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Incentive Compatible Financial Contracts, Asset Prices, and the Value of Control

JEFFREY M. LACKER

Research Department, P.O. Box 27622, Federal Reserve Bank of Richmond, Richmond, Virginia 23261

AND

ROBERT J. LEVY AND JOHN A. WEINBERG

Department of Economics, Krannert Graduate School of Management, Purdue University, West Lafayette, Indiana 47907

We examine a general equilibrium model of asset prices in the presence of a simple informational imperfection. Assets are productive only when combined with managerial services. A manager "controls" an asset; he can conceal some of the output at a cost. This limits the extent to which managers can shed risk by issuing claims. Incentive compatibility drives a wedge, the "value of control," between physical and financial asset values. Equilibrium allocations can be supported by alternative specifications of the right to "name the next manager." If this right is assigned to holders of claims, then financial asset prices exhibit "excess volatility." *Journal of Economic Literature* Classification Numbers: 020, 311, 520. © 1990 Academic Press Inc.

In recent years, an important literature has developed on optimal contracts under various forms of asymmetric information. This work has resulted in a sizeable body of knowledge regarding the restrictions which nontrivial incentive compatibility constraints impose on observable contractual forms. Moral hazard restricts the extent of insurance that a risk neutral principal can provide to a risk averse agent (see, for example, Hart and Holmstrom, 1987). Similarly, private information may limit the extent to which a "borrower" can make state contingent payments to a

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"lender" (see, for example, Townsend, 1988). By contrast, relatively little is known about what such restrictions, when applied to financial contracting, imply about the behavior of financial asset prices. This paper takes a step in this direction by examining a general equilibrium asset pricing model in which physical assets must be "managed" and in which managers may have "adverse incentives." The traded financial claims in our model bear a close resemblance to observed equity markets and are surprisingly consistent with some of the empirical regularities they display.

We examine a simple overlapping generations economy with a set of indivisible, durable, productive assets. These assets are similar to those in Lucas (1978) in that the output of each asset follows a certain stochastic process. The assets are different, however, in that an asset must be "managed" by an agent in order to yield output. An individual agent's endowment is not sufficient to acquire an asset outright, so that an agent seeking to manage an asset must issue some form of "financial claim." An asset's manager has the ability to "falsify" or hide some of the output produced—total output less whatever is hidden is public information. Such evasive activity, however, imposes a resource cost on the manager in the sense that some of the hidden output is lost in the process of hiding.

The contracting problem that arises from the possibility of "costly falsification" has been examined in detail in Lacker and Weinberg (1989). The tension here is very similar to that introduced by the standard moral hazard problem, in which an agent takes a costly action *ex ante* which affects output; incentive compatibility limits the degree of risk sharing in financial contracts. In contrast, the action of falsification in our setup is taken after output is realized. One of the advantages of our "ex post moral hazard" formulation is that it yields simple and easily interpreted contracts. As Lacker and Weinberg show, linear contracts result for a wide class of nonlinear falsification cost technologies. The optimal financial claim in our environment resembles observed equity shares; it entitles its holder to a fixed percentage share of the asset's output as well as the resale value of "ownership rights."

The manager's inability to fully diversify asset-specific risk gives rise immediately to a sort of "dividend smoothing." In fact, incentive compatibility places an upper bound on the rate at which dividends can vary with output. Hence, a firm's dividend policy is explicitly determined by the optimal contract. That the manager must bear some risk also requires that managerial income include a risk premium relative to the riskless return to the (fully diversified) portfolio held by investors. This premium causes the value of financial claims to deviate from the value of the underlying physical assets, and this difference in value can be interpreted as the value of control. A manager must pay more than can be raised in the financial market to gain control of a productive asset. This excess value, under the optimal contractual arrangement, accrues ultimately to investors.

There is a fundamental indeterminacy in our model concerning the assignment of property rights. One can assume that the right to determine the identity of the next manager resides either with the current manager or with the current shareholders (jointly). Equilibrium allocations are identical, but the definition of "dividends" is different in each regime. Whether the value of control accrues to investors via dividends or via capital gains differs across regimes. If current shareholders can irrevocably name the next manager then part of the return on a stock is the premium the next manager is willing to pay for the control of the asset. Because of the presence of a distinct value of control, financial asset prices can exhibit excess volatility relative to the stream of dividends to which such an asset is a claim. [See West (1988b) for a survey of empirical work on excess volatility.] Excess volatility arises even though equilibrium discount rates are constant, "bubbles" and "fads" are excluded, and expectations are universally rational.

The source of excess volatility in our model is novel. The result does not stem solely from an alternative description of the process generating a stream of dividends or of how the market values that stream. Instead, a crucial feature in our result is the existence of an additional source of value for shareholders, separate from dividends. Hence, it is the importance of the value of control which differentiates our result from other candidate explanations of excess volatility.

It should be noted that we do not offer our model as a definitive explanation of stock price volatility or other asset pricing phenomena. The model is clearly too simple and abstract to be able to confront the data in a truly satisfactory fashion. At the same time, the level of abstraction allows us to demonstrate very precisely how asset price behavior can be affected by the terms of the contracts governing the use of productive resources.

A number of recent papers have examined models of asset prices in the presence of moral hazard. Papers by Diamond and Verrecchia (1982), Campbell and Kracaw (1985), and Kihlstrom and Matthews (1988) study managerial contracts when shares in the firm are publicly traded. The informational imperfection is the standard moral hazard problem; managerial effort is unobserved, and the compensation must give the manager incentive to behave appropriately. The focus is on the role of the manager's holdings of shares in the firm in motivating the manager. Clearly, managerial moral hazard will, in turn, affect the prices of a firm's securities. This was first pointed out by Holmstrom (1982) who noted that with moral hazard, asset prices would depend on idiosyncratic as well as systematic risk. This point was further explored by Ramakrishnan and Thakor (1984) who drew further implications for the relationship between a firm's risk characteristics and managerial compensation schemes. In contrast, in this paper we focus directly on the implications of imperfect managerial compensation schemes for the behavior of asset prices. A paper by Kahn (1988) is more closely related. Kahn also examines the asset price implications of moral hazard, and the attendant imperfect risk sharing, but he seeks an explanation of the "equity premium," the puzzlingly large gap between observed mean returns on equities and "riskless" assets. In his framework, however, moral hazard limits the risk shedding available to investors and alters asset demands without affecting the form of marketed claims. In contrast, complete risk shedding is available to *investors* in our model, but not to *managers*.

In Section 1, we describe the economy in detail. Sections 2 and 3 establish some properties of the financial claims market and optimal contracts. Section 4 considers the competitive equilibrium for this economy; an existence proposition is stated and proved. Some of the characteristics of equilibrium prices in this economy are then examined in Section 5. In Section 6 we discuss alternative property rights regimes and the possibility of excess volatility. Finally, in Section 7, we offer some concluding remarks and thoughts on directions for further study.

1. THE ECONOMY

The economy is populated by overlapping generations of two-period lived agents. Each period a countably infinite number of agents are born. Each agent is identical and has an endowment of α units of consumption good when young and receives no endowment when old. Agents care only about consumption when they are old according to $E[U(c')]$, where c' is consumption in the second period of life, and $U(\quad)$ is strictly increasing, strictly concave, and bounded. Allowing agents to care about consumption in both periods of life would complicate equilibrium conditions without altering any of the results below. The essential pattern of trade, for our purposes, is for the physical assets to be sold by members of the old generation to members of the young generation in each period. This will occur regardless of the pattern of preferences over agents' lifetimes; holding an asset after it has yielded its period t output does no good for the old. In each period, the assets are supplied inelastically by the old. The young agent's endowment is used only to acquire assets when young, the return from which is consumed when old.

A brief remark is in order concerning the role of the overlapping generations demographic structure we employ. As is common, this structure aids the analytic tractability of our model, but it serves another role here as well. In our model it forces periodic changes in the control and management of assets. We do not mean to propose a demographic theory of changes in corporate control; rather, we wish to avoid, for the purposes of this paper, having to provide a deep explanation of the timing of changes in control. If we were in possession of such a theory, we feel confident that our analysis would carry through in a setting with long- or infinitely lived agents.

There are a countably infinite number of distinct, infinitely lived, productive assets. Let J denote the set of all assets, with typical element j. Each period each asset is capable of producing a certain amount of the consumption good. The amount produced by asset j, x_j, is random and can take on one of a finite number of values. The set of possible values of x_j is $X \equiv \{x^1, x^2, \ldots, x^n, \ldots, x^N\}$, where $x^n > x^{n-1}$ for $n = 2, \ldots, N$. For convenience we will assume that $x^1 = 0$. This has the effect of suppressing a constant term that otherwise would appear in the optimal contract; none of the results that follow are materially affected. Since we focus on stationary equilibria throughout, we will suppress time subscripts and use primed variables to designate next period's values and unprimed variables to designate current values. For each asset j, the amount produced is assumed to follow a stationary Markov process, with transition probabilities

$$\pi_{mn} = \Pr[x_j' = x^m | x_j = x^n], \qquad m, n = 1, \ldots, N. \tag{1.1}$$

Each asset's potential output is independent of the potential output of other assets. Let $\{\pi_m\}$ denote the stationary probabilities, so that

$$\pi_m = \sum_{n=1}^{N} \pi_{mn}\pi_n, \qquad m = 1, \ldots, N. \tag{1.2}$$

We will assume that x_j' is stochastically increasing in x_j in the sense of first-order stochastic dominance, and that the matrix $\{\pi_{mn}\}$ is nonsingular.

Output in a given period can only be obtained with the input of the labor services of an agent between the previous period and this period; otherwise output is zero. This agent will be referred to as the "manager" of the asset. An agent is only capable of managing a single asset between youth and old age, and this service is indivisible. Managing an asset is inseparable from control of the output of the asset in a sense to be described below. To anticipate, when young an agent will acquire the rights to manage an asset, and when old the agent will dispose of the output and cede the management rights to a young agent of the next generation.

The central feature of the model is that asset managers can falsify or "hide" any portion of the output from their asset. A manager can with-hold an amount z_j' of output, allowing the amount $\hat{x}_j' = x_j' - z_j'$ to be publicly observed (where x_j' is the true output). Falsification involves a cost of $\gamma z_j'$ units of consumption good, where γ is a constant between zero and one. The ability to falsify output is unique to the asset manager and is inseparable from the manager's role. There is no independent verification capability.

The costly falsification technology is explored in detail in a two-agent setting in Lacker and Weinberg, and also appears in an application to managerial earnings reporting by Dye (1987). Lacker and Weinberg consider general falsification cost technologies, and characterize optimal contracts under various cost functions. Their main result is that under a fairly broad class of cost functions the optimal contract is a piecewise linear payment schedule. The simple linear falsification cost that we posit here gives rise to linear payment schedules as well, but it should be emphasized that linearity of payment schedules can be obtained under nonlinear falsification cost technologies; we use linear costs to simplify the exposition.[1]

Finally, some demographic specifications are required. The population is constant and not all agents can act as managers. Formally, let I and I' denote the sets of young and old agents, respectively. Define $K \equiv I \cup I' \cup J$. Let κ be a mapping, from K to the positive integers, that denotes the type of each agent or asset. Agent i can produce output with asset j if and only if their types match, i.e., if $\kappa(i) = \kappa(j)$. Let $|X|$ denote the cardinality of the set X. We will assume that for all positive integers n,

$$|I \cap \kappa^{-1}(n)| = |I' \cap \kappa^{-1}(n)| = \lambda|J \cap \kappa^{-1}(n)| < \infty.$$

Hence, for each type, there are λ potential managers for each asset. We assume that $\lambda > 1$. In effect, λ is the ratio of agents of a given generation to assets. With a finite economy, this ratio could be specified directly, with all agents and assets having the same type.

In the next four sections we describe equilibrium arrangements and examine the characteristics of claims prices. Rather than begin with a formal, but at this stage necessarily general, definition of equilibrium, we adopt a more streamlined presentation. In the next section we take the claims issued by managers to be arbitrary functions of their asset's realized (displayed) return, and we characterize the market for those claims, deriving the form of the equilibrium claims pricing function. In Section 3

[1] This is not quite precise; it is strictly true when the state space, X, is a continuum. Because X is discrete here, optimal schedules would be nonlinear for nonlinear falsification costs, because of the discrete distance between adjacent states. Strict linearity is *not* essential to our results, however. For other settings in which optimal incentive contracts take a linear form see Holmstrom and Milgrom (1987), and Laffont and Tirole (1986).

we take the pricing function as given and examine the characteristics of the claims issued by asset managers. We derive the form of those claims, taking into account the incentives managers may have to falsify the asset's return. Then in Section 4 we bring these results together with market clearing conditions to establish that an equilibrium actually exists.

2. MARKETS FOR CLAIMS

A young agent acquires the right to manage asset j from an old agent for the price q_j units of consumption good; when old, the manager–agent obtains output, x_j', and sells the right to manage the asset to a member of the next generation for q_j'. The endowment of a single agent will be insufficient (in the equilibria we consider) to purchase an asset outright, and consequently the agent must issue claims on future proceeds from the asset. Define R_j' as the total payment from the manager to claimholders next period. R_j' can depend on any variable publicly observed next period (or earlier). Because output is independent across assets, in equilibrium the return on asset j need only vary with x_j' and q_j'. If R_j' varies with x_j' the manager may have an incentive to falsify the publicly observed value of x_j'. Agents are assumed to take this into account in valuing marketed claims. In the next section we show how the possibility of falsification constrains the form of the payment schedule; for now it is sufficient to take the total payment schedule, R_j', as given.

Agents that do not manage assets—"investors"—will use their endowment to purchase claims issued by various managers. Different claim schedules could be sold to different agents, but since all investors are identical and asset returns are independent there is no loss of generality in assuming that investors purchase shares of the total payment, R_j'. Define s_{ij} as the shares purchased by investor–agent i in the claims issued by the manager of tree j. Investor i takes as given share prices, p_j, $j \in J$, and payment schedules, R_j', $j \in J$, and chooses share purchases, s_{ij}, $j \in J$, to solve:

Problem 1.

$$V_I \equiv \max_{\text{s.t.}} E[U(c'(\omega'))|\omega]$$

$$\sum_{j \in J} s_{ij} p_j \leq \alpha$$

$$c'(\omega') \leq \sum_{j \in J} s_{ij} R_j'(x_j'), \qquad \text{for all } \omega',$$

where the expectation is over the state of the nature next period, $\omega' \equiv \{x_1', x_2', \ldots\}$, and is conditional on the relevant information available in the current period, $\omega \equiv \{x_1, x_2, \ldots\}$. Note that we do not exclude short sales.

Because there are a countably infinite number of *independent* random asset returns, there is clearly no systematic risk; any agent can (in the limit) form a perfectly diversified portfolio, making next period's consumption perfectly certain. As in Connor (1984), we allow portfolios to be arbitrary linear functionals on $\mathbb{R}^\infty$ under the usual norm. Thus, investors can hold a limit portfolio. If consumption is perfectly certain, then claims are only valued for their expected return: if asset h has a lower expected rate of return than asset j, no agent will be willing to hold shares in asset h. Since this is inconsistent with market clearing, all assets must have the same expected rate of return in equilibrium. Therefore, asset pricing is particularly simple,

$$rp_j = E[R_j'(x_j')|\omega], \qquad j \in J, \tag{2.1}$$

where r, the riskless rate of return, is a constant to be determined in equilibrium.[2]

3. FALSIFICATION AND THE FORM OF FINANCIAL CLAIMS

We can now consider the form of the claim schedules issued by asset managers. Taking a payment schedule as given, a manager will choose the amount of output to hide (if any) in order to maximize consumption. Investors will take into account the effect of the payment schedule on the manager's falsification decision. Equilibrium contracts must satisfy the condition that no manager can increase expected utility by offering some other payment schedule. This condition, along with the possibility of falsification, will determine the equilibrium payment schedule.

We will focus on a typical manager, managing asset j, say. After managing the asset the manager obtains the output, x_j', and receives q_j' for the sale to the next generation of the right to manage the asset. q_j' is publicly observed and cannot be falsified by the manager; only x_j' can be falsified. q_j' will depend on the characteristics of asset j, however, since the probability distribution governing future output from the asset will help deter-

[2] Equation (2.1) is an implication of Corollary 1, in Chamberlain (1983), and actually requires only the absence of arbitrage opportunities and the fact that asset returns have an "approximate K-factor structure" with $K = 0$. We have a "strict K-factor structure."

mine how much a young agent of the next generation is willing to pay for the management rights. Given the Markov law that governs output from assets, the only characteristic on which q_j' will depend is x_j', current output. In equilibrium there will be an asset price function, $q(\ )$, relating q_j' and *observed* x_j'. For this section we will take this function as given, and will write q_j' as $q(\hat{x}_j')$, where $\hat{x}_j'$ is the amount of output (possibly falsified) that is publicly observed.

The payment schedule, R_j', in principle can depend on any observed variables. Since returns are independent across assets there is no value to investors in having R_j' depend on the return to some other asset. And since assets are valued according to the expected value of their return, there is no value to the asset manager in having R_j' depend on the return to some other asset. So, without loss of generality, we can restrict attention to payment schedules that depend only on asset j variables: $R_j' = R_j'(x_j', q(x_j'))$.

The manager uses endowment, α, either as net investment in the asset, $q_j - p_j$, or as purchases of claims on other assets. The budget constraint faced by the manager when young is therefore

$$q_j - p_j + \sum_{h\in J} s_{ih} p_h \leq \alpha. \tag{3.1}$$

When old, the manager's consumption is

$$c' = x_j' + q(\hat{x}_j') - R_j'(\hat{x}_j', q(\hat{x}_j')) - \gamma(x_j' - \hat{x}_j') + \sum_{h\in J} s_{ih} R_h'. \tag{3.2}$$

For every $x_j' \in X$, the manager chooses $\hat{x}_j' \in X$ to maximize c'. Define $y_j'(x_j')$ as the amount displayed by the manager. We will need to ensure that $y_j'(x_j')$ maximizes consumption for each x_j'.

For any given payment schedule, asset markets determine the price, p_j, agents are willing to pay for that schedule in the current period. Managers take as given the (equilibrium determined) mapping from payment schedules to values of p_j. In view of the results of the previous section, this mapping takes a particularly simple form here; rp_j is equal to the expected value of the payment schedule, taking $y_j'(x_j')$ into account (where r is a constant that has yet to be determined). Given this mapping, and given q_j and $q(\ )$, the manager will offer the payment schedule that provides the highest expected utility. Therefore, we can find equilibrium payment schedules by choosing a payment schedule R_j' and a display schedule y_j' to solve the following problem:

Problem 2.

$$V_M \equiv \max_{\text{s.t.}} E[U(c'(x_j'))]$$

$$c'(x_j') = x_j' + q(y_j'(x_j')) - R_j'(y_j'(x_j'), q(y_j'(x_j')))$$

$$- \gamma(x_j' - y_j'(x_j')) + \sum_{h \in J} s_{ih} R_h', \qquad \forall x_j' \in X, \tag{3.3}$$

$$q_j - p_j + \sum_{h \in J} s_{ih} p_h \leq \alpha, \tag{3.4}$$

$$r p_j = E[R_j'(y_j'(x_j'), q(y_j'(x_j')))], \tag{3.5}$$

$$x_j' + q(y_j'(x_j')) - R_j'(y_j'(x_j'), q(y_j'(x_j'))) - \gamma(x_j' - y_j'(x_j')) + \sum_{h \in J} s_{ih} R_h'$$

$$\geq x_j' + q(\hat{x}_j') - R_j'(\hat{x}_j', q(\hat{x}_j')) - \gamma(x_j' - \hat{x}_j') + \sum_{h \in J} s_{ih} R_h',$$

$$\forall x_j', \hat{x}_j' \in X. \tag{3.6}$$

We will adopt the convention that if the manager is indifferent between two contracts the one with smaller expected falsification costs will be adopted. In this setting, Problem 2 is equivalent to finding a contract that maximizes the utility of the manager subject to the constraint that the expected value of the payment schedule is greater than or equal to some given minimum. An equivalent approach in a two-agent setting, as in Lacker and Weinberg, is to maximize the utility of the manager subject a minimum utility constraint for a risk neutral agent receiving R_j'. We have essentially the same risk-sharing role for contracting here, but due to the risk neutrality of asset pricing rather than the risk neutrality of a particular agent.

Characterizing the solution to Problem 2 has three steps. First, the fact that asset markets allow perfect diversification implies that, like investors, managers can obtain a perfectly certain return on that portion of their portfolio devoted to marketed claims: $\alpha - (q_j - p_j)$. This implies that the term, $\sum_{h \in J} s_{ih} R_h'$ in (3.6) can be replaced by $r[\alpha - (q_j - p_j)]$. We can use this fact to combine Eqs. (3.3) and (3.4), obtaining

$$c'(x_j') = x_j' + q(y_j'(x_j')) - R_j'(y_j'(x_j'), q(y_j'(x_j'))) - \gamma(x_j' - y_j'(x_j'))$$
$$+ \alpha r - q_j r + E[R_j'(y_j'(x_j'), q(y_j'(x_j')))|x_j]. \tag{3.7}$$

Second, consider an alternative realization of output, $\bar{x}_j'$, such that $\bar{x}_j' < x_j'$. Because $\hat{x}_j'$ is chosen to maximize consumption, we know that

$$c'(x_j') \geq x_j' + q(y_j'(\bar{x}_j')) - R_j'(y_j'(\bar{x}_j'), q(y_j'(\bar{x}_j'))) \\ - \gamma(x_j' - y_j'(\bar{x}_j')) + \alpha r - q_j r + E[R_j'(y_j'(x_j'), q(y_j'(x_j')))|x_j]. \quad (3.8)$$

By combining this equation with the definition of $c'(\bar{x}_j')$, we can obtain a simple implication of incentive compatibility:

$$c'(x_j') - c'(\bar{x}_j') \geq (1 - \gamma)(x_j' - \bar{x}_j'). \quad (3.9)$$

It should be emphasized that this condition holds whether or not falsification occurs. In fact, any consumption schedule that satisfies (3.9) can be supported by some payment schedule and incentive-compatible display schedule.

Finally, suppose that the payment schedule is

$$R_j'(x_j', q(x_j')) = x^1 + \gamma(x_j' - x^1) + q(x_j') \\ = \gamma x_j' + q(x_j'). \quad (3.10)$$

Now the consumption schedule satisfies (3.9) with equality for any display schedule, including the truthful one, $y_j'(x_j') = x_j'$. But p_j is affected by the display schedule, via (3.5), and is *largest* for the truthful schedule. Thus mean consumption is largest for the truthful schedule, since falsification costs are zero [see (3.7)]. So for the payment schedule given by (3.10), the truthful schedule dominates all other display schedules. From (3.7) it is clear that no other payment schedule provides greater mean consumption. Any payment schedule that provides the same mean consumption as (3.10) and $y_j'(x_j') = x_j'$ must involve no falsification. It is easy to show that any such payment schedule implies a consumption schedule that is a mean preserving spread of that implied by (3.10) and $y_j'(x_j') = x_j'$, by the "single-crossing property" (see Lacker and Weinberg for details). Therefore, (3.10) and $y_j'(x_j') = x_j'$ is the unique solution to Problem 2.

For some insight into this result, combine the incentive constraint (3.9) with the definition of $c'(x_j')$ to obtain

$$R_j'(x_j', q(x_j')) - R_j'(\bar{x}_j', q(\bar{x}_j')) \leq \gamma(x_j' - \bar{x}_j') + q(x_j') - q(\bar{x}_j'). \quad (3.11)$$

Because the manager is risk averse the optimal contract will attempt to shift as much risk as possible from the manager to the "market." Complete shedding of risk by the manager would require $R_j' = x_j' + q(x_j') +$ (constant), but this would violate (3.11). Clearly, it is incentive compatible to have the payment vary one-for-one with the resale price, $q(x_j')$; q_j' is just passed through from the manager to investors. But as (3.11) indicates, it is not incentive compatible to have the payment vary one-for-one with output. Imagine that it did: by hiding some of the output the manager would gain more in reduced payment than would be lost to falsification costs. Therefore, the payment schedule cannot have a slope greater than γ.

The optimal payment schedule (3.10) implies that the consumption of the manager is

$$c'(x_j') = (1 - \gamma)x_j' + r(\alpha - q_j + p_j). \tag{3.12}$$

The second term is the certain return from the portion of the manager's initial endowment that is invested in (perfectly diversified) market securities. The first term is an undiversifiable risk born by the manager. This risk cannot be diversified away precisely because of the possibility of falsification; any claim schedule that provided perfect diversification for the manager would also provide the manager with incentive to cheat by hiding output when output is high. This, of course, closely parallels the initial insight of Holmstrom (1982).

4. EQUILIBRIUM

In this section we define a stationary equilibrium and show that a unique stationary equilibrium exists. The price vector for the economy consists of a (riskless) rate of return, r, along with two asset price functions: $p(\ )$, the price of claims issued by asset managers, and $q(\ )$, the price of management rights to productive assets. Taking these as given agents choose whether or not to purchase management rights to an asset, and how to allocate their portfolios. An equilibrium consists of a price vector, portfolio choices $\{s_{ij}\}$, payment schedules $\{R_j'(\ )\}$, and assignments of managing agents to assets.

Agents must be indifferent between managing assets and becoming investors in equilibrium, so we require

$$V_I = V_M. \tag{4.1}$$

Actual assignments of agents to assets is a matter of labeling. The market for shares in asset claims must clear. This condition can be most clearly stated by averaging over all assets in a given current state. All assets with current output of x^n are identical, and, by the law of large numbers, the fraction of all assets in state n at any time is π_n, the stationary probability of state n. Let s_n be the average, or per capita, holdings of claims to assets with current state n. Market clearing in claims requires

$$\lambda s_n = \pi_n, \qquad \text{for } n = 1, \ldots, N. \tag{4.2}$$

In addition, equilibrium quantities must solve Problems 1 and 2, taking the price vector as given.

It will prove useful to define a new variable:

$$\phi_n = \phi(x^n) = E[x' + q(x')|x^n] - rq(x^n), \qquad \text{for } n = 1, \ldots, N. \tag{4.3}$$

For an asset whose current output is $x_j = x^n$, ϕ_n is the *risk premium* required by managers to compensate for the undiversifiable risk associated with asset management. To see this, note that consumption by the manager of this asset can be written

$$c'(x') = (1 - \gamma)(x' - \mu_n) + \alpha r + \phi_n, \tag{4.4}$$

where $\mu_n \equiv E[x'|x^n] = \Sigma\pi_{mn}x^m$. Consumption is a mean zero random variable plus the certain consumption of investors, αr, plus ϕ_n. The equilibrium condition (4.1) can be written

$$E[U((1 - \gamma)(x' - \mu_n) + \alpha r + \phi_n)|x^n] = U(\alpha r), \qquad \text{for } n = 1, \ldots, N. \tag{4.5}$$

Finally, the asset market clearing conditions can be collected and written as

$$\bar{q} \equiv \sum_{n=1}^{N} \pi_n q(x^n) = \alpha\lambda. \tag{4.6}$$

This states that the value of assets equals the net demand for assets expressed on a per asset basis. Equations (4.3), (4.5), and (4.6) provide $2N + 1$ equations in the $2N + 1$ unknowns ϕ_n, $q(x^n)$, $n = 1, \ldots, N$, and r. Define μ by $\mu = \Sigma_n\pi_n\mu_n$, and note that, by stationarity, $\mu = \Sigma_m\pi_m x^m$. We can now state:

PROPOSITION 1. *Suppose that*

$$U(\alpha\mathbf{r}) \geq E[U((1 - \gamma)(x' - x^1))|x^n], \qquad \text{for } n = 1, \ldots, N, \ \mathbf{r} \equiv 1 + (\alpha\lambda)^{-1}\gamma\mu. \tag{4.7}$$

Then a unique equilibrium exists, with $r \geq \mathbf{r}$. If $\gamma < 1$, then $r > \mathbf{r}$.

$\mathbf{r}$ is a lower bound on the rate of return on assets, corresponding to upper bounds on the values of the risk premia, ϕ_n. The condition in the proposition states that at $\mathbf{r}$, utility is greater than the expected utility of the smallest feasible manager's return. This ensures that (4.5) can hold at interior values of r. Note that in the perfect information case ($\gamma = 1$), $r = \mathbf{r} = 1 + (\alpha\lambda)^{-1}\mu$, $\phi_n = 0$ and $q(x^n) = p(x^n)$ for all n, and (4.7) is satisfied trivially. In this case the manager perfectly diversifies, issuing exactly as much in liabilities as is required to obtain the asset.

Proof of Proposition 1. Define $\phi_n(r)$ by

$$E[U((1-\gamma)(x' - \mu_n) + \alpha r + \phi_n(r))|x^n] = U(\alpha r), \qquad \text{for } n = 1, \ldots, N. \tag{4.8}$$

$\phi_n(r)$ are strictly positive and bounded by the strict concavity of U. They are defined for all $r \geq \mathbf{r}$, by the conditions of the proposition. They are continuously differentiable in r, and $\phi_n'(r) > -\alpha$, since $[\alpha r + \phi_n(r)]$ is strictly increasing in r. Monotonicity of U also implies that

$$\phi_n(r) < (1 - \gamma)\mu_n. \tag{4.9}$$

Define $\phi(r) = \sum_{n=1}^{N} \pi_n \phi_n(r)$. Then (4.3) can be rewritten

$$\phi_n(r) = \sum_{m=1}^{N} \pi_{mn} x^m + \sum_{m=1}^{N} \pi_{mn} q(x^m) - rq(x^n).$$

Multiplying by π_n and adding across n, using stationarity, we obtain $\phi(r) = \mu + (1 - r)\bar{q}$, where $\mu = \sum \pi_n \mu_n$. Rearranging, using (4.6), $r = 1 + (\alpha\lambda)^{-1}(\mu - \phi(r)) \equiv \Psi(r)$. We seek a value of r satisfying $r = \Psi(r)$. $\Psi(r)$ is defined for $r \geq \mathbf{r}$. $\Psi(r) > \mathbf{r}$ for all $r \geq \mathbf{r}$, since $\mu - \phi(r) > \gamma\mu$ by (4.9). $\Psi(r)$ is bounded. And

$$\begin{aligned}\Psi'(r) &= -(\alpha\lambda)^{-1} \sum_{n=1}^{N} \pi_n \phi_n'(r) \\ &< (\alpha\lambda)^{-1} \sum_{n=1}^{N} \pi_n \alpha \\ &< \lambda^{-1} < 1.\end{aligned}$$

Therefore there exists a unique solution to $r = \Psi(r)$.

Now (4.3) can be rewritten

$$q(x^n) = r^{-1}\left[\mu_n + \sum_{m=1}^{N} \pi_{mn} q(x^m) - \phi_n\right], \qquad \text{for } n = 1, \ldots, N. \quad (4.10)$$

Given the nonsingularity of $\{\pi_{mn}\}$, this system of linear equations provides a solution for the pricing function $q(x^n)$. Q.E.D.

The allocation generated by the equilibrium described in this section cannot be improved upon by any alternative contractual arrangements that respect the technological and informational constraints of the environment.[3] Proposition 1 establishes the existence of a competitive equilibrium which supports this allocation. This equilibrium arises when the economy is decentralized by means of a particular "market arrangement." Under this arrangement a young manager "purchases" a productive asset from an old manager. The purchase price is, then, part of what the old manager is contractually bound to pay out to his (old) investors. A specification of property rights is implicit in this market arrangement. Specifically, the productive resource and the right to "control" it is the old manager's to sell. It is worth noting here that the same equilibrium allocations, and, in fact, the same asset prices, can be supported under alternative market arrangements or property rights regimes. These alternative arrangements will be considered in Section 6.

5. CHARACTERISTICS OF EQUILIBRIUM PRICES

The previous section makes clear that there are two prices associated with each asset, p and q. The first is the price of the financial asset issued by a manager while the second is the price the manager pays to acquire the physical asset. That these prices are different for an asset with a given current state is due to the friction which incentive compatibility imposes on the manager's ability to shed risk; under perfect information they are identical. The unique properties of asset prices in our model are the direct result of the difference between p and q. Because these assets bear a strong resemblance to observed traded equity claims, we will occasionally refer to them as "stocks."

The state contingent price of physical assets is given by the stochastic difference equation (4.10), which can be rewritten as

$$q(x^n) = r^{-1}\{E[x_{t+1} + q(x_{t+1})|x_t = x^n] - \phi(x^n)\}. \quad (5.1)$$

[3] We do not claim that the equilibrium allocation is Pareto-optimal. There are reallocations, even just within generations, that dominate our equilibrium: have agent $i + 1$ give ε of the consumption good to agent i, for all $i \in I$.

(In this section we will be explicit about time.) Repeated substitution for $E[q(x_{t+1})|x_t = x^n]$ yields

$$q(x^n) = \sum_{s=1}^{\infty} r^{-s}E[x_{t+s} - \phi(x_{t+s-1})|x_t = x^n]. \tag{5.2}$$

Equation (5.2) states that the current price of control of an asset of type x^n is equal to the expected present discounted value of future output from the asset, minus the expected present discounted value of the risk premia required to compensate future managers. Note that the stream of output begins with x_{t+1}, while the stream of risk premia begin with $\phi(x_t)$; this makes sense because $\phi(x_t)$ is the premium associated with the manager from period t to period $t + 1$, who controls output x_{t+1}. Equations (2.1) and (3.10) give stock prices as

$$p(x^n) = r^{-1}E[\gamma x_{t+1} + q(x_{t+1})|x_t = x^n]. \tag{5.3}$$

Using (5.2) we can derive an expression for $p(x^n)$ in terms of expected future output alone:

$$p(x^n) = r^{-1}E[\gamma x_{t+1}|x_t = x^n] + \sum_{s=2}^{\infty} r^{-s}E[x_{t+s} - \phi(x_{t+s-1})|x_t = x^n]. \tag{5.4}$$

Equation (5.4) states that the current value of marketed claims on an asset of type x^n is equal to the expected present discounted value of the portion of next period's output distributed to claimholders plus the expected present discounted value of the stream of output from period $t + 2$ on, net of the associated managerial risk premia. Comparing (5.2) and (5.4), it is apparent that these two prices differ only for the period $t + 1$ term. The difference is given by

$$q(x^n) - p(x^n) = r^{-1}\{(1 - \gamma)E[x_{t+1}|x_t = x^n] - \phi(x^n)\}. \tag{5.5}$$

In the perfect information case ($\gamma = 1$), Eqs. (5.1) and (5.3) simplify to

$$q(x^n) = p(x^n) = r^{-1}E[x_{t+1} + q(x_{t+1})|x_t = x^n]. \tag{5.6}$$

The manager completely diversifies, no risk premium is required ($\phi(x^n) = 0$), and a standard asset price formula is obtained. In this case the value of the liabilities of the manager, $p(x^n)$, are equal to the value of the asset the manager acquires: the manager is fully leveraged. The asset's equilibrium value is just the present discounted value of expected future output.

Under costly falsification ($\gamma < 1$) asset price formulae are very different. The manager is not able to fully diversify because the resulting financial claim would not be incentive compatible. Thus $q(x^n) > p(x^n)$ for all x^n, and the manager must invest a significant portion of his own endowment to obtain control of the asset.[4] The difference between $q(x^n)$ and $p(x^n)$ is the discounted expected value of the risky portion of the output consumed by the manager, less the premium necessary to induce the manager to bear that risk. Equation (5.1) shows that the incentive compatibility constraint depresses $q(x^n)$, the cost of the asset, since the risk premium, ϕ_n, is deducted from expected future output at each date.

The incentive problem associated with the possibility of falsification "drives a wedge" between the values of financial assets and the physical assets by which they are backed. This leads to several interesting implications about the behavior of financial asset prices. Note, first, that the fact that $q(x^n) > p(x^n)$ might be interpreted (incorrectly) as meaning that the "firms" in this economy are "undervalued." $q(x^n)$ is the "replacement cost" of the type x^n capital: the cost to a manager of acquiring an asset whose current state, or output, is x^n. Since $p(x^n)$ is the market value of the equity of the "firm," p/q is reminiscent of "Tobin's Q." Deviations of Tobin's Q from unity are often taken to indicate that a firm or economy is out of "long run equilibrium" (Tobin, 1969). In particular, a value of Q less than unity is usually associated with positive net investment. Q is always less than one in our model, both for individual firms and in the aggregate, because managers are obligated to bear undiversifiable risk in their own productive assets.

There is no relationship between $Q = p/q$ and investment in the model of this paper, since the stock of assets is permanently fixed. Our analysis does suggest, however, that Tobin's Q can deviate systematically from unity for reasons unrelated to the capital formation process. The model illustrates that the forces which determine the contractual nature of the firm will affect the relationship between the values of financial and physical assets.

6. ALTERNATIVE PROPERTY RIGHTS REGIMES

The nature of the optimal contract in this economy also has interesting implications for the observed relation between financial asset prices and measured dividends. These implications, however, depend on the market arrangement or property rights regime assumed to hold in the economy.

[4] To prove that $q(x^n) > p(x^n)$, note that by Eq. (4.9) the second term on the right hand side of (5.5) is always positive.

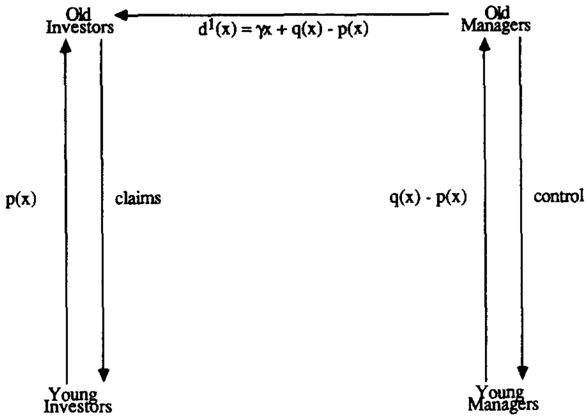

FIG. 1. The pattern of exchange under Regime 1.

From whom, we must ask, does a young manager acquire the control of a productive asset? Until now we have assumed that the old manager possesses the "right" to determine the identity of the next manager and so a new manager must compensate the old manager to obtain that right. In this section we consider two alternate property rights regimes, both of which yield identical equilibrium allocations. Under the first specification we obtain a standard relation between asset prices and dividends. Under the second specification asset prices exhibit excess volatility. We will argue below that observed economies might be expected to exhibit behavior between these two polar cases.

Regime 1. A manager of the young generation purchases control of an asset from a manager of the old generation for a price of $q(x^n) - p(x^n)$. This amount, together with γx^n, is passed on to the old investors by contractual obligation. Old investors then sell their claims (ex dividend) to young investors at price $p(x^n)$. Under this regime, dividends are the amount transferred from old managers to old investors:

$$d^1(x^n) \equiv \gamma x^n + q(x^n) - p(x^n).$$

In this regime, the right to transfer control of productive resources lies with the incumbent managers of those resources. This right is itself an asset with value $q(x^n) - p(x^n)$. Optimal contracts, however, are such that outgoing managers are obligated to pass this value on to their investors. The flow of exchange in this regime is depicted in Fig. 1.

Under this regime, the pricing equation for financial assets (5.3) can be written

$$p(x^n) = r^{-1}E[d^1(x_{t+1}) + p(x_{t+1})|x_t = x^n].$$

This is a standard pricing equation for a risk neutral asset market. Repeated substitution for $E[p(x_{t+1})|x_t = x^n]$ yields the well known "present value condition" which arises in many asset pricing models (see Brealey and Myers, 1981, pp. 42–45). Hence, for an economy in which all transactions involving financial assets are carried out exclusively among investors (no new claims are issued, no old claims are bought out by new managers), our model yields very standard predictions concerning the behavior of asset prices.

Regime 2. A manager of the old generation pays γx^n to old investors. Then a manager of the young generation acquires the physical asset directly from investors of the old generation at a price of $q(x^n)$. The young manager finances his acquisition by issuing a perfectly divisible claim to $\gamma x'$, which sells for $p(x^n)$. Under this regime, dividends are

$$d^2(x^n) \equiv \gamma x^n.$$

This regime corresponds to a legal system vesting the right to determine the identity of the management with the financial claims of investors: young managers are "hired" by old owner–investors. An important additional feature of this regime is that the installation of a young manager is irrevocable until the end of his productive life. Figure 2 depicts the pattern of exchange in Regime 2.

Under this regime the relation between asset prices and dividends is very different. It will be convenient to introduce a new function, $\eta(x^n)$, defined as

$$\eta(x^n) \equiv (1 - \gamma)\mu_n - \phi_n = r[q(x^n) - p(x^n)]. \tag{6.1}$$

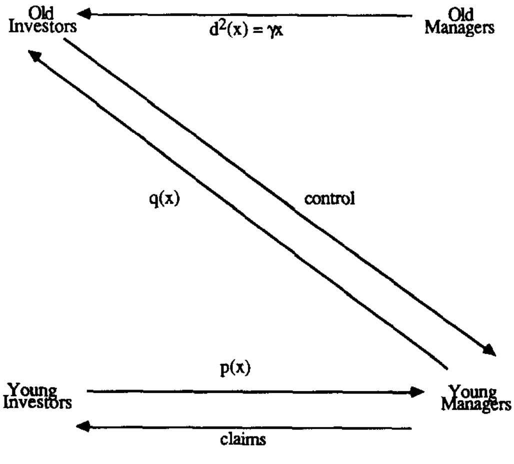

FIG. 2. The pattern of exchange under Regime 2.

$\eta(x^n)$ can be thought of as the "value of control"; it is the premium a manager is willing to pay to acquire the right to control the firm. With this definition, and dividends defined as d^2, financial asset prices can be written as

$$p(x^n) = r^{-1}E[d^2(x_{t+1}) + r^{-1}\eta(x_{t+1}) + p(x_{t+1})|x_t = x^n]. \tag{6.2}$$

The current price of the asset is equal to the expected discounted value of the sum of next period's dividend, next period's price, and the premium that the young manager is willing to pay next period. Repeated substitution for $E[p(x_{t+1})|x_t = x^n]$ yields

$$p(x^n) = E\left[\sum_{s=1}^{\infty} r^{-s}d^2(x_{t+s}) + r^{-s-1}\eta(x_{t+s})|x_t = x^n\right]. \tag{6.3}$$

Note that the present value condition is augmented by the $\eta(x_{t+s})$ terms, the expected future value of control. Suppose an economist possessed time series observations on $\{p(x_t), d^2(x_t)\}$ for a long stretch of time. The economist would find that $p(x^n)$ moves "too much to be justified by subsequent changes in dividends" as Shiller (1981) puts it. Specifically, the variance of $p(x_t)$, conditional on $t - 1$ information, is larger than the corresponding conditional variance of the expected present value of the stream of future dividends. Thus, under Regime 2 stock prices display "excess volatility." This is made precise in the following proposition:

PROPOSITION 2. *If dividends are given by $d^2(x)$ and x_{t+1} is stochastically increasing in x_t, then* $\text{var}_{t-1}[p(x_t)] > \text{var}_{t-1}[V_d(x_t)]$, *where*

$$V_d(x^n) \equiv E\left[\sum_{s=1}^{\infty} r^{-s}d^2(x_{t+s})|x_t = x^n\right].$$

Proof. Define $V_\eta(x^n)$ as

$$V_\eta(x^n) \equiv E\left[\sum_{s=1}^{\infty} r^{-s}\eta(x_{t+s})|x_t = x^n\right].$$

Now Eq. (6.3) can be written $p(x^n) = V_d(x^n) + r^{-1}V_\eta(x^n)$. The result will be immediate once it is shown that $\text{cov}_{t-1}(V_d(x_t), V_\eta(x_t)) > 0$. Because x_{t+1} is stochastically increasing in x_t, and all future values of x_{t+s} are positively correlated (given x_t), we need only establish that $\eta(x_t)$ is increasing. From the definitions of $\phi(x^n)$ and $\eta(x^n)$ we have

$$E[U((1-\gamma)x_{t+1} - (1-\gamma)\mu_n + \phi(x^n) + \alpha r)|x_t = x^n] \tag{6.4}$$
$$= E[U((1-\gamma)x_{t+1} - \eta(x^n) + \alpha r)|x_t = x^n]$$
$$= U(\alpha r).$$

The only random term in the expected utility expressions in (6.4) is $(1-\gamma)x_{t+1}$. For fixed η, the left hand side of the second equality in (6.4) is increasing in x_t, since x_{t+1} is stochastically increasing in x_t. Hence, to maintain equality with the constant $U(\alpha r)$, $\eta(x)$ must be increasing. From this, it follows that the covariance above is positive and that the variance (as of period $t-1$) of a financial asset's price at t is strictly greater than the variance (as of $t-1$) of the present value of the stream of dividends starting in period $t+1$. Q.E.D.

The excess volatility result presumes that the economist sees $p(x_t)$ but not $q(x_t)$. It might be argued that time series observations on stock prices would include some or all of both prices, since the new manager's purchase of shares from old investors is a market transaction under this interpretation. Allowing this possibility would just strengthen our case, however, because the variance calculated using such a time series would be even greater than the variance of $p(x_t)$.[5]

Regimes 1 and 2 differ according to how the quantity $q-p$ is transferred from the young manager to the old investors. Our excess volatility result is obtained under one interpretation of the model—that of Regime 2. The quantity $\eta = q - p$ can be thought of as the "value of control," since it accrues to the agent or agents that possess the right to determine the identity of the next manager. Whether this value is passed to old investors as dividends or instead by a "direct purchase of shares" depends on the nature of the transactions constituting changes of control, which in turn depends on the assignment of property rights.

It is worth emphasizing that Proposition 2 requires the feature of Regime 2 that installation of the younger manager is irrevocable. If a young manager could be unseated, other potential young managers would be

[5] To see this, divide each period into two subperiods, one in which the asset price is $q(x_t)$, and another in which it is $p(x_t)$. The variance of this time series can be written as

$$\tfrac{1}{2}[\mathrm{var}(p(x_t)) + \mathrm{var}(q(x_t)) + (\bar{q} - \bar{p})^2],$$

where $\bar{q}$ and $\bar{p}$ are the means of $p(x_t)$ and $q(x_t)$. Because $p(x_t)$ and $\eta(x_t)$ are both increasing in x_t, the definition of $\eta(x_t)$ implies that $\mathrm{var}(q(x_t)) > \mathrm{var}(p(x_t))$. Therefore, the expression above is strictly greater than $\mathrm{var}(p(x_t))$. Note that this applies for both conditional and unconditional variances.

willing to pay anything up to q for control of the firm. But this would be inconsistent with the original young manager financing the acquisition with claims valued at $p < q$. Thus the young manager is willing to pay q even though investors pay only p for financial claims; the young manager acquires something—control for one period—that new investors do not receive. Hence, p and q are prices of different objects.

Which of the two regimes more closely resembles the allocation of property rights in the modern corporate economy? The answer is not immediately apparent. The meaning and specification of rights relating to changes in corporate control is a somewhat unsettled issue in the literature on the law and economics of the corporation (see Fama and Jensen, 1983; Manne, 1965). While it is clear that ultimately shareholders have the right to determine who shall control the corporation's assets, much of the authority over changes in control is delegated to managers; top management has considerable discretion over internal succession and offers from outside acquirers. It is true, however, that some changes in control take the form of direct purchases from investors by a manager, backed by the issue of new claims. It is this latter form of transfer of control—the "takeover"—which resembles our Regime 2 and in our model is associated with excess volatility. This suggests that the actual specification of property rights in the corporate economy may be some mixture of the two polar cases examined here. The presence of even some transactions resembling those under Regime 2 would produce excess volatility in an economy characterized by the type of incentive problem we have examined.

Although alternative regimes give rise to different definitions of dividends, it is worth emphasizing that the definition of dividends is not arbitrary. In all cases, we have defined dividends as the state contingent transfer made from an old manager to his (old) investors. This transfer is determined in equilibrium by the optimal contract and the market arrangement governing changes in control.

The excess volatility that arises in this regime is consistent with current empirical results on stock price volatility (see, for instance, West, 1988b and Campbell and Shiller, 1987). The real rate is constant over time, even though it is endogenous, and expectations are rational, so the model is consistent with West's (1988a) findings that excess volatility is probably not attributable to irrational expectations or varying discount rates.

Empirical studies of stock price volatility focus on aggregate data, while our volatility results pertain to the stock in a given firm. There is no aggregate excess volatility in our model, because there is no aggregate uncertainty. At one level, we feel this is not a serious shortcoming. Aggregate excess volatility obviously requires excess volatility at the level of the individual firm, for at least some firms in the economy. Of course, it is also true that for any finite aggregation of assets in our model our excess volatility result continues to hold.

A more convincing approach would be to extend the model to allow for aggregate uncertainty. In certain forms, aggregate uncertainty is easily accommodated, fluctuations in average rates of return, for example. Other extensions might affect the form of the optimal contract, and so would require careful analysis. We believe, though we have not actually proven this yet, that our analysis could be carried out allowing for non-trivial market risk. The optimal contract would be unchanged, since the manager would still wish to shed as much *idiosyncratic* risk as possible. Asset price equations would still contain an η term, but now the effect of η on the aggregate stock price would vary with the aggregate shock.

Our model differs in an important respect from other theoretical explanations of stock price volatility. Most existing work takes one of two approaches. Some authors have proposed alternative models of the process generating the stream of dividends, while others have sought to model the process by which such a stream gets valued by the market in ways which deviate from the traditional "efficient markets" approach. The former approach starts with the observation that "too much variation in prices" might be reinterpreted as "too little variation in dividends." Marsh and Merton (1986) posit dividend smoothing by managers and show that the "variance bounds" restrictions of Shiller (1981) are no longer implied by market rationality. Kumar and Spatt (1987) show that dividend smoothing can arise as the equilibrium of a multiperiod signalling game.

There is a sense in which dividends are smoothed in our model. Under "first-best" risk sharing, the manager's consumption would be constant, and dividend payout would vary one-for-one with output, x. This is not the same, however, as in Marsh and Merton or Kumar and Spatt, where dividends are "smoother than cash flow." If one thinks of $(1 - \gamma)x$ in our model as contractually guaranteed managerial compensation, then γx, the dividend in Regime 2, is equal to cash flow.

The second approach mentioned above seeks formulations under which the market value of a stock might deviate from its "fundamental" value, usually associated with a stream of dividends. One formulation which achieves this involves the participation of "irrational" or "noise" traders (DeLong *et al.* 1987; Campbell and Kyle, 1988) Such models are usually associated with the notion of fads or random waves of optimism or pessimism in the market.

In overlapping generations models with multiple rational expectations equilibria, it has been demonstrated by Aiyagari (1988) and Ravikumar (1989) that a stock price can fluctuate even if dividends are constant. These models are similar in structure to those that give rise to "bubbles" or "sunspot" equilibria. As in the noise trader literature, the deterministic cycles literature seeks a model of the financial market's valuation of a stream of dividends. By contrast, in our model a stock is a claim to more than the stream of dividends. This focus on the value of control is what differentiates our result from the previous literature on volatility.

Our point of departure from the literature has potential empirical implications. Broadly stated, the results in this paper suggest that inclusion of an aggregate measure of the value of control in market transactions for control should "improve the fit" of the present value model. While a direct measure of the value of control is unlikely to be available, a reasonable proxy might be the asset value to takeover activity. There may also be useful international comparisons to be made. To the extent that the level of activity in the market for corporate control varies persistently across countries, so should the "fit" of the present value model. In short, our analysis suggests that variation in activity in the market for control may contribute to our understanding of stock market fluctuations. We feel that this possibility is well worth exploring.

7. CONCLUDING REMARKS

Private information and incentive problems place limits on the contracts which can be written among the participants in productive activity. There is a substantial consensus that our understanding of the behavior of firms can be greatly enhanced by paying careful attention to these limits. This basic insight has proved useful in the examination of issues ranging from the "employment relationship" and the structure of wages within a firm to the nature of ownership and vertical integration. Much of this work has implicitly recognized a link between the frictions of asymmetric information and the firm's ability to attract financing from the capital market. This link becomes explicit when the optimal contracting literature is brought to bear on the firm's financial structure. To the extent that such contractual forces are important in determining the financial policy of the typical firm, one would expect those same forces to have a noticeable effect on equilibrium in the capital markets. We have presented an explicit model of this link.

Rather than take the stream of payments underlying the asset as given, our model simultaneously determines the form of the claims which will be issued in equilibrium. The marketed financial asset differs from a simple claim to dividends by an amount which can be interpreted as the value of control of the "firm's" productive resources. This finding enhances our interpretation of the equilibrium claim as an equity share. Under this interpretation, the model's results shed light on the behavior of stock prices. In particular, excess volatility of stock prices emerges for reasons intimately related to the "separation of ownership and control" of productive resources. One is tempted to note that the apparently extreme volatility in the stock market in recent years has coincided with an unprecedented flurry of activity in the market for corporate control.

While we have examined the link between incentive compatibility and asset prices for a very specific incentive problem, we are confident that the intuition built here will extend to other settings. The essential friction would be the same, for instance, if managers' behavior was subject to an *ex ante* more hazard problem. In fact, similar results should arise from any setting in which managers must hold idiosyncratic risk while investors hold only systematic risk.

This paper establishes a useful framework within which to understand the behavior of asset prices in a corporate economy. Consideration of the forces affecting the organization of production produces insights into the nature of financial assets issued by productive organizations. Our model isolates one such force, that of incentive compatibility in the face of an informational imperfection.

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