Wage Offers and On-the-job Search

Tristan Potter* Dan Bernhardt†

April 1, 2021

Abstract

We study the wage-setting problem of an employer with private information about demand for its product when workers can engage in costly on-the-job search. Employers understand that low wage offers may convey bad news that induces workers to search. The unique perfect sequential equilibrium wage strategy is characterized by: (i) pooling by intermediate-revenue employers on a common wage that just deters search; (ii) discontinuously lower revealing offers by low-revenue employers for whom the benefit of deterring search fails to warrant the required high pooling wage; and (iii) high revealing offers by high-revenue employers seeking to deter aggressive raiders.

JEL Classification: D82, J30, M54
Keywords: Wage offers; on-the-job search; signaling

*Drexel University, tristan.l.potter@drexel.edu (corresponding author)
†University of Illinois, danber@illinois.edu and University of Warwick, M.D.Bernhardt@warwick.ac.uk

1 Introduction

Consider a company that experiences a large negative demand shock for its product. If its production entails the use of an input such as widgets, the company may want to open its books to its widget supplier to reveal this information. Even though opening its books is costly, revealing the bad news to its widget supplier may allow it to negotiate a lower price for its widgets that more than offsets those costs.

Employees are also inputs to production—but workers are not widgets. The key difference is that revealing bad news may give workers incentives to search for new jobs, increasing the risk that the company loses valued employees. That is, a worker who learns that her company is in trouble may initiate costly on-the-job search to try to find a more secure job. If the worker leaves, the company's hardship will be exacerbated. To forestall such search, a company may work to conceal bad news from its workers, understanding that workers may be likely to search and terminate relationships, but that widgets (or widget suppliers) are not.

This paper studies how the wage that an employer offers its workers varies with the employer's information about demand for its product in such scenarios. We consider an employer that privately observes the market conditions underlying the revenues that a worker would generate. When the employer makes its wage offer, it considers the consequences for a worker's actions and the associated probability of retention. In our framework, a worker's motivation to search is driven by a fear that her employer may be facing weak demand, and thus likely to shut down, leaving her unemployed. Because a worker only sees the wage offer and not the underlying market conditions, she uses the information contained in the wage offer to decide whether to engage in costly on-the-job search that improves the likelihood of drawing an outside offer. We identify and exhaustively characterize the unique perfect sequential equilibrium.

A worker's search decision depends on her employer's perceived viability: Bad news portending shutdown increases the value of soliciting outside offers, while good news reduces the value of such effort. An employer's equilibrium wage offer reflects an understanding of such considerations by its workers: In normal times—when expected revenues are neither very low nor very high—the employer chooses a common wage that does not vary with its expected revenues. This common wage is just high enough that it is only justifiable for an employer in reasonable health, just convincing the worker that times are not *so* bad that search is warranted. When times are tougher, setting this common wage to deter search ceases to be justifiable. Instead, an employer expecting low revenues opts for a discontinuously lower wage, understanding that the worker will search for outside offers upon observing the wage. When times are sufficiently good, by contrast, the employer offers more than the common wage to signal the good news and to reduce the risk of losing the worker who, despite not searching, may still be hired away by an aggressive outside firm.

Qualitatively, the keys for this characterization are only that (i) wage offers convey information about market conditions to workers; and (ii) higher wage offers raise the likelihood of retaining a worker. Our results extend to alternative formulations of wage competition between the employer and raiding firms that preserve these features. For example, successful search may result in the worker being able to draw a wage from an exogenous distribution, or an employer may be able to sometimes, but not always, enter a bidding war and make a counter-offer in what becomes a second-price auction. The qualitative implications for wage setting extend beyond search to settings in which workers may take other actions that employers care about, as long as good news encourages the preferred action and employers with good news gain more from this action. For example, our analysis can characterize wage offers when a worker must decide whether to make a human capital investment in the presence of production complementarities between privately-observed demand and the investment.

The informational asymmetry between employers and workers has direct implications for job loss among workers. For employers that set the common wage but expect relatively low revenues, doing so serves to shroud unfavorable information about future viability, distorting their workers' search decisions: Upon observing the common wage, these workers incorrectly infer that their employers are likely in better health than they actually are, and hence do not search. Had the workers known the truth—had there been no informational asymmetry—they would have searched in order to insulate themselves from job loss. The result is avoidable job loss among workers for those employers that end up shuttering their doors. We study the welfare implications of employers' wage-setting decisions, comparing how total expected employer plus employee surplus under incomplete information relative to the complete-information benchmark varies with the employer's market demand and model primitives.

Importantly, the unique equilibrium wage structure emerging from our characterization is consistent with three real-world features of labor markets, each of which we discuss below:

1. Pervasive information asymmetries, as reflected in the existence of advance notice laws;
2. Wage rigidity among job-stayers;

3. Excess kurtosis in earnings growth distributions among job stayers.

The premise that employers have private information about demand, and thus the likelihood of shutdown, is motivated by the Worker Adjustment and Retraining Notification (WARN) laws in the United States. The WARN Act of 1988 requires employers to provide workers with two-months advance notice of anticipated plant closings and mass layoffs.[1] Per the Department of Labor, advance notice is intended to:

> *"...give workers and their families some transition time to adjust to the prospective loss of employment, to seek and obtain other jobs..."*

Such laws represent prima facie evidence of the informational structure and mechanism that we study—that employers have private information about their future viability and, in the absence of legislation mandating disclosure, will choose to withhold such information, thereby exposing their workers to avoidable job loss. Our model delivers a simple expression for the (strictly positive) measure of workers losing their job as a result of these informational asymmetries. That such disclosure laws are costly to employers (Clinebell and Clinebell (1994)) adds empirical weight to this argument. Relatedly, Gortmaker et al. (2019) provide evidence consistent with our model that workers respond asymmetrically to signals of their firms' financial condition in their search decisions. Using anonymized networking activity on LinkedIn, they uncover significant increases in weekly connection formation after announcement of credit-rating downgrades (but not upgrades). Moreover, more senior, more skilled, and less mobile workers have the strongest reactions.

The role of wages in mediating informational asymmetries between workers and firms is furthermore motivated by two empirical regularities pertaining to wage (and earnings) change distributions. First, a large empirical literature documents evidence that wages change relatively infrequently among workers remaining with the same employer (e.g., Akerlof et al. (1996), Altonji and Devereux (2000), Gottschalk (2005)). This literature consistently identifies a mass point in the wage change distribution around zero. Although a quantitative dynamic model of wage setting is beyond the scope of this paper, we embed our static model of wage setting in a stylized dynamic framework and show that it can deliver a plausible degree of wage rigidity.

Separately, our work is motivated by an empirical literature that exploits confidential

[1] WARN laws apply to employers with over 100 employees, excluding those who have worked fewer than six of the last 12 months and those who average fewer than 20 hours of work per week.

administrative data to show that earnings growth distributions exhibit substantial kurtosis (e.g., Guvenen et al. (2020) and Karahan et al. (2020)). Using the stylized dynamic version of our model, we show that incomplete information gives rise to a leptokurtic wage change distribution (i.e., exhibiting excess kurtosis), as observed in the data; in contrast, the complete-information version of the model is platykurtic. Moreover, the source of the excess kurtosis that we document is unique to our characterization of wages, presenting an alternative explanation for this empirical regularity not previously considered by researchers. In particular, the existence of a high pooling wage implies that if and when previously pooling firms actually realize low revenues, they may not value workers enough to justify continuing to pay the high pooling wage to deter on-the-job search, resulting in large, discrete reductions in wages among job stayers. We believe that our paper is the first to propose informational asymmetries as a unified explanation for the wage rigidity and excess kurtosis in wage change distributions.

Theoretically, our model is related to efficiency wage models, especially those with labor turnover motives (e.g., Stiglitz (1985)). A key difference is the form of informational asymmetry: In efficiency-wage models, wage-setting decisions reflect that a worker's action is private information to the worker and thus non-contractible, motivating a role for wages to influence worker behavior. Here, by contrast, wage-setting decisions reflect that *employers* have private information, motivating a role for wages to convey information to workers and affect search decisions. Our model is also related to Weingarden (2017), who studies employment decisions of firms in an asymmetric information setting in which firms seek to induce worker effort.

2 Static model

2.1 Environment and assumptions

We study a one-period game between a risk-neutral worker and employer. The employer sees the market conditions that underlie the revenues a worker would generate and makes a wage offer. The worker only sees the wage offer and not the market conditions. Given the wage offer, the worker decides whether to engage in costly on-the-job search.

At the outset, the employer observes a signal $y \in [\underline{y}, \bar{y}] \equiv Y$ equal to the expected revenues that the worker will generate if she stays and the employer remains viable. We assume that y is drawn from a commonly-known distribution H_I that is twice continuously differentiable with density h_I. This revenue signal also contains information about the employer's future viability: with probability $g(y)$ the employer remains viable, but with probability

$1 - g(y)$ the employer will shut down, lay off the worker and earn zero profits. We assume that $g'(y) > 0$: employers expecting higher revenues are more likely to be viable. After observing y, but prior to the shut-down shock, the employer makes a wage offer $w \geq \underline{w}$ that the worker would receive were she to stay with her employer who remains viable, where $\underline{w} \leq \underline{y}$ is a fixed wage floor.[2] A laid-off worker who fails to find employment elsewhere receives unemployment benefit b, where $\underline{w} > b$, reflecting an assumption that unemployment is costly for workers—we discuss this assumption in greater detail below.

The worker does not see y, but the employer's wage offer w conveys information about y. Given w, the worker decides whether to engage in costly on-the-job search. Search entails a fixed cost $\kappa > 0$, but improves a worker's likelihood of drawing an outside offer: a searching worker encounters a raiding firm with probability $\alpha \in (0, 1]$, while a non-searching worker does so with lower probability $\beta \in (0, \alpha)$. Here, $\beta > 0$ captures the two-sided nature of search—Faberman et al. (2020) find that employed job seekers receive high numbers of both solicited and unsolicited job offers, indicating that outside firms often initiate searches by directly contacting workers at other employers. We assume that the revenues the worker would generate at the raider are drawn independently from a distribution H_P with non-increasing density h_P on $[\underline{y}, \bar{y}]$ that could differ from H_I. The raider observes the employer's wage offer (and whether it survived) before making a take-it-or-leave-it wage offer.[3] We assume that the layoff risk is high enough that a worker would want to search were she to observe the lowest signal $\underline{y}$: $(1 - g(\underline{y}))(\underline{w} - b)(\alpha - \beta) > \kappa$. These assumptions imply a strictly positive employment rent for the worker, i.e., for avoiding unemployment, giving rise to a precautionary motive for search.

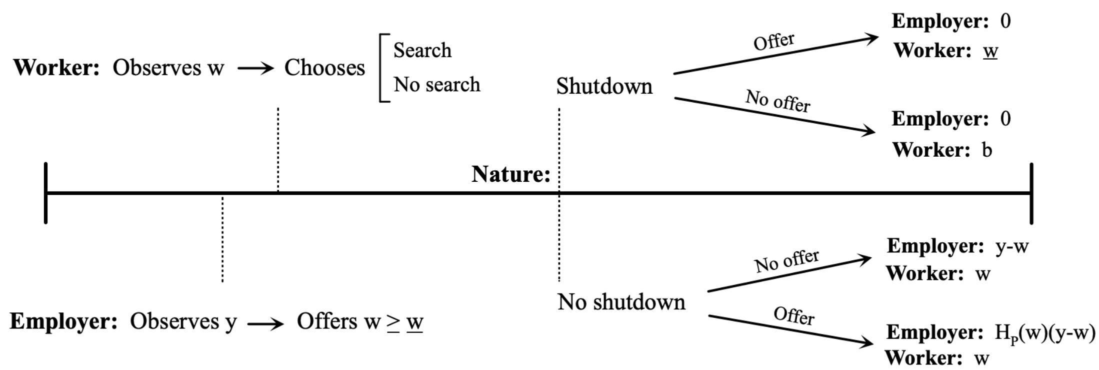
To make the exposition transparent, the model is designed so the sole reason for search is this precautionary motive. To see this, note that if an incumbent employer survives, a worker who receives an outside offer joins the raider if and only if it offers a wage $w' \geq w$. If the employer shuts down, the worker joins the raiding firm if and only if it offers a feasible wage $w' \geq \underline{w}$. Thus, if the incumbent employer survives, a raider with $y' > w$ will hire the worker at wage $w' = w$, while a raiding firm with $y' \leq w$ will either not make an offer, or will offer $w' < w$, and have its offer rejected. If the incumbent shuts down, a raider hires the worker at $w' = \underline{w}$. It eases presentation to assume that $\underline{y} = \underline{w}$.[4] The timing of events

[2] Employers with $y < \underline{w}$ can never earn profits by retaining workers.

[3] We abstract from bargaining and counteroffers solely to simplify the exposition. Appendix C discusses alternative models of wage determination.

[4] $\underline{y} > \underline{w}$ complicates the exposition by introducing a kink in the employer's objective function resulting from the fact that, in our setting, the probability an employer is outbid by a poaching firm equals one for any

Figure 1: Timing of events



described above is depicted in Figure 1.

The model highlights the twin roles played by wage offers: (i) they convey information to workers about the market conditions faced by an employer, and hence the value of search; and (ii) when raiders seek to hire workers, higher wage offers increase the likelihood that an incumbent employer retains a worker.

Discussion of Assumptions. For clarity, we briefly summarize the key assumptions undergirding our analysis and explain their relevance for our results. Other assumptions described above are made simply to ease exposition and are inessential to the analysis.

1. *Wage competition:* In our model, surviving incumbent firms make and commit to wage offers, after which poachers, if encountered, make offers to workers. Our characterization of wage setting extends so long as (i) the expected gain from searching is weakly decreasing in wages, given beliefs; (ii) the benefit of a higher wage is greater for more productive firm types; and (iii) expected profits are single-peaked in w. These conditions are satisfied if, for example, workers draw from a distribution of posted wages,[5] or the incumbent can sometimes (but not always) make a counter-offer.[6] See Section 2.3 and Appendix C for details.

2. *On-the-job search:* We assume that workers make discrete search decisions, deciding

$w < \underline{y}$. None of the analysis is materially changed in this case, but we focus on $\underline{w} = \underline{y}$ to simplify exposition.

[5]This could occur if successful search yields contact with a single raider who either does not observe the employer's offer, or does not know the worker's valuation of her current job because the worker cannot credibly reveal its non-pecuniary value.

[6]Empirically, counter-offers are rare: Faberman et al. (2020) find that only 12% of employed workers who receive an outside offer received counter-offers from their current employers.

either to search or not search. In Appendix D, we show that our characterization of wage-setting extends when workers make continuous search decisions so long as there is a fixed component of search costs and more productive type firms offer higher complete-information wages. The requirement of a fixed component to search costs seems natural (consider, for example, the cost of making and updating a resume or setting up a profile on an online job board) and it finds clear support in the data: The vast majority of employed workers do not actively search for work. It also seems natural that more productive firm types would offer higher complete-information wages.

3. *Costly unemployment ($b < \underline{w}$):* We assume that job loss is sufficiently costly to a worker that its threat would induce some workers to engage in on-the-job search that would reduce the probability of job loss. Together, these assumptions imply the existence of a precautionary motive for search, consistent with the data (see, e.g., Gortmaker et al. (2019)). The threat of job loss also captures the threat of any costs associated with a deterioration in working conditions that would induce search. The formalization $b < \underline{w}$ is a stand-in for features of the economic environment, including psychic costs, human capital deterioration, or search frictions during unemployment, that make unemployment costly for workers.

4. *Costly turnover:* We implicitly assume that worker turnover is costly for firms due to the cost of recruiting and training new workers, the foregone specific skills and institutional knowledge lost, or matching frictions more generally. Rather than explicitly modeling these costs, we simply assume that no production occurs if a worker leaves.

5. *Single-job firm:* We assume that each employer is matched with one worker. This assumption is a simplification reflecting the fact that the relevant scale in our setting is at the plant level or smaller—for example, a plant manufacturing a particular car model (or small set of car models). Larger firms typically make shut-down decisions at the plant level, and, reflecting this, WARN laws are operative at the plant level. At the plant level, there is typically limited meaning to idiosyncratic demand shocks—plants produce relatively few products and their demands are typically very highly correlated. Similarly, retail outlets—restaurants or department stores such as JC Penny or Sears—face correlated shocks in terms of the level of foot traffic at the store location level that determines their profitability (and whether they stay open), even though the set of products that they sell evolves at a higher frequency (and might be approximated by idiosyncratic shocks, leaving the aggregate local demand shock or online competition

shock as the relevant shock). The single job formulation of our model is a stylized way to capture the relevant low-dimensional nature of the private information of the firm (plant, retail outlet, etc.) about its prospects.

6. *Wage contracts*: We assume that firms offer, and commit to, a single wage. We have already argued that allowing firms to sometimes make counter-offers would not fundamentally alter our conclusions. We emphasize here that richer contracting environments would be unlikely to have relevance in our setting. In the first place, search is unobservable, so a firm cannot write contracts that condition on search decisions. Furthermore, limited liability precludes firms from offering compensation conditional on shutting down. Relatedly, while it is possible that a firm could offer a deferred compensation contract which would be forgone if a worker were to leave, and such a contract would plausibly affect a worker's incentive to engage in on-the-job search for a better paying job, it remains the case that limited liability would preclude the firm from being able to credibly deter precautionary search—search intended to prevent costly job loss in the event of a firm shutdown—which is precisely the type of search on which we focus.

The scope of the model is governed by the empirical motivation set out in the Introduction: (i) the fact that firms are better-informed about their prospects than their employees (and hence the existence of advance notice laws to protect workers), (ii) wage rigidity, and (iii) excess kurtosis in wage-change distributions. We focus on the wage-setting decisions of single-worker firms as an embodiment of the fact that WARN laws largely apply at the scale of a plant or retail outlet, which is also the relevant level for asymmetries in information. We formalize our points in a static model, but, as we show, insights extend to a simple dynamic setting designed to illustrate the mechanism's relevance for understanding empirical wage change distributions.

2.2 Complete information benchmark

As a prelude, we characterize equilibrium outcomes when a worker sees y before making search decisions. The employer's strategy is a wage offer function $\bar{\omega}(y)$ that maps each value of y into a wage offer w. A worker's strategy is a function $\bar{\sigma}(w, y)$ mapping each (w, y) pair into a search intensity $\{\alpha, \beta\}$, corresponding to the probability of receiving an outside wage offer. An equilibrium is a pair $\bar{\sigma}^*(w, y)$ and $\bar{\omega}^*(y)$ such that:

1. The worker searches, i.e., $\bar{\sigma}^*(w,y)=\alpha$, if and only if

$$\mathbb{E}\Big[(1-g(y))\Big((1-\alpha)b+\alpha\underline{w}\Big)+g(y)w-\kappa\Big|w,y\Big] > \mathbb{E}\Big[(1-g(y))\Big((1-\beta)b+\beta\underline{w}\Big)+g(y)w\Big|w,y\Big] \tag{1}$$

2. The employer's wage offer $\bar{\omega}^*(y)$ maximizes expected profits given $\bar{\sigma}^*(w,y)$, solving

$$\max_{w\geq\underline{w}}\Big\{g(y)(y-w)[1-\bar{\sigma}^*(w,y)(1-H_P(w))]\Big\}. \tag{2}$$

The definition of equilibrium subsumes the formalization of optimization by a raiding firm and a worker's choice of where to work, detailed above. Focusing first on (1), the first term inside the expectation operator (on both sides of the inequality) represents the probability of the incumbent firm shutting down, $1-g(y)$, multiplied by the expected payoff to the worker in the event of shutdown, which in turn depends on the probability of having found a new job (i.e., the search decision, α or β) and the value of that job ($\underline{w}$) relative to unemployment (b). The second term represents the probability of the incumbent firm surviving, $g(y)$, multiplied by the expected payoff to the worker in the event of survival (w), which is invariant to the search decision, as described above. The benefits of searching in terms of preserving employment in the event of shutdown are balanced against the costs, κ. Next, (2) is just the expected profit of the firm, which is given by flow profits, $y-w$, multiplied by the probability that the firm remains viable and the worker is not poached.[7]

If a worker observes y, she does not need to use her wage w to forecast y, so her search decision only depends on y. Because lower values of y imply higher probabilities of job loss, a worker's search decision is characterized by a cutoff y^*, where the worker searches if and only if $y<y^*$. The optimal cutoff solves (1) at equality: y^* is given by the implicit solution to $g(y^*)=1-\frac{\kappa}{(\alpha-\beta)(\underline{w}-b)}$. We abuse notation slightly and write the worker's strategy as $\bar{\sigma}^*(y)=\alpha$ if $y<y^*$ and $\bar{\sigma}^*(y)=\beta$ if $y\geq y^*$.[8]

An employer's optimization problem is also simple. Expected employer profits are strictly concave in the wage w it offers. Therefore, when y and hence the expected revenue from retaining a worker are very low, an employer offers the lowest feasible wage that will retain a worker who does not receive an outside wage offer. However, when expected revenues

[7] Thus, in the event of a shutdown, or of the worker being poached, the firm earns zero profit. In our parsimonious framework, the latter captures costs associated with worker turnover, including the costs of recruiting and training new workers, or the firm-specific skills and institutional knowledge lost.

[8] To be precise, at y^*, the worker is indifferent betwen searching and not, so search decisions are not pinned down; without loss of generality, we assume that a worker does not search when she observes y^*.

are high enough, an employer offers a higher wage that trades off the reduced profits when the worker is retained against the increased likelihood of retaining a worker who encounters a raider.[9] When interior, the optimal wage offer solves the first-order condition for (2),

$$(y - w)\bar{\sigma}^*(y)h_P(w) = [1 - \bar{\sigma}^*(y)(1 - H_P(w))]. \tag{3}$$

That is, the equilibrium wage offer is given by $\bar{\omega}^*(y) = \underline{w}$ for $y < \hat{y}(\bar{\sigma}^*(y))$, and $\bar{\omega}^*(y) = w(y, \bar{\sigma}^*(y))$ for $y \geq \hat{y}(\bar{\sigma}^*(y))$, where $\hat{y}(\bar{\sigma}^*(y))$ solves

$$(\hat{y} - \underline{w})(1 - \bar{\sigma}^*(\hat{y})) = (\hat{y} - w(\hat{y}, \bar{\sigma}^*(\hat{y})))(1 - \bar{\sigma}^*(\hat{y})(1 - H_P(w(\hat{y}, \bar{\sigma}^*(\hat{y}))))).$$

Inspection of (3) reveals that, fixing $\bar{\sigma}^*(y)$, because an employer with better prospects loses more if its employee leaves, the optimal wage rises with y. So, too, fixing y, the optimal wage rises with $\bar{\sigma}^*(y)$, i.e., with the equilibrium probability that a worker gets an outside offer.

2.3 Incomplete information

We next characterize equilibrium outcomes when workers do not see y prior to deciding whether to search. In this environment, workers make inferences about y, and hence the likelihood of layoff $1 - g(y)$, based on the wage offers they receive.

The employer's strategy is a function $\omega(y)$ mapping each y into a wage offer w. The worker's strategy is a function $\sigma(w)$ mapping each wage offer w into a search intensity $\{\alpha, \beta\}$. A worker belief function is a function mapping each feasible wage offer w into a probability distribution $\mu(y|w)$ over y. We next define a perfect Bayesian equilibrium (PBE):

Definition. *A pure-strategy perfect Bayesian equilibrium (PBE) is a pair of strategies, $\sigma^*(w)$ and $\omega^*(y)$, and a worker belief function $\mu(y|w)$ such that:*

1. *The worker engages in costly search, i.e., $\sigma^*(w) = \alpha$, if*

$$\mathbb{E}_\mu\Big[(1-g(y))\Big((1-\alpha)b+\alpha\underline{w}\Big)+g(y)w-\kappa\Big|w\Big] > \mathbb{E}_\mu\Big[(1-g(y))\Big((1-\beta)b+\beta\underline{w}\Big)+g(y)w\Big|w\Big], \tag{4}$$

   but not if the inequality is reversed.

[9]We assume that $\bar{y} > \hat{y}(\beta)$, i.e., the risk that an employer fails can be sufficiently low relative to the cost κ of search that workers do not search.

2. *The employer's wage offer $\omega^*(y)$ maximizes expected profits given $\sigma^*(w)$, solving*

$$\max_{w \geq \underline{w}} \Big\{ g(y)(y-w)(1-\sigma^*(w)(1-H_P(w)) \Big\}. \quad (5)$$

3. *For all possible equilibrium-path wages (i.e., $\forall w \in \{w | \exists y \in Y \text{ with } \omega^*(y) = w\}$), beliefs $\mu(y|w)$ are updated via Bayes' rule.*

Refining equiibria, we let $\pi(y, w, \sigma)$ denote an employer of type y's profit from wage w given search decision σ. We define a perfect sequential equilibrium (PSE) as follows:

Definition. *A pure-strategy perfect sequential equilibrium (PSE) is any pure-strategy PBE for which beliefs following out-of-equilibrium wage offers satisfy the credibility condition:*

> *For all wage offers not made in equilibrium (i.e., $\forall \tilde{w} \notin \{w | \exists y \in Y \text{ with } \omega^*(y) = w\}$), there does not exist a corresponding set of firm (expected revenue) types $J(\tilde{w})$ such that*

$$\mathbb{E}[\pi(y, \omega^*(y), \sigma^*(\omega^*(y)))] < \min_{\tilde{\sigma} \in BR(J(\tilde{w}), \tilde{w})} \Big\{ \mathbb{E}[\pi(y, \tilde{w}, \tilde{\sigma})] \Big\} \quad \iff \quad y \in J(\tilde{w}). \quad (6)$$

The refinement rules out the possibility of a consistent set of types J that would strictly want to make a posited out-of-equilibrium wage offer given the most pessimistic consistent best response by workers to this set. We focus on pure-strategy PSE, i.e., equilibria that satisfy this credibility condition (see Grossman and Perry (1986)). After characterizing PSE, we describe the properties possessed by all PBE. Appendix A exhaustively characterizes all PBE.

Workers search when the offered wage indicates a sufficiently high probability of job loss. A worker's search decision is again characterized by a cutoff rule, but now the cutoff rule reflects a worker's beliefs about $g(y)$ following the wage offer w: $\sigma^*(w) = \alpha$ if $\mathbb{E}_\mu[g(y)|w] < g(y^*)$, and $\sigma^*(w) = \beta$ if $\mathbb{E}_\mu[g(y)|w] > g(y^*)$.

An employer's optimization problem reflects the dual role played by wage offers: wage offers directly affect the likelihood of retaining a worker *and* they convey information about the market conditions faced by an employer, potentially affecting search decisions. Below, we use $\bar{\omega}^*(y, \sigma)$ to denote the optimal complete-information wage for fixed a search decision σ, and write $\bar{\omega}^{*-1}(w, \sigma) = \max\{y | \bar{\omega}^*(y, \sigma) = w\}$. Proposition 1 establishes that the equilibrium is unique[10] given a restriction to credible beliefs.

[10] More precisely, the set of PSE is unique up to the action choice by the unique indifferent revenue type who either reveals and induces search or pools and deters search.

Proposition 1. *There is a unique PSE wage strategy $\omega^*(\cdot)$. The strategy is characterized by:*

- $\mathcal{W}1$ *The pooling wage w^p solves $\mathbb{E}_\mu[g(y)|w^p] = g(y^*)$ when $\mathbb{E}_\mu[g(y)|\underline{w}] \leq g(y^*)$.*[11] *When interior, the connected set $Y^p \equiv \{y|\omega^*(y) = w^p\}$ of firm types y that offer w^p is bounded from below by the y that solves $\mathbb{E}[\pi(y, w^p, \beta)] = \mathbb{E}[\pi(y, \bar{\omega}^*(y, \alpha), \alpha)]$, and it is bounded from above by $\bar{\omega}^{*-1}(w^p, \beta)$.*[12]

When $\underline{y}$ is sufficiently low and $\bar{y}$ is sufficiently high that the set Y^p is interior, then:

- $\mathcal{W}2$ *Lower types $y < \inf\{Y^p\}$ offer low revealing (complete-information) wages that induce their workers to search.*
- $\mathcal{W}3$ *Type $y = \inf\{Y^p\}$ is indifferent between setting w^p and the discontinuously lower complete-information wage that induces search.*
- $\mathcal{W}4$ *Types $y \in Y^p$ pool on a wage just high enough to deter search: $\mathbb{E}_\mu[g(y)|w^p] = g(y^*)$.*
- $\mathcal{W}5$ *Higher types $y > \max\{Y^p\}$ offer high revealing (complete-information) wages that strictly discourage search.*
- $\mathcal{W}6$ *w^p is the complete-information wage of the highest pooling type.*

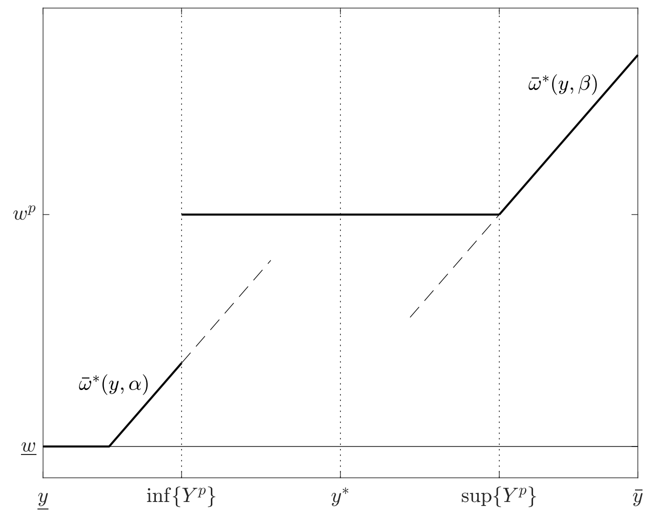
Proof. See Appendix B. □

The informational role of wage offers underlies why employers anticipating intermediate revenues pool on a common wage thereby concealing their private information. Employers receiving higher signals about revenues place greater value on the employment relationship, as they benefit more from retaining employees. As a result, $\omega^*(\cdot)$ weakly increases with an employer's expected revenue. Therefore, higher wage offers signal higher expected revenues, reducing a worker's incentive to search. The set of employers for whom revealing their types would induce search can be partitioned into two groups: a group that chooses to offer their low complete information wages that reveal their types, which causes their workers to search; and a group that chooses to conceal their types by offering higher wages to discourage search. This latter group, which expects relatively high revenues, offers a wage that exceeds what they would offer absent informational asymmetries—in order to emulate a higher firm type whose worker would prefer not to search. Pooling thus emerges in any PSE.

[11] If the minimum wage that a firm can offer, $\underline{w}$, binds on a sufficiently large number of firms that $\mathbb{E}_\mu[g(y)|\underline{w}] > g(y^*)$, then the pooling wage is $\underline{w}$.

[12] Y^p is bounded from below by $\underline{y}$ if $\mathbb{E}[\pi(\underline{y}, w^p, \beta)] \geq \mathbb{E}[\pi(y, \bar{\omega}^*(\underline{y}, \alpha), \alpha)]$, and from above by $\bar{y}$ if $\bar{y} \leq \bar{\omega}^{*-1}(w^p, \beta)$.

Figure 2: Incomplete information (unique PSE)



Notes: Uniform uncertainty with $g(y) = y$.

The structure and uniqueness of the pooling wage offer in $\mathcal{W}1$ reflects the requirement that workers' beliefs be credible. To understand, observe that if employers pool on some wage $w^p > \underline{w}$ for which $\mathbb{E}_\mu[g(y)|w^p] > g(y^*)$, then there is a slightly lower wage, $w^p - \epsilon$, that is preferred to w^p by a coalition including (i) non-pooling types $y < \inf\{Y^p\}$ for whom $w^p - \epsilon$ would rationalize deviating from their low revealing wage in order to deter search, and (ii) pooling types for whom $w^p - \epsilon$ is closer to their complete-information wage, as long as the deviation also deters search. Because this coalition consists only of relatively high types, such deviations must induce workers to believe $\mathbb{E}_\mu[g(y)|w^p - \epsilon] > g(y^*)$, to which their unique best response is not to search. Thus, for any such $w^p > \underline{w}$, there always exists a profitable deviation to $w^p - \epsilon$ when beliefs must be credible.

$\mathcal{W}2$–$\mathcal{W}6$ characterize the equilibrium wage structure $\omega^*(y)$ when the distribution of revenue types has sufficient support. Figure 2 depicts the key qualitative features.

$\mathcal{W}2$ establishes that as long as the prospects for some employers are sufficiently dire, i.e., as long as $\underline{y}$ is sufficiently low, then some employers do not value the employment relationship enough to justify paying the common pooling wage needed to deter search. Such employers understand that lower wage offers will reveal that economic conditions are so bad that workers should search; thus, they do best to offer their optimal complete-information wage. Employers expecting higher revenues value the employment relationship by more—the opportunity cost of losing a worker is higher. $\mathcal{W}3$ establishes that some employer is just indifferent between offering a low wage that reveals low expected revenues and induces search, and offering the discontinuously higher pooling wage that induces beliefs that expected revenues exceed what they in fact are, deterring search.

Employers with better outlooks than this indifferent type thus prefer to offer wages that deter search. $\mathcal{W}4$ establishes that the pooling wage leaves workers just indifferent between searching and not: $\mathbb{E}_\mu[g(y)|w^p] = g(y^*)$. The sufficient support assumption ensures that $w^p > \underline{w}$. Were a higher pooling wage offered such that $\mathbb{E}_\mu[g(y)|w^p] > g(y^*)$, then a coalition of relatively high types would deviate to a wage slightly below w^p, as described above. In response, workers with credible beliefs would forego search knowing that only relatively high types would consider such a deviation, so such wage strategies cannot be part of a PSE.

Employers with even better prospects whose complete-information wages exceed w^p know that such offers will signal high expected revenues and thus also deter search. For such employers, pooling on w^p requires making an uncompetitively low offer (given their high valuations of workers) while conferring no benefits in terms of search behavior. Hence, they offer their complete-information wages. As $\mathcal{W}5$ details, provided $\bar{y}$ is sufficiently high, wages eventually rise smoothly from the pooling wage, reflecting that employers expecting such high revenues want to offer a wage over and above the pooling wage to reduce the risk of losing workers to raiding firms. Finally, $\mathcal{W}6$ establishes that employers who deter search offer the pooling wage if it weakly exceeds the wage they would offer if they could ensure that a worker would not search.

2.4 Implications for existence of advance notice laws

We have argued that our model provides a parsimonious explanation for the existence of advance notice legislation mandating that employers give advance notice to workers ahead of shutting down. The Department of Labor explicitly states that such laws are expressly intended to "give workers and their families some transition time to adjust to the prospective loss of employment, to seek and obtain other jobs." This statement represents an implicit acknowledgement that lawmakers are concerned that employers (i) have private information about their viability that is not available to workers, and (ii) may not disclose this information, resulting in avoidable job loss and unemployment. The WARN Act of 1988 introduced such laws at a federal level in the United States, requiring employers with over 100 employees who have worked for at least six of the past 12 months for at least 20 hours per week to provide two-months notice of anticipated plant closings and mass layoffs. Similar laws exist in several states, and many other countries.

Our model rationalizes the existence of such legislation by showing that job loss and unemployment necessarily result when firms have private information about their viability. Specifically, the characterization of wages that arises from the informational asymmetry in our model induces search decisions that have implications for employment outcomes. Employers offering the pooling wage for whom expected revenues are relatively low deter search by workers who would have searched in the absence of informational asymmetries. Because search increases the likelihood of obtaining outside offers, such workers fail to effectively insulate themselves from job loss. Formally, the model implies that measure

$$(\alpha - \beta) \int_{\inf\{Y^p(w^p)\}}^{y^*} h_I(y)(1 - g(y))dy > 0 \tag{7}$$

of workers become unemployed due to the informational asymmetry. This is precisely the subset of workers that advance notice laws exist to protect.

3 Dynamic model

The equilibrium structure of wages arising in our static model of wage-setting can shed light on several well-documented dynamic features of labor markets. First, a large empirical literature has documented that job stayers' nominal wages change infrequently, with wage change distributions exhibiting a near-universal mass point at zero (see, e.g., Akerlof et al. (1996), Altonji and Devereux (2000), Gottschalk (2005), and many others). Second, a more recent empirical literature (e.g., Guvenen et al. (2020) and Karahan et al. (2020)) exploits confidential employer-employee matched administrative panel data on earnings to establish that earnings growth distributions among job stayers exhibit a substantial degree of excess kurtosis.[13] To illustrate its qualitative relevance for these features of the data we now embed our static model in a simple dynamic framework.

3.1 Environment

Consider a simple steady-state economy in which time is discrete and runs forever. The economy is populated by a unit measure of infinitely-lived workers who are either employed or unemployed. Firms in the economy can employ at most one worker and are either matched

[13] This literature also finds that earnings growth distributions are negatively skewed, although this appears to be driven by job changers, not job stayers.

or vacant. Within each period, the timing of events is as depicted in Figure 1: At the start of each period, previously-matched and previously-vacant firms draw revenue signals y from a common distribution H and choose wage offers w. A realization of y governs expected revenues from production and the probability of surviving until the end of the period $g(y)$. Measure $1-\mathbb{E}[g(y)]$ of firms therefore shut down each period and are replaced by new entrants such that the measure of firms in the economy remains constant over time. For simplicity, we assume that $y \sim U[\underline{y}, \bar{y}]$ and is i.i.d. over time and across firms, and that $g(y)$ is linear.

A worker is unemployed in a period if her firm shuts down and she fails to receive an outside offer via on-the-job search. Unemployment lasts one period, after which an unemployed worker is frictionlessly matched with a firm. A firm is vacant in a period if it survives but its worker is poached by a new entrant. Vacancies likewise last one period, after which a vacant firm is frictionlessly matched with an unemployed worker.[14] This simple approach to modeling search frictions—according to which unemployment and vacancies both last for one period after which vacant firms are frictionlessly matched with unemployed workers—lets us embed our static model of wage-setting in an optimizing dynamic framework without significantly altering the underlying analysis.

Let $\delta \in (0,1)$ denote the discount factor. The value of searching and not searching, respectively, are now given by

$$V^s(w,y) = \mathbb{E}\Big[(1-g(y))\Big((1-\alpha)b + \alpha \underline{w}\Big) + g(y)w - \kappa + \delta \max\{V^s(w',y'), V^{ns}(w',y')\}|w,y\Big] \tag{8}$$

$$V^{ns}(w,y) = \mathbb{E}\Big[(1-g(y))\Big((1-\beta)b + \beta \underline{w}\Big) + g(y)w + \delta \max\{V^s(w',y'), V^{ns}(w',y')\}|w,y\Big]. \tag{9}$$

Equations (8) and (9) imply that a worker's optimal search decision $\bar{\sigma}^*(w,y)$ is the same as in the static model. The value function for a firm with expected revenue y is now given by

$$\begin{aligned} V(y) &= \max_{w \geq \underline{w}} \Big\{ g(y) \Big[[1-\bar{\sigma}^*(w,y)(1-H(w))](y - w + \delta \mathbb{E}[V(y')]) + \bar{\sigma}^*(w,y)(1-H(w))\delta \mathbb{E}[V(y')] \Big] \Big\} \\ &= \max_{w \geq \underline{w}} \Big\{ g(y) \Big[[1-\bar{\sigma}^*(w,y)(1-H(w))](y-w) + \delta \mathbb{E}[V(y')] \Big] \Big\}. \end{aligned} \tag{10}$$

Equation (10) implies that the optimal complete-information wage $\bar{\omega}^*(y,\sigma)$ is the same as in the static model.

[14] We therefore assume that previously-vacant firms match with unemployed workers as opposed to poaching employed workers and that poachers do not face shut-down shocks in the period of entry. These assumptions facilitate exposition but are inessential.

The analysis of the complete-information benchmark implies that our characterization of the unique PSE in the incomplete-information static model (Proposition 1) is likewise unchanged in our simple dynamic setting. To see this, note that the firm's wage offer in the static incomplete-information environment is characterized by three requirements: (i) the pooling wage must leave workers indifferent between searching and not searching, i.e., $\mathbb{E}_\mu[g(y)|w^p] = g(y^*)$, which is unaffected by dynamics because the complete-information search cutoff is unaffected by dynamics; (ii) revealing firms choose the corresponding complete-information wage $\bar{\omega}^*(y, \sigma)$, which is unaffected by dynamics; and (iii) an equal-profit condition defining the lower bound of the pooling region, i.e., $\mathbb{E}[\pi(y, w^p, \beta)] = \mathbb{E}[\pi(y, \bar{\omega}^*(y, \alpha), \alpha)]$, which must now be replaced by a requirement that the present-discounted value of profits from pooling and offering a low revealing wage are equalized. This final requirement implies the same lower-bound for pooling as in the static model because the continuation values in (10) are independent of the wage offer and induced search decisions.

3.2 Implications for wage change distributions

To draw out the model's implications for wage rigidity and excess kurtosis among job stayers, we perform a simple back-of-envelope calibration of the incomplete-information model to match data from Faberman et al. (2020), simulate the calibrated model, and then compute the statistics of interest in a manner consistent with the empirical literature.

We set the period length to one year corresponding to the frequency of observations in most studies on earnings growth and wage rigidity. We choose the probabilities of an employed worker receiving an outside offer conditional on search (α) and no search (β) to match the (annualized) probabilities that an employed worker receives at least one (possibly unrealized) offer from Table 5 of Faberman et al. (2020), implying $\alpha = 0.99$ and $\beta = 0.71$. We choose the fixed cost of search (κ) to match the fraction of employed workers who actively search for work in Table 2 of Faberman et al. (2020), implying $\kappa = 0.09$. We normalize the lower bound of the revenue distribution to $\underline{y} = 1$ and choose the upper bound to match the standard deviation of log offered wages of 0.24, again following Faberman et al. (2020) who use the value estimated in Hall and Mueller (2018), yielding $\bar{y} = 6.85$. Finally, because we assume that $g(y)$ is linear, we fix $g(\underline{y}) = 0$ and choose $g(\bar{y})$ to match the empirical ratio of vacancies to unemployment (between 2001 and present) of 0.56, implying $g(\bar{y}) = 0.35$.

We simulate the complete- and incomplete-information models for 100,000 workers for 100 years. We then compute one-year, within-worker wage growth rates, trimming observations around job loss and job-to-job transitions consistent with the definition of job stayers in Guvenen et al. (2020). Table 1 reports the standard deviation of log wage offers, the fraction of zero wage growth observations (as a measure of wage rigidity), and the fourth centralized moment (kurtosis) of the wage growth distribution.

Table 1: Simulated moments

Information Structure	Std. Dev. $\sigma(\ln(w_{i,t}))$	Wage rigidity $Pr\big(\Delta \ln(w_{i,t}) = 0\big)$	Kurtosis $\kappa(\Delta \ln(w_{i,t}))$
Complete Information (benchmark)	0.24	0%	2.64
Incomplete Information	0.24	34%	5.26

Moments based on 100,000 independent 100-period simulations. The sample is restricted to job stayers, defined as individuals who have been at the same firm for at least one period prior to the base year of the growth rate calculation. Standard deviation and kurtosis correspond to the second and fourth centralized sample moments, the latter defined as $\kappa(x_i) = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x}_n)^4}{\left(\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x}_n)^2\right)^2}$.

The first column of Table 1 reports the standard deviation of the log wage offer distribution, which is calibrated to match the value of 0.24 in both cases to facilitate comparability across models. The second column reports a simple measure of wage rigidity: the fraction of observations for which there is exactly zero wage growth. The value of 34% in the incomplete-information model is consistent with the spike at zero that is commonly observed in nominal wage change distributions in the data. Of course, there are no such observations in the complete-information model. Despite the model's simplicity, the fraction of zero wage changes in the incomplete-information environment is well within the range found in the empirical literature, and happens to exactly equal the value for private-sector workers reported in Table 2 of Akerlof et al. (1996).

The third column reports the sample kurtosis from both models. Roughly speaking, a high degree of kurtosis indicates that a relatively large fraction of observations are either very close to zero or very large, with relatively few in between. Table 1 indicates that the model with complete information is slightly platykurtic, exhibiting less kurtosis than that of a Normal distribution (which has kurtosis of 3). By contrast, the model with incomplete information is markedly leptokurtic—its kurtosis is nearly double that of the model with complete information and well above that of a Normal distribution. The excess kurtosis generated by the incomplete information model is qualitatively consistent with the findings of Guvenen et al. (2020) and Karahan et al. (2020), who find a significant degree of excess kurtosis in earnings growth distributions among job stayers. Researchers have attempted to explain this excess kurtosis in earnings growth distributions among job stayers as resulting from episodes of unemployment followed by recall by the previous employer.[15] Our model offers an alternative explanation: When workers are uninformed about their employer's profitability, firms pool on relatively high wages to deter search. In a dynamic setting, in addition to generating a mass point at zero wage change as discussed above, pooling on a high wage implies that when firms periodically realize low revenues, they do not value workers enough to justify continuing to pay the high pooling wage, resulting in a large discrete drop in wages. Graphically, this is seen in the discontinuity in the wage distribution in Figure 2. This effect accounts for a majority of the excess kurtosis in the incomplete-information model in Table 1.

4 Extensions

4.1 Alternative models of wage competition

The qualitative properties of the equilibrium extend when competition between incumbent and raider is enriched to capture additional real world features of labor markets. For example, they extend when successful search yields a draw with positive probability from some non-trivial wage offer distribution. Such a scenario would arise when successful search yields contact with a single raider who either does not observe the employer's offer, or who does not know the worker's valuation of her current job because the worker cannot credibly reveal its non-pecuniary value. Even when an incumbent can sometimes make a counter-offer and thus compete with potential raiders in the auction, the incentive to set a wage above that required to deter search in order to preemptively outbid outside offers is reduced but the underlying logic is unchanged. We establish this formally in Appendix C.

Such scenarios increase workers' incentives to search given any wage and belief about her employer due to the added benefit of increasing the probability of securing a higher outside offer. An employer's wage offer now affects search decisions via two distinct channels: the information channel emphasized in our model (through which a higher wage signals better news, reducing search incentives), and a direct channel via its level (through which higher offers reduce the likelihood of dominating outside offers, likewise reducing search incentives). Because employers expecting higher revenues lose more when workers leave, such considerations raise their incentives to deter search.[16]

[15] See Karahan et al. (2020) and Hubmer (2018).

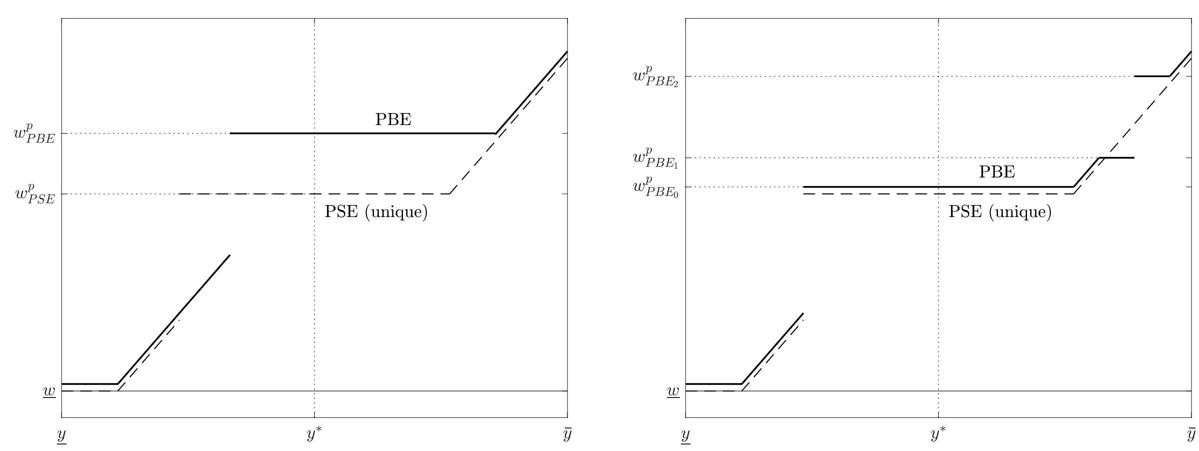
[16] A similar rationale emerges in the preemptive-wage setting of Scoones and Bernhardt (1998).

Because both wage channels affect search in the same direction, incorporating such additional features would result in higher equilibrium pooling wages, but would not otherwise alter the model's qualitative properties. Indeed, adding these two assumptions, one can drop the precautionary motive for search and assume that $g(y) = 1$ for all y.

4.2 Perfect Bayesian equilibria

When beliefs are not required to be credible following unexpected wage offers, multiple equilibria emerge. Nonetheless, Appendix A shows that *all* PBE possess many properties of the unique PSE: (a) wage offers weakly increase with y, reflecting that the opportunity cost of losing workers rises with y; (b) employers expecting low revenues offer low wages—equal to those made when demand is public information—thereby revealing bad news and inducing search, reflecting that the employment relationship is not sufficiently valuable to justify the higher wage needed to deter search; (c) employers expecting intermediate revenues pool on the lowest wage that deters search, as higher search-deterring wages would entail over-bidding with no countervailing benefit in terms of search behavior; and (d) employers expecting high revenues who reveal their types (except possibly $\bar{y}$) offer wages arbitrarily close to their complete-information optima—wages that diverge non-trivially would induce emulation by similar types who would gain from offering wages closer to their complete-information optimum (so the offer would not be revealing).

Figure 3: Incomplete information (multiple PBE)



(a) High pooling wage (b) Multiple pooling wages

Notes: Uniform uncertainty with $g(y) = y$.

The multiplicity of PBE reflects two possibilities that are sustained only by incredible beliefs. One possibility, depicted in Figure 3(a), is equilibria with pooling on wages above the pooling wage in Proposition 1. Such equilibria result if pooling on otherwise preferred lower wages would induce pessimistic worker beliefs and hence search. If workers can adopt such pessimistic beliefs, pooling on the higher wage is sustained. But such pessimism is not credible following small deviations from a high pooling wage: Only employers expecting high revenue value the employment relationship enough to offer such wages. The second possibility, depicted in Figure 3(b), is equilibria featuring multiple pooling regions at higher wages. Such equilibria are sustained by a similar argument applied to employers expecting higher revenue: Workers observing high off-path wages can adopt an incredible degree of pessimism to credibly threaten to search, rendering deviations away from high pooling wages unprofitable for high types. The result is a proliferation of PBE, each featuring (possibly many) connected segments of high-revenue type employers pooling on high wages that may be above or below the wages they would optimally choose conditional on deterring search.

4.3 Welfare

We next investigate the welfare implications of the wage-setting behavior of employers and the search decisions of workers. In our setting, the relevant welfare considerations are from the perspective of the contracting parties—the worker and incumbent firm. Therefore, we measure welfare as the expected total surplus accruing to the employer and worker—i.e., the employer's expected profits plus the worker's expected compensation—and study how the welfare differences between the signaling (i.e., from informational incompleteness) and complete-information benchmarks vary with y. Profits earned by the poacher are excluded because they are not part of the strategic game between the worker and the incumbent firm. Because the complete- and incomplete-information wage offers only differ in the pooling region, we can restrict attention to $y \in Y^p$ (elsewhere the welfare difference is zero). Formally, our welfare metrics for the complete- and incomplete-information scenarios, respectively, are

$$W^{CI}(y) = \begin{cases} \mathbb{E}[\pi(y, \bar{\omega}^*(y), \alpha)] + g(y)\bar{\omega}^*(y) + (1-g(y))\left[\alpha \underline{w} + (1-\alpha)b\right] - \kappa & y < y^* \\ \mathbb{E}[\pi(y, \bar{\omega}^*(y), \beta)] + g(y)\bar{\omega}^*(y) + (1-g(y))\left[\beta \underline{w} + (1-\beta)b\right] & y > y^* \end{cases} \tag{11}$$

$$W^{II}(y) = \mathbb{E}[\pi(y, w^p, \beta)] + g(y)w^p + (1-g(y))\left[\beta \underline{w} + (1-\beta)b\right]. \tag{12}$$

Three principal externalities govern the welfare gain (or loss) associated with signaling. First, the employer does not internalize the wage gain that a worker receives when it offers a higher wage and remains viable but the worker is, nonetheless, poached away. Second, the employer does not internalize the negative effect of its wage offer, and the induced search decision, on the likelihood of costly unemployment in the event of a shutdown: The measure $(\alpha - \beta)\Big[H_I(y^*) - H_I(\inf\{Y^p(w^p)\})\Big] > 0$ of workers who choose not to search in the incomplete-information environment, but who otherwise would have searched, face an increased risk of unemployment, and thus lost income, if the incumbent fails to remain viable. Third, workers do not internalize the profit losses incurred by employers when they quit.

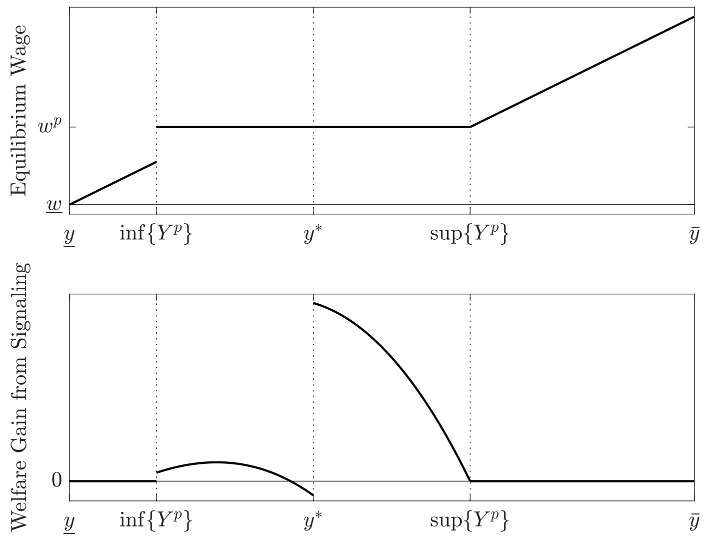
The net effect of these three forces, and thus the welfare effect of incomplete information, depends on the level of demand y. For very low and very high types ($y < \inf\{Y^p\}$ and $y > \sup\{Y^p\}$), the optimal wage strategy under incomplete information coincides with the complete-information wage, so there is no welfare difference. For moderately high types ($y \in (y^*, \sup\{Y^p\})$), workers prefer not to search regardless of the information structure. It follows that the second and third externalities discussed above—in particular, those associated with distorted search decisions—disappear. The only remaining externality is the first, associated with the worker attracting better outside offers when its current employer offers a higher wage. Because such employers cannot set a lower wage without inducing the worker to search when information is incomplete, the relatively high pooling wage just represents a redistribution from employer to worker in the event that there is no separation, and hence nets out in terms of total surplus; but the worker gains when she is poached, so total welfare necessarily rises in expectation. For moderately low types ($y \in (\inf\{Y^p\}, y^*)$), by contrast, the high pooling wage associated with informational incompleteness deters workers from searching when they otherwise would have preferred to search. Thus, in such cases, all three externalities are operative and the net effect on welfare is ambiguous.

The top panel of Figure 4 depicts the unique PSE wage strategy associated with uniformly-distributed demand (H_P,$H_I \sim U[0, 1]$) and a survival probability that is linear in demand ($g(y) = y$). The bottom panel depicts the associated welfare gain from signaling, reflecting the preceding intuition: Welfare is unaffected at the extremes, unambiguously higher when information is incomplete for moderately high types, and potentially higher or lower, depending on which of the externalities dominates, for moderately low types.

5 Conclusion

The observation at the heart of this paper—that when employers have private information, wage offers convey news that affects workers' decisions—is germane to many settings. So long as workers are inclined to take the action preferred by their employers—be it abstaining

Figure 4: Welfare



Notes: Uniform uncertainty with $g(y) = y$.

from on-the-job search, investing in firm-specific human capital, exerting extra effort, etc.—when they believe their employer is in good health, and so long as that action is more valuable to employers in better health, the qualitative structure of wage offers should obtain. In particular, equilibrium wages are characterized by: pooling by intermediate employer types on a common wage that just encourages the worker to take the desired action; discretely lower revealing offers by low-revenue employers for whom the value of the desired action does not warrant the higher pooling wage needed to induce the action; and high revealing offers by high-revenue employers for whom workers would happily take the desired action, so that other considerations dictate wage offers. Such generality suggests that the mechanism we identify has wide-ranging empirical relevance for wage-setting that merits further investigation.

6 Bibliography

Akerlof, George, William Dickens and George Perry (1996). "The Macroeconomics of Low Inflation". *Brookings Papers on Economic Activity* No. 1.

Altonji, Joseph and Paul Devereux (2000). "The Extent and Consequences of Downward Nominal Wage Rigidity". *Research in Labor Economics* Vol. 19.

Bernhardt, Dan and David Scoones (1998). "Promotion, Turnover, and Discretionary Human Capital Acquisition". *Journal of Labor Economics* Vol. 16, No. 1.

Clinebell, Sharon and John Clinebell (1994). "The Effect of Advance Notice of Plant Closings on Firm Value". *Journal of Management* Vol. 20, Issue 3.

Faberman, Jason, Andreas Mueller, Aysegul Sahin and Giorgio Topa (2020). "Job Search Behavior among the Employed and Non-Employed". NBER Working Paper.

Gortmaker, Jeff, Jessica Jeffers and Michael Lee (2019). "Labor Reactions to Financial Distress: Evidence from LinkedIn Activity". Working paper.

Gottschalk, Peter (2005). "Downward Nominal-Wage Flexibility: Real or Measurement Error?". *Review of Economics and Statistics* Vol. 87, Issue 3.

Grossman, Sanford and Motty Perry (1986). "Perfect Sequential Equilibrium". *Journal of Economic Theory* Vol. 39, Issue 1.

Guvenen, Fatih, Fatih Karahan, Serdar Ozkan and Jae Song (2020). "What Do Data on Millions of U.S. Workers Reveal about Life-Cycle Earnings Dynamics?" Working Paper.

Hall, Robert and Andreas Mueller (2018). "Wage Dispersion and Search Behavior: The Importance of Nonwage Job Values". *Journal of Political Economy* Vol. 126, No. 4.

Hubmer (2018). "The job ladder and its implications for earnings risk". *Review of Economic Dynamics* Vol. 29.

Karahan, Fatih, Serdar Ozkan and Jae Song (2020). "Anatomy of Lifetime Earnings Inequality: Heterogeneity in Job Ladder Risk vs. Human Capital." Working Paper.

Mortensen, Dale and Kenneth Burdett (1998). "Wage Differentials, Employer Size, and Unemployment". *International Economic Review* Vol. 39.

Stiglitz, Joseph (1985). "Equilibrium Wage Distributions". *The Economic Journal* Vol. 95, No. 379.

Weingarden, Alison (2017). "Employment Dynamics in a Signaling Model with Workers' Incentives". *Finance and Economics Discussion Series, Board of Governors of the Federal Reserve System* 2017-040

Appendix

To conserve notation, let $r(w, \sigma) \equiv 1-\sigma(1-H_P(w))$ denote the probability that the employer retains a worker given w and σ. Slightly abusing notation, let $\bar{\omega}^*(y, \alpha)$ and $\bar{\omega}^*(y, \beta)$ denote the complete-information optimal wage offers given search and no-search, respectively. Finally, let $Y^s \equiv \{y|\sigma^*(\omega^*(y)) = \alpha\}$ and $Y^{ns} \equiv \{y|\sigma^*(\omega^*(y)) = \beta\}$ denote the set of y for which the employer's wage offer induces search and no-search, respectively.

A Characterization of PBE

Propositions 2 and 3 characterize the set of pure-strategy PBE wage strategies.

Proposition 2. *The equilibrium wage strategy $\omega^*(\cdot)$ has the following properties:*

W1 Wage offers are weakly increasing in revenues: If $y < y'$, then $\omega^*(y) \leq \omega^*(y')$.

W2 If a wage offer induces a worker to search, then it equals the complete information wage: If $y \in Y^s$, then $\omega^*(y) = \bar{\omega}^*(y)$.

W3 Only low revenue employers make wage offers that induce workers to search: If $y \in Y^s$ and $y' \in Y^{ns}$, then $y' > y$.

W4 Employers expecting sufficiently high revenues make wage offers that discourage search: Y^{ns} is non-empty.

W5 Employer profits, $\mathbb{E}[\pi(y, \omega^*(y), \sigma^*(\omega^*(y)))]$, are continuous in y.

Proposition 3. *Equilibrium wage offers that deter search have the following properties:*

W6 The set of revenue types that offer a pooling wage that deters search is connected: If $y < y' \in Y^{ns}$ and $\omega^*(y') = \omega^*(y)$, then $\omega^*(y'') = \omega^*(y)$, $\forall\ y'' \in (y, y')$.

W7 If $\omega^*(y)$ discourages search and is not part of a pooling wage offer, i.e., if $\nexists\ y'$ such that $\omega^*(y') = \omega^*(y)$, then either it is arbitrarily close to the complete information wage, i.e., for all $\epsilon > 0$, $|\omega^*(y) - \bar{\omega}^*(y)| < \epsilon$, or the employer is the highest revenue type $\bar{y}$.

W8 If Y^s and Y^{ns} are non-empty, then wages jump at the highest y for which the worker searches: $\omega^*(y)$ is discontinuous upward at $\sup\{Y^s\}$.

W9 There is pooling at the lowest wage that deters search: $\exists y' > \inf\{Y^{ns}\}$ *such that* $\forall y \in (\inf\{Y^{ns}\}, y')$, $\omega^*(y) = w^p$. *Furthermore,* $y' \geq \min\{\bar{y}, \sup\{y|\bar{\omega}^*(y,\beta) = w^p\}\}$.

W10 If $\mathbb{E}[g(y)] < g(y^*)$, *then* Y^s *is non-empty.*

Proof. We consider Propositions 2 and 3 together.

W1 If $y < y'$, *then* $\omega^*(y) \leq \omega^*(y')$.

If the search decision is the same after $\omega^*(y)$ as $\omega^*(y')$ then it follows immediately that $\omega^*(y) \leq \omega^*(y')$ because for a given probability σ of an outside offer, $\frac{\partial^2 \mathbb{E}[\pi(y,w,\sigma)]/g(y)}{\partial y \partial w} = \sigma h_P(w) > 0$, for $w > \underline{y}$. Moreover, the optimal complete information wage increases in the probability that the worker gets an outside offer, precluding $\omega^*(y) > \omega^*(y')$ for $y \in Y^{ns}$, $y' \in Y^s$. It remains to rule out $w \equiv \omega^*(y) > \omega^*(y') \equiv w'$ for $y \in Y^s$, $y' \in Y^{ns}$. This is immediate if $r(w,\alpha) \leq r(w',\beta)$. Suppose $r(w,\alpha) > r(w',\beta)$. Optimization by y requires

$$\begin{aligned}
&\mathbb{E}[\pi(y,w,\alpha)] \geq \mathbb{E}[\pi(y,w',\beta)] \\
\implies &y[r(w,\alpha) - r(w',\beta)] \geq wr(w,\alpha) - w'r(w',\beta) \\
\implies &y'[r(w,\alpha) - r(w',\beta)] > wr(w,\alpha) - w'r(w',\beta) \\
\implies &\mathbb{E}[\pi(y',w,\alpha)] > \mathbb{E}[\pi(y',w',\beta)]
\end{aligned}$$

contradicting optimization by y' types.

W2 If $y \in Y^s$, *then* $\omega^*(y) = \bar{\omega}^*(y)$.

Immediate. For any $w \neq \bar{\omega}^*(y)$, we have $\mathbb{E}[\pi(y,w,\alpha)] < \mathbb{E}[\pi(y,\bar{\omega}^*(y),\alpha)] < \mathbb{E}[\pi(y,\bar{\omega}^*(y),\beta)]$. The first inequality follows from optimality of $\bar{\omega}^*(y)$ given search and the second from the fact that deterring search raises profits for a given wage. Thus, y types prefer $\bar{\omega}^*(y)$ to w.

W3 If $y \in Y^s$ *and* $y' \in Y^{ns}$, *then* $y' > y$.

Suppose $y' < y$. By W1, $\omega^*(y') \leq \omega^*(y)$. Because $y' \in Y^{ns}$ and $y \in Y^s$, it must be that $\omega^*(y') < \omega^*(y)$. But then, because $\sigma^*(\omega^*(y')) = \beta$ by assumption, if search decisions are monotonically decreasing in w, it must also be that $\sigma^*(\omega^*(y)) = \beta$, a contradiction. To see that search decisions are monotonically decreasing in w, note that in the model in the text, wages only affect search through beliefs. Thus, because W1 together with Bayes' rule imply that $\mathbb{E}_\mu[g(y)|w]$ is increasing in w, it must be that search is decreasing in w.[17]

[17] More generally, if we wish to consider an alternative model of poaching, for the claim to hold it is sufficient to show that the expected gain from searching is weakly decreasing in w given beliefs about $g(y)$.

W4 Y^{ns} is non-empty.

If Y^{ns} is empty, then $\omega^*(y) = \bar{\omega}^*(y)$ for all y and wage offers are revealing. But then when offered $\bar{\omega}^*(\bar{y})$, beliefs are such that $\mathbb{E}_\mu[g(y)|\bar{\omega}^*(\bar{y})] = g(\bar{y}) > g(y^*)$, so a worker prefers to not search.

W5 $\mathbb{E}[\pi(y, \omega^*(y), \sigma^*(\omega^*(y)))]$ is continuous in y.

Suppose $\mathbb{E}[\pi(y, \omega^*(y), \sigma^*(\omega^*(y)))]$ is discontinuous at $y_0 \in Y$. Then $\exists \epsilon > 0$ such that for any $\delta > 0$, $\exists y'$ with $|y' - y_0| < \delta$ but $|\mathbb{E}[\pi(y', \omega^*(y'), \sigma^*(\omega^*(y')))] - \mathbb{E}[\pi(y_0, \omega^*(y_0), \sigma^*(\omega^*(y_0)))]| > \epsilon$. Continuity of $\mathbb{E}[\pi(y, \tilde{w}, \sigma^*(\tilde{w}))]$ for fixed $\tilde{w}$ implies that $\forall \epsilon' > 0$, $\exists \delta' > 0$ such that if $|y - y_0| < \delta'$, then $|\mathbb{E}[\pi(y, \tilde{w}, \sigma^*(\tilde{w}))] - \mathbb{E}[\pi(y_0, \tilde{w}, \sigma^*(\tilde{w}))]| < \epsilon'$. Set $\epsilon' = \epsilon$ and $\delta = \delta'$ and let $w' \equiv \omega^*(y')$ and $w_0 \equiv \omega^*(y_0)$. Then y' satisfies the preceding and

$$|\mathbb{E}[\pi(y', \tilde{w}, \sigma^*(\tilde{w}))] - \mathbb{E}[\pi(y_0, \tilde{w}, \sigma^*(\tilde{w}))]| < \epsilon < |\mathbb{E}[\pi(y', w', \sigma^*(w')] - \mathbb{E}[\pi(y_0, w_0, \sigma^*(w_0))]|.$$

If $y' > y_0$, then setting $\tilde{w} = w'$ implies $\mathbb{E}[\pi(y_0, w_0, \sigma^*(w_0))] < \mathbb{E}[\pi(y_0, w', \sigma^*(w'))]$, so w_0 is not optimal for y_0 (since $\mathbb{E}[\pi(y, \omega^*(y), \sigma^*(\omega^*(y)))]$ increases in y). If $y' < y_0$, then setting $\tilde{w} = w_0$ implies $\mathbb{E}[\pi(y', w_0, \sigma^*(w_0))] > \mathbb{E}[\pi(y', w', \sigma^*(w'))]$, so w' is not optimal for y'.

W6 Let y, $y' \in Y^{ns}$. If $y < y'$ and $\omega^*(y') = \omega^*(y)$, then $\omega^*(y'') = \omega^*(y)$, $\forall y'' \in (y, y')$.

Suppose $\exists y'' \in (y, y')$ such that $\omega^*(y'') \neq \omega^*(y)$. Let $w \equiv \omega^*(y) = \omega^*(y')$, $w'' \equiv \omega^*(y'')$ and $y'' = cy + (1-c)y'$ for some $c \in (0,1)$. $\omega^*(\cdot)$ is weakly increasing for all types in Y^{ns} ($\frac{\partial^2 \mathbb{E}[\pi(y,w,\beta)]/g(y)}{\partial y \partial w} = \beta h_P(w) > 0$), so $y'' \in Y^s$. But then optimality of w for y, y' implies

$$cy[r(w,\beta) - r(w'',\alpha)] \geq c[wr(w,\beta) - w''r(w'',\alpha)]$$
$$(1-c)y'[r(w,\beta) - r(w'',\alpha)] > (1-c)[wr(w,\beta) - w''r(w'',\alpha)].$$

Adding yields

$$y''[r(w,\beta) - r(w'',\alpha)] > wr(w,\beta) - w''r(w'',\alpha),$$

contradicting optimality of w'' for y''.

To see this, let $V^{s-ns}(w, \mathbb{E}_\mu[g(y)|w])$ denote the expected gain from searching. Then for any $w < w'$ we have

$$V^{s-ns}(w, \mathbb{E}_\mu[g(y)|w]) \geq V^{s-ns}(w', \mathbb{E}_\mu[g(y)|w]) > V^{s-ns}(w', \mathbb{E}_\mu[g(y)|w'])$$
$$\implies V^{s-ns}(w, \mathbb{E}_\mu[g(y)|w]) > V^{s-ns}(w', \mathbb{E}_\mu[g(y)|w'])$$

where the first inequality follows from the the condition that the expected gain from searching is weakly decreasing in w for given beliefs, and the second inequality follows from W1 and Bayes' rule.

W7 Let $y \in Y^{ns}$. If $\nexists\ y'$ such that $\omega^*(y') = \omega^*(y)$, then either $|\omega^*(y) - \bar{\omega}^*(y)| < \epsilon$ for all $\epsilon > 0$, or $y = \bar{y}$.

Suppose not. First note that $y \neq \underline{y}$, or else the worker infers that $y = \underline{y} < y^*$, and hence searches. But if she searches, it is optimal to offer $\bar{\omega}^*(\underline{y})$. So consider $y \in (\underline{y}, \bar{y})$.

Because $\mathbb{E}[\pi(y, w, \beta)]$ is single-peaked and continuous in w, if $\omega^*(y) < \bar{\omega}^*(y)$, then $\sigma^*(\omega^*(y)) = \beta$ and $\nexists w' \in (\omega^*(y), \bar{\omega}^*(y)]$ such that $\sigma^*(w') = \beta$. Similarly, if $\omega^*(y) > \bar{\omega}^*(y)$, then $\sigma^*(\omega^*(y)) = \beta$ and $\nexists w' \in [\bar{\omega}^*(y), \omega^*(y))$ such that $\sigma^*(w') = \beta$.

Suppose now that $\bar{\omega}^*(y) - \sup\{w|w < \bar{\omega}^*(y) \text{ and } \sigma^*(w) = \beta\} > 0$. Then, because marginal profits of a higher w increase in y for fixed σ and $\mathbb{E}[\pi(y, w, \beta)]$ is continuous in y, there exists a $\delta > 0$ with $y - \delta > \underline{y}$ such that for all $y' \in (y - \delta, y)$, we have $\omega^*(y') = \max\{w|w < \bar{\omega}^*(y) \text{ and } \sigma^*(w) = \beta\} = \omega^*(y)$, a contradiction of the premise. Thus, if $\omega^*(y) < \bar{\omega}^*(y)$, then $\bar{\omega}^*(y) = \sup\{w|w < \bar{\omega}^*(y) \text{ and } \sigma^*(w) = \beta\}$. An analogous argument precludes $\omega^*(y) > \bar{\omega}^*(y)$ for $y < \bar{y}$.

W8 If Y^s and Y^{ns} are non-empty, then $\omega^*(y)$ is discontinuous at $\sup\{Y^s\}$.

Immediate. Fixing the probability that a worker receives an offer, employer profits are continuous in w, but higher by $g(y)(y - w)(\alpha - \beta)H_P(w)$ if the worker does not search for a fixed w. The result then follows from optimization in the neighborhood of $\sup\{Y^s\}$.

W9 $\exists y' > \inf\{Y^{ns}\}$ such that $\forall y \in Y^{ns}$ with $y \leq y'$, $\omega^*(y) = w^p$. Furthermore, $y' \geq \min\{\bar{y}, \max\{y|\bar{\omega}^*(y, \beta) = w^p\}\}$.

Suppose there is no $y' \in Y^{ns}$ such that all $y \in Y^{ns}$ with $y \leq y'$ pool on some w^p. If Y^s is non-empty, then $\inf\{\omega^*(y)|y \in Y^{ns}\} < \sup\{\omega^*(y)|y \in Y^s\}$, contradicting monotonicity. If Y^s is empty, then $\omega^*(\underline{y})$ is revealing and induces search, contradicting the premise.

Furthermore, it must be that $y' \geq \min\{\bar{y}, \max\{y|\bar{\omega}^*(y, \beta) = w^p\}\}$, or else there will be a type $y'' > y'$ for which $\omega^*(y'') > w^p \geq \bar{\omega}^*(y'', \beta)$, contradicting optimality of $\omega^*(y'')$ for y''.

W10 If $\mathbb{E}[g(y)] < g(y^*)$, then Y^s is non-empty.

From monotonicity of $\omega^*(y)$ in y, $\mathbb{E}_\mu[g(y)|\omega^*(\underline{y})] \leq \mathbb{E}[g(y)]$. Thus, $\mathbb{E}_\mu[g(y)|\omega^*(\underline{y})] < g(y^*)$, so the worker prefers to search following $\omega^*(\underline{y})$.

□

B Characterization of PSE

Proof.

$\mathcal{W}1$ *There is an essentially unique PSE wage strategy $\omega^*(\cdot)$. The strategy is characterized by a unique pooling wage, w^p, given by $\underline{w}$ if $\mathbb{E}_\mu[g(y)|\underline{w}] > g(y^*)$, and otherwise solving $\mathbb{E}_\mu[g(y)|w^p] = g(y^*)$. The pooling region Y^p is bounded from below by $\underline{y}$ if $\mathbb{E}[\pi(\underline{y}, w^p, \beta)] > \mathbb{E}[\pi(y, \bar{\omega}^*(\underline{y}, \alpha), \alpha)]$, and otherwise by the y solving $\mathbb{E}[\pi(y, w^p, \beta)] = \mathbb{E}[\pi(y, \bar{\omega}^*(y, \alpha), \alpha)]$. It is bounded from above by $\bar{y}$ if $\bar{y} < \bar{\omega}^{*-1}(w^p, \beta)$, and otherwise by $\bar{\omega}^{*-1}(w^p, \beta)$.*

We first establish uniqueness of w^p. By W9, at least one pooling wage, w^p, exists. Suppose there are multiple, and consider type $\tilde{y}$ pooling on $w^{p'} > w^p$ with $w^{p'} \neq \bar{\omega}^*(\tilde{y})$ and $g(\tilde{y}) > \mathbb{E}_\mu[g(y)|w^{p'}]$. Then $\tilde{w} \equiv \bar{\omega}^*(\tilde{y}) > w^p$ and $g(y^*) \leq \mathbb{E}_\mu[g(y)|w^p] < \mathbb{E}_\mu[g(y)|w^{p'}] < g(\tilde{y})$. Note that $\tilde{w}$ is not offered in equilibrium: if it were, then $\sigma^*(\tilde{w}) = \beta$, so $\tilde{y}$ should deviate from $w^{p'}$ to $\tilde{w}$.

To show that the credibility condition is violated for $\tilde{w}$, define $J(\tilde{w}) \equiv \{y|\mathbb{E}[\pi(y, \tilde{w}, \beta)] > \mathbb{E}[\pi(y, \omega^*(y), \sigma^*(\omega^*(y)))]\}$. Clearly, $\tilde{y} \in J(\tilde{w})$, so $J(\tilde{w})$ is non-empty. Furthermore, for all $y \in Y^s$, $\mathbb{E}[\pi(y, \bar{\omega}^*(y), \alpha)] \geq \mathbb{E}[\pi(y, w^p, \beta)] > \mathbb{E}[\pi(y, \tilde{w}, \beta)]$ from optimization by $y \in Y^s$ and single-peakedness, so $Y^s \cap J(\tilde{w}) = \emptyset$.

In fact, by continuity of profits in y (W5), $w^p > \bar{\omega}^*(\inf\{y|\omega^*(y) = w^p\}, \alpha) > \bar{\omega}^*(\inf\{y|\omega^*(y) = w^p\}, \beta)$, so sufficiently low types that pool on w^p strictly prefer that to deviating to $\tilde{w}$, regardless of whether $\tilde{w}$ deters search. Therefore $\mathbb{E}_\mu[g(y)|y \in J(\tilde{w})] > g(y^*)$, so the worker should not search following $\tilde{w}$. Thus, the credibility condition fails.

We next establish that w^p is given by $\underline{w}$ if $\mathbb{E}_\mu[g(y)|\underline{w}] > g(y^*)$ and otherwise solves $\mathbb{E}_\mu[g(y)|w^p] = g(y^*)$. Suppose not. Then $w^p > \underline{w}$ and $\mathbb{E}_\mu[g(y)|w^p] > g(y^*)$. To show that the credibility condition is violated, consider some $\tilde{\tilde{w}} < w^p$, and define $J'(\tilde{\tilde{w}}) \equiv \{y|\mathbb{E}[\pi(y, \tilde{\tilde{w}}, \beta)] \geq \mathbb{E}[\pi(y, \omega^*(y), \sigma^*(\omega^*(y)))]\}$. $\mathbb{E}_\mu[g(y)|y \in J'(\tilde{\tilde{w}})]$ is weakly increasing and continuous in $\tilde{\tilde{w}}$. Thus, for any $\epsilon > 0$, $\exists\delta > 0$ such that for all $\tilde{\tilde{w}} \in (w^p - \delta, w^p)$, we have $\mathbb{E}_\mu[g(y)|y \in J'(w^p)] - \mathbb{E}_\mu[g(y)|y \in J'(\tilde{\tilde{w}})] < \epsilon$. Set $\epsilon \equiv \mathbb{E}_\mu[g(y)|y \in J'(w^p)] - g(y^*)$ and note that $\mathbb{E}_\mu[g(y)|y \in J'(w^p)] = \mathbb{E}_\mu[g(y)|w^p] > g(y^*)$. Therefore, $\mathbb{E}_\mu[g(y)|y \in J'(\tilde{\tilde{w}})] > g(y^*)$. For $\tilde{\tilde{w}} < w^p$, the measure of types that strictly prefer $\tilde{\tilde{w}}$ to $\omega^*(y)$ equals the measure of types that weakly prefer $\tilde{\tilde{w}}$ to $\omega^*(y)$, so $\mathbb{E}_\mu[g(y)|y \in J(\tilde{\tilde{w}})] = \mathbb{E}_\mu[g(y)|y \in J'(\tilde{\tilde{w}})] > g(y^*)$, violating the credibility condition.

Finally, we establish the bounds on $Y^p(w^p)$. Consider the lower bound, $\inf\{Y^p\}$. If

$\mathbb{E}[\pi(\inf\{Y^p\}, w^p, \beta)] > \mathbb{E}[\pi(\inf\{Y^p\}, \bar{\omega}^*(\inf\{Y^p\}, \alpha), \alpha)]$, then either $\inf\{Y^p\} = \underline{y}$ or by continuity $\exists y < \inf\{Y^p\}$ with $\mathbb{E}[\pi(y, w^p, \beta)] > \mathbb{E}[\pi(y, \bar{\omega}^*(y, \alpha), \alpha)]$, in which case $\bar{\omega}^*(y)$ is not optimal for y. Conversely, if $\mathbb{E}[\pi(\inf\{Y^p\}, w^p, \beta)] < \mathbb{E}[\pi(\inf\{Y^p\}, \bar{\omega}^*(\inf\{Y^p\}, \alpha), \alpha)]$, then by continuity $\exists y \in Y^p$ with $\mathbb{E}[\pi(y, w^p, \beta)] < \mathbb{E}[\pi(y, \bar{\omega}^*(y, \alpha), \alpha)] \leq \mathbb{E}[\pi(y, \bar{\omega}^*(y, \alpha), \beta)]$, in which case w^p is not optimal for y.

Consider the upper bound, $\max\{Y^p\}$. If $\max\{Y^p\} < \bar{\omega}^{*-1}(w^p, \beta)$ then either $\max\{Y^p\} = \bar{y}$ or W9 is violated. If $\max\{Y^p\} > \bar{\omega}^{*-1}(w^p, \beta)$ then, by single-peakedness, all pooling types $y > \bar{\omega}^{*-1}(w^p, \beta)$ prefer $\bar{\omega}^*(y, \beta)$ to w^p because $\sigma^*(\bar{\omega}^*(y, \beta)) = \beta$, contradicting optimality of w^p for these types.

When $\underline{y}$ is sufficiently low (i.e., $\underline{y} < \inf\{y | \mathbb{E}[\pi(y, w^p, \beta)] = \mathbb{E}[\pi(y, \bar{\omega}^*(y, \alpha), \alpha)]\}$) and $\bar{y}$ is sufficiently high (i.e., $\bar{y} > \bar{\omega}^{*-1}(w^p, \beta)$), then:

$\mathcal{W}2$ *Lower types $y < \inf\{Y^p\}$ offer low revealing (complete-information) wages that induce workers to search.*

All low types $y < \inf\{Y^p\}$ induce search (W3) and all such types set $\bar{\omega}^*(y, \alpha) < w^p$ (W2).

$\mathcal{W}3$ *Type $y = \inf\{Y^p\}$ is indifferent between setting w^p and the discontinuously lower complete-information wage that induces search.*

The claim follows immediately from $\mathcal{W}1$ and the sufficient support restriction.

$\mathcal{W}4$ *Types $y \in Y^p$ pool on a wage w^p just high enough to deter search, i.e., $\mathbb{E}_\mu[g(y)|w^p] = g(y^*)$.*

$\mathbb{E}_\mu[g(y)|y \in Y^p(w^p)]$ is monotone increasing in w^p, so $w^p > \underline{w}$ uniquely solves $\mathbb{E}_\mu[g(y)|w^p] = g(y^*)$ provided $\mathbb{E}_\mu[g(y)|\underline{w}] < g(y^*)$. But if $\mathbb{E}_\mu[g(y)|\underline{w}] \geq g(y^*)$, then $\inf\{Y^p\} = \underline{y}$, a contradiction.

$\mathcal{W}5$ *Higher types $y > \max\{Y^p\}$ offer high revealing (complete-information) wages that strictly discourage search.*

All high types $y > \max\{Y^p\}$ discourage search (W3). All such types who don't pool set $\bar{\omega}^*(y, \beta)$ by single-peakedness, as no other type prefers $\bar{\omega}^*(y, \beta)$, and so $\sigma^*(\bar{\omega}^*(y, \beta)) = \beta$.

$\mathcal{W}6$ *w^p is the complete-information wage of the highest pooling type.*

The claim follows immediately from $\mathcal{W}1$ and the sufficient support restriction.

□

C Alternative models of wage competition

Our main qualitative characterizations extend to alternative models of wage competition. To see this, note that if the incumbent is committed to its initial offer, the following conditions are sufficient for the proofs of Propositions 1-3:

1. The expected gain from searching is weakly decreasing in w, given beliefs.

2. The benefit of a higher wage is greater for higher types.

3. Expected profits are single-peaked in w.

Thus, to determine whether our qualitative results extend to hold for a particular alternative model of wage competition, it suffices to verify that these conditions hold.

Consider, for example, a scenario in which successful search allows a worker to draw a wage w' from some exogenous distribution H_P. Such a scenario would arise, for example, if the raiding firm could not observe the incumbent's offer, or if the current job has some non-pecuniary value that the worker cannot credibly reveal to the raiding firm. To see that Condition 1 is satisfied, first note that the expected payoff from successful search is given by $\mathbb{E}[\max\{x, w'\}]$ where $w' \sim H_P$ and $x \in \{b, w\}$ are constants. Then, the expected gain from searching with wage offer w in hand may be written as

$$(\alpha - \beta)\left[\Big(1 - \mathbb{E}_\mu[g(y)|w]\Big)\big[\mathbb{E}[\max\{b, w'\}] - b\big] + \mathbb{E}_\mu[g(y)|w]\big[\mathbb{E}[\max\{w, w'\}] - w\big]\right] - \kappa.$$

For fixed beliefs $\mathbb{E}_\mu[g(y)|w]$, the expected gain from searching with wage offer w in hand is thus weakly decreasing in w so long as $\frac{\partial \mathbb{E}[\max\{w,w'\}]}{\partial w} = H_P(w) \leq 1$. Condition 1 is therefore satisfied. To see that Conditions 2 and 3 are satisfied, note that, for fixed σ, the firm's expected profit function is unchanged: $\mathbb{E}[\pi(y, w, \sigma)] = g(y)(y - w)[1 - \sigma(1 - H_P(w))]$. Condition 2 then follows immediately from the cross-partial: $\frac{\partial^2 \mathbb{E}[\pi(y,w,\sigma)]/g(y)}{\partial y \partial w} = \sigma h_P(w) > 0$. Condition 3 likewise follows immediately from strict concavity of expected profits in w.

D Alternative models of search

In our baseline model we assume that the search decision is discrete, abstracting from a continuous component of that decision. The assumption that there is a fixed component to search costs resulting in a discrete search decision is strongly supported by the data: most employed workers do not actively search for work. Nonetheless, it is straightforward to extend our model to allow for a continuous component of search.

To show this, we consider a simple setting in which: (1) the probability of a worker receiving an outside offer given search effort $e \in [0, 1]$ is $f(e) = \beta + e(\alpha - \beta)$; and (2) the cost of strictly positive search $e > 0$ is $\kappa + \frac{c}{2}e^2$, where κ and c are strictly positive.

Under complete information, when interior, optimal search satisfies $\bar{e}^*(y) = \frac{(\alpha-\beta)(\underline{w}-b)(1-g(y))}{c}$ and workers choose strictly positive search if $y < y^*$, where y^* is defined by $g(y^*) = 1 - \frac{\sqrt{2\kappa c}}{(\alpha-\beta)(\underline{w}-b)}$. Together, these results imply that the probability of a worker encountering a raider is given by

$$f(\bar{e}^*(y)) = \begin{cases} \beta + \frac{(\alpha-\beta)^2(\underline{w}-b)(1-g(y))}{c} & y < y^* \\ \beta & y > y^*. \end{cases} \tag{13}$$

Because, under complete information, workers' search decisions do not depend on w, the firm's optimal choice of the wage solves:

$$\max_{w \geq \underline{w}} \Big\{ g(y)(y-w)[1 - f(\bar{e}^*(y))(1 - H_P(w))] \Big\}. \tag{14}$$

Under incomplete information, the analysis of the search decision is analogous with the caveat that search effort is made on the basis of the expected value of y given w, as in the baseline model. Thus, when interior, the optimal choice of search effort is given by $e^*(w) = \frac{(\alpha-\beta)(\underline{w}-b)(1-\mathbb{E}[g(y)|w])}{c}$ and workers choose strictly positive search if $\mathbb{E}[g(y)|w] < g(y^*)$. The probability of a worker encountering a raider is thus

$$f(e^*(w)) = \begin{cases} \beta + \frac{(\alpha-\beta)^2(\underline{w}-b)(1-\mathbb{E}[g(y)|w])}{c} & \mathbb{E}[g(y)|w] < g(y^*) \\ \beta & \mathbb{E}[g(y)|w] > g(y^*). \end{cases} \tag{15}$$

The key difference resulting from incorporating a continuous search decision is that search effort by those choosing to search decreases with the perceived likelihood of a firm surviving, due to the reduced precautionary motive for search. The conditions under which our qualitative characterization of wage-setting continues to hold in the presence of a continuous component of the search decision are then the same as those discussed in Appendix C. Condition 1 holds because, as in the baseline model, the expected gain from search is invariant to w given beliefs: The motive for search is purely precautionary so wages only affect search through their effect on beliefs. Condition 2 is complicated by the fact that with a continuous choice of search, two forces affect the value of offering a higher wage by higher type firms. As in the baseline model, all firms benefit from a higher wage due to its deterrence effect in the event that a poaching firm is encountered, and higher (more productive) firm types have stronger incentives to deter poachers. However, for low revealing types whose workers engage in strictly positive search that varies with revealed y, a higher value of y reduces search effort, and so reduces the likelihood of having to deter a poaching firm, attenuating the deterrence motive for higher wages. Formally, Condition 2 holds if the optimal complete-information wage increases in y, i.e., if

$$\frac{\partial^2 \mathbb{E}[\pi]}{\partial w \partial y} = h_P(w) f(\bar{e}^*(y)) + \frac{f'(\bar{e}^*(y))}{f(\bar{e}^*(y))} \bar{e}^*_y(y) > 0. \tag{16}$$

Condition 3 is satisfied immediately in light of (14). Thus, so long as there remains a fixed component to search costs yielding a discontinuity in the search effort function and (16) holds, our qualitative characterizations of wages extend when workers make continuous search decisions.