Horizon Problems and Property Rights in Labor-Managed Firms

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The Furubotn–Pejovich horizon problem arises from the lack of any recoupable claim on the equity in Yugoslav-type social-property LMFs. This problem has been solved by the system of internal capital accounts of the Mondragon-type individual-equity LMFs. The worker's profit rights are contingent on working in a LMF, so a Jensen–Meckling-type residual horizon problem might remain even in an individual-equity LMF. But property-theoretic analysis shows that the basic difference with a capitalist firm lies in contractual opportunities, not property rights. Capitalist owners may hire future workers; members of a LMF may not. *J. Comp. Econ.*, March 1986, **10**(1), pp. 62–78. Boston College, Boston, Massachusetts 02167 and Industrial Cooperative Association, Somerville, Massachusetts 02144. © 1986 Academic Press, Inc.

THE FURUBOTN–PEJOVICH HORIZON PROBLEM

Most of the economic literature on labor-managed firms (LMFs) has either assumed a capital structure like the Yugoslav self-managed firms or has not modeled the capital structure of the LMFs (see Bonin and Putterman, forthcoming, for a survey of the economic literature). In the Yugoslav-type LMFs, there are no individualized claims on the net worth of the firm. The equity is treated as social property. Cooperatives incorporated as nonprofit corporations and the common-ownership firms in England have similar capital structures with no recoupable claims on equity.

Furubotn and Pejovich (1970) have analyzed certain economic problems that arise in these social-property LMFs. With no recoupable claim on retained earnings, the incentive is to distribute all earnings and then attempt to finance all investment by borrowing. Capital-maintenance requirements, credit shortages, and government controls may nevertheless induce the direct reinvestment of earnings. Durable assets purchased with the reinvested earnings can only be used by the workers during the tenure of their work in the firm. The treatment of the reinvested earnings as social property would not penalize those workers if they all remained with the firm long enough to completely depreciate the purchased assets. But labor horizons differ. Workers who leave the firm before the asset is depreciated are forced to "forfeit" the undepreciated portion of the asset, which they nevertheless "paid for" with their reinvested earnings. This inability to recoup the reinvested equity and the resulting dilution of investment incentives is the Furubotn–Pejovich horizon problem. Another residual horizon problem will be considered later.

Capital-Maintenance Requirements: Not a Solution

The Furubotn–Pejovich horizon problem does not arise if there is no equity to recoup, i.e., if all the assets are financed by (renewable) debt so the net worth is zero. But this pure-rental or 100% external-financing solution is largely a theoretical construction. For a variety of reasons, it is neither realistic nor advisable to finance a firm with 100% external renewable debt.

The pure-rental solution has, nevertheless, had a role in the debate. The rental (net of maintenance) on a durable asset is composed of the interest and depreciation charges. It is sometimes argued that a capital-maintenance requirement of enforcing interest and depreciation charges on social property is equivalent to the pure rental solution to the Furubotn–Pejovich horizon problem. By deducting the interest and depreciation charges from the workers' labor income, the workers are paying the rent for the social capital.

The flaw in this argument is uncovered by considering the source of the social property. Any internal net investment of surplus labor income (i.e., after interest, depreciation, and other expenses) invalidates the pure-rental assumption of 100% external financing. The workers who could have otherwise distributed that labor income were the source of that "social property." And should the workers leave before the purchased assets are completely depreciated, they still forfeit the undepreciated portion of the assets they financed.

Internal Capital Accounts: A Solution

A hypothetical variation on the pure-rental LMF might be obtained with the cooperation of a local bank. Instead of retaining a certain amount of earnings, a LMF distributes the earnings to the members on the condition that the money is deposited in savings accounts in the local bank. Then, by prearrangement, the bank loans the earnings back to the firm. By this circuitous route, the LMF is indirectly self-financing its investment but without the horizon problem since the workers retain their claim on the principal in the savings accounts. They can eliminate the bank by moving the "savings accounts" directly into the LMF. This is one way to conceptually arrive at the capital structure of internal capital accounts.

The system of internal capital accounts was not developed to resolve the Furubotn–Pejovich horizon problem. This capital structure was developed

in the 1950s by the Mondragon group of cooperatives in the Basque region of Northern Spain (Thomas and Logan, 1982; Ellerman, 1984b). The Mondragon development shows that the internal capital-account solution is, unlike the pure-rental example, a practical institutional structure. Many observers consider the Mondragon group to be the most successful cooperative complex in the world today.

The Mondragon capital structure has also been adapted for use in American worker cooperatives. Many worker co-ops in the United States use a set of by-laws that establish a system of internal capital accounts, e.g., ICA (1984). A special incorporation statute for worker cooperatives with internal capital accounts was passed in Massachusetts in 1982 (see Ellerman and Pitegoff, 1983) and parallel statutes have since been passed in four other states: Maine, Connecticut, New York, and Vermont.

In a worker cooperative with internal capital accounts, there is one capital account for each current member. The sum of the balances of the capital accounts equals the equity on the balance sheet of the cooperative. The capital accounts bear interest. After subtracting interest, the remaining retained net income, positive or negative, is allocated among the accounts in accordance with the labor of the members during the fiscal year. Thus the internal-capital-account balances are automatically adjusted upwards or downwards so that the balance sheet balances at the end of each fiscal year. For the purposes of theoretical modeling, it should be assumed that the firm uses accounting according to economic principles (see, e.g., Ellerman, 1982) so that the balance-sheet net worth equals the economic value of the assets minus the liabilities.

The internal capital accounts cannot be paid out upon demand. During the tenure of an individual's work and thus membership in the cooperative, it is important that a substantial balance remains in the member's account. This balance serves as a "commitment mechanism" (Schlicht and von Weizsäcker, 1977) and as a "damage deposit" to absorb possible future debits. When the individual terminates work and thus membership in the cooperative, the account is closed.

There are several methods of paying out the accounts. The simplest for the purposes of theoretical discussion is to assume the departing worker is paid in perpetual bonds or consols for the closing balance in the account. The worker can hold the bonds and collect the interest, or sell the bonds in a market for debt securities. The firm can also retire the debt by repurchasing the bonds. In the presence of uncertainty, cooperatives could pool the risk of default by issuing the bonds through a financial intermediary.

A labor-managed firm with the capital structure of internal capital accounts will be called a *Mondragon-type worker cooperative* or an *individual-equity LMF* in contrast to the social-equity Yugoslav-type LMF and the no-equity pure-rental model (see Ellerman, 1984a). The balance in the capital accounts is owed to the members. The members own the accounts as property rights,

like the depositor's ownership of a savings account in a bank. If a member dies, the balance owed the worker, repackaged as a bond, passes to the estate.

Jaroslav Vanek has advocated 100% external financing (the pure-rental model) as a solution to the Furubotn–Pejovich horizon problem. But Vanek has also noted that the problem is solved with "individualized redeemable internal funding" (Vanek, 1975, p. 453). However, Vanek refers to these "redeemable savings deposits of members" as "external funding" (p. 445) which has caused some confusion in the literature. The reinvestment of earnings through internal capital accounts is internal self-financing.

The Residual Horizon Problem

The Furubotn–Pejovich horizon problem arose from the inability of workers in a social-property LMF to recoup the unexpensed principal of their retained earnings. But some writers, such as Jensen and Meckling (1979), have suggested a more general horizon problem for LMFs since a worker's claim on future cash flows is partly or wholly contingent on work in the firm. Does the system of internal capital accounts solve this more general horizon problem? Does a LMF with capital accounts still suffer from an unavoidable attenuation or truncation of property rights in comparison with a conventional capitalist corporation?

This residual horizon problem turns out to be surprisingly deep. The resolution of the question requires not a better understanding of LMFs, but new insights into the property structure of conventional corporations. And that requires reexamining the foundations of capital theory to understand which property rights are and are not part of the ownership of a capital asset. The surprising result is not that an individual-equity LMF has more property rights, but that a conventional corporation has less property rights than is ordinarily thought. The existing property rights at any point in time are quite comparable in the two types of firms. The real difference is that the capitalist corporation can hire wage workers; the members of a LMF cannot. That implies a difference in the appropriation of future rights. The development of these arguments requires a number of new concepts from property theory, and a number of reconceptualizations that differ from the conventional point of view.

APPROPRIATION IN PROPERTY THEORY

How is it that one legal party rather than another owns the product of a given production process? Consider a technical description of a specific production process. A specific set of people perform certain labor services that use a given plant and machinery and various other materials to produce certain outputs. But that process is not just a technical activity; it is embedded in a matrix of legal institutions of property and contract. This surrounding set of legal structures will determine which legal party owns the product. But how?

What is the legal mechanism or right that determines who owns the product? The "standard" answer is that the right to the product is included in or attached to the ownership of some asset. The rights to use an asset, the use-rights, are distinguished from the *right-to-the-product* or *right-to-the-fruits*.

> When an individual has legally sanctioned rights to use an object or claim as he pleases, he has a right of *ownership-utilization* over it (*jus utendi* in Roman law). When he is permitted by the laws of the ruling organization to dispose of or consume its products, he has a right of *ownership-over-the asset's-products*, or *jus fruendi*. (Montias, 1976, p. 116)

The assumed legal institutional setting is a private-property market economy. In such an economy, this so-called "right-to-the-fruits" does not exist as a legal right separate from the use-rights. The ownership of the product is determined by the use-rights together with a certain legal-fact pattern. The "right-to-the-fruits" is only a shorthand way to refer to the appropriate fact pattern (described below).

The point can be easily seen by considering the abstract economic description of a production process. Let direct materials, labor services, and the services of capital be the inputs needed to produce the outputs of a production process specified by a given production function. There are numerous ways this technical production process could be legally organized in a market economy. The owner of any one of the inputs could purchase the complementary inputs, e.g., the owner of the direct materials could hire the capital and the workers. Or another party entirely could hire the capital and the workers, and could purchase the direct materials. In any case the party who hired the inputs, the *hiring party,* would bear the costs of the input services and materials used up in the production process. Assuming those were all the required inputs, that hiring party would have the defensible legal claim on the produced outputs. That is the *market mechanism of appropriation.*

When the owner of one of the inputs A (e.g., capital) acquired the other inputs B and laid claim to the product, it is sometimes said that the ownership of the nonmarketed input A included the "right-to-the-fruits." But this claim is easily refuted by considering a rearrangement of the use-rights. Let the owner of B hire A instead of vice versa. Then the new hiring party (the owner of B) could lay claim to the product without having purchased any so-called "right-to-the-fruits." It was sufficient to purchase the use-rights, i.e., to hire (or already own) all the factors used in production. The ownership of the new nonmarketed input (input B) does not suddenly incorporate the elusive "right-to-the-fruits." In each of the cases, a party claimed the outputs because the party had borne the costs of the inputs consumed in production. The usual "right-to-the-fruits" is a somewhat misleading way to refer to that fact pattern.

The uncritical acceptance of the right-to-the-fruits concept has led to a neglect of the whole topic of property appropriation in economic theory. If the right to the product was part and parcel of the ownership of certain assets, then the product was not "appropriated"; it was preowned by the asset owner.

To find appropriation, under that theory, one would have to trace the ownership of assets back in a regress to some Lockean original state—long since enveloped in the mists of the past. The initial or original distribution of factor ownership is considered in the models used in welfare economics, but these models do not even recognize the occurrence of appropriation in *all* the production that follows the initial distribution of factors. The question of property appropriation has simply not been a live topic in economic theory.

THE DISTRIBUTIVE-SHARES METAPHOR

Prior to the neoclassical marginalist revolution, the structure of property rights was considered part of political economy (e.g., J. S. Mill's *Principles of Political Economy,* especially Book II, Chaps. I and II, "Of Property" and "The Same Subject Continued"). There has been a recent revival of interest among economists in property rights, e.g., in the work of Alchian, Coase, Demsetz, Furubotn, Pejovich, Williamson, and many others (e.g., Furubotn and Pejovich, 1974). This work will be referred to as the *economics of property rights* literature. The conventional economics of property rights has no rigorously specified theory of property appropriation in production. The literature is informal and largely metaphorical; it often uses the methodology of "*as if.*" It is "as if " the firm was a "coalition" of factor suppliers each contracting for a share of the product with the entrepreneur as the residual claimant (e.g., Alchian, 1984). It is "as if" piece-workers were selling their product (e.g., Cheung, 1983). It is "as if" employees with "profit-sharing" joined the entrepreneur in getting a share of the residual profits.

The core metaphor is the *distributive shares metaphor,* which pictures the factor owners as getting shares in the product. Income is pictured as being distributed within a firm "as if" each factor supplier had a contractual claim on a fixed or variable share of the product. In the usual treatment of marginal-productivity theory, each factor is pictured "as if" it "produced" and then "received" a share of the product. It is "as if" all this were the case, but what is actually the case?

As a description of *property rights,* the distributive-shares picture is quite misleading and false. The simple fact is that one legal party, such as the employer in a capitalist firm, *owns all the product.* For example, General Motors does not just own "capital's share" of the GM cars produced; it owns all of them. There is no need to view the product ownership as being "distributed" to account for the factor incomes. Property can take either a positive *or negative* form as assets or liabilities, i.e., as property rights or obligations. By "product," economists mean only the positive product, the output assets produced in production. But there is also a *negative product.* To produce the output assets, it is necessary to incur the liabilities for using up the inputs. And one can "own" or hold liabilities just as one can own assets.

The simple fact that accounts for the other factor incomes without the benefit of the distributive-shares metaphor is the fact that the one party who owns all the positive product also owns all the negative product, i.e., also holds all the liabilities for the used-up inputs. General Motors not only owns all the GM cars produced but also holds all the liabilities for the factors such as steel, rubber, glass, and labor used up in production. The money paid out to satisfy these liabilities represents the costs of production. The suppliers of the steel, labor, and other factors, *instead* of being joint claimants on the product, are only creditors of that one party who owns all the positive and negative product. One party owns all the outputs but that party does not receive its value in gross terms since that party must also satisfy the liabilities for the inputs.

The Whole Product

In order to accurately describe the structure of property rights in production without the benefit of the distributive-shares metaphor, it is necessary to expand the usual concept of "product" to include the negative product (input liabilities) in addition to the usual positive product (output assets). This bundle of property rights and obligations will be called the *whole product*, i.e.,

$$\text{whole product} = \text{output assets} + \text{input liabilities}.$$

If the output $Q = F(K, L)$ is produced using the capital services K and the labor services L, then the positive product is the vector of output assets $(Q, 0, 0)$, the negative product is the vector of input liabilities $(0, -K, -L)$, and the whole product is the sum $(Q, -K, -L)$:

$$\text{whole product} = \text{positive product} + \text{negative product}.$$

$$(Q, -K, -L) = \quad (Q, 0, 0) \quad + \quad (0, -K, -L)$$

In property theory, as opposed to price theory or value theory, the notion of the whole product replaces the notion of the residual. There is no quantity residual: only a value residual. One cannot subtract the liabilities for the used-up inputs of steel, glass, and rubber from the output of cars to obtain a property residual. The vector notion of the whole product is needed to deal with the property rights and obligations whose net value is the residual profit. Technically feasible whole-product vectors are the production vectors used in the modern production-set representation of technical opportunities. A whole-product vector is also called a "production-possibility vector" (Arrow and Debreu, 1954, p. 267), an "activity vector" (Arrow and Hahn, 1971, p. 59), a "production" (Debreu, 1959, p. 38), or an "input-output vector" (Quirk and Saposnik, 1968, p. 27).

Given a production activity, the legal party who legally appropriates the whole product of the production activity will be called the *firm*. The descriptive question of who is to be the firm is answered by the market mechanism of appropriation. The whole-product appropriator is the party who hired (or already owned) the inputs and assumed those costs as the inputs were used up in production and thus could lay claim to the produced outputs. Hence the determination of who is the firm, i.e., who appropriates the whole product, is based on the *direction* of the hiring contracts. If Capital hires Labor, then Capital is the firm. If Labor hires the capital, then Labor is the firm. If some third party (such as an entrepreneur or even the State) hires both the capital and workers, then that third party is the firm. Hence the determination of who is to be the firm is decided in factor markets by *who hires what or whom.*

CORPORATE OWNERSHIP IS NOT THE "OWNERSHIP OF THE FIRM"

When the appropriation of the whole product is implicitly considered in the theory of the firm, the pattern is to construe the right to the whole product as being part of a preexistent property right. In its commonest form, this property right is called the "ownership of the firm." We have defined the word "firm" to be the party who ends up appropriating the whole product:

$$\text{"firm"} = \text{"whole-product appropriator."}$$

The identity of the firm (in this technical sense of whole-product appropriator) is determined not by some preexistent property right such as the so-called "ownership of the firm," but by who hires what or whom.

Economists sometimes use a rather abstract version of the "ownership of a firm." Technical production possibilities are represented by a production function, a production set, or a "production-opportunity locus" (Hirshleifer, 1970, p. 124), and then economists speak of the "owners" of these technical possibilities, e.g., the "owners of the productive opportunity" (Hirshleifer, p. 125). But there is no such ownership right. The lack of attention to property-theoretic questions in price theory is illustrated by the postulation of this peculiar "ownership" of a mathematical description of technically possible production opportunities such as a production function or a production set.

The notion of "ownership of a production set" is probably intended as an abstract version of the ownership of a corporation. But, a corporation is an owner of certain factors such as physical and financial capital. The legal process of incorporation is not a philosopher's stone that miraculously transmutes the ownership of capital assets into the ownership of a production set. The ownership of a corporation is only the indirect ownership of certain resources; it is not the "ownership of the firm." There is no "ownership of the firm." Being the firm is a contractual role, not a property right.

The Imputation Fallacies of Capital Theory

The general form of the argument is as follows. Broadly speaking, economic resources have two types of uses, active and passive. A resource is used *passively*

when it is sold or rented out in return for some market price or rental. A resource is used *actively* when, instead of being evaluated directly on the market, it is used up in production, usually along with other resources. Then the liabilities for the used-up resources and the rights to any produced assets are appropriated. Thus appropriation is involved in the active use, not in the passive use of resources.

Difficulties arise in the conventional treatment of the active case, since economics tends to ignore appropriation. The economic return in the active case is not just the value of the original resource but the extra value of the appropriated property. But the total return in the active case is mistakenly imputed only to the original resource, as if the ownership of the appropriated property were already included in ownership of the original resource. Property that is appropriated cannot be previously owned; otherwise it could not be appropriated. The extra value of the appropriated property (e.g., the whole product) is not a return to the original resource. In the context of the market appropriation mechanism, it is a return to the contractual role of being the hiring party.

The Capitalized Value of an Asset

The primary *imputation fallacy* in capital theory is the basic definition of the *capitalized value of an asset*. The definition is usually stated in a rather general fashion; owning the asset "yields" a future income stream, and the discounted present value of the income stream is the capitalized value of the asset. But there are quite different ways in which "owning an asset" can "yield" an income stream. There are the active and the passive uses of capital. The capitalized-value concept is unproblematic in the passive case where the income stream is the stream of rentals plus the scrap value. For purposes of illustration, let r be the constant interest rate, and let

$$A(n, r) = 1/(1 + r) + 1/(1 + r)^2 + \cdots + 1/(1 + r)^n$$

be the present value of an ordinary annuity of one for n years with the interest rate r per year. Consider a capital asset that has the market price *cost*, which yields K units of capital services per year, and which has the salvage or scrap value of S after n years. If the capital services rent for R per unit, then the discounted present value of the rental plus salvage stream is

$$A(n, r)RK + S/(1 + r)^n.$$

Competitive arbitrage between buy and lease markets would enforce equality between the market cost of the asset and that rental plus salvage stream:

$$\text{cost} = A(n, r)RK + S/(1 + r)^n.$$

Bonds and annuities provide similar examples of income streams generated by renting out or loaning out capital assets, i.e., by the passive use of capital.

Capital theory would be somewhat less controversial if it stuck to such examples of hired-out capital. However, the capitalized-value definition is also applied to the quite different active case where, instead of hiring out the capital, labor is hired in and a product is produced and sold. The present value of the stream of net proceeds is then called the "capitalized value of the capital asset" as if to impute the net proceeds to the capital asset. Assume L units of labor are hired in at the wage W. Using K units of capital services from the capital asset per year, the outputs Q are produced and sold at the unit price P. The so-called *capitalized value of the capital asset* is the discounted present value of the net proceeds (and salvage value):

$$\text{value} := A(n, r)(PQ - WL) + S/(1 + r)^n.$$

Each year the whole product $(Q, -K, -L)$ is produced and sold in return for the

$$\text{profit} := (P, R, W)(Q, -K, -L) = PQ - RK - WL.$$

The discounted present value of the profit stream is called the

$$\text{goodwill} := A(n, r)(PQ - RK - WL) = \text{capitalization factor*profit}.$$

The "capitalized value" of the asset can be analyzed into the stream of implicit rentals on the capital assets (including scrap value) *plus* the so-called "goodwill," which is the present value of the future appropriated whole products:

$$\text{value} = A(n, r)RK + S/(1 + r)^n + A(n, r)(PQ - RK - WL)$$

$$= \text{cost} + \text{goodwill}.$$

The rentals are the return to the capital asset; the whole products are the return to the contractual role played by the capital owner (when the capital is used actively). The rights to the whole products are not part of the rights to the capital asset; the whole products are appropriated.

The capitalized-value definition overlooks appropriation. One might then think that by purchasing the asset or the "means of production," one is thereby purchasing the outputs and the net proceeds—so there is no need to appropriate the outputs.

When a man buys an investment or capital-asset, he purchases the right to the series of prospective returns, which he expects to obtain from selling its output, after deducting the running expenses of obtaining that output, during the life of the asset (Keynes, 1936, p. 135).

But in fact he thereby purchases only the asset. Any further return will depend on his contracts. If he rents out the asset and sells the scrap, then he receives only the rental-plus-scrap income stream. If, instead, he hires in labor, bears the costs of the used-up labor and capital services, and claims and sells the

outputs, *then* he receives the net proceeds mentioned by Keynes. In each case, he owned the asset. The difference lies in the pattern of the subsequent contracts. By making the contracts so that one was the hiring party, one could additionally appropriate the whole product each time period with its positive or negative value. The capitalized-value definition fallaciously imputes the value of the appropriated whole products to the capital assets rather than to the contractual role played by the capital owner.

The Value of a Corporation

The capitalized-value definition is then applied to a corporation. A highly simplified model of production in a manufacturing corporation will be used with the simplest nontrivial assumptions. The corporation repeats the same productive operations each year. No new shares are issued and no old shares are redeemed. The dividends of div are declared and distributed at the end of each year. The owners of the corporation receive the steady stream of dividends div. The value of the corporation is the discounted present value of the stream of dividends. Let r be the constant interest rate. With constant dividends, the value of the corporation will also be constant in some amount V. Using the capitalization formula for perpetuities, we have

$$\text{value of a corporation} = v = \text{div}/r.$$

More complex versions of this *stream of dividends formula* for the value of a corporation can be found in the literature (e.g., Miller and Modigliani, 1961, formula (14); Fama and Miller, 1972, p. 8; Ellerman, 1982, Chap. XII, Sect. 4).

On the corporation's balance sheet, the principal items are the fixed assets, which we take to be a machine, and a debt in the amount D. The debt is perpetually maintained with only an annual interest payment of rD. The machine is the only balance sheet asset. The produced outputs Q are available at the end of the year, are sold, and all payments (including dividends) are made immediately, so there is no need for any inventories or cash holdings.

In a year's use, the machine yields K units of capital services. Let M be the maintenance costs expended in using the machine for a year. Let C be the price of a machine in new condition, and let C' be the price after it has been used a year. Thus the economic depreciation is $C - C'$. The depreciation can be thought of as the amount of the machine used-up each year. We assume that the (gross) investment of the amount $C - C'$ will restore the machine to the original condition.

There are two ways to obtain a year's services from the machine. Rent it for a year, or buy it, use it, and resell it. If R is the (gross) price per unit of capital services, then the gross rent is RK, while the net rental is the gross rental minus the maintenance. The alternative to paying the gross rental is

to borrow C dollars, purchase the machine, use it, pay the maintenance M, resell it for C', and then pay off the loan with $(1 + r)C$. The net amount paid at the year's end is

$$(1 + r)C - C' + M = (C - C') + rC + M$$
$$= \text{depreciation} + \text{interest} + \text{maintenance}.$$

The rent or buy options are two ways of legally packaging the same real services, K units of capital services per year. Hence arbitrage between competitive markets for renting and for buying machinery would enforce the equation:

$$RK = (C - C') + rC + M$$
$$\text{gross rental} = \text{depreciation} + \text{interest} + \text{maintenance}. \qquad (1)$$

Let GBV and NBV be, respectively, the gross and net book value of the corporate assets. If the machine is the only balance-sheet asset, then GBV = C so the *balance-sheet equation* is

$$\text{assets} = \text{liabilities} + \text{net worth}$$
$$C = D + \text{NBV}. \qquad (2)$$

The annual gross investment of $C - C'$ counteracts the depreciation and restores the same gross book value at the end of each year.

In the production process, the people working in the corporation perform L units of labor (for simplicity, all labor is of the same type) which produce Q units of output by using up K units of the machine services. Let P be the unit price of output and let W be the wage rate. Hence the revenue is PQ. The labor costs are WL and the other accounting expenses are $C - C' + M + rD$, the depreciation plus machine maintenance plus the interest on debt. Hence the *accounting net income ANI* is

$$\text{ANI} = PQ - (C - C') - M - rD - WL. \qquad (3)$$

Conventional accounting does not treat the interest opportunity cost of tying up the equity capital NBV for the year as an expense—but economics does. Hence the *economic net income ENI*, also called "economic profit," "pure profit," or "economic residual," is

$$\text{ENI} = \text{ANI} - r\text{NBV}$$
$$= PQ - (C - C') - M - rD - WL - r\text{NBV}$$
$$= PQ - (C - C') - M - rC - WL$$
$$= PQ - RK - WL$$
$$= (P, R, W)(Q, -K, -L)$$
$$= \text{value of the whole product } (Q, -K, -L),$$

where we have used Eqs. (1), (2), and (3).

Since there are no cash holdings, the net cash flow is zero. The cash revenue minus the cash expenses is

$$PQ - M - rD - WL = \text{ANI} + (C - C').$$

The (gross) capital investment each year is equal to the depreciation $C - C'$, and the dividends are div. Hence the *net cash flow* of zero can be expressed as

$$\text{ANI} + (C - C') - (C - C') - \text{div} = 0,$$

so the dividends equal the accounting net income, i.e.,

$$\text{div} = \text{ANI} = \text{ENI} + r\text{NBV}. \tag{4}$$

Dividing (4) by r yields another expression for the value of the corporation:

book plus goodwill formula: $V = \text{NBV} + \text{ENI}/r$

(for a more general model, see Ellerman, 1982, Chap. XII, Sect. 6). Thus the value V of the corporation can also be expressed as the net book value NBV of the corporate assets plus the discounted present value ENI/r of the stream of future economic profits, i.e., the value of the stream of future whole products $(Q, -K, -L)$.

The bundle of ownership rights in a conventional corporation consists essentially of

(A) the voting rights (e.g., to elect the Board), and
(B) the value V of the corporation.

The book-plus-goodwill formula gives a crucial partition of (B), the right to the value V, so the conventional ownership bundle can be reformulated as

(A) the voting rights,
(B1) the rights to the stream of economic profits of value ENI/r, and
(B2) the rights to the net book value NBV.

The Residual Horizon Problem Resolved

Miller and Modigliani (1961) gave four equivalent formulas for the value of a corporation. The book-plus-goodwill formula is a fifth equivalent formula. It is the most important formula from the property-theoretic viewpoint because the property rights behind the formula can be easily discerned. It cuts the value V at the property-theoretic joints. NBV is the net value of the corporate assets and liabilities. Instead of being the value of some hypothecated "intangible assets" or "goodwill," ENI/r is the present value of the stream of future whole products:

$$(Q, -K, -L), (Q, -K, -L), \ldots, (Q, -K, -L), \ldots.$$

The two horizon problems can be precisely related to these two components in the value V of a corporation. The Furubotn–Pejovich horizon problem was concerned with the claim on the balance-sheet equity NBV, and the system of internal capital accounts assigns precisely that value to the current members. The residual horizon problem is concerned (by definition) with the claim on the residual value $V - \text{NBV} = \text{ENI}/r$, which is the value of the stream of future whole products.

In terms of legal structure, a labor-managed firm is defined as a firm where the current voting rights and the current residual claimant rights (the current time-slice of the voting rights (A) and the residual stream (B1)) are personal rights attached to the functional role of working in the firm. In a Mondragon-type worker cooperative, i.e., an individual equity LMF, the system of internal capital accounts assigns the net book-value-rights (B2) as property rights to the current members.

All the value V of the corporation is accounted for except the future portion of the stream of economic profits (B1) beyond the current year. If we take the time to be the break between fiscal years, then the retained profits from the past year's whole product have been closed into the internal capital accounts, i.e., have become (B2) rights. Then all the (B1) rights refer to future whole products.

A LMF does not provide present property rights to the future whole products $(Q, -K, -L)$. Those whole products are to be appropriated by the future workers who produce them. The surprising result is that this does not represent an attenuation of property rights relative to the capitalist corporation. Since the whole-product vectors $(Q, -K, -L)$ must be *appropriated* in any case, there can exist no present property right to those bundles of assets and liabilities in the capitalist firm either.

From the viewpoint of property rights, the stream of future capital services K per year is on a totally different footing than the stream of annual whole products $(Q, -K, -L)$. There *does* exist a present right to the future stream of capital services K, namely, the ownership of the capital assets yielding those services. Yet there *does not* exist any analogous present property right to the future whole products. The whole-product vectors are appropriated in the future time periods by the parties then having the contractual role of the hiring party, i.e., the parties who will bear the cost of the used-up inputs and then lay claim to the produced outputs. Since the whole products must be appropriated, they cannot be preowned. Moreover, future contracts for the necessary inputs are not equivalent to appropriation of the whole products. The inputs could be resold. It is only when the inputs are used up that the input liabilities are appropriated so that then a defensible claim on the produced outputs can be made.

In a labor-managed economy of individual-equity LMFs, there is no attenuation of property rights to future whole products, i.e., no residual horizon

problem, relative to conventional capitalist corporations. Neither type of firm can preown the whole products.

There is only one fundamental difference in a labor-managed economy: the employer–employee contract is legally recognized as being an invalid contract. Any differences in property rights are more apparent than real. The differences are reflections of the basic inability to hire labor in a labor-managed economy.

For example, the ownership bundle in the capitalist corporation does contain the rights (B1) to the future residual-claimant's role in the corporation. But it is the future contracts the corporation makes that determine whether labor is hired in and the future whole products $(Q, -K, -L)$ are appropriated, or whether capital is hired out. In the model of corporate valuation considered above, it was *assumed* the corporation continued to play the hiring-party role. But that was only an assumption, not a consequence of the corporation's property rights. It is no violation of a capital owner's property rights for the capital to be hired out instead of the labor being hired in. If the capital was hired out, the revenue to the firm would only be the rentals RK, and the net value accruing to the residual claimant would be zero (after deducting the implicit rental RK).

In a labor-managed economy, there could still be a "capitalist corporation," that treated the bundle of rights (A), (B1), and (B2) as marketable property rights. But with hired labor outlawed, this corporation would only be able to hire out its capital. Then it would be perfectly clear that selling the corporation would only be an indirect way to sell the assets with the accompanying liabilities with the net value $V = \text{NBV}$.

In the capitalist milieu, the conventional corporation has no new property rights; it has another contractual opportunity, the option to hire workers. Thus it can take on the contractual role of being the hiring party and appropriate the whole product. Even though the future whole products cannot be preowned, the future contractual opportunities to hire labor and appropriate the whole product could elevate the value of the same ownership bundle to $V = \text{NBV} + \text{ENI}/r$. This is not part of our argument, but any serious notion of competitive equilibrium (e.g., McKenzie, 1981) would entail zero economic profits, i.e., $\text{ENI} = 0$. Hence competitive assumptions would neutralize the value difference by driving the value of the whole products to zero. But our analysis is concerned with the property rights to the whole products and is independent of their value.

There is, by assumption, no property difference between the capitalist corporation in the capitalist legal milieu and in the labor-managed legal milieu, only the valuation difference (in noncompetitive settings). What then is the difference in the property rights held by the owners/members of a capitalist corporation and a LMF where both are in a labor-managed economy? The capitalist owner does own the future residual-claimant rights for his organi-

zation as well as its current assets and liabilities. But since labor cannot be hired in, the owner can either sell the current assets and liabilities for their net book value NBV, or can hire out the capital for the annual rental (see Eq. (1)):

$$RK = (C - C') + rC + M.$$

In the rental case, the depreciation $C - C'$ is reinvested and the maintenance M and debt service rD are paid out, so the annual net cash flow is $rC - rD$ with the same present value NBV, i.e.,

$$(rC - rD)/r = C - D = \text{NBV}.$$

Hence without hired labor, the capitalist rights (B) boil down to various ways of repackaging of the current assets and liabilities with the value NBV.

The members in an individual-equity LMF do not own the future residual-claimant rights in their organization. They do, however, own the current assets and liabilities of the firm, and their value is the *same* NBV expressed as the sum of the balances in the internal capital accounts.

In conclusion, there are differences between the property rights held by the owners in a capitalist corporation and the members in an individual-equity LMF. But since future whole products cannot be preowned, these property differences boil down to different ways of repackaging the current assets and liabilities of the corporation. Thus the real difference is that the capitalist owners may hire future workers in the capitalist legal environment; the members of a LMF may not.

REFERENCES

Alchian, Armen, "Specificity, Specialization, and Coalitions." *Zeitschr. Gesamte Staatswissensch.* **140**:34–49, 1984.
Arrow, Kenneth J., and Debreu, Gerard, "Existence of an Equilibrium for a Competitive Economy." *Econometrica* 22:265–290, 1954.
Arrow, Kenneth J., and Hahn, Frank H., *General Competitive Analysis.* San Francisco: Holden-Day, 1971.
Bonin, John, and Putterman, Louis, "Economics of Cooperation and the Labor-Managed Economy." In *Encyclopedia of Economics* (forthcoming).
Cheung, Steven, "The Contractual Nature of the Firm." *J. Law & Econ.* 26:1–21, April 1983.
Debreu, Gerard, *Theory of Value.* New York: Wiley, 1959.
Ellerman, David, *Economics, Accounting, and Property Theory.* Lexington, Mass.: Heath, 1982.
Ellerman, David, and Pitegoff, Peter, "The Democratic Corporation: The New Worker Cooperative Statute in Massachusetts." *NYU Rev. Law & Soc. Change* 11, 3:441–472, Winter 1983.
Ellerman, David, "Theory of Legal Structure: Worker Cooperatives." *J. Econ. Issues* 18, 3:861–891, Sept. 1984a.
Ellerman, David, "Entrepreneurship in the Mondragon Cooperatives." *Rev. Social Econ.* 42, 3:272–298, Dec. 1984b.
Fama, Eugene, and Miller, Merton H., *The Theory of Finance.* New York: Holt, Rinehart and Winston, 1972.

Furubotn, Eirik, and Pejovich, Svetozar, "Property Rights and the Behavior of the Firm in a Socialist State: The Example of Yugoslavia." *Zeitschr. Nationalökon.* **30,** 3–4:431–454, 1970.

Furubotn, Eirik, and Pejovich, Svetozar, Eds., *The Economics of Property Rights.* Cambridge, Mass.: Ballinger, 1974.

Hirshleifer, Jack, *Investment, Interest, and Capital.* Englewood Cliffs, N. J.: Prentice-Hall, 1970.

ICA Model By-laws for a Worker Cooperative: Version II. Somerville, Mass.: Industr. Coop. Assn., 1984.

Jensen, Michael, and Meckling, William, "Rights and Production Functions: An Application to Labor-managed Firms and Codetermination." *J. Bus.* **52,** 4:469–506, Oct. 1979.

Keynes, John M., *The General Theory of Employment, Interest, and Money.* New York: Harcourt, Brace & World, 1936.

McKenzie, Lionel, "The Classical Theorem on Existence of Competitive Equilibrium." *Econometrica* **49,** 4:819–841, July 1981.

Mill, John Stuart, *Principles of Political Economy.* Donald Winch, Ed. Harmondsworth: Penguin, 1970 (orig. published in 1848).

Miller, Merton H., and Modigliani, Franco, "Dividend Policy, Growth, and the Valuation of Shares." *J. Bus.* **34,** 4:411–433, Oct. 1961.

Montias, John Michael, *The Structure of Economic Systems.* New Haven: Yale Univ. Press, 1976.

Quirk, James, and Saposnik, Rubin, *Introduction to General Equilibrium Theory and Welfare Economics.* New York: McGraw-Hill, 1968.

Schlicht, E., and von Weizsäcker, C. C., "Risk Financing in Labour Managed Economies: The Commitment Problem." *Zeitschr. Gesamte Staatwissensch.* **133:**53–66, 1977.

Thomas, Henk, and Logan, Chris, *Mondragon: An Economic Analysis.* London: Allen & Unwin, 1982.

Vanek, Jaroslav, "The Basic Theory of Financing of Participatory Firms." In Jaroslav Vanek, Ed., *Self-Management,* pp. 445–455. Harmondsworth: Penguin, 1975.

Vanek, Jaroslav, *The Labor-Managed Economy.* Ithaca, N. Y.: Cornell Univ. Press, 1977.