CEO Pay and the Lake Wobegon Effect

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Abstract

The "Lake Wobegon Effect," which is widely cited as a potential cause for rising CEO pay, is said to occur because no firm wants to admit to having a CEO who is below average, and so no firm allows its CEO's pay package to lag market expectations. We develop a game-theoretic model of this Effect. In our model, a CEO's wage may serve as a signal of match surplus, and therefore affect the value of the firm. We compare equilibria of our model to a full-information case and derive conditions under which equilibrium wages are distorted upward.

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1 Introduction

CEO pay levels in the US have risen ten times as fast as average worker wages since the 1970s (The Economist, 2006). These ever-increasing paychecks continue to attract the attention of policymakers, the media, and the public. One much-discussed potential cause for the increase in CEO pay has come to be known as the Lake Wobegon Effect. In public radio host Garrison Keillor's mythical home town of Lake Wobegon, Minnesota, all the children are above average. And so it is claimed with CEOs — no firm wants to admit to having a CEO who is below average, and so each firm wants its CEO's pay package to put him at or above the median pay level for comparable firms. It is well known that firms commonly *disclose* an intention to pay well; Bizjak et al. (2008) report that 73 out of 100 randomly selected firms "mention targeting at least one component of pay at or above the peer group median or mean." Of course, not every CEO can be paid more than average, and so (it is claimed) we see ever-increasing levels of CEO pay. The reasoning behind this effect was perhaps best summarized by former DuPont CEO Edward S. Woolard, Jr., speaking at a 2002 Harvard Business School roundtable on CEO pay (Elson, 2003): "The main reason compensation increases every year is that most boards want their CEO to be in the top half of the CEO peer group, because they think it makes the company look strong. So when Tom, Dick, and Harry receive compensation increases in 2002, I get one too, even if I had a bad year.... (This leads to an) upward spiral."

A remarkable range of commentators have referenced the Lake Wobegon Effect in discussing CEO pay, including consultant turned pay-critic Graef Crystal (The Washington Post, 2002), former Harvard Business School dean Kim Clark (2003, 2006), and the director of the SEC's Division of Corporation Finance, Alan Beller (2004). The Effect has even been cited by disgruntled shareholders in picking proxy fights with management over pay levels. After *Business Week* ranked Alcoa worst nationally in the relation between CEO pay and stock price performance, The Catholic Funds introduced a shareholder resolution citing the Lake Wobegon Effect and instructing the board to review the firm's pay practices. The resolution failed.

Despite the prevalence of the Lake Wobegon Effect argument among pundits and commentators, there has been no attempt to model it in the large academic literature on CEO pay. In this paper, we offer a formal, game-theoretic model of the Lake Wobegon Effect in CEO pay.[1] We use this model to ask whether the Lake Wobegon Effect can increase CEO pay in

[1] Other research examines a Lake Wobegon Effect in employee evaluations, where supervisors are unwilling to rate employees honestly and thus mark everyone as above average (Moran and Morgan, 2001, MacLeod, 2003).

equilibrium, and if so, under what conditions.

We build our model of the Lake Wobegon Effect on three key assumptions. First, there must be asymmetric information regarding the manager's ability to create value at the firm. Second, the pay package given to a manager must convey information about the manager's ability to create value at the firm. Third, the firm must have some preference for favorably affecting outsiders' perceptions of firm value. We build in these three key assumptions by modeling a firm and a manager who privately observe a parameter that affects the productivity of their match. Stock market participants cannot observe this parameter, but attempt to infer it from observing the manager's wage. The firm maximizes a weighted sum of short-run and terminal firm value, and so may wish to distort the publicly observable wage to affect the market's beliefs regarding firm value.

We apply the standard tools of information economics to compare the Perfect Bayesian Equilibrium of our model to the outcome in a full-information benchmark case. Within our model, we define a Lake Wobegon Effect to occur when the wage schedule that obtains in the full-information case *cannot* be part of a Perfect Bayesian Equilibrium of the asymmetric information case.

We present three main results. First, we show the Lake Wobegon Effect can occur. That is, there are instances of our model in which the full-information benchmark is not an equilibrium, and firms distort pay upward to affect market perceptions of firm value. Second, we characterize the settings in which the Lake Wobegon Effect does occur. We show that our three key assumptions — asymmetric information, managerial rents, and corporate myopia — are not sufficient to guarantee upward distortions in pay. In the basic version of our model, two additional conditions are necessary: (1) the marginal effect of increases in managerial ability on match surplus — defined as the difference between the parties' output when working together and when pursuing their outside options — is positive, and (2) the weight placed by the firm on short-run share prices is greater than the fraction of the match surplus that is captured by the manager.

Third, we find that the temptation to distort pay upward is stronger when the information asymmetry pertains to characteristics of the *firm* rather than characteristics of the manager. When the manager's ability is uncertain, increases in the manager's pay do boost the market's assessment of managerial ability; however, the manager — not the firm — captures rents associated with increases in managerial ability. Thus, the marginal increase in firm value associated with a dollar increase in managerial pay is low when the uncertainty pertains to a characteristic of the manager.

While our analysis shows that the Lake Wobegon Effect is a theoretical possibility, we note that, within our model, the three key assumptions are not sufficient conditions for the Lake Wobegon Effect. In the basic version of our model, there is no Lake Wobegon Effect if the match surplus does not grow as managerial ability grows. Further, there is no Effect if the firm's myopia is less than the share of match surplus captured by the manager.

These additional necessary conditions may strike some readers as extreme, and thus our findings may be taken as grounds for dismissal of the Lake Wobegon Effect as an explanation for recent CEO pay increases. However, we think the first additional necessary condition — that managerial ability increases match surplus — is likely to be met in at least some cases. It is, in some sense, a specific human capital condition. If "ability" is related to general cognitive skills, then it is reasonable that higher ability would boost the manager's productivity both inside and outside the firm, which could push the match surplus in either direction. But if ability is a complement to "firm-specific" knowledge, then the firm's output could well grow faster with ability than does the manager's value when producing elsewhere.

The second condition — on the relative magnitudes of myopia and managerial bargaining power — is more difficult to assess. While it is commonly alleged that public firms value high short-run share prices, we are not aware of any empirically measurable analogue to the myopia parameter commonly used in models like ours. Further, even with extremely detailed information on CEO pay, it is not clear how one would measure managerial bargaining power. Bargaining power is the share of match surplus captured by the manager; assessing this figure empirically would require knowledge of the manager's pay in his next most attractive job, the firm's value when employing its second-choice manager, and the value the parties create when working together. Difficulties in measuring both the CEO's share of match surplus and the firm's degree of myopia imply that while our model shows the Lake Wobegon Effect *can* occur, it remains to be shown whether it actually *does* occur.

Our model is consistent with some existing empirical evidence. In the model, pay can be "too high" because market participants make inferences about firm value from observing pay. If pay levels are not disclosed, then there is no reason for firms to boost pay levels to increase short-run market values. Park et al. (2001) study how pay levels at Canadian firms changed after a 1994 disclosure mandate, and report increases in the level of CEO pay in the post-disclosure period relative to pre-disclosure. This evidence is consistent with other theories, however, and thus cannot be interpreted as confirming the existence of a Lake Wobegon Effect.

Devising sharper tests of the model will require some way of assessing across-firm variation in myopia and managerial bargaining power, and even this will be complicated by the possibility that myopia at one firm will affect pay at another, if the firms compete in the labor market.

Finally, we note that some discussions of the Lake Wobegon Effect focus exclusively on the effects of peer-group comparisons on CEO pay. Crystal (1991), for example, has argued that pay-benchmarking combined with strategic choice of peer groups can artificially inflate pay. We argue, however, that the quotations from Woolard and others suggest forces *beyond* peer-group benchmarking are at work. Specifically, peer-group benchmarking is by itself not necessarily problematic for the pay process; pay should be positively related to peer group pay under almost any model of well-functioning labor markets. Further, if strategic choice of peer groups drives pay up, one wonders why boards cannot simply undo these strategies by collecting their own peer-group samples. While our model does not speak directly to the question of why firms would want to pay well *relative to peers* in particular, it does offer a justification for the practice of paying well *relative to some market expectation* of pay, which, as noted, might derive from peer groups. In our model, firms pay well to "look strong," even if doing so is not necessitated by labor market competition, and even if peer groups are chosen non-strategically.

2 Model Outline

We consider a single-period game with four dates and no discounting, as depicted in Figure 1. At date 1, the firm is matched with a potential manager. The firm and potential manager costlessly learn firm- and manager-specific productivity parameters, and a match-specific productivity parameter. We denote the firm- and manager-specific productivity parameters as $q \in [q_L, q_H]$ and $a \in [a_L, a_H]$, respectively. Let the value of the output generated when the manager works for the firm be the differentiable and increasing function $f(q, a; \gamma)$, where $\gamma \in [\gamma_L, \gamma_H]$ is a match-specific productivity parameter. We assume these parameters are common knowledge between the firm and the manager, but may not be observable to others. Note the firm- and manager-specific productivity parameters may affect both the parties' outside options and the rent they split if they enter into an employment relationship and work together. We therefore interpret the manager's productivity parameter a as a measure of general-purpose skill or ability. We can interpret the firm-specific productivity parameter q as some measure of the firm's technology or investment opportunities.

If employment is efficient, the firm and manager negotiate an employment contract at date

2. We ignore moral hazard on the part of the manager, and assume the firm's terminal value is non-contractible. Under these assumptions, the employment contract simply consists of a wage w.[2] We assume the terms of this wage contract are publicly observable.[3] If employment is inefficient, then the parties separate, receive their reservation values, and the game ends. Note that the model can be interpreted as applying either to the negotiation of hiring-date pay packages or to the negotiation of yearly salary levels for an incumbent CEO.

At date 3, a round of trading in the firm's shares occurs. The date 3 market value of the firm's shares — which we refer to as the firm's "interim value" — is conditioned on the date 2 contract between the firm and manager. However, the interim value cannot be conditioned (directly) on f, because this is observed only by the firm and the manager. Instead, stock market participants form beliefs about f based on the observed date 2 contract.

At date 4, production occurs. The shareholders receive the firm's output f minus the wage paid to the manager. We refer to this payment to shareholders as the firm's terminal value.[4] The game ends.

We build in our three key assumptions as follows. First, we assume that some aspect of productivity — one of the match-specific productivity, the manager-specific productivity, or the firm-specific productivity — is not observed by market participants. Thus, there is asymmetric information about the firm's terminal value.

Second, we assume that the manager has sufficient bargaining power to capture some part of the rent resulting from the match. This implies that contract terms will vary with the value

[2]The assumption of non-contractibility of terminal value can be justified by imagining that some production takes the form of an investment that does not yield returns until after the manager's tenure in office has ended. It is straightforward to extend the model to allow for pay-for-performance contracting and moral hazard by assuming the marginal return to unobservable CEO effort is match-specific (see Schaefer, 1998). In this case, pay levels can be distorted upwards and incentives can be "too strong" relative to the full-information benchmark. This "pay-for-performance" extension of our basic model also suggests that the Lake Wobegon Effect can lead to reductions in social welfare. In the simple version presented here, there are no welfare consequences of the Lake Wobegon Effect, because increases in managerial pay are a transfer. See also Hayes and Schaefer (2005) for a signaling model of yearly bonuses in a relational contracts setting.

[3]Specifically, we assume that the firm must truthfully disclose the wage paid to the manager. As will become clear, the firm may face an incentive to over-report pay. If firms can costlessly report pay that is higher than the manager's actual wage, then pay disclosures become uninformative cheap talk.

[4]The timing of the payment to the manager is not important in the analysis and can readily be shifted to date 2. If the firm can costlessly borrow, then payments to the manager can be made at any time.

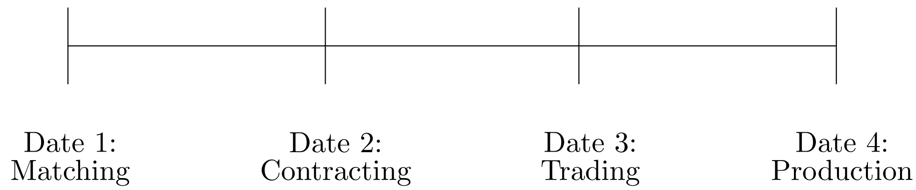

Figure 1: Timeline.

of the firm, and thus that stock-market participants will condition their beliefs about the firm's terminal value on the payment made to the manager.

Third, we assume that the firm has some preference for a high *interim* share price. Many justifications for the assumption of corporate short-termism or myopia have been proposed in the literature. Miller and Rock (1985), for example, assume that shareholders have exogenously differing time horizons. In their model, shareholders are *ex ante* identical, and learn their specific time horizons after the firm's dividend policy is chosen; thus, all shareholders have some preference for high interim share prices. In Stein (1988), a corporate raider considers purchasing all of the firm's shares immediately after a corporate action is taken, but before the terminal payoff. The expected payoff to current shareholders is therefore the weighted sum of interim and terminal values, with the weights determined by the probability of a takeover. In our analysis, we follow Stein (1989) by suppressing the precise reasons underlying corporate myopia. We assume that the firm places weight k on the interim value and $1-k$ on the terminal value. The variable k parameterizes the firm's myopia, with higher k implying a greater concern for interim share prices.

The twin assumptions of asymmetric information and corporate short-termism have been widely used in the financial economics literature. For example, Myers and Majluf (1984) and Miller and Rock (1985) — who study capital structure and dividend policy, respectively — assume that shareholders care about short-term share prices, and that managerial compensation contracts induce managers (who actually make the capital structure and dividend policy decisions) to value high short-run share prices as well. This literature has been criticized by Dybvig and Zender (1991), who argue that shareholders need not write contracts that motivate managers to care about short-run share prices. Indeed, given that equilibria in these models typically involve inefficient investment, shareholders are best off writing contracts that give managers a different objective function than shareholders themselves hold; essentially, Dybvig and Zender offer delegation-as-commitment as a solution to a strategic problem, as in Fershtman and Judd (1987). The delegation-as-commitment literature has been criticized by Katz (1991), Persons (1994), and others on the grounds that such contracts are not renegotiation-proof. If secret renegotiation of contracts is possible, then delegation may be strategically irrelevant. Dewatripont (1988) counters this claim by noting that informational problems may impede renegotiation, thus restoring a strategic role for contracts.

We remain agnostic on the debate over delegation-as-commitment, for two reasons. First, our analysis differs from the corporate finance literature in that it is the managerial wage contract itself — rather than a choice of capital structure or dividend policy which, in turn, is a function of the wage contract — that is affected by the information asymmetry and myopia. Thus, an appropriately constructed managerial incentive contract cannot help here. Second, the prescription of Dybvig and Zender (1991) — that myopic shareholders should credibly delegate decisions to an intermediary whose preferences are manipulated using contracts — is potentially descriptive of status quo institutional arrangements, where pay decisions are delegated to a subcommittee of the board. We are unaware, however, of any studies of the relative myopia of shareholders vs. directors.

3 Analysis

In this section, we develop several variants of our basic model. We consider idiosyncratic matching, where the parties' outside options are assumed to be equal to their individual-specific productivity parameters. We examine three cases, each corresponding to a different source of information asymmetry regarding firm value. First, we suppose that managerial ability a is unknown to stock market participants. Second, we assume that stock market participants are uninformed regarding the firm's individual productivity q. Third, we assume that the information asymmetry pertains to the match-specific productivity parameter γ. For each case, we characterize the settings in which the Lake Wobegon Effect occurs.

3.1 Asymmetric Information Regarding Managerial Ability

We first consider the effects of asymmetric information regarding managerial ability, a. To focus on this effect, we make a number of assumptions. Let the firm's individual productivity parameter q be common knowledge among all players of the game. Let the parties' output be $f(q,a)$, where the function f is common knowledge and the match-specific productivity parameter γ is suppressed. Finally, we assume that the outside options of the firm and manager are given by q and a respectively.[5] Under these assumptions, the match surplus — that is, the difference between the parties' output when working together and when pursuing their outside options — is given by

$$f(q,a) - q - a.$$

If all players in the game can observe managerial ability a at date 1, then there is no reason for the firm to behave strategically to try to affect the firm's interim value. We assume that in this case, the firm and manager split the match surplus according to Nash bargaining. Here, we are assuming that there are rents — that is, value in excess of the parties' outside options — in the managerial labor market, and that these rents can be shared between the firm and the manager.[6] Assuming the manager has bargaining power α, he will command a wage of

$$\tilde{w}(a) = a + \alpha\big(f\left(q,a\right) - q - a\big). \tag{1}$$

Let the wage schedule $\tilde{w}(a)$ be a full-information benchmark.[7]

Suppose, however, that a is observed by the firm and manager at date 1, but that market participants cannot learn a directly until date 4 when the firm's terminal value is revealed.[8]

[5]This assumption is without loss of generality. Suppose a' is some measure of a manager's general cognitive skill (IQ perhaps). Let $g(q,a')$ be the output when the manager works for the firm, and let $v(a')$ be the the manager's outside option, where both g and v are strictly increasing in a' and differentiable. To transform this setup into ours, simply define $a = v(a')$ and $f(q, v(a')) = g(q,a')$. Differentiating both sides of the definition of f with respect to a', it follows that f is strictly increasing in a.

[6]Several theories in labor and personnel economics predict that workers (and especially top executives) can earn rents. Such theories include tournaments, firm/worker matching, firm-specific human capital, efficiency wages, and rent extraction. See Lazear and Oyer (2007) for descriptions of these models and related empirical work. Note the setting where the firm captures all of the rents ($\alpha = 0$) is a special case of our model.

[7]Within our framework it is clear that many forces — including changes in f or α — could explain why CEO pay has increased. We do not use this framework to examine all possible reasons for recent CEO pay increases, but instead use it to develop conditions under which firms are eager to pay well relative to some external benchmark.

[8]We have in mind a setting where the firm and manager know the value of the manager's next best job option even without a job offer being made. Outsiders lack specific knowledge of the labor market, and thus do not know the manager's outside option unless a job offer is publicly announced. It is not important that the firm and manager know the outside option with certainty; they must merely have better information than outsiders. A potentially useful analogy is that a finance professor's department chair might know reasonably well whether

Given this, the firm may want to distort the manager's pay upward in an attempt to affect outsiders' perceptions of terminal value, which will then influence the market-determined interim value. In equilibrium, of course, such attempts to fool the market must fail, so a wage schedule that is part of a Perfect Bayesian Equilibrium (PBE) must satisfy a set of no-mimic constraints.

A firm whose manager has ability a must not prefer to mimic a firm whose manager has ability $\hat{a} \neq a$. Denoting the PBE wage schedule under asymmetric information as $\hat{w}(a)$, we see that a type-a firm's interim value when mimicking a type-$\hat{a}$ firm is

$$f(q, \hat{a}) - \hat{w}(\hat{a}).$$

Note here that interim value can be *increasing* in the wage paid to the manager. Paying a higher wage can increase the market's perception of the available match surplus. Stock market participants therefore expect a higher terminal value, and would have a higher willingness-to-pay for the firm's shares at the date 3 interim stage. Ordinarily, of course, higher factor prices reduce firm value, but this need not be the case given the information asymmetry here.

A type-a firm's terminal value when mimicking a type-$\hat{a}$ firm is

$$f(q, a) - \hat{w}(\hat{a}).$$

The firm places weight k on its interim value, so its payoff when mimicking a type-$\hat{a}$ firm is given by

$$k\big(f(q, \hat{a}) - \hat{w}(\hat{a})\big) + (1-k)\big(f(q, a) - \hat{w}(\hat{a})\big).$$

If a type-a firm instead elects not to mimic another type, then its interim and terminal values are identical, and equal to

$$f(q, a) - \hat{w}(a).$$

A type-a firm will not mimic another type if $\hat{w}(a)$ satisfies

$$f(q, a) - \hat{w}(a) \geq k\big(f(q, \hat{a}) - \hat{w}(\hat{a})\big) + (1-k)\big(f(q, a) - \hat{w}(\hat{a})\big) \tag{2}$$

for all $\hat{a} \neq a$.[9] A wage schedule must satisfy this condition for all a in order to be part of a PBE. To build intuition, note that there are both costs and benefits to a type-a firm mimicking

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the professor's threat to obtain a high-salary offer from another university is credible. An outsider such as a dean or provost, lacking specific knowledge of the field, may not know whether this threat is credible until an offer is actually made.

[9]Note that in equilibrium, the interim and terminal market values are always the same, as required by market

a type-$\hat{a}$ firm, where $\hat{a} > a$. Because we have assumed $f_a > 0$ (where the subscript denotes a partial derivative), mimicking a higher type causes the market's conjecture about the firm's date 4 output to increase. However, the firm must also increase the employee's wage from $\hat{w}(a)$ to $\hat{w}(\hat{a})$ — this cost is felt both at date 3 and date 4, reducing both the interim and terminal values.

As noted above, our central aim is to examine conditions under which the firm distorts pay levels upward; that is, we want to know when the full-information wage schedule $\tilde{w}(a)$ cannot be part of a PBE. To this end, we replace $\hat{w}(a)$ in Inequality (2) with $\tilde{w}(a)$ from Equation (1). We assume the manager's bargaining power is sufficient to guarantee that he will always earn at least $\tilde{w}(a)$, so deviations from the equilibrium that involve paying less than this amount are not considered. Thus, for all a and for all $\hat{a} > a$, we must have

$$f(q,a) - \tilde{w}(a) \geq k\big(f(q,\hat{a}) - \tilde{w}(\hat{a})\big) + (1-k)\big(f(q,a) - \tilde{w}(\hat{a})\big).$$

Additional algebra shows that this condition is equivalent to

$$(1-\alpha) \geq (k-\alpha)\frac{f(q,\hat{a}) - f(q,a)}{\hat{a} - a}$$

for all a and for all $\hat{a} > a$. Next define

$$f_a^{\max} = \max_{a \in [a_L, a_H]} f_a(q,a)$$

and note that our assumption that f is differentiable implies

$$\sup_{a < \hat{a} \in [a_L, a_H]} \frac{f(q,\hat{a}) - f(q,a)}{\hat{a} - a} = f_a^{\max}.$$

In words, we define $f_a^{\max}$ to be the largest value taken by f_a over the interval $[a_L, a_H]$. Note also that $\frac{f(q,\hat{a})-f(q,a)}{\hat{a}-a}$ is the average rate of increase in f over the interval $[a, \hat{a}]$; if f is differentiable, then this quantity can be equal to or arbitrarily close to, but never greater than, $f_a^{\max}$. Thus, the statement that

$$(1-\alpha) \geq (k-\alpha)\frac{f(q,\hat{a}) - f(q,a)}{\hat{a} - a} \tag{3}$$

for all a and for all $\hat{a} > a$ is implied by

$$(1-\alpha) \geq (k-\alpha) f_a^{\max}.$$

efficiency. The driver of our model is the observation that the interim and terminal values could differ *off the equilibrium path*. If a firm were to deviate from the equilibrium wage schedule, then these values could differ as the market is fooled by the high pay. The equilibrium is constructed by stating that such deviations are never profitable, and therefore that interim and terminal values are always the same in equilibrium.

One final step of algebra shows that if

$$k \leq \alpha + \frac{1-\alpha}{f_a^{\max}}, \tag{4}$$

then the full-information wage schedule forms a PBE.

Inequality (4) yields our first main result. Because k and α can take values on the [0,1] interval and $f_a^{\max} > 0$, it is possible for this inequality to be violated. In our model, there are instances for which the full-information wage schedule is not a PBE. In these cases, firms distort pay upward in an attempt to affect short-run market valuations. Thus, the Lake Wobegon Effect can occur.

Inequality (4) also establishes our second main result: the Lake Wobegon Effect can occur only if additional necessary conditions are met. Specifically, pay is distorted upward only if the firm's myopia level is sufficiently high. To facilitate comparisons between the case of asymmetric information regarding managerial ability a and the cases of asymmetric information regarding q and γ (which we discuss below), we define the firm's "myopia threshold" to be the largest k satisfying Inequality (4). We make three observations about the comparative statics of this threshold:

- Note first that a higher α means a higher myopia threshold. Why? A high α means that a greater share of the match surplus is captured by the manager rather than the firm. This both increases the marginal cost and reduces the marginal benefit of attempts to boost the market's perception of managerial ability. The marginal benefit falls because an increase in perceived match surplus has a smaller effect on interim value. The marginal cost rises because a larger wage increase is required to move market perceptions of managerial ability. Because a high α makes it both more costly and less beneficial to overpay a manager, a firm would have to be very myopic in order to overpay when it has a high α.

- Second, if $f_a^{\max}$ — the maximum of the marginal effect of managerial ability on output — is less than or equal to one, then the right-hand side of (4) is greater than or equal to one, and hence the full-information wage schedule is always part of a PBE regardless of the value of α. Because match surplus is given by $f(q,a)-q-a$, boosting market perceptions of managerial ability can positively affect interim value only if $f_a^{\max} > 1$.[10] Economically,

[10] To see why this is true, note that the firm's terminal value is $f(q,a) - w(a)$. Under the full-information wage schedule, $\tilde{w}_a$ is always greater than or equal to one, because the manager's outside option increases by one for each one-unit increase in a. So, if $f_a^{\max} \leq 1$, then having a better manager does not increase firm's terminal value. As a result, the firm would never want to pretend its manager is better than he is.

$f_a^{\max} > 1$ means there is some a for which an increase in managerial ability increases the match surplus $f(q, a) - q - a$.[11] Our analysis shows that this is a necessary condition for pay to be distorted upward.

- Third, in the case where $f_a^{\max} > 1$, increases in $f_a^{\max}$ reduce the firm's myopia threshold. As $f_a^{\max}$ grows, the marginal effect of an additional dollar of wages on the firm's interim value grows. Because overpaying the manager increases the firm's assessment of managerial ability, and beliefs about ability have a larger effect on interim value when $f_a^{\max}$ is large, overpaying becomes a more attractive option when $f_a^{\max}$ is large.

As these observations indicate, the three assumptions of the Lake Wobegon Effect are not sufficient to guarantee that managers will be overpaid relative to the full-information case. Overpayment can occur only if $f_a^{\max} > 1$, and only if the firm's myopia is sufficiently large relative to the manager's bargaining power.

Given one additional assumption, it is straightforward to characterize a separating PBE when the full-information wage schedule cannot be part of an equilibrium. We assume f is concave, which allows us to replace the global no-mimic constraints in (2) with the local no-mimic constraint:

$$\hat{w}_a \geq k f_a \tag{5}$$

for all a.[12]

We begin by considering the case where

$$k > \alpha + \frac{1 - \alpha}{f_a(a_H)}.$$

Here, the fact that f_a is decreasing means that the full information wage schedule does not satisfy (4) for any $a \in [a_L, a_H]$. Applying the standard refinement of minimal signaling, we can

[11] Recall that we assumed that managerial ability a is identically equal to the manager's outside wage. Absent this normalization, the condition that $f_a^{\max} \leq 1$ would, using the notation from footnote 5, take the form that $g_{a'} - v_{a'} \leq 0$ for all a'.

[12] Concavity insures that if it is profitable for a type-a firm to mimic a type-$\hat{a} > a$ firm, then it is also profitable for the type a firm to mimic a type-$a + \epsilon$ firm, where ϵ is arbitrarily small. The local no-mimic constraint in (5) — which states that mimicking the $a + \epsilon$ type must be unprofitable for each a — thus implies the global no-mimic constraint in (2). As Laffont and Martimort (2002) observe, it is difficult to obtain general results in signaling games with continuous types without making assumptions to insure that local incentive constraints imply global. Note that our main result above — a characterization of the firm's myopia threshold — assumed only that f was differentiable and increasing.

derive the PBE by solving the differential equation in (5). Our boundary condition comes from the assertion that each manager's bargaining power is sufficient to guarantee he is paid at least $\tilde{w}(a)$. Thus, our boundary condition is

$$\begin{aligned}\hat{w}(a_L) &= \tilde{w}(a_L) \\ &= a_L + \alpha\big(f(q, a_L) - q - a_L\big).\end{aligned}$$

We therefore have that for $k > \alpha + (1-\alpha)/f_a(a_H)$, the PBE wage schedule is the solution to

$$\begin{aligned}w_a &= k f_a \\ w(a_L) &= a_L + \alpha\big(f(q, a_L) - q - a_L\big).\end{aligned}$$

Next, we consider the case where

$$\alpha + \frac{1-\alpha}{f_a(a_L)} < k < \alpha + \frac{1-\alpha}{f_a(a_H)}.$$

Here, the full-information wage schedule satisfies the no-mimic constraint for some but not all values of a. The PBE wage schedule in this case is given by

$$\hat{w}(a) = \max\big[\overline{w}(a), \tilde{w}(a)\big],$$

where $\overline{w}(a)$ is the solution to the differential equation

$$w_a = k f_a$$

with boundary condition

$$w(a_L) = a_L + \alpha\big(f(q, a_L) - q - a_L\big).$$

In this case, it is possible that pay is distorted upward relative to the full-information case for low-ability managers, but not for high-ability managers.

To illustrate the construction of equilibrium wage schedules, we consider a simple numerical example. Assume $f(q, a) = 8\sqrt{qa}$, and let $q = 1.5$ be common knowledge. Let $a \in [1, 2]$. If $\alpha = 0.25$, then the full-information wage schedule is given by

$$\tilde{w}(a) = a + \frac{9.80\sqrt{a} - 1.5 - a}{4}.$$

It is straightforward to verify that if $k > (4 + \sqrt{6})/16 \approx 0.403$, then the full-information wage schedule cannot be part of a PBE. So if, for example, $k = 1/2$, the PBE wage schedule is the function w that solves

$$\begin{aligned}w_a &= \sqrt{\frac{6}{a}} \\ w(1) &= 2.82\end{aligned}$$

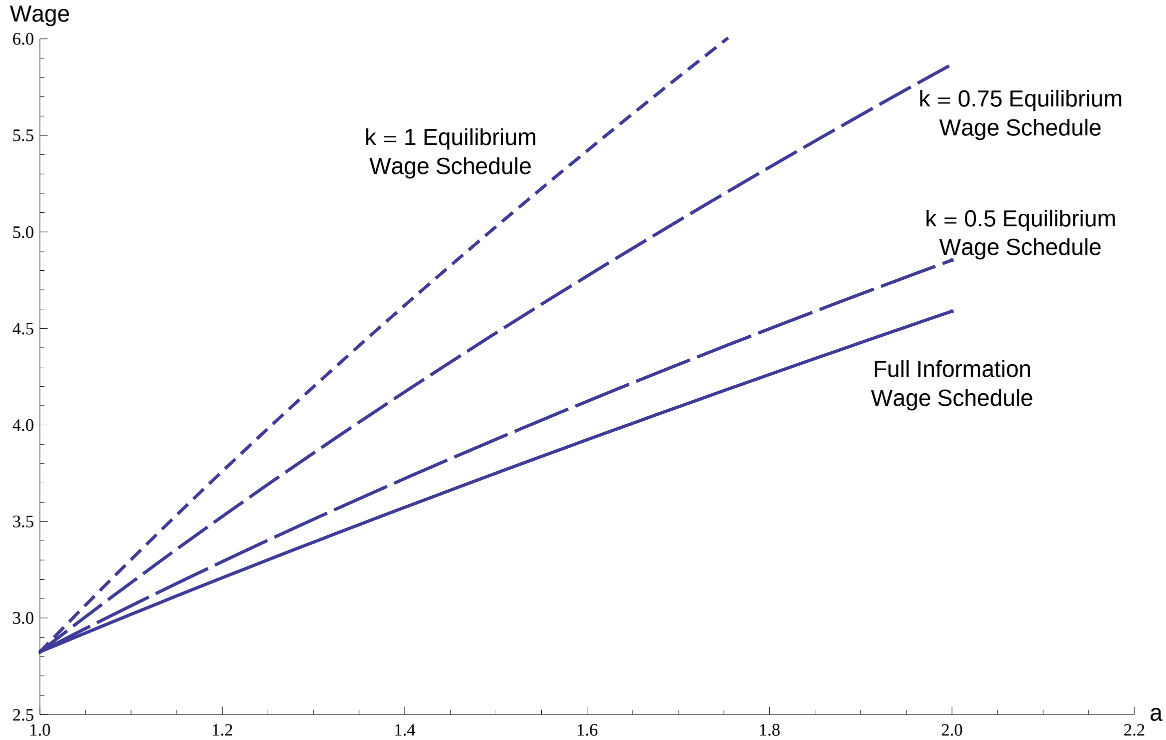

Figure 2: This figure demonstrates how the equilibrium wage schedule varies with k. As the firm becomes more myopic, the equilibrium wage schedule shifts up. The specific example considered here is $f(q,a) = 8\sqrt{qa}$, $q = 1.5$, $\alpha = 0.25$, and $a \in [1,2]$.

This works out to

$$\overline{w}(a) = 4.89\sqrt{a} - 2.07$$

We plot both the full-information wage schedule $\tilde{w}$ and the asymmetric information wage schedule $\overline{w}$ (using various values for k) in Figure 2.

3.2 Asymmetric Information Regarding Firm Characteristics

Next, we consider the case where the information asymmetry pertains to the firm's individual-specific productivity parameter q. Let the manager's individual productivity parameter a be common knowledge among all players of the game. Let the firm's output be $f(q,a)$, where the function f is common knowledge and the match-specific productivity parameter γ is suppressed.

Define the full-information wage schedule as

$$\tilde{w}(q) = a + \alpha\big(f(q,a) - q - a\big). \tag{6}$$

To study the asymmetric-information case, assume that market participants cannot observe q directly, but instead condition their beliefs regarding firm value on the observed wage payment to the manager. A type-q firm will not mimic another type if the equilibrium wage schedule $\hat{w}(q)$ satisfies

$$f(q,a) - \hat{w}(q) \geq k\big(f(\hat{q},a) - \hat{w}(\hat{q})\big) + (1-k)\big(f(q,a) - \hat{w}(\hat{q})\big) \tag{7}$$

for all $\hat{q} \neq q$.

We proceed by developing reasoning similar to that in Section 3.1. We examine conditions under which the full-information wage schedule is a PBE by substituting $\tilde{w}(q)$ from (6) into (7). Algebra yields

$$(\alpha - k)\frac{f(\hat{q},a) - f(q,a)}{\hat{q} - q} \geq \alpha$$

for all q and for all $\hat{q} > q$.

Here, it is a *low* value of $\frac{f(\hat{q},a)-f(q,a)}{\hat{q}-q}$ that makes it harder to satisfy this constraint, so we define

$$f_q^{\min} = \min_{q \in [q_L, q_H]} f_q(q,a).$$

Substituting and re-arranging, we see that the no-mimic constraint is satisfied by the full-information wage schedule if

$$k \leq \alpha\left(1 - \frac{1}{f_q^{\min}}\right). \tag{8}$$

The magnitude of the myopia threshold — that is, the minimum k satisfying (8) — again depends on two parameters: (1) the manager's bargaining power α, and (2) $f_q^{\min}$, the minumum of the marginal effect of the firm's productivity parameter output. Higher α means a higher myopia threshold, and the reasoning behind this result is again that higher α makes overpaying the manager less attractive.

Notably, however, the effects of $f_q^{\min}$ here are the reverse of those of $f_a^{\max}$ above. While the myopia threshold is decreasing in $f_a^{\max}$ when uncertainty pertains to a, the myopia threshold is increasing in $f_q^{\min}$ when uncertainty pertains to q. To see why these results hold, note that the firm captures all of any increase in its outside option q, but must share increases in the match surplus $f(q,a) - a - q$ with the manager. When $f_q^{\min}$ is small, the firm does not need to increase the manager's wage by much in order to convince the market that q is high. This makes it more attractive to distort pay upward to influence interim market values.[13]

A comparison of Inequalities (4) and (8) yields our third main result: For fixed α, myopia thresholds are higher when the market's uncertainty pertains to characteristics of the *firm* rather than to characteristics of the *manager.* In the case of information asymmetry regarding a, the firm's myopia threshold is always greater than or equal to α, while the threshold is always less than or equal to α in the q case. Incentives to overpay the manager to boost interim values are stronger when the market is uncertain about firm characteristics. This statement holds for any values of $f_q^{\min}$ and $f_a^{\max}$.

The intuition behind our third main result is easiest to explain after we have developed the case where information asymmetry pertains to the match-specific productivity parameter γ. As such, we briefly defer this discussion and turn next to our final case.[14]

3.3 Asymmetric Information Regarding Match Quality

Finally, we consider the case where the information asymmetry pertains to a match-specific productivity parameter γ. Again, we make a number of assumptions to focus specifically on the effect of asymmetric information regarding γ. First, assume that both the manager's and the firm's individual-specific productivity parameters, a and q, are commonly known to all players as of date 1. Next, suppose that the match value is given by $f(\gamma) = \gamma$, where $\gamma \in [\gamma_L, \gamma_H]$.[15] Here, we have suppressed the role of the individual-specific productivity parameters in f. Because these parameters are common knowledge, it is necessary for us to consider only the role of γ in determining the match value. Define, as above, the full-information wage schedule as

$$\tilde{w}(\gamma) = a + \alpha\big(\gamma - q - a\big).$$

[13]If $f_q^{\min} \leq 1$, then (8) is violated for any $k > 0$. Note however that if $f_q^{\min} < 1$, then the manager's full information wage in (6) is actually decreasing in q. Because we assume the manager's bargaining power insures that he is always paid at least $\tilde{w}(q)$, it is not feasible for a firm to mimic a higher type in this case.

[14]It is again straightforward to compute the PBE in the case where the firm's myopia exceeds the myopia threshold. For example, if $k > \alpha\left(1 - \frac{1}{f_q(q_L)}\right)$, then the PBE wage schedule is the solution to the differential equation $w_q = kf_q$ with boundary condition $w(q_L) = a + \alpha\big(f(q_L, a) - q_L - a\big)$.

[15]The restriction that $f(\gamma) = \gamma$ is without loss of generality, because the scale of this match parameter is arbitrary. The function f is necessary to the analysis in Sections 3.1 and 3.2 above, as it specifies the relative rates at which increases in managerial ability and firm characteristics affect the firm's output and the parties' outside options.

We assume that market participants cannot observe γ directly, but instead condition their beliefs regarding the firm's terminal value on the observed wage payment to the manager. A type-γ firm will not mimic another type if the equilibrium wage schedule $\hat{w}(\gamma)$ satisfies

$$\gamma - \hat{w}(\gamma) \geq k\big(\hat{\gamma} - \hat{w}(\hat{\gamma})\big) + (1-k)\big(\gamma - \hat{w}(\hat{\gamma})\big) \tag{9}$$

for all $\hat{\gamma} \neq \gamma$.

Analysis similar to that in Sections 3.1 and 3.2 reveals that (9) holds if

$$k \leq \alpha. \tag{10}$$

Thus, the condition under which $\tilde{w}(\gamma)$ is an equilibrium wage schedule takes an especially simple form. If the firm's myopia k is less than the manager's bargaining power α, then then $\tilde{w}(\gamma)$ is a PBE wage schedule, and otherwise not.[16]

Comparing (10) to (4) and (8) above, we see that the myopia thresholds — that is, the smallest k satisfying each inequality — vary markedly, depending on the source of the market's uncertainty. When the market's uncertainty pertains to characteristics of the manager (the parameter a in our model), the firm's myopia threshold is always weakly greater than α. When the market's uncertainty pertains to match quality γ, the firm's myopia threshold equals α. When the market's uncertainty pertains to firm characteristics q, the firm's myopia threshold is weakly less than α.

We show the relations among these myopia thresholds graphically (using a specific example) in Figure 3. We place α and k on the x and y axes, respectively, and depict the firm's myopia thresholds in each of the three cases. The dashed line is Inequality (4); it therefore shows how the firm's myopia threshold varies with α in the case where market uncertainty pertains to managerial ability. The solid line is the firm's myopia threshold for the γ case (from Inequality (10)), and the dotted line is the myopia threshold from the q case (from Inequality (8)). Focusing, say, on $\alpha = 0.5$, we see that myopia thresholds rise from 0.36 to 0.50 to 0.60 as the source of market uncertainty shifts from firm characteristics to match quality to managerial ability.

To explain the intuition for the differences in myopia thresholds, we focus on the case where the information asymmetry pertains to γ. Consider, in this case, the effect on interim firm

[16] If $k > \alpha$, then the PBE wage schedule is given by the solution to $w_\gamma = k$ with boundary condition $w(\gamma_L) = a + \alpha(\gamma - q - a)$.

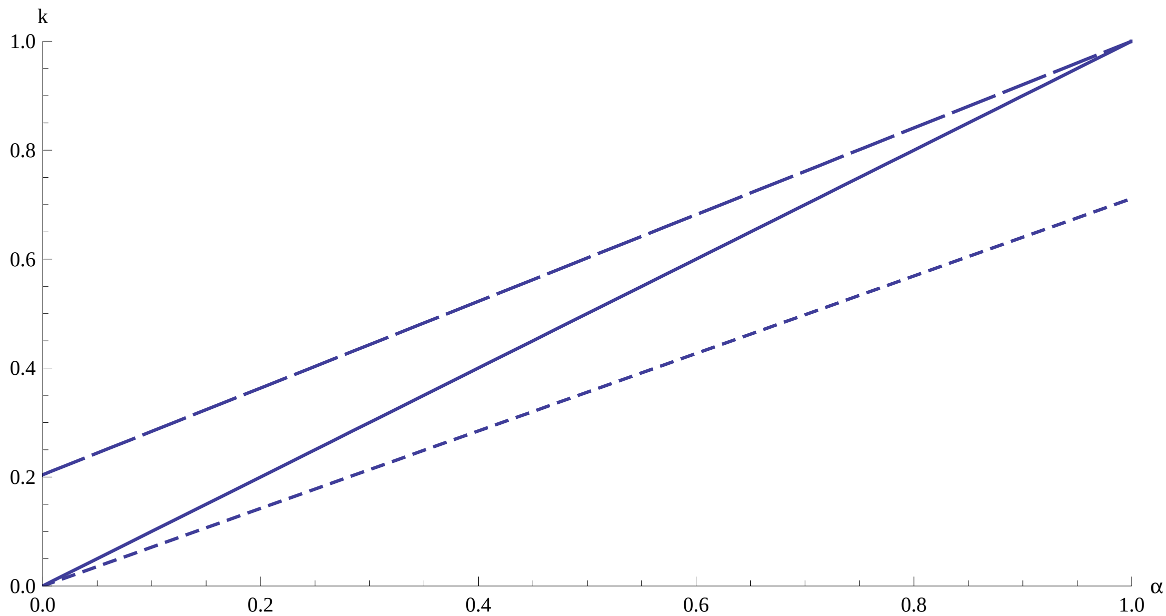

Figure 3: This figure shows how myopia thresholds vary with α, and by the source of the information asymmetry. The specific example considered here is $f(q, a) = 8\sqrt{qa}$, and $q, a \in [1, 2]$. The dashed line is the inequality from (4) assuming $q = 1.5$. If the information asymmetry pertains to a, then the full-information wage schedule is a PBE for all (α, k) below the dashed line. The solid line is the inequality from (10). If the information asymmetry pertains to γ, then the full-information wage schedule is a PBE for all (α, k) below the solid line. The dotted line is the inequality from (8) assuming $a = 1.5$. If the information asymmetry pertains to q, then the full-information wage schedule is a PBE for all (α, k) below the dotted line.

value when the firm pays the manager one additional dollar in wages. Paying an additional dollar in wages is the equilibrium action of a firm of type $\hat{\gamma}$, where $\hat{\gamma}$ is defined by

$$\alpha\big(\hat{\gamma} - \gamma\big) = 1.$$

Thus, a firm paying an additional dollar in wages is behaving as though its match surplus is higher by $1/\alpha$. Because the firm captures fraction $1 - \alpha$ of the match surplus, paying an additional dollar in wages increases the firm's interim value by $(1 - \alpha)/\alpha$.

Now suppose the information asymmetry pertains to managerial ability a, and again consider the effect on interim value when the firm pays the manager an additional dollar in wages. Paying one additional dollar in wages is the equilibrium action of a firm of type $\hat{a}$, where $\hat{a}$ is defined by

$$\begin{aligned} 1 &= \hat{a} - a + \alpha\big(f(q,\hat{a}) - \hat{a} - f(q,a) + a\big) \\ &= (1-\alpha)(\hat{a} - a) + \alpha\big(f(q,\hat{a}) - f(q,a)\big). \end{aligned}$$

Here, because the information asymmetry pertains to the manager's ability and hence to his outside option, only part of the additional dollar in wages is attributed to an increase in the match surplus. As a result, a firm paying an additional dollar in wages is behaving as though its match surplus is higher, but by an amount strictly less than $1/\alpha$. Because the firm captures fraction $1-\alpha$ of the match surplus, paying an additional dollar in wages increases the firm's date 3 market value by an amount strictly less than $(1-\alpha)/\alpha$.

Because the market attributes part of any increase in wages to an increase in the manager's outside option and therefore not to an increase in the match surplus, the marginal effect of a wage increase on interim value is smaller when the information asymmetry pertains to managerial ability a rather than to a match-specific productivity parameter γ. Thus, the set of (α, k) values for which the manager's wage is distorted upward relative to the full-information case is larger when the information asymmetry pertains to γ.

Finally, suppose the information asymmetry pertains to firm productivity q, and again consider the effect on interim value when the firm pays the manager an additional dollar in wages. Paying one additional dollar in wages is the equilibrium action of a firm of type $\hat{q}$, where $\hat{q}$ is defined by

$$\alpha\big(f(\hat{q},a) - f(q,a) - (\hat{q} - q)\big) = 1.$$

A firm paying an additional dollar in wages is behaving as though its match surplus is higher by $\frac{1}{\alpha}$. Note, however, that the increase in interim value is strictly larger than $\frac{1-\alpha}{\alpha}$, because higher match surplus means a higher value of q. That is, by paying the manager more, the firm increases the market's assessment of the match surplus. Because the only unknown affecting match surplus is the firm-specific productivity parameter q, an increase in match surplus means the firm's outside option is higher as well. Thus, the marginal effect of a dollar of wages on interim value is highest when the information asymmetry pertains to q, second highest when γ is unknown, and lowest when a is unknown. This explains the pattern evident in Figure 3.

The reasoning outlined in the preceding four paragraphs — on the marginal effect of a dollar of wages on interim value — can also be used to describe the implications of market uncertainty regarding the manager's bargaining power, α. Suppose that α is privately observed by the firm and manager, but a, γ, and q are public. In this case, disclosure of the manager's wage contains no information about the firm's output f. Thus, terminal value is strictly decreasing in the wage, and interim value will be decreasing in the wage as well. Firms therefore have no incentive to increase pay to boost interim market values. If the market cannot observe a in addition to α, then the main force in our basic model — that firms may face incentives to raise wages to boost interim value — is still present. To see why, consider the market's inference when the firm pays an extra dollar of wages. This increase in wage will be attributed in part to an increase in the manager's outside option, in part to an increase in the manager's bargaining power, and in part to an increase in the match surplus. The specifics of this inference will depend on the market's beliefs about the distributions of α and a.

Before concluding this section, we briefly revisit the quotation from Edward S. Woolard, Jr. that we discussed in the introduction. Woolard indicates that increasing the manager's pay helps make "the company look strong." Notably, our analysis suggests that the temptation to overpay a manager to influence market beliefs is strongest when there is significant uncertainty regarding firm-specific productivity and weakest when there is significant uncertainty regarding managerial ability. Overpaying a manager to increase the market's assessment of managerial ability has a small effect on interim value, because the market expects the gains from increases in managerial ability to be captured at least in part by the manager. Overpaying a manager to increase the market's assessment of some firm-specific element of productivity has a large effect on firm value, because the market expects the gains from increases in firm productivity to be captured largely by the firm. Woolard's assertion that Wobegon Effects are mostly likely intended to make the company look strong — rather than making the manager look good — therefore fits with our findings.

4 Discussion

Our analysis examines whether three key assumptions — asymmetric information, managerial rents, and corporate myopia — can cause firms to distort CEO pay upward in an attempt to affect market perceptions of firm value. We find the three assumptions are not sufficient to lead to a Lake Wobegon Effect; two additional conditions are necessary. For the case where the information asymmetry pertains to managerial ability, we find that the Lake Wobegon Effect can occur only if managerial ability increases the match surplus, and only if the firm's myopia is strictly greater than the manager's bargaining power. These conditions may strike some readers as sufficiently restrictive to warrant dismissing the Lake Wobegon Effect as an explanation for recent CEO pay increases. That said, we think the "ability increases match surplus" condition is likely to be met, at least in some cases. The second condition — on the relative magnitudes of myopia and bargaining power — is harder to assess. As we note below, few direct proxies for corporate myopia are available, and it is not clear how one would measure managerial bargaining power.

The effects studied in our model do fit with some existing empirical evidence. If, for some reason, firms do not disclose pay levels, then there is no reason (in our model) to increase managerial pay to boost interim values. Requiring disclosure may therefore introduce the effects studied in this paper. The observation that pay disclosure may spur a Lake Wobegon Effect fits with evidence in Park et al. (2001) regarding a 1994 change in Canadian disclosure rules. This change, which was not anticipated far in advance, required firms to retroactively disclose CEO pay levels from 1992 and 1993. This allows for easy comparison of pre-disclosure and post-disclosure pay packages. Park et al. (2001) report that pay levels rose in the post-disclosure period, and, citing O'Reilly et al. (1988), attribute this to the practice of setting CEO pay in relation to the pay of other CEOs. Our model explains why it might be rational for firms to set pay in relation to some external benchmark, but only *after* pay levels are required to be disclosed to capital market participants.[17] Note, however, that other theories can explain the Canadian disclosure evidence; if the disclosure reduces search costs for firms attempting to hire new CEOs, then it is possible that wages would rise as a result of the new rules. More research is needed before the Canadian disclosure change can be tied directly to the Lake Wobegon Effect.

Devising a sharp test of the model is likely to be challenging, however. Like many models of asymmetric information, the comparative statics of our model relate mostly to quantities that are hard to measure. For example, our model suggests that the Lake Wobegon Effect depends (in varying ways, depending on the source of the information asymmetry) on the relation between the firm's myopia k and the manager's bargaining power α. Higher k favors upward distortions in pay, while higher α favors the full-information wage schedule. While these myopia and bargaining-power parameters are standard in the theoretical literature, there are no

[17] Craighead et al. (2004) and Swan and Zhou (2006) also examine changes in CEO pay in Canada post-1994, and document increased CEO pay-performance sensitivity. While our model does not address this facet of CEO pay directly, it is possible to extend our analysis to show that corporate myopia may cause pay to be tied inefficiently closely to firm performance (see footnote 2). This suggests that Canadian pay-performance increases may not have been value-maximizing.

standard measures of these parameters in the empirical literature. Some measures of corporate myopia are available (see, for example, Bushee, 1998), but it can be difficult to interpret these measures as "weight on short-run share price," as our myopia parameter is defined. Any measure of bargaining power would seemingly require knowledge of the outside options of the manager and the firm, and the output when the two work together, all of which are difficult to observe. An additional complication arises when our model is embedded in an equilibrium model of a labor market. Even if a cross-sectional measure of corporate myopia were readily available, a firm's pay level can be affected by the myopia of its labor market competitors. It is therefore not necessarily the case that pay should be increasing in myopia within a cross-section of firms that compete for the same managerial talent.

Finally, we note that it is straightforward to extend our model to yield "upward spirals" in CEO pay, as suggested by Woolard. In an earlier version of this article, we considered a two-firm version of the model with assortative matching. That is, we assumed a complementarity between some firm characteristic (say, size) and managerial ability. The complementarity implies that the equilibrium assignment of managers to firms will involve sorting: the highest ability manager will be matched with the largest firm, second highest with second largest, and so on. Assortative matching models have been studied extensively by labor economists; see Sattinger (1993).

The advantage of this assortative matching approach is that it allows us to endogenize the parties' outside options. The bargaining between, say, the large firm and the abler manager is framed by the possibility that the large firm could hire the second-best manager or the best manager could seek employment at the smaller firm. The extension of our model yielded two results. First, pay for the manager of the large firm is weakly increasing in the myopia of small firm. Second, if the large and small firms are equally myopic, then pay for the large firm's manager increases faster (weakly) with that common degree of myopia than does pay for the small firm's manager.

5 Conclusion

Our analysis offers a model of the widely discussed Lake Wobegon Effect. In our model, we define the Lake Wobegon Effect to occur when firms distort CEO pay upward in an attempt to affect market perceptions of firm value. The model relies on three key assumptions — asymmetric information, managerial rents, and corporate myopia — and yields four main conclusions. First, we show simply that the Lake Wobegon Effect can occur. Second, we show that those three assumptions are not sufficient for the Effect; two other conditions are necessary. Third, we show that the myopia level at which the Lake Wobegon Effect occurs is highest for the case where the information asymmetry pertains to managerial ability, and lowest for the case where the information asymmetry pertains to characteristics of the firm. Future research can proceed by examining whether the assumptions of our model, and the necessary conditions for the Lake Wobegon Effect derived within the model, are satisfied empirically.

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