Mark A. Wolfson*
Stanford University

Tax, Incentive, and Risk-sharing Issues in the Allocation of Property Rights: The Generalized Lease-or-Buy Problem

This study is designed to augment the buy-versus-lease literature by incorporating (1) risk-sharing motives, (2) moral-hazard-related incentive problems and their mitigation, and (3) tax considerations in the choice of how to allocate an asset's property rights. A game-theoretic framework is used to characterize the equilibrium shared ownership arrangement. Buying and leasing emerge as special cases of the analysis. Real estate investments are emphasized as an illustrative context, where it is shown that (1) the efficiency of shared home-ownership contracts can be improved by using local housing price indices and (2) taxes encourage investors to bear risk, resulting in reduced asset maintenance unless the actions of the resident are directly monitored.

I. Introduction

The lease-versus-buy question has captured the attention of accountants and financial economists for many years.[1] The analyses to date have adopted a traditional neoclassical perspective: markets are complete, information is symmetric among agents, and contracts are costlessly enforceable. Alternatives are compared on the basis of their future cash flows. When taxes are factored into the analysis, they are typically shown to have a first-order effect on the decision. Miller and Upton (1976) represent the best work in the area to date, although they discuss some ways in which their analysis is restrictive. I wish to focus on their assumption that future maintenance costs and asset values are the same whether the asset is leased or owned:

> [We make] the convenient simplification that the maintenance required for any machine is

* The first draft of this paper was prepared while I was a Ford Foundation Visiting Associate Professor at the University of Chicago (1981–82). I am grateful to the following people for helpful suggestions: Amin Amershi, Rick Antle, Jeremy Bulow, Joel Demski, Doug Diamond, Phil Dybvig, Ron Dye, Sandy Grossman, Chuck Holloway, Bengt Holmstrom, Jon Ingersoll, Bob Kaplan, Roger Kormendi, Dave Kreps, Michael Mussa, Jim Patell, John Roberts, Myron Scholes, Jim Van Horne, Ro Verrecchia, Roman Weil, Bob Wilson, and Jerry Zimmerman.

1. Vancil (1961) apparently deserves much of the credit for getting the ball rolling.

(*Journal of Business*, 1985, vol. 58, no. 2)

0021-9398/85/5802-0001$01.50

> given exogenously. Actually, of course, the level of maintenance is itself an economic decision, and one, moreover, in which the optimality criterion might be different under some conditions, depending on who happens to have legal title to the machine.
>
> The problem arises because the maintenance expenditures undertaken will affect the terminal value of the property and its efficiency in providing services during the period of the lease. A short-term lessee, after all, has an incentive to keep maintenance expenditures down to the level that minimizes the sum of his own production and maintenance costs, even though this may lead to a substantial drop in the resale value of the equipment. [P. 766]

The analysis required to attack Miller and Upton's concern requires moving away from the symmetric information, costless contracting setting. The game-theoretic approach of agency theory is particularly appropriate to deal with this issue; it is the approach I adopt.

There is a second way in which to generalize the traditional lease-or-buy analysis: scope. Whether to buy or to lease is too narrow a question. An infinite number of ways exist to allocate the property rights to an asset among economic agents. Buying an asset or leasing a durable asset for a single period represent the two natural extreme points of the continuum of available allocations of property rights: the buyer (lessee) of an asset bears all (none) of the market value risk of the asset. Since economic agents are risk averse, a demand for risk sharing will generally render shared ownership preferable to sole ownership to either the manager or a (syndicate of) nonmanager(s) of the asset.[2] This risk-sharing motive for shared ownership has largely escaped the attention of contributors to the traditional lease-or-buy literature.[3]

This study is designed to augment the lease-or-buy literature by incorporating (1) risk-sharing motives, (2) moral-hazard-related incentive problems and their mitigation, and (3) tax considerations in the choice of how to allocate an asset's property rights. A standard game-theoretic framework is used to characterize the equilibrium shared ownership arrangement. Buying and leasing emerge as special cases of the analysis. For concreteness, real estate investments are emphasized; this provides a particularly appropriate illustrative context since it is one in which we observe buying and leasing as well as a variety of shared ownership arrangements in between.

Although shared ownership of commercial property has been com-

2. In the absence of tax considerations and information problems, syndicate theory à la Wilson (1968) implies that risk of market value uncertainty will be borne in proportion to the risk tolerances of the syndicate members. Fellingham and Wolfson (1985) generalize this by incorporating taxes.

3. The literature does occasionally consider the risk-sharing issue qualitatively. For example, Van Horne (1983) correctly points out that a lessee can adjust the degree of risk borne by (1) varying the term of the lease contract and (2) including purchase options in the lease contract.

mon for many years, shared ownership of single-family residential property has only recently gained a modicum of popularity as a legal organizational form.[4] Two contributing factors may explain the departure from sole ownership of single-family residences as the only observed arrangement.

1. Since real estate prices have risen considerably faster than the general price level over the past decade, personal residences play a larger role in contributing to the uncertainty of wealth of many individuals.[5] To avoid putting all one's eggs in a single basket, one may enter into a shared ownership agreement with another investor.[6] Risk sharing, then, is one motive for individuals to enter into such agreements.

2. Real estate investments have been popular as tax-sheltering devices for many years. For resident owners, the income tax deductibility of property taxes and the tax exemption on the value of the service flows obtained from consumer durables provide the primary pecuniary motivation for ownership.[7] For nonresident owners, the major motivation for investment is generous depreciation allowances relative to changes in the market value of property. The Economic Recovery Tax Act of 1981 (ERTA) enhanced the value of real estate investments by making depreciation allowances even more generous; the level of investment in real estate limited partnerships has exploded since the Accelerated Cost Recovery System was introduced by ERTA. A desire to share tax benefits efficiently represents another important motive for entering into shared ownership arrangements.[8]

The models discussed in this paper explore the risk-sharing and tax-shifting motives of shared ownership arrangements.[9] They also address

4. For example, insurance companies such as Prudential now routinely take equity positions in the commercial projects they finance.

5. Quoting Summers (1980): "The real market price of corporate capital as reflected in the stock market declined by 45 percent between 1965 and 1980. During the same period, the real price of owner-occupied housing increased by 34 percent. These capital gains and losses have had a substantial impact on the composition of wealth. In 1965, the market value of corporate capital exceeded that of owner-occupied housing by nearly 30 percent, yet by the end of 1979, the value of owner-occupied housing was almost twice the value of corporate capital" (p. 429).

6. Implicit in this argument is an assumption that the desired insurance is not freely available in some other form.

7. The tax exemption of implicit income from consumer durables may be less important than is commonly believed. In a setting of cross-sectional differences in tax rates, market equilibrium may provide residents with even better investment opportunities than tax-exempt returns from home ownership.

8. Note also that a progressive income tax, which results in declining marginal after-tax returns from tax-sheltered investment as the level of investment rises, encourages shared ownership.

9. For the sake of tractability, liquidity preferences, though important, are not explicitly factored into the models. This is less serious a shortcoming here than if we were modeling so-called reverse mortgage contracts, where an elderly owner-occupant enters into a sale-leaseback agreement, receiving periodic payments for life. The incentive problems in the shared equity contract and the reverse mortgage contract are quite similar.

the inevitable incentive problems that arise when the outside coinvestor cannot costlessly observe the actions of the resident coinvestor. A notable feature of the models is their crisp empirical implications.

The analysis is organized as follows: Section II ignores taxes and begins by discussing the familiar agency problem of trading off risk sharing and incentive considerations. The notion of a neighborhood (of houses) is then introduced, and the role that a common source of market value uncertainty plays in controlling the incentive problem is considered. In Section III, risk-sharing considerations are suppressed to provide a transparent analysis of the tax-sharing/incentives tradeoff. Concluding remarks appear in Section IV.

II. Risk Sharing and Incentive Considerations[10]

Two individuals wish to contract for the joint purchase of a house. One individual, who is risk averse, will reside in and maintain the house. This resident investor shuns effort, an aversion that increases with the level of effort provided. The resident also derives the benefit of the service flow provided by the house. This service flow increases with the state of repair of the house, and the production function is such that the service flows increase linearly with the level of maintenance effort supplied by the resident. The resident's preferences are linear in the service flows. For tractability, the resident's utility over wealth, $U(w)$, service flow provided by the house, $W(s)$, and disutility from expending effort, $V(e)$, are assumed to be additive and separable in the three components; that is,

$$U(w, s, e) = U(w) + W[s(e)] + V(e),$$

with $U' > 0$, $U'' < 0$, $W' > 0$, $W'' = 0$, $V' < 0$, and $V'' < 0$.

The outside coinvestor is risk neutral. His problem is to design a contract that maximizes his expected profit from investing in the house, subject to the constraint that the resident coinvestor be provided terms at least as attractive as those available in his next best alternative, as defined by the resident coinvestor's exogenously fixed minimum utility level.

I adopt a single-period perspective. The coinvestors are to share the proceeds from the sale of the house at the end of the period, according to the terms of the contract written at the beginning of the period. The end-of-period market value of the house, x, is determined by two factors of production: the effort in maintenance, e, that the resident provides and a random state variable realization. There are positive but decreasing marginal returns to maintenance, although the range of pos-

10. This section draws heavily from the developments in Holmstrom (1979, 1982) and Baiman and Demski (1980).

sible end-of-period market value realizations is unaffected by the e chosen (i.e., x has constant support).

A. Optimal Contract with Perfect Information

Because risk is a source of disutility to the resident and a matter of indifference to the outside investor, if there are no incentive problems (i.e., the resident's actions are observable to the outside investor), the outside investor will fully insure the resident against random fluctuations in the market value of the house resulting from (uncontrollable) state uncertainty; a standard lease contract will be written. For example, suppose that the resident's preferences over wealth (w), service flows from the house (s), and effort (e) are represented by

$$U(w, s, e) = \sqrt{2w} + s - e^2$$

Suppose also that the service flow from the house, which is determined by the house's state of repair, is equal to the level of effort supplied by the agent to maintain the house. Further assume that the resident's opportunity set is such that with the amount he (exogenously) agrees to invest, he can achieve an expected utility level of $\theta = 1.0$ in his next best alternative. Finally, assume that the end-of-period market value of the house, x, is distributed exponentially with a mean equal to the (appropriately normalized) level of care, e, chosen by the resident.

The constant, w, to be paid to the resident must satisfy $\sqrt{2w} + e - e^2 = 1$, implying that $w(e) = (1 - e + e^2)^2/2$. The outside investor's problem, then, is to choose a level of effort, e^*, to "buy" from the resident that will maximize the investor's expected utility:

$$\begin{aligned} e^* &= \max_{e \in E} E[x(e)] - w(e) \\ &= \max_{e \in E} e - \frac{(1 - e + e^2)^2}{2}. \end{aligned}$$

The solution is $e^* = 1$, which provides for $w = ½$ and an expected utility to the outside investor of ½ (= 1 − ½). Suppose that all the variables are measured in units of \$100,000. Then the expected proceeds from the sale of the house at the end of the period are \$100,000. The resident is guaranteed half (\$50,000) in exchange for his share of the investment and for providing a maintenance level of $e^* = 1$. The outside coinvestor receives the random residual amount, which is distributed exponentially with a mean of \$50,000.

B. Resident's Actions Unobservable to the Outside Investor

We now turn to the more interesting case in which the resident's chosen effort level is not jointly observed. Only the end-of-period market value of the house is jointly observable, and, hence, it is the only variable on which to base the contract. An incentive problem arises because, in deciding on the level of effort to provide, the resident fails to internalize the benefit that an increase in the market value of the house provides to the outside investor.[11] Returning to my example, if the resident were offered a fixed end-of-period payment, w, independent of the market value of the house, he would choose an effort level that would satisfy

$$e^* = \max_{e \in E} E[U(w, e)] = \max_{e \in E} \sqrt{2w} + e - e^2.$$

The solution is $e^* = ½$. Recall that when effort is observable, $e^* = 1.0$. The only reason any voluntary effort would be provided is the resident's desire to avoid living in squalor. To induce the resident to supply a higher effort level, the outside investor must at least partially tie the resident's fortune to the market value of the house, implying a departure from the Pareto optimal risk-sharing contract.[12]

More formally, the outside investor's problem is to choose an effort level, e, and a sharing function, $z(x)$, that maximizes the outside investor's expected utility, subject to meeting two constraints: (i) the resident's expected utility under the contract must be at least θ; and (ii) the effort level chosen must maximize the expected utility of the resident given the sharing function[13]

$$\max_{\substack{z(x) \in Z \\ e \in E}} \int [x - z(x)] f(x|e)\, dx$$

subject to

$$\text{(i) } \int U[z(x)] f(x|e)\, dx + W(s) + V(e) \geq \theta,$$

$$\text{(ii) } \int U[z(x)] f_e(x|e)\, dx + \partial W/\partial e + V'(e) = 0.$$

Returning again to our example, the optimal contract is given by

$$z(x) = \frac{\left(\lambda_1 + \lambda_2 \dfrac{x - e}{e^2}\right)^2}{2} \approx (.352 + .296x)^2,$$

where λ_1 and λ_2 are the Lagrange multipliers on the two constraints of the outside investor's program. The optimal effort level in the second-best setting is equal to 0.709 versus 1.000 when effort was observable (the first-best setting). The expected utility of the outside investor de-

11. I ignore the outside coinvestor's option to acquire maintenance services from another agent who specializes in such activities. This would simply create a different set of incentive problems.

12. Note that in the special case of $W[s(e)] = V(e)$, the incentive problem disappears.

13. A unique effort level is assumed to satisfy the resident's incentive compatibility constraint, (ii), rendering the first-order approach an appropriate way to characterize this strategic feature of the problem.

clines to .350 here from .500 in the first-best contract.[14] A measure of the amount of risk imposed on the resident to induce a greater level of effort is provided by the average slope of the continuously differentiable sharing function, $\int z'(x) f(x|e)\, dx$. Here, it is 0.332 versus zero in the first-best setting, implying that, on average, unexpected capital gains on the house are allocated one-third to the resident and two-thirds to the investor.

C. *Neighborhoods*

Suppose that next door to the co-owned house there exists a neighbor's house whose market value is determined jointly by the neighbor's level of home care and the realization of the same state variable that affects the market value of the co-owned house. If (i) the neighbor's preferences are known, (ii) the production function that determines the market value of the neighbor's house is known, and (iii) the market value of the neighbor's house is jointly observable to the outside investor and the resident, then (presuming suitable regularity) the state variable realization effectively becomes observable. That is, by observing the value of the neighbor's house, we can separate out common market effects, rendering the resident's effort level effectively observable, and thus a first-best solution can be achieved. Moreover, the availability of a first-best solution in no way depends on whether the neighbor is a sole owner of his house; first-best solutions are available even if the neighbor coinvests with an outside investor,[15] as long as (i) the neighbor and the resident do not collude, (ii) there are no joint production effects of the neighbor's and the resident's actions—for example, the neighbor's maintenance decisions are assumed not to affect the market value of the resident's house—and (iii) the effort level that solves the neighbor's optimization problem is unique.

In effect, the market value of the neighbor's house, y, is used as a benchmark against which to evaluate the performance of the resident. For example, if (i) the neighbor is sole owner of his house, (ii) his preferences are given by $U(w, e) = w + e - e^2$, and (iii) the market value of the neighbor's house (y) depends on the state and effort level in the same way as does the investor's/resident's house, then the optimal contract between the investor and the resident will be

$$z(x, y) = \begin{cases} .5, \text{ if } x = y \\ p, \text{ otherwise,} \end{cases}$$

where $p \ll .5$ is a penalty assessed against the resident for not supplying the required level of effort.

14. The outside investor's expected utility is equal to the expected market value of the house less the expected payment to the resident, i.e., .709 − .359.

15. This is implied by Holmstrom (1982), theorem 7. It is also proved by Baiman and Demski (1980).

When observation of the market value of the neighbor's house provides imperfect information about the state variable realization, the first-best solution is no longer available. To capture this notion, suppose the random state variable can be decomposed into a "neighborhood risk" that affects the market value of both houses and a "site-specific risk" that affects each house separately. Now the optimal payment schedule depends on both the market value of the jointly owned house and that of the neighbor's house, and for incentive reasons the resident must bear *some* of the risk of fluctuations in market value. The investor, however, will continue to bear all the neighborhood risk, because the fluctuations in the neighborhood variable provide no information about the resident's effort level; they represent pure noise. In an optimal arrangement a risk-neutral investor will shield a risk-averse resident from this uncertainty.[16]

When the neighborhood contains *several* houses, the optimal contract generally will exploit each market value observation. Theorem 8 of Holmstrom (1982) provides two special cases in which the optimal shared ownership contract can be written in terms of the value of the individual house and a local housing price index:

$$\text{I:}\quad x_i(e_i, \mu) = e_i + \eta + \epsilon_i,\ i = 1, \ldots, N$$

$$\text{II:}\quad x_i(e_i, \mu) = e_i(\eta + \epsilon_i),\ i = 1, \ldots, N,$$

where $\mu = (\eta, \epsilon_1, \ldots, \epsilon_N)$ is a random vector with common uncertainty parameter η (the common neighborhood factor), idiosyncratic uncertainty parameters ϵ_i (the site-specific uncertainty), effort levels e_i, market values x, and N houses in the neighborhood. It is assumed that $\eta, \epsilon_1, \ldots, \epsilon_N$ are independent and normally distributed.[17]

The suggestion that local housing indices can improve the efficiency of shared home ownership contracts represents an application of the "correlated random variable" approach to controlling the unobservable actions of agents, which has received much attention in the literature.[18] Over the past several years, a variety of organizations have developed standardized contracts (boilerplates) for shared home ownership (e.g., Advance Mortgage Co.; Electronic Realty Associates, Inc.; Santa Clara Properties; Stanford University; Ticket of Texas). All these contracts exhibit a common feature: contrary to the normative implications of my analysis, the sharing function does *not* explicitly incorporate the market value of any house other than the one in which

16. See Holmström (1982), theorem 5, for a proof in a more general setting. See also Baiman and Demski (1980), corollary 2.2.

17. The market value of each house in the housing index is weighted by the relative precision of the idiosyncratic uncertainty factor. Note that this need not resemble weighting by relative market values.

18. See Diamond and Verrecchia (1982) and the references listed in n. 1 of Holmström (1982).

the resident coinvestor resides.[19] There exist several potential explanations for the apparent predictive failure of the analysis:

1. The assumption of costlessly observable market values of homes in the neighborhood is too strong.

2. Even where local housing indices exist, they may contain large measurement errors. Of course, this is not a sufficient reason to ignore the indices. A straightforward application of Holmstrom's (1979) informativeness condition suggests that even if market values are measured with random error, including the index as a contracting parameter provides gains to the contracting parties. In addition to measurement error, however, there may exist moral hazard on the aggregation of the index numbers. For example, the index may depend in part on subjective appraisals that are partially under the control of the outside equity owner.

3. There exist substitutes for local housing indices to control resident coinvestors' actions, namely, direct monitoring of resident coinvestors' actions. To the extent that monitoring policy is conditioned on local housing indices, there is no real predictive failure of the analysis.

III. Tax and Incentive Considerations

Many observed institutional arrangements would surely be anomalous but for the existence of income taxes. To provide a flavor of the role that taxes play in shared real estate ownership contracts, I assume that a fixed, nominal income tax deduction (depreciation) is available and that it is to be shared between the outside investor and resident coinvestor. The coinvestors are *not* entirely free to allocate the deduction as they desire. If complete freedom existed, 100% of the depreciation would be allocated to the coinvestor with the higher tax rate, and taxes would not affect the contracting problem in any substantive way. Instead, the Internal Revenue Code requires that each individual is allocated a potential tax deduction in proportion to the amount of risk of market value fluctuation that each bears.[20] In the previous section, the average slope of the sharing rule was introduced as a measure of the proportion of risk borne by the resident coinvestor. The proportion of risk borne by the outside coinvestor is one minus the sharing function's average slope.[21] I assume that no investor is permitted a negative depreciation deduction.

19. Stanford University was seriously considering incorporating a campus housing price index shortly before its shared investment program was terminated.

20. See I.R.C. sec. 1.704-1(b)(2). Also see the case of Stanley C. Orrisch, 55 T.C. 395 (1971), *aff'd.*, 31 AFTR 2d. 73-1069 (CA-9, 1973).

21. Note that in the special case of linear sharing rules, one minus the average slope of the sharing rule is equal to the standard deviation of the residual payment to the outside investor, $\sqrt{\text{var}[x - z(x)]}$, divided by the standard deviation of the market value of the house, $\sqrt{\text{var}(x)}$. To see this, note that: $\text{var}[x - z(x)] = \text{var}(x) + b^2 \text{var}(x) - 2b \text{var}(x) = \text{var}(x)(1 - b)^2$, where b is the constant slope of the linear contract. Hence, $\sqrt{\text{var}[x - z(x)]}/\sqrt{\text{var}(x)} = 1 - b$. This suggests that the risk measure used is sensible.

I assume that the risk-neutral outside investor pays a higher marginal tax rate than the resident coinvestor, and as a first approximation I assume that only the outside investor is taxed.[22] Intuitively, it would seem that taxes make it desirable for the outside investor to bear more risk than he would otherwise bear so that a larger portion of the tax subsidy can be captured. There is a cost, however, of achieving this subsidy: the coinvestors must move away from a sharing function that provides the optimal trade-off between risk-sharing and incentive benefits in a taxless world. More formally, the outside investor's problem is now given by the following program:

$$\max_{\substack{z(x)\in Z\\ e\in E}} \int \{x - z(x) + T[1 - z'(x)]\} f(x|e)\, dx$$

subject to

$$\int U[z(x)] f(x|e)\, dx + W(s) + V(e) \geq 0, \tag{i}$$

$$\int U(z(x)] f_e(x|e)\, dx + \partial W/\partial e + V'(e) = 0, \tag{ii}$$

where T is the tax subsidy available to the outside investor if he were to bear all the risk of market value uncertainty. The subsidy is reduced to the extent the resident bears risk. This is a particularly convenient way to introduce the tax effect because the Euler condition for the sharing function easily accommodates the $z'(x)$ term:

$$-f(x|e) + \lambda_1 U' f(x|e) + \lambda_2 U' f_e(x|e) - \frac{d}{dx}[-Tf(x|e)] = 0,$$

or

$$\frac{1 - T\dfrac{f_x(x|e)}{f(x|e)}}{U'} = \lambda_1 + \lambda_2 \frac{f_e(x|e)}{f(x|e)}.$$

Although the analysis above is reasonably general, the Euler condition is intractable for further analysis. By simplifying the outcome distribution, the effort supply choice set, or the resident's preferences,

22. Even if the resident coinvestor's tax rate were the same order of magnitude as that of the outside investor, the resident does not benefit from depreciation because it is a nondeductible personal expense. On the other hand, the resident does benefit from the tax deductibility of property taxes and the tax exemption on the value of service flows from the house. In addition, if the asset is a business (rather than a consumer) durable, the resident does benefit from depreciation, although service flows become taxable. These benefits are ignored here, but they are not difficult to model. More generally, the argument of the resident's utility function for wealth is $z(x) + S(x)z'(x)$, where $S(\cdot)$ denotes the subsidy available to the resident if he is the sole owner of the asset (i.e., $z'[x] = 1$ for all x). The maximum tax subsidy available to the resident typically differs from that available to the outside investor, and this provides a tax motivation for the resident to move away from complete ownership.

the effect of taxes can be made more transparent. However, before simplifying the analysis, I state one proposition.

PROPOSITION: Assume that $z'(x)$ is bounded. Then as the potential tax subsidy, T, becomes large, the optimal contract, $z^*(x)$, becomes a pure rental contract; that is, $z^*(x)$ = constant.

To prove the proposition, separate the principal's objective function into two terms: (i) $E[x - z(x)]$ and (ii) $TE[1 - z'(x)]$. As T gets large, the second term (i.e., the tax effect) dominates and the outside investor cares only about maximizing the tax subsidy. Since neither player is permitted a negative depreciation allocation, the tax subsidy is maximized by choosing $z'(x) = 0$ for all x. This implies $z(x)$ = constant.

The proposition deals with the case in which tax considerations dominate all other contracting considerations. I now consider the role that taxes play when incentive considerations are also important. I simplify the analysis by introducing binary outcome support and a binary effort choice set and by suppressing risk-sharing considerations, although the results generalize considerably. More precisely, the realized end-of-period market value of the house will be one of two possible values: x_1 or x_2, with $x_1 > x_2$. The resident may expend two possible levels of effort to maintain the house: h (high) or l (low). Value x_1 occurs with probability $\pi(h)$ or $\pi(l)$, and $\pi(h) > \pi(l)$. Value x_2 occurs with probability $1 - \pi(\cdot)$. Both the resident and the investor are assumed to be risk neutral and the resident is effort averse. The resident's utility, U_R, can be expressed as $U_R = z(x) + G(e)$, where $G(e) \equiv W[s(e)] + V(e)$; $G(e = h) < G(e = l)$ by assumption.

Given binary outcome support, $z(x)$ can be expressed in the form $a + bx$. If the outside investor is modeled as a Stackleberg leader, as usual, the investor's problem becomes

$$\max_{\substack{a,b \\ e\in\{l,h\}}} \; E\{x(e) - [a + bx(e)]\} + T(1 - b),$$

subject to

$$E[a + bx(e)] + G(e) \geq \theta, \tag{i}$$

$$e \in \arg\max_{e\,\in\,\{l,\,h\}} E[a + bx(e)] + G(e). \tag{ii}$$

Suppose $e^* = h$ is optimal. Then the problem becomes

$$\begin{aligned}\max_{a,b}\; & -a + (1 - b)\{\pi(h)x_1 + [1 - \pi(h)]x_2 + T\} \\ & + \lambda_1\big(a + b\{\pi(h)x_1 + [1 - \pi(h)]x_2\} + G(h) - \theta\big) \\ & + \lambda_2\big(b(x_1 - x_2)[\pi(h) - \pi(l)] + G(h) - G(l)\big).\end{aligned}$$

From the first-order conditions, one can show that $\lambda_1 = 1$ and $\lambda_2 = T/\{(x_1 - x_2)[\pi(h) - \pi(l)]\}$.

Note that in the absence of taxes (i.e., $T = 0$), $\lambda_2 = 0$, which implies that the incentive compatibility constraint is not binding. A first-best solution can be achieved by setting $b \geq [G(l) - G(h)]/\{(x_1 - x_2)[\Pi(h) - \Pi(l)]\}$. This will result in the resident's supplying the efficient level of effort with no sacrifice of Pareto-optimal risk sharing, since the resident is risk neutral. However, once taxes are introduced ($T > 0$), a tax-induced demand by the investor to bear risk arises, and an incentive problem is created. In fact the only way for the investor to capture all of the available tax benefits (which requires setting $b = 0$) is to allow the resident to shirk (supply $e = l$).

Hence, the investor is faced with a choice between

$$\begin{cases} \text{tax subsidy} = T\left[1 - \dfrac{G(l) - G(h)}{(x_1 - x_2)[\pi(h) - \pi(l)]}\right] < T \\ \text{labor supply} = h \end{cases} \tag{1}$$

and

$$\begin{cases} \text{tax subsidy} = T \\ \text{labor supply} = l. \end{cases} \tag{2}$$

The Lagrange multiplier on the incentive compatibility constraint, λ_2, is strictly positive once taxes are introduced and $e^* = h$. More precisely, the cost of inducing the agent to supply the higher level of effort increases linearly in T, the maximum available tax subsidy. As T gets very large, the cost of inducing higher labor supply becomes excessive, and the optimal contract becomes $b = 0$ with $e^* = l$, consistent with the proposition stated earlier. This corner solution characterizes a standard lease contract. The resident becomes a tenant even though there is a moral hazard problem and even though he does not mind bearing risk.

IV. Concluding Remarks

The two insights emphasized in this study are as follows:

1. The efficiency of shared home-ownership contracts could be improved through the use of local housing price indices. The indices provide exogenous standards against which the performance of resident coinvestors can be evaluated.

2. Taxes encourage outside investors to bear a larger portion of the risk of market value fluctuations than they would otherwise bear. Under fairly general conditions, this will reduce the resident's maintenance efforts (and state of repair of the house), unless the resident's actions are directly monitored. If the tax effect is sufficiently large, the outside investor will become a landlord, bearing all the risk of fluctua-

tion in the market value of the house, despite the induced moral hazard problem that encourages the resident to shirk on house care.

A variety of simplifications underlie these conclusions. For example, the investors' portfolio decisions were suppressed. Clearly, the risk-sharing motive is attenuated when low-cost opportunities for diversification are available. In addition, several aspects of the tax code were suppressed, particularly the fact that the service flow from home ownership is tax exempt, whereas rental income is taxable to an outside owner and rental payments paid on a personal residence are not tax deductible. This, of course, tends to encourage resident ownership. Finally, moral hazard issues were explicitly considered, but adverse selection issues were not addressed.

These and other complications might alter the extent of the relationships that the models predict, but not their fundamental nature. In an efficient joint home-ownership contract, the contracting parties must carefully trade off risk sharing and tax benefits against the incentives necessary to induce the resident coinvestor to take good care of the home.

References

Baiman, S., and Demski, J. 1980. Economically optimal performance evaluation and control systems. *Journal of Accounting Research* 19 (Suppl.): 184–220.

Diamond, D., and Verrecchia, R. 1982. Optimal managerial contracts and equilibrium security prices. *Journal of Finance* 37 (May): 275–87.

Fellingham, J., and Wolfson, M. 1985. Taxes and risk sharing. *Accounting Review* 60 (January), in press.

Holmström, B. 1979. Moral hazard and observability. *Bell Journal of Economics* 10 (Spring): 74–91.

Holmström, B. 1982. Moral hazard in teams. *Bell Journal of Economics* 13 (Autumn): 324–40.

Miller, M., and Upton, C. 1976. Leasing, buying, and the cost of capital services. *Journal of Finance* 31 (June): 761–86.

Summers, L. 1980. Inflation, the stock market, and owner-occupied housing. *American Economic Review Papers and Proceedings* 70 (May): 429–34.

Vancil, R. 1961. Lease or borrow: New method of analysis. *Harvard Business Review* 39 (September–October): 122–36.

Van Horne, J. 1983. *Financial Management and Policy*. 6th ed. Englewood Cliffs, N.J.: Prentice-Hall.

Wilson, R. 1968. The theory of syndicates. *Econometrica* 36 (January): 119–32.