Empire building by corporate managers: The corporation as a savings instrument

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Abstract

The paper reports two findings. First, independent corporate managers operating under a linear incentive contract tend to overinvest, thus failing to maximize the wealth of corporate owners. This provides a formal proof of Jensen’s influential proposal that under separation of ownership and control investment will be inefficient. Second, the empire-building motive is shown to be related to the degree of uncertainty, the structure of the managerial compensation scheme, and the degree of risk aversion and preference for prudence. The model provides an integration of the traditional neoclassical theory of investment under uncertainty and the theory of investment under separation of ownership and control introduced by the theory of corporate finance. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

It is more than a decade since Jensen (1986) advanced his influential vision of the conflict of interest between corporate managers and shareholders resulting in inefficient corporate investment behavior: “Corporate managers are the agents of shareholders fraught with conflicting interests.” “Managers have incentives to cause their firms to grow beyond the optimal size.” In Jensen’s view, “Growth...
increases managers’ power by increasing the resources under their control. It is also associated with increases in managers’ compensation, because changes in compensation are positively related to the growth in sales.”

Jensen has identified an issue which is of major relevance when the profession wants to build understanding of how investment decisions are undertaken and how market economies operate under agency relations. The fact that successful hostile takeovers occur supports Jensen’s proposition. One of the fundamental implications of his view, that managers of publicly held corporations tend to invest “too much”, is related to the quality of corporate investment. Unfortunately, such an “empire-building” motive has so far eluded formal justification based on economic fundamentals. The current paper raises the question of whether it is likely that independent managers operating under typical managerial compensation schemes choose inefficient investment programs.

The paper is based on the following ideas. First, corporate investment is subject to market risks. Second, information is asymmetric between shareholders and corporate managers. Third, the behavior of managers is governed by risk aversion and by the preference for prudence. Fourth, the management operates under a linear compensation scheme. Fifth, the return on human capital of managers is saved inside the firm. The corporation thus functions like a savings instrument for management, independent managers deriving private benefits from the resources of company over which they have control.

To cope with the issues of risk, the model to be introduced will be formulated in the framework of stochastic optimal control. We find it helpful to contrast our results with those obtained in the neo-classical tradition with a value-maximizing model (Abel, 1983). Our model will be more complicated in that risk aversion and managerial compensation create additional mechanisms.1

We prove the following results. First, a management with concave utility function is willing to invest in projects whose marginal value to shareholders is less than their marginal cost. This provides a formal justification for Jensen’s proposal. The empire-building incentive can be controlled if the management renumeration is made contingent on current profits of the firm net of the investment cost. The incentive does not, however, disappear, if the rate of time preference of the managers is small (future consumption is appreciated) or if the stock-price-related pay is important relative to pay related to current

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1 The introduction of such mechanisms turns out to be technically quite a hard task. It leads to a control problem with a forward-looking integral constraint. As far as the author is aware, the control problem including such a constraint has not been studied earlier in the literature.
It has been suggested by Grossman and Hart (1982), Easterbrook (1984), Jensen (1986), Zwiebel (1994) and Hart (1995) that capital markets create mechanisms to control corporate managers' incentives to invest in unprofitable projects. The hypothesis of inefficient investment was also developed by Stulz (1990). Hart and Moore (1995) showed that long-term debt can be used to constrain the managerial overinvestment incentive. In Rajan and Winton (1995), a credit contract creates an incentive for the bank to monitor the corporation. However, capital markets do not control use of the internal funds by the managers. This is the subject of the present analysis. Therefore, the reward structure, the extent to which the managerial reward is subject to risks, is essential for the optimal management response to price uncertainty. Under greater vulnerability to risk, capital investment provides the managers with an instrument for a precautionary strategy. This finding suggests that the commonly observed managerial contracts not only create incentives for empire building within companies but that these incentives are related to the degree of market uncertainty.

2. Management preferences and overinvestment

We consider now a share company under separation of ownership and control. Conflicts of interest between the owners and the management may arise in many ways; our model is consistent with several explanations. We can think that investment planning is complex enough to require special competence. Some agents, called managers, have access to the required skill, while the outside shareholders are atomistic, have no incentive to engage in costly monitoring effort and do not possess such a skill. Hence, they confine themselves to trading the firm’s shares. Once the contractual relationship has been established, a moral hazard problem arises under delegation of investment decisions. It may

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2 It has been suggested by Grossman and Hart (1982), Easterbrook (1984), Jensen (1986), Zwiebel (1994) and Hart (1995) that capital markets create mechanisms to control corporate managers' incentives to invest in unprofitable projects. The hypothesis of inefficient investment was also developed by Stulz (1990). Hart and Moore (1995) showed that long-term debt can be used to constrain the managerial overinvestment incentive. In Rajan and Winton (1995), a credit contract creates an incentive for the bank to monitor the corporation. However, capital markets do not control use of the internal funds by the managers. This is the subject of the present analysis.

3 While risk aversion means a desire to accept a safe income instead of a fair gamble, preference for prudence generates precautionary behavior, the desire to defer consumption in the face of uncertainty.
arise from hidden information or it may be impossible for the principal to have information about the agent’s true preferences.4

The informational constraint introduced represents a vital departure from the neoclassical tradition. From the technical perspective, it is helpful to compare our model with that of Abel (1983). He introduced a parametric model to obtain a closed-form solution for optimal investment of a value-maximizing competitive firm under output price uncertainty and subject to cost of adjustment with constant elasticity and depreciation of capital. His results include the natural property that a firm’s value is linear in capital under constant returns. To focus on the principal-agent problem, our model abstracts from cost of adjustment and depreciation introducing the utility function of corporate managers instead, assumes constant returns in production and derives the optimal investment rule under uncertainty.

It is the implication of the information structure assumed that the corporate shareholders are unable to judge the optimal investment rule or decisions by the managers. It is assumed that their best response is to take the management’s announcement of future investment policy as given. The shareholders are, however, assumed to understand that the production technology is characterized by constant returns. Owners try, however, to introduce appropriate incentive schemes to shape the executives’ behavior.

To introduce the formal model, let $k$ stand for the capital stock. Denote the firm’s short-run profits, strictly convex in its output price $p$, by $pk\pi(p)$. This follows from the assumption of constant returns. Price $p$ is assumed to follow a geometric Brownian motion, $dp_t/p_t = \sigma_p \, dz_t$, where $dz_t$ is the increment of a Wiener process with $\sigma_p^2 > 0$ as its variance rate. Let $V$ denote the stock market value of the shares of the company. The labor contract delegates the investment decisions to the managers. We assume that the owners or their representatives have decided upon the managers’ compensation $(m_t)$ to be related to corporate performance. The effects of managerial compensation will create the key incentive mechanisms of the model. We investigate the implications of a general management remuneration scheme5

$$m = \psi_0 + \psi_1[pk\pi(p) - \gamma f] + \psi_2 V, \quad \psi_0 > 0, \, \psi_1 > 0, \, \psi_2 > 0,$$

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4 The view that knowledge of preferences is private information is natural though it is a stricter constraint than that introduced by the early principal agent models. The conflict of interest may also arise from career concerns, cf. Holmstrom and Ricart I Costa (1986).

5 The manager’s compensation is made contingent upon performance of the firm. The best established empirical regularity is that pay increases with the size of the firm. It is also statistically well established that pay for senior executives is sensitive to firm performance. When performance was measured by accounting rates of return, Rosen (1990) found that the elasticity of top executive pay with respect to accounting rates of return lies near 1.0. The schemes are firm-specific and many firms have experimented with a variety of managerial incentive-pay formulas.
where $\psi_0$ is the riskless return, the payment which is unrelated to the state variables. In addition, the remuneration is linear in profits and the stock value.\footnote{In hidden action models, linearity is efficient under some conditions, cf. Holmstrom and Milgrom (1987) and Diamond (1995). For the optimality issue, see also Dybvig and Zender (1991) and Persson (1994). It is often suggested that linking pay to performance does not create high-powered incentives for corporate managers and that corporate size is more relevant for incentives. Our model allows for this interpretation.}

We work out two cases, i.e. when the remuneration is positively related to profits prior to and net of the cost of investment $\gamma j$ where $j = \text{the current rate of investment, } jdt = dk$, and $\gamma$ is its unit cost. Intuitively, the condition for empire building can be expected to be somewhat reduced in the latter case.\footnote{This insight has been suggested by the referee.} The scheme (1) provides at most a partial hedge ($\psi_0$) for the managers’ against income risk because $\psi_1, \psi_2 > 0$. Moreover, the managers are constrained by the fact that their current policy not only affects their current reward (through $\psi_2$), but also has an effect on their future rewards (through $\psi_1$ and $\psi_2$).

Our formulation (1) is sufficiently flexible to cover salaries which are fixed in advance, performance-tied bonuses, restricted stock awards, and management compensation in the form of phantom stock plans. Obviously, myopic behavior cannot be expected to be optimal for the management in the light of compensation structure (1), even though we will not introduce costs of adjusting corporate capital into the model.

Use $D$ to denote the flow of dividends to corporate owners net of the managerial compensation, $D(k, p) = pk\pi(p) - \gamma j - m$. The managers control dividends by investing the corporate cash flow. There is nothing in the model to restrict the managers from investing the free cash flow (in the sense of Jensen (1986)) to projects with negative net present value instead of paying it out as dividends.

The standard asset pricing argument then gives the valuation of corporate shares in the stock market as the expected discounted value of future cash dividends

$$V(k_p, p_t) = E_t \int_t^\infty e^{-r(t-n)}D(k_n, p_n) \, \text{d}n,$$

where $E_t$ is an expectations operator, conditional on all information acquired by the owners through to time $t$ and where $r$ is the owners’ capital market opportunity cost. The owners know that from each unit of current cash flow, fraction $\psi_1$ is paid out to the management. They also know that fraction $\psi_2$ of a change in the stock price is absorbed by the management. This must then affect the effective discount rate of the owners. It is possible to study this effect
explicitly by elaborating Eq. (2) a few steps further. The derivation is carried out in Appendix A. We report here the final outcome before we develop the rest of the model:

\[
V(k_t, p_t) = -\frac{\psi_0}{r + \psi_2} + \left(\int_t^\infty e^{-(r + \psi_2)(\tau - \tau)}E_t[(1 - \psi_1)p_t\pi(p_t)\,d\tau]\right)k_t
\]

\[
+ \int_t^\infty e^{-(r + \psi_2)(\tau - \tau)}E_t\left[\left(\int_{\tau}^\infty e^{-(r + \psi_2)(\tau' - \tau)}E_t((1 - \psi_1)p_{\tau}\pi(p_{\tau}))\,d\tau'\right)\right]d\tau.
\]

(3)

The expression for the share value (3) is helpful in considering how the owners value the firm. Under any announced investment program, the market value can be decomposed, net of the present value of the fixed management remuneration (the first term \(-\psi_0/(r + \psi_2)\)), as between two effects. The present value of income from capital accumulated so far is given by the second term in Eq. (3), i.e. \(V_k k_t\) where the multiplier of \(k_t\) in Eq. (3), \(V_k\) (relative to \(\gamma\)) stands for Tobin’s “q”. The expected discounted value of the net cash flow from the future investment program, whatever it will be, is given by the last and a somewhat more complicated expression in Eq. (3). The second term in Eq. (3) therefore summarizes the effect of the firm’s history while the first and last terms capture the effect of its expected future on the value of the firm. We should emphasize that in Eq. (3), shareholders are not assumed to regard the flow \(j_t\) as the choice variable, but consider it parametric because of informational asymmetries. Note then from the second term in Eq. (3) that under any given investment program, \(V_{kp} > 0, V_{kpp} > 0\). Thus, \(V_k\) is convex in price.\(^8\)

We now explicitly introduce the assumption that the firm is run by a risk-averse management taking the model in the direction of the managerial and corporate finance theories. Assume that \(u(m)\) stands for the managerial utility function with \(u' > 0, u'' < 0, \lim_{m \to 0}u'(m) = \infty\) with \(A(m) = -u''(m)/u'(m) > 0\) as the measure of absolute risk aversion and \(P(m) = -u''(m)/u''(m) > 0\) as the

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\(^8\)Allowing the stockholders to be better informed about the firm’s investment planning would complicate the mechanisms of the model and make the analytic solution much harder, if not impossible, to obtain. The ability of the owners fully to understand the determination of the investment program would complicate the decision problem of the management. It should also then be optimal for the management to take account of the potential feedback effects from current capital to current investment. If the shareholders, however, had access to such an ability with perfect monitoring, the need to hire an outsider management would disappear in the first place.
Kimball (1990) measure of (absolute) prudence. It holds for all utility functions with decreasing absolute risk aversion (within the HARA family) that \( P(m) > 0 \). It is also easy to see that \( P(m) > 0 \) holds for an exponential utility function with constant absolute risk aversion. Moreover, we assume that the human capital of management cannot be diversified because of imperfect spanning in asset markets, nor is the management assumed to be engaged in capital market transactions. By investing, the management saves inside the firm, creating resources to be consumed as private benefits. In the absence of spanning, we introduce a positive discount rate for management, equal to the capital market rate, stay loyal to the expected utility hypothesis and write the separable intertemporal utility as

\[
J(k_t, p_t) = \max_j E_t \int_{\tau}^{\infty} e^{-r(t-\tau)} u(m(k_t, p_t)) d\tau. \tag{4}
\]

There is a fundamental difference from the Abel (1983) model here in that we consider below the investment program which maximizes the managerial utility (4), not that which maximizes the value of the firm’s shares (2). It is clear that the approach we have introduced is much more complicated in terms of management-owner interaction than what has been offered by the more traditional neoclassical models of corporate investment. Not surprisingly therefore, it is more difficult to predict what the solution to the investment problem will be. Yet, as we will show, the complications we have introduced will provide a good payoff in terms of novel results.

To obtain these results technically, however, the informational assumptions introduced above need to be fully exploited. Since the atomistic shareholders are taken to be unable to judge which investment program is optimal for the managers, their best response is to take the announced investment program as given and, because of constant returns, regard the market value of shares as linear in capital. Hence given the commodity price, it is rational for the shareholders to value the shares using this linearity rule, \( V_k > 0 \) and \( V_{kk} = 0 \). It also follows that \( V_{kj} = 0 \), because the marginal valuation of capital is independent of

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9 Recall that the preference for prudence which is related to precautionary behavior is reflected in the convexity of the marginal utility. The role of condition \( \nu'' > 0 \) in generating more prudent behavior in the case of uncertainty was derived by Leland (1968), who showed that risk aversion alone is insufficient to guarantee a precautionary demand for saving. The equivalence between the sign of \( \nu'' \) and an individual’s preference for or aversion to downside risk was established by Menezes, Geiss and Tressler (1980).

10 For techniques of dynamic programming when spanning does not hold, see Dixit and Pindyck (1994).
the amount of capital. To arrive at the optimal investment rule, we will employ the theory of stochastic optimal control which has proved to be a powerful approach in dynamic economic problems, thus becoming popular both in economics and in finance.

It is helpful to recall that the necessary condition for optimal investment in Abel’s model reads as \( \gamma \beta^\beta - 1 = V_k \) arising from convex investment cost \( \gamma j^\beta \) with \( \beta > 1 \). Such a condition states the equality between the marginal cost of investment and the marginal valuation of capital. If \( \beta = 1 \) instead (our case), the condition simplifies to \( V_k/\gamma = 1 \). In contrast, we plan to show that within the framework we have introduced, the management has no incentive to restrict the investment program to projects with non-negative net present value. Instead, it has an incentive at any point on the adjustment path to use some of the free cash flow to invest in projects with negative net present value as suggested by Jensen (1986). Our proposition shows that a manager with a concave utility function invests in projects whose marginal value to shareholders is less than their marginal cost, \( V_k/\gamma < 1 \).

To verify this claim, an investment program which maximizes the management’s utility (4) has to satisfy the Hamilton–Jacobi–Bellman equation

\[
\frac{rJ(k, p)}{dt} = \max_j H(j) = \max_j u(m(k, p; j)) dt + E_t(dJ). \tag{5}
\]

Note that \( J_t = 0 \) because the problem is autonomous. The right-hand side of Eq. (5), the expected gain on the current investment decision, is decomposed in the spirit of dynamic programming as between current utility and the expected gain in terms of discounted future utilities. Optimality requires that the management equate the expected gain with the required gain (the left-hand side). To evaluate the expected rate of change in gain on the right-hand side, we use Ito’s lemma, the fundamental principle in stochastic calculus, to write

\[
(1/dt)E_t(dJ) = jJ_k + (\frac{1}{2})p^2 \sigma^2 p J_{pp}. \tag{6}
\]

Here \( J_k \) is the conditional expectation of the value of all future utility gains to the management from the marginal capital. Carrying out the maximization on the right-hand side of Eq. (5), we find that to qualify for an interior solution any candidate for optimal control has to satisfy the following first-order condition:

\[
-u'(m)(\psi_2 V_j - \psi_1 \gamma) = J_k. \tag{7}
\]

Within the traditional theory, \( V_j = 0 \) by the optimality condition; here the value of \( V_j \) has, however, to be evaluated. Clearly, it is necessary for an interior optimum with finite optimal \( j \) that there be a current utility loss which is the case

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11 One way to view our approach is to regard the owners as “followers” who take the management’s strategy as given. Management, in turn, is a “leader” who understands the market’s reaction to the announced investment policy through share valuation.
only when \( \psi_2 V_j - \psi_1 j < 0 \) or \( V_j < (\psi_1/\psi_2)_j \). The case \( V_j > (\psi_1/\psi_2)_j \) represents an explosive investment program with infinite optimal \( j \).

We will now provide the intuition for the first-order condition (7) for the case where we have an interior optimum \( 0 < j < \infty \). Consider a firm with an initial capital \( k \) and a once-and-for-all investment \( j > 0 \). This means a cut in the current cash dividend to the owners, resulting in reduction in the stock market value of the company if \( V_j < 0 \). Under the managerial compensation, when related to the cash flow of the current investment, the impact is more complicated: the case \( 0 < V_j < \psi_1/\psi_2 \) is not excluded. Below, we show in Eq. (11) the precise relationship between \( j \) and the (exogenous) \( V_k \). There is an income loss (or gain) to the management by \( t_2 \). There is an additional income loss arising from the cash-flow-related compensation \( -\psi_1 j j \). These losses in current earnings are subjectively valued at the marginal utility \( u'(m) \) on the left-hand side of Eq. (7). As a result of investment, the empire of the firm has, however, been expanded in that the capital stock \( k \) is permanently bigger. The discounted future utility gains are summarized by \( J_k \) on the right-hand side of Eq. (7). One should pause at condition (7) to pay attention to the way the management-owner interaction shows up: both valuation functions \( V \) and \( J \) enter the first-order condition. In the neoclassical benchmark model, it is only the share value \( V \) which enters.

Since Eq. (7) depends on \( V \), the asset pricing (2) creates a constraint for the management’s maximization problem. It is, however, in an integral form. To cope with this technical difficulty, we proceed as follows. Over a short time interval \( dt \), the asset holders value their shares (cf. Dixit and Pindyck, 1994) as the sum of current dividend and the share value, as discounted,

\[
V(k_t, p_t) = D_t \, dt + e^{-r \, dt} E_t V(k_t + dk_t, p_t + dp_t).
\]  

We have suppressed the flow of investment \( j \) from valuation \( V(k, p) \) since it is the strategic variable of the management but parametric for the asset holders. From Eq. (8), Itô’s lemma yields

\[
(1/dt)E_t (V(k + dk, p + dp) - V(k, p)) = jV_k + (1/2)V_{pp} \sigma_p^2.
\]  

Then, noting that \( e^{-r \, dt} \approx 1 - r \, dt \) and that \( (dt)^2 \approx 0 \), we see from Eqs. (8) and (9) that the market value \( V \) satisfies everywhere the partial differential equation

\[
V(k, p) = [(1 - \psi_1)pk\pi(p) - (1 - \psi_1)j] - \psi_0 + jV_k + \frac{1}{2}V_{pp} \sigma_p^2] / (r + \psi_2).
\]  

Differentiating with respect to current investment \( j_n \), one finds that the impact of the investment program on share value is obtained as the present value

\[
V_j = \frac{V_k - (1 - \psi_1)j}{r + \psi_2}.
\]  

\[\text{Eq. (11)}\]
The rather natural interpretation of Eq. (11) is that the asset holders compare the discounted future returns against the discounted cost of the investment program. The discounted future returns from a marginally greater current capital stock are given by
$$<k/(r + \psi_2)$$
while the cost to shareholders of corporate investment is given by $$$(1 - \psi_1)\gamma/(r + \psi_2)$$, allowing for the foregone interest. If the management compensation is related to profits prior to current investment, the numerator simplifies to $$V_k - \gamma$$.

Natural as it is, the marginal valuation of capital $$J_k$$ is always positive. To see this, solve for $$J_k$$, differentiate Eq. (5) with respect to state variable $$k$$, make use of the transversality condition
$$\lim_{t \to \infty} e^{-zt}J_k(k, p) = 0$$
and use Fubini’s theorem to solve for the marginal valuation of capital
$$\int_{t_i}^{t_f} e^{-zt}E_t[u'(m(\tau))m_k(\tau)] d\tau > 0. \quad (12)$$

We now prove the central result of this paper:

**Proposition 1 (Empire Building).** In contrast to value-maximizing behavior, risk-averse management with a concave utility function $$u(m)$$ with $$u'(m) > 0, u''(m) < 0$$ and with a managerial compensation scheme (1) is typically willing to invest in projects whose marginal value to shareholders is less than their marginal cost.

**Proof.** Re-write the necessary condition (7) (after substituting for $$V_f$$ from Eq. (11)) as Eq. (7a). Then contrast it to the value-maximizing model, Eq. (7b)

$$V_k = \gamma - \frac{1}{\psi_2}[(r + \psi_2)\frac{J_k}{u(m)} - r\psi_1\gamma] \quad \text{(managerial model).} \quad (7a)$$
$$V_k = \gamma \quad \text{(value - maximizing model).} \quad (7b)$$

We see from Eq. (7a) that the empire-building incentive arises unambiguously when the management renunciation is related to the current profit of the firm, $$pk\tau(k)$$. The last term $$r\psi_1\gamma$$ then vanishes from Eq. (7a) and $$V_k < \gamma$$ definitively. When the renunciation is related to the profit flow net of the current investment cost instead, the incentive is somewhat weaker and conditional on the rate of time preference of the managers and the relative weighting in their compensation scheme. From Eq. (7a), Jensen’s claim continues to hold when the contract is such that $$\psi_2$$ is great enough relative to $$\psi_1$$. Moreover and more generally, the result holds regardless of the relative weights $$\psi_1, \psi_2$$ in the contract if the rate of time preference $$r$$ is sufficiently small (a smaller discount rate raises $$J_k$$ but reduces $$r\psi_1\gamma$$). These two qualifications appeal to intuition.

Technically, the first-order conditions (7) and (7a) will, of course, also hold in the absence of uncertainty i.e. when $$\sigma^2_p = 0$$. The agency relations,
however, become meaningful only under risks and informational asymmetries. We therefore proceed in Section 3 to examine the effects of risk aversion on optimal investment.

To explain the result of Proposition 1, we note that the managers can alter the stochastic nature of their intertemporal income stream by the choice of corporate investment. In the light of their risk aversion, the first-order condition (7) suggests that the managers are willing to trade off some of the current utility $u'(m)$ at the margin as payment to hedge against future uncertainty. As a savings instrument, a larger firm provides such a hedge in terms of the expected future utility gains $J_k$, though at the cost of reduced efficiency of investment. Given Eq. (7a), it should be emphasized that when $V_j < (\psi_1/\psi_2)\gamma$ we have an interior optimum in our model with a determinate firm size even in the absence of cost of adjustment. We note that from time to time managers might come up with an exceptional idea, a “gold mine” with a high $V_k$. Alternatively, the output price in the current industry may evolve favorably. In the framework of our model, it would then pay to expand capital at the maximum rate, abstaining from paying dividends. The firm would be on an explosive path.\(^1\)

Most typically, however, the investment projects available are not “gold mines” but ones with more limited profitability. Suppose that the evolution of output prices is less favorable, reducing the valuation of marginal capital to $V_k < \gamma$. According to Proposition 1, the managers have an incentive to continue investing even in such a case; given concave utility, Eq. (7a) then stands as the condition for a unique, finite, interior optimum. Such an investment behavior is definitively against the interest of the owners who would vote against capital expansion and would prefer its reduction, say through liquidation. This is the Jensen free cash flow case; mature companies with few profitable growth opportunities would continue to spend their cash flow inefficiently instead of paying it out as dividends. The question then is how much the managers want to overinvest instead of paying the cash flow out as dividends.\(^2\)

We provide the mathematical solution in Section 3 and present the intuition here.

\(^1\) Introduction of convex adjustment costs, irreversibility of investment, or alternatively, decreasing returns to capital, would make the current investment finite even in such a case.

\(^2\) It is helpful to point out that in the Abel (1983) model value-maximizing investment behavior dictates that the firm invest even when $V_k < \gamma$. However, such an incentive arises from optimal investment smoothing in face of strictly increasing cost of adjustment. This has, however, nothing to do with the empire-building motive to be studied here. In the absence of costs of adjustment ($\beta = 1$), such a smoothing incentive disappears and the firm would choose the investment path to maintain the equality between the cost of investment and the marginal valuation of capital, $V_k = \gamma$, throughout.
Given ${V}_k$, Eq. (7a) can be used to solve for the interior optimum $j$. To see how the solution arises note that in Eq. (7) or (7a) it is only $u'(m)$ which depends on $j$. The dynamic problem is transformed into a sequence of “static” ones. Consider the maximand $H(j)$ in Eq. (5) recalling that $J_k$ is independent of $j$ by the optimality principle. Thus $jJ_k$ is an increasing linear function in $j$. The investment program, however, reduces current managerial compensation. Such a static effect is immediate. Thus $u(m(j)) + (1/2)p^2\sigma_p^2 J_{pp}$ is declining in $j$. With large $j$, the negative static effect starts dominating, restricting the investment program. At the optimum, the second-order condition $u''(m)m_j^2 < 0$ is also satisfied. Limits to expansion do exist and are provided by the concavity of the utility function.

3. Risk aversion, preference for prudence and optimal investment

Proposition 1 established the overinvestment incentive. The framework which we have introduced allows us to address more precisely the issue of how the empire-building incentive actually is shaped by market risk, the structure of the managerial incentive contract and the risk aversion given atomistic shareholders who abstain from monitoring.

It is a fascinating feature of the study by Abel (1983) that the optimal investment could be derived explicitly in terms of the shadow price of capital. As a next step, we show now how the optimal investment can also be derived in the more general model. It is a remarkable outcome that this can be accomplished without deriving the explicit solution for the unknown value function $J(k, p).$ We show that a more risk-averse management is willing to invest more and to accept a larger reduction in current utility as insurance in exchange than a less risk-averse management. One should recall that while the coefficient of absolute risk aversion $A(m)$ helps to study the impact of uncertainty on expected utility, the coefficient of preference for prudence $P(m)$ helps to study the impact of uncertainty on the expected marginal utility (hence on $J_k$). We suggest the following:

**Proposition 2.** In the managerial model, the optimal investment is positively related to risk aversion $A(m)$ and preference for prudence $P(m)$.

For proof, see Appendix B where it is shown that the optimal investment rule is given by

$$j = \left(\frac{1}{\eta_0}\right)[\eta_1 + \eta_2\sigma_p^2],$$

(13)
where we have adopted the notation

\[ \eta_0 = (-V_j + \gamma)m_k > 0, \eta_1 = \left(1 - \frac{1}{A(m)}\right)[\psi(\pi(p) - r\gamma) + V_k + rV_j], \] (14a)

\[ \eta_2 = \left(\frac{1}{2}\right)\left[ P(m)(-V_j + \gamma)m_p^2 + 2m_pV_{kp} \left(\frac{1}{r + \psi_2}\right) + (V_j - \gamma)m_{pp} - \frac{1}{A(m)}V_{kpp} \left(\frac{1}{r + \psi_2}\right) \right]p^2, \] (14b)

where \( \psi = \psi_1/\psi_2 \). Our investment rule (13) shows explicitly how managerial risk aversion \( A(m) \) and preference for prudence \( P(m) \) shape the investment incentives, making the managerial model richer than the neoclassical model. We look now into the mechanisms somewhat more deeply though we confine ourselves to a brief discussion.

The finding that current investment is positively related to the value of \( V_k \), the shadow price of capital through the \( \eta_1/\eta_0 \) term, is analogous to the result in Abel (1983) with maximization of the market value. However, optimal investment, though positively related to current and future profitability, is inversely related to the measure of concavity of the utility function, \( A(m) \) through \( \eta_1 \). Such a mechanism of course operates even in the absence of price uncertainty. Even large unexpected price shocks resulting in revaluation of \( V_k \) may then give rise to only small changes in investment through the \( \eta_1/\eta_0 \) effect if \( A(m) \) is great, since diminishing marginal utility tends to stabilize revision of investment.

Move to the second term, the uncertainty effect proper, \( \eta_2/\eta_0 \sigma_p^2 \). Suppose that there is a small mean-preserving spread in price starting with \( \sigma_p^2 = 0 \). It is then the sign of \( \eta_2 \) which is informative as to the uncertainty effect. Though \( \eta_2 \) is rather involved, some immediate conclusions are at hand. Through \( \eta_2 \), optimal investment is indeed positively related to \( A(m) \) and \( P(m) \). Because \( (V_j - \gamma)m_{pp} - V_{kpp}/A(m)(r + \psi_2) < 0 \), it is not, however, necessarily the case that price uncertainty induces the management to invest more than with stable prices. (Take for the sake of illustration the case of quadratic utility with \( P(m) = 0 \) and low \( A(m) \)). \( \eta_2 \) may take either sign. It is, however, definitely positive when \( P(m) \) is sufficiently large. This effect is reinforced when \( A(m) \) is also large. When can one expect \( A(m) \) and \( P(m) \) to be large?

Recall first that the management reward consists of safe income (through \( \psi_0 \)) and risky income (through \( \psi_1 \) and \( \psi_2 \)). Let us introduce the plausible hypotheses of decreasing absolute risk aversion and decreasing preference for prudence as a function of the relative share of safe income in the managerial compensation package. Though the argument then is somewhat heuristic, under these hypotheses one is likely to have low \( A(m) \) and low \( P(m) \) when \( \psi_0 \) is relatively high, providing high insurance against income risk. Conversely, when the share of risky income (through \( \psi_1 \) and \( \psi_2 \)) becomes greater, one is clearly likely to have
greater risk aversion $A(m)$ and preference for prudence $P(m)$. It follows that in the latter case $\eta_2/\eta_0 > 0$ and the optimal investment is bigger, as stated in Proposition 2. It is thus the relative share of non-risky and risky income in the managerial reward structure that matters for optimal investment program under output price uncertainty.

The reward structure, the extent to which the management income is subject to risk, thus is essential for the optimal management response to price uncertainty. Under large risks, a current increase in capital investment provides managers with an instrument for a precautionary strategy. This finding suggests that the commonly observed incentive contracts not only create incentives for empire building within companies but that these incentives are related to the degree of market uncertainty.

4. Final remarks

There has been an obvious need to integrate the theory of corporate finance emphasizing separation between ownership and decision-making and the neoclassical theory of investment focusing on wealth-maximizing investment strategies. This is what the current paper has done. Using the standard tools of neoclassical investment theory, it was possible to provide a formal confirmation of Jensen’s (1986) influential proposal that corporate managers tend to invest in projects which are in conflict with the target of maximizing the wealth of corporate owners. The paper was successful in establishing that investment incentive is positively related to risk aversion and preference for prudence. Such a result also is of interest in the light of the recent discussion of executive compensation schemes. The role of these schemes and their relationship to corporate performance has been subject to public debate and active economic research in recent years. An important question is whether CEO compensation schemes provide managers with the appropriate incentives to maximize the market value of the firm or not. Given our framework with separation of ownership and control and with shareholders restricted to choosing among linear compensation schemes, inefficient investment behavior emerges as a severe problem in market economies.

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Appendix A. Deriving the share valuation, Eq. (3)

Inserting \( m \) from Eq. (1), the market value of shares (2) can be rewritten as

\[
V(k_t, p_t) = \int_t^\infty e^{(-r+\psi_2)(t-\tau)}E_t[(1 - \psi_1)p_t\pi(p_t) - (1 - \psi_1)\gamma_j_t] \, d\tau - \frac{\psi_0}{r + \psi_2}.
\]

(A.1)

Using the relationship between the flow of investment and stock of capital

\[
k_{s} = k_{t} + \int_t^s j_x \, ds, \quad s \geq t,
\]

the share value reads as

\[
V(k_t, p_t) = \left(\int_t^\infty e^{-(r+\psi_2)(t-\tau)}E_t[(1 - \psi_1)p_t\pi(p_t)] \, d\tau\right) k_t
\]

\[
+ \int_t^\infty \int_t^\infty e^{-(r+\psi_2)(t-\tau)}E_t[(1 - \psi_1)p_t\pi(p_t)\gamma_j_t] \, dy \, d\tau
\]

\[
- \int_t^\infty e^{-(r+\psi_2)(t-\tau)}(1 - \psi_1)\gamma E_t[\gamma_j_t] \, d\tau - \frac{\psi_0}{r + \psi_2}.
\]

(A.2)

Using Fubini’s theorem (reversing the order of integration), it is convenient to rewrite this equation as (3) in the text.

Appendix B. Proof of Proposition 2

We eliminate first the unknown value function \( J \) from the first-order condition. Differentiating Eq. (5) with respect to \( k \) and using Eq. (7) gives a version of the Euler-equation

\[
ru'\psi_2( - V_j + \psi \gamma ) = u' [\psi_1 p \pi(p) + \psi_2 V_k] + \frac{1}{dt} E_t \, dJ_k(k, p).
\]

(B.1)

We then use the first-order condition (7) again to establish

\[
J_{kp} = \psi_2 \left[ u''( - V_j + \psi \gamma )m_p - u' V_{kp} \left( \frac{1}{r + \psi_2} \right) \right],
\]

(B.2)

\[
J_{kpp} = \psi_2 \left[ u''( - V_j + \psi \gamma )m_p^2 - 2u' V_{kp} \left( \frac{1}{r + \psi_2} \right) \right]
\]

\[
+ u''( - V_j + \psi \gamma )mp - u' V_{kpp} \left( \frac{1}{r + \psi_2} \right).
\]

(B.3)
We now eliminate the last term in Eq. (B.1) using Ito’s lemma. Solving for $j$, we finally arrive at Eq. (13), the expression for the current investment where the parameters $\eta_0$, $\eta_1$ and $\eta_2$ are given in Eqs. (14a) and (14b) and where $\psi = \psi_1/\psi_2$. The claim in Proposition 2 follows from examining the coefficients of prudence $P(m)$ and absolute risk aversion $A(m)$ in $\eta_2$.

References