covariates controlling for local market characteristics and relative farm isolation is expected to control for this. Instrument exogeneity with respect to prices paid, once other covariates are controlled for, has to be assumed and cannot be tested because there is only one instrument. A simple binary correlation between price paid and parental membership shows no statistically significant correlation for base and premia-adjusted prices (p-values are 0.34 and 0.19 respectively), but a 0.13 correlation with final price, significant at 5% (p-value = 0.017). However, because farm location tends to be the same from parents to children, parents' membership status may be picking up local agro-ecological and market structure characteristics, which in turn are related to prices paid. Once these other covariates are controlled for in the price equation, there is no particular reason to expect parents' membership status to be correlated with current farmers' unobserved ability or expected gains from cooperative membership, i.e. with the unobservables in the price equation.

If intergenerational transmission of membership depends on farmers having a *status quo* bias, however, one may argue that such *status quo* bias may derive from, overall, a higher vulnerability to the market due to unfavourable observed and unobserved characteristics. Whether or not this is a problem for the use of this instrument, however, will depend on the extent to which these 'unfavourable' traits are sufficiently accounted for by observable characteristics such as, among others, schooling, gender, farm scale of production, relative farm isolation and availability of alternatives.

Another potential problem with the use of this instrument is similar to that that arises when using lagged values of causal variables (Weil 2007): instrument exogeneity assumes that parental membership is correlated with current membership and uncorrelated with current price; however, this may not hold if there is serial correlation in the error term in the price equation. However, the lag between parental and current membership is quite large in the sample, where mean age of current farm managers is 50 and mean number of years they spent managing the farm directly is 22. A number of events, including changes in weather and policy, likely occurred over this time, weakening the possible serial correlation in prices and reducing this threat to validity. At the very least, membership status of parents removes the element of temporal proximity, if not simultaneity, between price agreement between farmer and processor and farmer's decision of whether or not to join or remain with a cooperative.

6.5. Estimation of the cooperative effect on prices paid

This section presents and compares the results of the different estimation methods used to recover the cooperative effect on prices paid. Table 6.2 summarises, for each type of price studied and for each method, the coefficient and standard error (in parenthesis) of the estimated effect of coop membership on prices paid, as well as the estimated average treatment effect (ATE) and average treatment effect on the treated (ATT) expressed as the percentage change in price resulting from cooperative membership. The ATE is the percentage change in price that a random individual in the sample would obtain as a result of cooperative membership; the ATT is the percentage change in price due to coop membership for actual members only. For IV-2SLS, the reported percentage change should be interpreted as a local average treatment effect (LATE): the effect of coop membership on those individuals who joined a coop because their parents had been coop members at some point in their lives, but would not have joined had their parents never been coop members (the group known in the literature as 'compliers').

All estimations were conducted using the Huber–White estimator of variance, which is robust against many types of misspecification of the model, except for the control function estimation, where standard errors were generated by bootstrapping with 50 replications. Only the results obtained with the main specifications are presented in Table 6.2. In the Appendix can be found (a) the full results of all estimation methods (Tables 3-A to 11-A), except OLS which will be presented in section 6.6; (b) the full results of all the robustness checks (Tables 12-A to 15-A). All estimations are conducted on the full sample and on the sub-sample of farmers who perceive both coops and capitalistic processors are available to them.

Table 6.2: Results for the estimation of the effect of coop membership on prices paid

		FULL SAMPLE			SUB-SAMPLE		
	Estimator	(1) Base price	(2) Premia-adjusted	(3) Final price	(4) Base price	(5) Premia-adjusted	(6) Final price
(1)	*Naïve estimator*						
(1.a)	Coefficient	0.100***	0.099***	0.118***	0.012	0.012	0.051**
(1.b)	St. error	(0.016)	(0.018)	(0.017)	(0.017)	(0.020)	(0.021)
(1.c)	ATE = ATT (% higher price)	10.5%	10.4%	12.5%	1.2%	1.2%	5.2%
(2)	*Least squares (OLS)*						
(2.a)	Coefficient	0.025	0.031*	0.054***	0.001	-0.002	0.034*
(2.b)	St. error	(0.017)	(0.019)	(0.018)	(0.018)	(0.020)	(0.020)
(2.c)	ATE = ATT (% higher price)	2.5%	3.1%	5.5%	0.05%	- 0.2%	3.5%
(3)	*Fully interacted linear model(FILM)*						
(3.a)	Coefficient	0.105***	0.058*	0.061*	0.008	-0.008	0.033
(3.b)	St. error	(0.029)	(0.033)	(0.032)	(0.019)	(0.024)	(0.023)
(3.c)	ATE (% higher price)	11.1%	6%	6.3%	0.8%	-0.8%	3.3%
(3.d)	ATT (% higher price)	13.5%	6.7%	6.4%	1.9%	0.1%	1.8%
(4)	*IV-2SLS*						
(4.a)	Coefficient	0.030	0.047	0.127	-0.006	0.021	0.064
(4.b)	St. error	(0.073)	(0.077)	(0.082)	(0.096)	(0.110)	(0.128)
(4.c)	LATE (% higher price)	3%	4.8%	13.5%	-0.6%	2.1%	6.6%
(5)	*Control function (homogeneous effects)*						
(5.a)	Coefficient	0.030	0.059	0.101**	0.009	0.049	0.068
(5.b)	St. error	(0.044)	(0.056)	(0.047)	(0.110)	(0.129)	(0.118)
(5.c)	ATE = ATT (% higher price)	3%	6.1%	10.6%	0.9%	5%	7%
(6)	*Control function (heterogeneous effects)*						
(6.a)	Coefficient	0.007	0.047	0.104*	-0.016	-0.022	0.024
(6.b)	St. error	(0.059)	(0.064)	(0.062)	(0.099)	(0.111)	(0.147)
(6.c)	ATE (% higher price)	0.6%	4.8%	10.8%	-1.6%	-2.2%	2.4%
(6.d)	ATT (% higher price)	0.7%	5.7%	11.2%	-3.3%	-0.1%	5.3%
(7)	*Propensity Score Matching*						
(7.a)	Coefficient (ATT)	0.032	0.043*	0.056**	-0.010	-0.020	0.026
(7.b)	St. error	(0.021)	(0.026)	(0.026)	(0.023)	(0.028)	(0.028)
(7.c)	ATE (% higher price)	2.5%	3.3%	4.6%	-0.8%	-1.4%	2.7%
(7.d)	ATT (% higher price)	3.4%	4.5%	5.7%	-1%	-2%	2.6%

Dependent variable is in logs. Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

6.5.1. The naïve estimator and sources of bias

In the general framework (3) discussed in Section 6.3.1, a naïve estimator of the impact of cooperative membership on price paid, relative to selling to a private processor, for individuals actually observed to be cooperative members, can be written as $E[y_i \mid C=1]-E[y_i \mid C=0]$, that is, the simple difference between the observed mean price received by cooperative members and the observed mean price received by non-members. In this way, earnings of non-members ($y_{0i} \mid C_i = 0$) are used to represent the unobserved counterfactual (y_{0i} | C_i = 1), and this can give rise to the sources of bias discussed in section 6.3.1.

According to the naïve estimator (row (1.c) in Table 6.2), cooperative members in the full sample receive a base price that is 10.5% higher, a premia-adjusted price that is 10.4% higher and a final price that is 12.5% higher than what they would have obtained had they not been members. The naïve estimate of the cooperative effect on the restricted sample of farmers who perceive both organisational forms are available is 1% for base price and for premia-adjusted price and 5.2% for final price. The effect on base and premia-adjusted prices is not just much smaller now, but also statistically not significant.

For both samples, this naïve estimate is likely to be composed by the actual cooperative effect (if any) plus a bias, given by possible differences in the distribution of characteristics between the groups of members and non-members and by possible selection into a cooperative due to unobserved characteristics. Selection bias issues will be addressed in the discussion of results obtained with IV and control function methods. Already at this stage, however, it is worth investigating the data further with respect to sources of bias due to differences in the distribution between the two groups. These essentially boil down to two issues. First, comparing uncomparable individuals, that is, a lack of overlapping support in characteristics, which leads to using as counterfactual for the price members would receive if supplying a private processor the outcome of a group of non-members which is not representative of members' characteristics. Second, mis-weighting comparable individuals, which may arise because the distributions of observable *X*s are not necessarily the same between the two groups even when restricted to the common support.

Recall from Chapter 4, Section 4.5.1, that cooperative members and non-members are significantly different in a number of characteristics. A visual inspection of the distribution of a few key variables, farm altitude, scale of production and average distance from the three closest processors, highlights the fact that both lack of common support and potential mis-weighting of observations within the common support are a concern with this sample.

Figure 6.5 compares members and non-members with respect to the distribution of altitude of the municipality where the farm is located, for the full sample and by province. The figure shows some lack of overlapping support between the two groups (B_1), which can be found also in each of the three provinces. Namely, 85 cooperative members located at a minimum altitude between 615 m and 1390 m have no comparable non-member with respect to altitude of the municipality. If, as expected, there is a positive relationship between altitude and milk quality, and a positive relationship between milk quality and price paid, ignoring this non-comparability would lead to overestimating the effect of cooperative membership, because non-members, predominantly located at lower altitude, are giving an overly pessimistic view of the price actual members would have been paid had they not been members. The figure also shows that the distribution of altitude between members and non-members differs within the region of overlapping support (B_2): the density of non-members is much higher than that of members at lower altitudes, while it is lower than that of members at altitudes above 450 m. The naïve estimator gives all observations the same weight, while a proper estimator should give less weight to the first and more weight to the second in order to make non-members' outcome as good as possible a measure of members' outcome had they not joined a coop.

Figure 6.5: Farm altitude: distribution by membership status by province

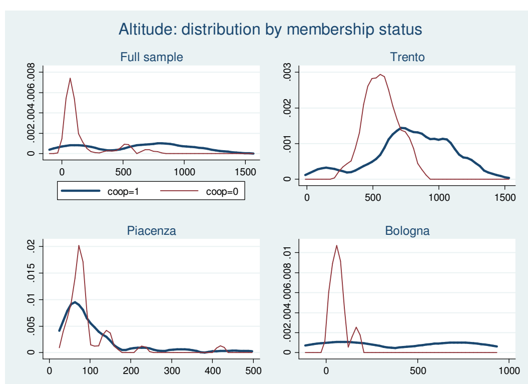


Figure 6.6 shows the distribution of annual farm milk output between the two groups. Lack of overlapping support is not as problematic in this case, but the distribution varies between the two groups, with farm scale of production much more skewed to the left for cooperative members than for non-members. The overall sample distribution seems however to be driven by Trento and, to a lesser extent, Bologna, while the distributions appear to be much more similar in Piacenza. If there is a positive relationship between output scale and prices (due to transaction costs for processors), ignoring this difference in distribution would lead to underestimating the effect of coop membership on current

members, because non-members, predominantly producing larger quantities, provide an overly optimistic picture of the price current members would obtain outside the coop.

Figure 6.6: Annual farm milk output: distribution by membership status by province

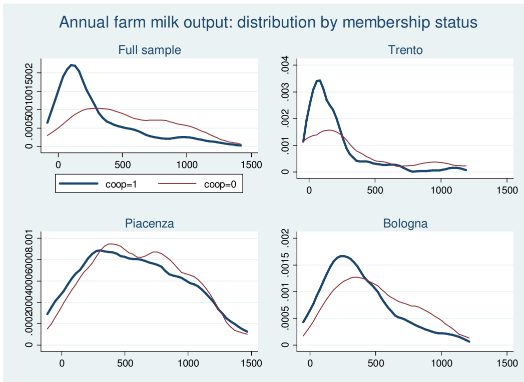
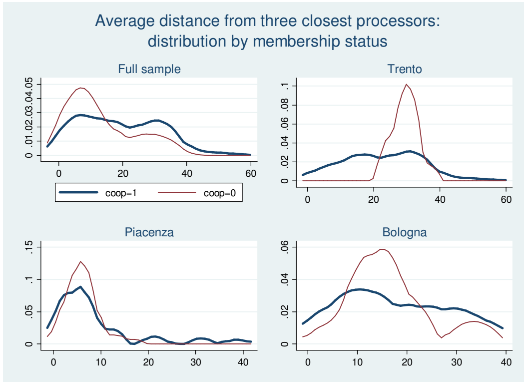


Figure 6.7 shows the distribution for the two groups of the average distance between the municipality where the farm is located and the municipalities where the three closest processors are located. Lack of common support appears to be a problem in Trento (where no non-members are located either relatively close or very far from closest processor) and Piacenza (where no non-members are located very far). Looking at the full sample, the density of non-members is however higher than that of members when distance is lower and lower when distance is larger, reflecting the fact that overall non-members are less isolated with respect to processors than members. Of course, the location of processors is itself likely to be related to local geographical characteristics. If, as hypothesised, there is a negative relationship between distance among processors and competition in the market for raw milk, and if more competition increases prices paid, ignoring these differences between members and non-members will again lead to underestimating the effect of cooperative membership for current members.

Figure 6.7: Average distance from the three closest processors: distribution by membership status by province



When these characteristics are examined for the sub-sample (figures included in the Appendix), it appears that problems of lack of common support in some parts of the data and of differences in distribution within the common support persist for altitude and distance, while they are reduced substantially for farm output.

Overall, this discussion suggests care is needed not just when considering the naïve estimator, but also when interpreting OLS estimates of the coop effect, to which I now turn, because the OLS estimator presents essentially the same potential biases that characterise the naïve estimator.

6.5.2. Least squares

Results of a standard linear least squares model for the full sample (row (2.c) in Table 6.2) show that cooperative membership has a fairly small effect on base price, 2.5%, which however is not statistically significant. The effect on premia-adjusted price is barely significant at 10% and suggests that premia-adjusted prices are, on average, 3.1% higher for cooperative members. The effect of cooperative membership on final prices is significant at 1% level and indicates that cooperative membership increases prices paid by 5.5%, on average and *ceteris paribus*. At the sample mean final price (40.26 eurocents/lt), this is a price increase by 2.23 eurocents/lt. Looking only at the sub-sample of farmers perceiving that both organisational forms are available, the membership effect is positive on base prices and negative on premia-adjusted prices, but neither effect is statistically significant and the point estimate is very small. The effect on final prices is statistically significant at 10% and its magnitude is equivalent to a 3.5% higher final price received by cooperative members. At the mean final price for this sub-sample, this is equivalent to a price increase by 1.31 eurocents/lt, on average and *ceteris paribus*.

Because this standard linear model constrains the effect of cooperative membership to be homogeneous across individuals with different characteristics, the estimated ATE and ATT are the same. If however the effect of cooperative membership varies across individuals with different characteristics, the estimated average treatment effect may differ from the membership effect on members, and the standard OLS regression will, in general, produce biased estimates of the ATT.

A more flexible fully interacted linear model (FILM) allows exploring whether heterogeneous membership impacts are present. This model includes as additional explanatory variables a set of interaction terms between all the explanatory variables and the membership dummy. A test for joint significance on the interaction terms can then be used to asses whether or not impact heterogeneity is present. Full results of FILM estimation, including the F-test for joint significance of the interaction terms, are reported in Table 3-A in the Appendix. Coefficients, ATE and ATT for the membership effect are reported in rows (3) in Table 6.2 above. The hypothesis of heterogeneous impacts of coop membership depending on individual characteristics can be rejected for final and premia adjusted price, but not for base prices: in this case, the interaction terms are jointly significant with an F-test of 2.30 for the full sample and 2.14 for the sub-sample (bottom row in Table 3-A in the Appendix). For the full sample, this result appears to be mostly driven by the significant interaction of the cooperative dummy with minimum altitude: the effect of cooperative membership on base prices is significantly stronger for farmers located at higher altitudes. There is also some evidence (barely statistically significant) that the effect of cooperative membership on base prices is stronger for larger farmers, for farmers that are located closer to the processing plant of their buyer, and for those that are located closer to the processing plant of the nearest three buyers.

FILM estimates, which allow for the coop effect to vary across individuals with different characteristics, suggest that current members, given their characteristics, would have received a significantly lower base price had they not been members: the average effect of membership for this group in the full sample (the ATT reported in row (3.d) of Table 6.2) is 13.5%, equivalent to a 5.6 eurocents/lt estimated lower price had they not been members. This is a much larger estimate than the 2.5% higher base price estimated by linear OLS, suggesting that ignoring observably heterogeneous effects leads to a downward bias in the standard least squares estimate of the cooperative effect on base prices paid. There is no evidence of heterogeneous returns of membership on final prices, but the FILM estimated ATE and ATT for the full sample (rows (3.c) and (3.d) in Table 6.2) are 6.3% and 6.4% respectively, both higher than the estimated linear OLS (homogeneous) effect of 5.5%. For the sub-sample, FILM does not reveal a statistically significant coop impact on any of the prices, but the estimated magnitude of the ATE on final prices is very similar between FILM and linear OLS (3.3% and 3.5% respectively). Before trusting the least squares estimates, however, it is necessary to deal with concerns about selection bias, potentially resulting in endogeneity of membership and prices paid, and about bias arising from differences in the distribution of characteristics between members and non-members, which may lead to comparing non comparable individuals. In the next section, I start by addressing the concern that cooperative membership and prices paid may be endogenous, with IV-2SLS and control function methods.

6.5.3. Selection on unobservables? IV-2SLS and control function

My first approach was to estimate the cooperative effect on prices with IV-2SLS, instrumenting the membership dummy with the dummy for parental membership status. The instrument appears to be strong for the full sample estimation, with an F-statistic ranging between 19.3 and 20.1 (reported at the bottom of Table 4-A in the Appendix), well above the rule of thumb of 10 suggested in the literature (Staiger and Stock 1997). Unfortunately, however, the instrument is not strong enough for the sub-sample of individuals with both types of alternatives, as shown by an F-statistic ranging between 2.8 and 4. First stage estimation results for both samples are presented in Table 6-A in the Appendix. The evidence just discussed on heterogeneous effects on the basis of observable characteristics suggests that also the 2SLS model should account for this and in particular for heterogeneity of membership impacts on the basis of farm altitude. I attempt to control for this endogenous interaction as well (results reported in Table 5-A in the Appendix) with an interaction term between altitude and parental membership status. However, the instruments appear not to have enough power to identify this model, as shown by their Shea's 'partial R-squared' reported at the bottom of Table 5-A, and this leads to poor performance of the interacted IV model.[47] The remainder of this discussion of IV-2SLS estimates will focus only on the model without the endogenous interaction, presented in Table 4-A in the Appendix.

Focussing on the estimated coop effect for the full sample, reported in Table 6.2 above, all the point estimates tend to be larger than the linear OLS estimates, and markedly so for final prices, where the estimated effect is 13.5% (row (4.c) in Table 6.2). However, none of these estimates is significantly different from zero. These estimates should in any case be interpreted as a LATE, that is, as the local average effect of cooperative membership for those farmers who were induced to become members by the fact that their parents had, at some point in their life, been members of a cooperative. The difference in OLS and IV-2SLS estimators may be due, at least in part, to the fact that 'compliers', for whom LATE is estimated, may be a sub-population with different characteristics from the general population. Besides this, however, is this difference in estimated coefficients evidence that the OLS estimated cooperative effect is downward biased? This could be the case if, for instance, unobserved farmer ability positively affects prices paid, and if farmers with higher unobserved ability are systematically less likely to join a cooperative. However, the Wu-Hausman test (statistic reported at the bottom of Table 4-A in the Appendix) indicates that, in this model, the hypothesis of exogeneity between prices paid and cooperative membership cannot be rejected. In this situation, the OLS model should be preferred, because it provides more precise estimates and also avoids the controversial implications of estimating the cooperative effect on the even more specific sub-group of compliers as is the case with LATE.

An alternative approach to controlling for potential selection on unobservables is provided by the control function method, which includes in the price equation a term that controls directly for the correlation between the error term in the price equation and the error term in the membership equation. This method augments the price regression with an additional equation fully specifying the determinants of coop membership. This also allows testing directly for presence of selection on unobservables, by testing for the significance of *rho*, the coefficient on the selection parameter (the inverse Mills ratio) which represents the correlation between the two equations. Full results are reported in

[47] Shea's 'partial R-squared' is a measure of instrument relevance that takes inter-correlation among instruments into account.

Tables 7-A and 8-A in the Appendix, allowing for homogeneous and heterogeneous membership impacts respectively.

The estimated membership equation, as discussed in section 6.4.2, includes all the covariates included also in the price equation, except stalling facilities, farm-to-plant distance and location of milk collection, which are expected to influence prices paid but not membership decision. The excluded instrument, included in the membership equation but not in the price equation, is also in this case parental membership status. The excluded instrument is highly significant in the membership equation for the full sample, less so for the sub-sample (results reported in Table 9-A in the Appendix). As expected, and as in the first stage of the IV-2SLS estimation, there is some evidence that more isolated farmers with smaller scale of production are more likely to join a cooperative. The membership equation for the sub-sample of farmers with both types of alternatives, however, does not appear to be well determined.

With respect to the outcome equation, assuming homogeneous impacts, the estimated cooperative effect on all prices (rows (5) in Table 6.2 above) is larger than the least squares estimate and close to the IV-2SLS one, at least for the full sample. Only the effect on final prices for the full sample, however, is statistically significant at 5% level, and estimated to be 10.6%, on average and *ceteris paribus* (row (5.c) in Table 6.2), suggesting a downward bias in the least squares estimate of 5.5%. Nonetheless, the correlation coefficient between the membership and price equations, rho (bottom line in Table 7-A in the Appendix), is never statistically significant, implying that the hypothesis of no selection bias on unobserved characteristics cannot be rejected, conditional on the inclusion of other covariates. This coefficient, although not significant, may however still be informative: it is consistently negative, also for the sub-sample. This, together with a smaller OLS estimate compared to the control function estimate, may provide some – weak – indication that farmers with less favourable unobserved individual characteristics are more likely to join a cooperative. If the only relevant characteristic is unobserved ability, this appears to suggest that lower-ability farmers are more likely to join a cooperative, possibly looking for some form of redistribution from higher- to lower-ability members.

The control function method also allows testing separately for the presence of selection on unobserved characteristics and on unobserved heterogeneous gains from membership. This has to be done manually by estimating the membership equation as a separate probit, calculating the inverse mills ratio and an interaction term between the

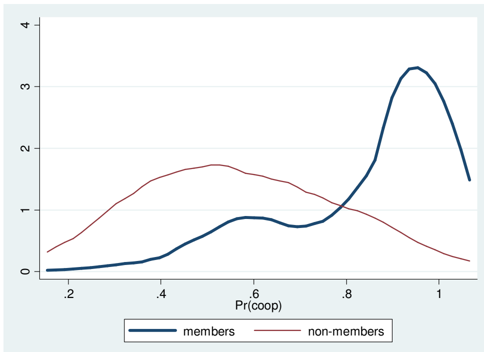
IMR and the cooperative dummy (the measure of selection on unobserved heterogeneous gains), and including them both in a least squares estimation of the price equation. Full results are reported in Table 8-A in the Appendix. With respect to membership impacts, only the estimated ATE and ATT on final prices for the full sample are statistically significant (rows (6.c) and (6.d) in Table 6.2 above). Results indicate an ATE of 10.8% and an ATT of 11.2%. Results show no evidence of selection on either unobserved characteristics or unobserved heterogeneous gains from membership (as shown by the coefficients on *mills* and *mills*coop* at the bottom of Table 8-A in the Appendix).

Overall, there do not seem to be sufficient elements to reject the conditional independence assumption (that is, selection into membership only on the basis of observed characteristics) that underlies OLS. It is now necessary to investigate further the concern that the OLS estimates may be biased because of a difference in the distribution of characteristics between members and non members, leading to a comparison of non-comparable people. This is done via propensity score matching, bearing in mind that this dataset is not particularly suited to the employment of this technique, which requires a large sample size and especially a larger sample size for the 'control' group of non-members. Yet, matching can help gauging to what extent the least squares estimate of the cooperative effect may be suffering from B_1 and B_2 types of bias.

6.5.4. Taking into account differences in the distribution of characteristics between members and non-members: propensity score matching (PSM)

The first step for implementing propensity score matching is the estimation of a probit model of cooperative membership. This should include all variables simultaneously affecting membership and prices paid. Results are reported in Table 10-A in Appendix. The predicted outcome represents the estimated probability of membership, or propensity score. The second step requires defining the region of common support where the distributions of the propensity scores for members and non-members overlap. As expected and shown in Figure 6.8, there are common support problems at very low and at very large propensity scores, and matching will result in dropping individuals located outside the common support area, in particular some cooperative members with very large propensity scores.

Figure 6.8: Distribution of propensity scores for members and non-members



Several different matching methods may be used to pair each member with a non-member on the basis of the propensity score. The criterion I use for choosing among methods is based on how well the estimator balances the characteristics of members and non-members, that is, whether or not it appears that the matching estimator is comparing comparable people who only differ on the basis of their membership status but not with respect to other observed characteristics. I explored one-to-one, nearest neighbour matching (with replacement) and many-to-one matching (choosing the 5 nearest neighbours), both with and without caliper.[48] With both methods, members and non-members still appeared to differ with respect to most observed characteristics. I then explored kernel matching, which constructs the counterfactual for each member by using a weighted average of the outcomes of all non-members, where the weight given to each non-member is proportional to the closeness of her observable characteristics to those of members; that is, non-members with a propensity score closer to that of members are given more weight in the estimation. Members whose propensity score is larger than the largest propensity score of non-members are off the common support and are left unmatched.

With kernel based matching, members and non-members within the common support appear well balanced and do not differ with respect to any of the observable characteristics considered. However, a very large share of members is lost, restricting

[48] Imposing a caliper amounts to imposing a threshold or tolerance on the maximum propensity score distance between members and non-members. The caliper I imposed, quite stringent, was 0.01.

the comparison to just 70 members and 50 non-members. Comparing characteristics of members on and off the common support (Table 11-A in the Appendix), it appears that non-comparable, excluded members are, on average, located at higher altitudes and in areas where cattle producing high quality is prevalent, less likely to have an alternative buyer, less likely to have modern stalling facilities and more likely to be managed by a woman. Matching clearly faces a trade-off between achieving comparability of members and non-members and potential sampling bias due to the exclusion of some members outside the region of common support, at least for the full sample.

Focussing on the coop effect on actual members (ATT, reported in row (7.d) in Table 6.2 above), results show that members within the common support receive on average a base price that is 3.4% higher because of their cooperative membership, a premia-adjusted price that is 4.5% higher and a final price that is 5.7% higher. The effect on premia-adjusted prices is significant at 10% and that on final prices is significant at 5%. The effect of membership on final prices is very similar to that estimated with OLS (5.5%), while the estimated least squares effect on base and premia-adjusted prices appears to be slightly underestimated.

The sub-sample of farmers who perceive both types of buyers are available is sufficiently well balanced (as expected because members and non-members are relatively more similar in this sub-group than in the full sample) and no observations are lost. The kernel matching estimator suggests no statistically significant effect of cooperative membership on prices paid for this group. Also the magnitude of the effect is small (smaller than OLS, as shown in rows (7.c) and (7.d) in Table 6.2), and actually negative for base and premia-adjusted price: -1% and -2% respectively, and a 2.6% higher final price.

6.5.5. Summary of results on the coop effect and robustness checks

Overall, the results show some evidence of a positive effect of cooperative membership on prices paid for the full sample, which however tends to become significant and larger only for final prices. This is robust across different specifications for farm scale of production and for competition among processors (Tables 12-A and 13-A in the Appendix), and also when the standard errors are clustered by province and municipalities to control for possible correlation in prices within geographical areas

(Tables 14-A and 15-A in the Appendix). Cooperative membership is however not consistently found to have an effect for the sub-sample of farmers who perceive both organisational forms are available. As noted in Chapter 4, Section 4.5.1, compared to farmers whose only available buyer is their current processor, the sub-sample with both alternatives is overall located at lower altitudes, where cattle producing high quality milk are less predominant, and producing larger output quantities. This seems to suggest that what is driving the positive effect of membership in the full sample is the presence of farmers with particularly 'unfavourable' characteristics (such as relative isolation and smaller scale of production), which make them more vulnerable to the potential exercise of market power by processors and which would result in a lower price paid had they supplied a private processor. If cooperatives have a competition enhancing effect, pushing private processors to pay farmers more, lack of an observable coop effect in the sub-sample may also be driven by this invisible effect of competition, i.e. the higher prices received by non-members compared to what they would receive in the absence of cooperatives.

The analysis could not reject the hypothesis that, in these models, selection into cooperative membership only occurs on the basis of observed characteristics, and that membership and prices paid are exogenous. For this reason, least squares results are preferred because they provide more precise estimates. Comparability of members and non-members is however problematic in the data. Estimation via propensity score matching in principle should help addressing this sort of bias, but confronts the trade-off between achieving comparability and sampling bias from excluding observations off the common support. The PSM estimated effect of cooperative membership for members within the common support is actually very similar to the full-sample OLS estimate for final prices. Members off the common support however present characteristics more conducive to vulnerability to potential exercise of market power by processors (including higher altitude and fewer available alternatives). The positive effect of membership may actually be larger for these individuals, and the PSM effect of membership for members on the common support might be underestimating the overall effect on all members.

6.6. Results on the other determinants of variation in prices paid

The analysis in this section is conducted mainly on the least squares results for the full sample and for the sub-sample of farmers with both cooperatives and private processors as perceived available alternatives, presented in Table 6.3 below. Results obtained with IV-2SLS and control function methods (Tables 4-A to 8-A in the Appendix) are used for comparison and to check robustness of key findings to alternative estimation methods. The robustness of the baseline OLS results is also compared to the least squares results obtained with different specifications for farm scale of production (herd size and output sold) and competition (number of processors buying milk from the municipality where the farm is located); and to those obtained with clustering of the standard errors into provinces or municipalities (results reported in Tables 12-A to 15-A in the Appendix).

Three key results emerge consistently across estimation methods, samples and specifications: milk quality, farm-to-plant distance and gender of farm household head are significantly related to producer prices paid.

Table 6.3: OLS regression results for variation in producer prices paid

	FULL SAMPLE			SUB-SAMPLE		
Ln(Price):	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final
Farmer is coop member (1 = yes)	0.025	0.031*	0.054***	0.001	-0.002	0.034*
	(0.017)	(0.019)	(0.018)	(0.018)	(0.020)	(0.020)
Ln(minimum altitude municipality)	0.042***	0.030**	0.022*	-0.000	-0.016	-0.004
	(0.014)	(0.013)	(0.013)	(0.012)	(0.016)	(0.016)
Modern stalling facilities (1 = yes)	0.026	0.032	0.021	0.067***	0.077***	0.085***
	(0.023)	(0.024)	(0.023)	(0.023)	(0.028)	(0.029)
N yrs experience as farm manager	-0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.001	-0.001	0.001	0.004	0.004	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Gender hh head (1 = female)	-0.036	-0.068**	-0.053**	-0.059**	-0.098**	-0.118***
	(0.024)	(0.028)	(0.027)	(0.025)	(0.040)	(0.043)
Highest n yrs schooling in hh	-0.001	0.002	0.002	-0.005*	-0.003	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Average age of hh members working on farm	0.000	0.000	0.000	0.001*	0.001**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% of cattle producing high quality milk in municipality	0.003***	0.002***	0.003***	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	0.006	0.013	0.017	-0.025*	-0.023	-0.028*
	(0.013)	(0.013)	(0.012)	(0.013)	(0.016)	(0.015)
Farmer perceives other buyers available (1=yes)	-0.031	-0.034	-0.008			
	(0.022)	(0.023)	(0.022)			
Ln(average distance from 3 closest processors)	-0.011	0.008	0.010	-0.009	0.002	-0.009
	(0.011)	(0.011)	(0.011)	(0.016)	(0.018)	(0.017)
N dairy farms in municipality	0.000	0.000	-0.000	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.025***	-0.026***	-0.020***	-0.015*	-0.016*	-0.013
	(0.008)	(0.008)	(0.008)	(0.009)	(0.010)	(0.010)
Processor collects at farmgate (1 = yes)	-0.042	-0.050*	-0.025	-0.093**	-0.110**	-0.073
	(0.029)	(0.030)	(0.029)	(0.041)	(0.046)	(0.044)
Trento	-0.161**	-0.113*	-0.091	0.052	0.084	0.068
	(0.064)	(0.063)	(0.058)	(0.069)	(0.070)	(0.078)
Bologna	0.105***	0.097***	0.073**	0.079**	0.064*	0.084**
	(0.030)	(0.031)	(0.030)	(0.033)	(0.038)	(0.039)
Constant	3.400***	3.411***	3.367***	3.742***	3.796***	3.730***
	(0.107)	(0.103)	(0.101)	(0.104)	(0.106)	(0.107)
Observations	241	241	265	106	106	113
R-squared	0.420	0.380	0.358	0.348	0.367	0.340
F	11.62	9.961	10.33	2.830	4.099	3.943

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

The significant milk quality variables for the full sample are different from those that appear as significant for the sub-sample with both cooperatives and private processors as perceived available alternatives. For the full sample, the importance of milk quality for prices paid is indicated by the positive effect of minimum altitude of the municipality where the farm is located and of the share of cattle producing higher quality milk in the municipality, as expected. The effect is fairly small, however, at least for altitude: a 10% increase in the minimum altitude of the municipality increases base price paid by 0.4% and final price paid by 0.2%. At the sample mean base and final price, this amounts to 0.15 and 0.08 eurocents per litre, respectively. The effect is stronger for herd composition: a one percentage point increase in the share of cattle in the municipality producing higher quality milk increases final price paid by 0.3%, equivalent to 0.12 eurocents per litre.

The sub-sample with both types of available alternative buyers is more homogeneous with respect to agro-ecological and cattle characteristics; thus, it is not surprising that these variables do not appear to play a very important role for these farmers. Instead, the importance of milk quality in this group is indicated by the significance of modern stalling facilities, which appears to increase base price paid by 6.9% (2.4 eurocents/lt) and final price by 8.9% (3.4 eurocents/lt). In addition to improving hygienic conditions and thereby milk quality, modern stalling facilities may also be capturing overall better farm management.

For this sub-sample there is also some indication that average age of household members working on farm is positively related with base and premia-adjusted prices paid, and that the highest level of education in the household is negatively related with base prices paid. These results are however not consistent across estimation methods and specifications. Moreover, the magnitude of the OLS estimated effect is fairly small. An increase in one year in the average age of the household members working on farm (at the sample mean, from 48 to 49) is associated with an increase in base and premia-adjusted price of 0.1%, equivalent to 0.03 eurocents/lt, suggesting, perhaps, that quality produced improves over time as the experience of household labour increases.[49] One extra year of schooling in the highest educational attainment of the household (at the sample mean, an increase from 12 to 13 years, i.e. completion of higher education equivalent to A-levels) is associated with a decrease in base price of 0.5%, equivalent to 0.17 eurocents/lt. This counterintuitive result may mean that these households are diversifying their income activities away from dairy, or that the individuals with the higher educational attainment are not actually involved in farm management issues.

With respect to farm-to-plant distance, results show a highly significant inverse relationship with prices paid, which is stronger for the full sample than for the sub-sample with both types of available alternatives, but whose magnitude is quite small. For the full sample, a 10% increase in farm-to plant distance (at the sample mean, an increase by 1.5 km) is associated with a 0.2% decrease in price paid. This finding is

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[49] An additional specification including a quadratic term for average age of family labour was also estimated, to account for possible non linearity in the relationship between age and price paid. The quadratic term is not significant and all the other results, including the positive effect of average age of family labour, remain unchanged.

consistent with adoption of FOB pricing policies and seems to contradict the anecdotal evidence I had collected during initial interviews and piloting of the questionnaire, which suggested that, when in charge of milk collection at the farm, processors (both cooperative and private) paid farmers a uniform-delivered price irrespective of farm-to-plant distance.

This result, however, appears to be driven by outliers. In fact, 67% of the sample is located at a distance from the processor that is less than 15 km; when the price equation is re-estimated for this sub-sample only (columns 1 to 3 in Table 16-A in the Appendix), there is no evidence of a significant inverse relationship between price and distance, even though its sign is still negative and magnitude fairly similar to the coefficient for the full sample. With respect to the remainder of the sample, 22% is located at a distance between 15 and 30 km; 7% is between 30 and 50km and the remaining 4% is located further away, with a maximum distance of 170 km.[50] Re-estimating the price equation for the sub-sample of farmers located at a distance of 15 km or larger, the effect becomes significant and larger than for the full sample. However, if the 12 outliers located more than 50km away are omitted (columns 7 to 9 in Table 16-A in the Appendix), the relationship becomes not significant also for this second sub-sample. Overall, these results appear to suggest that, when collecting milk at the farmgate, processors apply in general a pricing policy that is not dependent on farm-to-plant distance, consistent with UD-pricing, but charge a fee or apply a discount on prices paid for milk collection from distances beyond a certain threshold. When, on the other hand, farmers are in charge of transporting milk to the plant gate, they tend to receive a price that is higher than what obtained when processors collect at the farm gate, because it is gross of transportation costs for farmers. This is shown by the significant and negative coefficient on the dummy for milk collection at the farmgate.

Results also consistently show that female-headed farm households receive a significantly lower price. This holds for premia-adjusted and final prices for the full sample, and across all prices and with a larger magnitude in the sub-sample of farmers with both types of alternative buyers. In the full sample, female-headed farms receive a premia-adjusted price that is 7.4% lower (2.8 eurocents per litre at the sample mean) and a final price that is 5.4% lower (2.2 eurocents per litre at the sample mean) than male-headed farms. Among farmers with both types of alternatives, results indicate that

[50] This very large distance between farmer and processor is found in flat areas in Bologna, served by motorways.

female headed farms receive a 6.1% lower base price, a 10.3% lower premia-adjusted price, and a 12.5% lower final price than male-headed farms, equivalent to 2.1, 3.7 and 4.7 eurocents per litre less, respectively, on average and *ceteris paribus*. This is a sizeable effect that deserves further investigation.

The sub-sample of women farm heads is actually small: 32 for the full sample (10%) and 10 in the sub-sample with both types of available alternatives (8%). In both cases, the sub-sample of women is mostly composed of cooperative members from Trento. Women farm heads in the sample are either single, or women working full time on farm while their partner is working mostly or entirely off-farm. In both cases, these farms are likely to have less household labour available. These may also be more diversified households, where dairy farming is decreasing its importance, so that fewer resources are invested in milk production, with implications for both quality and quantity produced. There is also the possibility that, for various reasons including, broadly speaking, culture, women have lower bargaining power towards milk buyers, and even being cooperative members (as most of them are) may not have succeeded in reducing this problem. In fact, if the price equation is re-estimated for the sub-sample of cooperative members only (results presented in Table 17-A in the Appendix), the effect of gender on prices paid remains negative, but only statistically significant on premia-adjusted price: female-headed, coop-member farms receive a premia-adjusted price that is 6.4% lower than their male counterparts, equivalent to 2.58 eurocents less per litre. Among the sub-sample of cooperative members with both types of available alternatives, however, women-headed farms still receive a premia-adjusted price and final price that are 10% and 13% lower, respectively. I explore this further by comparing characteristics of female- and male-headed farms for the full sample, summarised in Table 6.4.

Female-headed households are located on average at significantly higher altitude. The role of dairy farming in household income is significantly smaller compared to male-headed farms (48% versus 70%), and their scale of production is also substantially smaller. While total land area and herd size is about half the size of male-headed farms, annual milk output of women farm heads is almost three times smaller. They are also significantly less likely to have modern stalling facilities and to hire labour. Female headed farms do not necessarily have fewer household members working on farm, but total hours per day worked on farm by both household members and farm head are significantly fewer. Even though women farm heads are slightly older, more likely to be also employed off-farm and to have completed fewer years of schooling than their male counterparts, these differences are not statistically significant. This pattern is broadly confirmed, and actually more marked with respect to differences in scale of production and in the degree of diversification of farm and household income, when focussing on the sub-sample of farmers with both types of alternatives, even though in this case the small sample size of the sub-group of female heads does not allow formal hypothesis tests. On balance, the characteristics of female- and male-headed farms appear to be so different that a reliable comparison does not seem possible: as highlighted above in the general discussion of matching, in order to have a meaningful comparison one would need to have farms that are very similar, other than in the gender of the household head. Lack of comparability makes it difficult to draw conclusions on this result.

Table 6.4: Comparison of characteristics between male and female-headed farms, full sample

	Male-headed farms			Female-headed farms			t-test
	N	Mean	St.dev.	N	Mean	St.dev.	
Minimum altitude (m)	274	360.19	310.63	32	551.92	321.64	-3.202***
Annual milk output (ton)	269	398.27	412.95	32	139.85	150.30	7.059***
Herd size	269	49.53	46.27	32	23.56	21.41	5.500***
Total land area (ha)	266	44.98	55.10	32	22.37	21.91	4.399***
% owned land	267	47.00%	35	32	34.51%	30	2.189**
% with modern stalling	271	48.34%	50	32	21.88%	42	3.298***
Hh size	273	3.01	1.25	32	2.72	1.02	1.508
N hh members working on farm	267	2.55	1.07	29	2.41	0.87	0.809
Hrs/day worked on farm by hh	267	22.72	10.97	31	17.65	9.52	2.766**
% heads also employed off-farm	269	7.8%	27	32	12.5%	33.6	-0.761
Hrs/day worked on farm by head	267	10.81	3.07	31	7.64	3.83	4.444***
% hiring labour	274	37%	44	32	12.2%	34	2.22**
Share of dairy in farm income	265	76.66	24.95	30	68.50	30.52	1.411
Share of dairy in hh income	265	69.93	29.22	30	47.83	31.99	3.615***
N years of experience	273	22.13	12.49	32	21.31	11.45	0.377
Age	251	50.04	13.37	32	53.00	12.10	-1.289
N years of schooling	270	9.15	3.47	32	8.72	3.18	0.714

*** p<0.01, ** p<0.05, * p<0.1

With respect to the other significant determinants of variation in producer prices, results on farm scale of production are not consistent across samples, estimation methods and specifications. In the full sample IV-2SLS and in the control function model allowing for heterogeneous impacts of cooperative membership, when farm scale of production is measured with annual milk output there is some weak evidence of a positive relationship with final prices paid, in line with what is expected if transaction costs for processors play a role and with payment of quantity premia. A 10% increase in milk output increases final price paid by 0.2%, or 0.08 eurocents per litre. However, this result is not found in the preferred least squares estimation and it is not consistent across different measurements of scale of production.

For the sub-sample of farms with both types of alternative buyers, results are more consistent across estimation models and specifications (although not significant when measuring farm scale of production with herd size) and are confirmed also when clustering standard errors by province or municipality. For these farmers the data actually reveal a negative, albeit weak, relationship with base and final prices paid. In the preferred OLS model reported in Table 6.3 above, a 10% increase in milk output is associated with a 0.25% decrease in base price and a 0.28% decrease in final price. At the sample mean prices for this sub-sample, this means 0.09 and 0.1 eurocents/lt less, respectively, on average and *ceteris paribus*. These results, however, appear to be driven by six outliers with annual milk output larger than 1500 tons. When the price equation for the sub-sample with both alternatives is re-estimated without these observations (results presented in Table 18-A in the Appendix), the relationship remains negative and with similar magnitude, but it is no longer statistically significant. Four of these six outliers supply a private processor, and five of them are located in Piacenza. The final price they report is the same as their base price, and they do not report obtaining any quality or quantity premia. A possible explanation for the overall inverse relationship between prices and scale of production may be that, in general, milk quality in terms of fat and protein contents begins to decrease as feeds are increasingly used to increase quantity; this in turn may impact negatively on quality premia and final prices.

The proxies for the degree of competition among processors (whether farmers perceive they have more than one alternative buyer, and the average distance between the municipality where the farm is located and the municipalities of the three closest processors) never show any statistically significant relationship with prices paid. This is consistent across samples and also holds when clustering the standard errors by province and municipality and when the additional measure of competition, the number of processors buying from the municipality, is included. This poses questions on the actual nature of competition in the areas under study.

If one focuses on the fact that the total number of processors active in each province is relatively large (ranging from 17 to 36, for a population of dairy farms ranging from 170 to 1'130 respectively), one may conclude that each processor always faces at least *potential* competition from (at least) its closest competitors, even though the distribution of processor presence is not homogeneous within provinces. This interpretation is reinforced by the large presence in all provinces of open-membership (at least formally) cooperative firms, which is expected (at least in theory) to have a pro-competitive effect by pushing prices paid by private processors to a level that is closer to what would emerge with perfect competition.

The market area within each province may however be split among processors into quasi-fixed market areas, within which each is behaving as a local monopsony. These market areas need not necessarily be based on space, i.e. geographical areas, but may follow some other criterion related to farmers' heterogeneous preferences for the different pecuniary and non-pecuniary characteristics of the transaction with each processor. One element that seems to support this interpretation is the relatively high level of inertia in outlet "choice" in this sample, whereby decisions taken in the past by either the current farm manager or her parents tend to be replicated in the present. For instance, 68% of farmers never changed their buyer since they became farm manager, and more than half of this group has been with the same buyer for more than 20 years. Moreover, the data suggest that the degree of preference heterogeneity among farmers for different transaction characteristics associated with the different ownership structure between cooperatives and private processors is not trivial: Chapter 5 highlighted how almost 60% of farmers stated that payment of a higher price alone by a processor with a different organisational form from that of their current buyer would not be enough for them to leave their current buyer. This finding may be extended to imply a considerable level of 'loyalty' of farmers to their existing buyer in particular, which in turn may favour the existence of quasi-monopsonistic market areas for individual processors. This does not need to mean, however, that individual processors are exploiting their market power by squeezing prices paid or lowering service quality below competitive levels: the large presence of alternative buyers within reasonable distance may remain as a sufficient check on monopsonistic tendencies, and overall does not rule out the existence of at least potential competition from other buyers.

6.7. Conclusions

This chapter investigated what accounts for the variation in prices paid observed in the data, and in particular whether cooperative membership, *per se*, has any effect on price received by farmers. A difference in price paid between cooperatives and private processors, with cooperatives paying a higher price, is expected in theory at high and intermediate magnitudes of transportation costs, which reduce direct economic interaction between the coop and its capitalistic rivals, and also when transportation costs are low and both types of processors adopt a uniform-delivered spatial pricing policy, as seems to be the case in the provinces under study.

The coop effect on prices paid is estimated using and comparing four different non-experimental evaluation methods (least squares, IV-2SLS, control function and propensity score matching), each of which uses different assumptions in order to construct the missing counterfactual that is needed in order to estimate the effect of cooperative membership, and addresses different aspects of the biases that may arise when using prices received by non-members to represent the prices that actual members would receive had they not joined a cooperative.

The purpose of combining these four methods is to be reasonably confident that a counterfactual is obtained that is as good a representation as possible of the price current coop members would have received had they not joined a cooperative, in order to reach a meaningful estimate of the coop effect on prices paid. To the best of my knowledge, empirical evidence on coop effects on prices paid is scanty at international level and absent for Italy, and the approach adopted in this chapter has not been used elsewhere to address this question. Comparing different estimators as done in this chapter also offers insights on the selection process into cooperative membership on the basis of observable and unobservable characteristics, and explicitly takes into account the problem of comparability of characteristics between members and non-members. The analysis was conducted on both the full sample, and on the sub-sample of farmers perceiving both cooperatives and private processors are available alternatives.

Overall, results show that higher milk quality increases price paid, as expected. Results on farm-to-plant distance and on scale of production appear to be mostly driven by outliers and become not significant when outliers are dropped. Processing firms appear to be adopting UD spatial pricing policies in the areas under study. Proxies for local market conditions never appear to be statistically significant. Female-headed farms appear to receive substantially lower prices, and this may be related to the overall lower level of resources devoted to dairy farming by these households, although comparability of female and male-headed farms seems to be problematic in the sample, not allowing to draw firm conclusions on what is driving this result.

With respect to the estimation of the effect of cooperative membership on prices paid, results show that selection into cooperative membership is mostly driven by observed characteristics (especially altitude, farm scale of production and parental membership), while selection on the basis of unobserved individual characteristics and/or expected gains from membership does not seem to play a significant role. Comparability of characteristics between members and non-members is clearly problematic in the data, but addressing it with propensity score matching entails a trade-off between comparability and possible sampling bias due to the exclusion of a sub-sample of members who have no comparable non-members and who tend to be located at higher altitudes, where higher quality milk is prevalent and where alternative buyers are less available.

Results obtained with least squares (for the full-sample) and with matching (within the sub-sample of comparable individuals) are actually very similar and indicate a positive and significant effect of cooperative membership of about 5.5% on final prices, on average and *ceteris paribus*, equivalent to about 2 eurocents more per litre. When the analysis is restricted to the sub-sample of farmers perceiving both alternatives are available, the magnitude of the cooperative effect is smaller. The least squares estimate is of 3.5% higher prices (about 1.3 eurocents/lt), but this is only significant at 10%. The matching estimate is not significantly different from zero.

Results seem to suggest that the positive cooperative effect is driven by the presence, in the full sample, of individuals with particularly ‘unfavourable’ characteristics, such as small scale of production and relative isolation, who would be significantly worse off if selling to a private processor and for whom cooperative membership provides the largest benefits. In the sub-sample where buyers with both organisational forms appear to coexist, coop membership may still have an effect, but this would be partly unobservable with the available data: as hypothesised by the theory, cooperative presence may have a competition enhancing effect, by pushing private processors to pay higher prices; part of the coop effect would thus translate into higher prices received by non-members. Unfortunately, lack of data on comparable areas where only private processors operate does not allow me to explore this possibility further.

Chapter 7 – Conclusions

This thesis analysed empirically the coexistence of cooperative and capitalistic processing and marketing firms in the market for raw milk in three Italian provinces, using a dataset I collected via a survey of dairy farmers, and investigated what accounts for variation in market structure within each province, what drives coop membership decision when choice is available, and whether there is any evidence that selling through a coop makes a difference for farmers, with respect to both price and non-price characteristics of the relationship. It confronted the limitation of working with a small cross-section sample, drawn from provinces which were not selected randomly, and which included a larger group of coop members than non-members, with quite distinct characteristics, which complicated the comparison of outcomes between the two groups. Results are considered to be mainly applicable to the provinces under studies. However, they may also be suggestive of broader trends for areas with similar characteristics to those of the areas under study, namely a geography conducive to high transportation costs and relative farm isolation, and heterogeneity in farm characteristics, where small farms coexist with larger ones.

Results suggest that geography, through its influence on transportation costs, is important for influencing the degree of competition among firms at a given location. Locations at higher altitude, where transport costs are likely to be higher due to topography, are significantly more likely to be characterised by monopsony. Geography, through its influence on agro-ecological characteristics, which in turn affect farm size and milk quality and their heterogeneity, also appears to have played an important role historically, in the three provinces, in the organisation of milk processing and marketing into a particular form, which then created incentives for both path dependence and change when new firms subsequently entered the market. The evolution of milk markets in the provinces under study broadly took two different paths. Areas characterised by high transportation costs and small and relatively homogeneous farm size were characterised by the initial organisation of milk processing and marketing into a cooperative form. Increasing returns from learning and coordination effects created incentives for new entrants to take the same form, until an increase in heterogeneity in farm characteristics pushed for a change in the path. Conversely, areas characterised by relatively low transportation costs and heterogeneous farm characteristics, with a large share of large farms and a smaller share of small farms, initially organised into capitalistic milk processing and marketing. When land distribution changed, cooperative formation began, as countervailing power and avoidance of market power.

With respect to the drivers of cooperative membership today, the data suggest that, in the areas under study, relative farm isolation and scale of production, characteristics typically related to the vulnerability to market power argument for coop membership, are related to membership status primarily by affecting the options farmers have available: where farms are more isolated and scale of production is smaller, cooperatives prevail, often to the point of being the only buyer. Conversely, when options are available to farmers, results suggest that observable farm and socioeconomic characteristics do not play a significant role in the decision to join a cooperative. The most important correlate of membership is parental membership status. The importance of the latter seems to suggest a combination of inertia in outlet choice and preference for the values associated with cooperation, which may have been transmitted from parents. This result is consistent with the pattern suggested in initial qualitative discussions with farmers, who revealed inter-generational transmission of membership and a preference for long-term relationships with milk buyers, which were perceived as fostering trust and security. Lack of evidence that variables related to vulnerability to market power matter for selection into a coop in areas where both types of buyers coexist also suggests that widespread presence of cooperative firms acts as a competitive yardstick restraining the ability of private processors to exercise market power.

With respect to the question whether selling through cooperatives makes any difference for farmers, the data provides some evidence suggesting that cooperatives are capable of providing significant benefits to farmers. In particular, it appears that cooperatives are more likely to provide technical assistance services and less likely to pay a price that is lower than agreed, and, even after controlling for other characteristics and possible endogeneity between membership status and prices paid, tend to pay a higher unit price per litre. These aspects were not immediately evident in the initial qualitative discussion with farmers, who however reported a stronger sense of trust and security when dealing with a cooperative.

The result on prices paid seems to be driven by presence, in the full sample, of individuals with particularly ‘unfavourable’ characteristics, in particular relative isolation and small scale of production, who currently confront a cooperative monopsony and who would be significantly worse off if selling to a private monopsony in the absence of the cooperative. It is to these farmers that cooperative membership provides the largest benefits. In the sub-sample where buyers with both organisational forms appear to coexist, a much smaller difference in price paid between members and non-members is found. Observing that price differences persist also in areas where firms coexist, but are smaller compared to differences that would be observed if comparing a cooperative and a capitalistic monopsony, is consistent with the predictions of the theory for the case of price competition between a cooperative and a capitalistic processor when both are using uniform-delivered spatial pricing policies, the spatial pricing policy that appears to be adopted in the provinces under study. In this case, a cooperative restricts the market area of the private processor and pushes it to increase its price above monopsony level, even though the private processor does not need to increase it to the same level of the coop in order to defend its procurement area, given that it does not fear loss of suppliers to the closed membership coop. Thus, part of the cooperative effect in areas of coexistence would be unobservable empirically with the available data, because it would consist in the price increase for non-members compared to what they would receive in a private monopsony. Lack of data on areas of private monopsony does not allow me to explore this further.

The finding that farmers can receive higher benefits, and in particular a higher price, by joining a cooperative leads to the question of why some farmers do not join, and sell to a private processor instead. I think there are three main reasons, which may interplay with each other. The first is preference heterogeneity. Different groups of people, depending on their characteristics, value differently the costs and benefits associated with cooperatives vis-à-vis capitalistic processors, as discussed in Chapter 5. Even among cooperative members, there is evidence that smaller farmers tend to value membership more than members with larger scale of production. Those are individuals for whom vulnerability to market power would be largest in the absence of cooperatives. This is consistent with findings from the initial qualitative discussions with farmers, where smaller scale farmers in mountainous regions tended to express a more positive evaluation of their experience of being in a cooperative compared to larger farmers. The latter may attribute more weight to the delay in receiving the full payment for their product and to the potentially slower decision making process in cooperatives, and may dislike having the same weight as smaller farmers in those decisions.

The second possible reason why some farmers do not join, in spite of the observed benefits and higher prices paid, is that they cannot: cooperatives may be adopting in practice a closed membership policy, even though they formally endorse the "open doors" principle. This may occur for instance on the basis of capacity constraints, production and quality requirements, or geographic restrictions. A policy of closed membership is consistent with adoption of uniform-delivered spatial pricing: the coop simultaneously chooses the price and procurement area that maximise its objective function, and does not accept deliveries from beyond its optimal market boundary, because that would entail a loss in processing. Helmberger, Cotterill and Sexton, among others and in a non-spatial framework, argue that a closed cooperative does not exercise any competitive yardstick effect on its private competitor, because its membership policy does not pose any threat to the private processors' market area and survival and leave it free to continue paying its monopsony price (Helmberger 1964; Cotterill 1987; Sexton 1990). In a spatial market, Fousekis shows that, when transportation costs are relatively high and a UD pricing cooperative competes with a FOB pricing private processor, it actually has a negative effect on the prices paid by the private processor, lowering them below monopsony level. This however is not the case when *both* firms use UD pricing, as they seem to do in the areas studied in the thesis, because presence of the cooperative pushes the private processor to raise its price above monopsony level in order to elicit increased supply from its restricted market area (Fousekis 2011). This result however depends on the assumption that farmers' supply function is linear. Presence of milk quotas in the areas under study, which can make farm supply relatively inelastic, may limit the competitive yardstick effect of UD-pricing cooperatives on UD-pricing private processors. However, non-members may still be able to enjoy some benefits resulting from presence of the cooperative, including a higher-than-monopsony price paid by the private processor, without having to sustain the costs of membership. This in turn would lower their incentives for joining even if they could.

The third possible reason why some farmers do not join is that the observed price difference is not consistent over time. This is one of the main shortcomings of observing price data at one point in time. To the best of my knowledge, unfortunately no time series study comparing producer prices between members and non-members (controlling for their characteristics) exists for Italy, nor any study on a cross section for the same or a different time period as studied here, which could offer some guidance on the robustness of the findings provided by my data with respect to broader and longer trends. Why may one suspect that the observed price difference could be a one-off? The magnitude of the cooperative effect is overall relatively small and compatible with what may be the payment of the cooperative dividend, i.e. the share of cooperative profit distributed to members in proportion to the amount of milk sold through the cooperative. In fact, the cooperative effect tends to become statistically significant only for final prices paid, that is, for the only price that includes the dividend. Because it depends on cooperative profits, the size of the dividend may fluctuate from one year to the next. Moreover, it also depends on how cooperative members decide, collectively, to distribute cooperative profits between dividends and cooperative reserves, a decision that does not follow entirely predictable rules and whose outcome, again, may vary from one year to the next. Even provided that a current private supplier has all the information on the prices paid in the previous year, including dividend, by its preferred cooperative alternative, a difference in prices paid by current and prospective buyer only determined by a potentially volatile dividend may not be enough, by itself, to push the farmer to join the cooperative.

Overall, however, a higher price paid by cooperatives driven by dividend payment implies that cooperatives are making a profit, which is then redistributed to their shareholders, that is, member-farmers. Even though cooperatives may differ in their performance depending on, among other things, managerial quality, the findings of the thesis suggest that, on aggregate, they are able to compete in the market and that they are also able to offer members a better deal than private processors. This was expected in theory because their objectives, whether to maximise welfare or prices paid, take into account surplus generated for farmers, but they could have eroded benefits to members by being inefficient. Instead, the evidence provided in the thesis suggests that, at least in the areas under study, there is no support for the view that cooperatives are an inefficient historical relic or a tool used by one group in order to extract rents on other, more vulnerable, individuals, as in the case analysed by Banerjee et al. (2001). Especially where geography favours relative farm isolation and where smaller farm scale is prevalent, banning cooperatives or tightening legislation against them in the name of ‘competition’ is unlikely to result in increased competition, and would rather favour the exercise of monopsonistic power by private processors towards farmers with an overall lower bargaining power, for whom cooperative presence and membership provide the largest benefits.

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Appendix A

Figure 1-A: Location of the three provinces in Italy

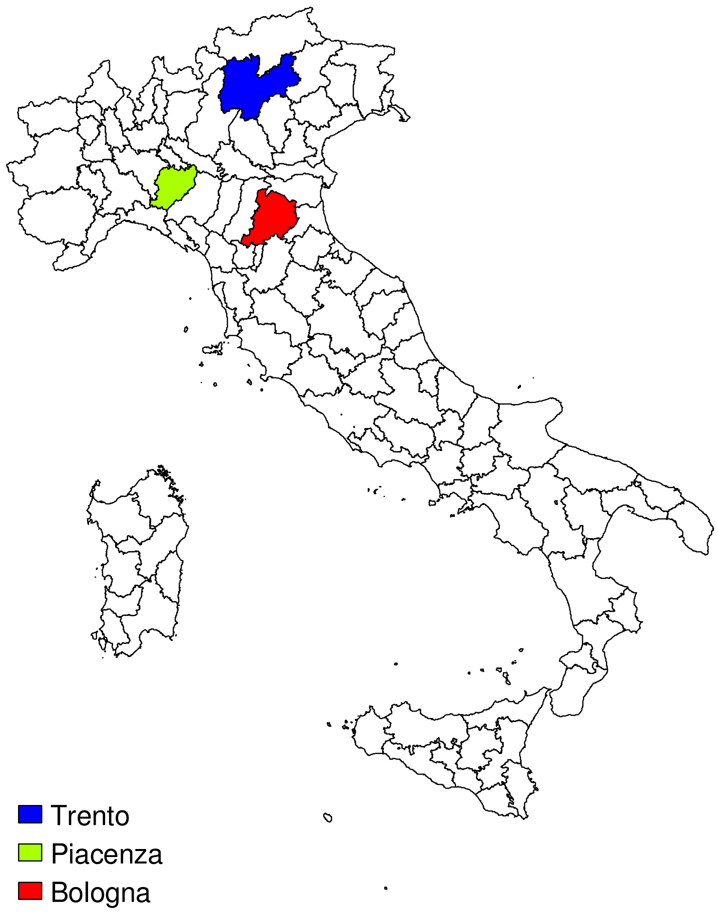

Table 1-A: OLS regression results for farm milk supply

	(1)	(2)	(3)
Dependent variable: ln(total volume of milk sold in 2007, in tons)			
Ln(base price)	-0.111		
	(0.350)		
Ln(premia adjusted price)		0.213	
		(0.379)	
Ln(final price)			0.377
			(0.345)
Farmer is coop member (1 = yes)	0.050	0.036	0.025
	(0.126)	(0.128)	(0.127)
N years of experience as farm manager	-0.002	-0.002	-0.002
	(0.005)	(0.005)	(0.005)
Gender of hh head	-0.168	-0.152	-0.212
	(0.159)	(0.159)	(0.147)
N of years of schooling of farm manager	0.033*	0.033*	0.022
	(0.019)	(0.019)	(0.018)
Highest n of years of schooling in hh	-0.034	-0.033	-0.035*
	(0.022)	(0.021)	(0.019)
Average age of hh members working on farm	-0.016***	-0.016***	-0.018***
	(0.006)	(0.006)	(0.006)
N of hh members working on farm	0.036	0.027	-0.012
	(0.085)	(0.083)	(0.078)
N hours/day worked on farm by hh members	0.013*	0.015*	0.017**
	(0.008)	(0.008)	(0.007)
Hired labour is employed (1 = yes)	0.310**	0.307**	0.366***
	(0.140)	(0.140)	(0.127)
Modern stalling facilities (1 = yes)	0.857***	0.843***	0.816***
	(0.125)	(0.127)	(0.120)
Ln(total operated land area)	0.520***	0.525***	0.518***
	(0.084)	(0.084)	(0.077)
Ln(minimum altitude)	-0.033	-0.048	-0.035
	(0.091)	(0.090)	(0.080)
Trento	-0.379	-0.384	-0.476**
	(0.249)	(0.250)	(0.226)
Bologna	-0.338**	-0.366**	-0.375**
	(0.171)	(0.172)	(0.156)
Constant	4.372***	3.250**	2.915**
	(1.353)	(1.490)	(1.328)
Observations	199	199	224
R^2	0.717	0.717	0.728
F	42.15	41.94	53.00

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 2-A: IV-2SLS model for farmers' use of technical assistance services; first stage

IV-2SLS, first stage Dep. var: farmer is coop member (1 = yes)	(1)
Parents were coop members (1 = yes)	0.280***
	(0.063)
Farmer perceives other buyers are available (1 = yes)	-0.115***
	(0.039)
Ln(N dairy farms in municipality)	0.080***
	(0.030)
Ln(minimum altitude of municipality)	0.061*
	(0.035)
Ln(farm-plant distance)	0.020
	(0.020)
All farm income from dairy (1 = yes)	-0.023
	(0.057)
Ln(N years of schooling hh head)	-0.043
	(0.070)
N of years of experience of hh head	-0.004
	(0.005)
Experience squared	0.000
	(0.000)
Trento	0.231**
	(0.101)
Bologna	0.160
	(0.098)
Constant	0.029
	(0.297)
Observations	240
R^2	0.339

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Figure 2-A: Farm altitude: distribution by membership status by province for the sub-sample

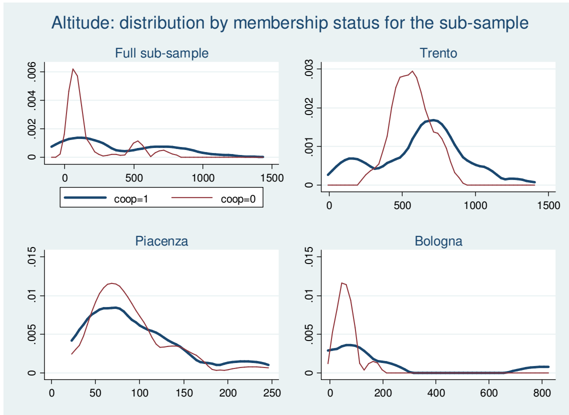

Figure 3-A: Annual farm milk output: distribution by membership status by province for the sub-sample

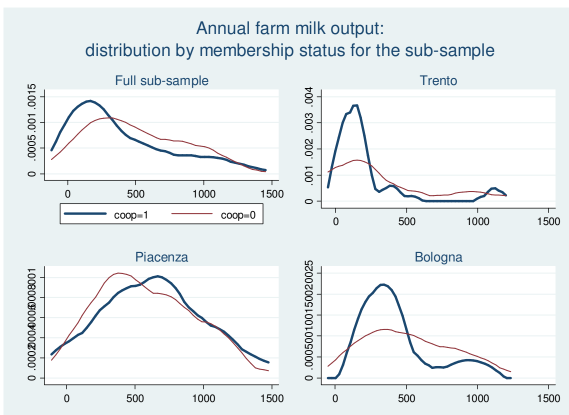

Figure 4-A: Average distance from the three closest processors: distribution by membership status by province for the sub-sample

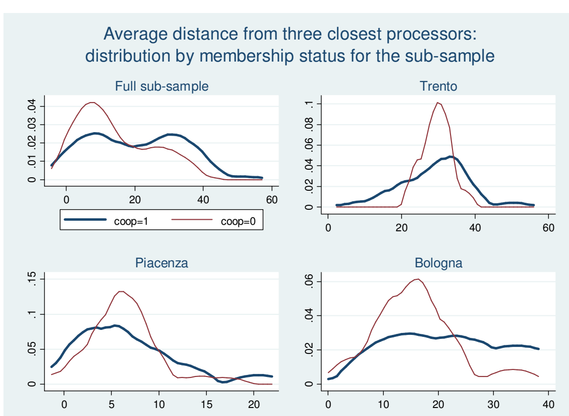

Table 3-A: Fully interacted linear model for variation in producer prices paid

FILM	FULL SAMPLE			SUB-SAMPLE		
Ln(Price):	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final
Farmer is coop member (1 = yes)	0.105***	0.058*	0.061*	0.008	-0.008	0.033
	(0.029)	(0.033)	(0.032)	(0.019)	(0.024)	(0.023)
Ln(minimum altitude municipality)	-0.013	-0.020	-0.020	-0.023**	-0.025	-0.026
	(0.011)	(0.018)	(0.019)	(0.010)	(0.020)	(0.020)
Modern stalling facilities (1 = yes)	0.037	0.055	0.056	0.047	0.064	0.064
	(0.033)	(0.050)	(0.050)	(0.037)	(0.059)	(0.058)
N yrs experience as farm manager	-0.001	-0.001	-0.002	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	-0.001	0.002	0.002	-0.003	0.001	0.001
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
Gender hh head (1 = female)	0.015	0.006	0.008	0.045	-0.001	0.001
	(0.038)	(0.067)	(0.066)	(0.052)	(0.086)	(0.084)
Highest n yrs schooling in hh	-0.002	-0.003	-0.002	-0.002	-0.002	-0.002
	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)
Average age of hh members working on farm	0.000	0.001*	0.001*	0.000	0.001*	0.001*
	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
% of cattle producing high quality milk in municipality	-0.001	0.000	0.002	-0.001	0.000	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Ln(annual farm milk output)	-0.026	-0.022	-0.021	-0.021	-0.024	-0.022
	(0.017)	(0.029)	(0.030)	(0.018)	(0.032)	(0.032)
Farmer perceives other buyers available (1 = yes)	0.023	-0.015	-0.017			
	(0.023)	(0.048)	(0.043)			
Ln(average distance from 3 closest processors)	0.035	0.049	0.050	0.047	0.042	0.043
	(0.023)	(0.031)	(0.031)	(0.031)	(0.045)	(0.045)
N dairy farms in municipality	-0.000	0.000	-0.000	-0.000	-0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	0.002	-0.017	-0.019	0.010	-0.010	-0.013
	(0.009)	(0.017)	(0.016)	(0.012)	(0.021)	(0.021)
Processor collects at farmgate (1 = yes)	-0.039	-0.052	-0.027	-0.046	-0.094*	0.000
	(0.031)	(0.032)	(0.030)	(0.045)	(0.056)	(0.000)
Trento	0.000	0.031	-0.065	0.014	0.023	-0.080
	(0.183)	(0.204)	(0.203)	(0.211)	(0.243)	(0.244)
Bologna	-0.005	-0.006	-0.012	-0.032	-0.028	-0.037
	(0.052)	(0.061)	(0.061)	(0.074)	(0.083)	(0.082)
_coop*ln(minimum altitude)	0.071***	0.062**	0.052**	0.025	0.010	0.029
	(0.021)	(0.024)	(0.025)	(0.021)	(0.033)	(0.031)
_coop*modern stalling	-0.027	-0.038	-0.049	0.016	0.012	0.025
	(0.043)	(0.057)	(0.057)	(0.049)	(0.071)	(0.073)
_coop*experience	0.001	0.001	0.002	0.002	0.002	0.002
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
_coop*schooling of hh head	0.002	-0.004	-0.000	0.016**	0.007	0.002
	(0.005)	(0.006)	(0.005)	(0.006)	(0.008)	(0.009)
_coop*gender	-0.044	-0.068	-0.055	-0.088	-0.098	-0.127
	(0.047)	(0.074)	(0.072)	(0.062)	(0.101)	(0.100)
_coop*highest schooling in hh	0.002	0.006	0.006	-0.009	-0.003	0.005
	(0.005)	(0.006)	(0.005)	(0.006)	(0.008)	(0.008)
_coop*average age hh members working on farm	-0.000	-0.001	-0.001	0.001	-0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
_coop*% cattle producing high qual milk	0.004	0.003	0.001	0.001	0.000	-0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
_coop*ln(annual farm milk output)	0.040*	0.044	0.045	-0.005	-0.001	-0.012
	(0.022)	(0.033)	(0.032)	(0.025)	(0.038)	(0.037)
_coop*other buyers are available	-0.051	-0.016	0.012	0.000	0.000	0.000
	(0.034)	(0.054)	(0.049)	(0.000)	(0.000)	(0.000)
_coop*ln(average distance from 3 closest buyers)	-0.047*	-0.039	-0.041	-0.073*	-0.049	-0.062
	(0.026)	(0.034)	(0.033)	(0.038)	(0.051)	(0.050)
_coop*N dairy farms in municipality	0.001	0.000	-0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
_coop*ln(farm-processor distance)	-0.032**	-0.012	-0.002	-0.034**	-0.011	-0.001
	(0.013)	(0.019)	(0.019)	(0.016)	(0.025)	(0.025)
_coop*processor collects at farmgate	0.000	0.000	0.000	0.000	0.000	-0.074
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.052)

_coop*Trento	-0.192	-0.173	-0.043	0.081	0.084	0.164
	(0.198)	(0.217)	(0.214)	(0.227)	(0.258)	(0.264)
_coop*Bologna	0.091	0.107	0.090	0.114	0.119	0.171
	(0.067)	(0.074)	(0.073)	(0.093)	(0.108)	(0.104)
Constant	3.704***	3.763***	3.738***	3.740***	3.833***	3.741***
	(0.076)	(0.126)	(0.126)	(0.101)	(0.151)	(0.141)
Observations	241	241	265	106	106	113
R^2	0.451	0.404	0.379	0.472	0.395	0.379
F	9.316	7.066	7.839	4.210	2.936	3.075
ATT	0.127***	0.065	0.062	0.019	0.001	0.018
	(0.036)	(0.040)	(0.038)	(0.021)	(0.028)	(0.028)
ATE	0.105***	0.058*	0.061*	0.008	-0.008	0.033
	(0.029)	(0.033)	(0.032)	(0.019)	(0.024)	(0.023)
F-test of heterogeneous effects	2.30	1.66	1.56	2.14	0.60	0.49

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4-A: IV-2SLS model for variation in producer prices paid; second stage, homogeneous effects

IV-2SLS, second stage – homogeneous effects	FULL SAMPLE			SUB-SAMPLE		
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Price):	Base	Premia-adjusted	Final	Base	Premia-adjusted	Final
Farmer is coop member (1 = yes)	0.030	0.047	0.127	-0.006	0.021	0.064
	(0.073)	(0.077)	(0.082)	(0.096)	(0.110)	(0.128)
Ln(minimum altitude municipality)	0.042***	0.028**	0.016	-0.001	-0.014	-0.004
	(0.014)	(0.013)	(0.014)	(0.013)	(0.016)	(0.015)
Modern stalling facilities (1 = yes)	0.026	0.032	0.021	0.067***	0.079***	0.088***
	(0.023)	(0.023)	(0.023)	(0.024)	(0.029)	(0.028)
N yrs experience as farm manager	-0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.001	-0.001	0.002	0.004	0.005	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Gender hh head (1 = female)	-0.036	-0.068**	-0.056**	-0.058**	-0.101***	-0.120***
	(0.023)	(0.027)	(0.026)	(0.025)	(0.038)	(0.039)
Highest n yrs schooling in hh	-0.001	0.002	0.003	-0.005	-0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)
Average age of hh members working on farm	0.000	0.000	0.000	0.001*	0.001**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% of cattle producing high quality milk in municipality	0.003***	0.002***	0.003***	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	0.006	0.013	0.019*	-0.025*	-0.024	-0.030**
	(0.012)	(0.012)	(0.011)	(0.013)	(0.016)	(0.015)
Farmer perceives other buyers available (1 = yes)	-0.031	-0.032	-0.000			
	(0.023)	(0.024)	(0.023)			
Ln(average distance from 3 closest processors)	-0.011	0.009	0.012	-0.009	0.000	-0.009
	(0.011)	(0.011)	(0.011)	(0.016)	(0.018)	(0.016)
N dairy farms in municipality	0.000	0.000	-0.001	0.001*	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.025***	-0.026***	-0.021***	-0.015*	-0.017*	-0.014
	(0.007)	(0.007)	(0.008)	(0.008)	(0.009)	(0.010)
Processor collects at farmgate (1 = yes)	-0.042	-0.050*	-0.022	-0.095**	-0.104**	-0.067
	(0.028)	(0.028)	(0.027)	(0.042)	(0.052)	(0.046)
Trento	-0.162**	-0.119*	-0.112*	0.054	0.076	0.059
	(0.067)	(0.067)	(0.061)	(0.074)	(0.077)	(0.085)
Bologna	0.104***	0.096***	0.068**	0.077*	0.071	0.089**
	(0.030)	(0.031)	(0.031)	(0.040)	(0.045)	(0.043)
Constant	3.397***	3.402***	3.325***	3.749***	3.773***	3.703***
	(0.106)	(0.105)	(0.107)	(0.145)	(0.159)	(0.175)
Observations	241	241	265	106	106	113
R^2	0.420	0.379	0.335	0.347	0.359	0.330
χ^2	208.2	185.2	179.1	54.10	77.98	73.74
Wald F-stat	20.066	20.066	19.2845	2.7822	2.7822	4.0210
Durbin-Wu-Hausman stat (p-value)	0.9456	0.8392	0.3906	0.9423	0.8489	0.8346

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 5-A: IV-2SLS model for variation in producer prices paid; second stage, heterogeneous effects

IV-2SLS, second stage – heterogeneous effects	FULL SAMPLE		
	(1)	(2)	(3)
Ln(Price):	Base	Premia-adjusted	Final
Farmer is coop member (1 = yes)	-0.205	0.194	-0.003
	(0.750)	(0.826)	(0.839)
_coop*ln(minimum altitude municipality)	0.054	-0.034	0.030
	(0.187)	(0.206)	(0.211)
Ln(minimum altitude municipality)	-0.001	0.055	-0.008
	(0.149)	(0.164)	(0.171)
Modern stalling facilities (1 = yes)	0.024	0.034	0.020
	(0.022)	(0.024)	(0.024)
N yrs experience as farm manager	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.000	-0.000	0.002
	(0.003)	(0.003)	(0.003)
Gender hh head (1 = female)	-0.039	-0.067**	-0.057*
	(0.026)	(0.029)	(0.030)
Highest n yrs schooling in hh	-0.000	0.002	0.003
	(0.003)	(0.003)	(0.003)
Average age of hh members working on farm	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
% of cattle producing high quality milk in municipality	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	0.007	0.013	0.019
	(0.012)	(0.013)	(0.012)
Farmer perceives other buyers available (1 = yes)	-0.026	-0.035	0.003
	(0.034)	(0.036)	(0.036)
Ln(average distance from 3 closest processors)	-0.010	0.008	0.012
	(0.011)	(0.012)	(0.012)
N dairy farms in municipality	0.001	0.000	-0.001
	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.023**	-0.028**	-0.020*
	(0.011)	(0.012)	(0.011)
Processor collects at farmgate (1 = yes)	-0.039	-0.051*	-0.020
	(0.028)	(0.028)	(0.027)
Trento	-0.165**	-0.117	-0.113*
	(0.071)	(0.071)	(0.064)
Bologna	0.094*	0.102*	0.063
	(0.051)	(0.057)	(0.055)
Constant	3.555***	3.303***	3.416***
	(0.532)	(0.577)	(0.603)
Observations	241	241	265
R^2	0.426	0.365	0.336
χ^2	209.0	187.4	201.0
Shea's partial R^2:			
coop	0.021	0.021	0.018
_coop*ln(minimum altitude)	0.017	0.017	0.014

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6-A: IV-2SLS model for variation in producer prices paid; first stage

IV-2SLS, first stage	FULL SAMPLE			SUB-SAMPLE		
Dep. var: farmer is coop member (1 = yes)	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final
Parents were coop members (1 = yes)	0.261***	0.261***	0.247***	0.211*	0.211*	0.240**
	(0.058)	(0.058)	(0.056)	(0.126)	(0.126)	(0.120)
Ln(minimum altitude municipality)	0.084**	0.084**	0.091**	-0.038	-0.038	0.004
	(0.038)	(0.038)	(0.035)	(0.062)	(0.062)	(0.066)
Modern stalling facilities (1 = yes)	-0.022	-0.022	-0.000	-0.067	-0.067	-0.045
	(0.060)	(0.060)	(0.056)	(0.128)	(0.128)	(0.125)
N yrs experience as farm manager	-0.000	-0.000	-0.000	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)
N yrs schooling of hh head	-0.006	-0.006	-0.006	-0.006	-0.006	-0.009
	(0.010)	(0.010)	(0.009)	(0.022)	(0.022)	(0.021)
Gender hh head (1 = female)	0.042	0.042	0.025	0.119	0.119	0.095
	(0.061)	(0.061)	(0.053)	(0.129)	(0.129)	(0.129)
Highest n yrs schooling in hh	-0.007	-0.007	-0.006	-0.017	-0.017	-0.012
	(0.008)	(0.008)	(0.007)	(0.019)	(0.019)	(0.018)
Average age of hh members working on farm	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
% of cattle producing high quality milk in municipality	-0.001	-0.001	-0.001	-0.000	-0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Ln(annual farm milk output)	-0.027	-0.027	-0.033	0.029	0.029	0.012
	(0.029)	(0.029)	(0.026)	(0.077)	(0.077)	(0.075)
Farmer perceives other buyers available (1 = yes)	-0.143***	-0.143***	-0.127***			
	(0.036)	(0.036)	(0.034)			
Ln(average distance from 3 closest processors)	-0.017	-0.017	-0.016	0.064	0.064	0.020
	(0.031)	(0.031)	(0.028)	(0.089)	(0.089)	(0.085)
N dairy farms in municipality	0.003**	0.003**	0.003**	0.002	0.002	0.002
	(0.002)	(0.002)	(0.001)	(0.004)	(0.004)	(0.004)
Ln(farm-processor distance)	0.018	0.018	0.021	0.024	0.024	0.016
	(0.022)	(0.022)	(0.020)	(0.048)	(0.048)	(0.045)
Processor collects at farmgate (1 = yes)	-0.019	-0.019	-0.022	-0.217*	-0.217*	-0.175
	(0.035)	(0.035)	(0.032)	(0.115)	(0.115)	(0.106)
Trento	0.229*	0.229*	0.205*	0.245	0.245	0.207
	(0.134)	(0.134)	(0.122)	(0.222)	(0.222)	(0.221)
Bologna	0.112	0.112	0.108	-0.183	-0.183	-0.091
	(0.103)	(0.103)	(0.098)	(0.182)	(0.182)	(0.179)
Constant	0.373	0.373	0.379	0.706	0.706	0.617
	(0.277)	(0.277)	(0.265)	(0.521)	(0.521)	(0.514)
Observations	241	241	265	106	106	113
R^2	0.361	0.361	0.340	0.267	0.267	0.252

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 7-A: Control function model for variation in producer prices paid; second stage, homogeneous effects

Control function, 2nd stage, homogeneous effects	FULL SAMPLE			SUB-SAMPLE		
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Price):	Base	Premia-adjusted	Final	Base	Premia-adjusted	Final
Farmer is coop member (1 = yes)	0.030	0.059	0.101**	0.009	0.049	0.068
	(0.044)	(0.056)	(0.047)	(0.110)	(0.129)	(0.118)
Ln(minimum altitude municipality)	0.042***	0.027**	0.022	-0.000	-0.014	-0.005
	(0.016)	(0.011)	(0.016)	(0.019)	(0.020)	(0.024)
Modern stalling facilities (1 = yes)	0.023	0.029	0.016	0.064***	0.073**	0.082**
	(0.024)	(0.022)	(0.024)	(0.022)	(0.034)	(0.034)
N yrs experience as farm manager	-0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.000	-0.000	0.001	0.004	0.005	0.003
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Gender hh head (1 = female)	-0.035	-0.069**	-0.055**	-0.059	-0.106*	-0.121**
	(0.024)	(0.027)	(0.028)	(0.040)	(0.056)	(0.051)
Highest n yrs schooling in hh	-0.000	0.002	0.003	-0.005	-0.002	0.002
	(0.003)	(0.003)	(0.003)	(0.004)	(0.006)	(0.005)
Average age of hh members working on farm	0.000	0.000	-0.000	0.001	0.001*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
% of cattle producing high quality milk in municipality	0.003***	0.002***	0.003***	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	0.007	0.015	0.020*	-0.024*	-0.022	-0.027
	(0.013)	(0.010)	(0.011)	(0.013)	(0.017)	(0.021)
Farmer perceives other buyers available (1 = yes)	-0.029	-0.030	-0.007			
	(0.020)	(0.025)	(0.025)			
Ln(average distance from 3 closest processors)	-0.012	0.009	0.015	-0.010	-0.001	-0.009
	(0.010)	(0.012)	(0.010)	(0.021)	(0.018)	(0.019)
N dairy farms in municipality	0.000	0.000	-0.000	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.026***	-0.028***	-0.022***	-0.017*	-0.019*	-0.016
	(0.007)	(0.009)	(0.008)	(0.009)	(0.010)	(0.010)
Processor collects at farmgate (1 = yes)	-0.039	-0.051*	-0.026	-0.092	-0.109**	-0.072
	(0.027)	(0.031)	(0.029)	(0.057)	(0.043)	(0.056)
Trento	-0.161**	-0.123*	-0.118**	0.051	0.063	0.057
	(0.071)	(0.064)	(0.056)	(0.111)	(0.087)	(0.106)
Bologna	0.106***	0.096***	0.064*	0.083	0.076	0.089
	(0.032)	(0.034)	(0.035)	(0.051)	(0.059)	(0.054)
Constant	3.395***	3.398***	3.323***	3.738***	3.756***	3.711***
	(0.134)	(0.087)	(0.122)	(0.219)	(0.196)	(0.182)
Observations	237	237	260	104	104	111
χ^2	259.4	196.6	213.3	9.36e-06	8.55e-07	8.53e-07
lambda	-0.00179	-0.0196	-0.0313	-0.00418	-0.0334	-0.0223
sigma	0.120	0.124	0.128	-0.00418	-0.0334	-0.0223
rho	-0.0149	-0.158	-0.244	0.0780	0.0921	0.101

Bootstrapped standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 8-A: Control function model for variation in producer prices paid; second stage, heterogeneous effects

Control function, 2nd stage, heterogeneous effects	FULL SAMPLE			SUB-SAMPLE		
Ln(Price):	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final
Farmer is coop member (1 = yes)	0.007	0.047	0.104*	-0.016	-0.022	0.024
	(0.059)	(0.064)	(0.062)	(0.099)	(0.111)	(0.147)
Ln(minimum altitude municipality)	0.044***	0.031**	0.022	-0.002	-0.015	-0.004
	(0.016)	(0.015)	(0.015)	(0.013)	(0.016)	(0.016)
Modern stalling facilities (1 = yes)	0.022	0.029	0.015	0.063**	0.072**	0.081***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.029)	(0.029)
N yrs experience as farm manager	-0.000	-0.000	-0.000	-0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.000	-0.000	0.001	0.004	0.005	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Gender hh head (1 = female)	-0.035	-0.066**	-0.054**	-0.059**	-0.092**	-0.111***
	(0.024)	(0.028)	(0.026)	(0.029)	(0.039)	(0.042)
Highest n yrs schooling in hh	-0.001	0.002	0.003	-0.005	-0.003	0.001
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Average age of hh members working on farm	0.000	0.000	-0.000	0.001	0.001**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% of cattle producing high quality milk in municipality	0.003***	0.002***	0.003***	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	0.007	0.014	0.020*	-0.025*	-0.024	-0.029*
	(0.013)	(0.013)	(0.012)	(0.014)	(0.017)	(0.017)
Farmer perceives other buyers available (1 = yes)	-0.031	-0.036	-0.010			
	(0.024)	(0.025)	(0.024)			
Ln(average distance from 3 closest processors)	-0.012	0.008	0.015	-0.010	0.002	-0.008
	(0.012)	(0.012)	(0.011)	(0.017)	(0.018)	(0.017)
N dairy farms in municipality	0.000	0.000	-0.000	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.026***	-0.028***	-0.022***	-0.015*	-0.020**	-0.018*
	(0.008)	(0.008)	(0.008)	(0.009)	(0.010)	(0.010)
Processor collects at farmgate (1 = yes)	-0.039	-0.052*	-0.026	-0.087**	-0.111**	-0.078*
	(0.030)	(0.031)	(0.030)	(0.042)	(0.047)	(0.045)
Trento	-0.154**	-0.117*	-0.117*	0.060	0.095	0.078
	(0.067)	(0.067)	(0.061)	(0.081)	(0.086)	(0.101)
Bologna	0.106***	0.098***	0.067**	0.076*	0.059	0.080
	(0.030)	(0.031)	(0.030)	(0.042)	(0.044)	(0.052)
Mills	0.013	-0.025	-0.035	0.028	-0.010	-0.024
	(0.029)	(0.031)	(0.029)	(0.052)	(0.057)	(0.071)
Mills*coop	0.002	0.045	0.010	-0.046	0.057	0.079
	(0.056)	(0.057)	(0.055)	(0.052)	(0.059)	(0.075)
Constant	3.406***	3.393***	3.324***	3.776***	3.814***	3.738***
	(0.110)	(0.105)	(0.102)	(0.154)	(0.159)	(0.193)
Observations	237	237	260	104	104	111
R^2	0.419	0.379	0.357	0.358	0.371	0.346
F	10.19	9.073	9.458	2.899	3.457	3.402

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 9-A: Control function model for variation in producer prices paid; first stage

Control function, homogeneous effects, 1st stage	FULL SAMPLE			SUB-SAMPLE		
Dep. var: farmer is coop member (1 = yes)	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final
Parents were coop members (1 = yes)	1.161***	1.161***	1.127***	0.707	0.707	0.758*
	(0.267)	(0.385)	(0.365)	(0.480)	(0.454)	(0.428)
Ln(minimum altitude municipality)	0.363	0.363**	0.396**	-0.112	-0.112	0.034
	(0.230)	(0.180)	(0.183)	(0.315)	(0.350)	(0.336)
Ln(herd size on farm)	-0.322	-0.322	-0.312*	-0.157	-0.157	-0.208
	(0.229)	(0.221)	(0.166)	(0.311)	(0.347)	(0.277)
N yrs experience as farm manager	-0.002	-0.002	-0.002	-0.005	-0.005	-0.006
	(0.012)	(0.010)	(0.012)	(0.018)	(0.017)	(0.018)
N yrs schooling of hh head	0.002	0.002	-0.000	0.009	0.009	0.001
	(0.063)	(0.057)	(0.066)	(0.091)	(0.062)	(0.086)
Gender hh head (1 = female)	0.718	0.718	0.641	0.902	0.902	0.712
	(2.215)	(1.554)	(2.259)	(1.817)	(1.580)	(1.688)
Highest n yrs schooling in hh	-0.043	-0.043	-0.042	-0.072	-0.072	-0.053
	(0.052)	(0.049)	(0.054)	(0.078)	(0.063)	(0.084)
Average age of hh members working on farm	-0.001	-0.001	-0.001	-0.002	-0.002	-0.001
	(0.005)	(0.005)	(0.005)	(0.006)	(0.007)	(0.007)
% of cattle producing high quality milk in municipality	0.002	0.002	0.003	-0.005	-0.005	-0.003
	(0.009)	(0.008)	(0.008)	(0.010)	(0.012)	(0.011)
Farmer perceives other buyers available (1 = yes)	-1.337	-1.337	-1.265			
	(1.583)	(1.664)	(0.905)			
Ln(average distance from 3 closest processors)	-0.073	-0.073	-0.078	0.218	0.218	0.086
	(0.210)	(0.171)	(0.222)	(0.294)	(0.345)	(0.316)
N dairy farms in municipality	0.018	0.018	0.016	0.010	0.010	0.010
	(0.011)	(0.011)	(0.012)	(0.014)	(0.014)	(0.015)
Trento	0.496	0.496	0.324	1.031	1.031	0.817
	(0.800)	(0.840)	(0.728)	(0.902)	(0.916)	(0.915)
Bologna	0.540	0.540	0.540	-0.581	-0.581	-0.262
	(0.568)	(0.480)	(0.501)	(0.703)	(1.607)	(0.570)
Constant	0.417	0.417	0.346	0.867	0.867	0.526
	(2.178)	(2.641)	(2.034)	(2.562)	(1.971)	(1.869)
Observations	237	237	260	104	104	111
χ^2	259.4	196.6	213.3	52.42	58.73	58.74
lambda	-0.00179	-0.0196	-0.0313	-0.00418	-0.0334	-0.0223
sigma	0.120	0.124	0.128	0.0780	0.0921	0.101
rho	-0.0149	-0.158	-0.244	-0.0537	-0.362	-0.222

Bootstrapped standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 10-A: Propensity score estimation (probit model): marginal effects

Dep. var: farmer is coop member (1 = yes)	(1) Full sample	(2) Sub-sample
Ln(minimum altitude municipality)	0.068**	-0.012
	(0.031)	(0.084)
Ln(annual farm milk output)	-0.023	0.014
	(0.032)	(0.085)
% of cattle producing high quality milk in municipality	0.001	0.000
	(0.001)	(0.003)
Modern stalling facilities (1 = yes)	0.013	-0.054
	(0.056)	(0.136)
N yrs experience as farm manager	-0.002	-0.004
	(0.002)	(0.005)
N yrs schooling of hh head	-0.005	-0.009
	(0.009)	(0.020)
Gender hh head (1 = female)	0.085	0.176
	(0.074)	(0.184)
Highest n yrs schooling in hh	-0.010	-0.025
	(0.008)	(0.018)
Average age of hh members working on farm	0.000	0.000
	(0.001)	(0.002)
Farmer perceives other buyers available (1 = yes)	-0.140***	
	(0.052)	
Ln(average distance from 3 closest processors)	-0.029	0.020
	(0.029)	(0.081)
N dairy farms in municipality	0.003*	0.002
	(0.002)	(0.004)
Trento	0.122	0.262
	(0.122)	(0.257)
Bologna	0.048	-0.228
	(0.066)	(0.206)
Observations	230	107
Pseudo R^2	0.278	0.131
χ^2	63.98	18.19

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 11-A: Matching quality

Variable		Mean		t-test
		Member	Non-member	
Ln(minimum altitude municipality)	unmatched	5.53	4.24	7.23***
	matched	4.74	4.65	0.5
Modern stalling facilities (1 = yes)	unmatched	44%	70%	-3.19***
	matched	61%	52%	1.12
N yrs experience as farm manager	unmatched	21.48	21.02	0.24
	matched	21.9	22.3	-0.2
N yrs schooling of hh head	unmatched	8.83	10.2	-2.45**
	matched	8.88	8.93	-0.08
Female farm head	unmatched	10%	4%	1.35
	matched	7%	3%	1.26
Highest n yrs schooling in hh	unmatched	11.1	12.5	-2.58**
	matched	11.5	11	0.92
Average age of hh members working on farm	unmatched	36.83	35.71	0.3
	matched	11.54	11	0.71
% of cattle producing high quality milk in municipality	unmatched	49%	10%	6.59***
	matched	21%	21%	0.05
Ln(annual farm milk output)	unmatched	5.3	6.13	-4.65***
	matched	5.89	5.54	1.94
Farmer perceives other buyers available (1 = yes)	unmatched	65%	94%	-4.12***
	matched	90%	93%	-0.65
Ln(average distance from 3 closest processors)	unmatched	2.65	2.19	3.1***
	matched	2.33	2.31	0.11

*** p<0.01, ** p<0.05, * p<0.1

Table 12-A: Preferred OLS model – different specifications for farm scale of production and competition, full sample

FULL SAMPLE Ln(Price):	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final	(7) Base	(8) Premia-adjusted	(9) Final
Farmer is coop member (1 = yes)	0.027	0.030	0.055***	0.025	0.031*	0.054***	0.044**	0.037	0.065***
	(0.017)	(0.019)	(0.018)	(0.017)	(0.019)	(0.018)	(0.020)	(0.024)	(0.023)
Ln(minimum altitude municipality)	0.042***	0.030**	0.026**	0.042***	0.030**	0.022*	0.055**	0.033	0.021
	(0.014)	(0.013)	(0.012)	(0.014)	(0.013)	(0.013)	(0.021)	(0.021)	(0.022)
Modern stalling facilities (1 = yes)	0.029	0.037	0.021	0.026	0.033	0.021	0.016	0.033	0.010
	(0.022)	(0.022)	(0.022)	(0.023)	(0.024)	(0.023)	(0.027)	(0.029)	(0.029)
N yrs experience as farm manager	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.001	-0.000	0.001	0.001	-0.001	0.001	0.001	-0.001	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Gender hh head (1 = female)	-0.037	-0.070**	-0.055**	-0.036	-0.068**	-0.053**	-0.036	-0.067*	-0.059*
	(0.024)	(0.028)	(0.027)	(0.024)	(0.028)	(0.027)	(0.028)	(0.035)	(0.032)
Highest n yrs schooling in hh	-0.000	0.002	0.003	-0.001	0.002	0.002	-0.000	0.003	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)
Average age of hh members working on farm	0.000	0.000	-0.000	0.000	0.000	0.000	0.000	0.001*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% of cattle producing high quality milk in municipality	0.003***	0.002***	0.002***	0.003***	0.002***	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(herd size on farm)	0.003	0.010	0.018						
	(0.016)	(0.015)	(0.014)						
Ln(total milk sold)				0.006	0.013	0.017			
				(0.012)	(0.012)	(0.012)			
Ln(annual farm milk output)							0.012	0.017	0.025*
							(0.014)	(0.014)	(0.013)
Farmer perceives other buyers available (1 = yes)	-0.029	-0.033	-0.012	-0.031	-0.034	-0.008	-0.003	-0.013	0.017
	(0.022)	(0.023)	(0.022)	(0.022)	(0.023)	(0.022)	(0.024)	(0.026)	(0.025)
Ln(average distance from 3 closest processors)	-0.013	0.006	0.012	-0.011	0.008	0.010	-0.016	0.009	0.015
	(0.011)	(0.011)	(0.010)	(0.011)	(0.011)	(0.011)	(0.013)	(0.014)	(0.013)
N processors buying in munic							-0.007	-0.003	-0.001
							(0.006)	(0.006)	(0.007)
N dairy farms in municipality	0.000	0.000	-0.000	0.000	0.000	-0.000	0.001	0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.026***	-0.027***	-0.021***	-0.025***	-0.026***	-0.020**	-0.027***	-0.028***	-0.026***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Processor collects at farmgate (1 = yes)	-0.037	-0.048	-0.024	-0.042	-0.050*	-0.024	-0.049*	-0.057*	-0.032
	(0.030)	(0.031)	(0.030)	(0.029)	(0.030)	(0.029)	(0.029)	(0.030)	(0.029)
Trento	-0.156**	-0.105*	-0.099*	-0.160**	-0.113*	-0.090	-0.219***	-0.143**	-0.118*
	(0.063)	(0.062)	(0.056)	(0.064)	(0.062)	(0.058)	(0.073)	(0.072)	(0.068)
Bologna	0.107***	0.101***	0.071**	0.105***	0.097***	0.073**			
	(0.030)	(0.031)	(0.029)	(0.030)	(0.031)	(0.030)			
Constant	3.420***	3.453***	3.387***	3.401***	3.414***	3.368***	3.322***	3.362***	3.293***
	(0.101)	(0.095)	(0.093)	(0.107)	(0.103)	(0.101)	(0.152)	(0.149)	(0.137)
Observations	239	239	262	241	241	265	200	200	219
R^2	0.418	0.376	0.353	0.420	0.380	0.358	0.479	0.412	0.387
F	11.40	9.747	9.993	11.63	9.974	10.34	12.93	9.930	10.23

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 13-A: Preferred OLS model – different specifications for farm scale of production and competition, sub-sample

SUB-SAMPLE Ln(Price):	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final	(7) Base	(8) Premia-adjusted	(9) Final
Farmer is coop member (1 = yes)	0.001	-0.007	0.028	0.001	-0.002	0.034*	0.018	0.006	0.038
	(0.019)	(0.021)	(0.021)	(0.018)	(0.020)	(0.020)	(0.022)	(0.025)	(0.025)
Ln(minimum altitude municipality)	-0.002	-0.019	-0.008	-0.000	-0.015	-0.004	0.001	-0.018	-0.011
	(0.012)	(0.015)	(0.015)	(0.012)	(0.016)	(0.016)	(0.021)	(0.027)	(0.029)
Modern stalling facilities (1 = yes)	0.054**	0.061**	0.067**	0.068***	0.078***	0.087***	0.073**	0.094**	0.098**
	(0.023)	(0.028)	(0.029)	(0.023)	(0.028)	(0.029)	(0.030)	(0.036)	(0.037)
N yrs experience as farm manager	-0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.004	0.004	0.003	0.004	0.004	0.003	0.005	0.004	0.003
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
Gender hh head (1 = female)	-0.055**	-0.095**	-0.112***	-0.058**	-0.099**	-0.118***	-0.077**	-0.136**	-0.146**
	(0.025)	(0.039)	(0.041)	(0.025)	(0.040)	(0.043)	(0.033)	(0.052)	(0.056)
Highest n yrs schooling in hh	-0.005*	-0.003	0.001	-0.005*	-0.003	0.002	-0.005	-0.001	0.003
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Average age of hh members working on farm	0.000	0.001**	0.000	0.001*	0.001**	0.000	0.001	0.001**	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
% of cattle producing high quality milk in municipality	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(herd size on farm)	-0.024	-0.021	-0.024						
	(0.018)	(0.021)	(0.020)						
Ln(total milk sold)				-0.026*	-0.024	-0.029*			
				(0.013)	(0.016)	(0.015)			
Ln(annual farm milk output)							-0.025	-0.028	-0.032*
							(0.016)	(0.018)	(0.017)
Ln(average distance from 3 closest processors)	-0.007	0.005	-0.007	-0.009	0.001	-0.009	-0.012	-0.000	-0.003
	(0.017)	(0.018)	(0.017)	(0.016)	(0.018)	(0.017)	(0.021)	(0.027)	(0.027)
N processors buying in munic							0.001	0.001	0.007
							(0.008)	(0.009)	(0.009)
N dairy farms in municipality	0.001	0.001	0.000	0.001	0.001	0.000	0.001	0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.017*	-0.019**	-0.017*	-0.015*	-0.016*	-0.013	-0.018*	-0.020*	-0.018
	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.012)	(0.013)
Processor collects at farmgate (1 = yes)	-0.095**	-0.111**	-0.077*	-0.094**	-0.110**	-0.074*	-0.088**	-0.104**	-0.072
	(0.040)	(0.044)	(0.042)	(0.040)	(0.046)	(0.044)	(0.042)	(0.050)	(0.050)
Trento	0.047	0.083	0.069	0.051	0.083	0.067	0.050	0.084	0.103
	(0.067)	(0.068)	(0.076)	(0.069)	(0.070)	(0.078)	(0.083)	(0.084)	(0.100)
Bologna	0.075**	0.058	0.077**	0.078**	0.064*	0.083**			
	(0.033)	(0.038)	(0.038)	(0.033)	(0.038)	(0.039)			
Constant	3.707***	3.779***	3.710***	3.744***	3.800***	3.733***	3.695***	3.792***	3.675***
	(0.092)	(0.094)	(0.096)	(0.104)	(0.106)	(0.107)	(0.156)	(0.195)	(0.192)
Observations	106	106	113	106	106	113	83	83	87
R^2	0.340	0.358	0.330	0.350	0.369	0.342	0.382	0.412	0.417
F	2.459	3.537	3.285	2.888	4.184	4.065	2.662	4.346	5.407

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 14-A: Preferred OLS model – clustered standard errors by province and municipality, full sample

Full sample	Clustering by province			Clustering by municipality		
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Price):	Base	Premia-adjusted	Final	Base	Premia-adjusted	Final
Farmer is coop member (1 = yes)	0.025	0.031***	0.054***	0.028	0.036*	0.060***
	(0.013)	(0.001)	(0.005)	(0.019)	(0.019)	(0.020)
Ln(minimum altitude municipality)	0.042	0.030**	0.022*	0.042***	0.030**	0.022
	(0.017)	(0.007)	(0.007)	(0.014)	(0.013)	(0.015)
Modern stalling facilities (1 = yes)	0.026	0.032	0.021	0.028	0.034	0.014
	(0.026)	(0.034)	(0.052)	(0.021)	(0.024)	(0.027)
N yrs experience as farm manager	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.001	-0.001	0.001	0.001	-0.000	0.002
	(0.001)	(0.002)	(0.001)	(0.003)	(0.003)	(0.003)
Gender hh head (1 = female)	-0.036*	-0.068***	-0.053***	-0.032	-0.063**	-0.059**
	(0.009)	(0.006)	(0.002)	(0.023)	(0.030)	(0.026)
Highest n yrs schooling in hh	-0.001	0.002	0.002	-0.001	0.002	0.003
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)
Average age of hh members working on farm	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% of cattle producing high quality milk in municipality	0.003***	0.002***	0.003**	0.003***	0.002***	0.003***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	0.006	0.013	0.017	0.006	0.013	0.019
	(0.012)	(0.014)	(0.021)	(0.012)	(0.012)	(0.012)
Farmer perceives other buyers available (1 = yes)	-0.031	-0.034	-0.008	-0.025	-0.027	0.001
	(0.022)	(0.014)	(0.016)	(0.026)	(0.026)	(0.025)
Ln(average distance from 3 closest processors)	-0.011	0.008	0.010	-0.010	0.009	0.012
	(0.012)	(0.013)	(0.005)	(0.012)	(0.012)	(0.012)
N dairy farms in municipality	0.000	0.000**	-0.000	0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Ln(farm-processor distance)	-0.025***	-0.026**	-0.020**	-0.026***	-0.026***	-0.022***
	(0.002)	(0.003)	(0.004)	(0.008)	(0.007)	(0.008)
Processor collects at farmgate (1 = yes)	-0.042***	-0.050***	-0.025*	-0.049*	-0.056**	-0.031
	(0.000)	(0.002)	(0.006)	(0.025)	(0.027)	(0.027)
Trento	-0.161*	-0.113**	-0.091*	-0.159**	-0.115*	-0.099
	(0.043)	(0.024)	(0.028)	(0.069)	(0.067)	(0.067)
Bologna	0.105*	0.097**	0.073***	0.110***	0.098***	0.073**
	(0.029)	(0.020)	(0.003)	(0.028)	(0.030)	(0.033)
Constant	3.400***	3.411***	3.367***	3.390***	3.394***	3.342***
	(0.143)	(0.090)	(0.138)	(0.112)	(0.110)	(0.123)
Observations	241	241	265	231	231	253
R^2	0.420	0.380	0.358	0.448	0.398	0.374
N clusters	3	3	3	111	111	115

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 15-A: Preferred OLS model – clustered standard errors by province and municipality, sub-sample

Sub-sample	Clustering by province			Clustering by municipality		
	(1)	(2)	(3)	(4)	(5)	(6)
Ln(Price):	Base	Premia-adjusted	Final	Base	Premia-adjusted	Final
Farmer is coop member (1 = yes)	0.001	-0.002	0.034**	0.005	0.004	0.039*
	(0.016)	(0.001)	(0.006)	(0.018)	(0.022)	(0.021)
Ln(minimum altitude municipality)	-0.000	-0.016**	-0.004	-0.001	-0.014	-0.006
	(0.005)	(0.003)	(0.005)	(0.013)	(0.017)	(0.015)
Modern stalling facilities (1 = yes)	0.067*	0.077	0.085	0.062***	0.071**	0.069**
	(0.022)	(0.040)	(0.049)	(0.022)	(0.028)	(0.032)
N yrs experience as farm manager	-0.000	0.000	0.000	0.000	0.000	0.001
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.004	0.004**	0.003	0.004	0.004	0.003
	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)	(0.004)
Gender hh head (1 = female)	-0.059*	-0.098	-0.118*	-0.061**	-0.104**	-0.118***
	(0.019)	(0.039)	(0.034)	(0.030)	(0.040)	(0.040)
Highest n yrs schooling in hh	-0.005	-0.003	0.002	-0.004	-0.001	0.003
	(0.003)	(0.001)	(0.002)	(0.003)	(0.004)	(0.004)
Average age of hh members working on farm	0.001	0.001*	0.000	0.001	0.001**	0.001
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
% of cattle producing high quality milk in municipality	0.000	0.000	0.001*	0.000	0.000	0.001
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	-0.025***	-0.023*	-0.028*	-0.025**	-0.022	-0.025*
	(0.002)	(0.006)	(0.009)	(0.012)	(0.014)	(0.014)
Ln(average distance from 3 closest processors)	-0.009	0.002	-0.009	-0.014	-0.003	-0.013
	(0.021)	(0.028)	(0.021)	(0.014)	(0.018)	(0.015)
N dairy farms in municipality	0.001	0.001***	0.000	0.001	0.001	0.000
	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.015	-0.016	-0.013	-0.012	-0.012	-0.008
	(0.011)	(0.009)	(0.011)	(0.010)	(0.010)	(0.010)
Processor collects at farmgate (1 = yes)	-0.093*	-0.110***	-0.073*	-0.097*	-0.112**	-0.078*
	(0.030)	(0.010)	(0.020)	(0.049)	(0.045)	(0.046)
Trento	0.052	0.084	0.068	0.057	0.083	0.071
	(0.050)	(0.041)	(0.030)	(0.072)	(0.069)	(0.077)
Bologna	0.079	0.064	0.084	0.086**	0.069*	0.083**
	(0.051)	(0.037)	(0.036)	(0.038)	(0.040)	(0.038)
Constant	3.742***	3.796***	3.730***	3.724***	3.766***	3.693***
	(0.028)	(0.077)	(0.062)	(0.112)	(0.104)	(0.109)
Observations	106	106	113	102	102	107
R^2	0.348	0.367	0.340	0.359	0.378	0.369
N clusters	3	3	3	56	56	59

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 16-A: Preferred OLS model – disaggregation by farm-to-plant distance, full sample

Distance:		> 15 km			15 km or larger			15-50 km	
Ln(Price):	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final	(7) Base	(8) Premia-adjusted	(9) Final
Farmer is coop member (1 = yes)	0.039	0.045	0.077***	0.004	0.012	0.034	0.030	0.028	0.050
	(0.026)	(0.030)	(0.029)	(0.032)	(0.031)	(0.026)	(0.042)	(0.040)	(0.031)
Ln(minimum altitude municipality)	0.037**	0.032*	0.020	0.047*	0.027	0.026	0.059*	0.029	0.029
	(0.018)	(0.017)	(0.018)	(0.026)	(0.023)	(0.021)	(0.035)	(0.031)	(0.028)
Modern stalling facilities (1 = yes)	0.007	0.019	0.002	0.051	0.064*	0.047	0.046	0.062	0.057
	(0.034)	(0.035)	(0.034)	(0.039)	(0.037)	(0.035)	(0.052)	(0.049)	(0.045)
N yrs experience as farm manager	-0.001	-0.001	-0.001	0.001	0.001	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
N yrs schooling of hh head	0.003	0.002	0.002	-0.003	-0.003	0.000	-0.003	-0.004	0.001
	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.006)	(0.007)	(0.008)	(0.007)
Gender hh head (1 = female)	-0.029	-0.051	-0.045	-0.029	-0.072*	-0.065*	-0.007	-0.063	-0.035
	(0.037)	(0.044)	(0.042)	(0.041)	(0.041)	(0.037)	(0.053)	(0.053)	(0.045)
Highest n yrs schooling in hh	-0.001	0.002	0.002	0.001	0.001	0.000	0.001	0.000	0.001
	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)	(0.007)	(0.008)	(0.009)	(0.008)
Average age of hh members working on farm	0.000	0.000	0.000	-0.000	0.000	-0.000	-0.000	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
% of cattle producing high quality milk in municipality	0.003***	0.002**	0.003***	0.003**	0.004***	0.003**	0.003**	0.004**	0.003*
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Ln(annual farm milk output)	0.010	0.014	0.023	0.016	0.017	0.009	0.025	0.020	0.012
	(0.016)	(0.017)	(0.017)	(0.024)	(0.023)	(0.020)	(0.028)	(0.028)	(0.024)
Farmer perceives other buyers available (1 = yes)	-0.032	-0.037	-0.000	-0.021	-0.017	-0.028	-0.015	-0.021	-0.035
	(0.026)	(0.029)	(0.028)	(0.043)	(0.041)	(0.039)	(0.048)	(0.047)	(0.045)
Ln(average distance from 3 closest processors)	-0.018	0.000	0.006	0.006	0.021	0.011	-0.011	0.007	-0.003
	(0.014)	(0.014)	(0.015)	(0.029)	(0.027)	(0.022)	(0.032)	(0.034)	(0.026)
N dairy farms in municipality	0.000	0.000	-0.001	0.002*	0.001	0.000	0.002	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.018	-0.021	-0.021	-0.043	-0.068**	-0.039*	-0.062	-0.094	-0.068
	(0.013)	(0.013)	(0.014)	(0.033)	(0.028)	(0.023)	(0.073)	(0.069)	(0.061)
Processor collects at farmgate (1 = yes)	-0.022	-0.027	-0.018	-0.119	-0.119	-0.046	-0.132	-0.119	-0.052
	(0.030)	(0.030)	(0.031)	(0.100)	(0.100)	(0.095)	(0.106)	(0.109)	(0.103)
Trento	-0.125	-0.064	-0.100	-0.231*	-0.224*	-0.111	-0.205	-0.189	-0.073
	(0.088)	(0.087)	(0.081)	(0.117)	(0.114)	(0.111)	(0.126)	(0.126)	(0.124)
Bologna	0.103**	0.103**	0.059	0.138**	0.135**	0.112**	0.165**	0.160**	0.123**
	(0.041)	(0.044)	(0.044)	(0.062)	(0.056)	(0.049)	(0.075)	(0.065)	(0.054)
Constant	3.372***	3.356***	3.337***	3.372***	3.556***	3.502***	3.334***	3.665***	3.552***
	(0.133)	(0.126)	(0.133)	(0.216)	(0.224)	(0.210)	(0.349)	(0.364)	(0.370)
Observations	159	159	174	82	82	91	71	71	80
R^2	0.453	0.387	0.357	0.325	0.389	0.373	0.356	0.389	0.386
F	10.05	7.235	7.675	1.292	2.066	3.155	1.148	1.829	2.964

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 17-A: Preferred OLS model – gender effect among cooperative members only

COOP MEMBERS ONLY	FUL SAMPLE			SUB-SAMPLE		
Ln(Price):	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final
Ln(minimum altitude municipality)	0.058***	0.042***	0.032**	0.001	-0.016	0.003
	(0.017)	(0.016)	(0.016)	(0.018)	(0.026)	(0.023)
Modern stalling facilities (1 = yes)	0.010	0.017	0.007	0.063**	0.077**	0.089**
	(0.027)	(0.027)	(0.027)	(0.031)	(0.038)	(0.042)
N yrs experience as farm manager	-0.000	-0.000	-0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.001	-0.002	0.002	0.013***	0.008	0.003
	(0.004)	(0.004)	(0.003)	(0.005)	(0.006)	(0.007)
Gender hh head (1 = female)	-0.030	-0.062*	-0.047	-0.043	-0.099*	-0.127**
	(0.027)	(0.032)	(0.029)	(0.033)	(0.051)	(0.053)
Highest n yrs schooling in hh	0.000	0.004	0.004	-0.011**	-0.005	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)
Average age of hh members working on farm	0.000	0.000	-0.000	0.001**	0.001*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
% of cattle producing high quality milk in municipality	0.003***	0.003***	0.003***	-0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	0.014	0.022	0.024*	-0.026	-0.024	-0.034*
	(0.014)	(0.014)	(0.013)	(0.017)	(0.019)	(0.019)
Farmer perceives other buyers available (1 = yes)	-0.028	-0.031	-0.005			
	(0.024)	(0.024)	(0.023)			
Ln(average distance from 3 closest processors)	-0.012	0.009	0.009	-0.026	-0.007	-0.019
	(0.013)	(0.013)	(0.013)	(0.021)	(0.023)	(0.022)
N dairy farms in municipality	0.000	0.000	-0.000	0.001*	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.029***	-0.029***	-0.021**	-0.025**	-0.021*	-0.014
	(0.009)	(0.009)	(0.009)	(0.010)	(0.012)	(0.013)
Processor collects at farmgate (1 = yes)	-0.039	-0.052*	-0.027	-0.046	-0.094*	-0.074
	(0.030)	(0.031)	(0.029)	(0.044)	(0.054)	(0.050)
Trento	-0.192**	-0.143*	-0.108	0.095	0.107	0.084
	(0.074)	(0.074)	(0.066)	(0.079)	(0.083)	(0.098)
Bologna	0.087**	0.101**	0.078**	0.082	0.091	0.133**
	(0.040)	(0.040)	(0.039)	(0.056)	(0.068)	(0.061)
Constant	3.318***	3.348***	3.334***	3.672***	3.774***	3.757***
	(0.129)	(0.126)	(0.122)	(0.144)	(0.156)	(0.162)
Observations	192	192	216	65	65	72
R^2	0.407	0.362	0.316	0.488	0.427	0.352

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 18-A: OLS regression results without outliers in scale of production

	FUL SAMPLE			SUB-SAMPLE		
Ln(Price):	(1) Base	(2) Premia-adjusted	(3) Final	(4) Base	(5) Premia-adjusted	(6) Final
Farmer is coop member (1 = yes)	0.022	0.029	0.051***	-0.001	-0.003	0.033
	(0.017)	(0.019)	(0.019)	(0.019)	(0.021)	(0.021)
Ln(minimum altitude municipality)	0.043***	0.030**	0.023*	-0.002	-0.016	-0.005
	(0.014)	(0.013)	(0.013)	(0.013)	(0.016)	(0.016)
Modern stalling facilities (1 = yes)	0.025	0.031	0.020	0.062**	0.074**	0.082***
	(0.023)	(0.024)	(0.023)	(0.024)	(0.029)	(0.030)
N yrs experience as farm manager	-0.000	-0.000	-0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N yrs schooling of hh head	0.001	-0.000	0.002	0.004	0.005	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Gender hh head (1 = female)	-0.036	-0.068**	-0.053**	-0.056**	-0.097**	-0.116***
	(0.024)	(0.028)	(0.027)	(0.026)	(0.040)	(0.043)
Highest n yrs schooling in hh	-0.001	0.002	0.002	-0.005*	-0.003	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
Average age of hh members working on farm	0.000	0.000	-0.000	0.001	0.001**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
% of cattle producing high quality milk in municipality	0.003***	0.003***	0.003***	-0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(annual farm milk output)	0.008	0.015	0.019	-0.017	-0.019	-0.023
	(0.013)	(0.013)	(0.012)	(0.015)	(0.018)	(0.017)
Farmer perceives other buyers available (1 = yes)	-0.031	-0.034	-0.008			
	(0.022)	(0.023)	(0.022)			
Ln(average distance from 3 closest processors)	-0.011	0.008	0.010	-0.005	0.004	-0.007
	(0.011)	(0.011)	(0.011)	(0.017)	(0.019)	(0.018)
N dairy farms in municipality	0.000	0.000	-0.000	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Ln(farm-processor distance)	-0.024***	-0.025***	-0.019**	-0.015	-0.015	-0.012
	(0.008)	(0.008)	(0.008)	(0.009)	(0.010)	(0.010)
Processor collects at farmgate (1 = yes)	-0.043	-0.050	-0.025	-0.111**	-0.115**	-0.077
	(0.030)	(0.031)	(0.029)	(0.045)	(0.052)	(0.049)
Trento	-0.170**	-0.129**	-0.108*	0.057	0.077	0.055
	(0.067)	(0.066)	(0.060)	(0.074)	(0.076)	(0.084)
Bologna	0.102***	0.093***	0.068**	0.071**	0.060	0.078*
	(0.030)	(0.031)	(0.031)	(0.034)	(0.040)	(0.040)
Constant	3.391***	3.407***	3.359***	3.711***	3.774***	3.706***
	(0.109)	(0.104)	(0.103)	(0.108)	(0.106)	(0.110)
Observations	236	236	260	101	101	108
R^2	0.413	0.375	0.353	0.342	0.343	0.319

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Appendix B

QUESTIONNAIRE – Please refer all questions to period 1 April 2006 – 31 March 2007

Farm location: Municipality .... Province ....

A. Farm and household characteristics

1. For how many years have you been managing this farm? .... ☐ ☐

2. Operated farm size area (ha): **Total:** ☐ ☐ ☐ ☐ .... **Owned:** ☐ ☐ ☐ ☐

3. Average number of lactating cows on farm in the year 2006/07................................. ☐ ☐ ☐ ☐

4. Type of milk produced:

☐ **Normal**

☐ **High Quality** ⇨ How many years have you been producing High Quality milk? .... ☐ ☐

☐ **Organic** ⇨ How many years have you been producing Organic milk? .... ☐ ☐

5. Annual milk production over the year 2006/2007 (quintals): **a. Total** .... ☐ ☐ ☐ ☐ ☐ , ☐ ☐

b. Deliveries .... ☐ ☐ ☐ ☐ ☐ , ☐ ☐ **c. Direct sales**....... ☐ ☐ ☐ ☐ ☐ , ☐ ☐

6. Type of stalling: .... **Unchained** ☐ ....**Chained** ☐

7. Average price per litre received over the year 2006/2007:

a. Base price (eurocents/lt) .... ☐ ☐ , ☐ ☐

b. Quality premia or penalty (average, eurocents/lt).. ☐ ☐ , ☐ ☐

c. Quantity premia or penalty (average, eurocents/lt)... ☐ ☐ , ☐ ☐

d. Final price, including any end-of-year bonus (eurocents/lt) .... ☐ ☐ , ☐ ☐

8. How much did dairy farming contribute to your farm revenues in 2006/07 (in %)? .... ☐ ☐ ☐ %

9. How much did dairy farming contribute to your household income in 2006/07 (in %)? ☐ ☐ ☐ %

10. Household structure: for each household member currently living on farm, please detail her/his relationship to farm manager, sex, age, highest diploma obtained, average number of hours worked on farm per day in 2006/07, and whether s/he was employed off farm in 2006/07.

Relationship to farm manager	Sex		Age	Highest diploma obtained	Average number of hours worked on farm per day	Employed off-farm?	
	M	F				Yes	No
1. Farm manager							
2.							
3.							
4.							
5.							
6.							

11. Hired labourers working on farm: for each hired labourer employed on farm please state if s/he is employed all year or seasonally, how many days and how many hours per day on average s/he worked on farm in the year 2006-07, and the hourly wage you paid.

Hired labourer	Yearly	Seasonal	Number of days worked on farm	Number of hours a day worked on farm	Hourly wage (euro)
1.					
2.					
3.					
4.					
5.					

B. Relationship with the milk buyer, year 2006-2007

The term 'BUYER' indicates the cooperative or private processing firm, or the milk merchant, to whom you supply most of the milk produced.

12. How many times have you changed buyer since you manage this farm? .... ☐ ☐

If you changed buyer at least one, the last buyer you supplied prior to 2006-2007 was:

☐ Milk collection cooperative ☐ Processing and marketing cooperative

☐ Private processing firm ☐ Milk merchant

13. Were you member of a dairy processing and marketing cooperative in 2006-2007? ....**Yes**☐**No**☐

14. Have your parents ever been member of a dairy processing and marketing cooperative?..**Yes**☐**No**☐

15. Please write the name of the main milk buyer you supplied milk to in 2006-2007:

....

16. Your main buyer is a: ☐ Milk collection cooperative ☐ Processing and marketing cooperative

☐ Private processing firm ☐ Milk merchant

17. For how many years has this firm been your main buyer? .... ☐ ☐

18. Do you have any other available buyer(s)? ....**Yes**☐**No**☐

19. **<u>If yes</u>**:

A] Your available alternative buyer(s) is (are) (<u>please tick all relevant answers</u>):

a. Milk collection cooperative .... ☐ **b.** Processing and marketing cooperative .... ☐
c. Private processing firm .... ☐ **d.** Milk merchant .... ☐

B] Do you know the average price per litre paid by your available alternative buyers? ....**Yes** ☐ **No** ☐

20. A] Why did you choose your current main buyer and not another buyer? <u>Please tick all relevant answers</u>:

a. Prices paid were higher than those paid by the closest alternative buyer .... ☐
b. Trustworthy buyer .... ☐
c. Security that exchange relationship with current buyer would continue for a long time ☐
d. Buyer offered best conditions for farm development .... ☐
e. Same buyer as your parent's .... ☐
f. Other buyers did not represent a real alternative .... ☐
Why? ....
....
h. Other – please specify ....
....

B] What was the single most important reason why you chose your current buyer?
....
....

21. How much per litre would an alternative buyer have to offer you for you to leave your current buyer?

a. Your current buyer is a cooperative and the alternative buyer is a private processor ..... ☐ ☐ **,** ☐ ☐

b. Your current buyer is a private processor and the alternative buyer is a cooperative ..... ☐ ☐ **,** ☐ ☐

c. A higher price is not enough to change buyer .... ☐

↳ Please explain <u>why</u> ....
....
....

22. What exchange relationship did you have with the buyer in 2006-2007?

☐ **Member**

☐ **Written contract** → What is the duration of the contract? ....

☐ **Verbal agreement** → What is the duration of the agreement? ....

☐ **Spot market sale**

23. Which of these items where included in the contract or agreement between you and your buyer?

Base milk price **Yes** ☐ **No** ☐ Frequency of payment **Yes** ☐ **No** ☐ Quantity of milk traded **Yes** ☐ **No** ☐
Party responsible for milk shipment **Yes** ☐ **No** ☐ Milk quality criteria, premia, penalties **Yes** ☐ **No** ☐
Production methods (e.g. requirements on feeds) **Yes** ☐ **No** ☐

24. Did you have any difficulties in reaching an agreement with your buyer? ....**Yes** ☐ **No** ☐

25. On a scale between 1 and 10, how much influence do you think you had in defining the terms of the exchange relationship with your buyer? (1 = lowest; 10 = highest) .... ☐ ☐

26. The price per litre you received in 2006-2007 was, on average and compared with price agreed formally or informally with your buyer: ..**a. Higher** ☐ ....**b. Lower** ☐ ....**c. About the same** ☐

27. Frequency of payment in 2006-2007 was, on average and compared with frequency agreed:
....**a. On time** ☐ ....**b. Late** ☐

28. Did your main buyer accept all the milk of suitable quality you intended to sell to this buyer?
....**Yes** ☐ **No** ☐

↳ If not, how much did it accept (in percentage)? .... ☐ ☐ ☐ %

29. Did you sell milk to your main buyer over the whole year 2006-2007? ....**Yes** ☐ **No** ☐

↳ If not, for how many months did you sell milk to your main buyer? .... ☐ ☐

30. Frequency of milk transport from farm to buyer's processing plant, 2006-2007:
Twice a day ☐ Once a day ☐ Once every two days ☐ Other: ....

31. Distance between your farm and buyer's processing plant (km) .... ☐ ☐ ☐

32. Average travel time to buyer's processing plant (minutes) .... ☐ ☐ ☐

33. Milk shipment from farm to buyer's processing plant, 2006-2007:

A. Buyer collects milk on farm .... **Yes** ☐ **No** ☐

B. Buyer collects milk from a collection point .... **Yes** ☐ **No** ☐

b.1. Distance between your farm and milk collection point (km) .... ☐ ☐ ☐

b.2. Travel time you need to transport milk to collection point (minutes per journey) .... ☐ ☐ ☐

C. You deliver the milk to buyer's processing plant .... **Yes** ☐ **No** ☐

c.1. Did you, alone or with other farmers, hire a tanker truck to transport the milk?
.... **Yes** ☐ **No** ☐

c.2. If yes, how much did each journey cost (Euro)? .... ☐ ☐ ☐ , ☐ ☐

34. Between the beginning of your exchange relationship with the current buyer and the year 2006-2007, has your buyer required you to change any of your production methods?

☐Purchase of refrigerated tank ☐Changes in cowshed ☐Use and quality of feeds
☐Changes in farm management (e.g. record-keeping) ☐Quality certifications
☐Other – please specify ....

↳ Do you think these investments tied you more to your current buyer? ....**Yes** ☐ **No** ☐

35. In 2006-2007 did your buyer offer you
a. Technical assistance ....**Yes** ☐ **No** ☐
b. Training ....**Yes** ☐ **No** ☐

↳ **If yes**: for a fee ☐ or free of charge ☐ ?

36. On a scale between 1 and 10, how much value do you attribute to each of these activities?
(1 = lowest; 10 = highest)

a. Take part in buyer's decisions regarding processing and marketing of the finished product .. ☐ ☐
b. Take part in buyer's decisions regarding distribution of revenues from value adding in processing and marketing stages .... ☐ ☐
c. Collaborate with fellow farmers to improve production quality .... ☐ ☐
d. Collaborate with fellow farmers to improve the conditions of your rural area .... ☐ ☐

37. Overall are you satisfied with the exchange relationship you had with your buyer in 2006-2007?
Very satisfied ☐ **.............. Satisfied** ☐ **.............. Average** ☐ **.............. Little** ☐ **.............. Not at all** ☐

38. Why?
....
....
....

Thank you!