Theoretical and Empirical Studies
of Producer Cooperatives:
Will Ever the Twain Meet?

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1. Characterizing Producer Cooperatives

Producer cooperatives (hereafter: PCs) have existed in Western economies since the advent of the factory system. The oldest surviving PCs in the U.K. and Italy are over one hundred years old. Nineteenth century economists of the stature of John Stuart Mill and Alfred Marshall commented on organizations that encouraged worker control. The first volumes published by the American Economic Association (1887, 1888) contained case studies of U.S. PCs.

Beginning with Benjamin Ward's seminal theoretical paper in 1958, the economic literature on PC-type firms has grown substantially. (For a survey, see Bonin and Puttermann 1997.) The burgeoning modern literature is matched by significant growth in the number of PCs in Western economies over roughly the same time period. From 1975-1981, 6,700 new PCs were created in the European Community (EC) accounting for 223,000 additional jobs (Ben-Ner 1988a). By 1981, EC countries had over 14,000 PCs with employment in these firms totaling about half a million people. How-

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ever, the incidence of PCs remains small relative to conventional organizational forms in Western economies. Italy has the largest PC sector employing an estimated 2.5 percent of the nonagricultural labor force and encompassing about 2.5 percent of all producing firms in 1981. Analogous estimates for other Western countries yield no figures above one percent.

It is difficult to explain the large outpouring of literature on the theory of the PC by referring only to its incidence in Western countries. For some scholars, interest in worker self-management arises from a concern about the quality of life (e.g., social relations and the potential for personal development in the conventional work environment) and a belief that the assignment of decision-making rights to workers is ethically correct. While such ideas may have motivated economists to study PCs, the resulting work reflects narrower concerns like job security and the distribution of rents within the organization. By analyzing the theoretical properties of PCs, economists hope to assess whether popularization of the PC form, or transplantation of some of its characteristics into other organizations, would benefit or harm social welfare.

Fundamental to any research on the topic is the following positive question. Why do so few PCs exist in Western market economies? A complete answer requires consideration of three related and more tractable questions. Are there recognizable differences in the way conventional firms (hereafter, CFs) and PCs respond to exogenous changes in the economic environment? Does the internal organization of the PC, in particular, worker participation in decision making and the sharing of value-added, affect worker motivation and productivity? How does the assignment of property rights in PCs affect investment and capital formation compared with that in CFs? In this essay, we review the existing theoretical and empirical literature using these three questions as organizational guides. We return to the fundamental question by considering explanations for the low incidence of PCs and for the recent growth of PCs in Western market economies.

Throughout, we restrict our attention to industrial PCs. Hence, consumer and marketing cooperatives (including farm coops), collective farms, partnerships and other forms of not-for-profit organizations are not considered. We concentrate on Western industrialized countries and exclude both developing countries and socialist (transforming) countries. In particular, Yugoslavia is not considered even though some argue it once provided the main laboratory for observing PC-type firms (Estrin 1983).

Our definition of a PC places further restrictions on the range of the material surveyed. The International Cooperative Alliance, to which many PCs belong, focuses on worker control of the firm in its guidelines for PC governance by specifying conditions such as free and voluntary membership and one member-one vote. The three characteristics associated with worker control are participation in firm decision making (including the appointment of management), profit sharing, and employee ownership. Of these three, we take the worker's decision-making right to be a necessary condition in our definition of the PC. Thus a firm

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1 In the theoretical literature, the organization is usually identified as a "labor-managed firm" or LMF. For consistency and to avoid confusion, we use the term PC which is commonly found in the empirical literature throughout our survey.

2 The relevance of the literature surveyed to a broader set of institutional arrangements is suggested by the fact that law and medical partnerships as well as university departments have been modeled as PCs (e.g., Mark Pauly and Michael Redisch 1973).
having employee ownership and/or profit sharing without according workers any
decision-making rights would not qualify as a PC by our definition. For example,
many U.S. companies have Employee Stock Ownership Plans (ESOPs) but do not
involve workers in meaningful decision making. Thus, many of the more
than 1,000 worker-owned firms in the U.S. employing in excess of 100,000 people
by 1989 (Ben-Ner 1989a) would be excluded.

On the theoretical side, profit sharing firms of the types proposed by Martin
Weitzman (1984) retain profit maximization as their objective while labor
remuneration becomes a combination of a fixed payment and a variable bonus share. As
employees have no decision-making rights in these share firms, we consider
the share-economy literature to be outside the purview of this essay. Worker
ownership and/or profit sharing must be combined in some way with worker
decision-making rights for us to classify the firm as a PC. For example, we do
consider firms in which not all workers have decision-making rights, i.e., worker-run
firms with some nonworker workers, and in which not all decision-making
rights are held by workers, i.e., firms in which nonworker financiers have a role
in decision making by virtue of their capital stake in the firm.

The theory of the PC focuses on the changes resulting from replacing the
profit-maximizing objective of the neoclassical firm with some other maximand
reflecting both workers' participation in the decision-making process and
workers' sharing in the residual surplus. If production decisions are to be made by
the workers, they must accept financial

responsibility for the outcomes. Otherwise, well-known moral hazard problems
would be pervasive. In the simplest case, each worker's remuneration consists of
a share in the firm's value-added which itself depends on the decisions taken by
the workers only. In this situation, Weitz consider value-added per worker as the
PC's appropriate main end.

The institutional structure of the PCs studied in the applied literature differs
significantly from such a "pure" organizational type. Partly for this reason, the
simple model has been amended to account for some of these differences so
that their significance should not be exaggerated. However, as the microeconomic
modeling of the PC evolved, a basic problem similar to one found in oligopoly
theory appeared. Slight changes in the assumptions and/or the specifications
of the model often alter significantly the behavioral propositions. The challenge is
to extract from theory insights into the behavior of real world PCs. We highlight
these propositions by discussing in some detail the theoretical literature that lays
the foundations for the surveyed empirical work or that provides guidance for
future empirical work.

Whereas we are very selective in citing what is a large body of theoretical literature, we
are more inclusive with respect to the empirical literature that is, for the
most part, in its infancy. To motivate the survey, we begin with a summary of the
select institutional details and provide some stylized facts about PCs in Western
countries. We then attempt to bridge what is often a significant gulf between
the theoretical and empirical literatures by considering contributions to both
literatures separated into four topic areas, three of which are based on the questions
posed above. We conclude by discussing the prospects for a closer integration of
the theoretical and empirical literatures.
II. Producer Cooperatives in Western Countries

The extent and nature of the PC sector vary enormously among Western countries. In the United States, the most prominent examples of PCs are in the plywood industry in the Pacific Northwest where they have been in existence since 1921. During the 1950s, the plywood PCs contributed as much as 25 percent of the industry’s total output but their market share and number have fallen recently. As the same time, a significant number of new PCs have formed in the U.S. reforestation industry.

In Britain, some PCs have existed for more than a century. Total employment in these long-established British PCs was about 3400 in 1968, but it had fallen to about half of that figure by 1980. The Mondragon group in Spain began in the mid-1950s as an integrated organization of workers in diverse activities (agriculture, retailing, education, finance) with the first PC having only 23 workers. By 1986, Mondragon had grown substantially making Spain’s PC sector the third largest in the West with more than 19,500 industrial jobs alone.

While examples of PCs have been found in France and Italy for a long time, both countries experienced substantial growth in the number of PCs since 1945. Italy has the largest PC sector in the West; two dramatic growth phases are evident, the first from 1945 to 1947 and the second during the 1970s and early 1980s (Jones and Alberto Zevi 1982). Italian PCs numbered more than 11,000 firms employing 428,000 workers in 1981—European Committee on Workers’ Cooperatives (CECOP). Due to a period of rapid growth after 1977, France had 1,345 PCs in 1986 employing 34,276 workers. The latter half of the 1970s was also a period of growth elsewhere in Western Europe.

Our defining characteristic, worker control, makes it difficult to classify firms as PCs or CFs in some countries. In Sweden, a firm is considered by law to be employee-owned if it has at least five employees, at least 50 percent of the workers control at least 50 percent of the voting rights, and ownership is evenly distributed among the employee/owners. Using this definition, 114 PCs employing close to 4000 people existed in 1983 in Sweden; 95 of these were in manufacturing, comprising about one percent of all firms in this sector (Bodil Thordarson 1987). Although Denmark has no specific legislation governing PCs, 21 Danish firms are identified as fully or partly worker-controlled in 1984 (Niels Mygind 1987). Without information about worker participation in Swedish employee-owned firms or the extent of worker control in Danish firms, we do not know how many of these firms correspond to our definition of a PC.

PCs are not pervasive in all sectors of Western economies but there is significant industrial clustering. Construction (Italy, France, and Sweden) and printing (France and U.K.) are sectors in which PCs were traditionally formed. In Italy, PCs have about an eight percent market share in building and construction and about ten percent in pottery, woodworking, glass-making, and certain types of mechanical engineering activities. In France, PCs were found traditionally in electrical engineering but recent growth has come in the service sector, especially diverse forms of consulting, and in mechanical goods. Some of the more recently formed PCs in Italy are also in the service sector. Long-established PCs in the U.K. are found in clothing and footwear while recently formed PCs are located in retail distribution, food processing, and publishing (in addition to printing). In the U.S., concentration occurs in the plywood industry, reforesta-
tion activities, and the taxi cab industry. The Mondragon group is more diversified in that about one-third of the workers are in consumer durable industries, another third produce intermediate goods and components, while about 20 percent of the workers are in capital goods production. In addition, the Mondragon group includes foundries, forges, and plants that manufacture building materials.

As measured by the number of workers, the size of PCs varies considerably both within and across countries. The average size of the work force in an Italian PC is less than twenty workers but variance is high with some construction PCs having employed up to almost 2500 workers. In 1987, CMC Ravenna employed 2427 workers and ranked as the 153rd largest enterprise according to sales volume in Italy. In France, average size is less than fifty workers (with sectoral averages of sixteen in consulting and sixty in construction). In the U.K., the largest PCs are found in the clothing industry while recently formed PCs average less than ten workers. In Sweden, about 40 percent of the worker-owned firms are small engineering plants averaging about forty workers per plant. In 1982, the eleven plywood cooperatives in the U.S. employed an average of 239 workers while the twenty-three reforestation cooperatives averaged twenty-nine workers. The average size of an industrial PC in the Mondragon group is 224 workers. In general, recently formed PCs seem to be of much smaller size than earlier-established ones.

Although the internal rules and policies of PCs are diverse, common practices can be found. As a proportion of labor, PCs tend to employ significantly more unskilled blue-collar workers and fewer white-collar and managerial workers than CFs. (William Bartlett et al. 1993, provide evidence for Italian PCs.) With respect to income distribution, a certain percentage of the surplus (i.e., revenues in excess of costs which include contractual wage payments) is required, either by statute or bylaws, to be distributed to the workers as “bonus” payments in all PCs (e.g., in France, at least 25% must be so distributed). Comparative data on wages for unskilled workers in PCs and CFs reflect the tendency for Western European PCs to set these wages according to trade-union-agreed rates and, thus, exhibit no significant differences. (For Italian PCs, see Estrin 1991.) However, earnings for blue-collar workers are higher in some PCs due to bonus payments and/or longer work hours.

In a sample of European PCs, annual bonus payments normalized with respect to the average weekly manufacturing wage in the respective country represent up to one week’s wages in the U.K., from two to eight weeks’ wages in France and from three to almost five weeks’ wages in Italy (Estrin, Jones, and Jan Svejnar 1987). Income distribution to workers is based on egalitarian principles in the U.S. plywood firms. Typically, members are paid equal hourly wages and are encouraged to equalize hours worked per member during the year so as to minimize differences in annual incomes. Income differentials are subject to constraints in Mondragon and Italy with the maximum allowed differential being 1 to 3 and 1 to 2.5, respectively. Consequently, the ratio of executive salaries to unskilled pay is almost 75 percent higher in Italian CFs when compared with their PC counterparts (Bartlett et al. 1992). PCs in the U.K. and France have no formal rules regarding income distribution.

All PCs, except those in the Mondragon group, allow nonmember workers. These “hired” workers are treated equivalently to members for the purpose of
making bonus payments in Italian and French PCs. In the Mondragon group, only "temporary" nonmember workers from other PCs within the group are permitted and they receive the same bonus payments as the members of the PC in which they work. Obviously membership and work status are not identical in any of the PCs outside of the Mondragon group. In practice, membership is linked to share ownership or to the payment of an entry fee to a collective fund. Italian and French PCs allow "hired" workers to become members at any time by purchasing shares. Even though the initial payment required is rather small, between 10 percent and 30 percent of the workers in Italian PCs and between 20 percent and 50 percent in French PCs choose not to exercise this option and prefer to remain as hired labor without membership rights including the right to participate in decision making.

In Mondragon and the U.S. plywood PCs, membership shares are created or transferred by "market-like" transactions. Workers wishing to become members in Mondragon must pay an initial (entry) fee and have their application accepted by the current membership. The initial membership fee is not set at a market-clearing level as evidenced by a continuing queue of hopeful new members. To promote harmony and commitment in the workforce, continuing members exercise discretion over the type of worker accepted as a new member in Mondragon.

In the plywood case, when a departing member wishes to sell his membership share, he consults with other members and a bank official who is familiar with the firm and industry to determine the likely flows of future income and to estimate the net present discounted value of the share. Using this calculation and taking account of the prices realized in previous share sales, an asking price is set by the departing member. The PC then has the right of first refusal and the sale to an outsider is finalized only if the remaining shareholders approve it by majority vote.

Although members leaving successful plywood PCs have sold their membership share for as much as $90,000 in 1983, the average price (in 1983 dollars) over a thirty-year period beginning in 1957 is about $44,000. Calculations based on this evidence indicate that the sale price of shares is substantially less than the price implied by the capitalization of actual income streams (Ben Craig and John Pencavel 1992). Risk differences due to the higher variability of PC earnings compared with CF wages might explain this discrepancy but a countervailing adjustment for the possibility of unemployment would be required because the calculations assume that, in the comparative scenario, the PC worker is always employed at the CF wage. Imperfect information and liquidity constraints faced by prospective worker/members would also support systematic undervaluation of share prices. Some observers consider the inability of workers to pay high share prices to be the main reason for the conversion of successful plywood PCs into conventional mills.

In all PCs, the principle of one vote per member applies to decision making so that financial voting in which the number of votes one may cast is determined by the number (percentage) of shares (assets) owned is not practiced. Furthermore, individual share ownership is limited. In Italy and France, members may not hold individual capital accounts in excess of six months' salary. Data on in-

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4 Actually the Mondragon PCs hire some professional workers or consultants (e.g., accountants). However, because they perform tasks that are tangential to the primary economic purpose of the PC, we consider the Mondragon plants to be an example of the "only members as workers" principle.
Industrial averages show that, in France, a member's capital account ranges from $1900 to $6000, in Italy, between $500 and $2000. In the U.K., the individual account varies from less than $50 to only $200. In these three countries, an interest rate below the market rate is paid on individual capital accounts.

In Mondragon, senior members have accumulated capital stakes of up to $50,000 due to a complex set of distributional rules. Current worker income consists of a wage that is calculated using a formula based on the unseen wage for a comparable job so that semiskilled workers essentially receive a wage equivalent to what they would earn elsewhere. However, due to the more narrow income differential applied in the Mondragon group, some highly skilled and professional members earn less, in current payment, than they would receive elsewhere. After wages and other costs are paid, the surplus is divided between individual capital accounts and a collective capital fund to which at least 30 percent of the surplus must be allocated. Individual capital accounts accrue interest at a real rate of six percent (under the assumption that the riskless real rate in Spain is 4.5% and an additional 1.5% is paid for the risk premium). However, individual capital accounts are "blocked" in the sense that a member is entitled to the full value of the accumulation upon retirement only. If a worker resigns (no worker has been dismissed in the history of the Mondragon group), he is entitled to only 70 percent of his accumulated individual capital account.

The PCs under consideration rarely borrow on the open market to finance investment. The bulk of capital financing comes from collective funds, made up of some percentage of initial membership contributions and accumulated allocations from surplus, and individual capital accounts (and sometimes personal loans from members). When specialized financial institutions exist, PCs do avail themselves of the opportunity to borrow. The best example of such external financing is the cooperative bank, Caja Laboral Popular, established in 1938 as an integral part of the Mondragon group. Dr. Jose Marcia Arizmendi took advantage of Spanish bank-type cooperatives to pay depositors an additional one percent above the legal maximum interest rate to attract capital by mobilizing local savings. In 1987, Mondragon's bank had 189 branches throughout the Basque region with total deposits amounting to roughly 1.13 billion making it Spain's twenty-fifth largest bank (Hans Wiener and Robert Osborn, 1987).

In addition to bank services, a PC in the Mondragon group has at its disposal technical support, education and training services, consulting services, for marketing and venture capital, and human resource management. At the other end of the spectrum is the U.K., where no PC supporting infrastructure exists at the national level and local initiatives are often ephemeral. For long established PCs in the U.K., there has been virtually no supporting infrastructure since 1950 (in contrast to the period between the two World Wars). Since 1975 in the U.K., an infrastructure including development agencies at national and local levels, has evolved contemporaneously with the emergence of new PCs. In Italy, each of the three divisions of the cooperative movement is integrated into a strong national federation that coordinates cooperative federations, provides human resource management, and lends variegated financial support. In France, national and regional federations provide similar support, but there is little overall national coordination.

As this brief summary of institutional arrangements and compilation of stylized
facts indicates, diversity rather than commonality is the prevailing feature among PCs in Western countries. Consequently, the usual methodology of the economics paradigm, i.e., empirical testing of behavioral propositions from well-structured theory, is in its infancy in this area. Empirical work on PCs falls into three basic categories: regression analysis using standard econometric methods (typically with all-PC samples), hypothesis testing comparing PCs with CFs (typically using the means of relevant characteristics, e.g., size of labor force), and numerous case studies which often assemble comparative stylized facts from PCs and CFs in the same sector. In what follows, we synthesize the published empirical work with emphasis on the first two categories.

III. Employment and Output

The most frequently quoted theoretical work on the PC is Ward’s (1958) model of the “Illyrian” firm in which profit as the short-run maximand of the neoclassical firm is replaced by dividend. The latter is defined as per capita value-added in production net of capital (financing) costs. In this model, labor and members are synonymous because hours and labor effort are fixed and nonmember workers can not be hired. Consequently, the denominator in per capita calculations is identical to the single variable input, labor, in the short-run production function. Finally, it is assumed that worker/members can be freely dismissed and that new workers can be engaged without reference to labor supply conditions.

In symbols, let \( p \) denote the parametric output price, \( Q \) the level of output, \( L \) the labor input (assumed to be equal to the number of members), and \( C \) all other fixed (contractual) costs of production. The maximand for Ward’s PC is the dividend given by \( (pQ - C)/L \). The task is to choose the number of worker/members, \( L \), to maximize this dividend. The first order condition equates the value marginal product of labor, i.e., \( pQ'(L) \), to the dividend, \( (pQ - C)/L \). The second-order condition for a maximum is satisfied at the optimum choice of \( L \) if the short-run production function \( Q(L) \) is strictly concave. Comparisons are made between a PC and its “twin” CF neoclassical counterpart which has the same production function, faces the same output price and cost conditions, but maximizes profit (rather than dividend) by hiring labor at a given parametric wage, \( w \). Taking positive profit for the CF as the usual short run situation, the three recurrent themes in the literature are smaller employment (and higher return to labor) in PCs, a negatively sloped supply curve for the PC, and a Pareto-inefficient allocation of labor in a producer cooperative economy (hereafter, PCE) defined as one consisting of PCs only.

To develop the analysis behind these propositions, we denote by \( L_c \) the optimal amount of labor hired by a price-taking/wage-taking/profit-maximizing CF and assume that \( (pQ - C - wL_c) \) is positive, i.e., the CF is profitable. That the price-taking/dividend-maximizing PC employs less labor (i.e., worker/members), denoted by \( L^* \), than does the twin CF follows from noticing that profit maximization requires \( w = pQ'(L_c) \) and that \( w < (pQ - C)/L_c \) if the CF is profitable but that \( L^* \) must satisfy \( pQ'(L^*) = (pQ - C)/L^* \). Therefore, \( pQ'(L^*) > pQ'(L_c) \) because dividend given by \( (pQ - C)/L \)

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5 Alternatively, the PC could be modeled as a firm in which a contractual wage is paid to the workers as is customary in PCs with the resulting fixed wage bill then subtracted from net value-added to determine the surplus to be shared on a per capita basis. In Ward’s simple short run model with one output and one variable input (labor), both forms of the objective function yield the same behavioral propositions.
is maximized at $L^*$ and $L^* < L_0$, so long as $Q''(L) < 0$.

This result depends on the exogenous wage faced by the CF being smaller than the per capita remuneration (the dividend) returned by the PC to its workers/members for labor services. If it faced a parametric wage equal to the maximized (exogenous) dividend of the PC, the CF would make zero profit and both firms would choose the same amount of labor and produce equal output. The different choices of labor, and therefore output in the short run, are attributable to the different decision-making problems used to stylize the two organizational forms, i.e., the wage is exogenous to the CF but endogenous and higher in the PC.

That the short-run allocation of labor is not Pareto-optimal in the PCE follows from noticing that the value of marginal product of labor is equated to the dividend in the PC rather than to a parametric wage. Differential short-run rents across firms (and industries) result in differential value marginal products of the mobile factor, labor, and thus to a Pareto-inefficient allocation. If a complete market in transferable membership rights exists, a Pareto-efficient allocation of labor is attainable in the short run under normal competitive conditions (Murat Sertel 1982 and Gregory Dow 1986). If entry and exit of PCs dissipate firm rents, the long-run equilibrium in the PCE coincides with the zero-profit competitive equilibrium and is thus Pareto optimal. Consequently, transferable membership rights and/or perfectly competitive markets may eliminate allocational inefficiencies in the PCE.

Turning to the comparative statics of the simple FC model, an increase in the parametric output price leads to a decrease in output supplied (a negatively sloped supply curve). In essence, an increase in $p$ yields a smaller increase in the value marginal product then in the dividend at $L^*$. Hence, the new optimal $L$ and consequently the new optimal $Q$ are smaller. As a complementary comparative static result, the FC tends to increase employment and output as fixed costs increase. Essentially, the dividend-maximizing firm seeks to share the added per capita fixed cost burden among additional members. Both of these results are considered to be "perversely", the FC's supply response is opposite in sign to that of a comparable CF and, unlike the FC, a profitable CF does not change output or employment as fixed costs vary.

The robustness of the negatively sloped supply curve attracted much attention in the theoretical literature. It does not generalize to the multiple output or multiple input case (Evsey Domar 1962; Benin and Walter Pulkkinen 1986). If hours of labor effort can be varied in response to a price change, the single-output short run supply curve may be positively sloped (Norman Flanders and Peter Law 1981). Furthermore, the relevance of Ward's simple model to real-world PCs has been questioned because of its treatment of membership as freely variable with no concern given either to the rights of an individual dismissed worker (Joan Robinson 1967; Vanek 1963; and James Meade 1973) or to the conditions under which additional members can be attracted (Domar 1968).

Focusing on an initial membership as the decision-making entity often eliminates the perverse supply responses. If members who collectively incur a debt are obligated financially to share its re-
payment and if those who are not engaged in production in the PC can secure alternative employment at the market-clearing wage, the PC will have the same Marshallian short-run supply curve as its CF twin (Bonin 1981). Faced with the prospect of random dismissals based on the realization of a stochastic output price if labor is adjusted to maximize dividend ex post, risk-neutral (or risk-averse) current members prefer no change in employment, in which case the PC exhibits a perfectly inelastic supply response (Alfred Steinherr and Jacques-Francois Thisse 1979). If these random layoffs in response to product price realizations are accompanied by monetary compensation, the short-run supply schedule is positively sloped (Hajime Miyazaki and Hugh Neary 1983). Hence, the negatively sloped supply curve is attributable to an unrealistic specification of freely variable labor in Ward’s model. When the focus shifts to the membership as the constituent decision-making body or when reasonable labor supply considerations are added, the result no longer holds.

Taking a longer term perspective in which membership can adjust to an optimal target by natural attrition, increased profitability of the PC is likely to lead to a smaller membership if compensation per worker is the only consideration. When output price is stochastic, the maximization of expected dividend by risk-neutral prospective members leads to an inverse relationship between optimal membership and expected output price (Bonin 1984).

Few easily testable hypotheses follow directly from this theoretical literature. The change in objectives from that of the neoclassical firm indicates that PCs will pay dividends to members in excess of the wage at which hired workers are (or would be) engaged by profitable CFs. Differential rents lead to differences in the value marginal product of labor across firms and thus to a Pareto inefficient short run allocation of labor. Normatively, policies designed to induce free entry, to facilitate transferable membership rights, or to provide alternative employment for members of PCs at the going market wage are hypothesized to support an efficient labor allocation in the PCE. From comparative static analysis, the output of a PC should respond relatively sluggishly to price changes, the PC should increase in size (employment and output) when fixed (overhead) costs increase, and membership should decrease as product market conditions improve. Finally, the importance of the membership as a decision-making body with its consequent rights and responsibilities suggests that PCs may follow selective and somewhat exclusionary membership practices.

The U.S. plywood industry in the Pacific Northwest provides one natural laboratory for comparative work. Firm-level data at various points in time are available for both PCs and CFs leading researchers to estimate production functions. By regressing value-added on labor and capital for 26 observations for PCs only, Smith (1984) finds that the Cobb-Douglas production function was the only form to yield meaningful coefficient estimates. Estimating separate production functions with physical output as the dependent variable for both PCs and CFs in a larger data set consisting of PCs and CFs (144 observations on 17 PCs and 20 CFs in five or six nonconsecutive years) from the plywood industry, Katrina Berman and Matthew Berman (1989) find that the Cobb-Douglas fits as well as the CES or translog. Authors use the estimated production coefficients to test some of the hypotheses from the theoretical literature.

Whether dividend maximization is appropriate by itself to describe the objectives of the PC is tested directly by esti-

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imating the parameters of an equation based on the first-order condition for maximizing a utility function having income (dividend) and employment as arguments. Using a Cobb-Douglas form for the utility function, Smith (1984) rejects the null hypothesis that employment does not matter for the plywood PCs. Taking the comparative statics equation from this two-variable utility function, the null hypothesis that labor (measured either by employees or hours worked) does not respond at all to product price can not be rejected.

To test for a Pareto-efficient allocation of labor among plywood PCs, Berman and Berman (1989) calculate short-run marginal products of labor based on the coefficient estimates from their production function estimation. The average short run marginal product is always less in the PC than in the CF but the difference is never statistically significant at even the 10 percent level. These authors find no evidence of a short-run inefficient allocation of labor in plywood PCs.

Tests using estimates of production function coefficients rely heavily on finding an appropriate measure for capital. Smith uses a raw measure, depreciation charges plus capital rental expenses deflated by the producer price index, and Berman and Berman use a stock measure, the book value of gross depreciable assets at original costs deflated by the GNP deflator. Neither is without its problems.

Using a data set with firm-level output prices for 41 plywood firms including PCs and two types of CFs, unionized and non-unionized, Craig and Pearson (1989) estimate supply responses by regressing real output on price. The supply elasticity of PCs is significantly positive and about one-half the value estimated for the union mills (although the difference is not statistically significant). The response of hours worked or employment to changes in output and input prices is as predicted by neoclassical theory for the CFs but not significantly different from zero for the PCs. Furthermore, whereas there is no significant relationship between output price and real wages in the CFs, a one-percent change in price is associated with almost the same change in real wages in PCs. Taken with evidence that employment is more stable in PCs over the business cycle, these results strongly suggest that plywood PCs trade off employment concerns of their members against potentially higher hourly wages.

In summary, empirical work using the U.S. plywood industry as a laboratory generates no evidence of short-run inefficiencies and rejects the notion of a negatively sloped supply curve in a direct test. The PC supply response does appear to be more sluggish than that of a CF. Dividend maximization is rejected as the sole objective for the plywood PCs and employment concerns are identified as having a significant influence on PC decision making. Hence, plywood PCs behave as if both earnings and employment matter and do not exhibit the perverse or inefficient behavior predicted by the simple model.

Direct comparisons of PCs and CFs using matched-pair data on Swedish manufacturing and construction firms (Thordarson 1987) and on eighteen of the
known twenty-one Danish PCs (Mygind 1987) fail to support strongly any of the hypotheses derived from the simple dividend-maximizing model. In Sweden, Thordarson finds no significant differences in employment levels or in the volatility of employment between firm types belonging to the same size class. Although finding no significant difference in employment levels might be expected in a given size class, the importance of membership stability (solidarity), a recurrent theme in the theoretical literature, is not supported by her conclusion of no significant difference in the volatility of employment among Swedish pairs. In Denmark, Mygind concludes that PCs do not behave significantly differently from CFs with respect to employment and earnings based on tabulated responses to changes in price or demand.\textsuperscript{11}

As the data sets in both studies include PCs in several industries, nonrefuted null hypotheses (or significant differences detected) could be due to other uncontrollable aspects across different types of PCs.

Although the theory is developed in terms of a discrete state of “being a PC,” actual PCs are in fact quite heterogenous. The effect of this divergence is illustrated in a study of 127 British firms from the clothing, footwear, and printing industries (Jones and Pliskin 1989). A large majority of these firms use some degree of profit sharing and are formally constituted as PCs but the data set includes firms having no profit sharing arrangements as well. Jones and Pliskin specify a log-linear employment equation that includes measures of employee participation in decision making and a profit sharing variable among the explanatory variables. When a dummy is used to differentiate firms with profit sharing (PCs) from those with no such arrangement (CFs), the coefficient of this dummy variable is negative and significant (although impossibly large). Such a result would support the theoretical proposition that PCs employ fewer workers than CFs. However, when Jones and Pliskin use a continuous measure of profit sharing, namely, the percentage of total worker remuneration distributed as a profit share, the regression coefficient is significant and positive. In other words, an increase in the degree of profit sharing in a firm leads to an increase in employment. Although it is subject to the criticism that it fails to control for the endogeneity of the measure of profit sharing, this analysis indicates that comparative studies using a dummy variable for profit sharing (PC or CF) may come to false conclusions because they do not reflect important differences among PCs related to decision making, e.g., practices regarding the hiring of nonmember workers.

In summary, the theory of the PC and in particular the comparison of the comparative statics of the dividend-maximizing firm to its profit-maximizing counterpart is overdeveloped relative to the empirical work that attempts to test the resulting behavioral hypotheses. As will be the case for empirical work on other issues in this field, this divergence is due in part to the difficulty of conducting the ideal empirical experiment having three properties: isolation, measurement, and modeling. First, the characteristic of interest should be imposed on a subset of randomly chosen agents and their behavior over time should be compared with a randomly chosen control group not having this characteristic (isolation property). Because PCs are established when it is rational for the forming members to do so, the PC characteristic is not a

\textsuperscript{11} Employment in PC and CF pairs changes in opposite directions in response to demand changes in only twenty-two of the seventy-four cases examined (and the author attributes ten of the opposite responses to external factors).
randomly imposed one. Although comparisons with a control group of CGs are more useful than studies undertaken in an all-PC sample, PCs are subject to selection bias and often differ from each other on the very characteristics used to distinguish the PC from the CF.

The second property of the ideal experiment requires that the measures of the key variables correspond closely to the theoretical concepts (measurement property). In addition to the usual problems found in empirical economics (e.g., measurement of capital services), PCs require measurement of worker control and surplus distribution. Proxies like membership ratios and accounting measures of bonus or surplus that are influenced significantly by tax treatment and internal accounting practices (including the specification of a basic wage or advancement to labor) are not wholly satisfactory. Third, well-specified models taking into account the institutional characteristics of actual PCs should yield testable hypotheses (modeling property). Theoretical studies have not examined important aspects of the compensation policies of actual PCs. In particular, those that delimit internal wage differences or link compensation to outside opportunity wages. Imposing these three properties as requirements on empirical work is a tall order; nonetheless, we will use them as critical guidelines to evaluate progress to date.

IV. Incentives and Productivity

The bulk of the empirical literature on PCs focuses on identifying the productivity effects of worker participation in decision making, collective ownership, and profit-sharing with little or no guidance from formal theory. The most closely related theoretical literature deals with the design of payment schemes to elicit efficient effort from workers. Within this rubric, variants include cases in which the individual worker's effort is presumed to be perfectly and costlessly measurable, those in which that effort is taken to be strictly unobservable, and those in which effort is imperfectly observable (with the accuracy of the observations sometimes depending on costly monitoring). The basic model consists of a firm made up of a given number of members, each of whom chooses individually optimal effort in a static setting.

The pioneering work of Amartya Sen (1983) takes effort to be perfectly observed and considers the effect of varying the rule for revenue distribution along a continuum from strictly egalitarian sharing to payment proportional to individual effort. As marginal payout is linked to average product, effort-proportional payment may induce effort in excess of that at which the value of marginal product equals effort's opportunity cost. However, a mix of equal and effort-proportional payment can elicit optimal effort. In the polar opposite case where effort is unobservable and sharing is egalitarian, suboptimal effort is provided in the absence of utility interdependence, repetition, or a budget-breaking scheme (Banerji and Holmstrom 1982).

In the most plausible case, effort is observable imperfectly (and at a cost) so that the key issues include the feasibility and adequacy of monitoring techniques. Some authors argue that the incentive problem identified with sharing schemes typically favors a hierarchical organization of the workplace in which the supervised worker receives a wage linked to his value marginal product and the responsibility for monitoring labor 50% on the residual claimant (Akerlof, Ashenfelter, and Perloff 1972). However,

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shirking by workers is never reported as a concern in studies of real world PCs; observers report that workers monitor each other successfully in cooperative organizations. Participation in decision making, profit sharing, and an absence of hierarchical relationships are hypothesized to convert the antagonistic labor relations characteristic of many conventional workplaces into environments marked by cooperative problem solving and informal policing of high-effort equilibria through social pressures and sanctions. In these situations, “horizontal monitoring” may actually be technologically advantageous (Keith Bradley and Alan Gelb 1981; FitzRoy and Kornelius Kraft 1986).

Not only is there no evidence that workers in PCs provide suboptimal effort, but recent practice indicates that profit sharing may promote effort. Non-PC firms have designed compensation schemes that tie pay partially to organizational performance in the hope of inducing higher productivity (Weitzman and Kruse 1990). When workers identify their efforts with organizational performance, morale is heightened leading to more and better work, improvements in production methods are facilitated by an upward flow of information from the shop floor, and lower turnover induces more accumulation of specific human capital. These considerations are expected to be particularly applicable to firms that are structured as cooperative organizations.

With respect to decision making, working conditions may be viewed as public goods which are better determined by collective choice than by a market matching employees to job offers (Drèze 1976). Other authors argue, however, that democratic decision making is cumbersome, especially in the face of worker heterogeneity (Michael Jensen and William Meckling 1979; Henry Hansmann 1990), and that the democratic firm may fail to make best use of either scarce managerial talent or the nonmanagerial skills of production workers (Oliver Williamson 1980). Inefficiencies may also arise if managers can not effectively supervise workers who have the power to discharge them (Beatrice Webb and Sidney Webb 1920). Organization theory provides no definite statement on the expected effects on productivity of profit sharing combined with worker decision making.

Lacking testable hypotheses about the effects of the cooperative form of organization on incentives and productivity, the empirical literature explores the relationship between productivity and worker participation, broadly defined to include decision-making rights, profit sharing, and employee ownership. Our definition of a PC emphasizes worker control. Relating per worker compensation to the firm's residual may provide both a direct motivation for individual effort and a rationale for mutual monitoring. Consequently, the effects of the first two aspects of participation on productivity are obviously relevant to this survey.

The rationale for linking worker ownership to productivity is less clear. When the workers have a financial stake in the firm, either individually or collectively, firm loyalty and worker morale may be higher (Oakeshott 1978 and Branko Horvat 1982). Relating a worker's wealth to the value of the firm's assets may induce increased individual effort and support horizontal monitoring in much the same way as does profit sharing. Because financial participation may therefore affect productivity, we follow the empirical literature by considering a "hybrid" PC in which worker participation takes all three forms: decision making, profit sharing, and individual or collective ownership.

The empirical papers on productivity tend to use data sets consisting of only PC firms because of the availability of
this information (often collected by a PC association or public registry), the relative homogeneity of accounting practices among PCs, and the difficulty in obtaining comparable data on twin CPs. The three attributes of worker participation are usually measured as continuous variables taking on different values within the sample. The most common method specifies value-added as the dependent variable in a regression equation with explanatory variables consisting of the usual production inputs augmented by the participation measures and dummy variables to control for industry, market, and other external factors. Although these studies make no direct comparisons with CPs, some PCs in the samples display very low values for the participation variables so that the effects of marked variation in the degree of participation on value-added can be examined in samples of PCs only.

The surveyed studies examine British PCs for five year intervals between 1973 and 1988 (Jones and David Reckers 1977; Jones 1982), French PCs for the years 1978 and 1979 (Defourny, Estrin, and Jones 1985; Estrin and Jones forthcoming), Italian PCs for the years 1973-79 (Jones and Svejnar 1985), and worker-owned firms in Sweden from 1983-95 (Lee 1988). In addition, Estrin, Jones, and Svejnar (1987) estimate production functions for PCs in France, Italy, and the U.K. as well as for separate industries or sectors within each country using the same group of participatory variables (with other controls).

These studies have several features in common. A standard production function augmented by a vector of participation variables is estimated and both the individual and joint significance of the components of that vector are examined. In most studies (e.g., Jones 1982; Defourny, Estrin, and Jones 1985), the participation variables act in a disembodied way. In some cases (e.g., Jones and Svejnar 1988), account is taken of labor-embodied versus disembodied effects of the relevant participation variables. As endogeneity of the participation regressors may be a problem, most studies use instrumental variables. Alternatively, Estrin and Jones (forthcoming) take a simultaneous-equation approach to the relationship between participation and performance.

The studies use similar measures of participation. For worker participation in decision making, the most frequently used is the proportion of the workforce who are members of the PC. For profit sharing, distributed profit (bonds) per worker is usually specified. For individual (collective) financial participation, measures of individually owned (collectively owned) assets per worker-member and the workers' share of individually owned (collectively owned) assets are used. All studies estimate different functional forms for technology, usually including Cobb-Douglas and translog. All employ data sets consisting of pooled cross-sectional and time-series observations. When the data are in the form of panels, specifications with and without firm-specific effects are estimated (e.g., for Italy and the U.K., Estrin, Jones, and Svejnar 1987).

The key result based on all studies where such tests are conducted (for all cases except the Swedish case) is that the null hypothesis that the various forms of participation taken together do not affect productivity is rejected. At the same time, the studies show that the effects of the various forms of participation vary across countries and industries. However, some general tendencies can be discerned from considering the significance of the participatory variables individually and across the different institutional settings. The most significant of the participatory variables is profit share.
ing. This is especially the case in French and Italian PCs where profit sharing was found to have a statistically significant and positive effect on productivity in 24 out of 32 reported regressions. However, for Sweden and the U.K., positive productivity effects for profit sharing are not uniformly present. In French and Italian PCs (but not in U.K. PCs), both the amount of individually owned capital per worker and the proportion of the workforce who are members has positive effects on performance in most cases. Attempts to relate both individual lending and collective ownership to productivity in PCs seldom yield significant results for any country.

In contrast, work using mixed or paired samples of PCs and CFs often finds no statistically significant effects when assessing the impact of the cooperative form on productivity. For the U.S. plywood firms, Berman and Berman (1989) estimate a production function with a PC dummy and find a significant negative coefficient which might indicate lower productivity in PCs. However, the authors reject at the one percent level the hypothesis that the other coefficients in the production function are the same when the data are divided into two subsamples (PCs and CFs). Consequently, inferences from the pooled-sample equation in which the production coefficients are implicitly assumed to be equal across firm types are not reliable.\(^{13}\) In a study of comparative productivity of Italian PCs and CFs, a PC dummy is also significant and negative when hours worked by blue-collar employees is used to measure the labor input but insignificant when labor is measured by employment (Estrin 1991). For a mixed sample of Swedish firms of similar size and industrial branch distribution, Lee (1988) finds no significant coefficient for the PC dummy nor does she find significant differences between production coefficient estimates for PCs and CFs.\(^{14}\) Adopting a different strategy to study the comparative technical efficiency of PCs and CFs, Defourny (1992) estimates production frontiers for each of fourteen industries in a data set containing annual observations on 500 French PCs from 1971–1979. Assuming that each estimated frontier would apply to CFs in the same industry, he compares average sectoral productivity and productivity by size class. Medium-sized PCs, defined as those employing between 20 and 49 workers, display higher average technical efficiency than CFs of the same size in most sectors. However, the opposite tends to hold for smaller firms, especially those with less than ten workers. In summary, the empirical evidence regarding comparative productivity is inconclusive when data are available for both PCs and comparable CFs.

Upon consideration of these often conflicting empirical findings, we note that it is frequently difficult to discern what factors lie behind the decision to adopt the PC form and whether these factors, rather than participation, are responsible for any observed productivity differ-

\(^{13}\) One possible strategy for comparing productivity would be to take the parameter estimates from the divided sample production functions as indicative of technological coefficients of the respective organizational types. If PC output is higher with CF technological coefficients while the reverse does not hold, the PC form would seem to exhibit lower productivity. However, if each type of firm achieves higher output using the other's technological parameters, the test would be indeterminate.

\(^{14}\) Lee uses a dummy variable to capture profit sharing and measures the other two participation variables by the proportion of workers who are members and the per worker value of individually owned assets, respectively. No significant coefficients are found for the dummy or for either of the other two participation measures. Indeed, the joint hypothesis that all of the participation coefficients are zero is not rejected. Furthermore, the null hypothesis that all production function parameter estimates are the same for the PC and CF subsamples is not rejected.
ences. In the case of U.S. plywood firms, some highly profitable PCs have converted to CFs to allow worker-partners to capitalize the value of shares which had become unaffordable for new workers entering the labor force (Christopher Gunn 1984). A tendency for successful PCs to exit the sample biases downward the observed productivity of PCs. In the Swedish case, most of the PCs are newly established and often set up with government assistance that aims at creating employment, a factor which might affect negatively their observed productivity. Further difficulties with studies of this type can be identified by considering isolation, measurement, and modeling problems.

To examine productivity differences between PCs and CFs, the comparison should be made between firms that are "twins" in all nonorganizational respects, e.g., in terms of technology, the product generated, and market conditions. However, identifying "twins" (isolation) is often impossible because the existing data on product type and technology are not sufficiently disaggregated. Firm-level data that applies consistent accounting conventions to both PCs and CFs in the same industry are rare. Furthermore, workers are not assigned randomly to the PC or CF; rather they choose the form to join. Selection bias violates the isolation property so that using a dummy variable (PC or not) to detect differences in technical efficiency is not wholly satisfactory. Moreover, case studies find significant variation among PCs in characteristics that would be unaccounted for by a PC dummy, e.g., the degree of cooperative decision making in the plywood PCs (Carl Bellas 1972).

The measurement property is violated when the labor input is proxies by size of workforce, leaving unanswered the question of whether apparent differences in productivity could result from more or longer workdays in one type of firm. Insofar as participation in decision making affects productivity through its impact on worker morale or on the upward flow of relevant technical information, the participation measures used do not take account of the percentage of workers who are actively involved in decision making or of the degree to which workers participate. Similarly, the concept of "the degree of profit sharing" has an unambiguous definition based on clear theoretical underpinnings. Consequently, finding the appropriate variable to capture the impact of profit sharing on work effort and productivity is problematic. 15

With no well-specified theoretical models to guide the empirical literature, the most important modeling problem is reverse causality. Wages, earnings retained for investment purposes, and profits distributed either to workers or to nonworker capital suppliers must sum to value-added which is itself the dependent variable in most of the studies. More productive firms are also more profitable; consequently, these firms are able to distribute more profit per worker. The decision to retain some surplus rather than distribute it to the workers as profit shares depends on the business prospects of the firm leading to another source of reverse causality. To control for reverse causality, instrumental vari-

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15 The theoretical literature distinguishes PCs from CFs in that workers in the former share the enterprise residual while these in the latter receive a fixed wage. Between these extremes, varying proportions of profit might be distributed to labor and to equity holders. If the effect of institutional profit sharing on worker productivity is at issue, the variable "proportion of profit distributed to workers" would be the relevant institutional measure. However, this measure may lack sufficient variation within the PC sample and thus be more useful in an institutionally mixed population. Furthermore, both the absolute level of profit shared and the percentage of compensation taking the form of a profit share or bonus will vary with the (possibly abnormal) wage bonus distinction and also with enterprise performance.
variables are used in some but not all studies. The adequacy of this technique depends critically on finding suitable instruments to overcome the problem of endogeneity of the regressors.\textsuperscript{16}

In summary, much of the empirical literature is devoted to estimating the effects of varying forms and degrees of worker decision making, profit sharing, and financial participation on PC performance using all-PC samples. Statistical support is found for the proposition that the participatory variables taken as a group are significant. Furthermore, profit sharing by itself is usually found to enhance productivity especially in situations where average levels of participation are relatively high. In contrast, no clear evidence of productivity effects from the other two types of worker participation is discerned across institutional settings. From the few studies that address directly the comparative productivity of PCs and CFs, no consensus emerges.

In addition to seeking improved methods for dealing with selection bias, measurement problems, and reverse causality, future research might focus on identifying the reasons why differing institutional settings apparently are conducive to varying productivity effects. One possibility (Estrin, Jones, and Svejnar 1987) is that the effects of the various types of participation are likely to be positive and larger where average levels of participation are relatively high. Such suggestions of nonlinear relationships between "participation" and organizational effectiveness again point to the need for better theoretical underpinnings with which to guide research.

V. Investment and Finance

While the role of labor in internal decision making is fundamental to our distinction between the PC and CF, the way in which capital requirements are financed and the resulting structure of ownership of the firm's assets are also significant. In the neoclassical CF, ownership of the firm's assets and control over decision making are both vested with the shareholders or their agent, management. The PC's assets may be owned by workers, either individually or collectively, and by nonworker financiers. According to our definition of a PC, control rights follow from membership in the firm's workforce and asset ownership by itself confers no decision-making rights. In theory, the share of assets owned by the workers can be small or nonexistent. However, the legal framework for the establishment and operation of business entities in industrial market economies usually presumes a link between ownership and control so that it may be difficult or impossible for workers to secure decision-making rights in a PC without being major equity holders (Ellerman 1984). If nonworker financiers are denied control rights but must bear a substantial portion of the financial risks, they may be willing to do so only on terms that are relatively unfavorable to the PC (Neuberger and Estelle James 1973). Hence, ownership and membership are linked to some degree in most real-world PCs.

The relatively small incidence of PCs in Western economies is often attributed to a lack of capital financing. The property-rights approach originating with the work of Svetozar Pejovich (1969), Eirik Furubotn and Pejovich (1970) and, independently, Vanek (1977), identifies a disincentive to finance capital with internal funds when worker-members do not have individual and transferable owner-

\textsuperscript{16}The endogeneity problem is not restricted to the participation variables but it also extends to the measures of capital, labor and other variables. Taking a simultaneous equations approach to account for reverse causality, Estrin and Jones (forthcoming) find a positive relationship between some participation variables and productivity in French PCs.
ship rights in the firm's assets. Rather than vote to retain some of the current surplus to finance capital goods, workers prefer to distribute the entire amount to themselves in the form of wages or bonuses. This strategy allows the individual worker not only to decide what portion of current income to save, but also to hold savings in an interest-bearing bank account providing the worker with an (individually) owned asset.

In contrast, an asset purchased with internally generated funds is considered in the literature to be "nonownable" because the individual worker has claim to the returns from this asset only so long as he is a member of the firm. If property rights are of this type (which is true of some but not all PCs), the individualized return to any internally financed investment project must be sufficient during a particular worker's tenure with the firm to compensate for both the interest foregone and the principal of this worker's contributions to the financing of the project. Otherwise, the worker will not be willing to vote for such internally financed investment.

To illustrate, suppose that the worker with the median expected tenure intends to belong to the PC for a period that is shorter than the time it takes for the stream of discounted net returns from the project (i.e., the surplus to be allocated to the workers using the rate of return on the owned asset as the discount rate) to equal the initial cost of the investment. Then, the structure of property rights assumed by Frisch, Pecchi, and Vareck prevents this "median" worker from reaping fully his share of the initial investment. If the worker has no transferable right (saleable or otherwise) to the returns from the project upon leaving the firm, he evaluates his individualized return using a truncated stream of discounted future returns with the final date coinciding with his expected departure. His vote, and that of all those who expect to be with the firm for a shorter period, will be based on only a portion of the discounted returns to the project. Hence, the internal rate of return on the ownership asset must be higher than that on the owned asset if internally financed investment is to be chosen when the median worker's expected tenure with the PC is shorter than the project's recoupment period.

The basic difference between this structure of property rights and that of a single proprietorship or a partnership is the inability of the individual worker to capture returns to assets upon leaving the firm. In the other two cases, ownership rights to the assets are saleable and the price in a perfect market will equal the discounted stream of future (remaining) returns. Due partly to the nontransferability of ownership rights, Vareck (1977) argues that the PC will choose to operate in the range of increasing returns to scale.\(^\text{17}\)

In theory, the limited appropriability problem in the PC can be solved with a different structure of property rights (Vareck 1977 and Ninoz Zaffos 1982). Suppose a worker is permitted to sell his right to the stream of returns on investment projects financed and undertaken during his tenure with the firm either to a new member or to remaining members. The departing worker can then capitalize fully the expected future returns in a competitive market.\(^\text{18}\) However, tradeable shares in ownership rights are rare in real-world PCs. An alternative solution would involve providing the departing member with a reimbursement...
for past contributions to PC capital equivalent to his share of the discounted value of future returns to these investments. The members' capital accounts may play this role in some PCs but restrictions are often imposed on withdrawing these funds (e.g., Mondragon where the accounts are blocked partially if a member leaves before retirement).

The basic result from the property rights approach is that PCs using internal funds only to finance capital will "under-invest" relative to comparable GFs (or PCs with tradeable shares) if a member's individual claim to the returns from these projects is not obtainable upon departure (voluntary or not) from the firm. As a corollary, workers will prefer external to internal funding because the former allows the cost of financing capital to be matched to the temporal path of the returns from the project (Pejovich 1973; Furubotn 1974). However, complete external financing (including bank borrowing) is not likely to be feasible. External financiers face the risk of default; thus, they consider carefully a potential borrower's credit worthiness. An equity stake held by agents capable of policing internal decision making is an important signaling device. For the workers, the risk of committing personal wealth to finance the firm's capital may be the cost they must bear to acquire decision-making rights (Ekkehart Schlicht and Carl Christian von Weizsacker 1977). According to Benedetto Cui (1985, p. 117):

worker-managers will be required to save and bear risks to a greater extent than subordinate workers. Their autonomy does have a cost.

To facilitate external financing, a non-voting equity-like instrument that earns dividends or profit shares and is sold at values reflecting expected future earnings has been proposed as an alternative to debt (Vanek 1970; Roger McCain 1977). However, an agency problem arises because investors are unable to install new decision makers if the workers are found to be appropriating the returns to capital (Jensen and Meckling 1979). Even if the workers' profit shares were directly related to the financiers' shares, "creative accounting" would allow the workers to augment their earnings at the expense of the financiers in situations of asymmetric (imperfect) information. Therefore, before providing external funds, investors are likely to require either some input into firm decision making or a premium that compensates for this risk.

To be sure simple PC theory considers capital as an input rented at a parametric rate but well-known agency problems and transaction costs render this stylization inappropriate for real-world PCs. The services of a concrete capital good, such as a hammer, cannot be accurately metered by an absentee owner so that the user will not have the appropriate incentive to husband the capital good economically (Alchian and Demsetz 1972). For idiosyncratic (for example, site- or user-specific) capital goods, a rental arrangement is a bilateral monopoly situation in which one party can expropriate the other's quasi-rents (Williamson 1985). Additional agency problems arise if wealth affects the willingness to bear risk. Relatively poor risk-averse worker-managers prefer projects with lower risk (and, thus, lower expected return) than those favored by wealthier financiers. Consequently, financiers prefer to invest in firms in which they can exercise more control (Herbert Gintis 1989).

Traditionally PCs have not sought funds from open capital markets. External financing has often been provided by sympathetic labor-movement sources or by quasi-vertical integration as consumer cooperatives have financed PCs in return for board representation. French law en-
ables external financiers to have minority representation on the board of directors but this is seldom the practice. Only the long-established PC's in the U.K. provide an example of continuing presence on the board of directors by networking members solely due to their financial contributions. PCs rely mainly on internal sources or sympathetic external sources for capital financing.

Given the underinvestment theme in the theoretical literature, several stylized hypotheses have been adopted in the empirical literature. PCs that rely substantially upon retained earnings for financing investment without providing individualized ownership rights in the resulting assets tend to be undercapitalized and may operate under increasing returns. Even when some individualized asset ownership attenuates this Fronebot-Pejovich-Venek underinvestment tendency, the practical necessity of some internal funding combined with worker risk-aversion and wealth constraints may lead to underinvestment. Therefore, PCs should have lower capital/labor and lower capital/output ratios than comparable CFs.

Using an all-PC sample from the British footwear industry, Jones and Beckus (1977) test the Venek hypothesis that PCs operate in the region of increasing returns. Both a generalized Cobb-Douglas production function and a Kmenta approximation to a CES production function are estimated and no evidence of increasing returns to scale is found until the sample is divided into subsamples of large (more than 100 workers) and small (less than 100 workers) PCs. Small PCs are discerned to operate under increasing returns and the coefficients in the two estimated equations are significantly different. However, the panel is small and there is no theoretical basis for assuming that PCs in different size classes will operate under different returns to scale (Frank Stephen 1984).

In paired samples of Danish bakery and construction firms, Donald George (1986) estimates the returns to scale parameter of a Cobb-Douglas production function. In both industries, the hypothesis that PCs operate in the region of constant returns to scale can not be rejected whereas CFs produce under decreasing returns to scale. Although Danish PCs do not produce in the increasing returns region as Venek predicted, they operate at higher scale elasticities than matching CFs. Other studies in which returns to scale parameters are estimated often exhibit implausible output elasticities and the interpretation of returns to scale is complicated by the inclusion among the set of regressors of a variety of institutional variables (Defourny, Estrosi and Jones 1988). Hence, there is little empirical evidence that PCs fail to exploit scale economies.

The degree of collective ownership of capital varies in their all-PC sample leading Jones and Beckus to test whether the Fronebot-Pejovich-Venek effect is stronger for PCs with a higher percentage of internal funding. The correlation of capital stock with the degree of collective ownership is negative and significant for the two subsamples (large and small firms) but only at the ten percent level. There are no significant correlations between the degree of collective ownership and the capital-labor ratio. In an indirect test of the underinvestment hypothesis using data on more than 500 French PCs from 1970-1979, Estrosi and Jones (1988) divide the explanatory variables of an investment equation into two categories, factors thought to influence investment in CFs (such as expected product demand) and factors stressed in theories of PCs as explanations of investment behavior (such as the extent of collective ownership, the availability of external finance, worker participation in decision making, and the time horizon of workers' members). For this all-PC sample, stas-
tical tests on the regression coefficients support the influence of the former and, except for the availability of external finance, reject that of most of the latter factors. Hence, no significant difference between factors explaining investment in French PCs and in CFs is found. Institutional explanations are offered to explain why French PCs would not act as modeled by Furobotn, Pejovich, and Varen so that this case may not be appropriate for testing that hypothesis. Nonetheless, no strong empirical support for the underinvestment hypothesis is found either in France or the U.K.

Comparing variable means without formal hypothesis testing, Hendrik Thomas (1982) finds that capital-labor ratios are not lower and have risen faster among the Mondragon group than in comparable conventional Spanish industrial firms. External financing is facilitated for Mondragon PCs by the financially strong supporting bank, Caja Laboral Popular. Furthermore, as in the French case, the decision to retain earnings for investment is governed not by voting but by internal rules that protect the viability of the PC from the possibility of myopic individual utility maximization. Although membership is marketable in the plywood PCs, some evidence of underinvestment arises in comparison with plywood CFs. PCs have significantly lower capital-labor ratios, significantly higher capacity utilization and nearly identical capital-output ratios (Berman and Berman 1989).

Swedish PCs have slightly higher capital-labor ratios than twin CFs (significant at the ten percent level) (Thordarson 1987). However, both types of firms have relatively low physical capital and relatively high human capital so that the technology is essentially a handicraft one. Among Danish bakeries and construction firms, PCs have significantly lower capital-labor ratios than CFs although for the latter group the significance level is only ten percent (George 1982). Underinvest-

ment in Italian PCs is suggested by fixed assets per worker that, when compared with comparable CFs, are about 30 percent lower in construction and about 37 percent lower in manufacturing PCs (Zevi 1982 and Bartlett et al. forthcoming). In the British footwear (or leather) and clothing industries, average investment per worker and average capital-labor ratios are lower in PCs than in CFs and average output growth was slower among the PCs than in CFs between 1948 and 1968 (Jones and Backus 1977).

Whether PCs in general fail to exploit scale economies and tend to invest less ceteris paribus than comparable CFs remains a question. The most pressing problem is a modeling one in that the theory lacks the intertemporal underpinnings necessary to inform fully solid empirical work. In this crucial respect, the property rights theory of PC investment is incomplete. The basis for the comparison of investment behavior between the PC and the CF is an investment project’s cash flow. However, from the perspective of the worker/member in a PC, incremental value-added (not the incremental profit used in cash flow calculations by a CF) is the relevant consideration. If investment projects require additional labor services due to input complementarity and these are not provided by hired workers but instead by new members in the PC, the two are not equivalent. Because new members share in decision making as well as in value-added, the effect on internal decision making (e.g., decisive coalitions) of adding new members must be considered. If theory progresses to a point where returns to scale and input elasticities can be estimated in well-specified investment functions based on intertemporal optimization, empirical work may

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10 Furubotn (1976) introduces these concerns for a Yugoslav-type PC but does not develop an intertemporal model.
corporate what is an intuitively appealing and recurrent theme: PCs have a difficult time accumulating capital without supporting financial institutions.

VI. Formation and Survival

The fundamental question of why so few PCs exist in industrial market economies encompasses factors influencing PC formation and survival. Beatrice Potter (1899), the future Mrs. Webb, asserted that PCs would "degenerate" inevitably with the passage of time into nondemocratic organizations due to restriction of membership and the use of hired labor. The idea of a full "life cycle" for PCs that begin as CFs is traceable to Mikhail Tugan-Baranovskii (1921). The scenario begins with an ailing capitalist firm faced with impending bankruptcy being turned over to the workers. For insurance reasons, risk-averse workers may willingly reorganize the failing CF even if they have alternative employment opportunities paying an uncertain wage that varies with labor market conditions (Miyazaki 1984). Issues of job security and relocation costs provide further rationale for this takeover. Debt is restructured with financiers (either old or new), workers participate in firm decision making and become part owners who accept wage cuts. If the newly organized PC avoids bankruptcy and begins to earn profits which are shared among the workers/members, a dissolution phase sets in and the firm completes its life cycle by reverting to the CF mode.

The PC has a tendency to transform into a CF because of the rent-seeking behavior of members who receive a profit share in excess of the going market wage paid for the type of labor service provided. To the extent that labor of equivalent quality is available in a competitive market for the going wage, replacing a member by a hired worker increases the profit share paid to all remaining members as the savings is shared among them. If all members are perfectly replaceable by hired workers, over time the PC becomes a single "member/owner" firm or CF (Ben-Ner 1988). Even if current members are not dismissed in order to increase the individual income of remaining members, those who leave voluntarily can be replaced with hired labor and the transformation proceeds at a slower pace.

Although some PCs are formed from unprofitable CFs, the majority of PCs in existence were created from scratch. Individual preference for democratic decision making in the workplace and concern over employment security promotes "births." Other aspects of the PC organizational form create an internal logic of formation (Ben-Ner 1988). Internal impediments include the lack of entrepreneurial talent, risk-aversion due to firm-specific income variation that cannot be diversified away, and a higher cost of capital because financiers are fixed with an unfamiliar organizational type, and because outside equity participation is adversely affected by moral hazard concerns. Internal advantages include better motivation, uninhibited flow of information about preferences, and broader scope for workers to choose governance rules and types of contracts. The internal logic argues that, when the former factors are less (more) important than the latter ones, PCs will form (not form), other things being equal.

The ceteris paribus assumption is particularly fragile because the external economic environment interacts with internal factors to influence PC formation. The aggregate business climate affects the formation of PCs and CFs differently. Economic growth generates an increase in workers' incomes that leads to an increase in savings available to finance worker equity, a decrease in risk-aver-
sion according to the usual axioms, and an increased desire for participation in decision making and control over working conditions if both are normal goods. On these counts, aggregate economic expansion encourages PC as well as CF formation. However, in recessionary periods, the costs of job search and relocation are increased due to depressed labor markets, hence PCs may be an appealing alternative to temporary unemployment. Depending on the strength of the countervailing tendencies, PC formation may or may not exhibit a cycle that is systematically either in or out of phase with the business cycle.

The birth of a PC depends on a combination of the internal logic and external influences; the pattern observed is one of waves which are longer than business cycles. To the extent that the availability of initial financing and venture capital is restricted due to lack of knowledge about the PC form, an informational externality would help to explain the longer waves of formation (Ben-Ner 1988a). The thinness of the PC sector in the U.S. and West Germany is partially explainable by incomplete and inaccurate information about PCs in financial markets (Michael Conto 1986). PC sectors are more prominent in Italy, France, and the U.K. where supporting organizations provide information about PCs, thus decreasing uncertainty for potential investors. Consequently, PC births may be bunched temporally due to an informational externality that influences the financial community’s perception of PCs.

Using annual time series data on the number of PCs formed in the U.S. between 1820 and 1960, Conte and Jones (1985) find no significant correlation between the aggregate unemployment rate and PC formation. Rather the data show PCs forming during both expansionary and contractionary periods. Examining trends through the 1970s, Ben-Ner (1988b) concludes that PC formation was higher than CF formation under economic conditions of high unemployment and stagnation. Because waves of PC formation that are longer than business cycles are observed in the data but, at the same time, PCs do seem to provide a relatively attractive option during hard economic times, the construction of an integrated theory to explain these stylized facts is needed.

Turning to demise, a PC ceases to exist (death) if the firm fails economically or if it is transformed into a CF because of its financial success. Some PC deaths may be attributable to ill-conceived government policies that encouraged formation in sectors and situations when the internal logic did not warrant a PC birth. Case studies present evidence on the survival of PCs without any statistical analysis. The Mondragon group has an excellent survival record with practically no demise (William Whyte and Kathleen Whyte 1988; Bradley and Gelb 1987). Long-established PCs in the U.K. have a greater capacity for survival than comparable CFs (Jones 1975). The Hoedads reforestation PCs in the U.S. have persisted in their cooperative form (Gunn 1984). Recently formed PCs in the U.K. have “good” rates of survival when compared with CFs (Chris Cornforth 1983). Data on all U.K. PCs indicate that survival rates were better for PCs than CFs in the second half of the seventies but worse in the first half of the eighties (Cornforth et al. 1988). On the other hand, case studies of U.S. PCs describe transformation in both taxi-driving and refuse collection (Raymond Russell 1985), in the plywood cooperatives (Gunn 1984; Katrina Berman 1967) and in now-defunct PCs such as barrel-making (Jones 1979).

In the empirical research, both transformations and demises are combined to determine death rates as a percentage.

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of total PCs (hazard rates). For several different countries and time periods, Ben-Ner (1988b) compares death rates of PCs with those of CFs (whose death rates include transformations into PCs) and the evidence indicates that PCs are at least as sturdy as CFs. For 20% PCs formed in Atlantic Canada between 1940-1957, Udo Staber (1989) examines the correspondence between failure rates and the age of the firm. PCs are found most likely to fail during the fifth year, a result that is in sharp contrast with studies for CFs in North America where failure rates are higher for firms in the first two or three years of their existence. In comparison, with data reported in other studies, death rates are found to be lower for PCs than CFs.

In an attempt to identify the factors contributing to viability of French PCs, Virginie Pérotin (1987) divides those in existence in 1978 into two groups, firms that would close during the period 1979-1982 (44) and PCs that survived (496) through 1982. Transformed firms seemed to survive better than those born anew as only 20 percent of the former died as compared with a 25 percent death rate for all firms. In tests for significant differences between the means, surviving PCs were found to have significantly more financial participation by workers than those that did not survive. Strong correlations were found between many of the financial variables and survival, raising an important issue of unraveling cause and effect.

Both the theoretical and empirical literatures leave many unanswered questions. What explains the observed industrial clustering of U.S. PCs in barrel-making, metal foundries, shingle-makers, and plywood manufacturing? In what type of industries should we expect to see PCs form? Under what circumstances are PCs likely to form as new organizations (de novo births)? Are there reasons to expect that a PC formed from an ailing CF (transformation) is more likely to survive than one formed from scratch? Given the lack of testable hypotheses, econometric work is disadvantaged but some progress is possible.

Theory suggests that we should find a higher concentration of PCs in industries that exhibit more pronounced cycles so that members can partially insulate themselves against employment risk. Many of the industries in which we find relatively high concentrations of PCs are strongly cyclical (e.g., plywood and construction). Theory also leads us to expect a decreasing percentage of members to workers over time in successful PCs if the members can hire nonmember workers who are as productive and motivated as members and if the newly hired workers can not obtain membership rights easily (Ben-Ner, 1984). Of the PCs considered in this essay, only the U.S. plywood PCs might fulfill both conditions. Craig and Peremace (1992) provide data on membership as a percentage of employment for fourteen plywood mills in Oregon and Washington in seven of the years during the period 1958-1982. Of the eleven PCs with enough annual observations to discern a trend, seven experience a decline.

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20% For PCs, the average death rate from 1970-1983 in France was 8.9%, from 1970-1983 in the U.K. it was 8.5%, and in Italy it was 8.5% in a sample including 1972 and 1975-1981. Ben-Ner found comparable data for CFs in France and the U.K. only. From 1974 to 1982, the average death rate (including transformations to PCs) in all industries in the U.K. was 10.5%. In France, the same statistic was 10% in manufacturing from 1970-1980 and 4.5% for firms with more than 100 workers from 1970-1981. In an earlier period, 1660-1686, the average death rate for U.S. manufacturing CFs was 13.8%. From Hazard (1959), rates calculated for over one million U.K. CFs "born" during the period 1974-1982 and about 1300 U.K. PCs born from 1974-1986, Ben-Ner concludes that the probability of death is greatest at about age 3 in both groups but that hazard rates are higher for CFs than PCs at every age.
in membership relative to employment.

Although French PCs have hired non-member workers, these hired hands may become members by purchasing a single capital stake. Because this does not seem to be a serious impediment to membership, we might observe higher (rather than lower) percentages of members to workers in successful French PCs as hired workers seek to invest in a profitable venture and obtain more job security. Using cross-sectional data for the 541 French PCs in existence in 1979, Estrin and Jones (1992) find a positive significant correlation between the percentage of members to workers (the membership ratio) and earnings, other things being equal. These authors also discover that the membership ratio is likely to decline during the early years but then increase in later years for successful PCs. Due to the ease of obtaining membership in French PCs, these results are not inconsistent with the theory of transformation.

One explanation for the almost-complete mismatch between theory and empirics in this area is that the factors influencing the formation and survival of PCs can not be separated from the topics in the preceding three sections. Employment security must be an important reason why some workers group together to form (or join) a PC. Incentives leading workers to exert more individual effort and to work more productively as a group must affect positively the survival of any production unit. Without sufficient sources of financing, no firm is viable. Given these interrelationships and the early stage of development of the theoretical and empirical literatures on formation and survival of PCs, to expect much in the way of an answer to the fundamental question of why so few PCs exist in Western industrial markets may be overly optimistic.

VII. Conclusion: The Meeting of the Twain?

The sequencing of the four previous sections reflects our assessment of the extent, from smaller to larger, of the existing gaps between the theoretical and empirical literatures within each area. Despite the increasing amount of (human) resources devoted to empirical work on PCs, the need for panels of firm-level data for PCs and CF twins over a reasonable number of years remains a stumbling block. To support future empirical work, more resources should be devoted both to data collection and to theoretical work informed by factual knowledge of existing PC forms. To identify the next steps in bringing the twain closer for each topic, we apply the three properties of our ideal empirical experiment, namely, isolation of the characteristic of interest, proper measurement of the important variables, and testing hypotheses from well-specified theoretical models.

Refinements of Ward’s simple theory indicate that PCs maintain stable employment (and output) in the face of variations in output price. The empirical literature finds relatively inelastic supply responses in PCs and supports the inclusion of employment, along with earnings, in the PC’s objective function. If PCs offer relatively stable employment, then the return to labor must be more flexible and more reflective of product market conditions than the relatively stable wage paid in the CF. Empirical comparisons of the variability of employment and the variance of earnings between PCs and CFs under strict ceteris paribus conditions are suggested. Finding appropriate data to quantify the dividend of PC theory is often difficult in practice, especially when member’s earnings combine current wages and deferred compensations.
(measurement problem). Nonetheless, the twain are most likely to meet first in tests of well-specified employment equations.

Organization theory suggests links between profit sharing and enhanced worker productivity while incentive theory focuses on the deleterious effects of free-ridding in a sharing situation when individual effort is not observable. Empirical work using data sets having PCs only finds positive relationships between the degree of profit sharing in a PC and productivity. However, studies using mixed pairs have been inconclusive. If more diligent workers choose to join PCs, selection bias (isolation problem) is a serious impediment to empirical work using mixed pairs. Hence, a theoretical foundation for analyzing the (separate) effects of varying degrees of worker participation in decision making, profit sharing, and financing in a PC is required to close the existing gap.

Property rights theory predicts underinvestment in PCs relying on self-financing but the empirical literature contains no econometric support for this hypothesis. Existing theory is not explicitly intertemporal and does not use the appropriate measure for comparing PCs and CEs (modeling problem). Although the existing evidence is sparse, PCs tend to operate with lower capital-labor ratios than comparable CEs. The explanation for, and the robustness of, this stylized fact await tests of well-specified PC investment functions based on appropriate cost of capital schedules.

Understanding the formation and viability of PCs is crucial to addressing the fundamental question with which we introduced this review. PC formation occurs in waves of longer duration than business cycles. Once in operation, PCs appear to be at least as sturdy as CEs. Yet PC life cycle theory provides no foundation for empirical tests of these observed characteristics. It is necessary to look to the topics already discussed for theoretical guidance. Some PCs insist on micro or promote employment. Others are born to provide an environment in which workers can interact in a nonalienated way to facilitate cooperative behavior and to share in the resulting productivity of the firm. However, if growth is stunted and PC viability is impairs, if capital financing is not available on reasonable terms. Before much headway (either empirical or theoretical) can be made on PC formation and viability, such interrelationships must be accounted for more fully.

Why are there so few PCs in industrial market economies? Workers' concerns about conditions in the workplace are likely to be multidimensional. Even though the public good character of these conditions is an argument in favor of participatory governance, heterogeneity of preferences may explain why worker control is rare except in small cooperatives with unusually homogeneous workforces. Yet some attributes of PCs (notably profit sharing) appear to improve organizational performance (productivity) and argue for an increase in PC-like firms.

The weight of the theoretical reasoning and evidence surveyed convinces us that the explanation of the relative scarcity of PCs lies in the nexus between decision making and financial support. Worker control requires (at least partial) worker-ownership for incentive reasons but the latter conflicts with the worker's desire to hold a relatively low-risk diversified portfolio. External financiers with no direct control of company governance will not commit significant funds without receiving a substantial premium to reflect the risk involved. Hence, worker-controlled PCs have difficulty finding internal sources and competing with CEs for investment funds. To be true to the spirit
of this paper, however, we acknowledge the need for research to distinguish between this and competing explanations, such as those focusing on collective choice or incentive issues.

Paucity in numbers aside, PCs exist and sometimes even thrive in market economies. The issues dealt with transcend the scope of the research surveyed. For example, virtually all of the privatization proposals in the transforming economies of Central Eastern Europe and the Commonwealth of Independent States incorporate some provision for employee ownership of large firms. During the 1980s, worker participation in decision making increased in these countries as part of the attempted reforms to decentralize the old command system. The role to be played by workers in the transformed firms of these emerging market economies is a hotly contested issue. Arguments put forth against worker ownership often rest on an ignorance of the results that we have surveyed. Although PCs are no panacea, evidence exists to suggest that worker participation does have a role to play in industrial mixed market economies.

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