# Providing Benefits to Uninformed Workers
(PRELIMINARY)

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**Abstract**

Pecuniary workplace benefits, such as employer-sponsored pensions and health insurance, constitute an increasing share of total compensation, but many workers display poor understanding of such benefits. In this paper, I study the impact of workers' unawareness on multidimensional compensation packages offered in equilibrium of a dynamic search model. First, modelling benefits as experience goods implies that equilibrium with uniformly high benefits is more difficult to sustain than equilibrium with uniformly low benefits, even though this harms firms' profits. Second, the presence of "uninformed workers" who do not update their beliefs about associated benefits when sampling a specific wage offer generates additional equilibria with spurious differentiation in benefits. I connect the model's predictions to the empirical literature on the provision of workplace pensions.

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## 1 Introduction

Workplace benefits constitute an increasing share of workers' compensation. For example, in 2022, 69% of total compensation received by an average employee in the US came in the form of wages, with the remaining 31% corresponding to various pecuniary benefits, most importantly health insurance, paid leave, and retirement benefits.[1] What is more, these benefits tend to be more unequally distributed than wages and thus wage-based measures of

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income inequality underestimate the extent of total compensation inequality (Kristal et al., 2020; Ouimet and Tate, 2023; Pierce, 2001).

At the same time, there is abundant evidence that an average individual is ill-equipped to evaluate complex financial contracts (Beshears et al., 2018; Lusardi and Mitchell, 2014). Focusing on workplace pensions, many individuals have poor understanding of the available benefits (Agnew et al., 2012; Gustman and Steinmeier, 2005), which is likely related to some robust behavioural patterns, such as status quo bias in choosing contribution rates and investment allocations (Madrian and Shea, 2001; Samuelson and Zeckhauser, 1988; Thaler and Benartzi, 2004) and not taking full advantage of the available employer's match (Choi et al., 2011; Engelhardt and Kumar, 2007; Mitchell et al., 2007).

In this paper I therefore study the implications of such unawareness for the design of multidimensional compensation packages offered in equilibria of a dynamic search model. I consider a setting in which each compensation package consists of an *observable component* ("wage") as well as a *hidden component* ("benefits"). While wages are continuous, benefits can take one of two values (high or low). There is a continuum of homogeneous workers and firms. The firms' provision costs and the workers' preferences are such that offering high benefits to every worker is efficient.

Crucially, a searching worker observes the sampled wages perfectly, but learns the true value of the associated benefits only after accepting a particular offer. Thus, I effectively model the benefits component of a compensation package as an experience good. After learning the value of the benefits she receives, the worker can remain in current employment or search on the job. With benefits being unobservable prior to acceptance, a (Perfect Bayesian) equilibrium with uniformly high benefits is more difficult to sustain than equilibrium with uniformly low benefits, which ultimately harms firms' profits (Proposition 1). This result suggests a potential obstacle to delegating the provision of benefits to firms when workers are imperfectly informed.

Next, I extend the model by introducing a fraction of "uninformed workers" who, in addition to learning the true value of benefits with delay, do not update their beliefs about associated benefits when sampling a specific wage offer.[2] The presence of uninformed workers generates additional equilibria with spurious differentiation in benefits. First, there may exist "perverse equilibria", in which high-wage jobs also offer high benefits, and vice versa (Proposition 2). In these equilibria, only uninformed workers accept dominated offers with low wages and low benefits, and these jobs induce strictly higher turnover. Second, there may also exist "fictitious compensating differentials equilibria", in which high wages are paired with low benefits, and vice versa (Proposition 3). Although qualitatively equivalent, the logic behind these equilibria and their efficiency properties are starkly different from the predic-

[2]This kind of behaviour boils down to correlation neglect or cursedness (Eyster, 2019).

tions of the classical theory of compensating differentials (Rosen, 1974, 1986).

**Related literature.** This paper contributes to several strands of the literature. First, modelling the benefits component of a job offer as a hidden attribute, I build on and extend the literature in behavioural industrial organisation studying the design of products with shrouded attributes, such as add-on prices. This literature, starting with Ellison (2005) and Gabaix and Laibson (2006), has analysed a range of topics that arise when firms engage in one-shot competition by choosing their perfectly observable headline price as well as imperfectly observable additional price, see Heidhues and Kőszegi (2018) for a review. In most closely related papers, Heidhues et al. (2021) and Gamp and Krähmer (2022) introduced limited attention and misperceptions, respectively, into the model of costly consumer search.[3]

To the best of my knowledge, no previous work accounts for the possibility that an agent eventually learns the true value of the hidden attribute chosen by the provider and might search again for a better alternative. Thus, the theoretical contribution of the present paper is to analyse the equilibrium effects of learning about the hidden attribute and possible re-contracting.[4]

Second, I contribute to the literature in behavioural labour economics (Dohmen, 2014) by modelling a multidimensional compensation package consisting of an observable wage and hidden benefits. In most closely related work, Bubb and Warren (2020) develop a theory of employer-sponsored pension plan design when workers are present-biased and underestimate the stickiness of the default option, and find that 75% of plans in their data are consistent with a notion of profit-maximising, rather than paternalistic, employers. Their model assumes away any search frictions, learning, or re-contracting.[5]

Third, the theoretical results of the present paper complement the empirical literature on

[3] Chen et al. (2022) study a consumer search problem with horizontally differentiated experience goods. With two periods, the firms have an incentive to provide high quality and build up reputation. In the first period, the authors restrict attention to uniform-pricing equilibria, in which quality remains hidden even though the consumers are fully rational. Equilibria of this kind can only be supported if the cost of providing high quality differs across firms.

[4] There are several papers that focus on other dynamic aspects of competition in such markets. Johnen (2019) and Murooka and Schwarz (2019) analyse the design of automatic-renewal contracts when consumers differ in their propensity to passively accept the automatic renewal after learning their (exogenous) utility from continued consumption. Johnen (2020) studies competition between firms who learn private information about their customers' naiveté. The consumers remain oblivious to the fact that they are being exploited, however. Heidhues et al. (2023) analyse a model where firms offer an initial price and a switching price. Consumers observe all current and future prices perfectly, but may procrastinate on switching.

[5] DellaVigna and Paserman (2005) derive and test predictions regarding the impact of impatience on exit rates from unemployment, depending on whether time discounting is exponential or hyperbolic. Spinnewijn (2015) analyses the optimal design of unemployment insurance when job seekers have biased perceptions of the job finding probability.

the provision of workplace benefits (e.g., Cole and Taska, 2023; Ouimet and Tate, 2023) and compensating differentials (Lavetti, 2023). I discuss the model's implications for the interpretation of the empirical patterns in more detail in section 4.

The remainder of this paper is structured as follows. In section 2, I characterise the worker's search behaviour conditional on belief formation. In section 3, I endogenise the distribution of wages and benefits offered in equilibrium. In section 4, I discuss the empirical relevance of the model's predictions. Section 5 concludes.

# 2 Search model with hidden attributes

## 2.1 Setup

Consider the following model of search and learning about the hidden attribute of an offer. There are two periods, $t = 1, 2$. In period 1, an agent searches for a job for the first time, performing random, sequential search with perfect recall until she accepts an offer, as in McCall (1970). Each search imposes a fixed cost of $c_1 > 0$. Having accepted an offer, the agent derives utility from being in employment, thus learning the value of the associated attributes. In period 2, she decides whether or not to continue searching on the job at a cost $c_2 \geq c_1$.[6] If the agent is not searching on the job, she derives the same utility from being in employment as in period 1. Otherwise, she searches on the job until she accepts an alternative offer and subsequently derives the associated utility.

The total utility from being in employment is a function of a simple attribute $w$ ('wage') and a complex attribute $\theta$. An agent who is sampling job offers can perfectly observe and compare their simple attributes. However, she only learns the exact value of the complex attribute of a particular offer after accepting it. For an agent $i$ working at firm $k$, the total utility from being employed in a single period is:

$$u_{ik} = w_k + \theta_{ik}.$$

Further, suppose that the complex attribute $\theta_{ik}$ is determined jointly by an idiosyncratic match quality $\epsilon_{ik}$ and a discretionary component $b_k$ ('benefits') chosen by the employer:

$$\theta_{ik} = b_k + \epsilon_{ik}.$$

[6] It is standard in the literature to assume that the search cost increases on the job, either due to classical economic reasons, such as a a higher opportunity cost of time (e.g., Burdett, 1978), or psychological factors, such as time-inconsistent preferences or loss aversion (e.g., Karle et al., 2023).

For simplicity, suppose that $\epsilon_{ik}$ is i.i.d. with mean zero. The employer can choose to offer either 'high' or 'low' benefits, i.e. $b_k \in \{\underline{b}, \bar{b}\}$ for some constants $\bar{b} > \underline{b} > 0$.

The agent's objective is to maximise the expected utility from being employed in two periods, net of her search costs. For notational simplicity, I omit time discounting. The value of the outside option (staying out of the labour market) is normalised to 0.

## 2.2 Beliefs and search behaviour

In this section I analyse the search behaviour of an agent facing an exogenously given distribution of multidimensional job offers. While I focus on boundedly rational agents for whom the complex component of an offer effectively remains hidden while searching, there are many degrees of freedom in specifying how the agents form their beliefs about $\theta_{ik}$. In this paper, I distinguish between "informed" and "uninformed workers", defined as follows. For an *informed worker*, the complex attribute of an offer remains hidden during search, effectively making it an experience good (Nelson, 1970). An informed worker nonetheless updates her beliefs about benefits after observing a particular wage offer, based on the joint distribution of wages and benefits. For an *uninformed worker*, the complex attribute of an offer is also an experience good, but she fails to take into account the correlation between the wage and benefits, even though she has correct beliefs about the marginal distributions of wages and benefits. In other words, I invoke a specific form of correlation neglect in order to model a worker who in a sense ignores the benefits while searching.[7] Note, however, that both informed and uninformed workers internalise the fact that they will learn the value of the complex attribute after acceptance. Thus, I depart from the approach prevalent in the behavioural industrial organization literature (Heidhues and Kőszegi, 2018), whereby a boundedly rational agent is often assumed to simply ignore the hidden component of an offer.

Solving the model backwards, I characterise a search strategy adopted by either type for a given distribution of offers.

**Period 2.** Worker $i$ employed at firm $k$ derives, and observes, the total utility of being employed $u_{ik} = w_k + \theta_{ik}$. If the worker searches on the job, her value function of sampling a wage offer $w$ is:

$$v_2^j(w) = \max \{w + \mathbb{E}^j[\theta \mid w] \; ; \; v_2^j - c_2\},$$

[7] Such belief formation can be micro-founded with the costs of information acquisition. In that vein, Heidhues et al. (2021) analyse when a boundedly rational individual prefers to "browse" multiple offers superficially rather than "study" a single offer in detail. See also Eyster (2019) for a taxonomy of errors that people make in strategic environments, summary of the lab and field evidence, and an overview of game-theoretic models incorporating these errors.

where $j \in \{I, U\}$ denotes the worker's type (informed or uninformed), $v_2^j = \int_w v_2^j(w)\phi(w)dw$, and $\phi(w)$ denotes the density function characterising the distribution of wage offers. The first expression inside the curly brackets represents the expected utility from accepting the offer. The second expression represents the expected utility from rejecting the offer and searching once more. Observe that $\mathbb{E}^j[\theta \mid w] = \mathbb{E}^j[b \mid w]$, since the idiosyncratic match component is i.i.d. with mean zero.

Provided that $d\,\mathbb{E}^j[b \mid w] \,/\, d\,w > -1$, $v_2^j(w)$ takes a constant value of $v_2^j - c_2$ for low $w$ and becomes strictly increasing for higher values of $w$. Consequently, the optimal search strategy is characterised by a cutoff which prescribes to continue searching until the first offer with $w + \mathbb{E}^j[b \mid w] \geq R_2^j$ is sampled (McCall, 1970).

For all $w + \mathbb{E}^j[b \mid w] < R_2^j$, $v_2^j(w) = v_2^j - c_2$, while for all $w + \mathbb{E}^j[b \mid w] \geq R_2^j$, $v_2^j(w) = w + \mathbb{E}^j[b \mid w]$. Combining this with the indifference at the cutoff, $R_2^j = v_2^j - c_2$, yields:

$$\begin{aligned}\int_w v_2^j(w)\phi(w)dw &= R_2^j \cdot \mathbb{P}[w + \mathbb{E}^j[b \mid w] < R_2^j] \;+\; \int_{w+\mathbb{E}^j[b \mid w] \geq R_2^j} (w + \mathbb{E}^j[b \mid w])\phi(w)dw \\ &= R_2^j \;+\; c_2,\end{aligned}$$

which solves for:

$$c_2 = \int_{w+\mathbb{E}^j[b \mid w] \geq R_2^j} (w + \mathbb{E}^j[b \mid w] - R_2^j)\phi(w)dw. \tag{1}$$

Intuitively, the optimal cutoff $R_2^j$ equalises the marginal cost of search with the marginal benefit of search. Since the right-hand side of the above equality is strictly decreasing in $R_2^j$, the optimal cutoff is uniquely determined.

How does the agent's type affect her search strategy? An uninformed worker perceives the benefits to be distributed independently of the wage, and thus $\mathbb{E}^U[b \mid w] = \mathbb{E}[b]$ for any $w$. Consequently, her strategy can be fully captured by a *reservation wage*, rather than a cutoff for total compensation.

Intuitively, whether an informed or an uninformed agent adopts a higher cutoff in period 2 should depend on whether the correlation between wages and benefits is positive or negative. For instance, if wages were negatively correlated with benefits, an uninformed worker would overestimate a benefit of sampling a higher wage offer, relative to an informed worker, and would adopt a higher cutoff as a result.

Formally, plugging either $\mathbb{E}^I[b \mid w] = \mathbb{E}[b \mid w]$ or $\mathbb{E}^U[b \mid w] = \mathbb{E}[b]$ into (1) yields:

**Lemma 1:** *If $d\,\mathbb{E}[b \mid w] \,/\, d\,w \lesseqgtr 0$ for any $w$, then $R_2^U \gtreqless R_2^I$. If $d\,\mathbb{E}[b \mid w] \,/\, d\,w = 0$, then $R_2^U = R_2^I$.*

Analogously to McCall (1970), a worker of type $j$ searches on the job in period 2 when $u_{ik} < R_2^j$, but remains in current employment otherwise.

**Period 1.** The optimal search strategy in period 1, i.e. during the initial job search, depends on the anticipated behaviour once in employment. Even though both types internalise the fact that they will learn the true value of benefits on the job, the difference in beliefs about the joint distribution of wages and benefits can result in divergent search rules.

Accounting for this, the value function of sampling an offer with wage $w$ in period 1 is:

$$v_1^j(w) = \max \{u_1^j(w), v_1^j - c_1\},$$

where:

$$\begin{aligned} u_1^j(w) = \big(w + \mathbb{E}^j[b \,|\, w]\big) \;+\; &\mathbb{P}^j[w + \theta \geq R_2^j \,|\, w] \cdot \big(w + \mathbb{E}^j[\theta \,|\, \theta \geq R_2^j - w, w]\big) \\ +\; &\mathbb{P}^j[w + \theta < R_2^j \,|\, w] \cdot \big(v_2^j - c_2\big) \end{aligned}$$

and $v_1^j = \int_w v_1^j(w)\phi(w)dw$. Conditional on accepting the offer, the agent expects to obtain the utility of $w + \mathbb{E}^j[b \,|\, w]$. Furthermore, if the realised utility from being employed turns out to exceed the type-dependent cutoff $R_2^j$, the agent expects to stay in the same employment and not engage in on-the-job search. Otherwise, she expects to search on the job, which yields an expected utility of $(v_2^j - c_2)$.

The optimal search strategy in period 1 is also given by a cutoff rule as long as $d\, u_1^j(w)/d\, w > 0$. Expanding yields:

$$\begin{aligned} \mathbb{P}^j[w + \theta \geq R_2^j \,|\, w] &= \int_{R_2^j - w} \psi^j(\theta \,|\, w) d\theta, \\ \mathbb{E}^j[\theta \,|\, \theta \geq R_2^j - w, w] &= \int_{R_2^j - w} \theta \psi^j(\theta \,|\, w) d\theta \;/\; \int_{R_2^j - w} \psi^j(\theta \,|\, w) d\theta, \end{aligned}$$

$$\begin{aligned} u_1^j(w) = \big(w + \mathbb{E}^j[b \,|\, w]\big) \;+\; w \cdot \textstyle\int_{R_2^j - w} \psi^j(\theta \,|\, w) d\theta \;+\; \int_{R_2^j - w} \theta \psi^j(\theta \,|\, w) d\theta \;+ \\ +\; (v_2^j - c_2) \cdot \textstyle\int^{R_2^j - w} \psi^j(\theta \,|\, w) d\theta, \end{aligned}$$

where $\psi^j(\theta \,|\, w)$ captures the type-dependent, perceived conditional distribution of the complex attribute. Specifically, denoting by $\psi(\cdot)$ the true distribution, $\psi^I(\theta \,|\, w) = \psi(\theta \,|\, w)$ and $\psi^U(\theta \,|\, w) = \psi(\theta)$. Then:

$$
\begin{aligned}
d\, u_1^j(w)/d\, w = \; & 1 + \mathbb{P}^j[w + \theta \geq R_2^j \,|\, w] + w \cdot \big[ -\psi^j(R_2^j - w \,|\, w)(-1) \big] \\
& + \big[ -(R_2^j - w)\psi^j(R_2^j - w \,|\, w)(-1) \big] + (v_2^j - c_2)\big[\psi^j(R_2^j - w \,|\, w)(-1)\big] \\
= \; & 1 + \mathbb{P}^j[w + \theta \geq R_2^j \,|\, w] + \psi^j(R_2^j - w \,|\, w) \underbrace{\big[R_2^j - (v_2^j - c_2)\big]}_{=0} > 0
\end{aligned}
$$

Since $u_1(w)$ is strictly increasing in $w$ for either type, proceeding as in the above analysis of the search problem in period 2 yields the condition for the optimal cutoff in period 1:

$$
c_1 = \int_{w \geq R_1^j} (u_1^j(w) - u_1(R_1^j))\phi(w) dw. \tag{2}
$$

The above specifies an optimal reservation wage $R_1^j$, because $u_1^j(w)$ embeds utility from all components of the compensation package. Moreover, the above implies that the marginal benefit from sampling a higher wage offer boils down to:

$$
\begin{aligned}
d\, u_1^I(w)/d\, w &= 1 + \mathbb{P}[w + \theta \geq R_2^I \,|\, w], \\
d\, u_1^U(w)/d\, w &= 1 + \mathbb{P}[w + \theta \geq R_2^U].
\end{aligned}
$$

Thus, even if the sign of correlation between wages and benefits allows to compare $R_2^I$ and $R_2^U$ (Lemma 1), the fact that informed workers apply a conditional distribution of the complex attribute to calculate the probability of staying in the initially accepted employment for both periods makes any sharp comparisons between $R_1^I$ and $R_1^U$ infeasible. This illustrates that dynamic incentives have a dramatic impact on how correlation neglect affects search behaviour, relative to a static search problem in period 2.

For example, if $d\, \mathbb{E}[b \,|\, w] \,/\, d\, w < 0$ for any $w$, there are two opposing forces shaping how the informed workers search, relative to their uninformed counterparts. On the one hand, $R_2^I < R_2^U$ implies that the initial choice is more consequential for informed workers, potentially making them search more intensely for a better offer. On the other hand, informed workers realise that higher wages are on average associated with lower benefits, which would make them less inclined to search hard for a high-wage offer. Whichever of these two considerations dominates, depends ultimately on the specific distribution of offers. While this will be endogenised in the next section, for now note the following:

**Lemma 2:** *If $d\, \mathbb{E}[b \,|\, w] \,/\, d\, w \neq 0$ for some $w$, then the comparison between $R_1^U$ and $R_1^I$ is ambiguous. If $d\, \mathbb{E}[b \,|\, w] \,/\, d\, w = 0$, then $R_1^U = R_1^I$.*

# 3 Equilibrium analysis

In this section, I characterise equilibria of the following game. There is a unit mass of identical firms. The firms simultaneously choose the wage and benefits they offer to a unit mass of searching workers, committing to the same offer for both periods 1 and 2. The worker's problem is as outlined in the previous section. In particular, the workers do not observe the benefits while searching, but learn their true value on the job. Suppose that a fraction $(1-\lambda) \in (0,1)$ of workers are informed, while the remaining share $\lambda$ are uninformed.

To focus attention on the simplest possible environment, consider a variant of the model in which $\text{Var}[\epsilon_{ik}] \to 0$, so that there is no role for match-specific shocks. Offering a compensation package $(w, b)$ costs the firm $w + (1-\tau)b$ per period, if accepted by a worker. Here, $\tau \in (0,1)$ represents tax advantages to providing workplace benefits.[8] Since the worker's utility aggregates received wages and benefits, it is socially desirable for the firms to offer high benefits $\bar{b}$ to all workers.

Each firm produces $y > 0$ units of a numeraire good per hired worker using a constant-returns-to-scale technology. Thus, the profit from hiring a worker for a single period is:

$$\pi = y - w - (1-\tau)b.$$

Let the equilibrium be defined as a tuple of strategies and beliefs, such that all players behave sequentially rationally given their beliefs. In contrast to a standard Weak Perfect Bayesian Equilibrium (PBE), I allow a fraction of uninformed workers to display correlation neglect. Formally, the equilibrium is defined as follows:

**Definition 1:** *The workers' strategies summarised by $(R_1^j, R_2^j)$, $j \in \{I, U\}$, the firms' strategies summarised by $(w_k, b_k)$, $k \in [0,1]$, and workers' beliefs about the distribution of offers $(w, b)$ constitute a (pure-strategy)* PBE with correlation neglect, *if:*

1. *The informed workers' beliefs about the joint distribution of wages and benefits are derived from the firms' strategies.*

2. *The uninformed workers' beliefs about the marginal distributions of wages and benefits are derived from the firms' strategies, but they display correlation neglect in that they perceive these two components as independently distributed.*

3. *Given their beliefs, informed and uninformed workers adopt perceived-optimal cutoff rules satisfying (1) and (2).*

[8] For example, all OECD countries offer preferential tax treatment of private pension contributions, including those made by the employers into qualified workplace plans (OECD, 2020).

4. *Given the strategies adopted by other players, each firm chooses its offer $(w_k, b_k)$ to maximise its expected profit.*

To clarify the above definition note the following. First, although a "fully cursed equilibrium" of Eyster and Rabin (2005) can also feature correlation neglect, this concept applies to static games with incomplete information (i.e., Bayesian games), while the above is a dynamic game with incomplete information. Second, correlation neglect can also arise in an "analogy-based expectation equilibrium" of Jehiel (2005), but this concept has been developed for dynamic games with complete information.

The workers' beliefs off-equilibrium-path, i.e. beliefs about benefits $b$ associated with a wage offer deviating from the equilibrium $w^*$, determine the profitability of potential deviations. Consider the following two specifications inspired by McAfee and Schwartz (1994). First, workers have "passive beliefs" if, upon observing a deviation from $w^*$, they do not update their beliefs about the corresponding benefits $b$. Second, workers have "wary beliefs" if, upon observing a deviation, they suppose that the offer is associated with low benefits $b = \underline{b}$. To maintain logical consistency with the belief formation of informed and uninformed workers on the equilibrium path, I assume that informed workers have wary beliefs, while uninformed workers have passive beliefs.[9] Finally, as in the standard sequential search model, the workers of either type do not update their beliefs about the *distribution* of benefits upon observing a deviation by a single firm (see Stahl, 1989; Janssen and Shelegia, 2015).[10]

**Assumption 1:** *Off the equilibrium path, informed workers hold wary beliefs and uninformed workers hold passive beliefs.*

### 3.1 Equilibria with a degenerate distribution of benefits

Consider first equilibria in pure strategies in which all firms offer an identical compensation package with some $w = w^*$ and $b = b^*$. Then, since correlation neglect plays no role when the distribution of benefits is degenerate, the workers of either type hold correct beliefs about the firms' offers. Furthermore, there is no role for learning and therefore each worker anticipates that she will stay in the same employment for two periods. Consequently, in period 1 a worker searches exactly once and accepts employment, as long as $2(w^* + b^*) - c_1 \geq 0$.

It is easy to see that conditional on $b^*$, all firms would offer the same wage equal to the workers' reservation wage $R_1$. Offering a higher wage would not affect the firm's hiring

[9] Arguably, it would be conceptually unappealing to discipline the beliefs of boundedly rational workers in a game with one firm type using more standard refinements, such as the Intuitive Criterion (Cho and Kreps, 1987), which would require the workers to be considerably more strategically sophisticated than they appear in a PBE with correlation neglect.

[10] With continuum of firms, the probability of re-sampling the same offer is zero.

probability or the worker's decision to stay, while offering a lower wage would result in the worker rejecting the offer. In equilibrium, this uniform wage has to make the workers exactly indifferent between accepting employment and not entering the labour market, which implies $w^* = c_1/2 - b^*$.[11] This is reminiscent of the main result in Diamond (1971).

Under what conditions can the efficient outcome with high benefits being offered to all workers be supported in equilibrium? Suppose that $b^* = \bar{b}$ and $w^* = c_1/2 - \bar{b}$. Irrespective of off-path beliefs, a firm that deviates to $b = \underline{b}$ cannot offer a wage lower than $w^*$, as this would result in all workers rejecting. Consider first a deviation whereby the firm does not adjust its wage offer and simply combines $w^*$ with low benefits $\underline{b}$. A worker who accepted, either informed or uninformed, searches on the job and leaves if $c_2 < \bar{b} - \underline{b}$. However, the deviator is still better off as long as:

$$y - w^* - (1-\tau)\underline{b} \ > \ 2(y - w^* - (1-\tau)\bar{b}) \iff$$

$$y - c_1/2 + (\bar{b} - \underline{b}) + \tau\underline{b} \ > \ 2\big(y - c_1/2 + \tau\bar{b}\big), \tag{3}$$

with the left-hand-side of the inequality taking into account that under such unilateral deviation there are no workers left in the market to re-hire in period 2. On the other hand, if $c_2 \geq \bar{b} - \underline{b}$, the worker does not search on the job and the deviator is strictly better off.

Second, consider a firm that deviates to $\underline{b}$ and simultaneously raises the wage offer to some $\tilde{w}$ in order to prevent the worker from searching on the job. The highest $\tilde{w}$ that the deviator might consider lies along its iso-profit curve and is thus given by $\tilde{w} = w^* + (1-\tau)(\bar{b} - \underline{b}) = c_1/2 - \underline{b} - \tau(\bar{b} - \underline{b})$. Given their passive beliefs, such an offer is accepted by all uninformed workers in period 1 as $\tilde{w} > w^*$. If $c_2 > \tau(\bar{b} - \underline{b})$, there exists a deviation that makes the hiring of an uninformed worker strictly more profitable, because the deviator could offer some wage strictly below $\tilde{w}$ without losing the worker. On the other hand, an uninformed worker leaves following a deviation when $c_2 < \tau(\bar{b} - \underline{b})$. In this case, a deviation whereby the firm does not raise its wage is preferable.

Given their wary beliefs, informed workers accept the deviator's offer in period 1 only if:

$$\tilde{w} \ \geq \ c_1/2 - \underline{b} \ > \ c_1/2 - \underline{b} - \tau(\bar{b} - \underline{b}),$$

which implies that there exists no such profitable deviation. Thus, the presence of informed workers with wary beliefs limits the scope for profitable deviations. In sum, for $c_2 \in \big(\tau(\bar{b} - \underline{b}), (\bar{b} - \underline{b})\big)$, a deviation to $b = \underline{b}$ and $w = \tilde{w} - \big(c_2 - \tau(\bar{b} - \underline{b})\big) = c_1/2 - \underline{b} - c_2$ is profitable as long as:

[11] Suppose instead that the uniform wage offered by all firms strictly exceeded $w^*$. Then, there would exist a profitable deviation whereby a firm lowers its wage by some $0 < \epsilon < c_1$ and still hires all the workers it encounters, contradicting the equilibrium condition.

$$\lambda\big(y - c_1/2 + c_2 + \tau\underline{b}\big) \; > \; 2\big(y - c_1/2 + \tau\bar{b}\big).$$

However, a comparison with (3) demonstrates that this payoff strictly dominated by a deviation to $b = \underline{b}$ not paired with a wage raise. Overall, an equilibrium in which all firms offer $b^* = \bar{b}$ exists if $c_2 \leq (\bar{b} - \underline{b})$ and $2\big(y - c_1/2 + \tau\bar{b}\big) \geq y - c_1/2 + (\bar{b} - \underline{b}) + \tau\underline{b}$ are both satisfied. If either one of these conditions fails, there exists a profitable deviation and thus all firms offering high benefits cannot be supported in equilibrium.

Next, an equilibrium with $b^* = \underline{b}$ always exists, provided that the hiring firms make non-negative profit. Notice that deviating to $\bar{b}$ would necessarily make a firm strictly worse off. This is due to the fact that with benefits being unobservable prior to acceptance, the deviator still has to offer a wage of at least $w^* = c_1/2 - \underline{b}$ in order to attract any workers, informed or uninformed. Thus, deviating to high benefits must raise the firm's labour cost without affecting the worker's decision to accept or to stay in employment. The condition for the firms to make non-negative profit is $y - w^* - (1-\tau)\underline{b} = y + \tau\underline{b} - c_1/2 \geq 0$, which is arguably very weak.

In sum, the following result obtains:

**Proposition 1:** *In any equilibrium with a degenerate distribution of benefits, the distribution of wage offers is also degenerate with $w^* = c_1/2 - b^*$.*

1. *An equilibrium in which all firms offer low benefits ($b^* = \underline{b}$) exists, provided that the firms make non-negative profits, i.e. $y + \tau\underline{b} \geq c_1/2$.*

2. *An equilibrium in which all firms offer high benefits ($b^* = \bar{b}$) exists if, in addition, $c_2 \leq (\bar{b} - \underline{b})$ and $2\big(y - c_1/2 + \tau\bar{b}\big) \geq y - c_1/2 + (\bar{b} - \underline{b}) + \tau\underline{b}$ both hold.*

When the equilibrium distribution of benefits is degenerate, correlation neglect has no bite and the distinction between informed and uninformed workers becomes inconsequential. As a result, the conditions above are independent of the distribution of types and one can interpret Proposition 1 as capturing the impact of modelling benefits as experience goods on the incentives of firms to offer either low or high benefits. Whenever the firms make non-negative profits when offering low benefits, and thus the equilibrium with $b^* = \underline{b}$ exists, the efficient equilibrium with high benefits $b^* = \bar{b}$ exists only if two additional conditions are met. First, the cost of searching on the job cannot be too high. Otherwise, a firm could deviate to offering low benefits without losing a worker. Second, the firms must actually make a higher profit from employing a worker for both periods rather than losing her after one period of employment with slightly lower total compensation. In that sense, equilibria with high benefits are more difficult to sustain.

Moreover, when the profits are non-negative in a low-benefit equilibrium and a high-benefit equilibrium exists, the firms are making strictly greater profits in the high-benefit equilibrium due to the associated tax advantages ($\tau > 0$). Thus, unobservability of benefits by the workers can be detrimental to the firms' profits.

## 3.2 Equilibria with spurious differentiation in benefits

Even though the firms are homogeneous, one might ask whether there exist equilibria with differentiated offers, since informed and uninformed workers adopt different search strategies when the distribution of benefits is non-degenerate. Following the logic in Albrecht and Axell (1984) and the discussion above, note that when the two types adopt reservation wages $R_1^I \neq R_1^U$ in period 1, no firm has an incentive to post a wage offer other than $R_1^I$ or $R_1^U$. Then, the firms that post the higher of the two wages, denoted $w_H$, hire all workers who contact them, while the firms that post the lower of the two wages, denoted $w_L$, hire one type only. Because of the trade-off between profits per worker and the number of hires, differential offers might co-exist in equilibrium as long as thy generate equivalent total expected profits.

**Perverse equilibria.** Consider first the case of a "perverse equilibrium" in which $b(w_H) = \bar{b}$ and $b(w_L) = \underline{b}$. That is, jobs that pay higher wages also offer high benefits, and vice versa. Suppose that a fraction $p \in (0, 1)$ of firms offer the high-wage, high-benefits jobs, while a fraction $(1 - p)$ offer the low-wage, low-benefit jobs.

Notice that, for this distribution of offers, informed workers put probability 1 on specific benefits associated with a given wage offer, while uninformed workers mistakenly believe that any wage offer comes together with high benefits with probability $p$ and with low benefits with probability $(1 - p)$. Consequently, the two types have the following value of searching on the job in period 2:

$$v_2^I = \max\{p(w_H + \bar{b}) + (1 - p)(w_L + \underline{b}) - c_2\,;\,(w_H + \bar{b}) - c_2/p\},$$
$$v_2^U = \max\{p(w_H + \bar{b}) + (1 - p)(w_L + \underline{b}) - c_2\,;\,w_H + p\bar{b} + (1 - p)\underline{b} - c_2/p\},$$

depending on whether they accept the first sampled offer or keep searching until an offer with $w_H$ is encountered. Notice that $v_2^I \geq v_2^U$, which implies that informed workers are more inclined to search on the job and, if they do, to search for a high-wage offer in period 2. Intuitively, the fact that high wages are paired with high benefits increases the informed worker's valuation of sampling $w_H$, relative to her uninformed counterpart.

Further, since $c_2 \geq c_1$, informed workers never accept an offer in period 1 with the intention to search on the job, but uninformed workers might. In addition, neither type has an incentive to search if the accepted offer turns out to provide $(w_H, \bar{b})$. Therefore:

$$u_1^I(w_H) = 2(w_H + \bar{b}), \quad u_1^I(w_L) = 2(w_L + \underline{b}),$$

$$u_1^U(w_H) = (w_H + p\bar{b} + (1-p)\underline{b}) + p(w_H + \bar{b}) + (1-p)[\max\{(w_H + \underline{b})\,;\, v_2^U\}],$$
$$u_1^U(w_L) = (w_L + p\bar{b} + (1-p)\underline{b}) + p[\max\{(w_L + \bar{b})\,;\, v_2^U\}] + (1-p)[\max\{(w_L + \underline{b})\,;\, v_2^U\}],$$

which implies $(u_1^I(w_H) - u_1^I(w_L)) > (u_1^U(w_H) - u_1^U(w_L))$. Thus, if the two types search differently in period 1, it must be the case that informed workers are searching for $(w_H, \bar{b})$, while uninformed workers accept both $w_L$ and $w_H$.

From the firms' perspective, the compensation package with a high wage and high benefits is strictly more costly to provide. Thus, for the equal profits condition to hold, the firms offering $(w_H, \bar{b})$ must either attract a larger mass of workers, retain a larger mass of workers, or both. While it can be shown that the first two cases result in a contradiction, here I construct an equilibrium in which the high-wage firms attract more workers and retain more workers that they hire. The first requires that only uninformed workers accept the low-wage jobs. The second requires that all uninformed workers who have accepted a low-wage job leave upon discovering low benefits.

Informed workers search for $(w_H, \bar{b})$ in period 1 if:

$$u_1^I(w_H) - u_1^I(w_L) = 2((w_H - w_L) + (\bar{b} - \underline{b})) > c_1/p,$$

while uninformed workers accept also $w_L$ if:

$$u_1^U(w_H) - u_1^U(w_L) = (w_H - w_L) + p\big((w_H + \bar{b}) - \max\{(w_L + \bar{b})\,;\, v_2^U\}\big) + (1 - p)\big(\max\{(w_H + \underline{b})\,;\, v_2^U\} - \max\{(w_L + \underline{b})\,;\, v_2^U\}\big) \leq c_1/p.$$

An uninformed worker leaves a job offering $(w_L, \underline{b})$ if $w_L + \underline{b} < v_2^U$. Since they accept the first encountered offer in period 1, $c_2 \geq c_1$ implies that the same must be true in period 2 and therefore $v_2^U = p(w_H + \bar{b}) + (1-p)(w_L + \underline{b}) - c_2$. Then, an uninformed worker leaves $(w_L, \underline{b})$ if:

$$c_2 < p\big((w_H - w_L) + (\bar{b} - \underline{b})\big).$$

For $(w_H, \bar{b})$ to be offered in equilibrium, at least informed workers should leave employment upon discovering $w_H$ paired with $\underline{b}$. By the above, $v_2^I = w_H + \bar{b} - c_2/p$ and thus:

$$v_2^I > w_H + \underline{b} \iff (\bar{b} - \underline{b}) < c_2/p.$$

To simplify $u_1^U(w_H)$ and $u_1^U(w_L)$ observe the following. An uninformed worker leaves $(w_H, \underline{b})$ if:

$$c_2 < -(1-p)(w_H - w_L) + p(\bar{b} - \underline{b}),$$

and she leaves $(w_L, \bar{b})$ if:

$$c_2 \ < \ p(w_H - w_L) - (1-p)(\bar{b} - \underline{b}).$$

Since these differences in expectations regarding offers that fail to materialise in equilibrium do not affect actual outcomes, suppose both of the above hold. Then, the condition for uninformed workers to accept $w_L$ in period 1 becomes:

$$(w_H - w_L) + p(1-p)\big((w_H - w_L) + (\bar{b} - \underline{b})\big) + pc_2 \ \leq \ c_1/p.$$

To sum up, for such an equilibrium to exist the following must hold simultaneously:

(i) $2((w_H - w_L) + (\bar{b} - \underline{b})) \ > \ c_1/p,$

(ii) $(w_H - w_L) + p(1-p)\big((w_H - w_L) + (\bar{b} - \underline{b})\big) + pc_2 \ \leq \ c_1/p,$

(iii) $c_2 \ < \ p\big((w_H - w_L) + (\bar{b} - \underline{b})\big),$

(iv) $(\bar{b} - \underline{b}) \ < \ c_2/p,$

(v) $c_2 \ < \ -(1-p)(w_H - w_L) + p(\bar{b} - \underline{b}),$

(vi) $c_2 \ < \ p(w_H - w_L) - (1-p)(\bar{b} - \underline{b}).$

It can be verified that the above are not contradictory. These conditions describing the worker's beliefs and resulting behaviour need to be supplemented with the equal profits condition, accounting for the worker flows:

$$\pi(w_H) \ = \ (2+\lambda)(y - w_H - (1-\tau)\bar{b}) \ = \ (2\lambda)(y - w_L - (1-\tau)\underline{b}) \ = \ \pi(w_L) \ \iff$$

(vii) $(2+\lambda)/(2\lambda) \ = \ \frac{(y - w_L - (1-\tau)\underline{b})}{(y - w_H - (1-\tau)\bar{b})}.$

The above conditions (i)-(vii) need to be satisfied in any perverse equilibrium, the existence of which relies on uninformed workers searching inefficiently little in period 1 and leaving dominated jobs offering low wages paired with low benefits.

**Proposition 2:** *A perverse equilibrium, in which high wages are paired with high benefits, and vice versa, may exist. In any such equilibrium, uninformed workers accept all offers in period 1 and then leave low-wage, low-benefit jobs in period 2. Informed workers search for high-wage, high-benefit jobs in period 1 and remain employed in period 2.*

**Fictitious compensating differentials equilibria.** Next, consider the case of a "fictitious compensating differentials equilibrium" in which $b(w_H) = \underline{b}$ and $b(w_L) = \bar{b}$. That is, jobs that pay higher wages 'compensate' by providing low benefits, and vice versa. After characterising such equilibria, I explain why the resulting compensating differentials are indeed 'fictitious'.

Suppose that a fraction $p \in (0, 1)$ of firms offer the high-wage, low-benefits jobs, while a fraction $(1 - p)$ offer the low-wage, high-benefits jobs. The two types have the following value of searching on the job in period 2:

$$v_2^I = \max\{p(w_H + \underline{b}) + (1-p)(w_L + \bar{b}) - c_2\,;\,(w_H + \underline{b}) - c_2/p\,;\,(w_L + \bar{b}) - c_2/(1-p)\},$$
$$v_2^U = \max\{p(w_H + \underline{b}) + (1-p)(w_L + \bar{b}) - c_2\,;\,w_H + p\underline{b} + (1-p)\bar{b} - c_2/p\},$$

depending on the adopted search strategy. Notice that in addition to accepting the first sampled offer, an informed worker could search specifically for either $(w_H, \underline{b})$ or $(w_L, \bar{b})$, depending on which compensation package provides higher total utility. An uniformed worker, in contrast, would either accept the first offer or search specifically for $w_H$.

To demonstrate that such equilibria exist without reliance on a strictly higher turnover of uninformed workers, I restrict attention to parametrisations under which $(w_H + \underline{b}) - c_2/p > (w_L + \bar{b}) - c_2/(1-p)$. This implies not only that an informed worker never targets $(w_L, \bar{b})$ in her search, but also that $v_2^U \geq v_2^I$. Intuitively, negative correlation between wages and benefits makes the uninformed worker more inclined to search on the job and to target high-wage jobs, in contrast to the case of perverse equilibrium with positive correlation.

In constructing these equilibria, it will be useful to distinguish between two cases, based on the cost ranking of the different job offers. Consider the following possibilities in turn.

### 3.2.1 Case 1: $w_H + (1-\tau)\underline{b} > w_L + (1-\tau)\bar{b}$

Since the high-wage, low-benefits job is more costly to offer, the equal profits condition requires that firms offering such a job attract a larger mass of workers, retain more workers, or both. Notice, however, that due to the existence of tax advantages, the ranking based on workers' utility does not need to coincide with the ranking based on firms' labour costs.

If it is the case that $w_H + \underline{b} \geq w_L + \bar{b}$, so that the high-wage, low-benefits jobs deliver greater utility to the workers, one can construct equilibria in which informed workers accept the first offer and uninformed workers search (inefficiently hard) for $w_H$. Upon discovering that $w_H$ is paired with $\underline{b}$, uninformed workers can either stay employed or search on the job. Neither case can be ruled out, demonstrating that higher turnover of uninformed workers is not necessary for the existence of such equilibria.

Here, I demonstrate in detail how a fictitious compensating differentials equilibrium in which $w_H + \underline{b} < w_L + \bar{b}$, so that the jobs that are more costly to provide also deliver *lower* utility, is constructed. Since the high-wage, low-benefit jobs are more costly to provide, the equal profits condition requires that they attract more workers. Because these jobs also deliver lower total utility, the only way this can be achieved is if the informed workers accept the first sampled offer in period 1, but the uninformed workers search specifically for $w_H$. Moreover, workers stay employed in their initially accepted jobs.

Expecting to stay, an informed worker accepts the first offer in period 1 if:

$$u_1^I(w_L) - u_1^I(w_H) \;=\; 2((\bar{b} - \underline{b}) - (w_H - w_L)) \;\leq\; c_1/(1-p).$$

For $(w_L, \bar{b})$ to be offered in equilibrium, workers should search on the job upon discovering $(w_L, \underline{b})$. In this case, the relevant condition applies to the informed workers, who are the only ones accepting $w_L$. Informed workers stay in low-wage, high-benefit jobs if:

$$w_L + \bar{b} \;\geq\; v_2^I \;=\; p(w_H + \underline{b}) + (1-p)(w_L + \bar{b}) - c_2 \quad\Longleftrightarrow\quad c_2 \;\geq\; p((w_H + \underline{b}) - (w_L + \bar{b})),$$

which is trivially satisfied. Informed workers leave low-wage, low-benefit jobs if:

$$w_L + \underline{b} \;<\; p(w_H + \underline{b}) + (1-p)(w_L + \bar{b}) - c_2 \quad\Longleftrightarrow\quad c_2 \;<\; p(w_H - w_L) + (1-p)(\bar{b} - \underline{b}).$$

Turning to uninformed workers, these search for $w_H$ in period 1 as long as:

$$u_1^U(w_H) - u_1^U(w_L) \;=\; (w_H - w_L) + p\big(\max\{(w_H + \underline{b})\,;\, v_2^U\} - v_2^U\big) + (1-p)\big((w_H + \bar{b}) - \max\{(w_L + \bar{b})\,;\, v_2^U\}\big) \;>\; c_1/p.$$

What does $v_2^U$ look like in this case? Suppose that when searching on the job in period 2, uninformed workers also search for $w_H$, which requires:

$$(w_H - w_L) \;>\; c_2/p.$$

Then, $v_2^U = w_H + p\underline{b} + (1-p)\bar{b} - c_2/p$. Both types stay employed in high-wage, low-benefit jobs provided that:

$$w_H + \underline{b} \;\geq\; v_2^U \quad\Longleftrightarrow\quad c_2/p \;\geq\; (1-p)(\bar{b} - \underline{b}),$$

since $v_2^U \geq v_2^I$. Even though they never accept low wages in period 1, one needs to specify uninformed workers' expectations regarding staying in low-wage, high-benefit jobs. Without loss of generality, suppose that uninformed workers expect to leave such jobs:

$$w_L + \bar{b} \;<\; v_2^U \quad\Longleftrightarrow\quad c_2/p \;<\; (w_H - w_L) - p(\bar{b} - \underline{b}).$$

Then, the uninformed workers indeed search for $w_H$ in period 1 as long as:

$$u_1^U(w_H) - u_1^U(w_L) \;=\; (w_H - w_L) + p\big((w_H + \underline{b}) - w_H - p\underline{b} - (1-p)\bar{b} + c_2/p\big) + (1 - p)\big((w_H + \bar{b}) - w_H - p\underline{b} - (1-p)\bar{b} + c_2/p\big) \;>\; c_1/p \iff$$
$$c_1/p \;<\; (w_H - w_L) + c_2/p,$$

which is trivially satisfied.

Finally, the equal profits condition boils down to:

$$\pi(w_H) \;=\; 2(y - w_H - (1-\tau)\underline{b}) \;=\; 2(1-\lambda)(y - w_L - (1-\tau)\bar{b}) \;=\; \pi(w_L) \iff$$
$$(1-\lambda) \;=\; \frac{(y - w_H - (1-\tau)\underline{b})}{(y - w_L - (1-\tau)\bar{b})}.$$

In sum, a fictitious compensating differentials equilibrium in which the high-wage, low-benefits job is strictly more costly to provide despite delivering lower utility to the workers exists and satisfies the following conditions simultaneously:

(i) $c_1/(1-p) \;\geq\; 2((\bar{b} - \underline{b}) - (w_H - w_L))$,

(ii) $c_2 \;<\; p(w_H - w_L) + (1-p)(\bar{b} - \underline{b})$,

(iii) $c_2/p \;<\; (w_H - w_L)$

(iv) $c_2/p \;\geq\; (1-p)(\bar{b} - \underline{b})$,

(v) $c_2/p \;<\; (w_H - w_L) - p(\bar{b} - \underline{b})$,

(vi) $(1-\lambda) \;=\; \frac{(y - w_H - (1-\tau)\underline{b})}{(y - w_L - (1-\tau)\bar{b})}$.

Such an equilibrium relies on the uninformed workers searching (inefficiently hard) for the high-wage offer, but not on a difference in turnover between the two types.

### 3.2.2 Case 2: $w_H + (1-\tau)\underline{b} \;\leq\; w_L + (1-\tau)\bar{b}$

When the high-wage, low-benefits job is less costly to provide, it must necessarily also deliver lower total utility. In this case, the equal profits condition requires that the low-wage, high-benefits jobs attract more workers, retain more workers, or both.

It can be shown that attracting a greater mass of workers is necessary to support such an equilibrium, while a difference in turnover between jobs is not.[12] I therefore present in detail

[12] Suppose that both jobs are accepted by both types. Then, the fact that no worker accepts with the intention of searching on the job upon discovering high benefits implies that higher retention of low-wage, high-benefit jobs relies on uninformed workers leaving high-wage, low-benefit jobs. However, when searching in period 2, uninformed workers must again accept all high-wage offers they sample, thus leading to a violation of the equal profits condition.

how to construct an equilibrium in which workers of both types remain in initially accepted employment, but low-wage, high-benefit jobs attract more workers. Given the corresponding utility ranking, the only possibility is for the uninformed workers to accept both offers, while the informed workers search specifically for $(w_L, \bar{b})$ in period 1.

Informed workers indeed search for $(w_L, \bar{b})$ if:

$$u_1^I(w_L) - u_1^I(w_H) \;=\; 2((\bar{b} - \underline{b}) - (w_H - w_L)) \;>\; c_1/(1-p).$$

Following a deviation, an informed worker would leave a low-wage, low-benefit job provided that $w_L + \underline{b} < v_2^I$. What does $v_2^I$ look like? Focusing on a case that does not result in a contradiction, suppose that an informed worker would search again for $(w_L, \bar{b})$ in period 2, which requires:

$$(w_L + \bar{b}) - (w_H + \underline{b}) \;>\; c_2/(1-p).$$

Then, $v_2^I = w_L + \bar{b} - c_2/(1-p)$ and an informed worker leaves $(w_L, \underline{b})$ provided that:

$$w_L + \underline{b} \;<\; w_L + \bar{b} - c_2/(1-p) \quad\Longleftrightarrow\quad c_2/(1-p) \;<\; (\bar{b} - \underline{b}).$$

Uninformed workers, on the other hand, accept the first offer in period 1 if:

$$u_1^U(w_H) - u_1^U(w_L) \;=$$
$$(w_H - w_L) + p\big((w_H + \underline{b}) - v_2^U\big) + (1-p)\big((w_H + \bar{b}) - \max\{(w_L + \bar{b})\,;\, v_2^U\}\big) \;\leq\; c_1/p.$$

When searching on the job in period 2, these worker target high-wage jobs as long as:

$$c_2/p \;<\; (w_H - w_L),$$

which implies $v_2^U \;=\; w_H + p\underline{b} + (1-p)\bar{b} - c_2/p$. Then, uninformed workers stay in high-wage, low benefit jobs provided that:

$$w_H + \underline{b} \;\geq\; w_H + p\underline{b} + (1-p)\bar{b} - c_2/p \quad\Longleftrightarrow\quad c_2/p \;\geq\; (1-p)(\bar{b} - \underline{b}).$$

Similarly, uninformed workers expect to stay in low-wage, high-benefit jobs if:

$$w_L + \bar{b} \;\geq\; w_H + p\underline{b} + (1-p)\bar{b} - c_2/p \quad\Longleftrightarrow\quad c_2/p \;\geq\; (w_H - w_L) - p(\bar{b} - \underline{b}).$$

Therefore:

$$u_1^U(w_H) - u_1^U(w_L) \;=\; (2-p)(w_H - w_L) - p(1-p)(\bar{b} - \underline{b}) + c_2 \;\leq\; c_1/p.$$

Finally, the equal profits condition in this case is:

$$\pi(w_H) = 2(1-\lambda)(y - w_H - (1-\tau)\underline{b}) = 2(y - w_L - (1-\tau)\bar{b}) = \pi(w_L) \iff$$
$$(1-\lambda) = \frac{(y-w_L-(1-\tau)\bar{b})}{(y-w_H-(1-\tau)\underline{b})}.$$

Overall, a fictitious compensating differentials equilibrium in which the low-wage, high-benefits job is strictly more costly to provide exists and satisfies the following conditions simultaneously:

(i) $c_1/(1-p) < 2((w_L + \bar{b}) - (w_H + \underline{b}))$,

(ii) $c_2/(1-p) < (w_L + \bar{b}) - (w_H + \underline{b})$,

(iii) $c_2/(1-p) < (\bar{b} - \underline{b})$,

(iv) $c_2/p < (w_H - w_L)$,

(v) $c_2/p \geq (1-p)(\bar{b} - \underline{b})$,

(vi) $c_2/p \geq (w_H - w_L) - p(\bar{b} - \underline{b})$,

(vii) $c_1/p \geq (2-p)(w_H - w_L) - p(1-p)(\bar{b} - \underline{b}) + c_2$,

(viii) $(1-\lambda) = \frac{(y-w_L-(1-\tau)\bar{b})}{(y-w_H-(1-\tau)\underline{b})}$.

In contrast to the previous case, such an equilibrium relies on the uninformed workers searching inefficiently little. Again, the difference in turnover between the two types is not necessary to support it.

To sum up, the following result obtains:

**Proposition 3:** *A fictitious compensating differentials equilibrium, in which high wages are paired with low benefits, and vice versa, may exist. If the high-wage, low-benefits package is strictly more costly to provide, any such equilibrium requires the uninformed workers to search (inefficiently hard) for the high-wage offers in period 1. Conversely, if the high-wage, low-benefits package is weakly less costly to provide, any such equilibrium requires the uninformed workers to search inefficiently little. Differences in turnover are not necessary, but can feature in such equilibria.*

The reason why in the above equilibria the compensating differential is fictitious is that it does not reflect the preferences of a marginal worker or the costs of a marginal firm. In the classical model of Rosen (1974, 1986), workers would have heterogeneous preferences for benefits and firms would have heterogeneous costs of providing benefits. Under perfect information, workers and firms sort into contracts with either high or low benefits, with the resulting difference in wage rates given by the indifference condition of a marginal worker and a marginal firm. With homogeneous preferences and costs, the classical framework yields an unambiguous prediction. Namely, all firms should offer high benefits, with wages set so as to satisfy the workers' participation constraint.

Accounting for information frictions on the workers' side therefore allows to generate spurious differentiation in benefits, despite the fact that all workers and all firms are identical. The fictitious compensating differentials underlying the derivation of Proposition 3 reflect the equivalence of *total profits* between firms attracting different numbers of workers, as well as the search strategies of boundedly rational workers who expect to learn the value of benefits only after accepting a particular offer.

## 3.3 Discussion

**Framing of the model.** Of course, the application to multidimensional compensation packages with salient 'wages' and hidden 'benefits' is just one way of framing predictions of the theoretical framework presented here. The same logic and results apply to settings where firms compete on observable 'price' and unobservable 'quality' of a subscription product.

**Mixed strategies.** Allowing the firms to adopt mixed strategies does not affect the conclusions drawn from the analysis above. First, if there does not exist a profitable, pure-strategy deviation from either equilibrium outlined in Proposition 1, there also does not exist a profitable deviation in mixed strategies. Second, the pure-strategy equilibria outlined in Propositions 2 and 3 are equivalent to a mixed-strategy equilibrium, in which each firm randomises over specific compensation packages. That is because the two offers generate identical expected profits.

Furthermore, in a deterministic setting, allowing for mixed strategies cannot be invoked to keep the benefits component 'hidden' from the workers. That is because for a given wage offer $w$, the firm would never have an incentive to independently randomise over the benefits component $b$. If the firm prefers the worker to stay for both periods, it would strictly prefer to offer the cheapest benefit level that prevents the worker from searching on the job. If the firm prefers the worker to leave, it would strictly prefer to offer the cheapest possible benefit.

**Continuous choice of benefits.** How would the results be affected if instead of a binary choice of benefits $b \in \{\underline{b}, \bar{b}\}$, the firms could select any benefits level from the interval $b \in [\underline{b}, \bar{b}]$? Keeping in mind that for a given wage offer $w$, the optimal level of benefits to provide is uniquely determined, we can discuss the qualitative robustness of the main results above. First, for any given $b$, a putative equilibrium with a degenerate distribution of offers necessarily features $w(b)$, such that the worker's participation constraint binds. Then, to verify whether $(w(b), b)$ indeed constitutes an equilibrium, one only needs to consider downward deviations from $b$. Suppose that the firm deviates by lowering the benefits by some $\epsilon > 0$. The deviating firm does not lose the worker, and the deviation is indeed profitable, as long as:

$$w(b) + b - c_2 \leq w(b) + b - \epsilon \iff \epsilon \leq c_2.$$

For $c_2 > 0$, one can always find a small enough increment $\epsilon \leq c_2$, such that the deviating firm is strictly better off. Thus, as long as $b > 0$, there must exist such profitable deviation and a result that is effectively an extreme version of Proposition 1 obtains. Namely, when workers cannot observe the benefits component while searching for a job, equilibria with benefits exceeding $\underline{b}$ do not exist due to unravelling. Similarly, equilibria with differentiated offers (Propositions 2 and 3) no longer exist if the firms offering high benefits can reduce those by an arbitrarily small amount.

**Behavioural types.** What is the role of specific assumptions about the workers' belief formation in generating the above results? On the equilibrium path, the informed workers associate the correct benefit level with each wage offer with probability 1. The assumption of unobservability of benefits prior to acceptance nonetheless determines the profitability of a firm deviating from high to low benefits.

The uninformed workers, in turn, may seem to act as completely naïve types who search for jobs by ignoring the complex component altogether. Nevertheless, the fact that they anticipate future learning feeds into the search strategy adopted by uninformed workers, while completely naïve types would ignore learning and thus the option value of searching on the job. For a given search strategy, the fact that uninformed workers expect to receive some benefit relaxes their participation constraint, relative to naifs.

# 4 Empirical relevance

In this section, I discuss the relevance of the model's theoretical predictions in light of the empirical work on the provision of workplace pension benefits.

**Inefficiently low benefits.** Modelling benefits as experience goods highlights a potential pitfall of delegating the provision of pension insurance to employers. Namely, if the workers find the benefits more difficult to understand and compare across offers than wages, the firms have weak incentives to offer high benefits (Proposition 1). Thus, such information frictions can result in an inefficiently low provision of benefits in equilibrium.

This prediction provides a complementary interpretation of the empirical results of Cole and Taska (2023). Combining data on job transitions with an online experiment, they find that a majority of workers have high willingness to pay (in terms of their total compensation) for access to a workplace pension plan and employer contributions. Consequently, a calibrated model of on-the-job search implies that 80% of firms could improve their hiring probability by shifting some of the total compensation towards higher benefits. While Cole and Taska (2023) explain this evidence of inefficiently low benefits by regulatory constraints on designing worker-specific compensation packages (most importantly, non-discriminatory rules in workplace pension provision), the fact that most workers place a high value on workplace benefits suggests that a reinforcing rationale could well be due to information frictions.[13]

**Benefits and turnover.** Dominated job offers with low wages and low benefits may co-exist in equilibrium with high-wage, high-benefit jobs, but they attract only the uninformed workers who leave upon learning the true value of benefits. The model therefore predicts that dominated jobs with low benefits must be characterised by higher turnover (Proposition 2).

This theoretical result resonates with robust evidence that lower benefits are associated with higher worker turnover, see for example Bennett et al. (1993), Lee et al. (2006), and Ouimet and Tate (2023). But why do workers accept these jobs in the first place? The model presented here proposes a specific mechanism based on information frictions on the worker side, specifically the difficulty of evaluating workplace benefits at the time of job search.

**Compensating differentials literature.** Information frictions would make empirical estimates of the size of compensating differentials basically impossible to interpret (Lavetti, 2023), which could explain the mixed empirical success of the conceptually appealing theory (see, e.g., Schiller and Weiss, 1980; Montgomery and Shaw, 1997; Lamadon et al., 2022).

The above model formalises the idea that workers' imperfect understanding of the complex component of a compensation package may generate spurious differentiation in benefits and fictitious compensating differentials (Proposition 3).

# 5 Conclusion

To account for the workers' imperfect understanding of complex compensation packages, in this paper I set up and analyse a dynamic search model in which boundedly rational agents treat workplace benefits as experience goods, which are not observable at the time of job search but become known after acceptance of a particular offer.

[13]By contrast, the school teachers' low willingness to pay for additional pension benefits would suggest an inefficiently high provision in the public sector (Fitzpatrick, 2015).

The model implies that under unobservabiliy of benefits prior to acceptance, an equilibrium with uniformly high benefits is more difficult to sustain than equilibrium with uniformly low benefits, which ultimately harms firms' profits (Proposition 1).

In addition, the presence of "uninformed workers", who do not update their beliefs about associated benefits when sampling a specific wage offer, generates additional equilibria with spurious differentiation in benefits. First, there may exist "perverse equilibria", in which high-wage jobs also offer high benefits, and vice versa (Proposition 2). In these equilibria, only uninformed workers accept dominated offers with low wages and low benefits, and these jobs induce strictly higher turnover. Second, there may also exist "fictitious compensating differentials equilibria", in which high wages are paired with low benefits, and vice versa (Proposition 3). Depending on the cost ranking of these differentiated offers, such equilibria require the uninformed workers to search either inefficiently hard or inefficiently little, but do not rely on differences in turnover. The logic behind these equilibria and their efficiency properties are starkly different from the qualitatively equivalent predictions of the compensating differentials theory (Rosen, 1974, 1986).

There are several avenues for future research. In particular, extending the model to account for screening of workers of heterogeneous productivity, the effects of benefits on productivity, or monopsony powers resulting from benefit differentiation would improve our understanding of how information frictions may interact with the classical rationales for providing workplace benefits.

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