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Is competition really bad news for cooperatives? Some empirical evidence for Italian cooperatives

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ABSTRACT

This paper analyses the mechanisms through which increasing market competition may help cooperatives to improve technical efficiency to guarantee positive profits. This hypothesis is first formalised in a partial equilibrium framework and then is tested on a sample of Italian conventional and cooperative firms, using frontier analysis. Technical efficiency indexes are computed by using the one-stage approach as suggested by Battese and Coelli (1995), where proxies for competition are introduced as determinants of efficiency, along with other exogenous factors accounting for the firms’ heterogeneity. The results support the hypothesis that increasing market competition can affect positively the cooperatives’ efficiency.

RIASSUNTO

In questo lavoro è sviluppato un modello teorico in cui si mostra come l’adozione di uno schema di profit-sharing in un’impresa cooperativa induce i soci, allorché aumenta la competizione nel mercato dei prodotti, ad aumentare lo sforzo lavorativo. In particolare, i soci aumentano l’investimento nell’acquisizione di competenze professionali, con il risultato che aumenta l’efficienza dell’impresa. Questa prescrizione teorica è sottoposta a verifica empirica con l’approccio di Battese e Coelli (1995), dove proxy per la competizione sono introdotte insieme ad altre variabili per tener conto dell’heterogeneità delle imprese. La verifica empirica convalida l’ipotesi che l’aumento della competizione nel mercato dei prodotti influenza positivamente l’efficienza tecnica delle imprese cooperative.

JEL Classification: J5, L2, D4.

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1. *Introduction*

It is a contentious issue in the economic literature whether cooperatives tend to be more (or at least as) efficient than conventional firms (Bonin et al., 1993; Porter and Scully, 1987). From a theoretical standpoint, there are a number of reasons why a cooperative should experience a higher level of efficiency than a conventional firm. A first group of theories emphasizes the positive impact that profit sharing can have on workers' effort. In a conventional firm, asymmetric information does not allow the management to verify the worker's effort and so workers may prefer to shirk and so exert the less than optimal level of effort. The profit-sharing agreement existing in a cooperative may help to realign the workers' incentives to those of the firm in several ways. It may enhance workers' effort in return for what they could perceive as the company's fairness in letting them participate to the economic success of the firm (so-called gift exchange) (Sessions, 1992). Profit sharing may also provide employees in a cooperative with an incentive to monitor each other and put pressure on shirkers (Jones and Svejnar, 1982). Finally, it may give workers and managers the incentive to circulate information, which in turn may limit the asymmetric information problem and so increase the productivity (Cable and Wilson, 1990). A second group of theories looks at the role that profit sharing in a cooperative can have on the workforce attributes, for instance skill levels. It is well known that in conventional firms workers may not be willing to invest in firm-specific skills. The reasons for this are well articulated in Hart (1995). When the workers' investment is not contractible (i.e. contracts are incomplete) and, at the same time, workers have to bear all the costs of the investment, they may correctly anticipate that the firm will try to expropriate them after the investment has been made. Therefore, they find optimal to under-invest. Profit sharing can, however, help to solve this problem. Indeed, with profit-sharing workers are made residual claimants of the firm, as they are entitled to a portion of the profits. In this case, workers, aware of the fact that some of the improved performance will accrue to them, will be willing to invest in costly firm-specific skills as profit-sharing reduces the potential for ex post expropriation.

As the above mentioned literature, the purpose of this paper is to understand what factors may explain the fact that cooperatives tend to be more efficient than conventional firms. However, it differs from it as we focus on the possibility that the
state of competition in the product market may affect the incentives for cooperatives to improve their efficiency. For conventional firms, the role that competition may play in this respect is very well established. Both Vickers (1995) and Nickell (1996) have pointed out two ways in which competition may induce conventional firms to be more efficient. The first effect is called "discovery and selection". In a model of entry with Cournot competition, a low cost entrant may drive some high cost incumbent out and the profitability of firms will be affected as output shifts from high cost firms to low cost firms. The second effect of competition is to sharpen incentives for managers, as they try to compensate the decreasing market share with higher productivity. However in the case of the cooperatives, it is not obvious that increasing market competition can help cooperatives to be more efficient. There is indeed some anecdotic evidence suggesting that increase in competition is the main cause of cooperatives’ mortality, as cooperatives become increasingly unprofitable (van Dijk, G. and Mackel, 1991; Birgegaard and Genberg, 1994; Filippi, 2004). However, there is no theoretical reason for this to be the case; on the contrary, even in the case of a cooperative, competition should give its workers the incentives to improve efficiency so to guarantee the firm’s survival. The reasons for this argument can be summarized as follows. Consider a cooperative where a) workers have control rights over a specific "asset", their effort and b) are paid by a fixed fraction of the overall surplus. The cooperative organizes the production using both a fixed asset and the worker's effort as inputs. To be able to produce, the cooperative needs the worker's effort that is, without the workers' effort, production cannot start. Because of the lag between the time the firm starts the production and the time the workers decide on effort, a standard hold-up problem arises (Hart, 1995). Workers prefer to invest in the effort so to maximize their own expected pay-off from the relationship with the firm, instead of the overall surplus (that is, both the workers' and firms' surplus). Therefore, the supplied effort is sub-optimal from the firm's standpoint and so she will appear inefficient, as the actual output will be lower than the potential output (or the output produced by the other firms in the industry). Suppose now there is an increase in the competition faced by the cooperative in the market. This may be due to several factors, some of which are related to economic policy (like the reduction of tariffs and other artificially created barriers to entry) and some to consumer’s taste. From the workers' standpoint, this implies that their profit sharing bonus decreases as well and therefore they may want to readjust their effort so to counterbalance the effect of the negative shock on the
profit-sharing bonus. However, this will not have any impact on the profit sharing bonus at this stage (as the level of investment is determined in the period before the shock) but it will have an effect on the next period's bonus. These re-adjustments affect the firm's technical efficiency. As workers increase their investment, the actual output increases and gets closer to the potential output. The result is that inefficiency for the firm reduces. We test empirically this prediction for a panel of conventional and cooperative Italian firms, specialized in the production of wine, over the time 1996-2001. We adopt the one-stage approach as in Battese and Coelli (1995) where technical efficiency is measured as the distance from the production frontier. A measure of the state of competition in the market is introduced as a determinant of efficiency along with other factors contributing to the firms' heterogeneity. The structure of the paper is the following. Section 2 presents a model of the theoretical relationship between competition, technical efficiency change and profit sharing. The empirical model and the results are presented in Section 3. Finally some concluding remarks are offered in Section 4.

2. The general framework

Consider an industry with \( i = 1, \ldots, N \) firms. There are \( i = 1, \ldots, N \) identical workers and worker \( i \) works in firm \( i \). The allocation of each worker to each firm is pre-determined and the worker cannot leave the firm. Each firm produces a differentiated good and faces a downward-sloping demand curve. Each period the firm uses the following production technology, where the worker’s effort appears as an input:

\[
y_{i,t} = e_{i,t-1}^\alpha
\]

(1)

with \( \alpha < 1 \). The worker in the firm provides a firm-specific input \( (e) \) which we can think of as related to the effort of learning new techniques which are specific to the firm and that therefore outside the firm they are of no use. We assume that in every time period new techniques are to be learnt by the worker. However, the decision on how much effort to invest in period \( t \) is made in period \( t-1 \) where the planning is done. Output is being sold at the price:
\[ p_{i,t} = y_{i,t}^{\theta - 1} \bar{y}_{i,t}^{1-\theta} = y_{i,t}^{\theta - 1} \]  \hspace{1cm} (2)

where \( y_{i,t} \) is the supply of the good \( i \), \( \bar{y} \) is an index of the overall market demand, assumed for simplicity to be equal to 1 and \( 0 < \theta < 1 \). We interpret \( \theta \) as an indicator of product market competition, where a large value is an indication that product market competition is intense.

The worker decides each period on how much effort to devote for the next period. Once the decision has been made, it cannot be undone immediately. We assume that the worker in firm \( i \) is rewarded by a share \( s_i \) of the profit \( p_{i,t} y_{i,t} \). The per period utility function of the worker is defined as:

\[ U_{i,t} = c_{i,t} - \frac{1}{2} e_{i,t}^2 \]  \hspace{1cm} (3)

with \( c_{i,t} \) being the consumption of the worker employed in the firm \( i \) at time \( t \). His budget constraint is \( c_{i,t} = s_i p_{i,t} y_{i,t} \). Lifetime utility is then:

\[ U_i = \sum_{t=0}^{T} \delta^t \left( s_i p_{i,t} y_{i,t} - \frac{1}{2} e_{i,t}^2 \right) \]  \hspace{1cm} (4)

where \( \delta \) is the discount factor and \( e_{i,t} = 0 \).

To simplify the analysis, we shall consider a three period version of the model with period \( t = 0, 1, 2 \). The time line of the model is as follows. At time 0, the firm is set up and the worker of the firm is hired. At time 1, the worker decides on \( e \). At time 2, the fixed asset is hired and so production can take place. Output is then sold and the surplus shared between the worker and the firm's owners. The worker consumes at the end of the period. Because of the lag between the moment the firm organizes the production and the time the worker decides on effort, it is impossible to write complete contracts and therefore a standard hold-up problem (Hart, 1995) arises: indeed the worker maximizes his own expected pay-off from the relationship with the firm, instead of the overall surplus (that is, both the worker's and firm's surplus).
Therefore, the effort is optimal from the worker's standpoint, but not for the firm. For this reason, the firm's actual output will differ from the output it could potentially produce if there was no hold-up problem and so the firm will appear technically inefficient. Notice that in the whole process the two parties have symmetric information and there is no uncertainty about the parties' costs and utility functions. We analyze the model by backwards induction and assume perfect foresight. Finally, we derive the measure of technical efficiency and measure how it varies when there is an increase in product market competition. In period 2, the worker is not going to invest any effort as there is no future and production takes place:

\[ y_{i,2} = e_{i,1}^{\alpha} \]  

(5)

and the worker's profit-sharing bonus (that is consumed by the worker) is \( s \cdot p_{i,2} \cdot y_{i,2} \). In period 1, the worker’s effort choice is:

\[ e_{i,1}^* = \arg \max \delta y_i \cdot p_{i,2} \cdot y_{i,2} - \frac{1}{2} e_{i,1}^{\alpha} \]

(6)

\[ = (\delta y_i \cdot \theta \alpha)^{\frac{1}{2 - \alpha \theta}} \]  

(7)

A sufficient condition for (7) to be a maximum is \( \theta < 2\alpha^{-1} \). In period 0, the worker faces a similar problem and he chooses similarly. Effort is increasing in the degree of competition (0).

**Proposition 1.** An unexpected increase in product market competition induces an increase of the worker’s effort.

**Proof.** Compute the derivative of the effort with respect to \( \theta \):

\[ \frac{\partial e_{i,1}^*}{\partial \theta} = \frac{\alpha e_{i,1}^*}{2 - \alpha \theta} \log(\delta y_i \cdot \alpha \theta) + \frac{e_{i,1}^*}{2 - \alpha \theta} \frac{1}{\theta} > 0 \]  

(8)

This derivative is positive if \( \theta < 2\alpha^{-1} \). Q.E.D.
The interpretation is straightforward. The worker makes his effort decision based on her expectations about future revenues. If she anticipates that competition gets stiffer and therefore its expected profit sharing bonus will decrease, she decides to spend more effort so to increase the firm’s output and this way its profit sharing bonus.

The industry is populated with firms with different input characteristics and therefore technical efficiency would be higher in some firms rather than in others. We can measure technical efficiency in firm \( i \) in period \( t \) as the ratio between the actual level of output produced at time \( t \) by the firm \( i \) \( (y_{it}) \), and the potential industry output, which could be produced at time \( t \) \( (\hat{y}_{it}) \) (Farrell, 1957).

\[
TE_{it} = \frac{y_{it}}{\hat{y}_{it}}
\]  

Our main interest is to find out how technical efficiency in periods 1 and 2 in firm \( i \) is affected by a permanent, but unexpected change in the product market competition in period 1. The fact that it is unexpected implies that it could not be taken into account when effort was decided in period 0. The fact that it is permanent implies that worker will wish to adjust the effort choice made in period 1, once he has observed the change in period 1. Many different factors, some related to specific policies and some to consumers’ taste affect the intensity of competition in the product market. Among the policy related factors we find tariffs and other artificially created barriers to entry that reduce competition, as well as policies that advance competition by introducing product standardization. Among the taste related factors, we notice that firms can avoid competition by exploiting the fact that consumers typically have a preference for variety and for particular brands. It is also important to note that the change to product market competition is specific to firm \( i \), that is, the shock is firm specific. Therefore, we can take the industry potential output as given.

Consider first what happens to technical efficiency in period 1. Since the effort has already been decided in period 0 based on expected competition, we get:
Next, consider period 2. After the change has been observed in period 1, it is incorporated in the expectations and the worker adjusts her effort choice to accommodate the new environment in period 2. The change in technical efficiency is period 2 is therefore given by:

$$\frac{\partial TE_{i,t}}{\partial \theta} = 0$$  \hspace{1cm} (10)$$

Therefore we can conclude that when product market competition increases, technical efficiency increases as well. The intuition behind this result is quite simple. An increase in competition implies for the worker that their profit sharing bonus decreases and therefore they may want to readjust their effort so to counterbalance the negative effect of competition. However, the decision of increasing effort will only have an impact on the next period's profit sharing bonus because of the time lag between the workers’ decision on effort and production. These re-adjustments have an impact on the firm's technical efficiency. As workers increase their effort in the first period, the actual output in period 2 increases and gets closer to the potential output. The result is that inefficiency in period 2 for the firm reduces.

3. **The empirical analysis: data and descriptive statistics**

The key prediction from the model is that cooperatives’ technical efficiency can increase as competition increases. To test this theoretical prediction, we use the so-called frontier approach to the measurement of technical efficiency where technical efficiency scores are computed as the distance from an estimated parametric production frontier. More specifically, we use the model by Battese and Coelli (1995) where the inefficiency effects \( u_{it} \) are expressed as an explicit function of a vector of firm-specific variables and a random error. The technology and the inefficiency parameters are so obtained by using a single-stage estimation procedure. The
advantage of this approach is that it allows to compute efficiency scores while controlling for the factors which influence the distribution of scores across different observations.

The model specification is the following:

$$\ln(y_{it}) = \beta_0 + \beta_1 \ln(K_{it}) + \beta_2 \ln(M_{it}) + \beta_3 (L_{it}) + \beta_4 \ln(K_{it})^2 + \beta_5 \ln(M_{it})^2 + \beta_6 \ln(L_{it})^2 + \beta_7 \ln(K_{it}) \ln(M_{it}) + \beta_8 \ln(K_{it}) \ln(L_{it}) + \beta_9 \ln(L_{it}) \ln(M_{it}) + \beta_{10} t + (v_{it} - u_{it}), \quad i = 1, \ldots, N, \quad t = 1, \ldots, T$$

(12)

where $y_{it}$ is (the logarithm of) the production of the $i$-th firm at the $t$-th time period, $K_{it}, L_{it}, M_{it}$ are a $k \times 1$ vector of (transformations of the) capital, labour and material, respectively, of the $i$-th firm at the $t$-th time period and $\beta$ is a vector of unknown parameters. We allow for the possibility of disembodied technical progress by introducing a time trend in the model. The $v_{it}$ are random variables which are assumed to be iid as a $N(0, \sigma_v^2)$, and independent of the $u_{it}$; in turn these are non-negative random variables assumed to account for technical inefficiency in production and to be independently distributed as truncations at zero of the $N(\mu_{it}, \sigma_u^2)$ distribution with $\mu_{it} = z_{it} \delta$, where $z_{it}$ is a $p \times 1$ vector of variables which may influence the efficiency of a firm and $\delta$ is a $1 \times p$ vector of parameters to be estimated together with $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$. The production frontier is finally estimated using Maximum Likelihood.

The data set we use is an unbalanced panel of Italian conventional and cooperative firms from 1996 to 2001, belonging to the sector of Wine Production (corresponding to the code A01131 of the Ateco 91 classification supplied by ISTAT, Italian Statistical Office). The data-set we use has been extracted from AIDA, a database collecting the annual balance sheets of those Italian companies whose operating revenue is equal to a minimum of 1 million euros. In addition to the information contained in the annual reports, the database reports information on companies’ location, the legal status and additional financial data, like short-term and long-term

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3 The firms classified in this sector include firms that both grow and process grapes to produce wine. For the remainder of the paper, we will refer to this sector interchangeably as the wine sector or wine industry.

4 More information on this database can be found at http://www.bvdep.com/browse5.asp.
debts. The total number of observations over the five years is 413. According to their legal status, 63 firms (corresponding to 250 observations over the whole time period) are cooperatives, while 40 firms (corresponding to 163 observations) are conventional firms.

The wine industry has been selected for a number of reasons: first the firms’ output mix is limited compared to that of firms belonging to other sectors as they produce only wine; therefore the firms in our sample will be more homogenous in terms of technology. Homogeneity of the technology available to the firms in the data set under consideration is an important requirement of the frontier analysis to be able to get meaningful frontier estimates. In addition, the number of cooperatives in the Italian wine industry has always been substantial and this implies that their market share has always been quite comparable to that of the conventional firms (van Bekkum and van Dijk, 1998). Finally, firms operating in the wine sector require workers to have some firm-specific skills, consistently with what is described in the theoretical model. Indeed, the land and weather conditions are different from firm to firm and this implies that the workers are required to learn skills (Pagano, 1992; Huffman, 2001) that cannot be easily transferred to other firms even if operating in the same sector (Galizzi, 2000).

In our production set, output is measured by the company's sales plus the change in inventories deflated with the appropriate production index (ISTAT, 2002). Among the inputs, we include the intermediate consumption (as a measure of the raw materials), the capital and the labour. Intermediate consumption is defined as the sum of materials and services while capital is the sum (at book value) of land, buildings, machinery and other fixed assets. Both variables have been deflated by the price index of material consumption and of investment goods for the beverage industry, respectively (ISTAT, 2002). All these variables (both of output and inputs) are expressed in 1995 million Italian liras. Labour is the number of employees at the end of the fiscal year and includes both full-time and seasonal workers. In the production set, we have also controlled for additional sources of heterogeneity in the firms’ technology. Indeed, we have introduced a dummy variable for the cooperatives...
(COOP), taking the value of 1 if the firm is a coop and 0 otherwise. We control for the firm’s location by using a dummy variable related to the geographic location of the firm (SOUTH); this takes the value of 1 if the firm is located in the South of Italy and 0 otherwise. This variable is introduced in the production set to capture the impact that different climatic conditions have on the firms’ output.

Among the $z$ variables, we introduce a set of additional factors that can explain the firms’ heterogeneity. Competition (the parameter $\theta$ in our model) is measured by the inverse of the lagged value of the individual firm’s market share ($\text{THETA}-1$); the market share has been lagged so to avoid potential endogeneity problems in the regression model.\(^\text{6}\) We control also for the firm's location with the variable SOUTH in the specification of the inefficiency model. It is a well established piece of evidence in the Italian literature that location matters for productive efficiency. A typical example is provided by Southern firms that tend to show low levels of efficiency. This is to be probably ascribed to the operation of local factors such as infrastructure endowment, external economies linked to the local technological potential or level of industrialisation, the presence of organised crime, and so on. We introduce the variable YEAR in the specification of the inefficiency model so to control for the impact on technical efficiency of factors like weather, pests and so on (INEA, 2002).

Table 1 reports the sample statistics for the output, inputs and for conventional firms and for cooperative firms, respectively. On average, cooperatives produce more than conventional firms, use less capital and labour but have more intermediate consumption than conventional firms for each year under consideration. This relative undercapitalisation of coops is quite common and not limited to the Italian coops. It is usually explained by the fact that members of coops do not have an incentive to invest in capital equipment as they may not appropriate the increase in value following the investment, in case they decide to leave the cooperative (Mosheim, 2002).

It is also clear from Table 1 that the market share for both coops and conventional firms has decreased. This is the result of two simultaneous factors: first, the market share of Italian wines in foreign markets has decreased due to aggressive

\(^5\) In particular, the firms (both coops and conventional) included in our sample are specialised in the production of medium quality wine.

\(^6\) See also Hay and Liu (1997) for a discussion on this point.
marketing of foreign wine producers in the international markets. Second, during this same period, the European Union (EU) has started to reduce the size of subsidies to firms operating in the agricultural sector and this has implied a downsizing of most companies whose size was not financially viable (van Bekkum and van Dijk, 1998). Interestingly, though, in spite of the general decrease of market share across the two groups of firms, the coops still are able to keep a larger market share than traditional firms.

4. The results

The maximum likelihood estimates of (12) are reported in table 2. The inefficiency model is accepted on the basis of the LR test that is equal to 74.75 with number of restrictions equal to 7 (against a critical value of 14.1 at a 5% significance level). The translog specification has also been tested against the Cobb-Douglas specification and is accepted on the basis of a LR test that is equal to 254.15 with number of restrictions equal to 6 (against a critical value of 12.6 at a 5% significance level). The significance of the coefficients related to inputs is generally quite good; the value and the sign of the cross terms coefficients seems to show that intermediate consumption is a substitute for labour and capital, while labour and capital are complementary. Among the other variables included in the specification of the production function, the dummy for the South of Italy and the year variable are not significant. This means that there is no significant difference in technology among firms located in the South of Italy and in the rest of Italy and there is no empirical evidence of disembodied technical progress. The dummy for coops is significant and negative: this means that, on average, coops produce less, after having taken into account the quantity of inputs they used.

On average for the wine industry, the value of input elasticities are respectively equal to: 0.05 for capital, 0.82 for intermediate consumption and 0.09 for labour in the case of cooperatives and 0.06 for capital, 0.77 for intermediate consumption and 0.11 for labour in the case of conventional firms. Then, returns to scale tend to be constant.  

7 There is neither evidence of embodied technical progress since the LR test of the translog specification with embodied technical progress against the actual specification is equal to 2.4 with number of restrictions equal to 4 (against a critical value of 9.5 at a 5% significance level). The
Among the factors used to explain inefficiency, the dummy for the South of Italy is significant: firms located there tend to be more inefficient; besides, coops are more inefficient than conventional firms but the difference in efficiency is quite small, as it can be seen from table 3. The coefficient of the variable YEAR is not statistically significant. The competition variable is statistically significant and positive: generally competition does increase inefficiency but the interaction with the dummy for coops is significant and negative; this means that inefficiency for coops decreases as they face increasing competition. This result for coops is in line with our theoretical expectation. Moreover, the fact that increasing competition has a negative impact on the levels of efficiency of conventional firms can be explained by the absence of an immediate incentive for workers to increase their effort. Indeed, it is reasonable to assume that eventually conventional firms will be able to increase efficiency once they have absorbed the shock of increasing competition, but only with some time lag. This can be explained by the fact that conventional firms rely mostly on seasonal labour unlike coops and therefore the adjustment to the new competitive environment takes longer than in the case of coops. Not surprisingly then, we can observe from table 3 that technical efficiency has increased for the coops while conventional firms have experienced decreasing levels of efficiency.

5. Concluding remarks

In this paper, we have tested the hypothesis that increasing product market competition can help cooperatives to improve efficiency. As cooperatives are typically characterized by problems of hold-up and therefore appear to be inefficient, an increase in competition has the effect of re-aligning the workers’ interests with those of the firm and therefore they will increase their investment in effort. These re-adjustments have an impact on the firm's technical efficiency. As workers increase their effort, the actual output increases and gets closer to the potential output. The result is that inefficiency for the firm reduces. To test this hypothesis, we have used a panel of traditional and cooperative firms from Italy specialized in the production of wine over the period 1996-2001. The empirical results show that cooperative firms specification, with 4 dummy variables for each year, used to detect the presence of discontinuous technical progress, has also been rejected on the basis of the LR test equal to 0.16.
experience positive technical efficiency change following an increase in competition. In addition, this relationship does not hold for conventional firms where, on the contrary, technical efficiency may worsen. These results give support to the original hypothesis that increasing competition can help a cooperative to improve technical efficiency as it re-aligns the workers' interests with those of the firm.
**Table 1. Descriptive Statistics**

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<th>Output*</th>
<th>Capital*</th>
<th>Inter. Consum.*</th>
<th>Labour</th>
<th>Theta-1</th>
<th>Market share-1**</th>
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<tr>
<td>Mean</td>
<td>7629</td>
<td>6422</td>
<td>6390</td>
<td>27</td>
<td>230</td>
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<td>st. deviation</td>
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<td>18679</td>
<td>8915</td>
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<td>minimum</td>
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<td>1</td>
<td>233</td>
<td>1</td>
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<td>maximum</td>
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<td>139473</td>
<td>64360</td>
<td>304</td>
<td>3190</td>
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<tr>
<td>1 quartile</td>
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<td>7</td>
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<td>2 quartile</td>
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<td>2534</td>
<td>3534</td>
<td>12</td>
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<td>3 quartile</td>
<td>6993</td>
<td>4571</td>
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<td>26</td>
<td>282</td>
<td>0.95</td>
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*1995 ml Italian liras  
**percentage
Table 2. MLE estimates

<table>
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<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>S.E.</th>
<th>t-ratio</th>
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<tr>
<td>Constant</td>
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<tr>
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<td>0.05</td>
<td>1.31</td>
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<td>LnMT</td>
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<td>-0.54</td>
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<tr>
<td>LnL</td>
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<td>7.37***</td>
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<td>0.01</td>
<td>0.00</td>
<td>3.98***</td>
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<td>LnMT^2</td>
<td>0.14</td>
<td>0.01</td>
<td>12.89***</td>
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<tr>
<td>LnL^2</td>
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<td>0.01</td>
<td>2.78***</td>
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<td>LnK*LnMT</td>
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<td>-2.75***</td>
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<tr>
<td>LnK*LnL</td>
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<td>0.00</td>
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<td>0.01</td>
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<td>SOUTH</td>
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<td>0.02</td>
<td>-1.61</td>
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<tr>
<td>COOP</td>
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<td>0.02</td>
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<tr>
<td>YEAR</td>
<td>-0.004</td>
<td>0.01</td>
<td>-0.67</td>
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*Inefficiency Model Parameters*

\[
\mu_0 = -0.28, \quad 0.10, \quad -2.97*** \\
SOUTH = 0.06, \quad 0.03, \quad 1.88* \\
COOP = 0.28, \quad 0.10, \quad 2.95*** \\
YEAR = -0.03, \quad 0.01, \quad -2.17** \\
\text{THETA} = 0.0008, \quad 0.00, \quad 6.32*** \\
\text{THETA*COOP} = -0.0006, \quad 0.00, \quad -4.55*** \\
\sigma^2 = 0.01, \quad 0.00, \quad 10.97*** \\
\gamma = 0.22, \quad 0.09, \quad 2.58***
\]

*** Coefficient significant at the 1% level  
** Coefficient significant at the 5% level  
* Coefficient significant at the 10% level
<table>
<thead>
<tr>
<th>Year</th>
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<tr>
<td>1998</td>
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<tr>
<td>1999</td>
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<tr>
<td>2000</td>
<td>0.969</td>
<td>0.954</td>
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<td>0.954</td>
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<tr>
<td>mean</td>
<td>0.965</td>
<td>0.971</td>
</tr>
</tbody>
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6. References


Van Dijk, Gert and Mackel, Chris, “Dutch Agriculture Seeking for Market Leader Strategies”, European Review of Agricultural Economics, v.18, 3-4, 345-64.


Galizzi, Giovanni, 2000, Le caratteristiche strutturali dell'offerta dei prodotti agricoli, mimeo, Piacenza,.


van Bekkum, Onno F., and van Dijk Gert, 1998, Lo sviluppo delle cooperative agricole nell'Unione Europea, Ancona: Edizioni CLUA.
