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The Productive Efficiency of Italian Producer Cooperatives:

Evidence from Conventional and Cooperative Firms

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Abstract

Existing theoretical and empirical evidence is inconclusive concerning the comparative performance of LMFs and conventional firms. By assembling and analyzing new data for a sample of 51 conventional firms and 26 producer cooperatives in the Italian construction industry during the period 1981 to 1989 we provide additional evidence. Except for organizational form, the cooperatives in our sample are fairly comparable to our conventional firms. Based on our production function estimates, and unlike some previous econometric studies, we find no significant productivity advantage of cooperatives over conventional firms. Our OLS point estimates generally indicated that output would be lower in a cooperative than in an otherwise identical conventional firm. The only statistically significant measure of financial and decision making participation is collective reserves. We conclude by offering some possible explanations for why our results may differ from some previous findings, especially those for Italian producer cooperatives. In particular we suggest that research methods that are new to the study of cooperatives are needed to help to resolve these questions.

Key words: producer cooperatives, labor managed firm, productive efficiency, Italy

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I. INTRODUCTION

One of the central and enduring issues concerning labor managed firms (LMFs), considered hereafter as producer co-operatives (PCs) in western market economies, is their economic performance. While the first econometric studies of the performance of LMFs appeared almost 30 years ago, the issues that are examined in that literature are still not definitively settled. Thus while the meta analysis by Doucouliagos (1995) concludes that the balance of evidence demonstrates better performance by PCs compared to participatory capitalist firms, other assessments, including Bonin et al. (1993:1305) and Dow (2003:184) are not so sanguine. This is particularly the case when evaluation is restricted to studies that endeavor to make comparisons between PCs and conventional firms within the same industry (for a review, see, e.g., Dow, 2003:184.) In this paper we contribute to this relatively limited set of literature by using a panel data set for Italian producer cooperatives and conventional firms in the construction sector to investigate technical efficiency. These data enable us to address what are believed to be many of the quite demanding data requirements for the design of such studies and also to do so for firms that are part of the largest worker cooperative sector in an industrialized country..

Several developments have fostered renewed interest in the performance of firms that are substantially controlled by workers. On the intellectual front, a key factor is the recent appearance of substantial new assessments of LMFs, most notably Dow (2003), but also Pencavel (2001). A related development is the explosion of a growing body of literature that examines diverse issues relating to economic viability concerning many forms of participatory firms, including co-determination, forms of shared capitalism including employee ownership, and teams.[1] Accompanying these changes we witness the emergence of diverse forms of

organization in the former communist countries including firms that formally provide for substantial degree of ownership by non-managerial employees (e.g. for Estonia, Jones and Mygind, 2002). Also substantial and significant sectors of worker-managed firms persist, notably the Mondragon cooperatives, the seventh largest consortium in Spain. And on the policy front the western world has been shaken by several recent corporate scandals, such as at Enron, which call attention to issues of corporate governance. The upshot of all of this is that the issues of the comparative performance of different organizational forms, including labor managed forms and traditional capitalist firms, is again a timely one.

We believe that the method we use in this paper and the data we use have useful properties when compared with many earlier comparative studies. This construction industry is interesting because construction cooperatives are mostly long-established firms, are comparable in size to conventional firms (at least in terms of average employment), and were typically formed as new firms rather than transformed private firms that failed (Zevi, 1982; Pittatotore and Turati, 2000.) Thus, it appears reasonable to assume that estimated productivity differences reflect organizational features of the firms rather than size, formation, or life cycle effects. However, as we will discuss below, some cooperatives might differ from conventional firms because they merged with other cooperatives to save jobs rather than to improve efficiency. Also compared to many influential studies our data set is reasonably large – we use a sample of 51 conventional firms and 26 producer cooperatives in the Italian construction industry. In addition we are able to estimate different forms of the production function and choose the appropriate form of technology.

The plan of this paper is as follows. The next section, briefly reviews key themes in the theoretical literature and also contains a review of previous empirical work. This is followed in section three by a description of our data. In section 4, we describe the production function

approach that is the basis of our estimating framework. Our empirical results are presented and discussed in section 5. We offer concluding remarks in section 6.

II Theory and Previous empirical work

Since ours is not a theoretical contribution, here we merely review some of the central themes in the literature. The key point is that economic theory yields conflicting predictions about the productivity effects of worker participation in profits, ownership, and decision making and is thus inconclusive concerning the expected comparative performance of PCs and conventional firms.[2]

Early theoretical work was often pessimistic concerning the expected performance of PCs. Alchian and Demsetz (1972) and Jensen and Meckling (1979) argue that productivity will be lower in a cooperative because efficient monitoring of workers requires the monitor to be the claimant on the firm's profits and that the cost of monitoring increases with the number of monitors. Another influential paper is Holmstrom (1982) who argues that effort level is expected to be beset with free-rider problems and thus sub-optimal when work takes place in teams (as is expected to be the case in PCs).

These pioneering theoretical papers have elicited a voluminous amount of responses and theoretical objections. Thus many authors, including Macleod (1984) and Weitzman and Kruse (1990) show how in a repeated game framework effort supply in LMFs need not be below that in conventional firm. Others point to other benefits of PCs. Thus cooperatives are expected to be more productive than conventional firms because incentives (financial participation), peer group pressure (horizontal monitoring) and the close identification of cooperative members with the firm will elicit greater effort from workers (Jones and Svejnar, 1985; Fitzroy and Kraft, 1987). .

In light of the ambiguity of economic theory, there is a need for empirical evidence.

While the relative performance of conventional firms and producer cooperatives has been estimated by comparing subsample means of measures such as value added per worker using data on both conventional firms and cooperatives,[3] most econometric evidence has been obtained from samples exclusively of producer cooperatives that estimate how the productive efficiency of firms varied with respect to measures of financial and decision making participation.[4]

The authors of these studies estimated the efficiency of a typical cooperative relative to a firm with no worker participation. Since the samples of cooperatives often exhibited considerable variation over both firms and time in the degree of worker participation, the estimated productivity effects might be reliable. However, other things remaining the same, one would prefer a sample of both conventional firms and cooperatives since the variance of the prediction errors is lower for observations that are similar to those in the sample than for atypical ones.

A few studies have estimated production functions using data on both conventional firms and cooperatives: George (1982), Jones (1987), Conte and Svejnar (1988), Lee (1988), Berman and Berman (1989), Estrin (1991) and Craig and Pencavel (1995). But only the papers by Jones, Lee, Estrin, and Craig and Pencavel (1995) focussed on the relative technical efficiency of cooperatives. In addition, there appears to have been limited decision making participation by workers in the cooperatives in the George, Jones, and Lee studies. Jones examined the effects of board representation and financial participation in a sample of retail (i.e., consumer) cooperatives. In some cooperatives workers were allowed to become members; in others workers were excluded from membership. While from the perspective of employees these latter consumer cooperatives were private firms, the cooperatives with worker members are not legally incorporated as worker cooperatives. Lee studied worker-owned firms and conventional firms in Sweden over the 1983 to 1985 period. However, it is not clear to what degree employees

participated in decision making in the worker-owned firms. Estrin used panel data on 49 producer cooperatives and 35 conventional firms in a variety of light manufacturing industries in Italy to estimate Cobb Douglas production functions. While the sample was constructed to include cooperatives and private firms that were fairly comparable in size and in their distribution across industries, Estrin describes his results as a "first cut." The last three papers did not provide sufficient information to determine the relative technical efficiency of cooperatives. Using data on U.S. plywood firms, Berman and Berman estimated a Cobb Douglas production function for the pooled sample and separate ones for cooperatives and conventional firms.[5] Conte and Svejnar estimated translog production functions using data on 40 U.S. firms including producing cooperatives in the plywood industry.[6] George estimated separate Cobb Douglas production functions for Danish cooperatives and conventional firms in the construction and bakery industries.[7] However, the degree of worker participation in decision making may be limited by the influence of nonworker shareholders such as trade unions and other organizations.

Finally, and most recently, the study by Craig and Pencavel (1995) is deserving of close examination, in part because of the careful way in which data were gathered and analyzed by the authors for plywood coops and conventional firms in the Pacific Northwest in that industry. The authors estimate separate Cobb Douglas and production functions for several types of firms including coops and conventional firms. They find that coops are between 6 and 14% more efficient than the principal conventional firms though there is little difference between the efficiency of the unionized and classical mills.

In sum, it would seem that a reasonable conclusion based on the research to date is that there is no strong evidence that either cooperatives or conventional firms have a sizeable and persistent significant edge in performance over the other organizational form. Equally it is

apparent that there is a need for more targeted research. For example, the most frequently comparative cited study nowadays is probably that of Craig and Pencavel (1995). However, while the quality of the data the authors use is most impressive arguably the robustness of the findings are diminished by the relatively small size of the data set (170 observations for 34 mills), the use of a problematic measure of capital in the production function estimates and the ability to estimate production functions with only Cobb Douglas technology.

III. Italian Producer Cooperatives: Institutions

Since informative accounts of Italian coops exist elsewhere, here we will merely summarize key features, especially those details that are pertinent to subsequent empirical work.[8]

The Italian PC movement is comparatively large and it has been reported that there are 38,000 PCs in Italy (Ammirtato, 1995). As a proportion of the overall labor force, they may represent the largest share of the labor force in any country. Italian producer cooperatives have existed for a long time, at least since the late 1800's, and as part of a wider cooperative movement.

The PC sector is strongly affected by the legal framework witin which itoperates, So far as employee participation is concerned, the law does not provide that all workers must become members of the PC, even after a probationary period. Nonetheless, in Italy, and unlike the experience elsewhere, most workers in PCs are members.

In terms of financial participation, there are numerous institutional provisions that are pertinent. For one thing, the law requires that new members pay an admission fee which is not returned when the member exits the firm. Members are also required to make a capital contribution with the law specifying both the minimum and the maximum amounts that PCs can ask of their members. When members leave the PC, this capital contribution is returned to them,

but the individual does not share in any additional capital accumulation that the firm might have enjoyed during the member's tenure at the firm.[9]

A key feature of the law is the stipulation that at least 20% of net revenue must go to reserves (Zevi, 1982). Importantly, these surpluses that do to reserves are not taxed. These provisions tend to lead to firms having capital structures that have a large fraction of assets that are collectively owned. Those net revenues that are not paid into reserves may be distributed to working members as a bonus that is allocated to members in proportion to their earnings. In addition, the net revenues may be used to declare a dividend on individual capital contributions though, this dividend rate is regulated and tends to be capped at the rate paid on government bonds. Finally, members may make loans to their cooperative. Moreover, the law provides that such loans pay a higher, tax-free interest rate than do comparable bank loans.

IV. DATA

The data used in this study were obtained from two sources. The data on producer cooperatives were supplied by a regional umbrella organization for cooperatives in Emilia Ravenna, that was part of the Lega federation of coops. Data on conventional firms were obtained from various annual editions of Le Principali Societa Italiane, a publication prepared by Mediobanca that reports economic data on large Italian enterprises.[10]

Since the Mediobanca publications also include data on seven producer cooperatives that are represented in the cooperative data set, we were able to examine how closely data from the two sources match. We examined five variables that were used in the econometric analysis: real value added, real fixed assets, labor, real profits, and real labor costs. (The last two variables are used to construct instruments.) For each variable except real profits, we regressed the natural logarithm of the variable from the Mediobanca data set on the natural logarithm of the

corresponding variable from the cooperative data set, a constant term, and six firm dummy variables to capture scale differences among the firms.[11] For real profits, which are negative for some observations, we used the level of real profits instead of its natural logarithm. In all regressions, we obtained an R^2 that exceeded .99, and except for labor and real fixed assets, the slope coefficients (i.e., the coefficients on the variables from the cooperative firm data set) were between .97 and 1.01. The slope coefficient on the labor variable was .62, which partly reflected the influence of one observation in which the data sources reported very different figures for labor. (When we excluded this observation, the slope coefficient rose to .81.) The slope coefficient on real fixed assets was .89, and it rose to 1.01 when we excluded the observation for which there was a relatively large discrepancy between the two data sources. If the six firm dummy variables are omitted, all R^2's continue to exceed .99 and the regressions coefficients are all between .99 and 1.03. In the case of labor and real fixed assets, the coefficients are influenced strongly by scale effects.[12]

The reasonably close correspondence between the two output series[13] is reassuring since we were not able to construct value added in the same manner that it was computed by Mediobanca. Value added was computed by Mediobanca as sales + final inventories - initial inventories - purchased inputs + any capitalization of fixed assets and cost adjustments (such as expenses recovered from customers or third parties) + income earned from activities other than normal business activities business. We lacked the appropriate data to account for capitalization of fixed assets, cost adjustments, and the additional income earned outside normal business operations.

Our sample consists of 51 conventional firms and 26 producer cooperatives in the construction industry. Data on producer cooperatives cover the 1981 to 1988 period, while the conventional firm sample runs from 1981 to 1989. Availability of data is the reason for the

slightly different time periods. As such the overall size of the data set compares very favorably with data sets used in previous work.

In Table 1 we report descriptive statistics separately for producer cooperatives and conventional firms for those observations used in the econometric analysis.[14] On average, conventional firms employ only slightly more workers, use more capital per worker, and pay their employees better than the cooperatives in our sample.[15] Zevi (1982) and Bartlett et al. (1992) also reported that conventional firms were more capital intensive than producer cooperatives.

The descriptive statistics for cooperatives reveal important features of how workers participate in the firms. Turning first to our indicator of participation in decision making (MEMB), we find that 77% of the permanent employees, on average, are members. This is at least as high as the average participation rates in the cooperatives in France, Italy, and the United Kingdom studied by Estrin, Jones, and Svejnar (1987). There are only four sample observations (corresponding to two cooperatives) for which members accounted for fewer than 50% of the cooperative's permanent employees; there is only one observation for which all permanent employees were members. Although cooperatives in our sample employed hired workers, their (permanent) workforce consisted predominately of worker-members.

In contrast to decision-making participation, financial participation appears to be much weaker. The average bonus, distributed to all workers, is small[16]. Indeed, in more than 90% of the observations the cooperative does not pay a bonus.[17] When workers received a bonus payment, it equalled, on average, only 3% of average labor costs per worker and was less than 7% of average labor costs for all observations in our sample. We suspect that the infrequency of bonus payments and their small fraction of compensation partly reflect the difficult time experienced by construction cooperatives in the 1980's (Earle, 1986). Since we lack data on

profit sharing by conventional firms, we assume that they did not distribute a bonus to their workers. This assumption is consistent with the survey evidence reported in Uvalic (1990) that indicates that few conventional Italian firms (across all industries) distributed bonuses to their workers during the 1984-87 period. However, profit sharing apparently increased in 1988 as the Italian economy improved. The individual ownership stake of worker-members (OWN) is quite modest compared to collective reserves per worker member (RES). This partly reflects various institutional forces previously described, notably the requirement that at least 20% of profits be allocated to a legal reserve fund and the exemption from corporate income tax of profits allocated to funds such as collective reserves (Zevi, 1982), and the ceiling on the rate of interest that can be paid on individual capital stakes, while loans can pay a higher rate (Zevi, 1982).[18] In addition to the different rates of return on loans and equity, a second reason why LOAN is on average higher than OWN is that our data for loans includes loans from both current worker members and other members (e.g., former workers).

IV. EMPIRICAL FRAMEWORK

Our empirical strategy is to estimate translog production functions that capture the effects of differences in the organizational structures of cooperatives and conventional firms in a variety of ways.[19] In some specifications, these differences are only allowed to directly affect output, while in other specifications the organizational form is also allowed to affect some or all of the coefficients on the labor and capital input variables. Our most general translog specification is given by

$$\ln Q_{it} = \alpha_i + \alpha_t + \alpha_{Ct} + \beta_L \ln L_{it} + \beta_K \ln K_{it} + \beta_{LL}(\ln L_{it})^2 + \beta_{KK}(\ln K_{it})^2 + \beta_{LK}(\ln L * \ln K)_{it} +$$

$$\beta_1 BONUS_{it} + \beta_2 MEMB_{it} + \beta_3 OWN_{it} + \beta_4 RES_{it} + \beta_5 LEND_{it} + \beta_{LC} COOP * \ln L_{it} +$$

$\beta_{KC}COOP*\ln K_{it} + \varepsilon_{it}$ ……. (1)

where Q is output (real value added), L is employment, K is the capital stock, BONUS is the average distributed profit per employee, MEMB is the proportion of permanent employees who are worker members, OWN is the average capital stake of worker members, RES is average collective reserves per worker member, LEND is the average loan capital per worker member, COOP is a dummy variable for producer cooperatives, α_i is the firm specific fixed effect, α_t is the time effect for conventional firms, $\alpha_t + \alpha_{Ct}$ is the time effect for cooperatives, and ε_{it} is the disturbance term. (See the Appendix for more detailed definitions of the variables.) We assume that ε_{it} is independently distributed (across firms and over time), but is possibly heteroskedastic. One source of heteroskedasticity is that value added for conventional firms and cooperatives are not necessarily calculated in the same way. In particular, the adjustments made by Mediobanca in computing value added might be thought of introducing measurement error that might inflate the variance of the disturbance terms of conventional firms.

We include firm specific effects (αi) to capture the time-invariant heterogeneity of the firms in our sample. In particular, the firm specific intercepts will attempt to control for differences among firms such as managerial abilities and worker quality. Additionally, as we will discuss below, the effect upon output that is common to all cooperatives might be captured by the firm specific effects. The time effects capture technological change and other shocks that are common to all conventional firms (α_t) and to all cooperatives ($\alpha_t + \alpha_{Ct}$) in the industry.

We include five variables, BONUS, MEMB, OWN, RES, and LEND, to capture how variations in financial and decision making participation directly affect output.[20] These measures have been used in previous studies of the technical efficiency of producer cooperatives such as Jones and Svejnar (1985) and Estrin, Jones and Svejnar (1987).[21] Following Ben-Ner and Jones

(1995), the inclusion of the five measures of participation assumes that the productive efficiency of cooperatives varies *both* with the degree of financial *and* the extent of decision-making participation.

Alternatively, one might assume that the five participation measures at best help capture variation in productive efficiency only within the cooperative segment of the industry, but that additionally, all cooperatives are fundamentally different than conventional firms. While it might be desirable to include a dummy variable (COOP) to capture the systematic common difference between cooperatives and conventional firms which directly affect output (as opposed to altering the effects of input changes on output), it is not possible when we include the firm specific fixed effects unless we impose restrictions on the α_i's and the coefficient on COOP.[22] Hence, to examine whether there is a common systematic difference between cooperatives and conventional firms, we include COOP and impose the restriction that the coefficient on COOP equals the difference between the average value of the firm specific fixed effects for cooperatives and the average value for conventional firms. Since our sample of firms includes most of the population of large construction firms, the coefficient on COOP might be a good indicator of a systematic difference between cooperatives and conventional firms.

The interaction terms involving the dummy variable, COOP, as defined above, and the input variables allow for changes in input levels in cooperatives to affect output differently than in conventional firms. In light of the modest size of our sample of cooperatives, it would be asking too much from the data to indicate how all five coefficients of the translog production function differ between cooperatives and conventional firms, i.e., to also interact COOP with $(LnL)^2$, $(LnK)^2$, and (LnL*LnK).[23] Thus, we consider a less ambitious specification in which COOP is interacted only with lnL and lnK, thereby allowing the output elasticities of labor and capital to differ for cooperatives and conventional firms.[24]

Additionally, the coefficients on COOP*lnL and COOP*lnK indicate if the productivity difference between cooperatives and conventional firms is affected by the size of the firm's labor force and its capital intensity.[25] Group incentives such as profit sharing are expected to be less effective in larger firms where the free rider problem would be more acute (Cable and Wilson, 1990). Larger firms might realize smaller productivity gains from worker participation in decision making because of the difficulties in providing information to and in reaching agreements among many decision makers.[26] Insofar as a large capital stock is an indicator of machined-paced production, one would expect small productivity gains from participation (Brown, 1990; Cable and Wilson, 1990). Our production function given by equation (1) implies that if a cooperative and a conventional firm used the same amounts of labor and capital, then output of the cooperative would be proportionally greater than output of the conventional firm by

$$\ln Q_1 - \ln Q_0 = \beta_1 BONUS + \beta_2 MEMB + \beta_3 OWN + \beta_4 RES + \beta_5 LEND + \beta_{LC} \ln L + \beta_{KC} \ln K \ldots \quad (2)$$

where Q_1 and Q_0 are output of the cooperative and conventional firm respectively. We can transform equation (2) to express the output of the cooperative relative to that of the conventional firm as a function of firm size (L) and capital intensity, i.e.,

$$\ln Q_1 - \ln Q_0 = \beta_1 BONUS + \beta_2 MEMB + \beta_3 OWN + \beta_4 RES + \beta_5 LEND + (\beta_{LC} + \beta_{KC}) \ln L + \beta_{KC} \ln(K/L) \quad \ldots\ldots \quad (3)$$

Thus, β_{KC} indicates the effect of capital intensity on the productive efficiency of the cooperative holding firm size constant, and $(\beta_{LC} + \beta_{KC})$ indicates the effect of firm size holding capital intensity constant.

For each specification, we estimate production functions by ordinary least squares (OLS) and by an instrumental variables (IV) procedure to account for the endogeneity of labor, the

capital stock, and contemporaneous measures of financial and decision making participation (except for the lagged value of BONUS, which will be assumed to be predetermined). We will treat COOP as a predetermined variable. The two variables that involve the interaction of COOP with lnL and lnK are explanatory variables that are endogenous over part of the sample and predetermined over the remaining observations. (Specifically, observations on one of these variables will be predetermined whenever the observation corresponds to a conventional firm.) To obtain consistent estimates, we treat these interaction terms as endogenous variables.

As Keane and Runkle (1992) note, predetermined variables are not legitimate instruments to use to estimate a fixed effects model when you have short panels (i.e., when the asymptotic properties of estimators, such as consistency, are derived for large N and fixed T). To obtain consistent estimates with our instrumental variables, which include lagged values of endogenous variables, equation (1) is first differenced to eliminate the firm specific fixed effects and then this equation is estimated by two stage least squares using instruments that include the second lags of the endogenous variables[27] (Anderson and Hsiao, 1981). These predetermined variables are legitimate instruments to use to estimate the first difference equation. However, the disturbance term of the first differenced equation ($\varepsilon_{it} - \varepsilon_{it-1}$) is a moving average process, which implies that the IV estimates are consistent but their estimated standard errors need not be consistent. We attempt to correct for this by computing standard errors that are robust to both heteroskedasticity and a first order moving average process.[28]

V. EMPIRICAL RESULTS

Tables 2 and 3 report the OLS and IV estimates of translog production functions that capture the effects of worker participation in different ways.[29] For purposes of exploring the data,

we start with a simple model that omits the firm fixed effects and includes a simple COOP dummy to capture the difference in technical efficiency between cooperatives and conventional firms. In the results reported in the first column of Table 2 we see that the estimated coefficient suggests that cooperatives are approximately 17% less efficient than conventional firms. However, our fixed effect OLS results, as reported in the remaining columns of Table 2, indicate that the fixed effects are statistically significant. Therefore, it is these results that we will focus on.

In contrast to the implications drawn from some previous econometric work, we do not always find that the productivity of cooperatives is significantly higher than for conventional firms. Our point estimates (when evaluated at the sample means of our cooperatives) indicate that the productivity of cooperatives is lower than conventional firms,[30] except in models containing interaction terms that allow the output elasticities to differ across types of firms and when we assume that there is no systematic difference between cooperatives and conventional firms captured by the firm specific fixed effects. Moreover, these estimated productivity differences are often statistically significant and quite large. These models that omit the interaction terms involving lnL and lnK and COOP, and reported in columns 2,4 and 6 of Table 2, thus imply that productivity in cooperatives is at least 20% lower than in conventional firms, assuming that the two type of firms use the same amount of capital and labor.

However the picture that emerges from the results for the three interaction terms is different.[31] When the average difference of the firm fixed effects is assumed to reflect the organizational form of the firm, a negative and significant productivity differential in favor of conventional firms is again implied. By contrast, under the assumption that the fixed effects capture firm differences that are unrelated to organizational form, we calculate that the productivity differential is now positive, but insignificant. (The positive estimated differential

reflects the large positive coefficient on COOP*lnL.)

The models that include measures of financial and decision making participation potentially help identify the sources of the productivity differences. However, except for RES, none of the individual measures of participation is significant in any of the specifications. RES is always negative and significant. Moreover, the estimated effect of RES on output is quite substantial in all cases.[32] However, as Bonin, Jones, and Putterman (1993) note, the motivation for including a measure of collective ownership is that it indicates the disincentives to undertake investment projects. While this implies that cooperatives will be less capital intensive than conventional firms (as our descriptive statistics show), our measure of technical efficiency is based on both types of firms using the same amounts of both inputs.[33] Thus, we find the importance of RES surprising. The small and infrequent bonuses distributed by cooperatives likely accounts for our failure to confirm most previous work, which finds profit sharing to be positive and significant in cooperatives.

Turning to the models that allow the productivity difference between cooperatives and conventional firms to vary with firm size and capital intensity, we find that COOP*lnL is always positive and significant, while COOP*lnK is negative and insignificant. However, the estimated difference in the output elasticity of labor is perhaps implausibly large.[34] The insignificant coefficient on COOP*lnK implies that productivity does not vary with the cooperatives capital intensity, while the estimated effect of firm size on productivity, holding capital intensity constant, is positive and insignificant.

While the IV results reported in Table 3 are not terribly strong, they each imply positive productivity differentials in favor of cooperatives. However, the estimated differentials are implausibly large (e.g. implying cooperatives are twice as productive as conventional firms), and many coefficients are imprecisely estimated. The only measure of participation that is

statistically significant is again collective reserves[35], but only in models that include the interaction terms -- lnL*COOP and lnK*COOP. However, cooperatives are estimated to have an implausibly higher output elasticity of capital than conventional firms so these estimated specifications appear to be very reliable. While the coefficients of some participation measures such as MEMB are fairly large, both the Newey-West and uncorrected standard errors indicate that they are not precisely estimated.

V1. CONCLUSION

Since both theoretical and empirical evidence is inconclusive concerning the comparative performance of LMFs and conventional firms, we assembled new data for a sample of Italian firms. We estimated production functions for the Italian construction industry using a panel of producer cooperatives and conventional firms. We are fortunate that the data we use have a number of advantages over data used in previous studies. Except for organizational form, the cooperatives in our sample are fairly comparable to our conventional firms: average employment is roughly the same, both types of firms likely were formed as new firms rather than as restructured bankrupt firms[36], and most firms were formed prior to the sample period.[37] While the capital intensity of cooperatives was lower than conventional firms, this seems to be fairly typical and may reflect the alleged tendency of cooperatives to invest less than conventional firms.

We find that translog production function estimates are preferred to the Cobb Douglas estimates. Based on these translog estimates, and unlike several previous econometric studies, we find no consistent evidence of significant productivity differences between cooperatives and conventional firms. While many OLS point estimates indicate that output would be lower in a cooperative than in an otherwise identical conventional firm, this is not the case in our IV

estimates. The only statistically significant measure of financial and decision making participation is collective reserves**.**

We conclude by first discussing some possible explanations for why our results differ somewhat from many previous findings, especially those for Italian producer cooperatives. First, there were a number of mergers involving producer cooperatives in the construction industry beginning in the late 1970's (Zevi, 1982). Many of these mergers were encouraged by cooperative associations (e.g., Lega) to save weaker cooperatives. Clearly, the absorption of weaker cooperatives may have lowered the productivity of financially stronger ones.[38] Second, managers are often paid less than their conventional firm counterparts (Holmstrom, 1989) and are often prevented from becoming members by a limit of 12% of total membership that can be accounted for by technical and administrative workers (Zevi, 1982). Both factors might contribute to less efficient supervision than found in conventional firms.[39] Third, we were able to construct a measure of distributed bonuses, while Jones and Svejnar (1985) were forced to use profits per worker to capture the effects of profit sharing in their study of Italian producer cooperatives. In light of the infrequency in which our cooperatives distributed profits to its workers, profits per worker is a poor proxy during our time period.[40] It is unclear to what degree previous results for Italian cooperatives based upon this proxy are spurious. Fourth, conventional construction firms and cooperatives might be systematically operating in different segments of the market and undertaking fundamentally different types of construction projects. Thus, our estimated productivity effects might be capturing differences in the firms' economic environments rather than the efficiency with which firms use labor and capital.[41] Finally, the average labor force of the cooperatives we studied is typically larger than cooperatives studied in most previous econometric work. Perhaps the productivity gains of cooperatives only characterize smaller firms?[42]

More generally, since the productive efficiency of cooperatives will likely vary across institutional settings (Jones and Pliskin, 1991a) and time periods, then it is perhaps not surprising that we found cooperatives to be less productive than conventional firms. Of course, this suggests that one element in future research would be to focus on identifying the institutional settings that are favorable to cooperatives. And a body of useful work is in process on this matter.[43]

In addition, arguably before firm conclusions can be reached, new research methods need to be applied to the question of the comparative performance and the like. We arrive at this view because of findings that emerge from recent theoretical and empirical developments. Concerning theory, theoretical work clearly shows how economic performance can be expected to be strongly affected by diverse human resource policies (HRPs), such as mechanisms designed to foster employee involvement and alternative forms of compensation. (see, e.g. Lazear, 2000, Prendegast, 1999) and not just key structural aspects of organizational form (such as cooperative versus private ownership.) Moreover, empirical studies of participatory capitalist firms, which include measures of programs including different kinds of compensation system and various kinds of teams, affirm that diverse HRPs matter much for firm performance. (See for example Ben-Ner et al., 2000 and Kruse et al., 2004.) In other words, since the data used in our study of Italian firms in construction is restricted to include measures only of those HRPs that emanate from organization form, such as membership ratios and measures of collective reserves in coops, it is possible that our study omits important variables and thus is compromised by severe measurement issues. Moreover, it is quite possible that the set of HRPs that existed in the average Italian cooperative in construction during the study period was less likely to enhance performance than was the comparable set of policies in place in conventional firms. Or even if formal HRPs were comparable across the two sets of firms, it is possible that they may have been

implemented more poorly in PCs and thus there effectiveness dissipated more rapidly than in conventional firms. While we do not have direct evidence for such conjectures, we note that for other PCs there is some evidence that HRP practices have been found to be less innovative when compared with capitalist firms in similar industries. For example, Greenberg (1986) reports how participatory structures in plywood PCs paid far less attention to safety issues than did conventional plywood mills. In addition, we note that there is evidence for Italy as for other parts of Europe that during this period practices that provided for employee involvement such as teams and participation in enterprise rewards were spreading fast; we expect that the rate of adoption for at least some of these practices might have been happening at a faster rate in conventional firms than in PCs. (See, e.g., Uvalic, 1990.) Potentially this point has significant implications for research design: in order to confidently assess the comparative performance of PCs and conventional firms we need to augment what is already a fairly set of daunting data requirements (see Bonin et al, 1993) to also include information on the full sets of relevant HRPs in both organizations, such as teams, QCs, safety committees, and alternative forms of compensation. Unless this is done then such studies necessarily must suffer from measurement error that may be expected to be quite large, and thus confound any estimated difference in technical efficiency that emerges from specifications that exclude key HRP variables.

In tandem with this proposed more expansive firm-level research design, other recent work suggests that more reliable evidence also requires that econometric case studies should also be undertaken.[44] Arguably the reliability of evidence on relationships between HRPs and enterprise outcomes may be questioned in studies that employed simple firm-level measures of HRPs, and yet firms had multiple plants (and possibly variation in HRPs within firms.) Relatedly, the use of firm-level data has meant that empirical work is necessarily limited in its ability to provide appropriate tests of some hypotheses—e.g. an inability to gauge the impacts of

HRPs on product quality when firms produce heterogeneous products. Conducting insider econometric studies where the impact of HR events (e.g. Freeman and Kleiner, 2005) or variation in HRPs within a plant (e.g. Hamilton et al., 2003) is needed to furnish additional reliable information. Until findings from such a twin pronged research strategy emerge—matched econometric case studies in tandem with a more expansive research design for firm level studies that includes data for full sets of HRPs—it is likely that the empirical picture concerning issues surrounding the comparative performance of capitalist firms and PCs will remain blurred.

APPENDIX: DEFINITIONS OF VARIABLES

Q = value added = sales + final inventories - initial inventories - purchased inputs. (For conventional firms, value added also adds in "any capitalization of fixed assets and cost adjustments, such as expenses recovered from customers or third parties and in general all income additional to that earned in the normal course of business." For cooperatives, we calculated purchased inputs as the sum of production inputs and "commercial costs of sales and general expenses." We also included the value of "work in economic and domestic production" as part of production by cooperatives. Increases in works-in-progress on contracts lasting more than one year are included in the sales of conventional firms, and therefore in their value added.)

L = permanent employees at year end. (For conventional firms, there was no explicit reference to permanent employees.)

K = fixed assets at historical cost.

BONUS = average distributed profits per worker. (Distributed profits consists of transfers to members (after settlement of profits), salary integration (after settlement of profits), member transfers (if considered among costs), and salary integration (if considered among costs)). BONUS is assumed to be zero for conventional firms.

MEMB = proportion of permanent employees who are members of the cooperative.

OWN = average capital stake per worker-member.

LEND = average loan capital per worker member. (Total loan capital includes loans from both worker members and other members.)

RES = average collectively owned reserves per worker-member.

LABOR COSTS = salaries and stipends, contributions, and returns to retirees. (For conventional firms, it consists of wages, salaries, social security contributions and charges to severance indemnity provisions.)

PROFITS = trade profit.

Note: All values are in millions of 1985 lire.

Table 1: Summary Statistics

	Cooperatives		Conventional Firms	
	Mean	St. dev.	Mean	St. dev.
Q	20,980	17,291	32,433	30,979
L	562	493	677	735
K	18,177	14,723	28,941	29,365
KLRATIO (K/L)	34.8	13.3	46.8	21.5
(LABOR COSTS)/L	28.8	4.0	38.3	9.5
BONUS	.07	.29		
MEMB	.77	.13		
OWN	2.23	1.39		
LEND	11.67	5.79		
RES	46.30	30.74		
# OF FIRMS	26		51	
TIME PERIOD	1982-1988		1982-1989	
# OF OBSERVATIONS	138		236	

Notes: (1) All variables are defined in the Appendix.
(2) All values are in millions of lire and are in constant 1985 prices.

Table 2: OLS Estimates of Translog Production Functions

lnL	.80 (1.35)	1.83 (1.82)	1.38 (1.28)	1.84 (1.80)	1.40 (1.29)	1.99 (2.13)	1.43 (1.38)
lnK	-.19 (.29)	-.89 (1.28)	- .65 (.90)	-.92 (1.37)	-.71 (.96)	-.96 (1.43)	-.71 (1.00)
$(lnL)^2$	.01 (.17)	.14 (1.27)	.09 (.73)	.13 (1.24)	.08 (.71)	.16 (1.85)	-.10 (.96)
$(lnK)^2$	.02 (.31)	.17 (1.87)	.12 (1.29)	.16 (1.85)	.13 (1.30)	.18 (2.36)	.13 (1.49)
lnL*lnK	-.02 (.14)	-.31 (1.22)	-.20 (1.17)	-.30 (1.56)	-.20 (.95)	-.36 (2.19)	-.22 (1.17)
COOP	-.17 (2.70)	.17 (.70)	-.55 (.41)	.16 (.65)	-.65 (.50)	-.03 (.42)	-.78 (.58)
COOP*LNL			.38 (2.32)		.39 (2.38)		.38 (2.26)
COOP*LNK			-.20 (1.17)		-.19 (1.14)		.36 (.94)
BONUS		.04 (1.13)	.03 (.89)				
$BONUS_{T-1}$				-.01 (.17)	-.02 (.41)		
MEMB		-.19 (.85)	.02 (.12)	-.17 (.72)	.05 (.24)		
OWN		-.02 (.83)	-.01 (.55)	-.02 (.90)	-.01 (.56)		
RES		-.007 (5.87)	-.006 (5.74)	-.007 (5.90)	-.006 (5.86)	-.007 (6.10)	-.006 (6.52)
LEND		-.0008 (.14)	.003 (.54)	-.001 (.22)	.003 (.49)		

Notes: (1) Absolute values of t statistics are in parentheses. These statistics are computed using heteroskedastic consistent standard errors.

(2) All models except the first include firm specific fixed effects. The estimated time effects for conventional firms and for cooperatives are not reported.

Table 3: IV Estimates of Translog Production Functions

lnL	1.95 (.60)	4.97 (.81)	2.11 (.66)	5.42 (.88)
lnK	2.21 (.58)	-.32 (.07)	2.12 (.56)	-.81 (.16)
$(lnL)^2$	-.06 (.14)	-.17 (.22)	-.02 (.04)	-.11 (.13)
$(lnK)^2$	-.11 (.34)	.01 (.03)	-.08 (.24)	.07 (.16)
lnL*lnK	-.05 (.08)	-.22 (.22)	-.12 (.20)	-.33 (.32)
COOP				
COOP*LNL		-.17 (.13)		-.26 (.19)
COOP*LNK		1.87 (.74)		1.99 (.77)
BONUS	-.13 (.54)	-.12 (.44)		
$BONUS_{T-1}$			-.06 (.66)	-.07 (.56)
MEMB	.63 (.58)	.19 (.15)	.80 (.77)	.34 (.27)
OWN	-.01 (.11)	-.03 (.30)	-.003 (.03)	-.03 (.26)
RES	-.007 (1.11)	-.01 (.44)	-.007 (1.17)	-.01 (2.05)
LEND	.04 (1.05)	.01 (.19)	.04 (.98)	.01 (.13)

Notes: (1) Absolute values of asymptotic t statistics are in parentheses. These statistics are computed using the Newey-West estimator based on autocorrelation of one period to obtain consistent standard errors.

(2) Coefficient estimates are obtained by first differencing the translog production function and estimating the first differenced model by two stage least squares.All models include separate time effects for conventional firms and cooperatives. The estimated time effects for conventional firms and for cooperatives are not reported.

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Endnotes

[1] See for example recent editions of Advances in the Economic analysis of Participatory and Labor Managed firms such Kalmi and Klinedinst (2006).

[2]See Bonin, Jones, and Putterman (1993), Jones and Pliskin (1991a) and Dow (2003) for surveys.

[3]For example, see Zevi (1982), George (1982), and Bartlett et al. (1992).

[4] For example, see Defourney, Estrin, and Jones (1985), Estrin and Jones (1988), Estrin, Jones, and Svejnar (1987), and Jones and Svejnar (1985). Some exceptions are Jones (1987), Lee (1988), Berman and Berman (1989), Estrin (1991) and Craig and Pencavel (1995).

[5]While the estimated coefficient on the dummy variable for cooperatives in the production function estimated over the pooled sample indicated that cooperatives were less productive than conventional firms, this result may be suspect because a Chow test rejected the hypothesis that the parameters of the production functions of the two types of firms were identical.

[6]Since the remaining firms either had profit sharing plans or employee stock ownership plans, the sample did not include conventional firms that did not offer financial participation.

[7]While his results showed that cooperatives in both industries were characterized by less severe decreasing returns to scale, it was not possible to estimate their relative technical efficiency.

[8] Good accounts include those by Ammirato (1996), Earle (1986), Holmstrom (1989) and Zevi (1982).

[9] Thus what a member receives bears no relation to the enterprises's net returns. In no way can the individual capital contributions be considered as the market membership price that is envisaged by some theorists of the LMF.

[10]These firms were among the 1500 or so largest manufacturing, service and trading firms ranked on the basis of sales. (The number of firms in a given year was based on a sales threshold and varied between 1115 and 1765 firms.)

[11]The regressions for real value added, real fixed assets, and real profits were based on 24 observations, while those for labor and real labor costs were based on 23 observations because of missing data. Some observations were not included in our econometric analysis discussed in section 4 because of missing data on labor or on one of the measures of participation. However, we use these observations to help assess how well the data from the two sources correspond.

[12] As an additional check of the consistency of the two data sets, in unreported regressions we used the Mediobanca employment data rather than the cooperative figures for employment. The results obtained using this procedure are essentially unaltered from those reported in the empirical section below.

[13]Using the 24 common observations on the seven cooperatives, the mean of the natural logarithm of value added calculated from the cooperative data set exceeded the corresponding mean from the Mediobanca data set by .032. Average real value added was 39,801 million 1985 lire for the 24 observations from the cooperative data set and 39,158 million lire for the

corresponding Mediobanca observations, a difference of 1.6%.

[14]The time period for both samples begins in 1982 because observations for 1981 are lost by our use of lagged values of some variables as instruments,

[15] As a referee pointed out, the higher wages in conventional firms could be due to different occupational structures or, if wages were higher for similar skill levels, this might reflect payment of efficiency wages.

[16]Bonus is defined to be transfers to both member and nonmembers divided by total employment. Transfers include payments to members and nonmember workers both before and after settlement of profits. Chillemi and Gui (1988) apparently computed their measures of profit sharing in a similar manner. We divide transfers by employment rather than the number of worker-members because as Zevi (1982) notes, workers who are not members share equally in the transfers in many cooperatives.

[17]Chillemi and Gui (1988) reported that many of the Italian cooperatives in their sample did not distribute a bonus. Also, see Uvalic (1990) which cites survey evidence that shows no profit sharing by Italian cooperatives in all industries from 1984-87.

[18] Note that the law capping dividends on shares in Italian coops was changed during the 1990's. However, for the period covered by this study, a ceiling was still operative.

[19] F tests lead us to prefer the translog form over the Cobb-Douglas form. Also, based on our calculations for critical parameters such as the marginal product of capital, we find that the translog estimates do yield meaningful production functions. (This has not always proved to be the case with work in this field. See, for example, Craig and Pencavel, 1995:147.)

[20]We consider alternative specifications in which the lagged value of BONUS is used in place of the current value. The lagged value of BONUS may best capture the incentives provided by sharing profits with workers because these payments are determined within the year or while drafting the balance sheet (Chillemi and Gui, 1988).

[21]As noted above, these studies were based on samples that did not contain conventional firms and the relative technical efficiency of cooperatives was assumed to reflect the extent to which their workers participated financially and in the making of decisions.

[22]Estrin (1991) captures the productivity effect of cooperatives using only a coop dummy variable. He is able to do so because none of his specifications include firm specific fixed effects.

[23]If we allow for the variance of the disturbance term to differ between cooperatives and conventional forms, this would be equivalent to estimating separate translog production functions for cooperatives and conventional firms.

[24] For example, the output elasticity of labor is given by $\beta_L + 2\beta_{LL}\ln L + \beta_{LK}\ln K + \beta_{LC}COOP$, implying that β_{LC} indicates the difference in output elasticities.

[25]In their studies of the productivity effect of alternative forms of compensation, Cable and

Wilson (1989, 1990) and Wadhwani and Wall (1990) allow their profit sharing dummy variables to affect the output elasticities of labor and capital in their Cobb Douglas specifications. In their study of the productivity effects of profit sharing and worker participation, Jones and Pliskin (1991b) adapted this approach to translog production functions.

[26]For example, Holmstrom (1989) discusses the efforts of the largest worker cooperative, CMC of Ravenna, to decentralize decision making to cope with difficulties arising from its size.

[27]In addition to the time effects, we use $\ln L_{t-2}$, $\ln K_{t-2}$, $(\ln L)^2_{t-2}$, $(\ln K)^2_{t-2}$, $(\ln L * \ln K)_{t-2}$, the second lags of the five measures of financial and decision-making participation, the natural logarithm of real value added, the natural logarithm of real labor costs per worker, real profits and all these variables interacted with COOP. A rationale for interacting these variables with the dummy variable for cooperatives is that even if conventional firms and cooperatives do not differ in technological efficiency, they may respond differently to changes their economic environment. Craig and Pencavel (1992) and Pencavel and Craig (1994) report that following changes in output and input prices, U.S. plywood cooperatives adjust their output and employment differently than do conventional plywood firms.

[28] We computed robust standard errors using a procedure based on Newey and West (1987). However, this procedure is not satisfactory in our case because it ignores the panel nature of our data.

[29]The OLS results are based on 374 observations, while the IV results are based on 293 observations. The difference reflects the loss of observations when we compute first differences: we lose at least one observation for each of the 77 firms. While the OLS, fixed effects sample may appear to be larger, we are also estimating 77 additional parameters-- the η_i's. Thus, the degrees of freedom of corresponding specifications are nearly the same.

[30]Estrin found that Italian cooperatives are significantly less productive than conventional firms when hours worked by blue collar was the measure of labor input. Moreover, the estimated differential was quite large - - roughly 28% to 38%. However, he did not find a significant productivity effect when labor was measured by total employment.

[31] And F tests lead us to prefer these specifications with interactions.

[32]This effect is based on comparing a firm with RES equal to its mean in the cooperative sub-sample with a firm in which RES equals 0. A referee points out that this finding could be due to the existence of a positive relationship between collective reserves and coop age. While, regretably, we do not have comprehensive data with which to investigate this conjecture, we do know cooperative age for two firms. For these firms, which we believe are above average age, collective reserves are considerably above average.

[33]The underinvestment hypothesis as Bonin, Jones, and Putterman state is one concerned with allocative efficiency rather than "factor productivity."

[34]Recall that these coefficients indicate the difference between cooperatives and conventional firms in their output elasticities of labor and capital.

[35]For these two models, RES is significant only when we use the Newey-West standard errors.

The "uncorrected" imply asymptotic t statistics of around 1.

[36]This is based on what is typical for producer cooperatives in the Italian construction industry rather than the histories of the 25 cooperatives in our sample.

[37]Since the firms are fairly large, it is unlikely that they are new firms. In addition, we excluded observations on any conventional firm from the sample when it was reported that it was involved in an acquisition or merger and its assets changed appreciably from the previous year.

[38]Mergers of consumer cooperatives in other nations (e.g., United Kingdom and Sweden) apparently had a similar effect on the combined cooperative.

[39]Craig and Pencavel (1993) report that some hired managers of U.S. plywood cooperatives have complained about interference from members.

[40]When we replaced BONUS by profits per worker, the coefficient on this variable was positive and statistically significant.

[41]Chillemi and Gui (1992) argue that studies of cooperatives need to distinguish between economic and technical efficiency. Moreover, we note that since the period examined in this study, Italian cooperatives appear to have continued to flourish. This contrasts with some other cases, notably the plywood coops which, notwithstanding their apparent productivity edge have virtually disappeared.

[42]However, this hypothesis was not confirmed by our econometric results for models that included COOP*lnL. Also, Estrin (1991) did not find that the productivity of small cooperatives in light manufacturing industries differed from comparable conventional firms.

[43]Smith (1994) reports evidence that Italian industrial cooperatives are relatively more efficient when they produce high quality products, use corporate alliances, and when its innovative activity is based on knowledge produced by its workers.

[44] For a discussion and examples of this method see Jones, Kalmi and Kauhanen (forthcoming, 2006.)