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COMPARATIVE EFFICIENCY OF PRODUCER COOPERATIVES AND CONVENTIONAL FIRMS IN A SAMPLE OF QUASI-TWIN COMPANIES

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Comparative efficiency of producer cooperatives and conventional firms in a sample of quasi-twin companies

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Abstract

We investigate the comparative technical efficiency of producer cooperatives (PCs) and conventional firms (CFs) by looking at the performance of a mixed sample of Sardinian wine producing companies over the period 2004-2009. Thanks to the similarity of the habitats in which the firms operate, the peculiarities of the production environment, and the careful measurement of some key inputs through suitable aggregation of accounting data, the observed units are "twins" in all non-organizational respects, providing one natural setting for comparative work. The analysis is carried out in two steps: in the first, technical efficiency indicators for each firm in each year are calculated using Data Envelopment Analysis (DEA) with reference to a common production frontier. Subsequently, the measured efficiency scores become the dependent variables of a pooled truncated maximum likelihood regression in which we control for external covariates and firm type. To assess the procedure's appropriateness, we test whether the separability condition that the support of the output variables does not depend on the set of external variables is satisfied. Moreover, a double bootstrap algorithm is run to compute valid standard errors and confidence intervals of the coefficients estimates. According to our findings cooperatives are less technically efficient than their capitalist counterparts and displays decreasing returns to scale. Both results are particularly worrying in light of the main challenges (liberalization of EU planting rights and climate changes) facing the wine industry in the near future.

Keywords: comparative firm efficiency, data envelopment analysis, double bootstrap.
Jel classification: C24, L25, P13, Q13, R11

1. Introduction

For a number of reasons, producer cooperatives continue to excite interest both across the research spectrum and in the policy arena. Even more so in times of financial and economic crisis like those we are facing, with the majority of enterprises struggling to cope with the pressures of the credit crunch and, more generally, with the negative impact of the Great Recession. As a matter of fact, despite the considerable variation of that impact across countries and sectors, it seems that "cooperative enterprises around the world are showing resilience to the crisis. Financial cooperatives remain financially sound; consumer cooperatives are reporting increased turnover; worker cooperatives are seeing growth as people choose the cooperative form of enterprise to respond to new economic realities." (Birchall and Ketilson, 2009).

History provides abundant examples showing that cooperatives thrive in difficult times. The first successful retail consumer cooperative was founded in 1844 in Britain, at a time of desperate hardship, and the first two Italian cooperatives were formed a decade later during a severe famine. Likewise, Germany's rural cooperative banks entered the scene during an agricultural depression in 1860s; while more recently it was the BSE crisis in Canada, the stagnation in farm prices in the US and Canada and the financial meltdown in Argentina that triggered the formation of several new cooperatives[1]. It is undoubtedly in light of this evidence, which underscores the invaluable contributions of cooperative enterprises to poverty reduction, employment generation and social integration at all latitudes, that the United Nations General Assembly (Resolution A/RES/64/136) has declared 2012 as the International Year of Cooperatives, with the aim of promoting the cooperative business model as an alternative means of doing business and furthering socioeconomic development.

Does that mean that careful investigation of the relative performance of PCs and CFs is no longer an issue or, worse, it is out-dated? Our opinion is that precisely in view of the remarkable social and economic significance achieved by cooperatives around the globe that line of investigation deserves further attention. While the notion of resilience

[1] More precisely, the depression in farm prices in the US and Canada inspired a new type of cooperative, which by aligning farmer share-ownership to delivery rights enabled farmers to go into food processing (see Birchall and Ketilson, 2009, p. 6).

captures an important dimension of an enterprise, namely the ability to stay in business under a significant set of contingencies including extreme financial crises, it is not irrelevant whether that ability is related or unrelated to efficiency. In the former case resilience would reinforce the "creative destruction" effect of capitalist crises (cleansing the system and freeing up resources for more productive uses) described by Schumpeter (1939); in the latter it would mitigate, if not impair, such process. By the same token, if an economic sector - like the one we consider below - is on the brink of a major structural reform, in order to assess the likely effect of the change and its desirability it is essential to know whether and why producers have different degrees of efficiency.

Our empirical inquiry is by no means the first investigation of efficiency differences between conventional firms and producer cooperatives: a research field which has received substantial attention in recent years. Yet, despite the growth of the literature and the availability of more powerful quantitative techniques[2], the evidence remains inconclusive. As pointed out recently by Arando et al. (2011), while a subset of studies demonstrates better performances by PCs compared for instance to participatory capitalist firms, other assessments are not so sanguine and the "ambivalence is particularly apparent when evaluation is restricted to studies that endeavor to make comparisons between PCs and conventional firms within the same industry" (p. 3). A major problem with the latter kind of applications was singled out some time ago in the authoritative survey by Bonin et al. (1993). They warned researchers that in order to examine productivity differences between PCs and CFs "the comparison should be made between firms that are 'twins' in all non-organizational respects, e.g., in terms of technology, the product generated, and market conditions" (p. 1306). Defourny (1992) and Craig and Pencavel (1992) are seminal examples of empirical inquiries concerning cooperatives and conventional firms consistent with that recommendation, but despite the upward trend in the broader comparative efficiency literature, the use of observations satisfying the stringent requirements just mentioned is still uncommon. Our dataset

[2] For a comprehensive panorama of the theoretical and empirical works produced in the broad area of participatory and labor managed organizations see the series of annual volumes *Advances in the Economic Analysis of Participatory and Labor-Managed Firms* began in 1985 by Derek and Svejnar and currently edited by Kato (2011).

instead meets most of those requirements. Hence we believe we can add a significant piece of evidence to the comparative efficiency debate and, for the specific sector under study, provide some clue as to the risks of the forthcoming EU market reform[3].

The basic question we address is whether observed technical efficiency differs significantly across PC's and CF's and to what extent it is affected by environmental factors (or non-discretionary variables) outside the control of the firm managers. To this end, we do the following steps: first we calculate DEA efficiency scores for each firm, then – after testing for the appropriateness of the adopted procedure - we run a pooled truncated maximum likelihood regression on these scores and a host of environmental covariates, finally we compute by means of a double bootstrap procedure the standard errors and confidence intervals of the coefficients estimates of the post DEA stage. The next section provides an overview of previous works related to our exercise. Then, in the following two sections, we describe the data as well as our estimation strategy. Finally, in the last two sections, we present the empirical and robustness results and draw the conclusions.

2. Overview of previous works

In the early 1990's, comparative empirical research on the performance of self-managed and capitalist firms was still underdeveloped relative to its theoretical counterpart. The difficulty of conducting the ideal empirical experiment was the main reason for the gap and most empirical papers focussed on data sets consisting of only PC firms (see Bonin et al., 1993, p. 1301). Common features of these earlier applications, that exploited the marked variation in the degree of participation among PC's, were a standard production function (usually with value-added as the dependent variable) augmented by participation measures and dummy variables to control for industry, market, and other

[3] One key objective of the reform of the sector is to rebalance the market by reducing the chronic wine surpluses and replace the current mix of measures that have not proved effective: e.g. the restrictions of planting rights and the financial aids for distillation, storage and use of must. The most controversial decision concerns the liberalization of planting rights from 1 January 2014 onwards in order to put EU wine growers on an equal footing with their competitors. At present, a coalition of 15 countries representing more than 98% of European wine production is opposing this decision and is calling for planting rights scheme to be maintained beyond 2015.

external influences. Combining results from these studies, Bonin et al., 1993, p. 1304, observe that "the null hypothesis that the various forms of participation taken together do not affect productivity is rejected" and that "the most significant of the participatory variable is profit sharing". Turning to works based on mixed or paired samples of PCs and CFs, the same authors note that most investigations find no statistically significant effects, thereby concluding that "the empirical evidence regarding comparative productivity is inconclusive when data are available for both PCs and comparable CFs" (p. 1305).

Prominent contributions in the latter stream of work, which bears directly upon our exercise, were Craig and Pencavel (1992), Defourny (1992), Pencavel and Craig (1994) and Craig and Pencavel (1995). Investigating participation and productivity on plywood mills in Washington state, where for a period of 70 years PCs and CFs have existed side by side producing virtually the same product by almost the same methods, the first two authors inquire whether a) the responses of PCs to changes in their economic environment differ from those of CFs b) the observed differences in output and input responses are consistent with conventional models of optimizing behaviour (i.e. orthodox models of profit and dividend maximization) c) for given level of observed inputs, the PCs produce more (or less) output than do CFs. Their findings provide support for the idea that PCs are more likely to adjust earnings and less likely to adjust employment to changes in output and input prices than CFs (Craig and Pencavel, 1992); these patterns of responses are those that might be expected if the CFs maximized profits and the PCs maximized net revenues per labor input (Pencavel and Craig, 1994). As for productivity, the main implication of their estimates of the parameters of a productivity equation with output per input ratios as the dependent variable (they consider labour productivity, raw material productivity and machine productivity) and indicators of firm type and year on the right hand side, is that PCs perform better than CFs (Craig and Pencavel, 1995). For later reference, it is worth noting that in this important seminal paper on the comparative productivity of twin firms the data set consists of "170 observations on 34 mills: 7 mills are cooperatives, 19 are unionized mills, and 8 are classical mills. For only three mills (one co-op, one unionized, and one classical) are there observations in each (even-numbered) year, so the data set is unbalanced. We calculate that our sample constitutes 49.7 percent of all active mills over these years, 37.5 percent of co-ops, 67.8 percent of unionized mills, and 34.0 percent of classical mills." (p. 137).

Starting from similar concerns about the conditions required for reliable results on the comparative efficiency of self-managed and capitalist firms, Defourny (1992) investigates the technical efficiency of PCs and CFs in 14 French industries in which large numbers of SCOPs (Société Coopératives Ouvriéres de Production) could be found. The sample used comprises 500 SCOPs from 1971-1979. Basically, for each industry, he estimates deterministic production frontiers (in which any difference between observed production and the corresponding maximum production that could have been obtained with the same inputs is ascribed to technical inefficiency) and calculates the distance between the "average firm" of each group (PCs and CFs) and the sector frontier (estimated, for lack of individual observations regarding conventional firms, on the basis of cooperative productions only). The calculations are replicated for different size categories across groups. It turns out that the overall results are driven by the size of firms and the type of activity. More precisely, whereas medium-sized PCs (employing between 20 and 49 workers) show greater technical efficiency than their capitalist counterparts, very small cooperatives (less than 10 workers) tend to have lower productivity scores. This latter results, however, is not found in very labour-intensive sectors.

Despite the large number of works that followed these earlier contributions, owing to the dearth of official firm-level statistics taking care of organizational types, not to mention the lack of consistent accounting standards across types, to date only a few applications have managed to put together consistent panel of PCs and CFs operating in the same product market environment. Within this segment, Ferrantino et al. (1995) examine the effect of ownership on intrafirm differences in technical, cost and allocative efficiency in the Indian sugar processing industry. The dataset includes both a small sample (129 observations for one year) and a large sample (239 observations for five years): in the latter labour data are missing while in the former, though complete relative to factor inputs, cooperatives, large factories and newer factories are disproportionately represented. Not surprisingly, the estimation strategy is strongly influenced by these limitations. The efficiency analysis is carried out in two stages: first, calculation of DEA (data envelopment analysis) efficiency scores and robustness check of associated rankings to sample selection and choice of inputs; second, estimation of the effects of organizational structure and additional controls on efficiency scores through multivariate analysis. While measured technical efficiency turns out to be higher for cooperatives and larger and newer factories, the expected technical efficiency advantage of cooperatives is supported only partially in the large sample and is not supported in the small sample. Following a different strategy to gauge the impact of liberalization on the performance of dairy processing firms in India, Singh et al. (2001) estimate a production frontier on a panel data sample of 23 plants (13 cooperative plants and 10 private plants) observed between 1992/93 and 1996/7 using as measurement method both SFA (stochastic frontier analysis) and DEA. The hypothesized functional form for the SFA is a Cobb-Douglas. One (composite) output and four input variables are specified. Technical (TE), allocative (AE) and cost efficiency (CE) scores are calculated for each plant relative to each type of frontier. Although the mean technical efficiency scores for each group under SFA differ from those under DEA (in the former regime cooperatives plants get higher scores relative to private plants, but the reverse holds in the latter), according to the Kruskall-Wallis test, the null that the scores of the two types of plants are not significantly different is always accepted at the 5% level of significance except in the case of AE under SFA. In a closely related application, Mosheim (2002) calculates and decompose cost efficiency for the Costa Rican coffee processing sector using an unbalanced panel of 16 investor-owned firms and 28 cooperatives spanning 5 years (from 1988-1989 to 1992-1993), for a total of 114 observations. After testing for the existence of a pooled technology, efficiency measures relative to a common deterministic frontier were obtained through DEA. According to the Wilcoxon-Mann-Whitney non-parametric test, all year-by-year differences in efficiency between CFs and PCs are insignificant. The calculated measures of efficiency are then regressed (both jointly and separately) on a set of explanatory variables (organizational type, time, location, firm and farm size, competition and bumper crops) within a SUR (seemingly unrelated regression) system. The cooperative form does not affect technical efficiency but exerts a positive influence on allocative efficiency and a negative one on scale efficiency. When the same system is estimated separately for each organizational group, competition is negatively related to technical, allocative and cost efficiency for both CFs and PCs when it is significant[4].

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[4] This rather puzzling result could be compared with the findings by Zhang et al. (2001) for Chinese enterprises and by Piesse et. al. (2005) for South African grain cooperatives. In the Chinese instance the multivariate analysis of efficiency measures shows that while competitive pressures in export markets is positively

Recent contributions to this "relatively limited set of literature", as Jones (2007) puts it, made an extra effort (in terms of data properties and methods) to mitigate the familiar difficulties of empirical research in this area. For instance, in order to make sure that results reflect differences by ownership type rather than size, formation or life cycle effects, Jones (2007) concentrate on a production sector, the Italian construction industry, in which cooperatives are long-established firms that are comparable in size to their capitalist counterparts and are "typically formed as new firms rather than transformed private firms that failed" (p. 3). The sample consists of 51 CFs and 26 PCs over the 1982-1989 period (374 observations). Translog production functions, with value added for output and basic controls (employees, fixed assets, fraction of employees who are coop members, distributed profits per workers, average capital stake per worker-member, average loan capital per worker-member, reserves per worker-member) plus a dummy variable for PCs, firm specific fixed effects and time specific effects, are estimated. The inclusion of the five measures of participation takes care of the hypothesis that PCs productive efficiency varies both with the degree of financial and the extent of decision-making participation (p. 13). To capture the productivity effect of PCs using both fixed effects and a coop dummy variable the restriction that the coefficient on the latter equals the difference between the average value of the firm specific fixed effect for PCs and CFs is imposed. In light of the size of the sample, the dummy variable for cooperatives is interacted only with labor and capital. Applying both OLS and IV estimation procedures, and unlike several previous econometric studies, the author finds no consistent evidence of significant productivity differences between cooperatives and conventional firms (p.18).

In a parallel attempt, Maietta and Sena (2010) examine the comparative technical efficiency of PCs and CFs in the Italian wine industry. The authors adopt a stochastic frontier approach based on a translog specification. The standard input variables included in the deterministic component are interacted with the coop dummy variable, but the latter

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associated with enterprise efficiency, no such link is found between domestic competition and efficiency. In the South African instance, the DEA measurement of efficiency levels before and after market reforms, shows that increased competition resulting from deregulation and subsidies removal has led to increased efficiency of grain cooperatives, although the greater dispersion of scores indicates differentiated responses "and some may have even dropped out altogether" (p. 216).

appears also on its own to care for the possibility of a direct effect of the PCs form on the output level. Dummy variables to capture local environmental conditions (the wine sector spans the country) are introduced along with a continuous time trend allowing for the possibility of disembodied technical progress. Since the primary objective of the paper is to test the hypothesis that financial constraints (and their adverse effects on investment and profitability of the firm) may actually increase efforts by coop members to cut costs and raise efficiency, the random component that captures inefficiency depends not only on some covariates already included in the basic specification but also on the indicator of financial distress, namely the interest coverage ratio, both on its own and interacted with the coop dummy variable. The main finding of the study is that on average PCs tend to be more efficient than CFs and both get less inefficient with financial distress, but the effect is larger for PCs.

Despite the success of these more recent contributions in providing estimates that reflect organizational features of the firms rather than size, formation or life cycle effects, the overall results are still mixed, leaving significant room for further empirical attempts. In particular, in light of the way the typical data set for these applications is collected (e.g. balance sheet information on firms above a given – usually sales – threshold, often from different sources), one reason behind the conflicting evidence could be the failure to control properly for truncation and measurement errors. Our data and the technical approach we take enable us to mitigate both problems.

3. Background information and data

The application focuses on a panel dataset of wine-producing conventional and cooperative firms operating in the island of Sardinia during the period 2004 to 2009. The region is not only an administrative district of Italy but also a wine region, i.e. a land with distinct geological and geographical attributes and a long-standing tradition in the production of wine. While it is well known that Italy is a leading country in the sector (see OIV, 2013), Sardinia – if any - is internationally known mainly for its beautiful (sea) water rather than for its wine. Yet, its viticulture dates back at least to the Phoenician domination, and a wine industry started to develop by the end of the 19th century. Most of the wine production, in those days, would be exported to France or to mainland destinations rather then being transformed *in loco*. Consequently, the reputation of Sardinian wines took a bit longer to be established. In fact it's only after the peak of the early 1980's that the total vineyard surface started shrinking along with the total harvest and wine production (see Figure 1). Since then the quality of wine has steadily improved and in just about three decades Sardinian wines have gained a remarkable reputation for quality both at home and abroad. Today the island ranks fifth among Italian regions in terms of number of quality wines produced in specified regions and its share of total production of DOCG and DOC wine (protected designation of origin or, to put it in French, AOC, Appelation d'Origine Contrôlée) is estimated (see Brandano and Vannini, 2010) around 2% relative to Italy and 9% with respect to Italy's Mezzogiorno.

Our sample includes the universe of all winemaking enterprises set up as a limited liability company, i.e. both for profit capitalist firms and producer cooperatives whose scope is to give benefits to members according to the cooperative values of self-help, solidarity and democracy. All firms with this legal status, irrespective of the size of their sales, are represented. Business entities not considered in the study are mainly small winemakers producing for self-consumption organized as partnership or sole proprietorship.

Due to missing observations on some covariates, the panel is technically unbalanced, but there is a large sub-panel (32 firms, 17 PC's and 15 CF's) which is observed throughout the period. As shown in Table 1, the fraction of observed operating firms (i.e. winemaking firms officially registered as limited liability company) is quite remarkable and, to the best of our knowledge, the few incompletely observed units are so at random. Keeping our panel as it stands we are able to cover more than 90% of the population of interest.

Two features of the data are worth stressing. First, none of the PC in the dataset was established during the period under study: the oldest was founded in 1924 while the youngest was founded in 1968, on average they are 61 years old. The number of members/farmers has increased significantly over the years, reaching an average of 300 members per PC. This trend however halted several decades ago, making us confident that "if there were specific advantages to co-op organizations at the time the co-op were formed, the advantages are likely to be expired many years ago" (see Craig and Pencavel, 1995, p. 135). Second, if it is true that the variance of unmeasured components is smaller within an industry and region than across industries and regions, our island economy should provide an ideal setting for this kind of applications.

While the size, assortment and no truncation property of the dataset compares very favorably with datasets used in previous work, the homogeneity of accounting practices across firm types continues to remain a matter of concern. Here, however, the problem is not so much the method used in computing specific balance sheet items, which is uniform across CFs and PCs, but rather the fact that the labor costs of the wine growers/members are not explicitly entered in the financial reports of our PCs (a type of agricultural production cooperatives), thus undermining the idea of comparison between firms that are "twins" in all non-organizational respect. These costs, however, are incorporated into the value of intermediate consumption, i.e. of the grapes sold by members to the collective cellar. Therefore, exploiting the fact that our PC's require that members bring all their grapes to the cooperative[5], we create a composite variable valid for all types of firms which reflects direct and indirect labor costs plus any goods and services consumed as intermediate consumption.
To conduct the efficiency analysis we consider for each firm three inputs (labor, capital and land) and two outputs (sales and earnings), all quantified – except land – in monetary terms. Labor is captured by the composite indicator (*L*) just mentioned above, whereas capital (K) is the book value of buildings, machinery and other fixed assets but land used in production. Land (*T*) indicates the hectares of land planted with vines in each year. As for the outputs, in addition to the company's sales (*S*) we calculate earnings before interest, taxes, depreciation and amortization (*EBITDA*). Table 2 shows some descriptive statistics for these variables.
We assess the technical efficiency of our firms with reference to a common production frontier using data envelopment analysis (DEA). The scores derived from this calculation are then further examined in a truncated regression aimed at gauging the effect on measured technical efficiency of the organizational form and a host of environmental variables. Similar estimation procedures are widespread in the literature, but relatively few works address the conditions for obtaining valid inferences in the second-stage. According to Simar and Wilson (2007), who drew attention to the fact that conventional methods fail in general to give valid inference (due to the fact that DEA efficiency estimates are

[5] The reason of course is to provide the right incentives to members, which otherwise might opportunistically keep the best grapes for other buyers and dump the rest in the collective cellar.

correlated by construction) and provided a bootstrap approach that yields valid inference in the second-stage regression when such regressions are appropriate, a "separability" condition between the input-output space and the space of the external factors must be met. Basically, the external factors should affect only the probability of being more or less efficient and have no influence on the attainable set. Daraio et. al. (2010) provide a fully non-parametric test of this condition. Against this backdrop, we developed our DEA and post-DEA application as described in the next section.

4. DEA and Post-DEA

As is well known, the DEA approach allows to measure the efficiency of a given DMU comparing it to the estimated production frontier. Unlike the parametric approach, that requires an a priori specification of the functional form of the production function and its disturbance term, DEA is a flexible technique that, in a multiple input-output framework, focuses on a virtual single-input-output structure. In this study we employ the Simar and Wilson (2007) DEA double bootstrap procedure to estimate and explain technical efficiency. Mathematically, the efficiency (θ) of the *i*-th DMU is given by the following expression:

$$\theta_t = \max\{\theta_t > 0 \,|\, \theta_t y_{it} \le \sum_{i=1}^{n} \gamma_{it} y_{it};\ x_{it} \ge \sum_{i=1}^{n} \gamma_{it} x_{it};\ \sum_{i=1}^{n} \gamma_{it} = 1;\ \gamma_{it} \ge 0,\ i = 1,\ldots,n,\ t = 1,\ldots,T\} \quad (1)$$

where γ_{it} a set of nonnegative parameter, and y_{it} and x_{it} are the outputs and inputs of the *i*-th DMU in year *t*, respectively. More precisely, the DMUs are technically efficient or inefficient when $\theta_{it} = 1$ or $\theta_{it} > 1$, respectively. After a preliminary investigation on the prevailing production regime across wineries, the variable return to scale (VRS) model was adopted.

In the second step, we investigate which factors affect the measured indicators of technical efficiency. Accordingly, the estimated DEA scores $\hat{\theta}_{it}$ become the dependent variables of a pooled truncated maximum likelihood regression:

$$\hat{\theta}_{it} = z_{it}\beta + \varepsilon_{it} \geq 1 \tag{2}$$

where z_{it} is a vector of variables assumed to impact on the choice and use of *y* and *x*, and on the level of technology employed, β is a vector of parameters and ε_{it} is a continuous *iid* random variable distributed $N(0, \sigma_\varepsilon^2)$ with left-truncation at $1-z_{it}\beta$ for each *i*.

The estimates are generated by a Tobit-regression and a double bootstrap procedure is run to compute the standard errors and confidence intervals of the coefficients estimates. Specifically, this method refers to the Algorithm #2 proposed by Simar and Wilson (2007), which involves several steps. First, the DEA is run for the DMUs under investigation. Second, Equation (2) is estimated by using the maximum likelihood method to obtain estimates of the parameters and standard errors. Third, for each DMU the following loop is repeated L_1 times (in this case 2,500 times): a) for each DMU, e_{itb} is drawn from the $N(0, \hat{\sigma}_\varepsilon)$ distribution with left truncation at $(1 - \hat{\alpha} x_{\text{itb}})$, with $b = 1,...,L_1$; b) again, for each DMU, $\theta^*_{itb} = \hat{\alpha}_0 + \hat{\alpha}_1 \ x_{it}$ is computed; c) a new pseudo data set is defined where $x^*_{it} = x_{it}$ and $y^*_{itb} = \dfrac{y_{it}\hat{\theta}_{it}}{\theta^*_{itb}}$; d) using the constructed pseudo data set, the input-oriented DEA is run to compute efficiency estimates for all the DMUs $(\hat{\theta}^*_{itb})$. Fourth, the bias-corrected efficiency scores are computed as follows: $\hat{\hat{\theta}}_{it} = 2\hat{\theta}_{it} - \sum_{b=1}^{L_1} \hat{\theta}^*_{itb}$. Fifth, the maximum likelihood method is used to estimate the Tobit-regression of the bias-corrected efficiency scores, that provides with marginal effects of the explanatory variables ($\hat{\hat{\alpha}}_0, \hat{\hat{\alpha}}_1$) and estimated standard deviation of the residuals ($\hat{\hat{\sigma}}_\varepsilon$). Sixth, again for each DMU the following bootstrapping loop is repeated L_2 times (again, 2,500 times): i) for each DMU, e_{its} is drawn from the $N(0, \hat{\hat{\sigma}}_\varepsilon)$ distribution with left truncation at $(1 - \hat{\hat{\alpha}} x_{\text{its}})$, with $s=1,...L_2$; ii) for each DMU, $\theta^{**}_{its} = \hat{\alpha}_{0s} + \hat{\alpha}_{1s} \ x_{it} + e_{its}$ is computed; iii) the maximum likelihood method is employed to estimate the Tobit-regression of θ^{**}_{its} that provides with a new set of marginal effects of the explanatory variables and standard errors. Such a loop produces a set of $\hat{\alpha}_{0s}$, $\hat{\alpha}_{1s}$ and $\hat{\hat{\sigma}}_{\varepsilon s}$ estimates. Hence, as a final step, the L_2 bootstrap estimates $\{(\hat{\alpha}_{0s},\ \hat{\alpha}_{1s},\ \hat{\hat{\sigma}}_{\varepsilon s})\}$ and the estimates of the marginal effects ($\hat{\hat{\alpha}}_0, \hat{\hat{\alpha}}_1$) and the estimated standard deviation of the residuals ($\hat{\hat{\sigma}}_{\varepsilon}$) are used to construct estimated confidence intervals for each of the unknown element in (2) (see also Balcombe et al., 2008; Assaf and Agbola, 2011).

In the previous section we noted that for either the first-stage or the second-stage results to be sensible the "separability" assumptions must hold (Badin et al, 2012). Accordingly, we implement the test proposed by Daraio et al. (2010), which involves not only the calculation of the test statistics but also the estimation of the critical values by bootstrap sub-sampling methods in order to assess their significance (p. 14). As the null hypothesis cannot be rejected at the 5% critical level we are confident that both the estimated efficiency scores and the subsequent examination of how the external covariates may impact on them is meaningful.

The post-DEA regression equation specification is as follows

$$\begin{aligned}\hat{\theta}_{it} &= \beta_0 + \beta_1 COOP_{it} + \beta_2 BOARD_{it} + \beta_3 MAGAZINE_{it} + \beta_4 HOTEL_{it} + \beta_5 FUND_{it} \\ &+ \beta_6 TEMP\_SEPT_{it} + \beta_7 RAIN\_AUG_{it} + \beta_8 AV\_TEMP_{it} + \beta_9 AV\_RAIN_{it} + \beta_{10} YEAR_t + u_{it}\end{aligned} \tag{3}$$

In addition to the dummy variable for producer cooperatives, *COOP*, the specification includes eight external covariates aimed at capturing different aspects of the production and market environment, along with the year dummies ($YEAR_t$) and the error component (u_{it}).

BOARD measures the size of the board of directors of each firm. Many theoretical and empirical studies suggest that board size, beyond a given threshold, may adversely affect corporate performance because the coordination, communication and free-riding problems overwhelm the benefits of having more directors (e.g. Lipton and Lorsch, 1992; Jensen, 1993; Eisenberg et al., 1998).

MAGAZINE is a dummy that takes care of the increasing role of wine guides and gurus judgements in shaping the preferences of customers and establishing the success of wines and wineries. Unlike many modern food "wine's attractions rely not on bold consistent flavours, but about a subtle array of shifting sensations that makes its charm difficult to define. In essence, wine producers are selling a sensory experience to the consumer." (Bisson et. al. 2002). Given this salient feature of wine, and the strong asymmetric information between producers and consumers that characterizes its market, the proliferation of wine rating agencies is not surprising. Fortunately, in the case under study, two long established independent associations of tasters, *Associazione Italiana Sommelier* (AIS) and *Gambero Rosso* (GR), dominate the scene with assessments published regularly in their annual guides. For a wine company, being featured in these publications is a strong signal of quality and reliability that is expected to promote sales. Our dummy equals one when a winery is included in the previous year publications and zero otherwise.

Although the island of Sardinia as a holiday destination is known mainly for its sun and beach combination, in line with the changing attitudes of tourists/consumers (e.g. shorter trips scattered throughout the year) an increasing number of visitors are willing to explore local cultures and lifestyles. Being associated with "terroir", wine is an integral component of the "local basket of goods" sought after by these visitors. This additional demand may affect the efficiency of local producers either by enhancing competition or, as long as some direct interaction with customers from different regions/countries takes place, by allowing them to know the characteristics/needs of new groups of consumers. We proxied this effect by the variable *HOTEL*, i.e. the total number of hotel beds in the municipality in which the winery is located.

Since the wine industry is significantly subsidized, we introduced a covariate, *FUNDS*, that indicates the amount of (national and/or regional) public aid for investment received in year t-1 by each winery.

Climate is a factor of the outmost importance to the viability and success of the wine industry. In general, the cultivation of grapevines requires not too freezing winters and generally moderate summer temperatures. Also, grape varieties are not likely to do well everywhere, so winegrowing regions have historically specialized. In Sardinia, for instance, indigenous grape varieties such as "cannonau" and "vermentino" dominate the scene. Growers are of course accustomed to dealing with changes in weather conditions, but deviations from normal levels need appropriate responses in terms of adaptation and mitigation. We capture these effects on the technical efficiency of our DMUs through the variables *TEMP_SEPT*, *RAIN_AUG*, *AV_TEMP* and *AV_RAIN*, which for each village in which the winery is located measure, respectively, the daily average temperature in September, the average amount of precipitation in August, and the seasonal average temperature and the average amount

of precipitation in the growing season up to the harvest (April to October).
Recall that our DMUs are technically efficient as long as $\theta_{it} > 1$. Therefore a (negative) positive sign in the *j*-th coefficient of equation (3) indicates a (positive) negative effect of the *j*-th variable on technical efficiency.

5. Results

Our first group of results are represented in Table 3, which shows the DEA scores for each year, obtained under the assumption of variable returns to scale and input orientation. As usual with DEA studies, the technology regime was adopted after a preliminary investigation which involved comparing DEA efficiency estimates under the alternative assumptions of constant, variable or non-increasing returns to scale. Furthermore, owing to the fact that in the short-run wine firms have more control over their inputs than over their outputs, the input-oriented model seemed more appropriate. We find that over time the average level of efficiency of the firms increased (from 1.97 in 2004 to 1.60 in 2009), but the number of perfectly efficient firms declined during the observation period, going from 43.24% in 2004 to 36.84% in 2009. At the same time, the coefficient of variation fell from 1.91 to 0.51, indicating a global converge toward a higher level of technical efficiency.
As shown in Table 3, the medians of conventional firms are systematically higher than those of cooperative wineries. By using the Kruskall-Wallis test we check whether these discrepancies are statistically different from zero, and in three years, namely 2004, 2006 and 2009, the null hypothesis is rejected.
The shares of the returns to scale are displayed at the bottom of Table 3. Interestingly, most of the wineries show decreasing returns to scale (above 90%), which indicates that firms could increase their efficiency if they reduce their size. Table 4 represents the cross tabulation between firms organization and returns to scale. As one can see, all the cooperative firms exhibit decreasing returns to scale.
In the second part of the analysis, by using Algorithm #2 of Simar and Wilson (2007), equation (3) is run in order to study the impact of environmental factors and firms characteristics on the technical efficiency of the DMUs. The results are shown in the first column of Table 5.
One can immediately observe that the dummy *COOP* is positive and highly significant: in other words, on average, the cooperative wineries

are less technically efficient (0.58) than their capitalist counterparts. Interestingly, the coefficient associated with the number of members in the board of directors (*BOARD*) is significant and negative, i.e. an increase in the board size would favour the efficiency of the firm. Given that both the mean and the median of the board size (about five directors) are significantly smaller than the optimum size (seven to nine directors) suggested for instance by Lipton and Lorsch (1992) and Jensen (1993), this may be an indication that the initial advantages of larger boards are still prevailing over inefficiencies.

As indicated by the coefficient of the variable *MAGAZINE*, being included in a specialized tasting magazine is beneficial for the performance of the firm. On the contrary, the higher the number of hotel accommodation in the neighborhood of the winery (*HOTEL*) the lower the level of the technical efficiency achieved by the firm. This unexpected results may have something to do with our imperfect measure of "local tourist flows", the number of beds in hotel, and the fact that the latter are mainly located on the coast: probably not the optimal places for wineries. From this point of view, a negative correlation is not puzzling.

Regional and National aids received by firms (*FUND*) seem to increase their efficiency. This is a sensible result, especially in light of the fact that the transfers considered were targeted to improve efficiency through new investment rather than provide temporary assistance such as crisis distillation.

As expected, climate plays an important role in explaining firms' efficiency. More precisely, an increase in the seasonal (April-October) average temperature (*AV_TEMP*) leads to lower efficiency (0.29), while an increase in the seasonal average rainfall (*AV_RAIN*) increases the performance of firms (-0.19). It is well known that the typical Mediterranean climate, with warm to hot, dry summers and mild to cool, wet winters, suits viticulture. Our measures impact on technical efficiency, for given varietal and location/soil of the vineyard, as long as the firm does not react quickly to changes in weather conditions through irrigation, fertilization, canopy management and so on. The sign of these effects can be interpreted in light of the peculiarities of the local climate. In particular, as the soil water balance (an account of all quantities of water added, removed or stored in a given volume of soil in a given period of time) of the island is usually negative, an increase in the average precipitation can mitigate (render less negative) this balance at the district level, directly benefiting grape vines, which can be dry farmed

(no irrigation) under conditions that will not support the growth of other crops. On the contrary, shifts in average temperatures, often accompanied by extreme events, such as very hot days and unseasonal freezes, seem to produce less manageable impacts leading to detrimental effects on technical efficiency.
Finally, columns 2 and 3 of Table 5 show the results obtained from the Simar and Wilson truncated regression *vis à vis* the simple truncated and OLS regressions. Despite some differences, the estimated equations are quite similar and taken together are reassuring of the robustness of the analysis.

6. Concluding comments

Given the inconclusiveness of the empirical evidence regarding the comparative efficiency of producer cooperatives and conventional firms, in this paper we try to gather new evidence by examining a panel dataset of firms operating in the wine sector of the island of Sardinia, Italy, in the period 2004-2009. Unlike many dataset of similar size used in previous work of this kind, our collection of data covers the universe of the sector's enterprises set up as a limited liability company, and it is balanced both in terms of firm-size and firm-type. Since the PCs and CFs involved belong to a single regional sector, we believe that the variance of unmeasured components is smaller than across industries and regions. By reclassifying some balance sheet entries, we have been able to calculate for each firm a set of inputs and outputs consistent across firm types. So, in this respect, our DMUs were twins in non-organizational aspects, as required for a meaningful comparative analysis of efficiency. The latter was carried out in two steps (DEA plus double bootstrap truncated regression of efficiency scores on a host of environmental factors) after ensuring that the procedure was statistically appropriate.
Our findings show that organizational structure matters and that, on average, PCs are less technically efficient than CFs. Measured efficiency is affected by the board size, the visibility acquired through specialized rating reports, the average temperatures and rainfalls and the amount of public aids for investment. The vast majority of the firms, and particularly PCs, operate under decreasing returns to scale.
Whereas the positive social role of producer cooperatives, especially in the rural world, is out of question, the fact that PCs have no technical advantages over their conventional counterparts is rather worrying when considered against the main challenges faced by sector under study,

namely the liberalization of planting rights and the effects of climate change. The former, which has been introduced by the CAP reform of 2008, shall go into effect from 2018 the latest and is expected to impact both on the production volumes and market prices for wine across the EU. There will be winners, mainly consumers and new entrants, and losers, like the original vineyards owners who will find themselves with less valuable land and lower market prices for their wines and producers unable to exploit the economy of scales associated with the enlarged market. Much the same for climate change, which requires adaptation and mitigation strategies not easily implementable by small inefficient producers. Moreover, if climate change makes feasible the expansion of the land under vines (presumably in northern regions), the above effects can only be reinforced. Whatever the case, in situations like the one under study, not uncommon in rural Europe, it seems to us that the viability of PCs is highly at risk and calls for more targeted policy actions other than fiscal benefits in order to make them fit for the future market and climate regime.

References

Arando, Saioa, Gago, Monica, Jones, Derek, Kato, Takao, 2011. Productive efficiency in the Mondragon cooperatives: Evidence from an econometric case study. Discussion Paper No. 5711. IZA, Bonn.

Assaf, George A., Agbola, Frank W., 2011. Modelling the Performance of Australian hotels: a DEA double bootstrap approach. Tourism Economics 17, 73-89.

Badin, Luiza, Daraio, Cinzia, Simar, Léopold, 2012. Explaining inefficiency in nonparametric production models: the state of the art. Annals of Operations Research, DOI: 10.1007/s10479-012-1173-7.

Balcombe, Kelvin, Fraser, Iain, Latruffe, Laure, Rahman, Mizanur, Smith, Laurence, 2008. An application of the DEA double bootstrap to examine sources of efficiency in Bangladesh rice farming. Applied Economics 40, 1919-1925.

Birchall, Johnston, Ketilson, Lou H., 2009. Resilience of the cooperative business model in times of crisis. Sustainable Enterprise Programme, International Labour Organization, Geneve.

Bisson, Linda F., Waterhouse, Andrew L., Ebeler, Susan E., Walker, Andrew M., Lapsley, James T., 2002. The present and future of the international wine industry. Nature 418, 696-699.

Bonin, John P., Derek, Jones C., Putterman, Louis, 1993. Theoretical and empirical studies of producer cooperatives: Will ever the twain meet?. Journal of Economic Literature 31, 1290-1320.

Brandano, Maria G., Vannini, Marco E. C., 2010. Economia del vino in Sardegna. In Saderi, Anna (ed.), Il vino in Sardegna*,* Ilisso, Nuoro

Craig, Ben, Pencavel, John, 1992. The behavior of worker cooperatives: The plywood companies of the Pacific Northwest. The American Economic Review 82, 1083-1105.

Craig, Ben, and John Pencavel, 1995. Participation and productivity: A comparison of worker cooperatives and conventional firms in the plywood industry. Brookings Papers on Economic Activity Microeconomics, 121-160.

Daraio, Cinzia, Simar, Léopold, Wilson, Paul W., 2010. Testing whether two-stage estimation is meaningful in non-parametric models of production. Discussion Paper 1035, Institut de Statistique, Université Catholique de Louvain, Louvain-la-Neuve.

Defourny, Jacques, 1992. Le secteur de l'economie sociale en Belgique. In Defourny, Jacques, Monzon Campos, Jose L. (eds), Economie sociale: entre economie capitaliste et economie publique / The Third Sector: Cooperative, Mutual and Nonprofit Organizations. CIRIEC and De Boeck-Wesmael, Brussels.

Derek, Jones C., Svejnar, Jan, 1985. Participation, profit sharing, worker ownership and efficiency in Italian producer cooperative. Economica 52, 449-465.

Eisenberg, Theodore, Sundgren, Stefan, Wells, Martin T., 1998. Larger board size and decreasing firm value in small firms. Journal of Financial Economics 48, 35-54.

Ferrantino, Michael, Ferrier Gary D., Linvill, Carl B., 1995. Organizational form and efficiency: Evidence from Indian sugar manufacturing. Journal of Comparative Economics 21, 29-53.

Jensen, Michael C., 1993. The modern industrial revolution, exit, and the failure of internal control systems, Journal of Finance 48, 831-880.

Jones, Derek, 2007. The productive efficiency of Italian producer cooperatives: Evidence from conventional and cooperative firms. Advances in the Economic Analysis of Participatory and Labour Managed Firms 10, 3-28.

Kato, Takao, 2011. Advances in the Economic Analysis of Participatory & Labor-managed Firms, vol. 12, Emerald Books, Bingley.

Lipton, Martin, Lorsch, Jay W., 1992. A modest proposal for improved corporate governance. Business Lawyer 48, 59-77.

Maietta, Ornella, Sena, Vania, 2010. Financial constraints and technical efficiency: Some empirical evidence for Italian producers' cooperatives. Annals of Public and Cooperative Economics 81, 21-38.

Mosheim, Roberto, 2002. Organizational type and efficiency in the Costa Rican coffee processing sector. Journal of Comparative Economics 30, 296–316.

OIV, 2013. Vine and Wine Outlook 2008-2009. Organisation Internationale de la vigne et du vin, Paris.

Pencavel, John, Craig, Ben, 1994. The empirical performance of orthodox models of the firm: Conventional firms and worker cooperatives. Journal of Political Economy 102, 718-744.

Piesse, Jenifer, Doyer, Tobias, Thirtle, Colin, Vink, Nick, 2005. The changing role of grain cooperatives in the transition to competitive markets in south Africa. Journal of Comparative Economics 33, 197-218.

Schumpeter, Joseph, 1939. Business Cycles. McGraw-Hill, New York.

Simar, Léopold, Wilson, Paul W., 2007. Estimation and inference in two-stage, semi-parametric models of production processes. Journal of Econometrics 13, 31–64.

Singh, Satbir, Coelli, Tim, Fleming, Euan, 2001. Performance of dairy plants in the Co-operative and private sectors in India. Annals of Public and Co-operative Economics 72, 453-479.

Zhang, Anming, Zhang, Yimin, Zhao, Ronald, 2001. Impact of ownership and competition on the productivity of Chinese enterprises. Journal of Comparative Economics 29, 327–346.

Table 1 - Distribution of observations across types of firms and over time

	2004	2005	2006	2007	2008	2009	Total
PC's	19	21	20	21	21	18	120
% operating PC's	*90.5%*	*100%*	*95.2%*	*100%*	*100%*	*85.7%*	
CF's	18	18	19	20	21	20	116
% operating CF's	*85.7%*	*85.7%*	*90.5%*	*95.2%*	*100%*	*95.2%*	
Total observations	37	39	39	41	42	38	236
Total operating firms	42	42	42	42	42	42	252
% of operating firms	*88.1%*	*92.9%*	*92.9%*	*97.6%*	*100%*	*90.5%*	93.6%

Table 2 – Descriptive statistics in millions (input/output of DEA)

Code	Unit	Variable	Min	Median	Mean	Max	S.D.
L	Euro	Input	0.00	1.00	2.39	20.14	3.46
K	Euro	Input	0.00	1.39	3.67	52.01	7.66
T	Metre^2	Input	0.02	1.50	2.50	12.00	2.69
S	Euro	Output	0.00	1.06	3.10	31.60	4.94
EBITDA	Euro	Output	0.00	0.07	0.31	6.52	1.05

Table 3 – Descriptive statistics of post-DEA covariates

Code	Min	Median	Mean	Max	S.D.
COOP	0.0	1.0	0.51	1.0	0.50
BOARD	1.0	5.0	4.90	11.0	3.39
MAGAZINE	0.0	0.0	0.34	1.0	0.47
HOTEL	129	8854	10270	37550	8106.79
FUNDS	0.00	0.00	0.01	0.81	0.07
TEMP_SEPT	20.80	21.80	21.77	24.00	0.64
RAIN_AUG	0.00	4.57	6.99	23.12	7.91
AV_TEMP	20.23	21.27	21.54	25.53	0.95
AV_RAIN	136.9	299.5	323.4	632.5	105.11

Table 4 – DEA scores summary (year: 2004-2009)

	2004	2005	2006	2007	2008	2009
Number of DMUs	37	39	39	41	42	38
Number efficient DMUs	16	15	13	16	14	14
% efficient DMUs	43.24%	38.46%	33.33%	39.02%	33.33%	36.84%
Mean VRS scores	1.97	1.70	1.46	1.68	2.13	1.60
Coefficient variation	1.91	1.15	0.62	0.94	0.81	0.51
Median scores Non-Coop. (*n.*)	1.0 (*18*)	1.03 (18)	1.0 (19)	1.05 (20)	1.03 (21)	1.07 (20)
Median scores Coop. (*n.*)	1.21 (*19*)	1.40 (*21*)	1.34 (*20*)	1.24 (*21*)	1.40 (*21*)	1.81 (*18*)
Kruskal-Wallis test	4.712**	1.780	3.253*	0.234	2.326	2.77*
Scale efficiency						
% IRS	0%	2.56%	2.56%	2.44%	2.38%	0%
% CRS	5.40%	2.56%	2.56%	7.32%	4.76%	7.89%
% DRS	94.59%	94.87%	94.87%	90.24%	92.86%	92.11%

* and ** indicate significance at the 10% and 5%, respectively.

Table 5 – Contingency table between returns to scale and firms organization

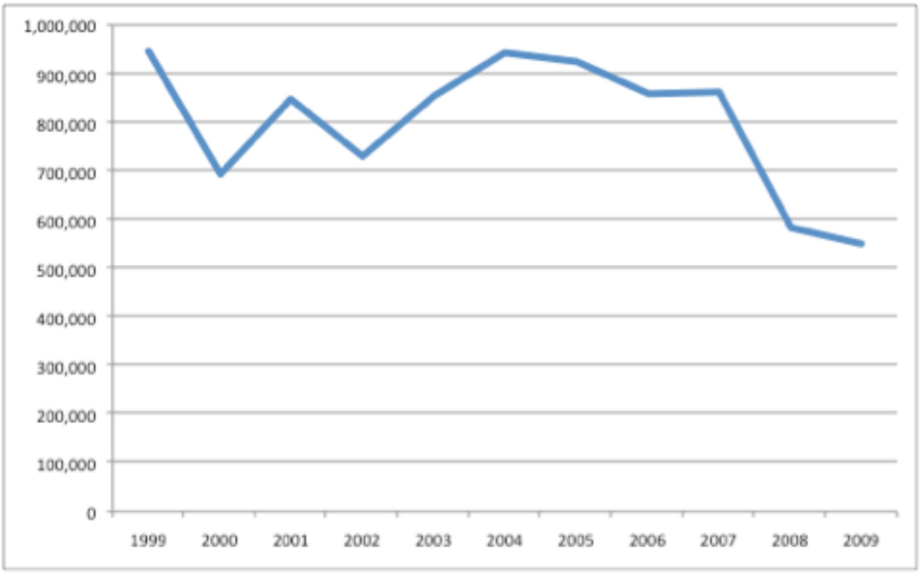
	Returns to scale		
	Decreasing	Constant	Increasing
Conventional wineries	100	12	4
Cooperative wineries	120	0	0
Total	220	12	4

Table 6 – Regression analysis

	Simar-Wilson[§] (1)	Truncated regression (2)	OLS (3)
COOP	0.58***	0.53***	0.42***
BOARD	-0.30***	-0.23***	-0.21***
MAGAZINE	-0.23***	-0.12*	-0.17***
HOTEL	0.07***	0.01	0.02
FUNDS	-1.24***	-0.28	-0.29
TEMP_SEPT	-0.11	0.05	0.03
RAIN_AUG	0.03	-0.02	0.00
AV_TEMP	0.29***	0.08	0.07
AV_RAIN	-0.19***	-0.06	-0.02
Const	0.04	1.21***	1.00***
Year dummies	Yes	Yes	Yes
Obs.	236	236	236

Note: 1) [§] 1,000 bootstrapping replications are used; 2) *, ** and *** indicate significance at the 10%, 5% and 1%, respectively.

Fig. 1 – Wine production in Sardinia – Years 1999-2009



Source: our elaboration on ISTAT data

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