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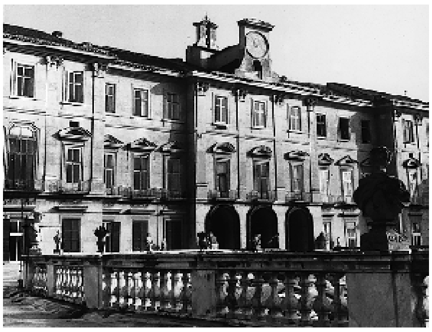

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Competition and Efficiency: Some theoretical prescription and Empirical evidence for the European dairy industry*

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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 European investor owned and cooperative firms, belonging to the dairy industry, using frontier analysis. Technical efficiency indexes are computed by using the one-stage approach as suggested by Reifschneider and Stevenson (1991), where proxies for competition are introduced as determinants of efficiency variancey. The results support the hypothesis that increasing market competition can affect positively the cooperatives´ efficiency.

Riassunto

Key words:

Parole chiave:

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1. *Introduction*

This paper analyses the relationships between market competition and efficiency for the European food industry. Due to the increasing competition in the product market and the reduced support from EU, European agricultural co-operatives have gone through a substantial restructuring process involving vertical integration and changes in ownership structure (van Bekkum and van Dijk Gert, 1998). This paper tests whether European cooperatives are experiencing an improvement in technical efficiency following these structural changes in the economic environment.

The work first formalises, in a partial equilibrium framework, the relationship between product market competition, profit sharing and technical efficiency. In the case of a cooperative, competition could give its workers the incentives to improve efficiency so to guarantee the firm survival for the following reasons. Consider a firm where workers have control rights over a specific asset, their effort, and are paid by a fixed fraction of the overall surplus. The firm organizes the production using both a fixed asset and the worker's effort as inputs; in order to produce, the firm 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. Workers may 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. 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. The degree of product market competition, faced by the cooperative in the market, can increase for several factors like economic policy and different consumers tastes. 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. These re-adjustments have an impact on the firm's technical efficiency. As workers increase their investment, the actual output increases and gets closer to the potential output; therefore, inefficiency for the firm reduces.

This theoretical hypothesis is tested empirically for a panel of investor-owned and cooperative European firms, specialized in the dairy production, over the time 1996-2003. The dataset includes both investor owned and cooperative firms sourced from

AMADEUS, a database that contains standardised annual accounts (for up to 10 years), financial ratios, activities and ownership for approximately 8 million companies throughout Europe. Technical efficiency indexes are computed by using the one-stage approach as suggested by Reifschneider and Stevenson (1991), where proxies of the state of competition in the market are introduced as determinants of efficiency. 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, the data and the results are presented in Section 3, 4 and 5. Finally some concluding remarks are offered in Section 6.

2. *The general framework*

Consider an industry with $i=1,..,N$ firms. There are $i=1,..,N$ 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:

$$y_{i,t} = e_{i,t-1}^{\alpha} \qquad (1)$$

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:

$$p_{i,t} = y_{i,t}^{\theta-1} \bar{y}_{i,t}^{1-\theta} = y_{i,t}^{\theta-1} \qquad (2)$$

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 θ 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 $p_{i,t}y_{i,}$. The per period utility function of the worker is defined as:

$$U_{i,t} = c_{i,t} - \frac{1}{2}e_{i,t}^2 \tag{3}$$

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

$$U_i = \sum_{t=0}^{T} \delta^t (s_i p_{i,t} y_{i,t} - \frac{1}{2}e_{i,t}^2) \tag{4}$$

where δ is the discount factor and e_{-1}=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:

$$y_{i,2} = e_{i,1}^{\alpha} \tag{5}$$

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

$$e_{i,1}^{*} = \arg\max \delta s_i p_{i,2} y_{i,2} - \frac{1}{2} e_{i,1}^{2} \tag{6}$$

$$= (\delta s_i \theta \alpha)^{\frac{1}{2-\alpha\theta}} \tag{7}$$

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 (θ).

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 θ:

$$\frac{\partial e_{i,1}^{*}}{\partial \theta} = \frac{\alpha e_{i,1}^{*}}{2-\alpha\theta} \log(\delta s_i \alpha\theta) + \frac{e_{i,1}^{*}}{2-\alpha\theta} \frac{1}{\theta} > 0 \tag{8}$$

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* ($y_{i,t}$), and the potential industry output, which could be produced at time *t* ($\hat{y}_{i,t}$) (Farrell, 1957).

$$TE_{i,t} = \frac{y_{i,t}}{\hat{y}_{i,t}} \tag{9}$$

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:

$$\frac{\partial TE_{i,1}}{\partial \theta} = 0 \tag{10}$$

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:

$$\frac{\partial TE_{i,2}}{\partial \theta} = \frac{\alpha\left(\partial e^{*}_{i,1} / \partial \theta\right)^{\alpha-1}}{\hat{e}^{\alpha}_{i,1}} > 0 \tag{11}$$

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*

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 stochastic parametric production frontier. This approach is motivated by the idea that deviations from the production frontier might not be entirely under the control of the firm being studied and might be due to measurement errors and other noise upon the frontier. The previous specification was usually based on cross-sectional data but recently the collection of longitudinal data on firms has encouraged the development of stochastic frontier models suitable for panel data. Besides, the analysis of the determinants of efficiency differentials was initially performed by the adoption of a two-stage approach: after estimating inefficiency by a stochastic frontier technique, inefficiency scores were regressed on the exogenous explanatory variables usually by OLS; however, the two-stage estimation procedure is inconsistent with the assumption of identically distributed inefficiency effects of the first stage. Recently, the one-stage approach has been proposed where the effects on inefficiency of exogenous variables are estimated simultaneously with the other parameters of the stochastic production frontier model. In this paper we follow this approach and let inefficiency to depend on exogenous factors by parameterising the variance of inefficiency by adopting the additive formulation for the variance of the pre-truncated distribution suggested by Reifschneider and Stevenson (1991). Compared to the more standard methodology, pionereed by Kumbhakar, Ghosh and McGuckin (1991), where it is the mean of the pretruncated distribution to be modelled, this approach has the advantage to address the problem of heteroskedasticity in the inefficiency component of the composite error term (Kumbhakar and Lovell, 2000) .More in detail, Reifschneider and Stevenson (1991) propose a model where the variance of the inefficiency effects (σ_{uit}) is expressed as an explicit function of a vector of firm-specific variables. 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 technology and the inefficiency model parameters are estimated by Maximum likelihood method.

The model specification is the following:

$$\ln(VA_{it}) = \beta_0 + \beta_1 \ln(K_{it}) + \beta_2 (LAb_{it}) + \beta_3 \ln(, QK_{it})^2 + \beta_4 \ln (LAB_{it})^2 + \beta_5 \ln(QK_{it}) \ln(LAB_{it}) + \beta_6 \ln(QK_{it})*YEAR + \beta_7 \ln(LAB_{it})*YEAR + \beta_8 \ln(QK_{it})*COOP + \beta_9 \ln(LAB_{it})*COOP + \beta_{10} YEAR + (v_{it} - u_{it}),$$

$$v_{it} = \gamma_0 + \gamma_1 SHAREHOLD + \gamma_2 DEP + \gamma_3 SUBS$$

$$u_{it} = \delta_0 + \delta_1 COOP + \delta_2 Theta\text{-}1 + \delta_3 Theta\text{-}1*COOP + \delta_4 C4 + \delta_3 C4*COOP \qquad (12)$$

where VA_{it} is the value added of the i-th firm at the t-th time period, QK_{it} and LAB_{it} are input quantities of the i-th firm at the t-th time period and β is a vector of unknown parameters. COOP is the dummy variable for the cooperatives, while YEAR is the time trend. The v_{it} are random variables which are assumed to be independently distributed as a symmetric $N(0, \sigma_v^2)$ distribution, independent of the $u_{it,}$ with $\sigma_{vit}^2 = \exp(w_{it}\gamma)$ where w_{it} is a vector of variables which may cause heteroscedasticity. The u_{it} are non-negative random variables assumed to account for technical inefficiency in production and to be independently distributed as a $N+(0, \sigma_{uit}^2)$ distribution with $\sigma_{uit}^2 = \exp(z_{it}\delta)$, where z_{it} is a p×1 vector of variables which may influence the efficiency of a firm and δ is an 1×p vector of parameters to be estimated.

Among the variables used to control for heteroscedasticity, we include those related to firm ownership structure and size: SHAREHOLD, DEP and SUBS, which are defined in following section. Among the *z* variables, we introduce competition, the parameter θ in our model (THETA-1), and an alternative measure, the concentration ratio (C4) of the four top firms at a national level and the interaction of both variables with the dummy COOP.

4. *Data and descriptive statistics*

The data set we used is a balanced panel of European investor owned and cooperative firms from 1996 to 2003, belonging to the sector of operation of diaries and cheese making[4] (corresponding to the code DA1551 of the NACE1.1 classification). The balanced panel has been extracted from AMADEUS[5], a database collecting the annual balance sheets of European companies. In addition to the information contained in the annual reports, the database reports information on companies' legal status and form and financial data. Firms has been defined as cooperative when so identified in the data set or, if not classified, when: the term cooperative or its translation[6] was included in the company name; the firm was mentioned in the COGECA (2005) report or, for Italy, if the company legal form was classified as S.C.A.R.L. According to the legal status, only active companies were included and companies classified as in default of payments, in bankrupty, inactive, dissolved, in liquidation were excluded as well those with a negative current value added. The balanced panel data, which has been extracted, includes 512 firms; then, the total number of observations, over the seven years, is 3584. According to their legal form, 173 firms (corresponding to 1211 observations over the whole time period) are cooperatives, while 339 firms (corresponding to 2373 observations) are investor owned firms.

The dairy industry has been selected because it is well-spread in Europe; in addition, the number of cooperatives has always been substantial in this sector and this implies that their market share has always been quite comparable to that of the investor owned firms

[4] This sector excludes the manufacture of ice creams. For the remainder of the paper, we will refer to this sector interchangeably as the dairy sector or dairy industry.

[5] More information on this database can be found at https://amadeus.bvdep.com.

[6] Information on the several legal forms over all the world can be found at http://www.gefeg.com/public/grefis-rf/1c1.htm

(van Bekkum and van Dijk, 1998; COGECA, 2005). Finally, firms operating in the dairy sector require workers to have some firm-specific skills, consistently with what is described in the theoretical model. In our production set, output is measured by the company's value added. Valued added has been obtained by subtracting from operating revenue (voice 25 in the AMADEUS database), deflated by the national production index (EUROSTAT[7]), intermediate consumption, which is the sum of material costs, costs of goods sold and other operating expenses (the voices 27, 29 and 42 in the AMADEUS database), deflated by the national price index of milk. The price index of intermediate consumption has been used in alternative but the former has been preferred on the basis of its higher and negative correlation with the voice of intermediate consumption after deflation. Among the inputs, we include the capital and the labor; the former is given by the tangible fixed assets which has been deflated by the national price index of investment goods for the industry (EUROSTAT). Both output and capital variables are expressed in thousand Euros 2000. Labor is the number of employees (voice 24 in the AMADEUS database). In the production set, we have also controlled for additional sources of heterogeneity in the firms' technology. We control for the firm's location by using a dummy variable related to the location of the firm, taking the value of 1 if the firm is located in the North countries (Belgium, Finland and Netherlands) and 0 otherwise. The dummy variable for the cooperatives, COOP, takes the value of 1 if the firm is a coop and 0 otherwise.

Among the variables used to control for heteroscedasticity, we include: SHAREHOLD, which is the number of recorded shareholders; DEP, a dummy variable, taking the value one if more than the 49.9% of direct or total ownership belongs to one shareholder, 0 otherwise, and SUBS, which is the number of recorded subsidiaries. Competition, THETA-1, is measured by the inverse of the lagged value of the individual firm's market share; the market share is measured by the ratio of firm sales respect to the sales of the entire sample for the same year. It has been lagged so to avoid potential endogeneity problems in the regression model.

Table 1 - *Mean of variables by year and by country for the investor owned firms (output and capital in thousands Euros 2000)*

[7] http://epp.eurostat.cec.eu.int/

Country	Variable	1997	1998	1999	2000	2001	2002	2003
Belgium	***Output***	18358	18016	18065	18653	24339	23101	26740
	Capital	5421	5873	5855	5893	6264	5962	5827
	Labor	119	122	128	132	136	137	139
	Market Share	0.005	0.005	0.005	0.004	0.005	0.004	0.004
	C4	0.069	0.065	0.065	0.06	0.06	0.059	0.059
Spain	***Output***	6416	6999	7863	8222	8821	9221	9700
	Capital	6516	7117	7991	8371	8966	9376	9858
	Labor	100	118	129	149	145	155	158
	Market Share	0.002	0.002	0.002	0.002	0.002	0.002	0.003
	C4	0.075	0.094	0.096	0.103	0.102	0.102	0.107
France	***Output***	5164	5371	5934	6427	6687	6090	6007
	Capital	5303	5510	6077	6577	6849	6250	6164
	Labor	139	139	143	150	162	160	157
	Market Share	0.004	0.003	0.003	0.004	0.004	0.004	0.004
	C4	0.174	0.198	0.195	0.197	0.199	0.196	0.183
Greece	***Output***	5963	5998	5741	5854	5923	6281	6815
	Capital	6068	6114	5857	5970	6039	6397	6931
	Labor	105	116	116	116	116	116	116
	Market Share	0.001	0.002	0.002	0.002	0.002	0.002	0.002
	C4	0.036	0.041	0.049	0.048	0.046	0.045	0.047
Italy	***Output***	5251	4419	4626	4638	5013	5088	5251
	Capital	2417	2546	2716	2934	3078	3133	3293
	Labor	36	37	37	39	46	49	49
	Market Share	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	C4	0.048	0.041	0.038	0.036	0.037	0.036	0.038
Netherlands	***Output***	13281	12853	13212	18314	18301	17105	15301
	Capital	13463	13041	13403	18510	18482	17273	15454
	Labor	182	189	192	197	181	168	153
	Market Share	0.001	0.002	0.002	0.002	0.003	0.002	0.003
	C4	0.018	0.019	0.022	0.022	0.023	0.025	0.025
Europe	***Output***	10143	10531	11156	11895	13376	13279	13692
	Capital	4351	4591	4935	5256	5516	5498	5672
	Labor	81	86	90	96	101	104	104
	Market Share	0.002	0.002	0.002	0.0021	0.0021	0.0021	0.0021
	C4	0.071	0.0733	0.0716	0.0709	0.0717	0.0707	0.0706

For the same reason, the second measure C4 of the degree of competition in the market has been derived by the concentration ratio, which is the sum of the market shares, as previously defined, of the four top firms at a national level.

Table 2 - *Mean of variables by year and by country for the cooperatives (output and capital in thousands Euros 2000)*

Country	Variable	1997	1998	1999	2000	2001	2002	2003
Belgium	***Output***	19786	18378	16783	15056	17408	18140	19136
	Capital	3578	3609	3364	2823	2817	3890	5827
	Labor	138	138	132	123	118	123	125
	Market Share	0.005	0.005	0.005	0.004	0.004	0.003	0.003
	C4	0.069	0.065	0.065	0.060	0.060	0.059	0.059
Spain	***Output***	195	176	190	300	354	396	395
	Capital	125	138	137	115	142	255	231
	Labor	6	6	5	8	10	11	9
	Market Share	0.00003	0.00004	0.00004	0.00004	0.00004	0.00004	0.00006
	C4	0.075	0.094	0.096	0.103	0.102	0.102	0.107
Finland	***Output***	223821	203517	202822	215511	225608	246800	247475
	Capital	142583	146418	141929	144287	150788	166737	203406
	Labor	2313	2302	2149	2081	2102	2235	2216
	Market Share	0.050	0.046	0.042	0.040	0.040	0.040	0.042
	C4	0.100	0.091	0.083	0.080	0.081	0.080	0.083
France	***Output***	125902	129240	130846	136638	145610	104018	54620
	Capital	41711	44163	45107	43081	38678	18246	18175
	Labor	800	859	908	948	955	748	532
	Market Share	0.016	0.023	0.022	0.021	0.020	0.019	0.016
	C4	0.174	0.198	0.195	0.197	0.199	0.196	0.183
Italy	***Output***	1949	1573	1621	1658	1740	1540	1498
	Capital	1439	1590	1652	1749	1752	1717	1717
	Labor	19	19	18	20	22	22	23
	Market Share	0.0006	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004
	C4	0.048	0.041	0.038	0.036	0.037	0.036	0.038
Netherlands	***Output***	53706	79357	68129	87562	105169	107139	109928
	Capital	17546	19865	20288	17822	22429	40236	41761
	Labor	109	112	113	115	119	126	130
	Market Share	0.008	0.008	0.009	0.009	0.009	0.010	0.010
	C4	0.018	0.019	0.022	0.022	0.023	0.025	0.025
Europe	***Output***	9510	9266	9144	9637	10398	9319	7940
	Capital	4513	4791	4816	4818	4821	4640	5169
	Labor	75	76	74	76	78	75	69
	Market Share	0.0018	0.0019	0.0018	0.0017	0.0017	0.0017	0.0016
	C4	0.0710	0.07331	0.07161	0.07087	0.07171	0.07068	0.0706

Tables 1 and 2 report the sample mean for the output, inputs, market shares and concentration ratio for investor owned firms and for cooperative firms, respectively. On average, cooperatives produce less than investor owned firms, use less capital and labour than investor owned firms. It is also clear from Tables 1 and 2 that the market share has decreased for coops and increased for investor owned firms.

5. *The results*

The maximum likelihood estimates of (12) are reported in table 3. The significance of the coefficients related to inputs is generally quite good and the production function is well-behaved. The interaction of input variable with coops is significant and negative for capital and significant and positive for labor: this means that, on average, coops use less capital and more labor than investor owned firms. This result supports the argument of a relative undercapitalisation of coops, not limited to the European coops (Mosheim, 2002)[8]. Besides, the significance of the interaction of input variables with time supplies evidence of embodied technical progress. Among the other variables included in the specification of the production function, the dummy for the North variable is negative and significant. This means that there is a significant difference in technology among firms located in the North and in the rest of Europe. On average for the dairy industry, the value of input elasticities are respectively equal to: 0.20 for capital and 0.81 for labor in the case of cooperatives and 0.58 for capital and 0.33 for labor in the case of investor owned firms. Then, returns to scale tend to be constant for cooperatives and decreasing for investor owned firms, probably because their production scale is larger.
Among the factors used to control for heteroscedasticity, the number of shareholders and the number of subsidiaries are significant: the variance of the symmetric component of the error term, v_{it}, is positively related to the above-mentioned variables. Among the factors used to explain inefficiency, coops are more efficient than investor owned firms but the difference in efficiency is quite small, as it can be seen from table 4. The competition variable is statistically significant and positive: generally competition does increase inefficiency variance and then 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. The previous result could be spurious in the sense that there could be a negative correlation among technical

[8] 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.

efficiency, that is *output-increasing*, and the decline in firm market share but it is supported by the significance of the concentration ratio of the top four firms, C4, and of its interaction with the coop dummy: generally, concentration does increase efficiency but it decreases efficiency for coops.

Table 3 - *MLE estimates. Dependent variable LnVA*

Variable	Coefficient	S.E.	*t-ratio*	|P[|Z|>z]
Constant	8.02	0.03	306.79	0.00
LnLAB	0.48	0.03	18.32	0.00
LnQK	0.37	0.02	18.91	0.00
LnQK^2	0.12	0.01	14.67	0.00
LnLAV^2	0.35	0.02	21.28	0.00
LnLAB*LnQK	-0.15	0.01	-16.89	0.00
LnQK*COOP	-0.13	0.02	-6.91	0.00
LnLAB*COOP	0.23	0.02	9.53	0.00
LnQK*YEAR	-0.01	0.00	-2.47	0.01
LLAB*YEAR	0.02	0.01	4.46	0.00
YEAR	-0.05	0.00	-9.40	0.00
NORTH	-0.0007	0.00	-13.80	0.00
Parameters in varance of v (symmetric)				
CONSTANT	-2.09	0.05	-38.82	0.00
SHAREHOLD	0.10	0.02	5.69	0.00
DEP	-0.07	0.08	-0.90	0.37
SUBS	0.22	0.02	13.14	0.00
Inefficiency Model Parameters: parameters in variance of u (one sided)				
CONSTANT	0.74	0.07	11.25	0.00
COOP	-1.67	0.20	-8.44	0.00
THETA-1	0.0000501	0.00	49.62	0.00
THCOOP	-0.0000504	0.00	-9.52	0.00
C4	-17.42	1.45	-12.05	0.00
C4COOP	18.91	4.53	4.18	0.00
N. observations	3534			
LogL	-3359.321			

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 investor owned 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 investor owned 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 investor owned firms rely mostly on less motivated labor and therefore the adjustment to the new competitive environment takes longer than in the case of coops. From table 4, we can observe that technical efficiency has increased for the investor owned firms while the trend in efficiency level experienced by coops is less clear.

Table 4 - Technical efficiency estimates

Year	Cooperatives	Investor owned firms
1997	0.64	0.58
1998	0.57	0.58
1999	0.61	0.59
2000	0.61	0.59
2001	0.59	0.59
2002	0.58	0.61
2003	0.59	0.62
mean	0.60	
st. dev.	0.19	
1° quart.	0.50	
2° quart.	0.62	
3° quart.	0.74	

6. *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 balanced panel of investor owned and cooperative firms from Europe specialized in the dairy production over the period 1996-2003. The empirical results show that cooperative firms experience positive technical efficiency change following an increase in competition. In addition, this relationship does not hold for investor owned 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.

7. *References*

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