WORKER PARTICIPATION AND PRODUCTIVITY IN LABOR-MANAGED AND PARTICIPATORY CAPITALIST FIRMS: A META-ANALYSIS

CHRIS DOUCOULIAGOS*

Using meta-analytic techniques, the author synthesizes the results of 43 published studies to investigate the effects on productivity of various forms of worker participation: worker participation in decision making; mandated codetermination; profit sharing; worker ownership (employee stock ownership or individual worker ownership of the firm's assets); and collective ownership of assets (workers' collective ownership of reserves over which they have no individual claim). He finds that codetermination laws are negatively associated with productivity, but profit sharing, worker ownership, and worker participation in decision making are all positively associated with productivity. All the observed correlations are stronger among labor-managed firms (firms owned and controlled by workers) than among participatory capitalist firms (firms adopting one or more participation schemes involving employees, such as ESOPs or quality circles).

Scientists have known for centuries that a single study will not resolve a major issue. Indeed, a small sample study will not even resolve a minor issue. Thus, the foundation of science is the cumulation of knowledge from the results of many studies.

Hunter and Schmidt, *Methods of Meta-Analysis*

Interest in the effects of worker participation on enterprise performance has grown phenomenally. In general, the literature can be divided into two camps. Supporters of participation argue that it strengthens workers' commitment to the firm, reduces the need for costly monitoring, and increases work effort and hence

*Chris Doucouliagos is a lecturer at the School of Economics, Deakin University. This paper benefited substantially from discussions with, and assistance from, George Tratolos, Phillip Hone, Douglas Kruse, Asraul Hoque, and participants in seminars at Deakin and Monash Universities.

All the data used in this study, as well as the computer program and a technical appendix, are available from the author at the School of Economics, Deakin University, 221 Burwood Highway, Burwood, Victoria, 3125, Australia.

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efficiency and productivity. The other camp argues that various forms of participation reduce managerial power, obstruct management decision making, waste valuable and scarce resources, and lead to free rider problems. Regardless of the theoretical arguments, however, "the proof of the pudding is in the eating." Accordingly, in this paper I apply meta-analysis to 43 studies that together represent a large proportion of the published empirical work on the subject, and by this means I estimate the *average* correlations between productivity and various forms of participation (worker participation in decision making, profit sharing, worker ownership, and collective ownership) found by other researchers.

Meta-analysis, a set of techniques for distilling a single estimate from a number of studies, is widely used in psychology and sociology and is beginning to be applied in management studies. Unfortunately, with a few notable exceptions (Jarrell and Stanley 1990; Weitzman and Kruse 1990), it has not been adopted in economic analysis. One reason for its disuse is that few researchers, apparently, are yet familiar with it (Wanous, Sullivan, and Malinak 1988); another is that varying methodological quality and differences in the measurement and specification of both dependent and independent variables across many empirical econometric studies make those studies difficult to compare. The few serious meta-analyses in applied economics have demonstrated its potential for synthesizing empirical economic results (Stanley and Jarrell 1989). For example, a meta-analysis by Weitzman and Kruse (1990) has been widely acclaimed and very widely cited as evidence of the positive association between profit sharing and productivity.

This paper offers the first meta-analysis of the effects on productivity of various forms of participation in labor-managed firms (LMFs—worker-owned firms in which labor exercises ultimate and democratic decision making power, with one vote per person) and participatory capitalist firms (PCFs—firms adopting one or more participation schemes involving employees, such as ESOPs, quality circles, gainsharing, profit sharing, and autonomous work groups). It is also the first meta-analysis examining how productivity is affected by worker ownership—employee stock ownership or individual worker ownership of the firm's assets—and collective ownership—collective ownership of reserves over which workers have no individual claim. (I do not look at participation through union representation.) Previous studies have either ignored LMFs (Miller and Monge 1986; Wagner and Gooding 1987) or grouped them together with PCFs (Weitzman and Kruse 1990).

I am interested in two broad questions. First, what productivity effects are associated with the various forms of participation examined here—and, in particular, what are the relative effects on productivity of participation in ownership, decision making, and profit sharing? And second, are those effects sensitive to organizational setting? That is, do the effects of various forms of participation on productivity differ according to whether the firm is labor-managed or participatory capitalist?

The Meta-Analysis Methodology

Meta-analysis is essentially a technique for combining results across studies, with the objective of reaching conclusions about the overall association among variables (Rosenthal 1987). Because meta-analysis condenses numerous studies into one study, it can greatly reduce the onus on scholars who need to digest the empirical literature on a given subject. Thus, it is easier to refer to, say, Weitzman and Kruse (1990) than it is to refer to a list of different studies, with different sample sizes and different results. Apart from narrative and vote counting reviews (comparisons of the number of significant and insignificant findings), meta-analysis is the only technique available for the cumulation of results from different studies. Further, and more important, two great advantages of meta-analysis over a simple narrative review are that it allows quantifiable assessment of the empirical literature and hypothesis testing of the relationships under investigation. Narrative

reviews and vote counting reviews are notorious for erroneous conclusions (Hunter and Schmidt 1990, Chapter 1).

The meta-analysis undertaken in this study is concerned with four issues. First, are there any relationships between productivity and various forms of worker participation (participation in decision making, profit sharing, and ownership)? Second, what is the magnitude of each of these relationships (known as the *effect size* or correlation)? Third, is the estimated effect size statistically significant? And fourth, what is the variance of the observed effect size from each individual study around the overall estimated mean effect size of all studies combined? These four issues have been called "bare-bones meta-analysis" (Hunter and Schmidt 1990).

A fuller meta-analysis would investigate and correct for study artifacts (for example, measurement error, restriction of range, and construct validity). Data limitations rule out those further steps in the present analysis.[1] A fuller meta-analysis would also explore the effects of moderator variables (for example, the size of the firm, its geographical location, product market conditions, and years of operation). Although I undertake some moderator analysis (for example, comparison of LMFs and PCFs and the impact of codetermination laws) and I test for the need for other moderator analysis, most analysis of that kind is set aside for further research (and awaits further data). This study should therefore be seen as an initial exploration.

Nevertheless, this study is more comprehensive than previous meta-analyses on this subject (Miller and Monge 1986; Wagner and Gooding 1987; Weitzman and Kruse 1990). The often-cited Weitzman and Kruse (1990) study only reported and cumulated t-statistics and, hence, only focused on significance testing and did not investigate variance and sampling error.[2] Further, Weitzman and Kruse (1990) and Levine and D'Andrea Tyson (1990) did not compare LMFs and PCFs, but grouped them together. As will be shown below, that feature of their studies is a major limitation. Wagner and Gooding (1987) noted that the study by Miller and Monge (1986) was biased because it included laboratory studies and studies without any objective data (percept-percept studies). Wagner and Gooding (1987) only included studies from the United States, did not include any studies from economics, and only explored the association between participation in decision making and productivity. Finally, previous studies have not compared the relative effects of the different participatory variables. For example, the productivity effects of profit sharing have not been compared with those of ownership.

Procedure

Study Selection

In order to cumulate findings across studies, it is necessary to compile a comprehensive set of published studies adopting a comparable methodology. The estimation technique chosen for this study is econometric analysis, because of its familiarity in economics, its reliability and rigor, and its wide application to the estimation of the association between participation and productivity. An extensive manual and computer search identified 43 studies that reported regression results relevant to various forms of participation and productivity. Employee participation was defined as joint decision making or influence sharing between employees and managers; profit sharing was defined as group-based compensation of any form, including Scanlon plans, Rucker plans, and Improshare; worker ownership was defined as employee stock ownership or individual worker ownership of the firm's assets (but excluding managerial stock ownership); and collec-

[1]Unfortunately, this problem is common in meta-analytic work. Wagner and Gooding (1987), Gooding and Wagner (1985), and Schmitt, Gooding, Noe, and Kirsch (1984) all faced similar problems.

[2]Weitzman and Kruse attempted to estimate the effect size between profit sharing and productivity (1990:138), but because they did not use effect sizes derived from meta-analysis, they could only estimate an effect for 12 of their 16 studies.

tive ownership was defined as collectively owned reserves over which workers have no individual claim.

Fifteen of the studies refer to LMFs and 28 to PCFs. Tables 1 and 2 list the studies.[3] These 43 studies are the *population* of all relevant published studies. Meta-analysis focusing on published data is the norm (Wagner and Gooding 1987); unpublished works (doctoral dissertations, mimeographs, and working papers) are excluded on the grounds that they may be methodologically weak.[4]

It may be objected that relying solely on published data biases the results. In particular, it may be argued that studies reporting positive findings (that is, findings of statistically significant positive correlations between the variables of interest) are far more likely to see publication than are studies reporting negative findings. That argument, however, is premised on the assumption that negative results are suppressed by either authors or journals. As Rosenthal (1987:223) pointed out, this argument, at the extreme, implies "that the journals are filled with the 5 percent of the studies that show type I error, while the file drawers back at the lab are filled with the 95 percent of the studies that show nonsignificant results." In the present case, given the lively debate in the economics literature about the merits or otherwise of various forms of participation, such a pattern seems highly unlikely. For example, balanced against the many writings advocating LMFs is a large body of theoretical literature arguing that LMFs are inefficient (for reviews, see Doucouliagos 1993 and Bonin, Jones, and Putterman 1993). Indeed, it may even be that the mainstream of the economics profession is of the latter view. It is difficult to believe that negative theoretical findings are published while negative empirical findings are censored. In any case, the current meta-analysis does include negative findings, so publication bias is unlikely to be significant (if it exists at all).[5] Further, a number of investigations into publication bias have found no such bias (Bullock and Svyantek 1983; Barrick and Alexander 1987).[6]

I excluded six bodies of literature from this meta-analysis:[7] (a) studies exploring the effects of unions on productivity, or estimates of the interaction among unions, various forms of participation, and productivity; (b) case studies that did not provide quantifiable relationships; (c) studies that did not analyze the relationship between participation and productivity (for example, studies focusing solely on information sharing and productivity *without* participation, or the effects of the industrial relations

[3]Information on the studies can be obtained directly from the studies themselves or from an appendix available on request to the author.

[4]Meta-analysis can be applied to unpublished work, but corrections should then be made for methodological weaknesses. For example, a lower weight can be attached to working papers than to journal articles. Because of the subjective nature of such weights, I have excluded unpublished studies, like most other researchers doing meta-analysis on this subject (although Weitzman and Kruse used three unpublished studies). Hunter and Schmidt (1990:509) noted that the publication "bias" could be in favor of methodologically stronger research studies. Reviewers are often selected by journal editors based on their judged methodological expertise, and it is therefore to be expected that their evaluations will focus heavily on the methodological quality of the study. Many methodological weaknesses have the expected effect of artifactually reducing the expected study effect size.

[5]A referee pointed out that publication bias is a problem when research reveals inconclusive and insignificant results, and authors omit these from their published work. While positive and negative findings may be published, insignificant findings may not. Such publication bias *is* a major problem for meta-analysis, but it is also a problem for narrative review and any other cross-study analysis.

[6]A review of the unpublished literature is beyond the scope of the present paper, but the meta-analysis results are consistent with this literature. See, for example, Kruse (1993) for a review of this literature relating to profit sharing.

[7]A full list of the excluded studies and reasons for exclusion is available on request to the author. Several studies presented problems with classification, for example, studies of Scanlon plans and studies containing both LMFs and PCFs. Works in the psychology and organizational change literatures were particularly likely to be screened out by the study selection procedure. The technical appendix (available from the author) explains how such studies were handled and why.

Table 1. The Associations Between Productivity and Various Forms of Participation in Labor-Managed Firms.

Study	*Sample Size*	*Average r Decision Making*	*Average r Profit Sharing*	*Average r Worker Ownership*	*Average r Collective Ownership*
Berman and Berman 1989	144	−0.22**	n.a.	n.a.	n.a.
Lee 1989	150	−0.21**	+0.26**	−0.08	n.a.
Sterner 1990	57	+0.02	n.a.	n.a.	n.a.
Jones and Svejnar 1985	631	+0.03	+0.34**	+0.13**	−0.16**
Estrin 1991	84	+0.05	n.a.	n.a.	n.a.
Jones and Backus 1977, Jones 1982, Estrin et al. 1987 (U.K. data)	146	+0.07	+0.27**	−0.05	−0.11
Jones 1993	181	+0.09	+0.16	+0.09	+0.29**
Defourny et al. 1985, Estrin et al. 1987, and Estrin and Jones 1992 and 1995	1064	+0.13**	+0.23**	+0.15**	+0.04
Jones 1987	50	+0.30**	+0.19	−0.29**	−0.13
Espinosa and Zimbalist 1981	35	+0.38**	n.a.	n.a.	n.a.
Bellas 1972	18	+0.59**	n.a.	n.a.	n.a.

Note: "r" = correlation.

Definitions of independent variables: Worker Participation in Decision Making is joint decision making or influence sharing between employees and managers; Profit Sharing is group-based compensation of any form, including Scanlon plans, Rucker plans, and Improshare; Worker Ownership is employee stock ownership or individual worker ownership of the firm's assets, excluding managerial stock ownership; and Collective Ownership is collectively owned reserves over which workers have no individual claim.

*Statistically significant at the .10 level; **at the .05 level (two-tailed tests).

climate on productivity; studies comparing the productivity performance of LMFs with that of PCFs; studies analyzing participation but not productivity; and studies analyzing the effects of, say, profit sharing on absenteeism and defect rates, but not on productivity); (d) studies based on laboratory tests; (e) studies in which both the dependent variable and the independent variable measured perceptions rather than objective data; and (f) studies based on sample means. With regard to (f), differences in sample means compare the productivity levels of one group to those of another, yielding data different from effect size estimates derived from econometric work. For example, by comparing the productivity of one type of firm with that of another we get an idea of the net differences in productivity. Suppose, though, that participation in decision making is associated with increased productivity but collective ownership is negatively associated with productivity, and the latter offsets the former; the finding that the LMF has lower productivity than the PCF will then mask the positive association between participation in decision making and productivity.

Multiple Correlations

Most econometric studies provide several estimates—for example, results from both Cobb-Douglas and Translog production functions. Often, several independent variables may be included. The standard procedure, which I follow here, is to include *all* the available and relevant estimates in the meta-analysis. Thus, effect sizes are derived from all specifications of estimated production functions and from all independent variables proxying for various forms of participation. The only estimates that are usually excluded from meta-analyses are those acknowledged by the authors of a study to be unreliable and reported as a contrast to the main results or out of curiosity. The inclusion of such estimates would bias cumulation and are

Table 2. The Associations Between Productivity and Various Forms of Participation in Participatory Capitalist Firms.

Study	*Sample Size*	*Average r Decision Making*	*Average r Profit Sharing*	*Average r Worker Ownership*
FitzRoy and Kraft 1985, 1986, 1987, and 1992	123	−0.23**	+0.26**	+0.31*
FitzRoy and Kraft 1993	224	−0.12*	n.a.	n.a.
Svejnar 1982	374	−0.06	n.a.	n.a.
Katz et al. 1985	64	0.00	n.a.	n.a.
Kruse 1993	4672	+0.01	+0.02	+0.01
Cooke 1994	841	+0.02	+0.12**	n.a.
Mitchell et al. 1990	886	+0.08*	+0.10**	+0.09*
Cutcher-Gershenfeld 1991	368	+0.10**	n.a.	n.a.
Conte and Svejnar 1988, 1990	155	+0.19**	+0.14*	−0.03
Katz et al. 1987	33	+0.27	n.a.	n.a.
Conte and Tannenbaum 1978	20	+0.27	n.a.	+0.54**
Cooke 1989	87	+0.28**	n.a.	n.a.
GAO 1987	47	+0.35**	n.a.	+0.05
Cable and FitzRoy 1980	126	+0.36**	+0.15	−0.11
Rosenberg and Rosenstein 1980	68	+0.43**	n.a.	n.a.
Kumbhakar and Dunbar 1993	861	n.a.	+0.14**	+0.09**
Wadhani and Wall 1990	97	n.a.	+0.18*	n.a.
Kruse 1992	20720	n.a.	+0.02**	+0.02**
Blanchflower and Oswald 1988	948	n.a.	+0.05	−0.02
Schuster 1983	404	n.a.	+0.22*	n.a.
Schuster 1984a	202	n.a.	+0.25**	n.a.
Schuster 1984b	495	n.a.	−0.03	n.a.
Jones and Kato 1993a and 1993b	543	n.a.	n.a.	+0.05

Note: "r" = correlation.
*Statistically significant at the .10 level; **at the .05 level (two-tailed tests).
For definitions of independent variables, see text or note to Table 1.

accordingly not included in this meta-analysis.

Some of the multiple estimates are statistically independent and others are not. The procedure for averaging multiple estimates from a single study is outlined in Hunter and Schmidt (1990, Chapter 10). If a study reports fully replicated design (for example, a production function is estimated for the footwear industry and is then replicated for the construction industry), then each estimate is statistically independent. Such fully replicated estimates are averaged and the sample size is the sum of the sample sizes across the different organizations or industries. If a study applies different functional forms or different independent variables to the same data set, however (making it a "conceptual replication"), the estimates are not statistically independent and are averaged with the sample size for the average being the sample size for the study.

Heterogeneous Measures, Methods, and Data

Studies generally differ in how they measure and specify the dependent and independent variables and in the methodology they employ. Even when studies are identical in those respects, they are likely to differ in data quality. This heterogeneity, which at first blush might appear to be a problem, is in fact a good thing for the field and the very raison d'etre for meta-analysis. First, it contributes to the advance of understanding because it provides many cross-checks on results. As Weitzman and Kruse (1990:137–38) noted,

> if all studies used identical methods and data, the results would be more suspect (since they

could all share common defects). The variety of specifications employed, as well as the diversity of data sources, lends greater credibility to the findings.

Second, it is because all studies are not exact replications and do not arrive at the same conclusions that meta-analysis is needed and is valuable. Hunter and Schmidt (1990, Chapters 11 and 13) pointed out that meta-analysis does not mix apples with oranges: it cumulates and averages study results (numbers), not studies themselves. The meta-analysis undertaken in this paper does not combine different independent *variables* (for example, it does not combine the association between profit sharing and productivity with the association between participation in decision making and productivity), but different *measures* of the same variable. Similarly, with respect to the dependent variable, in all the included studies it is defined as productivity, even though it is measured in different ways.[8]

Meta-analysis is well suited to test the universality of a relationship. For example, the data used in this study are from various countries. Meta-analysis can, and in this study does, detect differences across different countries in the relationship between various forms of participation and productivity. If statistically significant variance is detected, then the hypothesis of homogeneity of effect sizes is rejected. Data permitting, moderator analysis can then be undertaken. For example, we can then test to see whether there are any differences between developed and underdeveloped countries in the association between various forms of participation and productivity. Meta-analysis can also be used to determine whether differences in effect sizes are due to real moderator variables or simply to the way variables were measured.

Multiple Authorship

A substantial proportion of the studies emanated from the same author (see Tables 1 and 2). This is a problem that is common in all cross-study comparisons, including literature reviews. While we can assume statistical independence for studies with different authors who used different samples, we cannot make the same assumption for studies in which the same author(s) used the same data set. For this meta-analysis, studies that were not statistically independent were averaged and treated as "conceptual replications." Thus, the number of studies was reduced from a total of 43 to 34, with studies relating to LMFs reduced from 15 to 11 and studies relating to PCFs reduced from 28 to 23.

The number of studies examined here compares favorably with the number in other meta-analyses. Bullock and Tubbs (1990), for example, looked at 33 case studies; Weitzman and Kruse (1990), 16 studies on profit sharing (14 of these are included in the present meta-analysis but 2 remain unpublished); Miller and Monge (1986), 25 studies; and Scott and Taylor (1985), 21 studies. It should also be noted that a small number of studies in cells is also common in meta-analysis. While 34 statistically independent studies may appear to be a small number, it is the total sample size from these studies that is important (see Tables 3–6 for the relevant total sample sizes).

[8]Even if theory offered guidance to researchers, data limitations would still restrict the way productivity and participation variables are measured. Some of the variables used are as follows. (The full list is available from the author.) Productivity was typically measured as value added, value added per worker, real sales, total factor productivity, measure of above-average performance, and net sales revenue per employee. Participation was defined by a dummy for participation plans or as the proportion of the board of management who are worker-members, proportion of workers who are members, members as a proportion of the total labor force, or index of participation. Profit sharing was measured by a dummy for profit sharing or as total surplus distributed to workers, profits per worker, or dividend distributed per member. Worker ownership was measured by a dummy for the existence of an ESOP or as total share capital owned by workers, average capital stake per worker-member, individually owned capital, financial input per employee, or the proportion of stock owned by ESOP. Collective ownership was measured as collective reserves as a percentage of net assets and total assets.

Estimation Procedure

The first step in the estimation is to derive the relevant t-statistics from each study. The corresponding effect size is then calculated from the t-statistic. Several effect size statistics are available (Hunter and Schmidt 1990).[9] The effect size adopted here, because of its familiarity and general use, is the correlation coefficient.[10] Note that the resulting correlations are partial correlations, and not zero order (simple) correlations. This means that the estimates may change according to which other variables are included in the primary study's multiple regression estimation. Different variables may change the partial correlations, but I assume that the reported estimates are the best estimates from that data set (the most methodologically and theoretically sound, produced using robust estimation techniques).

The econometric literature cautions against the use of simple correlations and recommends use of partial correlations. For example, simple correlations may reveal, say, a positive association when theory and (well-constructed) econometric estimation yields a negative association. Unlike the simple correlation, regression coefficients and partial correlations have the same sign, a very important piece of information when cumulating associations that may, from a theoretical perspective, be either positive or negative. Simple correlations may fail to reveal the underlying relationship; partial correlations give a better or purer approximation of the true association (Johnson 1984:82).[11]

The next two steps are to calculate an overall weighted average correlation across all studies and then estimate the variance of the population correlations (the variance in observed correlations not due to sampling error). The latter involves estimating the weighted average squared error across all studies and estimating the sampling error variance. The sampling error variance is subtracted from the observed variance and the difference is called the remaining (or corrected) variance. If at least 75% of observed variance is due to sampling error variance, then it is likely that the remaining variance is due to artifacts not accounted for, such as measurement error (Hunter and Schmidt 1990).

However, the 75% rule may not be powerful enough in cases where only a few studies are available. Accordingly, the U-statistic is also estimated. The U-statistic provides a test for the presence of moderator variables. A chi-square test is then performed on the U-statistic to determine whether any remaining unexplained variance is statistically significant. (This test is given in Marascuilo [1971], is recommended by Rosenthal [1987] and Spector and Levine [1987], and has been applied in several studies, for example, Fisher and Gitelson [1983] and Scott and Taylor [1985].) The existence of a moderator variable is indicated by (a) the 75% rule, (b) the U-statistic, and (c) credibility intervals. A large or zero inclusive credibility interval indicates the presence of distinct subpopulations.[12] Separate meta-analysis

[9]All of these are transformations of each other, so the conclusions drawn from one effect size will be consistent with those drawn from another. That is, the results of meta-analysis do not depend on the chosen effect size. For an extended discussion of this issue, see Rosenthal (1987). Partial correlations and t-statistics are monotonic transformations of each other and hence it makes no difference which is used (Chow 1983:71).

[10]A technical appendix is available from the author with a comprehensive list of all the formulas used in this meta-analysis.

[11]If data permitted, a meta-analysis of simple correlations could be conducted and its results could be compared with the results from the meta-analysis of the partial correlations.

[12]In meta-analysis, credibility intervals are constructed on the basis of 1.96 corrected *standard deviations* (the square root of the corrected variance, or the variance remaining after removing sampling error variance) from the point estimate of the population correlation. Confidence intervals are constructed on the basis of 1.96 *standard errors* from the point estimate of the population correlation. There are two ways to derive the standard error, one appropriate when moderator variables exist and one appropriate when they do not. For a full discussion, see Schmidt, Hunter, and Raju (1988), Whitener (1990), or the technical appendix available from the author.

(if possible) is then undertaken. The existence of moderator variables is confirmed by (a) point estimates differing among subsets *and* (b) a corrected *average* variance in the subsets that is *lower* than the variance for the data as a whole (Hunter and Schmidt 1990:112). In all cases, moderator analysis should be guided by theory.

The next step is to test the statistical significance of the average correlation statistics. The statistical significance of a partial correlation is based on the statistical significance of the t-statistics from which it was derived (Chow 1983:71). Several tests are available for testing the significance of the average t-statistic.[13]

The final step is construction of confidence intervals. Confidence intervals provide information on the uncertainty surrounding point estimates. Unfortunately, reporting of confidence intervals is not a common practice (for example, Weitzman and Kruse [1990], Wagner and Gooding [1986], and Miller and Monge [1985] offer only point estimates). Confidence intervals can also be used to test whether the effects of different forms of participation on productivity are similar—a condition that would be indicated, for example, by overlapping confidence intervals.[14]

Averages derived from meta-analysis should be weighted, but caution must be exercised when a single study dominates and reverses results. In such cases separate meta-analysis should be conducted and the results compared.

A major limitation of this estimation procedure is that it assumes that studies are of equal quality and reliability. Such an assumption is not necessary in all meta-analysis; it is possible to grade or weigh studies according to some quality or reliability criterion. I did not attempt to do so in this study because of the subjective nature of such grading and because the literature provides little guidance in assessing research quality.

Various Forms of Participation and Productivity in LMFs and PCFs

There are several theoretical reasons why LMFs and PCFs may differ in the channels through which various forms of participation work and in the productivity effects they have. First, governance structures differ. In LMFs the locus of strategic decision making power rests with, and is diffused throughout, the entire membership. Workers, at least in theory, control the LMF. In PCFs, ultimate and strategic decision making power lies with the owners and senior members of the hierarchy. Thus, the extent of participation in decision making is potentially greater in LMFs than in PCFs, a difference that can be expected to result in different productivity effects from participatory programs.

Second, workers' control can lead to endogeneity. That is, the degree of participation in decision making, profit sharing, and ownership is under workers' control and, hence, so too is the impact of these variables on productivity (Jones and Svejnar 1985:458).

Third, supporters of participation argue that its presence in decision making, profit sharing, and worker ownership of the firm has positive effects on the firm. Participation in those three program types, however, is more extensive and more intensively adopted in LMFs than in PCFs. That is, various forms of participation may attain a *critical mass* in LMFs. Further, LMFs and PCFs differ in incentives and monitoring mechanisms. LMFs can be described as

[13]These include the Edgington test, the Winer method, the Stouffer method, the weighted Stouffer method, and the mean p-value test (see Rosenthal 1987 for formulas and a discussion). The estimated t-statistics and tests for statistical significance are available from the author on request. All confirmed the results and conclusions reported in Tables 3–6.

[14]An alternative estimation procedure is *meta-regression analysis*. This procedure involves making the correlations the dependent variable, and making study characteristics the explanatory variables, which can also proxy for moderator variables (see Stanley and Jarrell 1989 for full details). Unfortunately, data limitations preclude a full meta-regression analysis at this time; because the large number of independent variables results in very low degrees of freedom, none of the meta-regressions produce statistically significant variables.

firms characterized by high trust, with high autonomy, high discretionary decision making power, and low direct supervision (Fox 1974). The monitoring of work in LMFs tends to be undertaken with peer group monitoring as a substitute for formal monitoring (Bonin, Jones, and Putterman 1993), a mechanism with cost savings for the firm and without necessarily any loss in monitoring intensity.

Labor-Managed Firms

The results for the eleven statistically independent studies of LMFs that were included in this meta-analysis are shown in Table 1. Democratic worker participation in decision making (one vote per person) in LMFs was positively but not always statistically significantly correlated with productivity in seven (64%) of the eleven studies, was negative and statistically significant in two studies (18%), and was close to zero in two others (18%). All six studies that looked at profit sharing and productivity reported a positive association between the two, and in four of the six cases the association was statistically significant. Three of the six studies that looked at worker ownership found that it was negatively related to productivity, but in only one case was the association statistically significant. Two of the studies found a positive and statistically significant association between worker ownership and productivity. Collective ownership is associated with reduced productivity in three of the five studies that estimated this relationship, but the negative association was statistically significant in only one case.[15]

Participatory Capitalist Firms

Three (20%) of the studies found a negative association between worker participation in decision making and productivity (all three relate to the West German experience with legislation imposing Works Councils); in two of these cases the association was statistically significant. Of the 13 studies investigating profit sharing, only one (8%) found that it had a (nonsignificant) negative association with productivity. Of the 11 studies estimating the relationship between worker ownership and productivity, three (30%) found a negative association, in all cases nonsignificant.

Meta-Analysis of Various Forms of Worker Participation and Productivity

Worker Participation in Decision Making and Productivity

Table 3 presents the meta-analysis results for the association between worker participation in decision making and productivity. Four studies relating to LMFs were excluded from the final meta-analysis. (The first numerical data column in the first panel of Table 3 shows the impact of including and excluding these studies.) Three of these (Berman and Berman 1989; Sterner 1990; Estrin 1991) pooled data from LMFs and PCFs and also used dummies to proxy for the cooperative form. The study by Lee (1989) focused more on quasi-LMFs than on LMFs (Lee noted that "there is often no one-member one-vote principle" [1989:14]). The use of pooled data and dummy variables may, in this case, bias correlation estimates because, as a proxy for the cooperative form, dummy variables capture participation in decision making, profit sharing, and ownership. Dummies for cooperatives capture the *net* effect of these variables and not the individual effects in which I am interested.

The population correlation coefficient between worker participation in decision making and productivity in LMFs is highly unlikely to be zero (see the 95% confidence interval, column 3). Removing the French data (42% of the total sample size) does alter this result, but there is no statistical reason to exclude those data (Table 3, column four). We can conclude that worker participation in decision making in LMFs

[15]The estimate for collective ownership in Table 1 combines the U.K. estimates in Estrin et al. (1987) with the U.K. estimates in Jones and Backus (1977). The results are nearly identical if the reverse procedure is adopted.

Table 3. The Association Between Worker Participation in Decision Making and Productivity in Labor-Managed and Participatory Capitalist Firms.

Labor-Managed Firms

Measure	*All Data, K = 11*	*Without Lee and Pooled Data, K = 7*	*Without Lee, Pooled Data, and French Data, K = 6*
Sample Size	2,560	2,125	1,061
Mean r	+0.11	+0.23	+0.24
Weighted Mean r	+0.06	+0.10	+0.08
U-Statistic	40.15** d.f. = 10	14.13* d.f. = 6	12.76* d.f. = 5
Remaining Variance	0.011 (72%)	0.003 (46%)	0.005 (49%)
95% Credibility Interval	−0.14 to +0.27	0.00 to +0.21	−0.06 to +0.23
95% Confidence Interval	−0.01 to +0.14	+0.05 to +0.16	0.00 to +0.17

Participatory Capitalist Firms

Measure	*Codetermination Only, K = 3*	*Without Codetermination, K = 12*	*Without Codetermination and Kruse, K = 11*
Sample Size	721	7,367	2,695
Mean r	−0.14	+0.20	+0.21
Weighted Mean r	−0.11	+0.04	+0.11
U-Statistic	2.98 d.f. = 2	91.6** d.f. = 11	35.86** d.f. = 10
Remaining Variance	0.0 (0%)	0.005 (75%)	0.007 (65%)
95% Credibility Interval	−0.11 to −0.11	−0.09 to +0.18	−0.06 to 0.27
95% Confidence Interval	−0.04 to −0.18	0.00 to +0.09	+0.04 to +0.17

Full Sample

Measure	*All Firms, K = 19*	*Labor-Managed Firms, Without Lee and Pooled Data, K = 7*	*Participatory Capitalist Firms, Without Codetermination, K = 12*
Sample Size	9,492	2,125	7,367
Mean r	+0.21	+0.23	+0.20
Weighted Mean r	+0.06	+0.10	+0.04
U-Statistic	104.07** d.f. = 18	14.13* d.f. = 6	91.6** d.f. = 11
Remaining Variance	0.005 (72%)	0.003 (46%)	0.005 (75%)
95% Credibility Interval	−0.08 to +0.20	0.00 to +0.21	−0.09 to +0.18
95% Confidence Interval	+0.02 to +0.09	+0.05 to +0.16	0.00 to +0.09

Note: "r" = correlation; K = number of studies.

Worker participation in decision making is defined as joint decision making or influence sharing between employees and managers.

*Statistically significant at the .05 level; **at the .01 level (chi-squared tests).

has a small, positive, and statistically significant association with productivity, rejecting the traditional view that democratic management of the firm is associated with *reduced* efficiency (Alchian and Demsetz 1972; Jensen and Meckling 1979). How-

ever, the unexplained remaining variance (46% of observed variance), the statistically significant U-statistic, and the zero inclusive credibility interval all suggest the presence of moderator variables.[16]

For participatory capitalist firms, Table 3 reports separate meta-analysis without the three studies relating to codetermination.[17] Meta-analysis confirms that worker participation in decision making imposed by government decree is negatively associated with productivity ($r = -0.11$, and the confidence interval does not include zero, column 2). This finding is consistent with the theoretical arguments against codetermination (Furubotn 1978).[18] The weighted average correlation is positive if the codetermination studies are excluded (+0.04, column 3). However, even after the codetermination studies are removed, the confidence interval suggests the possibility of no association, and the U-statistic and credibility interval indicate the existence of moderator variables. Excluding the Kruse study (58% of the sample size) results in a stronger and statistically significant association. There is, however, no apparent reason to exclude that study.

The average correlation across all studies—that is, with studies of LMFs and PCFs combined (but with Lee, the codetermination studies, and the studies using dummy variables excluded)—is +0.06, but among LMFs it is +0.10 and among PCFs it is +0.04 (third panel of Table 3). While there is some overlap in the confidence intervals, analysis of variance suggests that the association between worker participation in decision making and productivity in LMFs differs from that in PCFs. The average corrected variance for LMFs and PCFs is less than the corrected variance for the entire data set ($(0.003 + 0.005)/2 = 0.004 < 0.005$). We can conclude that the type of firm acts as a moderator variable in the association between worker participation in decision making and productivity. The average correlation between worker participation in decision making and productivity is likely to be smaller in PCFs than in LMFs, possibly because this form of participation occurs to a greater degree in LMFs.[19]

Profit Sharing and Productivity

Meta-analysis confirms that the sharing of profits in LMFs is positively associated with productivity; $r = +0.26$ and the 95% confidence interval is strongly statistically significant (Table 4, column 3). Moreover, that association exceeds the positive productivity association of worker participation in decision making in LMFs. The weighted average correlation is larger for profit sharing, and the confidence intervals for profit sharing and participation in decision making do not overlap. Meta-analysis also indicates an absence of moderator variables, as only 30% of observed variance remains unexplained after sampling error is removed, the U-statistic is not statistically significant, and the credibility interval does not include zero. This pattern suggests that profit sharing in LMFs always has a positive association with productivity and that this association in LMFs is not moderated in any way (for example, by the size of the profit share). Removing

[16]The remaining variance in observed correlations may be entirely due to artifacts not accounted for, such as measurement error, or it could reflect the influence of moderator variables. However, the small number of studies (notwithstanding the large size of the combined sample) precludes moderator analysis, principally because the studies do not include a consistent set of moderator variables, for example, separate regressions for small and large cooperatives.

[17]The Cable and FitzRoy (1980) study analyzed participation schemes *other than* codetermination in German firms.

[18]Benelli, Loderer, and Lys (1987) found negative (but statistically insignificant) effects of codetermination on dividend payments, firm leverage, firm profitability, and investment policies. Gurdon and Rai (1990) used a non-parametric test and found that revenue per unit of labor declined as a result of the 1976 West German codetermination law.

[19]This conclusion is unchanged if all the studies are grouped together (including codetermination studies, Lee, and pooled data) and then all relevant studies for LMFs and CMFs are meta-analyzed separately.

Table 4. The Association Between Profit Sharing and Productivity in Labor-Managed and Participatory Capitalist Firms.

Full Sample

Measure	*All Firms, K = 19*	*Labor-Managed Firms, K = 6*	*Participatory Capitalist Firms, K = 13*
Sample Size	32,752	2,222	30,530
Mean r	+0.16	+0.24	+0.12
Weighted Mean r	+0.05	+0.26	+0.04
U-Statistic	181.12** d.f. = 18	9.23 d.f. = 5	59.56** d.f. = 12
Remaining Variance	0.005 (89%)	0.001 (30%)	0.002 (79%)
95% Credibility Interval	−0.08 to +0.19	+0.20 to +0.32	−0.04 to +0.11
95% Confidence Interval	+0.02 to +0.09	+0.21 to +0.31	+0.01 to +0.06

Part Samples

Measure	*Labor-Managed Firms, Without French Data, K = 5*	*Participatory Capitalist Firms, Without Kruse 1992 and 1993, K = 11*
Sample Size	1,158	5,138
Mean r	+0.24	+0.14
Weighted Mean r	+0.29	+0.11
U-Statistic	6.51 d.f. = 4	26.59** d.f. = 10
Remaining Variance	0.001 (24%)	0.003 (60%)
95% Credibility Interval	+0.22 to +0.35	0.00 to +0.22
95% Confidence Interval	+0.23 to +0.35	+0.07 to +0.15

Note: "r" = correlation; K = number of studies.

Profit sharing is defined as group-based compensation of any form, including Scanlon plans, Rucker plans, and Improshare.

*Statistically significant at the .05 level; **at the .01 level (chi-squared tests).

the French data does not alter these conclusions.

Profit sharing in PCFs has a small and statistically significant association with productivity. The 95% confidence interval for all PCF studies suggests that the population correlation may be close to zero (column four). Including or excluding the Kruse studies does not alter the positive and statistically significant association between profit sharing and productivity in PCFs.

These results, in conjunction with the U-statistic, credibility interval, and average variance of subpopulations, suggest that profit sharing has a smaller association with productivity in PCFs than in LMFs. That conclusion highlights the importance of conducting separate meta-analysis for LMFs and PCFs.[20]

[20]A referee suggested that the estimation technique may deflate the correlation. Most of the studies for PCFs use dummy variables for the existence of profit sharing, and this practice may account for the large difference in correlations between LMFs and PCFs. The average correlation among studies not using a financial variable was +0.03, compared to +0.26 among studies using some financial measure. Meta-regression analysis did not support this hypothesis; the correlations were regressed against sample size ($t = -1.41$, $p = 0.18$), a dummy for the use of profit sharing dummies ($t = -0.67$, $p = 0.51$), a dummy for the type of firm ($t = +1.54$, $p = 0.14$), and a dummy for the use of production functions ($t = +0.17$, $p = 0.87$).

Table 5. The Association Between Worker Ownership and Productivity in Labor-Managed and Participatory Capitalist Firms.

Measure	All Firms, K = 17	Labor-Managed Firms, K = 6	Participatory Capitalist Firms, K = 11
Full Sample			
Sample Size	31,323	2,222	29,101
Mean r	+0.06	−0.01	+0.09
Weighted Mean r	+0.03	+0.10	+0.02
U-Statistic	60.90**	18.73**	29.42**
	d.f. = 16	d.f. = 5	d.f. = 10
Remaining Variance	0.001 (72%)	0.006 (70%)	0.001 (62%)
95% Credibility Interval	−0.05 to +0.10	−0.05 to +0.25	−0.03 to +0.07
95% Confidence Interval	+0.01 to +0.05	+0.03 to +0.18	0.00 to +0.04

Measure	Labor-Managed Firms, Without French Data, K = 5	Participatory Capitalist Firms, Without Kruse K = 9
Part Samples		
Sample Size	1,158	3,709
Mean r	−0.04	+0.11
Weighted Mean r	+0.06	+0.05
Remaining Variance	0.008 (65%)	0.004 (64%)
U-Statistic	13.93**	24.98**
	d.f. = 4	d.f. = 8
95% Credibility Interval	−0.12 to +0.23	−0.07 to +0.18
95% Confidence Interval	−0.04 to +0.15	0.00 to +0.11

Note: "r" = correlation; K = number of studies.

Worker ownership is defined as employee stock ownership or individual worker ownership of the firm's assets, excluding managerial stock ownership.

*Statistically significant at the .05 level; **at the .01 level (chi-squared tests).

Worker Ownership and Productivity

The weighted average correlation is positive for the association between worker ownership and productivity in LMFs. The 95% confidence interval for the true population correlation indicates statistical significance, but does not rule out a near zero association (Table 5, column 3). The low association between worker ownership and productivity is not surprising, considering that LMFs often pay shareholders either no dividends or below market (opportunity cost) returns. If the French sample is excluded, the association may become negative (see 95% confidence interval, column 2), but there is no apparent reason to exclude those data.

Most of the observed variance is not due to sampling error. The statistically significant U-statistic and the very wide credibility interval strongly indicate the presence of moderator variables. Possible moderators are capital starvation and inadequate access to finance, problems that have been identified with LMFs (Craig and Pencavel 1992); the size of worker ownership hold-

Caution should be exercised in evaluating these results because of the small sample size and multicollinearity among the dummy variables. The results do suggest, however, that it is the type of firm rather than the estimation technique that moderates for profit sharing.

Table 6. The Association Between Collective Ownership and Productivity in Labor-Managed Firms.

Measure	*All Data, K = 5*	*Without French Data, K = 4*	*Without French and Polish Data, K = 3*
Sample Size	2,072	1,008	827
Mean r	−0.01	−0.03	−0.13
Weighted Mean r	−0.01	−0.07	−0.15
Remaining Variance	0.015 (86%)	0.025 (86%)	0 (0%)
U-Statistic	37.09** d.f. = 4	31.17** d.f. = 3	0.31 d.f. = 2
95% Credibility Interval	−0.25 to +0.22	−0.38 to +0.24	−0.15 to −0.15
95% Confidence Interval	−0.13 to +0.10	−0.24 to +0.10	−0.08 to −0.22

Note: "r" = correlation; K = number of studies.
Collective ownership is defined as collectively owned reserves over which workers have no individual claim.
*Statistically significant at the .05 level; **at the .01 level (chi-squared tests).

ings; and any risk aversion associated with individual share holdings because of workers' inability to spread risk (Buck 1982). These factors may moderate and, indeed, offset any incentives to work arising from worker ownership. Some of the studies with positive correlations are also the ones with the highest proportion of the firm's assets owned by workers.[21]

The point estimate of the degree of association between worker ownership and productivity is substantially smaller in PCFs (r = +0.02) than in LMFs (r = +0.10), and the confidence interval suggests a near zero association. (Removing Kruse [1992, 1993] does not alter the results.) A possible explanation for this result may be that in PCFs workers typically own a small proportion of assets. Also, where workers in PCFs have little input into decision making, financial participation may be ineffectual. The nonsignificant finding may also reflect the weakness of the link between work effort and share price.[22]

The confidence intervals overlap and the average corrected variance for the subpopulations is greater than the variance for the entire data set. This finding indicates that the type of firm may not moderate the association between worker ownership and productivity. Rather, factors such as the size of workers' capital stake and the proportion of total assets owned by workers may be more important moderators. Further research is clearly needed to determine what aspects of worker ownership, if any, are conducive or nonconducive to productivity.

Collective Ownership and Productivity

Because of the small number of studies looking at collective ownership, the results for collective ownership are less conclusive than those for the other forms of participation (see Table 6). When all available data are subjected to meta-analysis, the association between collective ownership and productivity is negative, small (r = −0.01), and statistically nonsignificant. One of the two studies reporting a positive association (Es-

[21]For example, the correlation of −0.05 from Jones (1982) was derived from cooperatives in which the share of assets owned by workers was around 4% to 7%. The Italian cooperatives (r = +0.13) and the French cooperatives (r = +0.15), however, had shares of around 11% and between 10% and 38%, respectively. In contrast, in the Polish sample only 0.3% of the total assets were owned by workers, but a positive association between worker ownership and productivity was established. Removing the Polish sample *does not* alter the point estimates or confidence intervals for the association between participation in decision making, profit sharing, or worker ownership. Results are available from the author. The Polish data do, however, influence the results for collective ownership of assets; see Table 6.

[22]An anonymous referee pointed this out.

trin, Jones, and Svejnar 1987) relates to French cooperatives and the other to Polish cooperatives (Jones 1993). If the French and Polish samples are excluded, the weighted average correlation increases to –0.15 and becomes statistically significant, and there is no remaining variance. Separating the French data is justified because, as noted by Estrin et al. (1987) and confirmed by analysis of the other studies, the French cooperatives have a relatively low proportion of collectively held assets. Jones (1993) noted that the Polish results may be influenced by the impact of underdeveloped capital markets in that country. Meta-analysis suggests that the ratio of collectively owned assets to individually owned assets may be a moderator variable in nonsocialist countries. Some small degree of collective ownership, as in the French data, may not be negatively associated with productivity, perhaps because it encourages solidarity.

The meta-analysis point estimates, correlations, and confidence intervals presented here have the same sign as in previous meta-analyses, but generally are lower in magnitude. That is an important difference, because with the exception of Weitzman and Kruse (1990), the other meta-analyses have used entirely different data sets (that is, have looked at different studies). For example, in relation to worker participation in decision making and productivity in PCFs, Miller and Monge (1985) found an overall weighted mean correlation of +0.15, and Wagner and Gooding (1987) found an average correlation of +0.12; Bullock and Tubbs (1990) derived an average correlation of +0.21 for gainsharing plans; and the Weitzman and Kruse (1990) study yielded an average correlation for profit sharing of +0.04 (author's estimate from Weitzman and Kruse).

No previous meta-analyses have investigated the productivity effects of worker ownership or collective ownership. None of the previous meta-analyses or narrative reviews constructed confidence intervals. Some meta-analysis results have differed from results derived from narrative review. For example, in their review of the literature, Bonin, Jones, and Putterman (1993:1305) concluded that the empirical results linking collective ownership to productivity "seldom yield significant results for any country." The results from the present meta-analysis suggest otherwise.

Concluding Remarks

This study is the first meta-analysis examining the productivity effects of worker ownership and collective ownership. It is also the first meta-analysis to examine the productivity effects of those and other forms of participation separately for labor-managed firms (LMFs) and participatory capitalist firms (PCFs). The results suggest several conclusions.

First, all the average correlations are small, although many are statistically significant. Second, with the possible exception of collective ownership (workers' collective ownership of reserves over which they have no individual claim), the various forms of participation do not hinder productivity. There is, however, a negative association between firms operating under codetermination laws and productivity.

Third, organizational setting appears to make a difference to the productivity effect of profit sharing and participation in decision making, but not to the productivity effect of worker ownership. In all cases the point estimates are higher for LMFs than for PCFs and, in general, so too are the confidence intervals. Fourth, contrary to the belief of many observers, democratic governance in LMFs is not negatively correlated with productivity.

Fifth, in LMFs profit sharing is more positively related to productivity than is worker participation in decision making. This finding lends some support to the view (for example, Locke et al. 1980) that workers are more motivated by remuneration than they are by participation in decision making. However, meta-analysis qualifies that view: profit sharing does not appear to be more important than participation in decision making in PCFs. These divergent findings for LMFs and PCFs may be explained by the fact that worker-owners asso-

ciated with LMFs are actually worker-entrepreneurs (labor hires capital), so that financial participation can be expected to boost productivity more than does participation in decision making. That is, worker-entrepreneurs are likely to be more interested in profit and the firm's survival than ordinary employees would be. Workers in PCFs, in contrast, who operate in an environment in which capital hires labor, may be more interested in participating in decision making concerning issues that affect them as workers than in furthering what are primarily the owners' interests.

Five important qualifications should be noted. First, the meta-analysis assumed that all studies were of equal quality. Because of that assumption, together with the heterogeneity of estimates, the results must be interpreted with a "broad brush." Second, any review, qualitative or meta-analytic, is limited to the available data. As in all studies, the results from this meta-analysis have to be tested against the results of future studies. Third, despite my occasional use, for convenience, of the phrase "productivity effects," it should be borne in mind that the results do not indicate causality. Analysis of causality is clearly needed, with, for example, the application of Grangian causality tests to time series data. Some time series studies (Schuster 1983, 1984a; FitzRoy and Kraft 1993) suggest that various forms of participation do cause changes in productivity, but the majority of studies only establish an association.

Fourth, interactions among the various forms of participation, and between the various forms of participation and other relevant variables, such as unionization, were not subjected to meta-analysis. Fifth, the meta-analysis presented in this paper presents only part of the picture of the analysis of LMFs. In order to get a fuller picture of the economic impact of LMFs, meta-analysis needs to be applied to studies investigating the impact of workers' control on the firm's survival rate, employment creation, probability of unemployment, and non-pecuniary benefits.

Finally, although this analysis has identified some moderator variables, it has yielded evidence of the presence of others that remain unidentified. Identification of the variables that moderate the association between various forms of participation and productivity will assist the formulation of policy relevant to participation.

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