Optimal Contracts, Managerial Rents, and Efficient Short-termism*

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This Draft: June, 2018

Abstract

This paper examines the interaction between managerial rents, talent acquisition, and the investment horizons of firms. With optimal contracting, longer investment horizons allow managers to extract higher rents from firms. This makes short-termism value-maximizing for some firms. When managers privately know their talent and firms compete for managers, the market endogenously segments into firms that practice short-termism and those that choose long-termism. Short-termism elevates both the average quality of managers hired and investment. However, labor market competition combined with asymmetric information about managerial talent reduces short-termism, as does a richer managerial talent pool.

Keywords: Short-termism, Managerial Talent, Wage Contracting, Capital Budgeting, Project Choice, Labor Markets

JEL Classification: D82, D86, G31, G32, J41, M43

*For helpful comments, I would like to thank Nittai Bergman, Aaron Brown, Bengt Holmström, Andrew Lo, Andrey Malenko, Gustavo Manso, Bob Merton, Stew Myers, Bruce Petersen, Antoinette Schoar, Fenghua Song, Eric Van den Steen, Jun Yang (discussant), and seminar participants at MIT and the 2017 MFA Meetings. I also thank Xuelin Li for research assistance. I alone am responsible for errors.

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“I am not sure what to believe in this area. On the one hand, there are many anecdotes suggesting that pressures to manage earnings hold back investment. And the short-termism view is very widely believed […] On the other hand, some of what is done in the name of the long-term may be unmonitored waste.”

–Lawrence Summers (2017)

1 Introduction

How do firms choose the investment horizons of their projects? This question has attracted considerable attention because it is believed that this choice affects not only the values of the projects firms invest in (e.g. Barton and Weisman (2014)), but also the nature of these projects (e.g. Barrot (2016)). In particular, many have argued that short-termism—the corporate practice of preferring (lower-valued) short-term projects over (higher-valued) long-term projects—is myopic and ill-advised, leading to excessive risk-taking and underinvestment.¹ Yet, the practice of short-termism continues unabated (see Graham and Harvey (2001)), which is puzzling. The existing theoretical explanations for the practice rely on stock market pressure to deliver short-term earnings at the expense of long-term value (e.g. Bolton, Scheinkman, and Xiong (2006a)) when blockholder monitoring is not there to prevent it (Edmans (2009)), shareholder-manager conflicts arising from managerial career concerns that sacrifice firm value (e.g. Narayanan (1985a)), and lack of managerial sophistication.² However, the empirical evidence is that the use of short-termism exhibits little correlation with firm performance or negative economic outcomes (Kaplan (2017), Roe (2018), and Fried and Wang (2018)), is used more in firms with stronger corporate governance (Gianetti and Yu (2016)), and is not used exclusively by incompetent or unsophisticated managers


²Edmans (2009) develops a model in which blockholders, by trading on their private information, cause prices to reflect fundamentals, thereby encouraging managers to abandon short-termism.
In this paper, I develop a theoretical model that examines the investment horizon choices of firms, reconciling the above stylized facts regarding why short-termism is ubiquitous even with optimal contracting in well-managed firms, and why it does not always lead to poor outcomes. The model takes into account the relationship between investment horizons, innate project value, rent extraction by managers, and the ability of firms to attract managerial talent. In particular, in equilibrium the market segments into firms that optimally practice value-maximizing short-termism, and firms that optimally have longer investment horizons.

I then analyze how this segmentation affects the sorting of managers (with varying levels of talent) across firms in the economy, and how this in turn affects the equilibrium segmentation of the market into long-term and short-term firms. Thus, the optimal investment horizons of firms and the labor market for managers interact and influence each other, and this has implications for investment and growth.

Specifically, the model has two time periods with learning about managerial ability and moral hazard related to project search effort and project choice. In the first period, a manager chooses whether to search for a long-horizon project or a short-horizon project, and then must expend personally costly effort to find the project. His search effort may fail to find a good project, in which case he can choose to not ask for funding or request funding for a bad project that is always available. The shareholders (or their representative) cannot tell whether funding is being requested for a good or a bad project. If a short-horizon project is selected at the start of the first period, its outcome is revealed at the end of the first period. If a long-horizon project is selected, its outcome is not revealed at the end of the first period, but a noisy signal of the outcome is available. In the second period, the manager searches again for a good project, but this is necessarily a short-horizon project because there is only one period left. In both periods, the payoff distribution of the project depends on the
manager’s ability, which is unknown to all.

In the first best, the higher-valued long-horizon project is always chosen in the first period. In the second best, when neither the manager’s search effort nor project quality can be observed, the firm designs optimal contracts for each period to simultaneously tackle the two incentive problems discussed above. The contracts also take into account the manager’s career concerns; the project outcome at the end of the first period affects not only the manager’s output-contingent first-period wage but also the firm’s perception of his ability and hence the second-period wage contract. The firm has the option to fire the manager after the first period and the manager has the option to quit.

I derive two main results with this base model. First, when second-best wage contracts are optimally designed, the manager gets efficiency wages with both the long-horizon project and the short-horizon project, but earns higher rents over two periods by opting for the long-horizon project in the first period.\(^4\) Thus, the manager strictly prefers long-termism. Second, as long as the difference between the first-best values of the long-horizon and short-horizon projects is not too large, the shareholders strictly prefer the manager to search for short-horizon projects in both periods in the second-best case. For these firms, (second-best) value is maximized by imposing a constraint that it will only fund short-horizon projects in both periods, i.e., by “institutionalizing” short-termism, even though long-horizon projects have higher intrinsic value. If the difference in first-best values is large, shareholders prefer the long-horizon project in the first period and short-termism is avoided.

At the heart of the model are two key features: (i) two incentive problems—motivating the manager to work hard to find a good project and also to not propose a bad project if he fails to find a good project; and (ii) the greater speed with which information about the success or failure of a short-horizon project is revealed relative to that of a long-horizon project. Since incentives for managers to search for and propose funding for good projects must be provided through wages that are paid before long-horizon project outcomes are

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\(^4\)See Katz (1986) for a review of the efficiency wage literature.
unambiguously revealed, performance signals that matter for managerial incentives are inherently more noisy for long-term projects than for short-term projects. This requires the firm to provide steeper incentives for observed success versus failure for long-term projects in order to induce search effort. But this creates another incentive problem—the higher “performance wage” makes it more attractive for the manager to gamble by proposing a bad project when he does not find a good one. This requires the firm to pay a higher wage to the manager for not requesting funding, leading to efficiency wages and a rent for the manager that is higher with a long-term project than with a short-term project. The main benefit to the firm of adopting short-termism is to reduce this managerial rent extraction. A second benefit is that short-termism reveals information about managerial ability faster, leading to more efficient ability-based assignments of managers to projects, although the learning benefit is not central to the optimality of short-termism, as discussed in the extension below.

The base model is then extended by allowing managers to privately know their types, i.e., whether they are talented or untalented. Firms now design contracts to attract the highest-quality pool of managers, and short-termism affects the pool quality in equilibrium. Although the value of the short-term project is the same for all firms, the value of the long-term project varies in the cross-section of firms. I solve endogenously for: (i) which firms opt for short-termism and which do not; (ii) the optimal wage contracts offered by firms; (iii) the strategies of managers in terms of the probabilities with which they apply to different firms; (iv) the probabilities with which managers will be employed by firms in equilibrium, based on their job application strategies; and (v) the equilibrium values of firms. There are three additional results. First, competition for managerial talent among firms that practice short-termism and those that do not, combined with asymmetric information, leads to an increase in the number of firms that do not practice short-termism, relative to when these two types of firms operate in exogenously segmented managerial labor markets and managerial types are known to firms. Second, on average, firms that practice short-termism attract a higher-quality pool of managers and invest more. Third, as the pool of managers becomes
richer in talent, short-termism declines.

Overall, this analysis shows that informational frictions bias the investment horizons of firms without any discounting-related time horizon effects (such as those in Laibson (1997)), that short-termism may be value-maximizing for some firms because it leads to lower agency costs, and that the choice of investment horizon affects the managerial talent that the firm hires.\(^5\)

This paper is related to the literature on short-termism, but differs from this literature in four significant respects. First, the firm’s preference for short-termism is independent of any stock market pressures, in sharp contrast to earlier research (e.g. Bolton, Scheinkman, and Xiong (2006a,b) and Stein (1989)), the risk that long-term projects may have their financing cut off (von Thadden (1995)), or lack of managerial sophistication.\(^6\) Second, it is the managers with career concerns who dislike short-term projects, which is the opposite of Narayanan (1985a,b) and Stein (1989), where managers dislike long-term projects even when the firm’s owners prefer them and could possibly use optimal contracting to align preferences.\(^7\) Third, in my model the firm is not raising external financing, so short-termism is not intended to generate internal funds that have a lower cost than external funds (Thakor (1990) and Whited (1992)).\(^8\) Fourth, I consider the interaction between short-termism and managerial talent allocation, unlike the previous literature.

This paper is also related to the literature on the effect of managerial career concerns on corporate investments, most notably Holmstrom and Ricart i Costa (1986). Unlike that\(^5\)This is in line with Roe (2015), who states: “Critics need to acknowledge that short-term thinking often makes sense for U.S. businesses, the economy and long-term employment...[i]t makes no sense for brick-and-mortar retailers, say, to invest long-term in new stores if their sector is likely to have no future because it will soon become a channel for Internet selling.”

\(^6\)Graham and Harvey (2001) found that 56.7% of the firms in their sample used payback and noted, “This is surprising given that financial textbooks have lamented the shortcomings of the payback criterion for years.” See also Lefley (1996) for evidence from U.K. firms.

\(^7\)Darrough (1987) shows that optimal incentive contracts can eliminate the equilibrium in Narayanan (1985a,b). Jeon (1991) shows that Stein’s (1989) effect can at most be transient if stock prices reflect the manager’s strategic behavior.

\(^8\)Other related papers are Grenadier and Wang (2005) who use a real options framework to show that managers value the option-to-wait-to-invest more than owners, and Hackbath, Rivera, and Wong (2017) who develop a model in which short-termism is ex post optimal for the shareholders in a levered firm due to a shareholder-bondholder conflict.
paper, which focuses on capital rationing and related capital budgeting issues, this paper focuses on short-termism. Moreover, in Holmstrom and Ricart i Costa (1986), the manager’s wage in any period is paid up-front and is thus not contingent on the output in that period. In contrast, I consider optimal incentive contracts in which wages in each period depend on observables at the end of the period, and examine the interaction between short-termism and the allocation of managerial talent.

Also relevant are recent papers on the interaction between the managerial labor market and finance. These papers take the attributes of certain professions (e.g. finance versus others) as given and analyze how managers with different talents choose which profession to pursue. Axelson and Bond (2015) craft an optimal dynamic contracting model to explain why finance jobs have high compensation, up-or-out promotion, and are demanding in terms of long work hours. Bond and Glode (2014) develop a model in which agents have different abilities, and the best ones choose to be bankers rather than regulators of banks. Glode and Lowery (2016) write a model in which workers can become bankers or traders, and traders are shown to earn more than bankers. Bolton, Santos, and Scheinkman (2016) develop a model in which agents can choose between being entrepreneurs and financial market traders. In equilibrium, an excessive amount of talent goes to financial market trading. While my model also has the interaction of the managerial labor market with the attributes of firms that hire them, in contrast to this literature, managers in my model do not choose between careers, but rather choose between firms with different types of projects. Firms are not a priori segmented into those that practice short-termism and those that practice long-termism. Rather, this segmentation arises endogenously in equilibrium based on the interaction between the contractual rents firms need to provide to attract managerial talent and the cross-sectional distribution of the value gap between long-term and short-term projects among firms in the economy.

The rest of this paper is organized as follows. Section 2 develops the base model. Section 3 contains the main results. Section 4 examines the extension in which managers privately
know their types. Section 5 concludes. All proofs are in the Appendix.

2 Model

2.1 Preferences

Consider a world in which all agents are risk neutral and the riskless interest rate is zero. There are three dates: \( t = 0, 1, 2 \). There are firms, all of which are unlevered, and have funds to invest in projects. There are two key agents in each firm: a Chief Executive Officer (CEO) and a manager. The CEO faithfully represents the interests of the firm’s owners (shareholders) and the manager maximizes expected utility over consumption at dates \( t = 1 \) and \( t = 2 \). The manager’s utility is:

\[
V(c_1, c_2) = c_1 + \delta c_2
\]  

(1)

where \( \delta \in (0, 1) \) is a consumption discount factor.

2.2 Investment Opportunity

The three dates define two time periods, the first beginning at \( t = 0 \) and ending at \( t = 1 \), and the second beginning at \( t = 1 \) and ending at \( t = 2 \). There are \( N > 1 \) firms in all. In each period, each firm can invest in a project requiring a $1 investment. At \( t = 0 \), the firm can choose between a short-horizon project, \( S \), that pays off at \( t = 1 \), and a long-horizon project, \( L \), that pays off at some distant future date \( t > 2 \) that lies beyond the planning horizon of the model.\(^9\) A noisy but informative signal, \( \phi \), of the eventual payoff is available.

\(^9\)This can be interpreted as the project paying off at a time that is beyond the manager’s tenure at the firm. The Bureau of Labor Statistics reports that the median number of years that wage and salary workers had been in their present jobs was 4.6 years, a time period much shorter than the duration of the typical long-term project in many industries. For example R&D investments by drug companies have payoff horizons typically exceeding 10 years. Similarly, companies (like AT&T) that build telecommunication networks have payoff horizons exceeding 15 years.
at $t = 1$. In the second period, the firm can invest only in a short-horizon project that pays off at $t = 2$.

The CEO’s responsibility is to approve (or deny) funding for the project in each period if the manager requests funding. In addition, the CEO can also decide whether to allow the manager to propose either $L$ or $S$ at $t = 0$ or to limit the manager to $S$ in each period. Limiting the manager’s choice to $S$ in each period is “short-termism”.

The manager’s responsibility at $t = 0$ is to first decide whether to opt for $L$ or $S$, and to then choose effort $e \in \{0, 1\}$ to search for a good ($G$) project. The private cost of effort for the manager is

$$
\psi(e) = \begin{cases} 
\psi > 0 & \text{if } e = 1 \\
0 & \text{if } e = 0 
\end{cases}
$$

Regardless of whether the manager opts for $L$ or $S$, a choice of $e = 1$ means that the manager finds a good project with probability $p \in (0, 1)$, and a choice of $e = 0$ means the probability of finding a good project is 0. If a good project is not found, the manager always has a bad ($B$) project available. At $t = 1$, the manager must opt for $S$ and can again choose $e \in \{0, 1\}$. If $e = 1$ is chosen, he finds a good project with probability $p$ in the second period, and $e = 0$ means the probability of a good project is 0. In each period, the manager can decide whether to request funding for a project or to do nothing.

### 2.3 Managerial Ability and Project Payoff Distributions

There is a total of $M (> N)$ managers. The manager’s ability affects the payoff distributions of projects. Let $\tau$ represent the manager’s ability, with $\tau \in \{T, U\}$. If $\tau = T$, it means the manager is “talented”, and if $\tau = U$, it means the manager is “untalented”. The good $L$ project pays off $R_L > 1$ at $t = 2$ with probability $\tilde{q}(\tau)$ (that depends on the manager’s

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10The assumption that there are more managers than firms means that firms will design contracts to minimize the rents they provide managers, subject to managerial participation constraints. Nonetheless, when I allow managers to privately know their types, firms will be compelled to compete for talented managers.
ability) and pays off 0 with probability $1 - \tilde{q}(\tau)$, with

$$
\tilde{q}(\tau) = \begin{cases} 
1 & \text{if } \tau = T \\
q \in (0, 1) & \text{if } \tau = U
\end{cases}
$$

(3)

The first-period good $S$ project pays off at $R_S \in (1, R_L)$ at $t = 1$ with probability $\tilde{q}(\tau)$ and 0 with probability $1 - \tilde{q}(\tau)$, and the second-period good $S$ project has the same payoff distribution at $t = 2$. The $\tilde{q}(\tau)$ for the $S$ project is also described by (3). This means that $L$ is higher-valued than $S$.

It is common knowledge that $\Pr(\tau = T \text{ at date } t) = \theta_t \in (0, 1)$. Define $\bar{q}_0 \equiv \theta_0 + [1 - \theta_0]q$. It is assumed that

$$
\bar{q}_0 R_S - \psi > 1 \quad \text{(4)}
$$

$$
q R_L < 1 \quad \text{(5)}
$$

These conditions mean that the expected net present value of $S$ at the prior beliefs about managerial ability is positive ((4)), and the expected net present value of even the $L$ project managed by the untalented manager is negative ((5)). Furthermore, it is assumed that $M_T \equiv \theta_0 M > N$, where $M_T$ is the (expected) number of talented managers. This means there are enough talented managers to fully staff all firms.

The bad $S$ project pays off $R_S$ with probability $b \in (0, q)$ and zero with probability $1 - b$, regardless of managerial ability. Similarly, the bad $L$ project pays off $R_L$ with probability $b$ and 0 with probability $1 - b$.

### 2.4 Informational Assumptions

The manager’s ability is unknown to all a priori and subsequent information revelation about it becomes symmetrically available to all agents at every date. Moreover, if the manager requests funding the CEO can see whether it is for an $L$ or an $S$ project. The manager’s
search effort choices at \( t = 0 \) and \( t = 1 \) are privately known only to the manager, but the manager has to tell the CEO whether he is searching for an \( L \) or an \( S \) project. Moreover, the manager privately observes whether he found a good project or not, and he also privately observes whether the project for which funding is requested is good or bad.

The payoff on the first-period \( S \) project, \( y_1^S \in \{R_S, 0\} \) is observed by all at \( t = 1 \), and the payoff on the second-period \( S \) project, \( y_2^S \in \{R_S, 0\} \), is observed by all at \( t = 2 \). The payoff on \( L \), \( y_L \in \{R_L, 0\} \) is realized at some \( t > 2 \) and not observed at any \( t \in \{0, 1, 2\} \), but a signal of this payoff is observed at \( t = 1 \) (with no further information at \( t = 2 \)). The distribution of this signal is:

\[
\Pr (\phi = \text{success} \mid y_L = R_L) = \Pr (\phi = \text{failure} \mid y_L = 0) = \beta \in (0.5, 1)
\]

This assumption is meant to capture the idea that a key difference between short and long horizon projects pertains to when accurate information about the success or failure of the project is available. With short-horizon projects—say a new consumer electronics product introduction—the firm knows within a couple of years whether the project is successful. With long-horizon projects—say a beer brewery with an estimated economic life of 20 years—the eventual success of failure of the project may be revealed only at a date long beyond the manager’s planning horizon; in the interim, only noisy signals of the final outcome are available. Further, it will be assumed that \( q \) is not too large:

\[
q < b[p + b][2\beta - 1]\{[p + b][2\beta - 1] + 1 - \beta\}^{-1}
\]

This restriction means that the good project is not very attractive to a manager who knows he is untalented. In the analysis in Section 4, this proves to be sufficient for a type-\( U \) manager, who privately knows his type, to choose not to search for a good project.\(^{11}\)

\(^{11}\) (7) is used only in the proof of Proposition 6.
2.5 Wage Contracts

The manager’s wage in each period can only be based on what is observable at the end of the period. Thus, for the \( L \) project, the manager’s wage, paid at \( t = 1 \), is \( W^x_L \), where the observable outcome \( x \in \{n, \phi\} \), with \( n \) representing the event that the manager is not requesting funding, and \( \phi \) is the value of the signal observed at \( t = 1 \) if the \( L \) project was funded at \( t = 0 \). For now, it is simply assumed that the wage on the first-period contract (with \( L \) or \( S \)) is paid at \( t = 1 \), i.e., there is no wage deferral. It will be formally proved later that this is optimal.

For the first-period \( S \) project, the manager’s wage, paid at \( t = 1 \), is \( W^x_S \), where \( x \in \{n, h, l\} \), with \( x = h \) representing \( y^1_S = R_S \) and \( x = l \) representing \( y^1_S = 0 \). For the second-period \( S \) project, the manager’s wage is \( W^x_{S2}(z_1) \), paid at \( t = 2 \), where \( x \in \{n, h, l\} \), with \( x = h \) representing \( y^2_S = R_S \) and \( x = l \) representing \( y^2_S = 0 \). Note that \( W^x_{S2}(z_1) \) is a function of the outcome \( z_1 \) on the first-period project that is observed at \( t = 1 \). Thus, \( z_1 \in \{n, \phi, y^1_S\} \), depending on whether there was no investment at \( t = 0 \) (\( n \)), there was investment in \( L \) at \( t = 0 \) and \( \phi \) was observed at \( t = 1 \) (\( \phi \)), or there was investment in \( S \) at \( t = 0 \) and \( y^1_S \) is observed at \( t = 1 \) (\( y^1_S \)). All wages are constrained to be non-negative.

2.6 The CEO’s Choices at \( t = 0 \) and \( t = 1 \)

At \( t = 0 \), the CEO:

1. either allows the manager unfettered choice of \( L \) or \( S \) or restricts the choice to \( L \) or \( S \); and

2. offers the manager a wage contract \( W^x_L \) or \( W^x_{S1} \), depending on whether the manager is searching for \( L \) or \( S \).

At \( t = 1 \), the CEO:

1. decides whether to retain the manager for the second period or fire him; and
2. if the manager is retained, the CEO offers a second-period contract $W^z_{S2}(z_1)$.

2.7 Manager’s Reservation Utility and Firm’s Firing Cost

The manager’s reservation utility in each period is 0. In each period, the CEO makes the manager a take-it-or-leave-it wage contract offer. The manager takes the contract if it satisfies his participation constraint.

It costs the firm $K > 0$ to fire and replace the manager. This is meant to reflect the transactions costs of searching for and hiring a new manager. To ensure that it makes sense for the firm to replace the manager with a new manager at $t = 1$, it will be assumed that

$$\bar{q}_0R - \bar{\psi}[A_1 + b][A_1]^{-1} - K > 0$$

(8)

where

$$A_1 \equiv p[\bar{q}_0 - b]$$

(9)

We will see later that $\bar{\psi}[A_1 + b][A_1]^{-1}$ is equal to the expected cost of compensating the manager under the optimal contract.

2.8 Equilibrium:

In the game between the CEO and the manager, I focus on subgame perfect equilibria, i.e., in each period the CEO designs contracts that maximize firm value over the remaining time horizon. The CEO take the choice of $S$ in the first period and solves for optimal wage contract for the first and second periods that will be offered to the manager. Similarly, she takes the choice of $L$ in the first period and solves for the optimal wage contracts to offer

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12The CEO makes her firing decision based solely on the cash flow observed at the end of the first period. This is different from Edmans (2011), who allows shareholders to determine the cause of the first-period project performance through monitoring and fire the manager only if he is believed to be untalented. Debt leads to equity concentration and encourages shareholder monitoring, which leads to skilled managers not being deterred from investing in long-term projects with low short-term cash flows.
the manager in both periods. In each case, she rationally anticipates the manager’s choices
of search effort and decisions about when to request funding, as well as her own decision
about when the manager will be replaced for the second period. She then compares the
values of the firm (net of managerial wages) in the two cases and decides whether to impose
a short-termism constraint.

3 Results

In this section, the model will be analyzed. I begin with some preliminaries.

3.1 First Best

In the first best case, the manager’s ability is known, his search effort is observable, and
the quality of the project is observable to the CEO. Thus, she will instruct the manager to
choose $e = 1$, pay him a fixed wage of $\psi$, and ask him to search for a good $L$ project at
t = 0. If the manager finds a good project, funding is provided; otherwise, no investment is
made at $t = 0$. Then at $t = 1$, the manager is again paid a fixed wage of $\bar{\psi}$, instructed to
choose $e = 1$ and search for a good $S$ project. Funding is provided only if the manager finds
a good project.

3.2 Second Best Contracts when Manager Searches for a Good $S$
Project at $t = 0$:

Now the manager’s search effort choice and the quality of the project for which funding
is requested are not observable. The model is solved by backward induction. So first the
optimal wage contract offered at $t = 1$ for the second period is solved for.
3.2.1 Second-period Contract

At $t = 1$, the posterior belief that the manager is $T$ is given by $\theta_1$. If there was no investment at $t = 0$, then clearly $\theta_1 = \theta_0$. If there was investment and the first-period $S$ project failed, then the posterior belief is:

$$\theta_1^l = \Pr (\tau = T \mid y^l_S = 0) = 0 \quad (10)$$

Given (5), we see that (10) implies that the manager will be fired and replaced with a new manager if $y^l_S = 0$. If $y^l_S = R_S$, then the posterior belief is

$$\theta_1^h = \Pr (\tau = T \mid y^l_S = R_S) = \frac{\theta_0}{\theta_0 + [1 - \theta_0] q} \quad (11)$$

Thus, the manager is retained and his wage contract is a triplet $\{W^n_{S2} (R_S), W^h_{S2} (R_S), W^l_{S2} (R_S)\}$, where $W^n_{S2} (R_S)$ is what the manager is paid if he does not request second-period funding, $W^h_{S2} (R_S)$ is his wage if a project is invested in and it pays off $R_S$ at $t = 2$, and $W^l_{S2} (R_S)$ is his wage if the project pays off 0. This contract must satisfy two incentive compatibility (IC) constraints and a managerial participation constraint.

The first IC constraint is that the manager prefers to choose $e = 1$:

$$\delta p \left\{ q_1^h W^h_{S2} (R_S) + \left[1 - q_1^h\right] W^l_{S2} (R_S) \right\} + \delta [1 - p] W^n_{S2} (R_S) - \bar{\psi} \geq \delta W^n_{S2} (R_S) \quad (12)$$

where

$$q_1^h \equiv \theta_1^h + [1 - \theta_1^h] q \quad (13)$$

The second IC constraint is that if the manager does not find a good project, he will not request funding:

$$b W^h_{S2} (R_S) + [1 - b] W^l_{S2} (R_S) \leq W^n_{S2} (R_S) \quad (14)$$
The manager’s participation constraint is:

$$\delta p \left\{ \frac{q_1^h}{q_1^l} W_{s2}^h (R_S) + \left[ 1 - \frac{q_1^h}{q_1^l} \right] W_{s2}^l (R_S) \right\} + \delta \left[ 1 - p \right] W_{s2}^n (R_S) - \bar{\psi} \geq 0 \tag{15}$$

The optimal wage contract in the second period is characterized below.

**Lemma 1:** If the manager searched for a short-horizon project in the first period that was funded and had \( y_{s2}^1 = R_S \) at \( t = 1 \), then the optimal second-period wage contract is:

\[
W_{s2}^h (R_S) = \frac{\bar{\psi}}{p \left[ \frac{q_1^h}{q_1^l} - b \right] \delta} \tag{16}
\]

\[
W_{s2}^l (R_S) = 0 \tag{17}
\]

\[
W_{s2}^n (R_S) = \frac{b\bar{\psi}}{p \left[ \frac{q_1^h}{q_1^l} - b \right] \delta} \tag{18}
\]

Two points are worth noting. First, it is clear that the higher \( W_{s2}^l (R_S) \) is, the more costly it is for the firm to ensure satisfaction of the IC constraint (12). So, given the zero lower bound constraint on wages, it is efficient to set \( W_{s2}^l (R_S) = 0 \). Second, to ensure satisfaction of the IC constraint (14), the manager must be paid a wage even when he does not request project funding. Absent this wage, the manager will request funding even for a bad project. We now have:

**Lemma 2:** Under the optimal contract in Lemma 1, the manager’s participation constraint (15) is slack and the manager earns a rent equal to \( W_{s2}^n (R_S) \), with utility value \( \delta W_{s2}^n (R_S) \).

The reason why the manager earns a rent is that he has to be motivated both to work hard to find a good project and also to not request funding for a bad project. Thus, the combination of the manager’s private information about his own effort choice and the quality of the project for which he is requesting funding generates an efficiency wage that provides an informational rent for him.
The next lemma characterizes the optimal second-period contract when the manager searched for $S$ in the first period but did not find a good project and thus did not request funding.

**Lemma 3:** If the manager searched for a short-horizon project at $t = 0$ but did not request funding for it, the optimal second-period wage contract is:

\[
W^{h}_{S2}(n) = \frac{\bar{\psi}}{p[\bar{q}_0 - b]\delta} \tag{19}
\]

\[
W^{l}_{S2}(n) = 0 \tag{20}
\]

\[
W^{n}_{S2}(n) = \frac{b\bar{\psi}}{p[\bar{q}_0 - b]\delta} \tag{21}
\]

The manager’s participation constraint is slack and he earns a rent of $W^{n}_{S2}(n)$.

The structure of contracts is the same as in Lemma 1, with $\bar{q}^h_1$ replaced by the prior belief $\bar{q}_0$, since a lack of investment in the first period leads to no revision of beliefs about managerial ability.

### 3.2.2 First-period Contract

The first-period contract is a triplet $\{W^n_{S1}(R_S), W^h_{S1}(R_S), W^l_{S1}(R_S)\}$. Using the logic used in proving Lemma 1, it can be shown that $W^l_{S1} = 0$. Thus, this contract is one that minimizes the firm’s expected wage bill subject to two IC constraints and one participation constraint. The first IC constraint is that the manager chooses $e = 1$ at $t = 0$:

\[
p\bar{q}_0 [W^h_{S1} + \delta W^n_{S2}(R_S)] + [1 - p] [W^n_{S1} + \delta W^n_{S2}(n)] - \bar{\psi} \geq W^n_{S1} + \delta W^n_{S2}(n) \tag{22}
\]

In writing this constraint, it is recognized that the manager is maximizing his expected utility over two periods in making his first-period choice and that he will get fired at $t = 1$ if $y^l_S = 0$, so there is no second-period rent for him to extract in this case. The second IC
constraint is that the manager will not request funding for a bad project:

\[ b \left[ W_{S1}^h + \delta W_{S2}^n (R_S) \right] \leq W_{S1}^n + \delta W_{S2}^n (n) \] (23)

The manager’s participation constraint is that:

\[ p\bar{q}_0 \left[ W_{S1}^h + W_{S2}^n (R_S) \right] + [1 - p] [W_{S1}^n + W_{S2}^n (n)] - \overline{\psi} \geq 0 \] (24)

This leads to the following result:

**Proposition 1:** The optimal first-period wage contract is as follows:

\[ W_{S1}^h = \frac{\overline{\psi}}{p [\overline{q}_0 - b]} - \delta W_{S2}^n (R_S) \] (25)

\[ W_{S1}^l = 0 \] (26)

\[ W_{S1}^n = \frac{b \overline{\psi}}{p [\overline{q}_0 - b]} - \delta W_{S2}^n (n) \] (27)

With this wage contract, the manager chooses \( e = 1 \) to search for \( S \) in the first period, requests first-period funding only if he finds a good project, and is retained in the second period if he requested first-period funding for \( S \) and experienced \( y_S^1 = R_S \) or if he did not request first-period funding. If the manager is retained in the second period, the wage contract he receives is described in Lemmas 1 and 3.

### 3.3 Second-Best Contracts when Manager Searches for a Good \( L \) Project in the First Period

#### 3.3.1 Second-Period Contract

We again solve the model backward by solving first for the optimal second-period contract when it is known that the manager searched for \( L \) in the first period. At \( t = 1 \), the CEO
observes the signal $\phi$ of the eventual payoff on $L$. The second-period contract in this case is a triplet $\{ W^n_{S2}(\phi), W^h_{S2}(\phi), W^l_{S2}(\phi) \}$. As before, we can show that $W^l_{S2}(\phi) = 0$ in the optimal contract. The following result can now be proved:

**Lemma 4:** $\exists \beta^* \in (0, 1)$ such that the CEO does not fire the manager at $t = 1$, regardless of the observed $\phi$, as long as $\beta \leq \beta^*$. The optimal second-period contract is:

$$
\hat{W}^h_{S2}(\phi) = \frac{\psi}{p [\hat{q}_1^h - b] \delta} \tag{28}
$$

$$
\hat{W}^l_{S2}(\phi) = 0 \tag{29}
$$

$$
\hat{W}^n_{S2}(\phi) = \frac{b\psi}{p [\hat{q}_1^n - b] \delta} \tag{30}
$$

where $\phi \in \{h, l\}$, with $h$ representing “success” and $l$ representing “failure”:

$$
\hat{q}_1^l = \frac{[1 - \beta] \theta_0}{[1 - \beta] \theta_0 + A_2 [1 - \theta_0]} + \frac{A_2 [1 - \theta_0] q}{[1 - \beta] \theta_0 + A_2 [1 - \theta_0]} \tag{31}
$$

$$
\hat{q}_1^h = \frac{\beta \theta_0}{\beta \theta_0 + [1 - A_2] [1 - \theta_0]} + \frac{[1 - A_2] [1 - \theta_0] q}{\beta \theta_0 + [1 - A_2] [1 - \theta_0]} \tag{32}
$$

where $A_2 \equiv q[1 - \beta] + [1 - q] \beta$. If the manager did not request first-period funding, the second-period contract is that stated in Lemma 3.

The intuition for why the manager is not fired at $t = 1$ when he invests in $L$ at $t = 0$ and $\phi = \text{failure at } t = 1$ is that the actual outcome on $L$ is not observed at $t = 1$. So if $\phi$ is a sufficiently noisy signal, the adverse information it conveys about the manager’s ability is not compelling enough for the CEO to incur the cost $K$ of firing the manager. However, since $\phi$ is an informative signal, its realization does affect the manager’s second-period contract. For the subsequent analysis, it will be assumed that $\beta \leq \beta^*$.  

18
3.3.2 First-Period Contract

Turning now to the first-period contract, it can be written as a triplet \( \{W^n_L, W^h_L, W^l_L\} \). The CEO designs the contract to minimize its expected wage bill subject to the two IC constraints and participation constraint considered earlier. The first IC constraint is that the manager chooses \( e = 1 \):

\[
p \left\{ \tilde{q}_0 \left[ \beta \left[ W^h_L + \delta \hat{W}^n_{S2}(h) \right] + [1 - \beta] \delta \hat{W}^n_{S2}(l) \right] + [1 - \tilde{q}_0] \left[ \beta \hat{W}^n_{S2}(l) \delta + [1 - \beta] \left\{ W^h_L + \delta \hat{W}^n_{S2}(h) \right\} \right] \right\} \\
+ [1 - p] \left[ W^n_L + \delta W^n_{S2}(n) \right] - \overline{\psi} \geq W^n_L + \delta W^n_{S2}(n) \tag{33}
\]

where \( W^n_{S2}(n) \) is given in (21) and we set \( W^l_L = 0 \) as before. The second IC constraint is that the manager does not request funding for a bad project if he does not find a good project:

\[
b \left\{ \beta \left[ W^h_L + \delta \hat{W}^n_{S2}(h) \right] + [1 - \beta] \delta \hat{W}^n_{S2}(l) \right\} \\
+ [1 - b] \left\{ \beta \delta \hat{W}^n_{S2}(l) + [1 - \beta] \left[ W^h_L + \delta \hat{W}^n_{S2}(h) \right] \right\} \leq W^n_L + \delta W^n_{S2}(n) \tag{34}
\]

The manager’s participation constraint is:

\[
p \left\{ \tilde{q}_0 \left[ \beta \left[ W^h_L + \delta \hat{W}^n_{S2}(h) \right] + [1 - \beta] \delta \hat{W}^n_{S2}(l) \right] + [1 - \tilde{q}_0] \left[ \beta \delta \hat{W}^n_{S2}(l) + [1 - \beta] \left[ W^h_L + \delta \hat{W}^n_{S2}(h) \right] \right] \right\} \\
+ [1 - p] \left[ W^n_L + \delta W^n_{S2}(n) \right] - \overline{\psi} \geq 0 \tag{35}
\]

**Proposition 2:** The optimal first-period wage contract for \( L \) is as follows:

\[
W^h_L = \frac{\overline{\psi}}{p \left[ \tilde{q}_0 - b \right] \left[ 2\beta - 1 \right]} + \left[ \hat{W}^n_{S2}(l) - \hat{W}^n_{S2}(h) \right] \delta \tag{36}
\]

\[
W^l_L = 0 \tag{37}
\]
\[ W^n_L = \frac{A_3 \overline{\psi}}{p [q_0 - b] [2 \beta - 1]} + \left[ \hat{W}^n_{S2}(l) - \hat{W}^n_{S2}(h) \right] \delta \] (38)

where

\[ A_3 \equiv b \beta + [1 - b] [1 - \beta] \] (39)

With this wage contract, the manager chooses \( e = 1 \) to search for \( L \) in the first period, requests first-period funding only if he finds a good project, and is retained in the second period regardless of the signal \( \phi \). The manager’s second-period wage contract is as described in Lemma 4.

The next result describes the manager’s preference for \( L \) versus \( S \) at \( t = 0 \).

**Proposition 3:** With the optimal wage contracts, the manager strictly prefers to search for \( L \).

The intuition is that \( L \) gives the manager rents that exceed the rents he can get by searching for \( S \) at \( t = 0 \). The reason for this is that the signal of project performance at \( t = 1 \) is more noisy with \( L \). Thus, a bad \( L \) project is less likely to be detected at \( t = 1 \) than a bad \( S \) project. Moreover, with \( S \), the manager gets fired at \( t = 1 \) if the project fails, which denies him his second-period rent. This does not happen with \( L \).

The manager’s incentive to work hard at \( t = 0 \) to find a good project is weaker with \( L \) than with \( S \), all else equal, i.e. agency costs are higher with \( L \). So the CEO is forced to make the incentives in the wage schedule steeper with \( L \) by paying the manager more for a good performance signal at \( t = 1 \). But this creates another incentive problem—it induces the manager to gamble and propose a bad project, so he can get the high performance bonus with a positive probability. To counter this, the firm must increase the efficiency wage, which the manager earns for doing nothing (no funding request). This gives the manager a rent.

This leads to the next result.

**Proposition 4:** As long as \( \vartriangle \equiv R_L - R_S < \text{some } \bar{\vartriangle} \), the firm strictly prefers that the manager search for \( S \) in the first period, so the CEO imposes a short-termism constraint to
limit the manager’s first-period choice to $S$. For $\Delta \geq \bar{\Delta}$, the firm prefers that the manager search for $L$ in the first period.

The intuition is as follows. From Proposition 3 we know that the manager earns higher rents when he chooses $L$ than when he chooses $S$ at $t = 0$. Thus, the firm’s expected wage cost is higher with $L$ than with $S$. This is one benefit of limiting the manager to $S$ at $t = 0$. The other benefit is that the firm learns more about managerial ability at $t = 1$ with $S$ than with $L$. This enables the firm to make a more efficient ability-based managerial assignment in the second period. Thus, the benefit of short-termism goes beyond just limiting a wealth transfer from the firm to the manager. The benefit of $L$ is that it has a higher first-best value, since $R_L > R_S$. So when the difference $\Delta$ is not too large, the firm will prefer short-termism.

### 3.3.3 Inefficiency of Wage Deferral

Until now, it has been assumed that deferring the manager’s wage that is payable at $t = 1$ until $t = 2$ is not allowed. It will be shown now that such a deferral is inefficient.

**Lemma 5:** Deferring the manager’s compensation at $t = 1$ until $t = 2$ is inefficient.

The intuition is as follows. Suppose the manager was asked to search for $L$ at $t = 0$. If the manager’s wage is paid at $t = 2$ instead of $t = 1$, then there are two possibilities. One is that the deferred wage is simply added to the manager’s second-period wage in each state, in which case it has no impact on the manager’s incentives on either the first-period project or the second-period project. In this case, the deferral is simply inefficient because the manager prefers consumption at $t = 1$ over consumption at $t = 2$, all else being equal. Further, the wage deferral cannot improve on the incentives provided by the optimal contract derived for $L$ in the previous analysis, since that is the least-cost contract to incentivize the manager to work hard and propose only the good project; such a contract cannot be improved upon by making the manager’s payoff contingent on a future project.
So deferral can only improve second-period incentives. But any optimal contract requires that the manager be paid nothing for a failed project. Thus, all of the wage deferral must be spread out over the manager’s second-period wage for success on the second-period project or his wage for not proposing a second-period project. However, this cannot improve incentives on the second-period project since we solved for the optimal contract with a zero payoff for project failure. Therefore, wage deferral fails to improve incentives and leads to a higher wage cost.

4 Competition for Managerial Talent

Thus far, it has been assumed that even though managers are heterogeneous in talent, the manager’s type is unknown to everyone at $t = 0$. However, in practice, a manager may know more about his type than others. In this section, we now allow this and assume that each manager privately knows his own type, but managers look observationally identical to others at $t = 0$. All that others can tell is that $\Pr(\tau = T \mid t = 0) = \theta_0 \in (0, 1)$. We examine the implications of this when firms compete for managers.

4.1 Perfect Information about Managerial Type

We begin by considering the base case where the firm also knows the manager’s type. We also introduce heterogeneity among firms by assuming that the probability distribution of the $S$ project is the same for all firms, but $R_L$ varies in the cross-section of firms. This means $\Delta$ varies cross-sectionally.

It is clear from the previous analysis that no firm wants to hire an untalented manager. Suppose that there are two types of firms, those with high $\Delta$ (say $\Delta > \Delta^0$) and those with low $\Delta$ (say $\Delta < \Delta^0$), and suppose initially that they operate in exogenously segmented managerial labor markets—i.e., they do not interact in hiring managers. Then the firms with $\Delta < \Delta^0$ will opt for short-term projects in the first period and offer contracts that provide
the appropriate incentives to the talented managers. The firms with $\Delta > \Delta^0$ will opt for long-term projects and also provide the appropriate incentives to the talented managers. We have the following result.

**Lemma 6:** Suppose the firm can identify managers by type. There exists a $\Delta^0$ such that firms with $\Delta > \Delta^0$ will hire only type-T managers and instruct them to search for an $L$ project in the first period and an $S$ project in the second period. The firms will offer the following contracts:

\[
\tilde{W}_{S2}^h(\phi) = \frac{\bar{\psi}}{p[1 - b]\delta} \tag{40}
\]
\[
\tilde{W}_{S2}^l(\phi) = 0 \tag{41}
\]
\[
\tilde{W}_{S2}^n(\phi) = \frac{b\bar{\psi}}{p[1 - b]\delta} \tag{42}
\]

and

\[
\tilde{W}_{L}^h = \frac{\bar{\psi}}{p[1 - b][2\beta - 1]} + \left[\tilde{W}_{S2}^n(l) - \tilde{W}_{S2}^n(h)\right] \delta \tag{43}
\]
\[
\tilde{W}_{L}^l = 0 \tag{44}
\]
\[
\tilde{W}_{L}^n = \frac{A_3\bar{\psi}}{p[1 - b][2\beta - 1]} + \left[\tilde{W}_{S2}^n(l) - \tilde{W}_{S2}^n(h)\right] \delta \tag{45}
\]

We have a similar result for the firms with $\Delta \leq \Delta^0$.

**Lemma 7:** Suppose the firm can identify managers by type. Then, with segmented labor markets, there exists $\Delta^0$ such that firms with $\Delta \leq \Delta^0$ will hire only type-T managers and instruct them to search for an $S$ project in the first period and an $S$ project in the second period. Firms will offer the manager second-period wage contracts \(\{\tilde{W}_{S2}^i(y_{S}^i) \mid i \in \{h, l, n\}, y_{S}^i \in \{R_S, n\}\}\) given by Lemma 1 for $y_{S}^i = R_S$ with $\tilde{q}_1^i = 1$, and given by Lemma 3 for $y_{S}^i = n$ with $\tilde{q}_n = 1$. The optimal first-period wage contract \(\{\tilde{W}_{S1}^i \mid i \in \{h, l, n\}\}\) is given by Proposition 1 with $\tilde{q}_0 = 1$. 23
In the above cases, since firms can identify managers by type, the prior and posterior beliefs about managerial ability are degenerate. These will serve as useful preliminaries for the following analysis.

4.2 Asymmetric Information about Managerial Type

In reality, firms may not know their managers’ types. So it is assumed now that no firm can distinguish between talented \((T)\) and untalented \((U)\) managers. Each manager privately knows his type and firms compete for managerial talent. Each firm’s \(R^L\) is drawn from \([R^L_{min}, R^L_{max}]\), and the distribution function \(\eta\) can be expressed as \(\eta(\hat{R}^L) = \text{number of firms with } R^L \leq \hat{R}^L\). It will be assumed throughout that \(R^S\) is close to but less than \(R^L_{min}\), e.g. \(R^L_{min} = R^S + \varepsilon\) where \(\varepsilon > 0\) is a small positive number, and that \(R^L_{max}\) is an arbitrarily large number. That is, \([R^L_{min}, R^L_{max}]\) has large measure.

Project choices of firms and the matching of managers and firms proceed as follows. Each firm decides on whether it wants its manager to search for an \(S\) project or an \(L\) project at \(t = 0\), announces this, and posts wages. After publicly observing the wage contracts of all other firms, each firm has an opportunity to change its project preference and wage contracts, and this process can go on until no firm wishes to change its offered wage contracts.\(^{13}\) After this, each manager decides on his \textit{job application strategy}, i.e., the probabilities with which to apply to an \(S\)-project firm and an \(L\)-project firm.

The core intuition underlying the analysis in this section is as follows. Because managers earn higher rents with the \(L\)-project firms, they will all flock to these firms, leaving the \(S\)-project firms possibly unstaffed. By designing contracts to offer \textit{only} the type-\(T\) managers higher rents than they get with the wages offered by these firms when they are not competing with the \(L\)-project firms, the \(S\)-project firms can poach some of the talent away from the \(L\)-project firms. I show that this is not possible in equilibrium for the \(L\)-project firms. Consequently, the \(S\)-project firms end up with a richer mix of talented managers than the

\(^{13}\)This iterative process is unnecessary in equilibrium.
The two steps described above lead to an equilibrium. A labor market equilibrium in offered wage contracts and project-choice directives is reached when no firm can achieve a higher expected value by offering a different set of wage contract or project-choice directives, given the anticipated reactions of other firms and job applicants to its offered contracts.

Before solving for the equilibrium, it is useful to establish a series of intermediate results.

**Lemma 8:** Firms that want their managers to search for the S project at $t = 0$ as well as those that want their managers to search for L projects at $t = 0$ will design their wage contracts to induce type-T managers in both types of firms to choose search effort $e = 1$ at $t = 0$ and at $t = 1$ and propose only good projects for funding. The contracts will induce type-U managers to choose $e = 0$ in both periods and not request any funding for projects.

The intuition is that even a good project chosen by the untalented manager has negative NPV, so the firm designs its wage contract to elicit search effort only from the talented managers. Given such a contract, the untalented manager strictly prefers not to search for a project or request funding for it, since searching for a good project is less profitable for the untalented manager.

**Lemma 9:** The contracts described in Lemmas 6 and 7 are feasible in the sense that they achieve the outcomes described in Lemma 8. However, given these contracts, with $N/M \in (0,1)$ and $\psi$ sufficiently large, all managers will strictly prefer to apply only to firms that want their managers to search for L projects.

Since working for an L-project firm gives both types of managers a higher rent (see Proposition 3), they all flock to those firms as long as the expected rent from applying to such a firm is higher than from applying to an S-project firm. The difference between the rents offered by the L-project and S-project firms is increasing in the effort cost $\psi$. Moreover, $N/M$ is the probability of being employed by a firm if all firms are L-project firms and all
managers apply to those firms. Of course, if firms expect managers to only apply to \( L \)-project firms, all firms will choose to be \( L \)-project firms. It will be assumed henceforth that the conditions in Lemma 9 hold.

To see how equilibrium is reached in such a market, we need to first discuss the sequence of events, which requires additional notation.

### 4.3 Offered Wage Contracts

The wage contracts offered by the \( S \)-project firms are
\[
\{\tilde{W}_{S1}^x, \tilde{W}_{S2}^z(x) \mid x \in \{h, l, n\}, z \in \{h, l, n\}\},
\]
where \( \tilde{W}_{S1}^x \) is the first-period contract, \( \tilde{W}_{S2}^z(x) \) is the second-period contract, \( x = h \) indicates \( y_S^1 = R_S \) at \( t = 1 \), \( x = l \) indicates \( y_S^1 = 0 \) at \( t = 1 \), and \( x = n \) indicates no project was proposed in the first period. Further, \( z = h \) indicates \( y_S^2 = R_S \) at \( t = 2 \), \( z = l \) indicates \( y_S^2 = 0 \) at \( t = 2 \), and \( z = n \) indicates no project was proposed in the second period. The wage contracts offered by the \( L \)-project firms are
\[
\{\tilde{W}_{L1}^\phi, \tilde{W}_{S2}^z(\phi) \mid \phi \in \{h, l, n\}, z \in \{h, l, n\}\},
\]
where \( \tilde{W}_{L1}^\phi \) is the first-period contract on the \( L \) project, and \( \tilde{W}_{S2}^z(\phi) \) is the second-period contract on the \( S \) project. Here \( \phi = h \) means that the signal \( \phi \) indicated success on \( L \), \( \phi = l \) means that the signal indicated failure, and \( \phi = n \) means no project was proposed. Further, \( z = h \) means \( y_S^2 = R_S \) at \( t = 2 \), \( z = l \) means \( y_S^2 = 0 \) at \( t = 2 \), and \( z = n \) means no project was proposed.

### 4.4 Equilibrium

#### 4.4.1 Equilibrium Definition

The equilibrium can now be defined. The equilibrium concept is Bayesian Perfect Nash Equilibrium, and the definition is as follows:

1. Each firm chooses whether to instruct its manager to search for \( S \) or \( L \) in the first period and the associated optimal wage contracts for both periods, \( \{\tilde{W}_{S1}^x, \tilde{W}_{S2}^z(x)\} \) or \( \{\tilde{W}_{L1}^\phi, \tilde{W}_{S2}^z(\phi)\} \), taking the equilibrium responses of the type \( \tau \in \{T, U\} \)
managers as given, so as to maximize firm value;

2. Faced with each firm’s announced first-period project search strategy and associated wage contract, each manager determines his application strategy—the probabilities with which to apply to L-project and S-project firms—to maximize his expected utility.

3. Subsequent to being matched with firms based on their rank-ordering strategies, type-T managers choose \( e = 1 \) in each period and propose only good projects, type-U managers choose \( e = 0 \) in each period and do not propose any projects.

In light of Lemma 9, we know that the contracts described in Lemmas 6 and 7 cannot be an equilibrium. To derive the equilibrium, the model will be solved via backward induction, starting with Step 3 above and going to Step 1. In the earlier analysis in Lemmas 6 through 9, Step 3 of the equilibrium has already been analyzed. We therefore move to Step 2.

4.4.2 Equilibrium Step 2: Managers’ Application Strategies

The following result can be shown.

**Proposition 5:** Suppose there are some firms offering \( \{ \langle \tilde{W}_{S1}^z \rangle, \langle \tilde{W}_{S2}^z \rangle \} \) and asking their managers to search for S in the first period, and some firms offering \( \{ \langle \tilde{W}_L^\phi \rangle, \langle \tilde{W}_{S2}^z(\phi) \rangle \} \) and asking their managers to search for L in the first period. Assume that the probability that a manager will be matched with a firm is the same regardless of whether the manager applies to an S-project firm or an L-project firm. Then:

(a) If the type-T managers strictly prefer \( \{ \langle \tilde{W}_L^\phi \rangle, \langle \tilde{W}_{S2}^z(\phi) \rangle \} \), both the type-T and type-U managers will apply only to the L-project firms.

(b) If the type-T managers strictly prefer \( \{ \langle \tilde{W}_{S1}^z \rangle, \langle \tilde{W}_{S2}^z \rangle \} \), it is possible for the type-U managers to strictly prefer \( \{ \langle \tilde{W}_L^\phi \rangle, \langle \tilde{W}_{S2}^z(\phi) \rangle \} \), but this can never be an equilibrium; and

(c) If the type-T managers are indifferent between the contracts offered by the two types of firms, type-U managers strictly prefer \( \{ \langle \tilde{W}_L^\phi \rangle, \langle \tilde{W}_{S2}^z(\phi) \rangle \} \).
The intuition is as follows. A manager’s preference for a particular firm comes from the rent he earns, and this rent in any period is exactly equal to the efficiency wage. Thus, (a) follows from the fact that both managers enjoy the same rent from the \( L \)-project firms. As for (b), given Lemma 9, the only way an \( S \)-project firm can create a strict preference for it is by offering higher wages than in Lemma 7. Since it is possible to provide part of the higher wage for success on the first-period project, the firm can generate a rent for the type-\( T \) manager that is unavailable to the type-\( U \) manager who does not invest in equilibrium. Consequently, the type-\( T \) manager can strictly prefer the \( S \)-project firm, whereas the type-\( U \) manager prefers the \( L \)-project firm. But this cannot be an equilibrium because the \( L \)-project firms would never hire just type-\( U \) managers. The logic for (c) is similar, but this can be an equilibrium due to the randomization by the type-\( T \) managers that can provide the \( L \)-project firms with a pool of both types of managers.

From Lemma 9 and Proposition 5, we see why designing its wage contract to induce the type-\( T \) managers to be indifferent between the \( S \)-project and \( L \)-project firms may be value-maximizing for the \( S \)-project firms. If all managers prefer the \( L \)-project firms, then the \( S \)-project firms are unstaffed and have a value of zero. If \( R_L^{\min} \) is close enough to \( R_S \), then it may pay for some low-\( R_L \) firms to pursue the \( S \) project and raise wages to attract (only some of) the type-\( T \) managers, with all type-\( T \) managers being indifferent between the \( S \)-project and \( L \)-project firms.

**Lemma 10:** Suppose there is an \( R_L^* \in [R_L^{\min}, R_L^{\max}] \) such that firms with \( R_L \leq R_L^* \) instruct their managers to search for \( S \) projects in both periods, and firms with \( R_L > R_L^* \) instruct their managers to search for \( L \) projects in the first period and \( S \) projects in the second period. Then the equilibrium must be such that each type-\( T \) manager asks to join an \( S \)-project firm with probability \( \xi \in (0, 1) \) and an \( L \)-project firm with probability \( 1 - \xi \). Type-\( U \) managers strictly prefer the \( L \)-project firms. There is an equilibrium in which a manager applying to an \( S \)-project firm has a probability \( e_S \in (0, 1) \) of being hired and a manager applying to an \( L \)-project firm has a probability \( e_L \in (0, 1) \) of being hired.
Throughout the rest of the analysis, it is assumed that $K$ is sufficiently large that a manager who does not propose a project at $t = 0$ is not fired at $t = 0$ or $t = 1$. We now have:

**Proposition 6:** Suppose both $S$-project and $L$-project firms are operating in the market. Then there is an equilibrium in which $e_S = 1$, $e_L = \frac{N - \eta(R_L^*)}{M - \eta(R_L^*)}$, $\xi = \frac{\eta(R_L^*)}{\theta_0M}$. Firms with $R_L \leq R_L^*$ instruct their managers to search for $S$ projects in both periods, and offer them second-period contracts in Lemma 7, and the following first-period contracts:

\[ \tilde{W}_{S1}^h = \frac{\bar{\psi}}{p} \left( 1 + \frac{e_L A_3 - b[2\beta - 1]}{p + b}[2\beta - 1][1 - b] \right) \]

(46)

\[ \tilde{W}_{S1}^v = 0 \]

(47)

\[ \tilde{W}_{S1}^n = \frac{b\bar{\psi} [e_L A_3 - b[2\beta - 1]]}{p[1 - b][p + b][2\beta - 1]} \]

(48)

\[ \tilde{W}_{S2}^n = \frac{b\bar{\psi}}{p[1 - b]\delta} \]

(49)

The firms with $R_L > R_L^*$ will instruct their managers to search for $L$ projects in the first period and $S$ projects in the second period, and offer the contracts in Lemma 6. The average expected talent of a manager in an $S$-project firm is higher than that in an $L$-project firm.

Assuming that both the $S$-project and $L$-project firms are in the same market, this proposition states that in equilibrium the firms that want their managers to search for $S$ projects in both periods have to provide them with more rents when they are competing with firms that are instructing their managers to search for $L$ projects in the first period. The additional rents make the type-$T$ managers indifferent between the two types of firms. However, any rent that makes the talented managers indifferent between the two types of firms will make the untalented managers strictly prefer the $L$-project firms (Proposition 5). The $S$-project firms are therefore able to attract a talent pool of managers that is better on average than that of the $L$-project firms. This increases each $S$-project firm’s
value, so the outcome in which all managers strictly prefer the $L$-project firm cannot be an equilibrium. The additional rent the $S$-project firm provides to attract the talented managers is efficiently offered on the first-period contract (reflected in (46)-(48)) because the manager values consumption at $t = 1$ more highly than consumption at $t = 2$. The $S$-project firms therefore are chosen by talented managers, but not by any untalented managers.

The $L$-project firms cannot improve their talent pool by raising wages because a higher wage only makes them more attractive to the untalented managers. And these firms cannot make the talented managers strictly prefer them because that would only induce the type-$S$ firms to raise their wages until the talented managers were indifferent. So the equilibrium must involve the offered wage contracts being such that the talented managers are indifferent between the two types of firms, and the untalented managers strictly prefer the $L$-project firms.

Moreover, given the equilibrium wage schedules, no $S$-project firm will wish to deviate by offering a lower wage, because doing so would cause its probability of hiring a manager to drop to zero.

Having solved for step 2, we now move to step 1 of the equilibrium.

### 4.4.3 Equilibrium Step 1: Firms’ Choice of $L$ versus $S$

Each firm takes into account managerial application strategies and determines whether to be an $S$-project or an $L$-project firm. This endogenizes $R^*_L$.

**Proposition 7:** There exists $R^*_L \in (R^*_L^{\min}, R^*_L^{\max})$ such that in equilibrium all firms with $R_L \leq R^*_L$ choose to have their manager search for $S$ in both periods and all firms with $R_L > R^*_L$ choose to have their managers search for $L$ in the first period and $S$ in the second period. The wage contracts offered by these firms are those described in Proposition 6. An increase in the fraction of talented managers, $\theta_0$, reduces $R^*_L$.

This proposition completes the specification of the equilibrium. Note that the equilibrium
characterized in Propositions 6 and 7 is not unique, but it is the one that maximizes the measure of $S$-project firms. The reason is that this equilibrium involves randomization by the type-$T$ managers that yields a probability of 1 that a type-$T$ manager who applies to an $S$-project firm will be employed. However, in all equilibria, the $S$-project firms have on average more talented managers than the $L$-project firms.

One implication of Proposition 7 is that an increase in the fraction of talented managers $\theta_0$ leads to fewer firms choosing short-termism. This is intuitive—as $\theta_0$ increases, the talent pool the $L$-project firms attract in equilibrium goes up in quality, making $L$ more attractive. This is a new testable prediction of the model.

**Corollary 1:** Compared to the situation in which all firms can identify managers by type and $S$-project and $L$-project firms operate in exogenously segmented labor markets, fewer firms have their managers search for the $S$ project in both periods when there is competition for managers between $S$-project and $L$-project firms and managerial types are unknown to firms.

This corollary has a couple of implications. First, the number of firms opting for short-termism shrinks when firms are competing for managers who privately know their types. That is, labor market competition combined with asymmetric information skew firms’ preferences towards a long-term orientation, which is inefficient in the sense of leading to lower firm values than when firms do not need to compete for managers and know managerial types. This means that while the distribution of the wedge, $\Delta$, between the values of the $L$ and $S$ projects across firms in the economy affects the distribution of managerial talent across firms, the nature of labor market competition and asymmetric information also affect which firms practice short-termism and which do not. Second, in equilibrium, the type-$U$ managers never expend costly effort to search for projects and never propose projects. Since the pool of managers hired by $L$-project firms has a higher proportion of untalented managers, this result implies that on average the $L$-project firms will invest less than the $S$-project firms.
That is, short-termism leads to stochastically higher investment and growth.

5 Conclusion

This paper has developed a theory of the choice of investment horizon by firms that relies on the interaction between investment horizon, innate project value, managerial rent extraction, and managerial talent selection. The analysis shows that optimal wage contracts generate efficiency wages, leading to informational rents for managers with unknown abilities that are higher when they invest in intrinsically higher-valued long-horizon projects. To limit managerial rent extraction, the firm chooses to limit the manager’s choice to short-horizon projects in the interest of its shareholders when the innate value difference between long-horizon and short-horizon projects is not large. This not only reduces the firm’s expected wage cost, but it also permits a more efficient managerial assignment to project management in the second period. Short-termism is eschewed when the long-horizon project is intrinsically much more highly valued than the short-horizon project. When managers privately know their abilities and firms that practice short-termism compete with those that do not for managerial talent, short-termism enables firms to attract better talent and invest more. This prediction of the model can be empirically tested.

The analysis shows that short-termism is not for all firms. It is more beneficial for firms that operate in labor markets that are not very rich in high-talent managers and where the value of the long-term project is not very high relative to the value of the short-term project. These represent additional testable predictions of the model.
References


[34] Summers, Lawrence, “Do Companies Care Too Much About the Short Term? The Jury is Still Out”, Washington Post Workblog, February 9, 2017.


Appendix

**Proof of Lemma 1:** As argued in the text, it is optimal to set $W_{S_2}^l (R_S) = 0$. Next, note that (12) and (14) will be binding in equilibrium. Solving these simultaneously yield (16) and (18). With this solution, (15) is clearly satisfied. ■

**Proof of Lemma 2:** Since (12) holds and $W_{S_2}^n (R_S) > 0$, it follows that (15) is slack, which means the manager earns a rent equal to $W_{S_2}^n (R_S)$. ■

**Proof of Lemma 3:** Since not investing at $t = 0$ leads to beliefs about managerial ability remaining unchanged at $t = 1$, the contract in Lemma 3 is identical to that in Lemma 1 with $\bar{q}_1^h$ replaced by $\bar{q}_0$. This yields (19)–(21). ■

**Proof of Proposition 1:** $W_{S_1}^l = 0$ follows from earlier arguments. (25) and (27) are obtained by solving (22) and (23) as simultaneous equations because both constraints are binding at the optimum. ■

**Proof of Lemma 4:** Suppose the firm retains the manager for the second period when the signal at $t = 1$ is $\phi = l$. Then the (subgame perfect) optimal contract will mirror (16)–(18) with $\tilde{q}_1^h$ replaced by $q_1^\phi$ and $\phi \in \{l, h\}$. This yields (28)–(30).

Now suppose $\phi = l$. Then

$$\theta_1^l = \Pr(\tau = T \mid \phi = l) = \frac{[1 - \beta]\theta_0}{[1 - \beta]\theta_0 + [1 - \theta_0] \{q[1 - \beta] + [1 - q]\beta\}}$$

(A.1)

and

$$\tilde{q}_1^l = \theta_1^l + [1 - \theta_1^l] q$$

(A.2)

Similarly, with $\phi = h$:

$$\theta_1^h = \Pr(\tau = T \mid \phi = h) = \frac{\beta\theta_0}{\beta\theta_0 + \{q\beta + [1 - q][1 - \beta]\}[1 - \theta_0]}$$

(A.3)
and

\[ \hat{q}_1^h = \theta_1^h + \left[ 1 - \theta_1^h \right] q \]  
(A.4)

Substituting \( A_2 \equiv q[1 - \beta] + [1 - q]\beta \), we see that (A.2) and (A.4) correspond to (31) and (32), respectively.

Then the firm’s expected second-period contracting cost with the original manager retained when \( \phi = l \) is

\[
\begin{aligned}
E\left[ \phi^L \right] &= pq_1^l \left[ \frac{\psi}{p \hat{q}_1^l - b} \right] + \left[ 1 - p \right] \left[ \frac{b\psi}{p \hat{q}_1^l - b} \right] \\
&= \frac{\psi \{ pq_1^l + [1 - p]b \}}{p \hat{q}_1^l - b} \delta 
\end{aligned}
\]  
(A.5)

The firm’s value if it continues at \( t = 1 \) with the original manager is

\[ \hat{q}_1^l R_S - E\left[ \phi^L \right] \]  
(A.6)

If the firm fires the manager and hires a new manager to replace him, the firm’s second-period value is

\[ \bar{q}_0^l R_S - \frac{\psi \{ pq_0^l + [1 - p]b \}}{\delta p \hat{q}_0^l - b} - K \]  
(A.7)

Now, if \( \beta = 0.5 \), then (A.6) becomes

\[ \bar{q}_0^l R_S - \frac{\psi \{ pq_0^l + [1 - p]b \}}{\delta p \hat{q}_0^l - b} \]  
(A.8)

which clearly exceeds (A.7). Thus, by continuity, \( \exists \beta^* > 0.5 \) such that (A.6) equals (A.7). For all \( \beta < \beta^* \), the expression in (A.6) will strictly exceed that in (A.7). \( \blacksquare \)

**Proof of Proposition 2:** \( W_L^l = 0 \) is clear from earlier arguments. Moreover, since (33) and (34) are binding in equilibrium, we can treat (33) and (34) as simultaneous equations to obtain (36) and (38). Clearly, (35) holds with (36) and (38). The rest of the proof follows in a straightforward manner. \( \blacksquare \)
Proof of Proposition 3: The manager’s rent (in units of utility) over two periods when he searches for $S$ at $t = 0$ is (using (22)):

$$\pi_S \equiv W_{S1}^n + \delta W_{S2}^n(n)$$  \hspace{1cm} (A.9)

Substituting for $W_{S1}^n$ from (27) into (A.9) gives us:

$$\pi_S = \frac{b\bar{\psi}}{p[q_0 - b]} - \delta W_{S2}^n(n) + \delta W_{S2}^n(n)$$

$$= \frac{b\bar{\psi}}{p[q_0 - b]}$$  \hspace{1cm} (A.10)

The manager’s rent over two periods when he searches for $L$ at $t = 0$ (using (33)) is:

$$\pi_L = W_L^n + \delta W_{S2}^n(n)$$  \hspace{1cm} (A.11)

Substituting for $W_L^n$ from (38) yields:

$$\pi_L = \frac{A_3\bar{\psi}}{p[q_0 - b][2\beta - 1]} + \left[\hat{W}_{S2}^n(l) - \hat{W}_{S2}^n(h)\right] \delta + W_{S2}^n(n)\delta$$  \hspace{1cm} (A.12)

Now

$$\frac{A_3\bar{\psi}}{p[q_0 - b][2\beta - 1]} > \frac{b\bar{\psi}}{p[q_0 - b]}$$  \hspace{1cm} (A.13)

and (using (28) and (30))

$$\hat{W}_{S2}^n(l) = \frac{b\bar{\psi}}{\delta p[q_1 - b]} > \frac{b\bar{\psi}}{\delta p[q_1^h - b]} = \hat{W}_{S2}^n(h)$$  \hspace{1cm} (A.14)

(because from (31) and (32) we know that $q_1^l < q_1^h$). Thus, it follows that $\pi_L > \pi_S$. ■

Proof of Proposition 4: From Proposition 3, we know that the manager’s rent is larger with $L$ than with $S$. This means that the firm’s expected wage cost over two periods is higher with $L$ than with $S$. So if firm value (excluding wage costs) is higher with $S$ being searched for at $t = 0$, then this is sufficient for short-termism to be optimal for the firm.
If $L$ is searched for at $t = 0$, then firm value over two periods (excluding wage costs) is:

$$V_L = p [\bar{q}_0 R_L - 1] + p [\bar{q}_0 R_S - 1]$$  \hspace{1cm} (A.15)

And if $S$ is searched for at $t = 0$, then firm value over two periods (excluding wage costs) is:

$$V_S = p \left\{ [\bar{q}_0 R_S - 1] + \bar{q}_0 p \left[ \hat{q}_1^h R_S - 1 \right] + [1 - \bar{q}_0] p [\bar{q}_0 R_S - 1] \right\}$$
$$+ [1 - p] p [\bar{q}_0 R_S - 1]$$  \hspace{1cm} (A.16)

Thus, a sufficient condition for the CEO to impose a short-termism constraint is for (A.16) to exceed (A.15). Now suppose we set $R_L$ in (A.15) equal to $R_S$. Then, since $\hat{q}_1^h > \bar{q}_0$:

$$V_S > p [\bar{q}_0 R_S - 1] + p \{ p [\bar{q}_0 R_S - 1] \} + [1 - p] p [\bar{q}_0 R_S - 1]$$
$$= p [\bar{q}_0 R_S - 1] + p [\bar{q}_0 R_S - 1] \left[ p + 1 - p \right]$$
$$= p [\bar{q}_0 R_S - 1] + p [\bar{q}_0 R_S - 1]$$
$$= V_L$$
$$V_S = V_L \text{ with } R_S = R_L$$  \hspace{1cm} (A.17)

Thus, $V_S > V_L$ if $\Delta = R_L - R_S$ is not too large. ■

**Proof of Lemma 5:** Suppose $\delta = 1$, and assume that the manager is paid $\{W^h_L, W^l_L, W^n_L\}$ described in Proposition 2 at $t = 2$ instead of $t = 1$. Given that $W^l_L = 0$, one possibility for the firm is to implement the deferral scheme by paying the manager $\hat{W}^h_{S2}(\phi) + W^\phi_L$ if the second-period project succeeds, $\hat{W}^l_{S2}(\phi) + W^\phi_L$ if the second-period project fails, and $\hat{W}^n_{S2}(\phi) + W^\phi_L$ if the manager did not request funding for the second-period project, where $\phi \in \{h, n\}$ on the first-period project. It is clear that doing this will have no effect on the manager’s incentives with respect to either the first-period or the second-period project. Of course, to maximize the effectiveness of incentives, we know that the manager should be paid 0 at $t = 2$ if the second-period project fails. To achieve this, the deferral can pay the manager $\hat{W}^h_{S2}(\phi) + \left[ W^\phi_L / \hat{q}_1^h \right]$ if the second-period project succeeds and $\hat{W}^n_{S2}(\phi) + \left[ W^\phi_L / \hat{q}_1^h \right]$ if no funding was requested for the second-period project, where $\phi \in \{h, n\}$. However, we derived the cheapest way to incentivize the manager to choose $e = 1$ and propose
only the good project in the second period when we solved for the subgame-perfect second-period contract. So we cannot improve on second-period incentives by paying the manager more. Further, the manager’s incentives on the first-period contract also cannot be improved by this deferral since beliefs follow a martingale and the manager’s choices on $L$ at $t = 0$ do not affect the success probability of $S$ chosen at $t = 1$.

Thus, with $\delta = 1$, wage deferral cannot improve on the outcome with the wage paid at $t = 1$. This means that with $\delta < 1$, wage deferral leads to a strictly higher expected wage cost (with no improvement in incentives).

**Proof of Lemma 6:** The proof follows directly from Propositions 2 and 4 and Lemma 4 with the prior and posterior probabilities of project success replaced by 1.

**Proof of Lemma 7:** The proof follows directly from Proposition 1 and Lemmas 1 and 3 with the prior and posterior probabilities of project success replaced by 1. For completeness and ease of later reference, these contracts are provided below. From Lemma 1,

\[
\tilde{W}_{S2}^h (R_S) = \frac{\psi}{p(1 - b)\delta} \tag{A.18}
\]

\[
\tilde{W}_{S2}^l (R_S) = 0 \tag{A.19}
\]

\[
\tilde{W}_{S2}^n (R_S) = \frac{b \psi}{p(1 - b)\delta} \tag{A.20}
\]

From Lemma 2,

\[
\tilde{W}_{S2}^h (n) = \frac{\psi}{p(1 - b)\delta} \tag{A.21}
\]

\[
\tilde{W}_{S2}^l (n) = 0 \tag{A.22}
\]

\[
\tilde{W}_{S2}^n (n) = \frac{b \psi}{p(1 - b)\delta} \tag{A.23}
\]

40
From Proposition 1,

\[ \tilde{W}_{s1}^h = \frac{\bar{\psi}}{p[1-b] \delta} - \delta \tilde{W}_{s2}^n (R_s) \]

\[ = \frac{\bar{\psi}}{p[1-b] \delta} - \frac{b \bar{\psi}}{p[1-b] \delta} \]

\[ = \frac{\bar{\psi}}{p} \]  \hspace{1cm} (A.24)

after substituting from (A.20). Furthermore,

\[ \tilde{W}_{s1}^l = 0 \]  \hspace{1cm} (A.25)

\[ \tilde{W}_{s1}^n = \frac{b \bar{\psi}}{p[1-b]} - \delta \tilde{W}_{s2}^n (n) \]

\[ = \frac{b \bar{\psi}}{p[1-b]} - \frac{b \bar{\psi}}{p[1-b]} \]

\[ = 0 \]  \hspace{1cm} (A.26)

after substituting from (A.23). ■

**Proof of Lemma 8:** The proof follows from the fact that incentivizing the type-\( U \) manager to expend search effort (choose \( e = 1 \)) is inefficient, given (5), i.e., it reduces firm value and cannot occur in equilibrium. Thus, in case the firm does end up with a type-\( U \) manager, it is efficient to not have the manager choose \( e = 1 \) and also to not propose a bad project. However, it is efficient to incentivize the type-\( T \) manager to choose \( e = 1 \) (see (4)) and propose only a good project, in that this increases firm value. Thus, it is part of the equilibrium. ■

**Proof of Lemma 9:** First, we prove feasibility. Consider the contracts in Lemma 6. We know from Lemma 4 that they are incentive compatible and satisfy the participation constraint of the type-\( T \) manager. It will be shown that the type-\( U \) manager will choose \( e = 0 \) in both periods and not propose a project for funding in either period. Consider the second period. For the type-\( U \)
manager to choose \( e = 0 \), it must be true that

\[
pq\hat{W}^h_{S_2}(\phi)\delta + [1 - p]\delta\hat{W}^n_{S_2}(\phi) - \bar{\psi} < \hat{W}^n_{S_2}(\phi)\delta
\]

which means we need

\[
p\delta \left[q\hat{W}^h_{S_2}(\phi) - \hat{W}^n_{S_2}(\phi)\right] < \psi \tag{A.28}
\]

Substituting from (40) and (42) into (A.28) gives:

\[
\frac{q\bar{\psi}}{1 - b} - \frac{b\bar{\psi}}{1 - b} < \psi \tag{A.29}
\]

or \( \frac{q_b - b}{1 - b} \) \( \bar{\psi} \) or \( q - b < 1 - b \), which is clearly true. To prove that the type-\( U \) manager will not propose a bad project, we need \( \delta b\hat{W}^h_{S_2}(\phi) \leq \delta\hat{W}^n_{S_2}(\phi) \) or \( \frac{b\bar{\psi}}{p[1 - b]} \leq \frac{b\bar{\psi}}{p[1 - b]} \), which clearly holds.

The rest of the proof for type-\( U \) follows similar arguments. It is also clear that the type-\( T \) manager will choose \( e = 1 \) and propose only a good project for funding in each period (see Lemma 6). Similar arguments can be used to prove feasibility for the contracts in Lemma 7. Now suppose all firms are \( L \)-project firms and all managers apply to \( L \)-project firms. Then the probability a manager will be hired is \( N/M \). The claim that both types of managers will strictly prefer to apply to the firms with the \( L \) projects is true if \( (N/M)(\pi_L^S) > \pi_S \), where \( \pi_S \) and \( \pi_L \) are defined in (A.10) and (A.12), respectively. Since \( \pi_S/\pi_L \) is decreasing in \( \bar{\psi} \), this inequality will hold for \( N/M \) and \( \bar{\psi} \) large enough. Thus, it is a Nash equilibrium for all managers to flock to type-\( L \) firms and for all firms to be type-\( L \) firms. ■

**Proof of Proposition 5:** The proof is similar to the arguments outlined in the text. Part (a) follows from the result that the two-period managerial rent is equal to the sum of the no-project wages over the two periods. Since these are the same for both type-\( T \) and type-\( U \) managers, (a) follows. As for (b) and (c), in light of Lemma 9, the only way for a type-\( T \) manager to strictly prefer the \( S \)-project firm is if it offers a higher wage than needed for incentive compatibility, i.e., set

\[
\tilde{W}^h_{S_1} = \hat{W}^h_{S_1} + \alpha
\]

(A.30)
where \( \alpha > 0 \) and \( \tilde{W}_{S1}^h = \tilde{\psi}/p \) (see (A.24)). Since in equilibrium the type-\( U \) manager does not propose a project, the additional rent \( \alpha \) is not available to such a manager, so it is possible that the type-\( T \) manager strictly prefers the \( S \)-project firm or is indifferent between \( S \)-project and \( L \)-project firms, and the type-\( U \) manager strictly prefers the \( L \)-project firm. Of course, the outcome in which the type-\( T \) manager strictly prefers the \( S \)-project firm and the type-\( U \) manager strictly prefers the \( L \)-project firm cannot be an equilibrium because the \( L \)-project firms would never participate. ■

**Proof of Lemma 10:** Given the assumption that some firms are pursuing \( S \) projects and some are pursuing \( L \) projects, it is clear that the \( S \)-project firms are offering a higher rent to the type-\( T \) managers in their offered wage contracts than that provided by the contracts in Lemma 7. From Proposition 5, we know that the offered contracts cannot be such that the type-\( T \) managers still strictly prefer the \( L \)-project firms (part (a) in Proposition 5), because in this case the \( S \)-project firms would be unstaffed, contradicting the premise that these firms are in the market. From (b) in Proposition 5, it can also not be the case that the type-\( T \) managers strictly prefer the \( S \)-project firms. Thus, part (c) is the only possibility. Given the indifference between the type-\( L \) and type-\( S \) firms on the part of the type-\( T \) managers, each will randomize applying across the two types of firms, with the probability \( \xi \) stipulated in the lemma. From Proposition 5, we know that in this case the type-\( U \) managers strictly prefer the \( L \)-project firms.

There will thus be \( \eta (R_L^*) \) \( S \)-project firms and \( N - \eta (R_L^*) \) \( L \)-project firms. A (type-\( T \)) manager applying to an \( S \)-project firm has a probability of

\[
e_S = \frac{\eta (R_L^*)}{\xi \theta_0 M}
\]

(A.31)

of being hired and a manager who applies to an \( L \)-project firm has a probability

\[
e_L = \frac{N - \eta (R_L^*)}{[1 - \theta_0] M + [1 - \xi] \theta_0 M}
\]

(A.32)

of being hired. It is clear that \( e_S > 0, e_L > 0 \). Moreover, since \( e_S \) and \( e_L \) are probabilities, it also follows that \( e_S \leq 1 \) and \( e_L \leq 1 \). Now by choosing \( \xi = \eta (R_L^*) / \theta_0 M < 1 \), which is allowed in
equilibrium, it is possible to make \( e_S = 1 \). Substituting this \( \xi \) in (A.32) yields

\[
e_L = \frac{N - \eta (R_L^*)}{M - \eta (R_L^*)} < 1
\]

(A.33)

Thus, \( e_S \in (0, 1) \) and \( e_L \in (0, 1) \) is an equilibrium. ■

**Proof of Proposition 6:** Given the earlier results, we know that for the \( S \)-project firm to hire a type-\( T \) manager (which must be the case in equilibrium), it must make the type-\( T \) manager indifferent between applying to the \( S \)-project and \( L \)-project firms. From the proof of Lemma 10, we know that if we set \( \xi = \eta (R_L^*) / \theta_0 M \in (0, 1) \), then \( e_S = 1 \) and \( e_L \) if given by (A.46), which are the expressions in the proposition.

Now, to make the type-\( T \) manager indifferent between the \( S \)-project and \( L \)-project firms, the \( S \)-project firms will need to raise their wage, \( \tilde{\tilde{W}}_{S1}^{h} \), as in (A.30), where \( \alpha > 0 \) remains to be solved for. Now using (A.24) and (A.30):

\[
\tilde{\tilde{W}}_{S1}^{h} = \frac{\bar{\psi}}{p[1 - b]} - \delta \tilde{W}_{S2}^{n} (R_S) + \alpha
\]

\[
= \bar{\psi} + \frac{\alpha}{p}
\]

(A.34)

The purpose of doing this is to raise the rent earned by the type-\( T \) manager to make him indifferent between the \( S \)-project and \( L \)-project firms. Note that the analog of the IC constraint (22) holds tightly with \( \tilde{\tilde{W}}_{S1}^{h} \) for the type-\( T \) manager:

\[
p \left[ \tilde{\tilde{W}}_{S1}^{h} + \delta \tilde{W}_{S2}^{n} (R_S) \right] + [1 - p] \left[ \tilde{W}_{S1}^{n} (n) + \delta \tilde{W}_{S2}^{n} (n) \right] - \bar{\psi} = \tilde{W}_{S1}^{n} + \delta \tilde{W}_{S2}^{n} (n)
\]

(A.35)

where

\[
\tilde{W}_{S2}^{n} (n) = \frac{b\bar{\psi}}{p\delta[1 - b]}
\]

(A.36)

Since the second IC constraint, the analog of (23), also holds tightly with \( \tilde{W}_{S1}^{n} \), we have:

\[
b \left[ \tilde{\tilde{W}}_{S1}^{h} + \delta \tilde{W}_{S2}^{n} (R_S) \right] = \tilde{W}_{S1}^{n} + \delta \tilde{W}_{S2}^{n} (n)
\]

(A.37)
which yields

\[
\tilde{W}^n_{S1} = \frac{b\tilde{w}}{p[1-b]} - \delta\tilde{W}^n_{S2} (n) \tag{A.38}
\]

But with \(\tilde{W}^h_{S1}\), the analog of (A.37) is:

\[
b \left[ \tilde{W}^h_{S1} + \delta\tilde{W}^n_{S2} (R_S) \right] = \tilde{W}^n_{S1} + \delta\tilde{W}^n_{S2} (n) \tag{A.39}
\]

which gives us:

\[
\tilde{W}^n_{S1} = \frac{b\tilde{w}}{p[1-b]} + b\alpha - \delta\tilde{W}^n_{S2} (n)
\]

\[
= \frac{b\tilde{w}}{p[1-b]} + b\alpha - \frac{b\tilde{w}}{p[1-b]}
\]

\[
= b\alpha \tag{A.40}
\]

With these contracts, the type-\(T\) manager’s rent in working for the \(S\)-project firm is:

\[
\tilde{\pi}_S = p\alpha + \tilde{W}^n_{S1} + \delta\tilde{W}^n_{S2} (n)
\]

\[
= p\alpha + b\alpha + \frac{b\tilde{w}}{p[1-b]} \tag{A.41}
\]

This is similar to (A.9), but with the extra term \(p\alpha\) that arises from the manager being paid \(\alpha\) conditional on project success, above that needed to have a binding effort IC constraint (i.e. the left-hand side of (A.35) exceeds the right-hand side when \(\tilde{W}^h_{S1}\) is replaced by \(\tilde{W}^h_{S1}\) and \(\tilde{W}^n_{S1} (n)\) is replaced by \(\tilde{W}^n_{S1} (n)\)). The manager’s rent from working for an \(L\)-project firm is (see (A.11)):

\[
\tilde{\pi}_L = \frac{A_3\tilde{w}}{p[1-b][2\beta - 1]} + \delta \left[ \tilde{W}^n_{S2} (l) - \tilde{W}^n_{S2} (h) \right] \tag{A.42}
\]

However, when the only manager who proposes projects in equilibrium is the type-\(T\) manager, then

\[
\tilde{W}^n_{S2} (l) = \tilde{W}^n_{S2} (h) = \frac{b\tilde{w}}{p[1-b]\delta} \tag{A.43}
\]
Thus, (A.42) becomes:

\[
\tilde{\pi}_L = \frac{A_3 \bar{\psi}}{p(1 - b)[2\beta - 1]} \quad (A.44)
\]

For the type-\(T\) manager to be indifferent between the two types of firms, we need \(\tilde{\pi}_S = e_L \tilde{\pi}_L\). Equating (A.41) and (A.44) gives us:

\[
\alpha = \frac{\bar{\psi} [e_L A_3 - b(2\beta - 1)]}{p[p + b][1 - b][2\beta - 1]} \quad (A.45)
\]

Substituting \(\alpha\) into (A.34) gives us (47), and substituting \(\alpha\) into (A.40) gives us (48).

Next we verify that the type-\(U\) manager will strictly prefer to choose \(e = 0\). This requires

\[
pq \left[ \tilde{W}^{h}_{S1} + \delta \tilde{W}^{n}_{S2} (R_S) \right] + [1 - p] \left[ \tilde{W}^{n}_{S1} (n) + \delta \tilde{W}^{n}_{S2} (n) \right] < \tilde{W}^{n}_{S1} + \delta \tilde{W}^{n}_{S2} (n) \quad (A.46)
\]

which reduces to

\[
pq[1 - b] \left[ \frac{\bar{\psi}}{p[1 - b]} + \alpha \right] < \bar{\psi}b \quad (A.47)
\]

after the appropriate substitutions. Simplifying, we see that (A.47) holds given (7). We also see that the type-\(U\) manager will strictly prefer to work for the \(L\)-project firm. The rent for such a manager with the \(S\)-project firm is given by

\[
\tilde{\pi}^{U}_{S} = \tilde{W}^{n}_{S1} (n) + \delta \tilde{W}^{n}_{S2} \quad (A.48)
\]

Since \(\tilde{\pi}^{U}_{S} < \tilde{\pi}_{S}\), the type-\(U\) manager strictly prefers the \(L\)-project firm. Now note that if a manager does not propose a project at \(t = 0\), the posterior belief about his type becomes

\[
\tilde{\theta}^n_1 = \frac{[1 - p]\theta_0}{[1 - p]\theta_0 + [1 - \theta_0]} < \theta_0 \quad (A.49)
\]

given the equilibrium strategies of the two types of managers. Thus, \(K\) needs to be high enough for it to be subgame perfect for the firm to not fire a manager who does not propose a project at \(t = 0\).

Finally, the earlier arguments make it clear that \(\xi \in (0, 1)\). \(\blacksquare\)
Proof of Proposition 7: Define

\[ \gamma \equiv \frac{[1 - \xi] \theta_0 M}{[(1 - \theta_0) M + [1 - \xi] \theta_0 M]} \quad (A.50) \]

Then the value of \( R_L \) at which the firm is indifferent between an \( S \) project and an \( L \) project, \( R^*_L \), is:

\[
p[R_S - 1] + p[R_S - 1] - \tilde{\pi}_S = \gamma \{p[R^*_L - 1] + p[R_S - 1]\} - \tilde{\pi}_L \quad (A.51)
\]

where \( \tilde{\pi}_S \) is given by (A.41). Substituting for \( \alpha \) from (A.45) into (A.41) and simplifying yields:

\[
\tilde{\pi}_S = \frac{\psi e_L A_3}{p[1 - b][2\beta - 1]} \quad (A.52)
\]

Substituting (A.44) and (A.52) into (A.51), using \( e_L = [N - \eta (R^*_L)] / [M - \eta (R^*_L)] \), and simplifying gives us:

\[
R^*_L - \frac{A_3 \psi [M - N]}{p[1 - b][2\beta - 1] \gamma p [M - \eta (R^*_L)]} = 1 + \frac{[R_S - 1] 2 - \gamma}{\gamma} \quad (A.53)
\]

as the equation that provides a solution for \( R^*_L \).

Finally, inspection of (A.53) reveals that an increase in \( \gamma \) must reduce \( R^*_L \). Since \( \gamma \) is increasing in \( \theta_0 \) (\( \xi \) is decreasing in \( \theta_0 \)), it follows that an increase in \( \theta_0 \) reduces \( R^*_L \). ■

Proof of Corollary 1: The result that \( \triangle_1 < \triangle_0 \) follows from the result that the \( S \)-project firms are paying higher wages with competition and asymmetric information about managerial types than without, whereas the \( L \)-project firms are unaffected. ■