Transparency, Recruitment and Retention in the Public Sector*

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Abstract

This paper argues that governments should pay greater heed to recruitment and retention when designing performance measurement systems for bureaucracies. In the face of pervasive rigidities in public sector pay, internal performance measurement rewards quitters and scars stayers and therefore makes it difficult to recruit *and* retain. Full and immediate publication of performance minimizes the cost of initial recruitment but entails retaining and paying rents to poor performers. This is optimal only if skill differences are low and the value of public production is moderate: high enough to warrant recruitment but not so high that good performers are retained. Human capital objectives are typically better met by abstaining from performance measurement altogether or 'stage-managing' its publication, suggesting that the current emphasis on incentives and accountability may be misplaced.

Keywords: performance measurement, disclosure, information management, sorting, wage compression, public sector.

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1 Introduction

Performance measurement is becoming an inescapable part of life in the public sector. At program level, the Government and Performance Results Act 1993 requires all federal agencies to prepare performance plans and report annually on progress towards program goals. Equally strong mandates exist in Canada, New Zealand and the UK, with similar initiatives, albeit with less top-down compulsion, in most OECD countries. At organization and team level, performance measurement pervades most areas of delivery.[1] In 2002, 43 US States published report card data at the level of individual schools (Kane and Staiger 2002, Figure 1). In the UK, summary levels-based indicators are published for every secondary school under the Education Acts 1988, 1992. In addition, many head teachers collect value-added performance measures as internal management tools (Wilson et al 2004). Individual performance measurement is also the increase. In health care, pressure from insurance plans, consumer groups and government is resulting in public disclosure of report card data right down to individual clinicians.[2]

Since political enthusiasm is not always a perfect predictor of economic efficiency, an important question is whether governments and their agencies are getting the design of performance measurement (PM) systems right. That is, are the right data being collected and are they being put to the appropriate uses? Or, more specifically, should performance be measured at program, team or individual level and should the resulting statistics be fed back confidentiality to employees or published to all stakeholders? As usual, the answer is: it depends; in this instance on the impact PM systems have on recruitment and retention (choices to take or keep a public sector job) and on incentives (effort or task choices once in the job).

Both the policy and academic literature have, to date, focused almost exclusively on the relationship between PM systems and incentives.[3] The reason for this emphasis is unclear as there is little to suggest, at least *a priori*, that incentives are more important than recruitment and retention. In the US there are widely publicised problems of attrition in the health and education sectors (see, for instance, GAO 2001 and Stinebrickner 2001). In the UK the Department of Health recently commented that "the biggest constraint in the NHS today is no longer a shortage of financial resources. It is a shortage of human resources, the doctors, nurses, therapists and other health professionals who keep the NHS going day in day out", NHS Plan (2000, cited in Audit Commission 2002). Recruitment and retention problems have also

[1]Mannion and Goddard (2000) provide a cross-sector survey of recent developments in the UK. For a comparative survey of US and UK organization and team-level PMs see Propper and Wilson (2003).

[2]Schemes similar to New York's Cardiac Surgery Reporting System - in place since 1989 - now exist in a variety of US States. In Europe, the closest comparators are the operating room PMs published for the NHS and hospital level clinical outcome data published by the Scottish Executive (cf. Mannion and Goddard 2004).

[3]See, for instance, Dixit's (2002) discussion of the optimality of 'low-powered' incentives due to the prevalence of multiple tasks, agents and principals or the burgeoning empirical literature that is documenting dysfunctional responses to incentive schemes (e.g. Courty and Marschke (1997), Heckman (2002)).

been identified in Canada, Denmark, Finland and Sweden, with crises imminent in Austria, Germany, Norway and Spain (Äijälä 2001).

Our contention in this paper is that there are features of public sector wage determination that suggest governments should pay greater heed to recruitment and retention when designing PM systems for bureaucracies. Almost by definition, public sector labor shortages must be arising because wages are failing to equilibrate demand and supply. As Katz and Krueger (1991) note, sluggishness in public sector pay has made it hard for government agencies to recruit and retain high skill groups. However, as their additional finding of job queues for blue-collar jobs illustrates, it also entails paying rents. This rent effect, typically overlooked in policy circles, lies at the heart of our results.

To emphasise the forces other than effort incentives at work, we look for the optimal public sector PM system in the presence of adverse selection rather than moral hazard. In this setting, we show that internal performance measurement (provision of confidential feedback to employees) is never optimal. A policy of transparency (full and immediate publication of performance) can be optimal but only in a restricted set of circumstances. For most parameters - namely the degree of pay inflexiblity, the value of public production and innate skill differences - it is optimal to keep employees in the dark or, if this is infeasible, to stage manage publication of PMs selectively or with a delay.

To see the intuition behind these results - and in particular why rents matter - it is useful to start by considering the following two period model, set out more fully in Section 3 and 4. A public sector employer competes to hire a worker in an entry-level market when innate skill is unknown to all and then again in period 2 after the worker's initial output has been realized. The market offers a wage equal to its expectation of the worker's productivity in period 1 and then again in period 2 and passively publishes output whenever it hires (think profit signals for a marketed good). In contrast, the public sector employer fixes both pay and a performance measurement system in advance.

This simple set up highlights two forces that limit the desirability of transparency. First, publishing is good for recruitment but bad for retention. If performance information is withheld the worker anticipates that public sector success will go unrewarded and demands greater compensation up-front (what we term the *option value* effect). But then, of course, he can be retained at a lower wage in period 2 (what we term the *outside offer* effect). This leaves the public sector employer with three alternatives: (i) recruit the worker from the private sector in period 2 at the market wage iff he is unsuccessful; (ii) recruit in period 1 at the market wage and retain the worker in period 2 iff he is unsuccessful; and (iii) recruit in period 1 by more than matching the market's entry-level offer and retain with certainty. Second, both alternatives (ii) and (iii) entail paying a rent to a poor, but only a poor, performer. In the latter case, the premium paid in period 1 nets out with the saving made on a good performer, leaving only the rent paid to a poor performer.

To be willing to recruit in period 1 rather than 2, the public sector employer must therefore be willing to give up some rent to a poor performer. This will be the case when the value of public production is high enough. But if this is true, then it makes sense to center public sector pay a little higher and retain a good performer. The expected benefit of 'adding' the good performer is lower (one success is more likely than two) but so is the expected cost and the latter effect dominates for all parameters.

The two period model is useful as an expositional device but hides several issues. The addition of another period reveals that transparency can be optimal but only if skill differences are low (so that the expected cost of adding good performers fails to dominate) and the value of public production is moderate (high enough to warrant recruitment but not so high that good performers are retained.). Together these requirements constitute a very small region of the parameter space, although one that would grow with the addition of further periods.

Adding a single period is also sufficient to show that internal PMs are never optimal. Measuring but failing to publish period 1 performance gives a good performer greater reason to quit the public sector in period 2 than a poor performer and so prompts the market to infer that separations are drawn from the high end of the skill distribution. This, in turn, drives up the period 2 outside offer to public sector quitters and, drives down period 3 outside offers to public sector stayers (what we term the creation of *public sector stigma*). As we show in Section 5.1, compared to a policy of transparency, internal PMs therefore make it no easier to recruit but substantially harder to retain in period 2 and 3 and are strictly dominated for all parameters.

Having outlined the pitfalls of internal PMs, in Section 5.2 we focus on what Wilson (1989) terms coping organizations. Absent intervention, workers and managers in a coping organization will have little sense of what has been achieved as outcomes are hard to measure. The best plan of attack is then, typically, to abstain from performance measurement to reduce the cost of long-term retention. The same cannot be said for what Wilson terms craft organizations; that is, government agencies staffed by skilled professionals well placed to judge their achievements even in the absence of formal PMs. As we show in Section 5.3, human capital considerations in craft organizations are typically best served by stage-managing publication. Performance must be published in some period to avoid stigmatization of public sector employees. A policy of transparency achieves this aim but increases the costs of retention. For most parameters, it is preferable to publish selectively to further a goal of long-term retention or with a delay to achieve short-term retention.

Governments have already begun to appreciate that incentive schemes can have perverse effects in public sector organizations. Our results suggest that increasing transparency can also have undesirable consequences. In Section 6.1 we provide a typology of organizations and objectives intended to inform the policy debate. Coping organizations are characterised by measurement problems and, to further long-term retention, choose to remain that way.

Transparent organizations stream performance information in real time to minimise the cost of entry-level recruitment. Finally, stage-managed organizations publish PMs judiciously to achieve either short-term retention, or in the face of worker unavoidable feedback, long-term retention. This tripartite classification is, no doubt, an over-simplification but serves to make our basic point that recruitment and retention considerations have a role to play in the design of public sector PM systems. We conclude in Section 6.2 by pointing to two testable implications of the model, namely that post-separation wage profiles and hazard rates should *interact* with PMs and pay inflexibility. These predictions suggest that there is a simple way to test the empirical significance of our analysis and hence move a step a closer towards more complete policy advice.

Related Literature Our approach relates to two strands of literature. The first strand - the adverse selection in labor markets literature - focuses on equilibrium wage profiles, holding the information structure constant.[4] The basic idea, first explored by Greenwald (1986), is that current employers will seek to prevent turnover of their better workers and hence prompt raiders to infer that job separations are disproportionately drawn from the *low* end of the productivity distribution.[5] The resulting 'lemons' problem reduces turnover and shifts wages towards the entry-level market, with entry-level employers offering more than unconditional expected productivity as they compete to place each worker in a captive situation. Greenwald shows that the adverse selection problem intensifies in the three period version of the model as workers bear the scars of separation for longer and so have even less incentive to quit. This, in turn, produces a short-term return to separation as separated workers must be compensated for the consequences of scarring in period 3.

Our results, echo several of Greenwald's findings. If our public sector employer fails to publish performance immediately she must also pay more than unconditional expected productivity to recruit in period 1. The reasons is, of course, very different. Public sector pay must *more than match* the market's entry-level offer to compensate the worker for the option value associated with going private. In the three period version of our model workers can also be scarred by the market. However, measuring but failing to publish initial performance prompts the market to infer that public sector quitters are drawn from the *high* end of the productivity distribution.[6] As a result, in our inter-sector setting, it is the period 2 public sector *stayers* rather than quitters that are scarred which, in turn, necessitates a higher level of public sector

[4]A comprehensive review of this literature is provided by Gibbons (1999, Section 3.4) and is not repeated here. For a review of the more tangentially related papers in the job-assignments as signalling literature (e.g. Waldman 1984), see Gibbons (1999, Section 3.2).

[5]The market fails to collapse completely by virtue of an exogenous probability of a job separation.

[6]Echoing the empirical findings of Katz and Krueger (1991), Borjas (2002) and Hoxby and Leigh (2004) described in Section 2, in our model public sector pay inflexibility creates *favourable* selection into the private sector labor market.

pay to secure retention in period 2.

The second strand - the nascent optimal performance disclosure literature - solves simultaneously for equilibrium wage profiles and information structures. Calzolari and Pavan (2004) and Koch and Peyrache (2003) assume workers/agents separate exogenously after period 1 and hence restrict attention to incentive and recruitment issues (interestingly both also find that transparency is rarely optimal). More closely related is Mukherjee (2004) who extends Greenwald's (endogenous separation) two period analysis by allowing entry-level employers to commit to a disclosure rule, as well as giving entry-level employees an effort choice. The central point is that transparency *can* be optimal. Immediately publishing performance maximises the trading surplus in period 2 by removing the winner's curse effect. This benefits the entry-level employer because the gain in surplus accrues to worker (by virtue of competition between raiders) and can therefore be appropriated up-front as a lower entry-level wage. In our setting transparency also enables the public sector employer to pay a lower entry-level wage - although by eliminating an option-value, rather than winner's curse, effect - but is not an optimal *public sector* PM system (i.e. in the presence of pay compression) because of the rents paid to poor performers.[7]

2 Evidence of Relative Pay Compression and Sorting

Anecdotal evidence of pay inflexibility is common place (see, for instance, Äijälä (2001), OECD (2002)) but is also borne out by the data. The wage gaps presented in Table A1 in Appendix A show that, across a wide range of countries, the unconditional wage distribution is indeed more compressed in the public sector. The 10th and 90th quantile regression estimates collated in Table A2 provide more compelling evidence that it is pay setting policies - rather than simply characteristics - that differ across sectors. With two exceptions (poorly educated British men and highly educated German women), the first number in each cell is higher than the second, indicating that the conditional wage distribution is more compressed in the public sector, both across and within education groups. More importantly, in many cells, the first number is positive and the second negative. This substantiates the claim that public sector pay is inflexible rather than simply ungenerous. To the extent that these estimates are 'true' premiums and penalties (see Disney and Gosling (1998) for a discussion), a public sector employee with given characteristics at the 10th percentile of wage distribution would, taken at random, lose from a move to the private sector while the converse would be true for an employee at the 90th percentile.

[7] Blanes i Vidal (2002) focuses on a rather different 'career concerns for experts' setting but makes a similar point. Delegating decision-rights (akin to not measuring performance in our or Mukerjee's setting) restores symmetry and hence kills the winner's curse. This benefits the entry-level employer by strengthening career concern incentives.

Turning to the implications of pay rigidity for human capital outcomes, Katz and Krueger (1991) report that, over the course of early 1980's, application rates per hire rose for blue-collar US federal jobs but fell for white-collar federal jobs, the median Math SAT score of new scientists and engineers at the US Department of Defence (DOD) declined relative to the student population and the separation rate for DOD scientists and engineers scoring above 650 on the Math SAT was 50% greater than those below that level. Exploiting better data (CPS-ORG files 1979-2002), Borjas (2002) estimates the partial effect of relative wage compression on the private sector wage gap (acting as a proxy for the skill gap) between US public sector quitters and prospective public sector entrants. Controlling for observable worker characteristics and year effects, Borjas suggests that the 15% drop in the inter-sector ratio of standard deviations of weekly log income between 1979-2002 increased the wage gap by about 4%. Hoxby and Leigh (2004) narrow their focus to education and attempt to apportion the blame for the decline in the aptitude of US public school teachers between improved job opportunities for females and the compression of teaching wages due to unionization. Using state labor laws as instruments to isolate wage effects due to unionization, they suggest that pay compression explains about 80% of the decline of the share of teachers in the highest aptitude group (SAT scores in the top 5 percentiles).

A variety of explanations for rigidities in public sector pay have been mooted, ranging from the economic (higher rates of unionization, larger employer size, non-profit status, inelastic/monopsonistic demand for labor) to the political (narrow nationwide pay scales, affirmative action/minium wage policies, electoral wage cycles) but there have been few rigorous attempts to pursue the issue. While this leaves the root causes of public sector pay inflexibility as an important open question, its concomitant effects appear clear: pay rigidities make it hard to for the public sector to recruit and retain the best, rather than worst, employees.

3 The Model

A public sector employer (she) and a private sector labor market compete to hire a worker (he) to a series of tasks. Each task takes one period to complete. The worker is productive for T periods and so can complete at most T tasks. All tasks either succeed or fail, with the outcome in period t denoted by $y_t \in \{s, f\}$. The probability that a task succeeds in period t is determined solely by the worker's innate skill level θ, i.e. $\Pr(y_t = s \mid \theta) = \theta$ for all $t = 1, ..., T$.[8] The realization of θ is unknown to everybody. In the entry-level market all players share the prior belief that the worker is as likely to be 'high-skilled' ($\theta = \theta_h$) as 'low-skilled' ($\theta = \theta_l$), where $\theta_h > \theta_l$ and $\theta_h + \theta_l = 1$.[9]

[8] Nothing would change if public and private sector tasks were of different difficulties, providing that task complexity was common knowledge.

[9] The assumption that $\theta_h = (1 - \theta_l)$ has two advantages. First, by fixing the mean of the skill distribution, it allows us to isolate the impact of changes in the importance of selection. Second, it ensures that $\Pr(s) = \Pr(s \mid$

The public sector employer (P_G) moves once at the beginning of the game, choosing a public sector pay formula and a performance measurement policy to maximise the net benefit of hiring. We normalize the value of task failure to 0, the value of success in the market to 1 and use the parameter $\alpha \geq 1$ to denote the value of success in the public sector.[10] We also make the, admittedly highly stylized, assumption that the public sector pay formula is given by $w_{gt} = \gamma\overline{w} + (1-\gamma)w_{m_t}$, where $\overline{w}$ is a choice variable, w_{m_t} is the offer made by the private sector labor market in period t and $\gamma \in (0, 1]$ is an exogenous parameter intended to capture pay inflexibility. When γ is equal to 1 public sector pay is constant through time and fails to rise and fall with the worker's earning capacity in the private sector. As γ approaches zero public sector pay reflects outside offers. The set of possible PM policies varies with the number periods and the innate observability of performance. We outline the available policies at the beginning of Sections 4 and 5. For now, let $\mathcal{P}$ denote the set of possible PM policies with typical element p.

To enable us to focus on public sector performance measurement, we treat the market as a passive player. This entails two assumptions. First, we assume that the market is unable to write contingent contracts. At the start of period t, the market offers its expectation of the worker's productivity in period t conditional on its information to date (H_t) and the worker's willingness to go private. Having normalized the market value of success to 1, this is simply the conditional (or in period 1 the unconditional) probability of success. To ease notation, we write the entry-level offer as w_0 and subsequent offers as $w(H_t)$. Second, we assume that private sector task outcomes cannot be hidden from the worker or outsiders (for instance due to profit signals from a marketed good). If the worker spent period 1 in the private sector, all players will have observed y_1 by the start of period 2.

The worker is assumed to be risk neutral and motivated purely by pecuniary gain. In each period t he chooses a sector $c_t \in \{g, m\}$ to maximise his current and undiscounted, expected future income. We refer to these choice as 'going public' and 'going private' and use A_{τ_t} to denote the worker's strategy type in period t. Under any PM policy the period 1 type set is $\mathcal{T}_1 = \{\emptyset\}$. If P_G fails to introduce a measurement system - what we will refer to as doing nothing - the type set in period 2 is $\mathcal{T}_2 = \{g, ms, mf\}$ and in period t is $\mathcal{T}_t = \mathcal{T}_{t-1} \times \{g, ms, mf\}$. Under any other policy the type set in period 2 is $\mathcal{T}_2 = \{gs, gf, ms, mf\}$ and in period t is $\mathcal{T}_t = \mathcal{T}_{t-1} \times \{gs, gf, ms, mf\}$. A behavioural strategy for the worker is then a $T-tuple$ $(\sigma_{\tau_1}, \sigma_{\tau_2}, ..., \sigma_{\tau_T})$, where $\sigma_{\tau_t} : \mathcal{P} \times \mathcal{T}_t \times \{w_{g_t}, w_{m_t}\} \rightarrow [0, 1]$. More intuitively, $\sigma_{\tau_t}(\overline{w}, p)$ is the probability with which P_G hires A_{τ_t} for a given $\overline{w}$ and p.

Since the worker's information and sector choices are of no intrinsic value to P_G, we distinguish between strategy types and the 'performance' types A_0, A_{y_1}, $A_{y_1 y_2}$ etc. Using this

$f, s) = \Pr(s \mid s, f)$, which rules out additional, but uninteresting, 'hiring alternatives'.

[10] Equivalently, one could assume that employers valued the the tasks equally but the worker derived a non-pecuniary benefit (warm glow) of $\alpha - 1 \geq 0$ from public sector success.

notation, the public sector employer's maximisation problem can be written (illustrating, for simplicity, with the case of $T = 2$) as

$$\max_{\overline{w}\geq 0, p\in\mathcal{P}} \Pr(hire\ A_0 \mid \overline{w}, p, \gamma)\left(\Pr(s)\alpha - w_{g_1}\right) + \sum_{y_1}\left[\Pr(y_1)\Pr(hire\ A_{y_1} \mid \overline{w}, p, \gamma)\left(\Pr(s \mid y_1)\alpha - w_{g_2}\right)\right]. \quad (1)$$

To summarize, the timing of the game is as follows.

Period 0. Nature chooses the worker's ability θ. P_G commits to the fixed component in the public sector pay formula $\overline{w}$ and a PM policy p.

Period $t = 1, ..., T$.

Stage 1 The worker is offered w_{gt} and w_{mt}.

Stage 2 The worker makes a sector choice $c_t \in \{g, m\}$ and is paid w_{gt} or w_{mt}. The task outcome $y_t \in \{s, f\}$ is realized. If $c_t = m$, all players observe y_t; if $c_t = g$, y_t is measured and published in accordance with p.

Discussion of Key Assumptions We take the degree of pay inflexibility γ to be exogenous for simplicity but also because, lacking any empirical evidence, we are agnostic about the root cause of the pay compression described in Section 2. It would be possible to micro-found pay inflexibility by re-specifying (1) as an isoelastic social welfare function with an inequality aversion parameter and/or including a concern for political support/contributions from labor groups that increase with γ. Alternatively, since our results are driven by the premia paid to poor performers, we could reach similar conclusions by assuming that the public sector can vary pay but faces high costs of firing.

Since teams are pervasive in the public sector, a more substantive issue is our decision to focus on a single worker and hence solely on individual performance measurement. There is no conceptual problem in aggregating our analysis up to team level; the same trade offs exist irrespective of whether the decision is to collect and publish a noisy team-based statistic or a more informative individual-based PM. If only the former are available, nothing would change save for the threshold skill difference above which transparency cannot be optimal. A thornier issue is that different performance measurement systems may be used at different tiers of the same organization. For instance, Wilson et al (2004) report that UK head teachers engage in extensive internal performance measurement in addition to publishing organization-level PMs (percentage of students gaining 5 or more A*-C GCSE passes) as mandated by the Education Reform Act. We conjecture that this is a sub-optimal arrangement (as internal PMs inhibit both recruitment and retention) but leave a thorough analysis of multi-dimensional PM systems to future research.

4 The Two Period Benchmark

In the two period version of the model there are 3 performance types - the inexperienced worker (A_0), the worker who experienced success in period 1 (A_s) and the worker who experienced failure in period 1 (A_f) - giving rise to the 8 hiring alternatives listed in Table 1. There are also three relevant PM policies: (i) publish y_1, (ii) measure (y_1 observed by the worker, but not the market, at the end of period 1) and (iii) do nothing (y_1 observed by no one). To establish which of these policies is optimal, we therefore need to know which, if any, wage and PM policy pair $(\overline{w}, p)$ achieves each hiring alternative at minimum expected cost.

Table 1: Hiring Alternatives

Alternative	Period 1	Period 2
0.	Do not recruit	Do not recruit
i.	Do not recruit	Recruit A_f from the private sector
ii	Recruit A_0	Retain only A_f
iii.	Recruit A_0	Retain A_f & A_s
Infeasible	Do not recruit	Recruit A_s from the private sector
	Do not recruit	Recruit A_f & A_s from the private sector
	Recruit A_0	Do not retain
	Recruit A_0	Retain only A_s

This is less tedious than it sounds. In the presence of pay inflexibility ($\gamma > 0$), the last four alternatives cannot be achieved for *any* $(\overline{w}, p)$. Setting public sector pay high enough to recruit the worker if he is successful in the private sector, simply prompts the worker to go public in the first place. Similarly, setting public sector pay high enough to recruit the worker in period 1 (or retain the worker in period 2 if he is successful), necessarily entails retaining him if he is unsuccessful. So, given that alternatives 0 and i can be achieved at the same minimum expected cost under *any* PM policy, we simply need to establish which pair $(\overline{w}, p)$ minimises the expected cost of alternatives ii and iii.

When P_G commits to publish y_1 the market's period 2 offer depends on the worker's initial performance but not on his sector choice. This implies that P_G can recruit in period 1 by matching the market's entry-level offer w_0 but then, having published y_1, will only be able to retain the worker is he is successful by matching the market's higher period 2 offer $w(s)$.

Now suppose that P_G commits to measure but not publish y_1. If the worker goes private in period 1, this PM policy has no bite but, if he goes public, the market fails to observe y_1. Given a longer time-frame, the market could potentially infer y_1 from the worker's choice of sector in period 2 (as we will show in Section 5). Here, however, both performance types have the same incentive to go private, leaving the market unable to screen and outside offers at w_0.

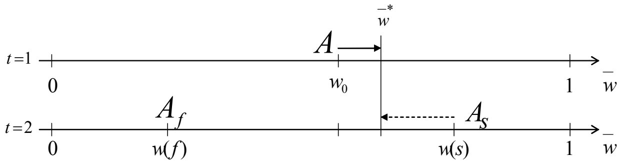

Figure 1: The Impact of Withholding y_1 ($T = 2$)

(The same is, of course, true if P_G commits to do nothing as the worker moves without private information). Withholding y_1 from the market therefore saves P_G the expense of having to match $w(s)$ to retain the worker if he is successful.

There is a downside however. Anticipating a lower reward for public sector success, the worker will require more compensation to go public in period 1. Specifically, to recruit in the entry-level market, P_G must *more than match* the market's entry-level offer by setting $\overline{w} = \overline{w}^*$, where

$$\begin{aligned} \overline{w}^* &\equiv \tfrac{1}{1+\Pr(s)} w_0 + \tfrac{\Pr(s)}{1+\Pr(s)} w(s) && (2) \\ \Rightarrow \overline{w}^* - w_0 &= \tfrac{\Pr(s)}{1+\Pr(s)} \left[w(s) - w_0 \right] && (3) \\ \Leftrightarrow w(s) - \overline{w}^* &= \tfrac{1}{1+\Pr(s)} \left[w(s) - w_0 \right]. && (4) \end{aligned}$$

More intuitively, committing to withhold y_1 has two effects. On one hand, it makes it harder to recruit by giving going private in period 1 an option value. If the worker fails in the private sector in period 1 he can earn $\gamma w_0 + (1-\gamma) w(f)$ in the public sector in period 2 (we discuss the possibility of P_G refusing to accept unsuccessful workers from the private sector in the next sub-Section) but, if he succeeds, he can exercise his option to stay in private sector and earn a higher wage of $w(s)$. The magnitude of this *option-value* effect is given in (3). Note that the more likely the worker feels that he is to succeed, the more likely this option is to be exercised and hence the larger the compensation needed in public sector pay to convince him to go public. On the other hand, since the worker is willing to go public in period 1 at $\overline{w}^* < w(s)$, it makes it easier to retain the worker if he is successful by driving down his outside offer. The magnitude of this *outside-offer* effect is given in (4).

The *option-value* and *outside-offer* effects are depicted by the solid and dashed arrows in Figure 1. A move from left to right, illustrates that P_G can achieve: alternative i at the same cost under any PM policy; alternative ii at least cost by setting $\overline{w} = w_0$ and committing to publish y_1; and alternative iii at least cost by setting $\overline{w} = \overline{w}^*$ and committing to withhold y_1. A comparison of the expected costs and benefits of these alternatives establishes our first result.

Proposition 1. *When the worker can complete two sequential tasks it is never optimal to publish public sector performance. The public sector employer should either introduce an internal PM or abstain from performance measurement.*

The public sector employer is free to adopt internal PMs because the market cannot screen. The reason why it is *never* optimal to publish is more subtle and stems from the fact that recruiting in period 1 entails paying rents to the worker if, but only if, he is unsuccessful. To see the intuition, it is helpful to think of P_G as facing the three decisions in Table 1.

Table 2: Comparing Feasible Hiring Alternatives

Decision	Expected Benefit	Expected Cost
Add A_f (pick i over 0)	$\Pr(f,s)\alpha$	$\Pr(f)w(f)$
Add A_0 (pick ii over i)	$\Pr(s)\alpha$	$w_0 + \Pr(f)\gamma\left[w_0 - w(f)\right]$
Add A_s (pick iii over ii)	$\Pr(s,s)\alpha$	$\Pr(s)w(s) + \Pr(f)\gamma\left[\overline{w}^* - w_0\right]$

Suppose that the worker's output is of equal value in both sectors ($\alpha = 1$). For any $\gamma > 0$, the expected benefit of picking alternative ii over i - 'adding A_0' - will be lower than the expected cost. Likewise the expected benefit of picking alternative iii over ii - 'adding A_s' - will be lower than the expected cost. Consequently, P_G will recruit from the private sector period 2 to avoid paying rent to the worker if he turns out to be unsuccessful.

Now suppose that the value of public sector success α is sufficiently high such that the expected benefit of 'adding A_0' equals the expected cost ($\Pr(s)\alpha = \Pr(s)+\Pr(f)\gamma\left[w_0 - w(f)\right]$). Will P_G stop at A_0 or is it optimal to add A_s? There are two competing effects. On one hand, 'adding A_0' yields a greater expected benefit than 'adding A_s' because one successful project is, *ex ante*, more likely than two ($\Pr(s,s) < \Pr(s)$). On the other hand, 'adding A_0' yields a greater expected cost than 'adding A_s'. (Notice that the *option-value* and *outside-offer* effects for A_0 and A_s wash out - i.e. $\gamma\left[\overline{w}^* - w_0\right] \equiv \Pr(s)\gamma\left[w(s) - \overline{w}^*\right]$ - leaving just the rent paid to A_f.) In this two task setting, the latter expected cost effect associated with paying rent to the worker if he is unsuccessful always dominates. So, if α is sufficiently high to prompt P_G to recruit in period 1, it must be worth centering the distribution of public sector pay a little higher to retain with certainty.

Figure 2 provides a graphical illustration of Proposition 1. The key point to note is that there is no region where it is optimal pick alternative ii. To fix this idea, consider a vertical slice through Figure 2, panel (a) with $\theta_h = 0.65$. The value of α at which it is optimal to switch from recruiting from the private sector in period 2 (alternative i) to recruiting in the entry-level market and retaining with certainty (alternative iii),

$$\alpha^*(\gamma, \theta_h) \equiv 1 + \frac{\frac{2}{3}\gamma\left[w_0 - w(f)\right]}{\frac{1}{2} + \Pr(s,s)}, \tag{5}$$

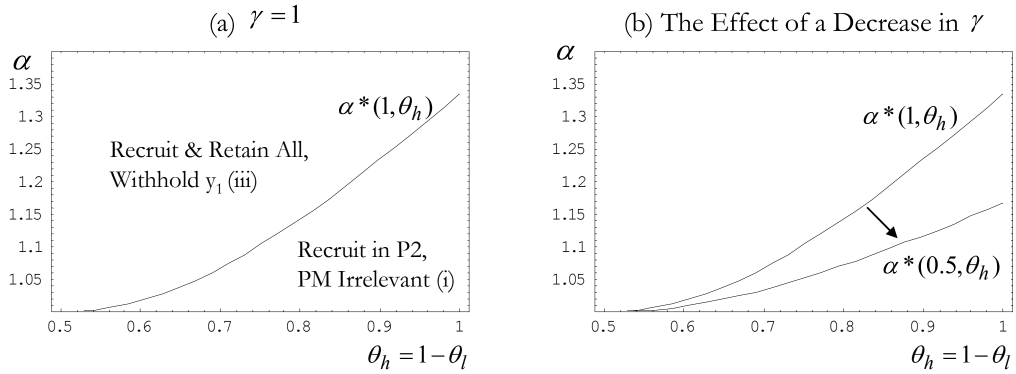

Figure 2: PMs, Recruitment and Retention ($T = 2$)

is then equal to 1.04. For any $\alpha < 1.04$, P_G will recruit in period 2 to avoid making a loss on the worker in period 2 should he turn out to be unsuccessful in period 1 (A_f). While, for any $\alpha \geq 1.04$, P_G will value public sector success sufficiently highly to recruit in period 1 and retain with certainty. The function α^* is increasing in γ simply because pay inflexibility increases the expected loss on A_f under alternative (iii). It depends on θ_h for two reasons. First, the expected cost of 'adding A_0 and A_s' increases with the difference in skill levels because market wages disperse and hence entail a greater, additional payment to A_f (the numerator in (5) is increasing in θ_h). This is also true of the expected benefit (the denominator is increasing in θ_h) but the cost effect dominates, ensuring that a higher level of α is needed to prompt a switch.

Fixed Entry Points So far we have assumed that the public sector employer was bound to retain a worker who had performed poorly in the public sector, *and* accept a worker who had performed poorly in the private sector, at the going public sector wage. We now show that Proposition 1 is robust to a relaxation of the second assumption. In more practical terms, we highlight that systems of 'fixed entry points' (commonly used for doctors, military personnel and civil servants) bring benefits but do not change our previous assertion that it is never optimal to publish.

Suppose that when choosing $(\overline{w}, p)$ in period 0, P_G commits not to hire from the private sector in period 2. If she also commits to publish y_1 she can now *undercut* the market's entry-level offer by setting $\overline{w} = \overline{w}^*_{fix}$, where

$$\overline{w}^*_{fix} \equiv \tfrac{1}{1+\Pr(f)} w_0 + \tfrac{\Pr(f)}{1+\Pr(f)} w(f), \tag{6}$$

and still recruit in period 1. The worker will be retained at the going level of public sector pay if he unsuccessful but iff $\overline{w} \geq w(s)$ should he be successful. In contrast, if P_G commits to withhold y_1 she must match the market's entry-level offer to recruit in period 1 but can retain with certainty at the going level of public sector pay w_0.

Conditional on hiring, the public sector employer therefore faces two options. She can achieve alternative ii by setting $\overline{w} = \overline{w}^*_{fix}$ and committing to publish y_1 and alternative iii by setting $\overline{w} = w_0$ and committing to withhold y_1. As with free entry, publishing is good for recruitment but bad for retention. Withholding y_1 makes it cheaper to retain because outside offers are kept down to w_0. Publishing y_1 makes it cheaper to recruit because it creates an option value to going public (rather than removing an option value to going private); if the worker succeeds in the public sector in period 1 he can still earn $w(s)$ in the private sector in period 2 but, if he fails, he can exercise his option to stay in the public sector and earn a wage above $w(f)$. Now, however, all rents are offset in expectation. If P_G chooses alternative ii she makes an expected loss on A_f that is offset by a gain on A_0. Likewise if she chooses alternative iii she pays A_0 his market value and makes an expected loss on A_f that is offset by the expected gain on A_s. Consequently, P_G always has a (weak) incentive to choose alternative iii to maximise the probability of task success.[11]

5 Main Analysis

The two period model illustrates the basic force that limits the desirability of transparency - payment of rents to poor performers - in a simple fashion but, in doing so, hides a number of issues. For instance, additional periods give rise to the possibility of screening and therefore have implications for the desirability of internal performance measurement. They also create further performance types and hence influence the trade off between minimizing the cost of recruiting and the cost of retaining good performers. Since just a single period complicates the analysis substantially but is sufficient to make our bsic points, we explore these issues in the context of a three period model.

Even in the three period model, this is a laborious task. The 7 performance types produce a vast array of logically possible hiring alternatives. Moreover, there are now 10 relevant PM policies: P_G can combine a decision to publish (P) or withhold (W) y_2 with (i) publishing y_1 immediately (T); (ii) measuring immediately but lagging publication to period 2 (L); (iii) measuring and publishing with a delay (D); (iv) measuring immediately (C) and (v) do nothing (N).[12] To solve for the optimal PM policy, we again need to know which, if any, wage and PM policy pair $(\overline{w}, p)$ achieves each hiring alternative at minimum expected cost.

This combinatorial problem can be eased by noting two points that follow directly from the two period analysis. First, if P_G commits to publish y_1 and y_2 immediately (TP) - what we term a policy of *transparency* - every performance type will go public at a wage equal to the

[11] It is of independent policy interest to note the expected payoff to picking alternative (b) with fixed entry points exceeds the expected payoffs in Table 1.

[12] This list excludes the, somewhat implausible, possibility of contingent reporting (i.e. publication of performance if and only if the agent remains in the public sector). An appendix confirming that this abstraction is without loss of generality is available upon request.

market's full information outside offer. We will compare the effects of all other PM policies to this benchmark outcome. Second, if P_G sets $\overline{w}$ low enough to recruit after period 1, we must be in one of the following cases analogous to those set out in Section 4.

Case 1 If P_G commits to publish y_2, she can recruit A_{my_1} at $w(y_1)$ but must offer $w(y_1, s)$ to retain A_{my_1gs}.

Case 2 If P_G commits to withhold y_2, she must beat the market's offer to A_{my_1} by $\overline{w}_{y_1} - w(y_1)$, where

$$\overline{w}_{y_1} \equiv \tfrac{1}{1+\Pr(s|y_1)} w(y_1) + \tfrac{\Pr(s|y_1)}{1+\Pr(s|y_1)} w(y_1, s), \tag{7}$$

to compensate for the *option-value* effect. The flip-side is that she can retain A_{my_1gs} at $\overline{w}_{y_1} < w(y_1, s)$ due to the *outside-offer* effect.

By direct analogy with Proposition 1, if P_G recruits after period 1, then it is never optimal to publish y_2. Consequently, our interest lies in the restricted set of hiring alternatives that involve recruiting after period 1; or, effectively, in establishing the cheapest way to recruit A_0 and retain A_s and A_{ss}.

5.1 The Pitfalls of Internal Performance Measurement

In this Section, we explore whether a commitment to measure but not publish y_1 in period 1 - what we term *internal performance measurement* - is good for recruitment or retention.

Suppose, first, that P_G commits to measure y_1 in period 1 but to publish y_1 and y_2 in period 2 (LP), what we term end of project reporting. If the worker goes private in period 1 we are in Case 1 and the outcome is equivalent to a policy of transparency. If the worker goes public in period 1, the market is fully informed at the start of period 3, but has no information bar the worker's initial sector choice at the start of period 2. Since period 2 sector choices have no impact on future wages, the market is unable to screen and continues to offer w_0. This leaves A_{τ_2} and A_0 in exactly in the same position as in the two period model and ensures that P_G recruits in period 1 iff $\overline{w} \geq \overline{w}^*$.

Now suppose that P_G commits to measure y_1 in period 1 but to publish only y_1 in period 2 (LW), what we term a policy of lagged publication. If the worker goes private in period 1 we are in Case 2: P_G recruits at $\overline{w}_{y_1}$ and automatically retains. Matters are very different, however, if the worker goes public in period 1. The following Lemma establishes the sub-game equilibria.[13]

[13]Formally, a PBE of this sub-game is a pair of strategy functions $(\sigma^o_{gs}, \sigma^o_{gf})$ and a wage offer $w_{m_2} = \Pr(y_2 = s \mid c_2 = g)$ such that: (i) at information sets on the equilibrium path w_{m_2} is derived via Bayes' Rule from the sector choice c_2 and strategies and (ii) these strategies are optimal given w_{m_2}. To remove the possibility of multiple equilibria supported by off-equilibrium beliefs when both types go public ($\sigma_{gs} = \sigma_{gf} = 1$), we assume that the market attributes off equilibrium moves to the type with the greater incentive to deviate.

Lemma 1. *Assume that the worker goes public in period 1. Under a policy of lagged publication (LW), the public sector employer retains an unsuccessful worker (A_{gf}) with positive probability iff $\overline{w} > w_0$ and certainty iff $\overline{w} \geq w(s)$, and a successful worker (A_{gs}) iff $\overline{w} \geq \overline{w}_s$.*

The critical value $\overline{w}_s$ is defined in (7). By adopting a policy of lagged publication, P_G induces hybrid or separating sub-game equilibria for any $\overline{w} \in (w_0, \overline{w}_s)$. Both aspects of this PM policy play a role in supporting these equilibria. The provision of internal feedback makes an unsuccessful worker more, and an unsuccessful worker less, confident of future success. While this was also true under a policy of end of project reporting, failure to publish y_2 now provides a link between period 2 sector choices and expected future wages. Basing his decision on current and expected future wages, a successful worker now has more of reason to quit and go private than an unsuccessful worker. Aware of this possibility, the market infers that period 2 separations are drawn from the high end of the skill distribution and so rewards public sector quitters with a higher wage. Separation therefore occurs for an intermediate range of public sector pay: $\overline{w}$ high enough for going public to be attractive to A_{gf} but low enough to be unattractive to A_{gs}.

All that remains is to solve for the entry-level wage at which the worker will go public, $\overline{w}^{LW}$. As we will soon verify, A_0 can only be indifferent between sectors if A_{gf} is willing to play a strictly mixed strategy, or equivalently, if $\overline{w} = w_{m_2}(g, 0, \sigma_{gf})$.[14] Substituting for the resulting period 2 strategies ($\sigma_{gs} = \sigma_{ms} = 0$, σ_{gf} and $\sigma_{mf} = 1$), the net benefit to A_0 from going public can be written as

$$\Delta^{LW} = \gamma\left[\overline{w} - w_0\right] + \overline{w} - \left(\Pr(s)w(s) + \Pr(f)\left[\gamma\overline{w} + (1-\gamma)w(f)\right]\right). \tag{8}$$

Equation (8) is equal to zero when $\overline{w} = \overline{w}^{LW}(\gamma)$, where

$$\begin{aligned} \overline{w}^{LW}(\gamma) &= \tfrac{1}{1+\gamma\Pr(s)}w_0 + \tfrac{\gamma\Pr(s)}{1+\gamma\Pr(s)}w(s) && (9) \\ \Rightarrow \sigma_{gf}(\overline{w}^{LW}(\gamma)) &= \tfrac{\gamma}{1+\gamma}. && (10) \end{aligned}$$

Notice that $\overline{w}^{LW}(\gamma)$ is an increasing function on $(w_0, \overline{w}^*]$ and, in contrast to $\overline{w}^*$, depends on the degree of pay inflexibility.

Figure 3 compares a policy of lagged publication with a policy of transparency. When public sector pay is below w_0 the market, expecting both types to quit, offers a pooling wage of w_0. Given these offers, P_G will indeed fail to hire. Since the two period analysis applies when P_G fails to recruit in period 1, Figure 3 is drawn for $\overline{w} \geq w_0$. When public sector pay is higher, say above $w(s)$ but below $w(s,s)$, the market, expecting only the successful (ready to capitalize on past success and confident of future success) to quit, offers a 'separating' wage of $w(s)$. Given these offers, P_G will indeed loose A_{gs} but now also faces the prospect of having to offer at least $w(s)$ to retain A_{gf}. (For any $\overline{w} \in (w_0, w(s))$, the market matches $\overline{w}$ and A_{gf} goes

[14]As shown in the Proof of Lemma 1, for any $\overline{w} > w(s,f)$ (22) simplifies to $\Delta_{gf}^{LW} = \gamma\left[\overline{w} - w_{m_2}(g)\right]$.

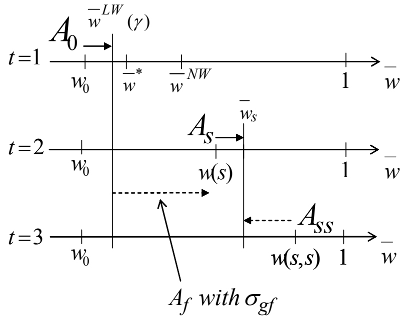

Figure 3: Lagged Publication of y_1

public with probability σ_{gf}). The end result is that, relative to a policy of transparency, it is more costly for P_G to retain *both* performance types in period 2.

All this, of course, impacts on the readiness of A_0 to go public. It is harder to recruit in period 1 than under transparency because A_{gf} must be playing a mixed strategy at any wage at wage at which A_0 is willing to go public. If A_{gf} goes private, the market offers w_0 in period 2. This gives A_0 and A_{gf} the same current offers but A_0 an option value. If A_{gf} goes public with certainty, the market offers $w(s)$, removing any option value to going private in period 1. This means that the market fails to back out success perfectly and so creates an option value to going private in period 1.

As we will show in Section 5.2, P_G can recruit and retain *all* performance types at a wage below $w(s)$ by committing to 'do nothing'. As a result, lagging publication can only be desirable (when feedback is avoidable) if P_G finds it beneficial to pay a premium of $\overline{w}^{LN}(\gamma) - w_0$ to reduce the probability of retaining a poor performer. Such a strategy seems counter-intuitive and, as the following Lemma confirms, is indeed never optimal.

Lemma 2. *Assume that $\overline{w} \in \{w_0, \overline{w}^{LW}(\gamma)\}$ and feedback is avoidable. A policy of lagged publication (LW) is strictly dominated by a policy of transparency (TP) for all parameters.*

Suppose, for ease of argument, that there are only two feasible levels of $\overline{w}$, w_0 and $\overline{w}^{LW}(\gamma)$. Committing to a policy of lagged publication and setting $\overline{w} = \overline{w}^{LW}(\gamma)$ minimizes expected costs. However, taking expected benefits into account (i.e. $\Pr(s, f)\alpha$), P_G does better by committing to a policy of transparency and setting $\overline{w} = w_0$.

Finally, suppose that P_G commits to measure y_t in period t but to never publish (CW), what we term a policy of confidentiality. (It is straightforward to show that the same outcome is obtained, if a little less plausibly in terms of out-of-equilibrium beliefs, if y_2 is published, CP). If the worker goes private in period 1 we are in Case 2: P_G recruits A_{my_1} at $\overline{w}_{y_1}$ and automatically retains both A_{my_1gf} and A_{my_1gs}. If the worker goes public in period 1 and stays public in period 2 the market, will offer $w(g, g)$ in period 3, while if he goes private it will offer $w(g, y_2)$. The fact that period 3 wages depend on period 2 sector choices, again gives the market the ability to screen. The following Lemma establishes the sub-game equilibria.

Lemma 3. *Assume $\gamma = 1$ and that A_0 goes public. Under a policy of confidentiality (CW), the public sector employer retains an unsuccessful worker (A_{gf}) with positive probability only if $\overline{w} > \overline{w}_{gf1}$ and certainty only if $\overline{w} \geq \overline{w}_{gf2}$, and a successful worker (A_{gs}) iff $\overline{w} \geq \overline{w}_s$. The level of public sector pay at which A_{gs} and A_{gf} go public is decreasing in γ.*

The critical values $\overline{w}_{gf1}$ and $\overline{w}_{gf2}$ are defined in Appendix B, along with the market's period 3 outsider offers ($\overline{w}_s$ is given in (7)). The bottom line is that a policy of confidentiality makes it even harder to retain in period 2. The intuition is simple. Lagged publication makes it hard to retain in period 2 because it drives up period 2 outside offers. Confidentiality makes matters worse because it muddies the waters for a further period and hence drives a wedge between period 3 outside offers. An unsuccessful worker has greater reason to quit in period 2, as his period 3 outsider offers following a decision to quit are driven up above $w(f, y_2)$. A successful worker has greater reason to quit in period 2 (for any $\gamma < 1$) as his period 3 outsider offer following a decision to stay is driven down to $w(f)$. In short, the further pitfall of confidentiality is that it *stigmatizes* those who choose to stay in the public sector.

Solving for the level of public sector pay at which the worker will go public in period 1 is complicated by the need to invert A_{gf}'s now, highly non-linear, mixed strategy. Fortunately, this is a moot point as we can again be certain that A_{gf} must be playing a mixed strategy at any wage at which A_0 is willing to go public and A_{gf} mixes only if $\overline{w} > \overline{w}_{gf1} > w_0$. Thus, following the logic outlined above for lagged publication, a policy of confidentiality is strictly dominated for any α.

In concluding this sub-section is will be useful to emphasize two points. When the worker can complete more than two tasks providing internal feedback, that is measuring but failing to publish in *any* period (CW) will always be dominated (strictly so for any $\gamma < 1$).[15] End of project reporting and lagged publication perform better, however, and may have merits if worker feedback is unavoidable.

5.2 Prescriptions for Coping Organizations

In this Section we show that publication of performance can be optimal when the worker can complete more tasks, although only for a very restricted set of parameters. To do so we need to compare the consequences of publishing in period 1 (TP and TW) with doing nothing in period 1 (NP, NW, DP & DW).

[15] It is should be noted that internal, interim feedback can be beneficial in settings where effort, as well as skill, determine output. For instance, Ederer (2004) shows that, given a multiplicative production function, tailoring of second period effort to beliefs can improve sorting in internal 'promotion' touraments.

Under a policy of transparency (TP) every performance type will go public at his full information market value. If P_G commits to publish y_1 but withhold y_2 and the worker goes private in period 1, we are in Case 2. But then, since P_G publishes y_1 immediately, exactly the same must be true if the worker goes public. Consequently, both PM policies (TP and TW) enable P_G to recruit A_0 at w_0.

Recall that the market cannot screen when both y_1 and y_2 are published in period 2. A commitment to delay both measurement and publication of y_1 to period 2 and publish y_2 (DP) must therefore be equivalent to a policy of end of project reporting (LP). That is, P_G can recruit A_0 and retain all performance types bar A_{ss} at $\overline{w}^*$, but A_{ss} can only be retained at $w(s, s)$.

Now suppose that P_G commits to do nothing with y_1 but to publish y_2 (NP), what we term selective reporting. If the worker goes private in period 1, we are in Case 1. Alternatively, if the worker goes public in period 1, the market offers A_{gmy_2} and A_{ggy_2} the same wage, namely $w(y_2)$ and A_g a wage of w_0. P_G therefore hires $A_{gc_2y_2}$ iff $\overline{w} \geq w(y_2)$ and, since the period 2 sector choice has no impact on period 3 wages, A_g iff $\overline{w} \geq w_0$. Given these period 2 and 3 strategies, the net benefit to A_0 from going public in period 1 can, for any level of public sector pay that we are interested in considering (i.e. $w_0 \leq \overline{w} < w(s)$) be written as

$$\Delta^{NP} = \gamma\left[\overline{w} - w_0\right] + \Pr(s, s)\gamma\left[\overline{w} - w(s, s)\right]. \tag{11}$$

Equation (11) is equal to zero when

$$\overline{w}^{NP} \equiv \tfrac{1}{1+\Pr(s,s)} w_0 + \tfrac{\Pr(s,s)}{1+\Pr(s,s)} w(s, s), \tag{12}$$

implying that P_G hires A_0 iff $\overline{w} \geq \overline{w}^{NP} > \overline{w}^*$.

The outcome is effectively identical if commits to measure and publish y_1 in period 2 and withhold y_2 (DW). If the worker goes private in period 1, we are in Case 2. If the worker goes public in period 1, the market offers $A_{gy_1my_2}$ a wage of $w(y_1, y_2)$, A_{gy_1g} (and $A_{gy_1gy_2}$) a wage of $w(y_1)$ and A_g a wage of w_0 and P_G hires $A_{gy_1my_2}$ iff $\overline{w} \geq w(y_1, y_2)$ and A_{gy_1g} iff $\overline{w} \geq w(y_1)$. The latter change implies that A_g will go public iff $\overline{w} > w_0$ as failure to publish y_2 creates an *option-value* effect. Since it makes no intrinsic difference to A_0 whether he is rewarded for succeeding in period 1 or period 2, from the perspective of period 1, things are the same. The net benefit to A_0 is given in (11), so, again, P_G hires A_0 iff $\overline{w} \geq \overline{w}^{NP}$.

Finally, suppose that P_G commits to do nothing with y_1 and withhold y_2 (NW). If the worker goes private in period 1, this policy is equivalent to Case 2. If the worker goes public in period 1, the market, aware that A_g moves without private information, offers A_{gmy_2} a wage of $w(y_2)$ and A_{gg} and A_g a wage of w_0. So P_G hires A_{gmy_2} iff $\overline{w} \geq w(y_2)$ and A_{gg} and A_g iff $\overline{w} \geq w_0$. Notice that A_g must decide on a sector in anticipation of one further move and equipped with the common prior over his chances of success. Applying the results from the two period model, P_G must therefore hire A_g iff $\overline{w} \geq \overline{w}^*$.

In light of these strategies, the net benefit to A_0 from going public in period 1 can, for $\overline{w} \geq w_0$, be written as

$$\Delta^{NW} = \gamma\left[\overline{w} - w_0\right] + \Pr(s)\gamma\left[\overline{w} - w(s)\right] + \Pr(s,s)\gamma\left[\overline{w} - w(s,s)\right]. \tag{13}$$

Equation (13) is equal to zero when $\overline{w} = \overline{w}^{NW}$, where

$$\overline{w}^{NW} \equiv \tfrac{1}{1+\Pr(s)+\Pr(s,s)} w_0 + \tfrac{\Pr(s)}{1+\Pr(s)+\Pr(s,s)} w(s) + \tfrac{\Pr(s,s)}{1+\Pr(s)+\Pr(s,s)} w(s,s). \tag{14}$$

The associated *option-value* and period 2 and 3 *outside-offer* effects of this PM policy are shown, respectively, by the solid and dashed lines in Figure 4, panel (d). As one would expect, failure to publish period 2 on top of period 1 performance increases the *option-value* effect, implying that P_G hires A_0 iff $\overline{w} \geq \overline{w}^{NW} > \overline{w}^*$.

Figure 4 compares the various PM systems described above. Failing to publish y_1 in period 1 (all bar TP and TW) makes it harder to recruit A_0 because of the *option-value* effect but easier to retain because of the *outside-offer* effect.[16] The *option-value* effect decreases with the amount of information published in period 2 (i.e. $\overline{w}^* < \overline{w}^{NP} < \overline{w}^{NW}$). End of project reporting minimizes the cost of retaining A_s, while doing nothing minimizes the cost of retaining A_{ss}. This is simply because these policies shift pay between the three periods. For instance, A_0 will need greater compensation up-front if he anticipates that he will be unable to reap the rewards of success in periods 2 *and* 3.

It should be clear from Figure 4 that a policy of selective reporting (NP) fails to minimize the cost of recruiting or retaining and so can only be desirable if P_G finds it beneficial to pay a premium of $\overline{w}^{NP} - \overline{w}^*$ to remove A_{fs} (or A_{sf} under DW). As we confirm in the Proof of Proposition 2 in the Appendix, this will never be the case for any α. Taken together with the analysis in Section 5.1, this leaves P_G with 6 remaining hiring alternatives. She can recruit: (1) A_{ff} from the private sector in period 3 by setting $\overline{w} = w(f,f)$ under any PM policy; (2) A_f from the private sector in period 2 and retain A_{ff} in period 3 by setting $\overline{w} = w(f)$ and committing to publish y_2; (3) A_f from the private sector in period 2 and retain with certainty in period 3 by setting $\overline{w} = \overline{w}_f$ and committing to withhold y_2; (4) A_0 in period 1 and all bar A_s and A_{ss} by setting $\overline{w} = w_0$ and committing to TP or TW; (5) A_0 and retain all bar A_{ss} by setting $\overline{w} = \overline{w}^*$ and committing to LP or DP; and (6) A_0 and retain with certainty in all periods by setting $\overline{w} = \overline{w}^{NW}$ and committing to NW.

Note that, as in Section 4, no PM system minimizes the expected cost of every alternative. In particular, a policy of transparency is good for recruitment, but bad for both short and long-term retention. A comparison of the expected costs and benefits of these alternatives establishes our second Proposition.

[16] Note that the period 2 *option-value* effect that arises when P_G commits to withhold y_2 has no impact in equilibrium; since A_0 faces more future periods it is the period 1 *option-value* effect that is important.

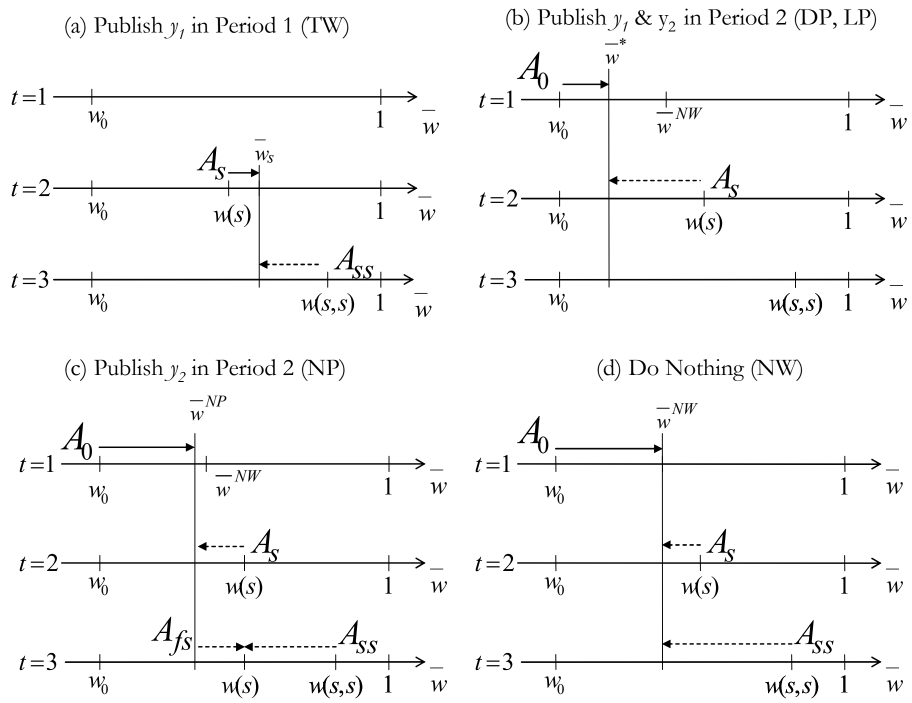

Figure 4: Comparing PM systems

Proposition 2. *When the worker can complete three sequential tasks and feedback is avoidable:*

(i) *it is optimal to publish public sector performance only if selection is of low importance ($\theta_h < 0.752$ for TP and $\theta_h < 0.724$ for LP) and then iff the value of public sector success α takes an intermediate value ($\alpha \in [\alpha_{34}, \min\{\alpha_{45}, \alpha_{46}\}]$ for TP and $\alpha \in [\alpha_{45}, \alpha_{56}]$ for LP);*

(ii) *for all other parameters it is optimal to abstain from performance measurement.*

A graphical illustration of Proposition 2 is provided in Figure 5. The functions α_{45}, α_{46} and α_{56} are derived in the proof in Appendix B; the function $\alpha'(\theta_h, \gamma)$ - shown by the thick line - separates regions where it is optimal to recruit after period 1 from those where it is optimal to recruit in period 1 and is therefore analogous to $\alpha^*(\theta_h, \gamma)$ in Section 4. Further details of the plot are given in Appendix C.

Since the pitfalls of measuring but failing to publish y_1 were established in Section 5.1, all that remains is to explain why there is now a region where it is optimal to recruit in period 1 but not retain good performers (i.e. to choose alternatives 4 & 5)? Since already know that it is not optimal to publish y_2 when recruiting *after* period 1, the intuition can be seen by thinking of P_G as facing the three decisions in Table 2.

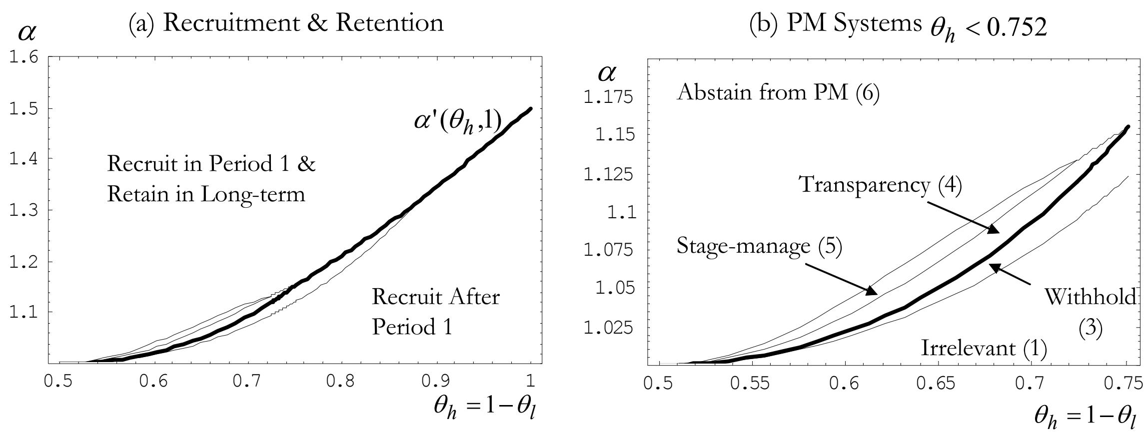

Figure 5: PMs, Recruitment and Retention ($\gamma = 1$, Feedback Avoidable)

Table 3: Comparing Hiring Alternatives ($T = 3$, Recruiting in Period 1)

Decision	Expected Benefit	Expected Cost
Add A_0 & A_{sf}	$[\Pr(s) + \Pr(f,s)]\,\alpha$	$w_0 + \Pr(f,s) + 2\Pr(f)\gamma\,[w_0 - \overline{w}_f]$
Add A_s	$\Pr(s,s)\alpha$	$\Pr(s,s) + [2\Pr(f) + \Pr(s,f)]\,\gamma\,[\overline{w}^* - w_0]$
Add A_{ss}	$\Pr(s,s,s)\alpha$	$\Pr(s,s,s) + [2\Pr(f) + \Pr(s,f)]\,\gamma\,\left[\overline{w}^{NW} - \overline{w}^*\right]$

Suppose that the value of public sector success α is sufficiently high such that the expected benefit of 'adding A_0 & A_{sf}' equals the expected cost ($[\Pr(s) + \Pr(f,s)]\,\alpha = w_0 + \Pr(f,s) + 2\Pr(f)\gamma\,[w_0 - \overline{w}_f]$). Will P_G add A_s? Again, there are two competing effects. On one hand, 'adding A_0 and A_{sf}' yields a greater expected benefit than 'adding A_s' ($\Pr(s) + \Pr(f,s) > \Pr(s,s)$). On the other hand, since the *option-value* and *outside-offer* effects for A_0 and A_s wash out, it also yields a greater expected cost. Now, however, when θ_h is low the expected benefit effect dominates.

The reason is straightforward: when θ_h is low the likelihood of a mixed performance (i.e. A_{sf}) is high, while the likelihood of A_s succeeding is low. The former increases both the expected benefit of 'adding A_0 and A_{sf}' and the expected cost of 'adding A_s', while the latter reduces the expected benefit of 'adding A_s'. As θ_h increases, however, these effects reverse. Or, put more simply, as skill differences increase, P_G need worry less about paying rents and more about getting the right 'man for the job'. Similar logic explains why it can be optimal to retain in the short-term (add A_s) but not in the long-term (add A_{ss}). 'Adding A_s' yields a greater expected benefit than 'adding A_{ss}' but also a greater expected cost, with the former dominating for $\theta_h < 0.724$ when the chance of A_{ss} succeeding is low.

The key point to note is that publishing y_1 *can* be optimal, but only for a very small region of the parameter space. To fix this idea, consider a vertical slice through Figure 5 with

$\theta_h = 0.65$. If the task at hand generates little in the way of value ($\alpha < 1.05$) the public sector employer will recruit after period 1 to minimize the rent paid to poor performers. If α is a little higher ($\alpha \in [1.05, 1.07]$) the public sector employer will be willing to recruit in period 1 by setting $\overline{w} = w_0$ and committing to a policy of transparency but unwilling to pay more to retain A_s given that the probability of retaining A_{sf} is high and the likelihood of A_s suceeding is low. If α is only a little higher still ($\alpha \in [1.07, 1.08]$) she will be willing to recruit and retain good performers in the short-term by setting $\overline{w} = \overline{w}^*$ and committing to a policy of end of project reporting but unwilling to pay more to retain A_{ss} since the probability of A_{ss} suceeding is low. Finally, if α is sufficiently high ($\alpha > 1.08$) the public sector employer will recruit and retain good performers in the long-term by setting $\overline{w} = \overline{w}^{NW}$ and committing to do nothing because even a small chance of adding A_{ss} is sufficient to compensate for the rent paid to poor performers.

Now consider a vertical slice with $\theta_h = 0.85$. If α is sufficiently low ($\alpha < 1.275$) the public sector employer will recruit after period 1 to minimize the, now higher, rent paid to poor performers. For any other α, however, she will recruit in period 1 and strive to retain good performers in the long-term as the expected cost of adding A_{ss}, A_s, A_0 and A_{sf} is sufficiently low relative to the expected cost of adding A_{fs} that it is optimal to retain even in the long-term.

To sum up, for the overwhelming majority of the parameter space, the public sector employer does best by abstaining from performance measurement. If θ_h is high, it is not optimal to publish for any α because the expected cost of adding performance types (in terms of extra rent paid to poor performers) is sufficiently low. If θ_h is lower it is optimal to publish for a small, intermediate range of α when the expected benefit of adding performance types is high enough to be prompt early recruitment but not too high to prompt retention.

5.3 Prescriptions for Craft Organizations

The message in Proposition 2 is that abstaining from performance measurement - or more accurately keeping the worker in the dark - is typically the best way for the public sector employer to manage her human capital. But what happens if this is not an option? For instance, the worker, closer to the front-line, may have a better idea of his performance. Is it best for the public sector employer to remain passive or to step in publish? As we now briefly outline, publication is typically necessary but a policy of transparency (full and immediate publication of all task outcomes) is rarely optimal.

When faced by unavoidable feedback, P_G can can combine a decision to withhold (W) or publish y_2 (P) with: (i) publishing y_1 immediately (T); (ii) measuring and lagging publication to period 2 (L); and (iii) measuring immediately (C). If P_G chooses to recruit after period 1, the relevant hiring alternatives are then: (1)-(4) as set out Section 5.2; (5) recruit A_0 and retain all bar A_{ss} by setting $\overline{w} = \overline{w}^*$ and committing to LP; and (6) recruit A_0 and retain with

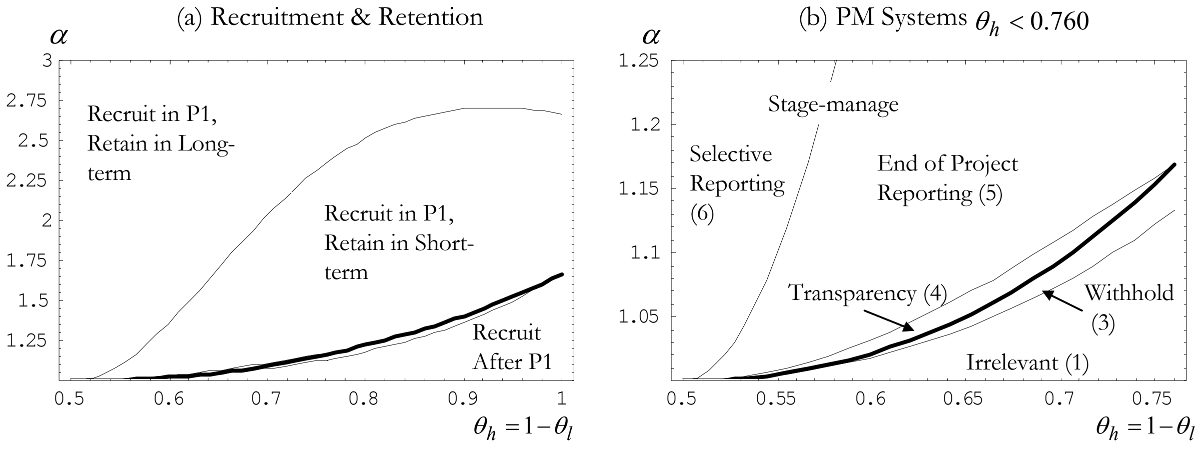

Figure 6: PMs, Recruitment and Retention ($\gamma = 1$, Feedback Unavoidable)

certainty in all periods by setting $\overline{w} = \overline{w}_s$ and committing to TW or LW.

Now, even if the public sector employer harbours an ambition to recruit and retain in the long-term, y_1 must be published. This is the only way to prevent the market from stigmatizing those who choose to remain in the public sector and hence minimize the costs of retention. The key question is therefore *when* not if y_1 should be published. A comparison of the expected costs and benefits of the available alternatives establishes our final result.

Proposition 3. *When the worker can complete three sequential tasks and feedback is unavoidable:*

(i) *it is optimal to adopt a policy of transparency (TP) only if selection is of low importance ($\theta_h < 0.760$) and then iff the value of public sector success α takes an intermediate value ($\alpha \in [\alpha_{34}, \alpha_{45}]$);*

(ii) *for all other parameters it is optimal to stage-manage publication of public sector performance.*

A graphical illustration of Proposition 2 is provided in Figure 6. The function $\alpha'(\theta_h, \gamma)$ again separates regions where it is optimal to recruit after period 1. Details of the plot are given in Appendix C. The intuition is straightforward in light of Proposition 2. If the value of public sector success is sufficiently high, the public sector employer will strive to recruit and retain good performers in the long-term. This alternative is now achieved at least cost by setting $\overline{w} = \overline{w}_s$ and committing to publish selectively. Since poor performers must be paid significantly more ($\overline{w}_s > \overline{w}^{NW}$) it is a less attractive option than in Section 5.2 and, as a result, it is not optimal for P_G to switch from Alternative 3 or 4 to 6 for any θ_h. It is, however, still optimal to switch from Alternative 3 to 5 if θ_h is high enough (nothing here has changed) confirming that it will be optimal to adopt a policy of transparency for the same small set of parameters irrespective of whether feedback can be avoided.[17] Accordingly, the key difference is simply that stage-management has replaced abstention as the dominant PM system.

6 Discussion

6.1 Policy Implications

The most obvious policy implication of our analysis is that recruitment and retention problems would ease if governments worked harder to remove rigidities in public sector pay. However, since at least some degree of pay inflexibility is likely to be here to stay, and our results hold for any $\gamma > 0$, our analysis also has implications for organizational design. Specifically, Propositions 2 and 3 suggest that public sector organizations, or roles within an organization, should take one of three forms.

- **Coping Organizations** that lack performance measurement systems.
  In his typology of government agencies, Wilson (1989) refers to coping organizations as those in which it is difficult or near impossible to measure outcomes (they must simply deal or cope with a testing environment). Some organizations may indeed lack PM systems because it is impossible to measure. Our analysis suggests another explanation: abstaining from measurement may be an optimal response to the need to manage human capital. If workers find it hard to get a sense of their achievements it may pay to leave things that way. Besides being cheap, such a policy minimizes the cost of long-term retention and will be associated with low rates of turnover. Such a policy stance will be optimal only if workers lack feedback, but then whenever selection is relatively important *or* when non-pecuniary benefits / public service motivation are high. Likely candidates include the police, high grades in the civil service, teachers and health professionals.

Abstention from performance measurement is not a universal panacea. Even if workers lack feedback it *can* be optimal to step in publish. Moreover, in what Wilson (1989) refers to as craft organizations, where workers have a keen sense of their own achievement, it will *always* be optimal to publish, at least in some period. Besides coping organizations we should therefore expect to see two further organizational forms.

- **Transparent Organizations** in which PMs are published in real time.
  A policy of transparency enables the organization to recruit from the entry-level market at low cost, although turnover rates are likely to be high as good performers quit after a short period in the job. This organizational form is optimal when two conditions are met:

[17] Strictly speaking the sets differ slightly for any $\theta_h \in (0.724, 0.760)$. For details see the derivations of Figures 5 and 6 in Appendix C.

(i) a good performance commands a low return in the market *and* has limited impact on future public sector success (Δ_θ low) and (ii) non-pecuniary benefits / public service motivation are limited (α intermediate). Likely candidates include support staff in most delivery areas and low-grade civil servants.

- **Stage-managed Organizations** in which PMs are published judiciously.
  Such spin may take two forms. Publication may be strategically 'bunched' at the end of a project or period of appraisal to enable the organization to recruit from the entry-level market and retain good performers in the short-term. Or, it may be selective, providing users and the market with an initial statistic but not subsequent performance, with a view to recruiting and retain good performers in the long-term. If workers have no informational advantage over managers, end of project reporting is optimal only if Δ_θ is low and α is intermediate. In the event that workers are better informed, however, stage-management should be pervasive. Likely candidates are areas of delivery where the public sector is a monopsonist provider (producing a strong service ethic) and employees are well-placed to judge the quality of their performance. Wilson's (1989) list of craft organizations - *inter alia* lawyers in the Anti-Trust division, engineers in the Army Corps and foresters in the Forest Service - provides various examples (for more details see p. 165-168).

Of course, we may also observe an inefficient 'opaque' organizational form where performance is measurable (and known to be measured) but not published to outsiders. Such a PM system fails to further any human capital objective and, moreover, is hard to reconcile with implicit incentives as outsiders must observe outcomes for career concerns to induce effort. If feedback is avoidable and public service motivation high, PMs should be removed. Otherwise, the organization should consider either a policy of transparency or, more typically, stage-managed publication.

Before turning to empirical predictions, we offer a final word of caution to organizational reformers. For simplicity, we have assumed that the value of public sector success, α, is exogenous. If one interprets $\alpha - 1$ as public service ethos, a further downside of PMs is that they may demotivate. Workers may be less willing to donate labor when confronted by the burden of collating performance information (as our own experience of the QAA and RAE in the UK Higher Education sector serves to testify). If it is true that α decreases with the introduction of PMs, transparency may be optimal *ex post*, but inefficient *ex ante*. The prospect of becoming stuck in a vicious circle of measurement, suggests that reformers should think longer and harder before extending performance measurement systems to further corners of the public sector.

6.2 Empirical Predictions

An attractive feature of the model is that it yields simple, testable predictions. While an empirical test is beyond the scope of this paper, we close with a few thoughts that may help indicate how far recruitment and retention considerations - *via à vis* incentives - should shape PM systems.

Post separation wages It is well known in the labor economics literature that 'relative to stayers, quits exhibit higher and layoffs lower wage growth in employment transitions' (McLaughlin 1990, p.76, see also the references there-in). Our model provides an informational foundation for this observation: the market will infer that separations from opaque organizations characterised by pay inflexibility are quits and hence drawn from the high end of the skill distribution. If this explanation is correct then pay inflexibility and performance measurements systems should be important determinants of post separation wage profiles.

Hazard rates It is also well known that hazard rates declined with tenure. Again, this is a prediction of our model: public sector stayers in opaque organizations become scarred by the market and so should, having failed to exit early on, find it less and less attractive to quit. As above, if this explanation is correct hazard rates should decline most steeply in opaque organizations characterised by a high degree of pay inflexibility.

7 Concluding Remarks

Governments have already begun to appreciate that incentive schemes can have perverse effects in public sector organizations. This paper suggests that increasing transparency can also have undesirable consequences.

Our findings suggest a number of directions for future research. Since performance measurement affects selection through the existence of pay inflexibility it seems crucial to understand whether such rigidity is driven by top-down political forces or bottom-up (and hence more easily changed) organizational or labor market structures. Since some degree of pay inflexibility is likely to be here to stay, it would also be desirable to conduct a test along the lines outlined in Section 6.2. Doing so would identify whether the human capital consequences of performance measurement are quantitatively important and hence result in more complete policy advice. On a more theoretical note, the current debate concerning the use of non-consolidated bonuses in government agencies suggests it would be interesting to explore the consequences of publishing performance when a fraction of pay is linked to an explicit incentive scheme.

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Appendix

A Evidence of Relative Pay Compression

Table A1: 90-10 Percentile Wage Gap by Gender and Sector

	Men		Women	
	Public	Private	Public	Private
Germany (Melly 2003, GSOEP 2000, log hourly wage spread)	0.9	1.1	1.0	1.3
UK (Disney & Gosling 1998, BHPS 1991-95, weekly wage ratio)	2.7	3.0	2.8	3.1
US (Borjas 2002, CPS 2000, log weekly wage spread)	1.3	1.7	1.3	1.5
Zambia (Nielsen & Rosholm 2001, LCMS 1996, wage ratio)	5.5	7.9	-	-

Table A2: Quantile Regression Estimates of Public Sector Wage Premia and Penalties

	Public Sector Premium (%) at 10th & 90th Percentile					
	Men, Education Group			Women, Education Group		
	All	High	Low	All	High	Low
Canada (Mueller 1998, LMAS 1990, log hourly wage)[1]	10, -5	-	-	22, -7	-	-
Germany (Melly 2003, GSOEP 2000, log hourly wage)[2]	7, -20	-8, -30	14, 0	22, -8	-50, -10	50, -6
UK (Disney & Gosling 1998, BHPS 1991-95, log weekly wage)[3]	10, -5	0, -20	0, 0	25, 7	20, -13	12, 0
US (Poterba & Rueben 1994, CPS 1991, log hourly wage)[4]	7, -8	12, -20	0, -13	9, -4	26, -14	7, 0
Zambia (Nielsen & Rosholm 2001, LCMS 1996, log wage)[5]	44, 9	17, -28	41, 16	-	18, -39	42, 0

Notes:

Non-zero estimates were reported as statistically different from zero at 5% or below.

Mueller (1998) and Melly (2003) combine Oaxaca decomposition with quantile regression. The remaining studies use only quantile regression analysis and hence constrain the returns to observable characteristics to be equal across sectors.

1. Covariates include: education, province, marital status, age, mother tongue, union status, job-related pension, visible minority, disability, immigrant, occupation.
2. Covariates: experience, job tenure, marital status, part-time status, education and occupation. High = university, low = basic or intermediate schooling with no training
3. Covariates: age quadratics, year dummies. High = degree, low = normal formal qualification.
4. Covariates: experience, marital status, SMSA status, race. High = > 16 yrs, low = < 12 yrs.
5. 'All' does not condition on gender and age. Covariates in other columns: gender, age, marital status, rural and province dummies. High = senior secondary, low = no education, estimates calculated for 35 yr old.

B Proofs

Proof of Proposition 1.

Our aim is to show that it is not optimal for P_G to choose Alternative ii for any α. Suppose that it is. From Table 2, we require

$$\begin{aligned} \Pr(s)\alpha &\geq w_0 + \gamma \Pr(f)\left[w_0 - w(f)\right] && (15)\\ \Leftrightarrow \alpha &\geq 1 + \tfrac{\Pr(f)}{\Pr(s)}\gamma\left[w_0 - w(f)\right] && (16)\end{aligned}$$

and

$$\Pr(s,s)\alpha < \Pr(s)w(s) + \Pr(f)\gamma\left[\overline{w}^* - w_0\right]. \quad (17)$$

Substituting for the RHS of (16) we can re-write (17) as

$$\begin{aligned} \Pr(s,s)\left(1 + \tfrac{\Pr(f)}{\Pr(s)}\gamma\left[w_0 - w(f)\right]\right) &< \Pr(s,s) + \Pr(f)\gamma\left[\overline{w}^* - w_0\right] && (18)\\ \Leftrightarrow \Pr(s,s)\left(\tfrac{\Pr(f)}{\Pr(s)}\gamma\left[w_0 - w(f)\right]\right) &< \Pr(f)\gamma\left[\overline{w}^* - w_0\right] && (19)\\ \Leftrightarrow \Pr(s \mid s)\gamma\left[w_0 - w(f)\right] &< \gamma\left[\overline{w}^* - w_0\right]. && (20)\end{aligned}$$

It follows from the definition of $\overline{w}^*$ in (2) that

$$\left[\overline{w}^* - w_0\right] \equiv \tfrac{\Pr(f)}{1+\Pr(s)}\left[w_0 - w(f)\right]. \quad (21)$$

So, given $\Pr(s \mid s) > \frac{\Pr(f)}{1+\Pr(s)}$, we have a contradiction. Accordingly, there cannot exist a value of α such that it is optimal to choose Alternative ii. ■

Proof of Lemma 1.

Substituting for the relevant period 3 strategies and wage offers, the net benefit to A_{gy_1} from going public in period 2 under policy LW iis

$$\Delta_{gy_1}^{LW} = \gamma\left[\overline{w} - w_{m_2}(g)\right] + \sum_{y_2}\Pr(y_2 \mid s)\left[\begin{array}{c}\max\{\gamma\overline{w} + (1-\gamma)w(y_1), w(y_1)\} - \\ \max\{\gamma\overline{w} + (1-\gamma)w(y_1,y_2), w(y_1,y_2)\}\end{array}\right] \quad (22)$$

where

$$w_{m_2}(g) = \sum_{y_1}\left(\frac{\Pr(y_1)(1-\sigma_{gy_1})}{\sum_{y_1}\Pr(y_1)(1-\sigma_{gy_1})}\right)w(y_1). \quad (23)$$

For any $\overline{w} \geq w_0$ we have $\Delta_{gs}^L \geq \Delta_{gf}^L$, implying that there are three possible sub-game equilibria in which at least one type goes public.

Semi-separation ($\sigma_{gs} = 0$, $\sigma_{gf} \in (0,1)$). For any $\overline{w} > w(s,f)$, $\Delta_{gf}^L = \gamma\left[\overline{w} - w_{m_2}(g)\right]$, where

$$w_{m_2}(g,0,\sigma_{gf}) = \tfrac{\Pr(s)}{\Pr(s)+\Pr(f)(1-\sigma_{gf})}w(s) + \tfrac{\Pr(f)(1-\sigma_{gf})}{\Pr(s)+\Pr(f)(1-\sigma_{gf})}w(f). \quad (24)$$

So, for any $\sigma_{gf} \in (0,1])$, we can find a level of $\overline{w} = w_{m_2}(g,0,\sigma_{gf})$ such that $\Delta_{gf}^L = 0$, implying that A_{gf} will be willing to mix with probability σ_{gf}. Notice that $w_{m_2}(g,0,\sigma_{gf})$ is an increasing function of σ_{gf} on $[w_0, w(s)]$. Since $\Delta^L_{gs} < 0$ for any such $\overline{w}$, this equilibrium exists for any $\overline{w} \in (w_0, w(s))$. Solving for the mixed strategy (and hence ultimately obtain (10)) simply involves inverting the function $\overline{w} = w_{m_2}(g, 0, \sigma_{gf})$ for σ_{gf}.

Separation ($\sigma_{gs} = 0$, $\sigma_{gf} = 1$). From (23), the market offers $w_{m_2}(g, 0, 1) = w(s)$. Substituting for this offer in (22), it follows that $\Delta^L_{gs} \leq 0$ iff $\overline{w} < \overline{w}_s$, while $\Delta^L_{gf} > 0$ only if $\overline{w} > w(s)$. So this equilibrium exists for any $\overline{w} \in [w(s), \overline{w}_s]$, where $\overline{w}_s$ is defined in (7).

Pooling on Public ($\sigma_{gs} = \sigma_{gf} = 1$). The market's offer is now off the equilibrium path. Applying our equilibrium refinement, $w_{m_2}(g, 1, 1) = w(s)$. Thus, from above, this equilibrium exists for any $\overline{w} \geq \overline{w}_s$. ■

Proof of Lemma 2.

Our aim is to show that it is never optimal to choose the pair $(\overline{w}^{LW}(\gamma), LW)$ over (w_0, TP). Suppose that it is. At the very least (i.e. $\alpha = 1$) we require

$$(1-\sigma_{gf}) \Pr(f) w(f) - \gamma [2 - \Pr(s,s)] \left[w_0 - \overline{w}^{LW}\right] - \Pr(f) \left[\gamma w_0 + (1-\gamma) w(f) - \sigma_{gf} \overline{w}^{LW}\right] \leq 0, \tag{25}$$

or rearranging terms,

$$\begin{aligned}(1-\sigma_{gf})\gamma \Pr(f) [w_0 - w(f)] \quad \geq \quad & \gamma [2 - \Pr(s,s)] \left[\overline{w}^{LW} - w_0\right] \\ & + \Pr(f) \sigma_{gf} \left[\overline{w}^{LW} - (\gamma w_0 + (1-\gamma) w(f))\right].\end{aligned} \tag{26}$$

It follows from the definition of $\overline{w}^{LW}$ in (9) that

$$\gamma \Pr(f) [w_0 - w(f)] = [1 + \Pr(s)\gamma] \left[\overline{w}^{LW} - w_0\right]. \tag{27}$$

Substituting in we have

$$\begin{aligned}\left[(1-\sigma_{gf})(1+\Pr(s)\gamma) - \sigma_{gf} \Pr(f)\gamma\right] \left[\overline{w}^{LW} - w_0\right] - \sigma_{gf} \Pr(f)(1-\gamma) \left[\overline{w}^{LW} - w(f)\right] \\ \geq \gamma [2 - \Pr(s,s)] \left[\overline{w}^{LW} - w_0\right]\end{aligned}$$

or, after some rearrangement,

$$\gamma \Pr(s) \left[\overline{w}^{LW} - w_0\right] \geq \gamma [2 - \Pr(s,s)] \left[\overline{w}^{LW} - w_0\right], \tag{28}$$

which, given $\Pr(s,s) < \Pr(s) < 1$ is clearly impossible for any $\gamma > 0$. ■

Proof of Lemma 3.

Substituting for the relevant period 3 strategies and wage offers, the net benefit to A_{gy_1} from going public in period 2 under policy CW is

$$\Delta^{CW}_{gy_1} = \gamma [\overline{w} - w_{m_2}(g)] + \sum_{y_2} \Pr(y_2 \mid y_1) \left[\begin{array}{c} \max\{\gamma \overline{w} + (1-\gamma) w_{m_3}(g,g), w_{m_3}(g,g)\} - \\ \max\{\gamma \overline{w} + (1-\gamma) w_{m_3}(g,y_2), w_{m_3}(g,y_2)\} \end{array}\right] \tag{29}$$

implying that $\Delta_{gs}^{CW} \leq \Delta_{gf}^{CW}$ for any $\overline{w}$ (with the inequality strict for any $\overline{w} < w(g,s)$). This leaves three possible sub-game equilibria in which at least one type going public.

Semi-separation. The market's wage offers under semi-separating beliefs are: $w_{m_2}(g)$ as given in (24), $w_{m_3}(g,f) = w_{m_3}(g,g) = w(f)$ and

$$\begin{aligned} w_{m_3}(g,s) \quad = \quad & \tfrac{\Pr(s,s)}{\Pr(s,s)+\Pr(f,s)(1-\sigma_{gf})} w(s,s) + \\ & \tfrac{\Pr(f,s)(1-\sigma_{gf})}{\Pr(s,s)+\Pr(f,s)(1-\sigma_{gf})} w(f,s). \end{aligned} \tag{30}$$

Notice that $w(g)$ and $w(g,s)$ are increasing functions of σ_{gf} on $[w_0, w(s)]$ and $[w(s), w(s,s)]$. From (29), P_g therefore hires A_{gy_1} with prob. zero (resp. one) for any $\overline{w} < w_0$ (resp. $\overline{w} > w(s,s)$). For any $\overline{w} \in [w_0, w(s,s)]$ (29) simplifies to $\Delta_{gy_1}^{CW} = \gamma\left[\overline{w} - w(g)\right] + \Pr(s \mid y_1)\gamma\left[\overline{w} - w(g,s)\right]$. For any given $\sigma_{gf}^* \in [0,1]$, we can therefore find a level of public sector pay,

$$\overline{w}_{mix}(\sigma_{gf}^*) = \tfrac{1}{1+\Pr(s|f)} w_{m_2}(g;\sigma_{gf}^*) + \tfrac{\Pr(s|f)}{1+\Pr(s|f)} w(g,s;\sigma_{gf}^*) \tag{31}$$

such that $\Delta_{gf}^{CW} = 0$ iff $\overline{w} = \overline{w}_{mix}\left(\widetilde{\sigma}_{gf}^*\right)$. Defining $\overline{w}_{gf1} \equiv \overline{w}_{mix}(0)$, P_g therefore hires A_{gf} with positive probability iff $\overline{w} > \overline{w}_{gf1}$.

Full-separation. The market now offers $w_{m_2}(g) = w(s)$, $w_{m_3}(g,g) = w(f)$, $w_{m_3}(g,y_2) = w(s,y_2)$. Defining $\overline{w}_{gf2} \equiv \overline{w}_{mix}(1)$, we therefore have $\Delta_{gs}^{CW} < 0$ and $\Delta_{gf}^{CW} > 0$ iff $\overline{w} \in (\overline{w}_{gf1}, \overline{w}_s)$, where $\overline{w}_s$ is given in (7).

Pooling on public. The market now offers $w_{m_2}(g) = w(s)$, $w_{m_3}(g,g) = w_0$ and $w_{m_3}(g,y_2) = w(s,y_2)$. P_g therefore hires A_s iff $\overline{w} \geq \overline{w}_s$.

Proof of Proposition 2.

Step 1. It is not optimal for P_G to choose Alternative 2 for any α for precisely the same reasons set out in the Proof of Proposition 1. For brevity we omit the details. For what follows it is important to note that it is optimal to choose Alternative 3 over 1 for any

$$\alpha \geq \alpha_{13} \equiv 1 + \tfrac{2\Pr(f)w(f)}{[\Pr(f,s)+\Pr(f,s,s)][1+w(f)]}\gamma\left[w_0 - w(f)\right]. \tag{32}$$

Step 2. We now show that it is not optimal to choose the pair $(\overline{w}^{NP}, NP)$ over $(\overline{w}^*, DP)$. Suppose that it is. We require

$$\Pr(f,s)w(f,s) - \gamma\left[2+\Pr(f)\right]\left[\overline{w}^* - \overline{w}^{NP}\right] - \Pr(f,s)\left[\gamma\overline{w}^* + (1-\gamma)w(f,s)\right] \leq 0, \tag{33}$$

or re-arranging terms,

$$\gamma\Pr(f,s)\left[\overline{w}^* - w(f,s)\right] \geq \gamma\left[2+\Pr(f)\right]\left[\overline{w}^{NP} - \overline{w}^*\right]. \tag{34}$$

It follows from the definition of $\overline{w}^*$ in (2) and $\overline{w}^{NP}$ in (12) that

$$\Pr(f,s)\left[\overline{w}^* - w(f,s)\right] = \left[1+\Pr(s,s)\right]\left[\overline{w}^{NP} - \overline{w}^*\right]. \tag{35}$$

Substituting in we have

$$\gamma\left[1+\Pr(s,s)\right]\left[\overline{w}^{NP}-\overline{w}^{*}\right]\geq\gamma\left[2+\Pr(f)\right]\left[\overline{w}^{NP}-\overline{w}^{*}\right], \tag{36}$$

which, given $\Pr(s,s)<1$ is clearly impossible for any $\gamma>0$. This completes Step 2.

Step 3. We now show that it is not optimal for P_G to choose Alternative 4 for any α if $\theta_h>0.752$. Since we need to solve numerically, we gain some clarity by substituting for $\Pr(s)=\frac{1}{2}(\theta_l+\theta_h)=\frac{1}{2}\Rightarrow\Pr(f)=\frac{1}{2}$ in the following expressions. We begin by showing that it is not optimal to choose Alternative 4 for any $\theta_h>0.760$. From Table 3, it is optimal to choose Alternative 4 over Alternative 3 (add A_0 and A_{sf}) only if

$$\begin{aligned}\left[\Pr(s)+\Pr(s,f,s)\right]\alpha\quad&\geq\quad w_0+\Pr(s,f)w(s,f)+2\Pr(f)\gamma\left[w_0-\overline{w}_f\right]\\ \Leftrightarrow\alpha\quad&\geq\quad\alpha_{34}\equiv1+\tfrac{1}{\frac{1}{2}+\Pr(s,f,s)}\gamma\left[w_0-\overline{w}_f\right]\\ \Leftrightarrow\quad&\alpha\geq1+\tfrac{1}{\frac{1}{2}+\Pr(s,f,s)}\tfrac{1}{1+w(f)}\gamma\left[w_0-w(f)\right]\end{aligned} \tag{37}$$

Similarly, from Table 3, it is optimal to choose Alternative 5 over 4 (add A_s) only if

$$\begin{aligned}\Pr(s,s)\alpha\quad&\geq\quad\Pr(s)w(s)+\left[\Pr(f)+1-\Pr(s,s)\right]\gamma\left[\overline{w}^{*}-w_0\right]\\ \Leftrightarrow\quad&\alpha\geq\alpha_{45}\equiv1+\tfrac{1+\Pr(s,f)}{\Pr(s,s)}\gamma\left[\overline{w}^{*}-w_0\right]\\ \Leftrightarrow\quad&\alpha\geq1+\tfrac{1+\Pr(s,f)}{\Pr(s,s)}\tfrac{1}{3}\gamma\left[w_0-w(f)\right].\end{aligned} \tag{38}$$

For it to be optimal to choose Alternative 4, we therefore require (at least) $\alpha_{34}\leq\alpha<\alpha_{45}$. But for any $\theta_h>0.760$ we have $\alpha_{45}<\alpha_{34}$ inducing a contradiction. (Details of this, and subsequent, calculations are available in a supplementary appendix downloadable in pdf or *Mathematica 5* notebook format at www.economics.ox.ac.uk/members/clare.leaver).

We now show that it is optimal to choose Alternative 6 over 5 for any for any $\theta_h>0.724$. From Table 3, it is optimal to choose Alternative 6 over 5 (add A_{ss}) only if

$$\begin{aligned}\Pr(s,s,s)\alpha\quad&\geq\quad\Pr(s,s)w(s,s)+\left[\Pr(f)+1-\Pr(s,s)\right]\gamma\left[\overline{w}^{NW}-\overline{w}^{*}\right]\\ \Leftrightarrow\quad&\alpha\geq\alpha_{56}\equiv1+\tfrac{1+\Pr(s,f)}{\Pr(s,s,s)}\gamma\left[\overline{w}^{NW}-\overline{w}^{*}\right]\\ \Leftrightarrow\quad&\alpha\geq1+\tfrac{1+\Pr(s,f)}{\Pr(s,s,s)}\tfrac{1+\Pr(s,f)}{1+\Pr(s)+\Pr(s,s)}\gamma\left[\overline{w}^{*}-w_0\right].\end{aligned} \tag{39}$$

For it to be optimal to choose Alternative 5 we therefore require (at least) $\alpha_{45}\leq\alpha<\alpha_{56}$. But for any $\theta_h>0.724$ we have $\alpha_{56}<\alpha_{45}$ inducing a contradiction.

Note that it is optimal to switch from Alternative 5 to 6 before (i.e. for a lower value of θ_h) it is optimal to switch from Alternative 4 to 5. To complete the proof we therefore need to show that it is optimal to choose Alternative 6 over 4 for any 0.752. It is optimal to choose Alternative 6 over 4 (add A_s and A_{ss}) only if

$$\begin{aligned}&\left[\Pr(s,s,s)+\Pr(s,s)\right]\alpha\geq\Pr(s)w(s)+\Pr(s,s)w(s,s)+\Pr(s)\gamma\left[\overline{w}^{NW}-w(s)\right]\\ &+\Pr(s,s)\gamma\left[\overline{w}^{NN}-w(s,s)\right]+\left[2-\Pr(s,s)+\Pr(f)\right]\gamma\left[\overline{w}^{NW}-w_0\right]\end{aligned} \tag{40}$$

or, using the fact that the option-value and outside offer effects wash out,

$$\begin{aligned}
[\Pr(s,s,s)+\Pr(s,s)]\,\alpha &\geq \Pr(s,s)+\Pr(s,s,s)+[1+\Pr(s,f)]\,\gamma\left[\overline{w}^{NW}-w_0\right] \qquad (41)\\
&\Leftrightarrow \alpha \geq \alpha_{46} \equiv 1+\tfrac{1+\Pr(s,f)}{\Pr(s,s,s)+\Pr(s,s)}\gamma\left[\overline{w}^{NW}-w_0\right]\\
&\Leftrightarrow \alpha \geq 1+\tfrac{1+\Pr(s,f)}{\Pr(s,s,s)+\Pr(s,s)}\tfrac{3}{1+\Pr(s)+\Pr(s,s)}\left[\overline{w}^{*}-w_0\right]\\
&\Leftrightarrow \alpha \geq 1+\tfrac{1+\Pr(s,f)}{\Pr(s,s,s)+\Pr(s,s)}\tfrac{1}{1+\Pr(s)+\Pr(s,s)}\left[w_0-wf\right].
\end{aligned}$$

For it to be optimal to choose Alternative 4 we therefore require (at least) $\alpha_{34} \leq \alpha < \alpha_{46}$. But for any $\theta_h > 0.752$ we have $\alpha_{46} < \alpha_{34}$ inducing a contradiction. Noting that it is (weakly) optimal to abstain from performance measurement if Alternative 1, 3 or 6 (the only remaining undominated Alternatives) are chosen completes the proof of Proposition 3. A derivation of the optimal PM policy for all values α, θ_h (Figure 5) is provided in Appendix C. ■

Proof of Proposition 3.

The need to publish y_1 in some period follows directly from Lemmas 1-3. Define $\hat{\alpha}_{56}$ such that

$$\hat{\alpha}_{56} = 1+\tfrac{\gamma(\Pr(s,s)[\overline{w}_s-w(s,s)]+[3-\Pr(s,s)][\overline{w}_s-\overline{w}^*]}{\Pr(s,s,s)}.$$

It is straight forward to show that $\hat{\alpha}_{56} > \alpha_{45}$. This implies that for any θ_h, there exists a value of α such that it is optimal to choose Alternative 5. From Step 3 of Proposition 2 it is therefore not optimal to choose Alternative 4 for any α if $\theta_h \geq 0.760$. ■

C Derivation of Figures 5 and 6

Both Figures were plotted using *Mathematica 5*. Figure 5 is comprised of 4 regions.

Region 1 $\theta_h \in [0.5, 0.724]$: a plot of α_{13}, α_{34}, α_{45} and α_{56} (in ascending order)..

Region 2 $\theta_h \in [0.724, 0.752]$: a plot of α_{13}, α_{34} and α_{46}.

Region 3 $\theta_h \in [0.752, 0.877]$: a plot of α_{13} and α_{36}, where
$\alpha_{36} = 1+\frac{\gamma\left(2\Pr(s)\left[\overline{w}^{NN}-w(s)\right]+\left[\overline{w}^{NN}-w_0\right]+2\Pr(f)\left[\overline{w}^{NN}-\overline{w}_f\right]\right)}{2\Pr(s,s)+\Pr(s)}$.

Region 4 $\theta_h \in [0.877, 1]$: a plot of α_{16}, where $\alpha_{16} = 1+\frac{\gamma\left(3\left[\overline{w}^{NN}-w_0\right]+\Pr(f,f)\left[\overline{w}^{NN}-w(f,f)\right]\right)}{3\Pr(s)-\Pr(f,f,s)}$.

Figure 6 is comprised of 2 regions.

Region 1 $\theta_h \in [0.5, 0.760]$: a plot of α_{13}, α_{34}, α_{45} and $\hat{\alpha}_{56}$.

Region 2 $\theta_h \in [0.760, 1]$: a plot of α_{13}, α_{35} and $\hat{\alpha}_{56}$, where
$\alpha_{35} = 1+\frac{\gamma\left(\Pr(s)[\overline{w}^*-w(s)]+[1+\Pr(s,f)][\overline{w}^*-w_0]+2\Pr(f)\left[\overline{w}^*-\overline{w}_f\right]\right)}{\Pr(s,s)+\Pr(s)+\Pr(s,f,s)}$.