Outplacement as Endogenous Adverse Selection*

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Abstract

When things do not work out, firms often help their employees find alternative employment. Little such help is provided for employees that firms wish to retain. Such behavior arises as an optimal solution to an information design problem. Workers agree to this kind of endogenous information friction, which transfers surplus efficiently, to pay for efficient training. This information structure creates adverse selection but differently for retained and released workers. It implies that wages for retained workers will be lower on average than for released workers, in contrast to a standard approach for testing for adverse selection in the labour market.

1 Introduction

In professional services, such as law firms, and consultants, and other industries where human capital is of paramount importance, firms pride themselves on outplacement

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support.[1] Such outplacement activities involve firms helping to place ill-matched or unsuitable workers through introductions to potential recruiters, for example, while providing less support for well-matched workers to find external offers.[2] By making introductions, writing reference letters and other organizational and support decisions, firms can help overcome asymmetries of information that may create adverse selection in labour markets.[3]

This paper models such outplacement activities as an equilibrium outcome of a competitive labour market, and highlights that such activities naturally arise when young workers gain valuable training. We present a model where firms compete to attract trainees (who will turn out to differ in their ability and in their match with the training firm) through offers that consist of wages, training, and information structures. While the former two aspects are familiar in the labour literature, the latter is perhaps less familiar. An information structure is a mapping from information about the worker to a publicly observable information. Potential rival employers use this public information to determine how much they would pay the worker, and,

[1] As a representative example, Bain and Co.'s recruitment page https://www.bain.com/careers/ (accessed 22nd April 2019) notes that:

> We want our employees to thrive at Bain, regardless of what their future plans are. Our dedicated career teams (Bain Career Advisory and Bain Executive Network) provide guidance and support at all stages as you plan for your future.
>
> Just two or three years with us will offer you incredible opportunities, both at Bain and beyond—from becoming a Bain partner to starting your own business, stepping into a senior role at a top tech company, joining a private equity firm or making a meaningful social impact at a nonprofit you love.

[2] To our knowledge, such support and its interaction with training has not been much explored in the economics literature. In the law literature, Gilson and Mnookin (1989), also take motivation from professional services firms—in their case, law firms. They consider outplacement support when an up-or-out policy results in the worker going out, which might also be a reasonable interpretation of our framework. However, while they consider investments in firm-specific capital, they do not allow for heterogeneous match values—a key element in our analysis that leads to rather different mechanisms, focus and results.

[3] There is a rich theoretical and empirical literature on adverse selection markets. Seminal papers include Waldman (1984), Greenwald (1986), and Gibbons and Katz (1991). Waldman (2017) brings together a number of important contributions. A recent paper, also inspired by professional services, but more focused on dynamics and featuring exogenous information structures is Kaniel and Orlov (2020).

so this information impacts on the worker's wages.

Workers vary both in their general human capital and in the quality of the match at their training firm. Indeed the latter, may be positive or negative implying that turnover can have implications for allocative efficiency.[4] Given that workers are characterized by both general human capital and match, there is scope for asymmetry of information to be rich. The current employer may know relatively more about general human capital, or about the match, or about specific realizations of both. We allow for firm to commit to any information structure and so allow for the asymmetry of information to arise in any of these ways. In this way, this paper is related to the information design literature; we consider information design in a game with multi-dimensional asymmetric information that we introduced in Bar-Isaac, Jewitt, and Leaver (2020).[5] Compared to our earlier work and to more common approaches that characterize all outcomes that can be attained through varying the information structure, here we endogenize the information structure through competition to recruit a trainee. Consequently, we focus on a particular information structure, one with a natural interpretation as outplacement. Moreover we highlight that a possibility raised in Bar-Isaac, Jewitt and Leaver (2020) that contrasts with some approaches to testing for adverse selection in labour markets—namely, that those staying on in a firm may earn less than those who move on—is a natural equilibrium outcome.

The labour context that we analyse is somewhat different from the familiar product market examples, such as for second-hand cars. In product market applications, prices are meaningful for goods that are traded. Instead, in the labour market context, wages are defined and consequential whether the worker moves to a new firm or stays at the current one. An employer naturally would prefer to retain workers at lower wages, and might prefer that workers who move on do so at high wages

[4] This can be contrasted with some of the extant literature on adverse selection in labour markets. For example, in Greenwald (1986) there may be exogenous turnover but otherwise workers are equally valuable at all firms; in Waldman (1984) misallocation is through task assignment rather than by firm; Ferreira and Nikolowa (2020) consider heterogeneous firms leading to a job ladder, so that there may be inefficient turnover.

[5] For surveys on the evolving literature on information design, see Bergemann and Morris (2019) and Kamenica (2019).

since this can make it easier to recruit employees initially. Indeed, in our set-up the information structure and the future career trajectory that it (along with training) implies is one of the tools that firms use to compete for recruits. In practice, career trajectories are key for recruitment in professional services and other human-capital-intensive industries.[6] Other studies have noted that information can play a role in this, and so in attracting workers or affecting their wages—notable examples include Stern (2004); Koch and Peyrache (2005); Albano and Leaver (2005); Mukherjee (2008); Strobl and Van Wesep (2013); Bar-Isaac and Lévy (2020); and Pallais (2014) who, in a field experiment, contrasts two different "information structures" (in our language) and shows a significant wage effect. Our study differs from this literature in its focus on heterogeneity in match-specific, as well as general, human capital; in allowing for a rich set of possible information structures; and in highlighting that an information structure that is much like the provision of outplacement support emerges as an equilibrium outcome.

Specifically, we show that by revealing the general human capital of workers who are poor matches but revealing no information about workers who are good matches, firms ensure an efficient allocation (and so maximize surplus from employment) but do so in a way that maximizes the amount of surplus that the employer obtains. In this way it provides an efficient means of workers paying for training.

Following an insight of Pigou (1912) and the seminal contribution of Becker (1962, 1964), it is well understood that general human capital might be under-provided when workers face credit constraints or employers cannot commit to provide it. It is well known that when labour markets are imperfect, firms might sponsor general training (Acemoglu and Pischke (1999) is an excellent overview). An important and widely-discussed source of such labour market imperfection is asymmetric information.[7] In this paper, in effect, we consider causality as running in the other direction: Given

[6] Bidwell, Won, Barbulescu, and Mollick (2015), for example, find that "students applying to investment banks consistently rated the extent to which the rm's reputation would help with future employability as the most important factor shaping their decisions" (p. 1170).

[7] See, also, the foundational contributions of Katz and Ziderman (1990), Chang and Wang (1996) and Acemoglu and Pischke (1998). Carter (2020) is related to our study in allowing for firm-worker matches which play an important role in leading to wage compression and in determining training decisions, though the focus is on delayed training as this match is revealed gradually.

efficient enough general training opportunities, employers structure jobs to create asymmetric information. In this way, workers can effectively pledge future surplus (in the form of reduced wages) to pay for training.[8]

Thus, our analysis highlights a natural link between firms' decisions about information structures, such as outplacement activities, and training decisions. These come together to make a position more attractive to a potential employee and are a part of a broad human capital management strategy that aims to attract, develop and retain the right talent—the key strategy for human-capital-intensive firms, such as professional services and high-tech firms.[9,10]

2 Model

Identical firms compete to attract a worker by offering a training position.[11] The training position attracts a worker through both the current wage and the prospect of opportunities in the next employment period, whether she remains at the training firm or moves to a rival employer. If the worker accepts the training position, two or more rival firms make her wage offers in the following employment period; the training firm can then choose to match the highest offer and retain the worker or to release her.

The productivity of the worker during employment depends on her type (G, M)

[8] Almazan, de Motta, and Titman (2007) consider location choice (rather than asymmetric information) as a strategic decision to introduce labour market frictions that allow for training.

[9] For example, Maister (1997, p. 189) writes that "the ability to attract, develop, retain and deploy staff will be the single biggest determinant of a professional service firm's success." Similarly in the 2004 Google IPO prospectus (p.13) states: "Our performance is largely dependent on the talents and efforts of highly skilled individuals. Our future success depends on our continuing ability to identify, hire, develop, motivate and retain highly skilled personnel for all areas of our organization."

[10] Bar-Isaac and Lévy (2020) share a similar motivation in understanding the interaction of all the elements of the proposition thaat a firm offers in terms of both compensation and future opportunities. They allow for worker efforts (which this paper does not) but considerably simplify with respect to possible information structures and, instead, consider the possibility of generating a rival offer.

[11] The case of heterogeneous firms is obviously of some interest and applied insight. We briefly consider it in the discussion at the end of the paper.

which takes realizations in $\mathcal{G} \times \mathcal{M} \subset \mathbb{R}^2$, where the set, $\mathcal{G} \times \mathcal{M}$, of feasible types is finite, and $|\mathcal{G}| \geq 2$ and $|\mathcal{M}| \geq 2$. In this notation, G is understood as the worker's natural general human capital—a productivity component common across all potential employers—and M is understood as the match value at the training firm or that part of the worker's productivity that is specific to the match; and $\mathcal{G}$ and $\mathcal{M}$ as the sets of possible values for the general and match-specific human capital, respectively.[12] The worker's productivity at her employer is simply $G + M$, the sum of her general ability and her match at that particular employer.

We assume that, while matches can be good or bad (so that $\min \mathcal{M} < 0 < \max \mathcal{M}$), all workers are productive—that is, $\min \mathcal{G} > 0$. There is a common prior, $F(.)$, with frequency $f(.)$, shared by all market participants and that this has full support—that is, $f(G, M) > 0$ for all $(G, M) \in \mathcal{G} \times \mathcal{M}$.

Firms compete to attract the worker initially by offering a contract, with three elements: first, a training wage $w_t \in \mathbb{R}_+$; second, a commitment to training, or knowledge provision, specifying whether or not general human capital training will be provided. Such training comes at a cost c and raises the human capital of any worker by a constant $a \geq 0$ when provided, so that the worker's general productivity is $G + k$ when her general human-capital type is G and $k \in \{0, a\}$ takes the value a when training is provided and 0 otherwise. With some abuse of notation we also use K to represent the firm's commitment to training. Third, the contract includes a commitment to a disclosure policy μ. This is a function from the set of types to some distribution of possible signals; that is, $\mu : \mathcal{G} \times \mathcal{M} \longrightarrow \Delta(\mathcal{T})$ where the cardinality of $\mathcal{T}$ is at least as high as $|\mathcal{G} \times \mathcal{M}|$.This determines how much of the training firm's private information is publicly revealed at the end of the training period.

In the course of training, the training firm learns the worker's type perfectly and at the end of the period, all other firms observe a common signal T, this signal is generated according to the agreed-upon information structure.[13] In particular, T is

[12] More formally, if there are n potential employers, a type might more appropriately be thought of as $\mathcal{G} \times \mathcal{M}_1 \times \mathcal{M}_2 ... \times \mathcal{M}_n$—that is, a distinct match at each possible firm. We suppose that the distribution of match values across firms is iid and zero mean. Since only the match at the training firm is relevant we suppress this notation and hope that this does not cause undue confusion.

[13] Supposing that the training firm also has choices to make regarding how much private informa-

distributed according to $\mu(G, M)$. As in the Bayesian persuasion and the recent related literature on information design, we (for now) that the training firm can commit to the information structure μ. After observing a realization, T, all other firms update their beliefs about the worker's type according to Bayes' rule.

We highlight that in writing $w_t \in \mathbb{R}_+$, we impose a lower bound (namely, zero) on the training wage. This lower bound plays an important role: the training firm's desire to claw back future rents from a credit-constrained worker motivates the firm's choice of information structure.

At the end of the first (training) period, given the information that is revealed (that is, the realization of public information T), the rival firms compete by making wage offers of the form $w \in \mathbb{R}_+$. The training firm (on the basis of its private information and, specifically, the value of the worker if retained at the firm, $G+M+k$) can choose whether to match the highest offer and retain the worker, or, instead, release the worker.[14]

Timing. The timing of the game can be summarized and formally described as follows:

First/Training Period Each firm, simultaneously offers a training contract of the form (w_t, μ, k). The worker chooses a training contract from some firm (the employer) and training takes place. The worker is paid the training wage w_t. Training is provided or not, according to k, and the cost of training (if provided) is incurred. The employer privately observes G and M, and the outside firms all observe the realization of T which is distributed according to $\mu(G, M)$ in addition to the training contract.

Second/Employment Period All outside firms simultaneously post employment wage contract offers of the form $w \in \mathbb{R}_+$ to the worker. The em-

tion to acquire (for example, the nature and intensity of internal evaluation) is clearly an interesting extension. We return to this question in the conclusion.

[14]The second-period competition for a worker effectively follows the procedure set out by Greenwald (1986), which has been adopted by much of the subsequent literature, including Gibbons and Katz (1991) and Acemoglu and Pischke (1998). Variants on this wage-setting protocol include Pinkston (2009), who studies ascending 'button' auctions, and Li (2012), who studies first-price auctions.

ployer observes the outside offers and then makes an employment wage counteroffer. The worker chooses which employment offer to accept. Production takes place; employment wages are paid according to contracts; and payoffs are realized. Worker payoffs are the undiscounted sum of wages received, while firm payoffs are undiscounted profits—i.e., productivity less wages.

Our solution concept is Perfect Bayesian Equilibrium (PBE), in which the worker's contract choice maximizes her lifetime expected wages given her beliefs, taken as the simple sum of the training wage and expected employment wage (for simplicity, there is no discounting between periods); each firm's contract offer maximizes its expected profit (again with no discounting between periods); and in the second period, the wage offer of each non-training firm, maximizes its expected profit given T and its beliefs about the wage offers by other outside firms and the strategy of the employer.

2.1 A simple illustrative case

To ease exposition and provide intuition, it is convenient to introduce a simple numerical example. We can illustrate many themes by taking $\mathcal{G}\times\mathcal{M} = \{(5,-3),(5,3),(10,-3),(10,3)\}$, so that the general ability may take the value 5 or 10, and the match value might be 3 or -3. Each combination is equally likely; that is, $f(5,-3) = f(5,3) = f(10,-3) = f(10,3) = \frac{1}{4}$. Note that $E[M] = 0$, and $E[G] = E[G|M \geq 0] = E[G|M < 0] = 7\frac{1}{2}$. We consider various training effects (that is, values for a) and associated costs, c, in the course of the paper.

3 Analysis

Rather than provide a full characterization of the game for all possible parameter values, we build intuition and derive results by describing two fairly natural information structures—full information and an outplacement-like information structure that we call "Full-Information-on-Bad-Matches." We describe properties of these information structures and when these may emerge in equilibrium.

3.1 Full information

First, as a clear benchmark consider the following information structure, that we term full information:

$$\mu^{Full}(G, M) := (G, M).^{15}$$

In the second period, competition between potential rival employers will lead them to bid up to their expected value of employing the worker. Since under full disclosure the worker's general human capital is observed directly, rival employers will bid up to this level; that is in this case, writing the wage under full information associated with a realization (G, M) of the worker's type as $w^{Full}(G, M)$, then $w^{Full}(G, M) = G + k$, where k reflects the current employer's training decision.

Of course, the current employer will match this wage and retain the worker when the worker's output in the firm is above this wage this level, that is if and only if $m+g+k > g+k$, or, equivalently, $m > 0$. This establishes the following immediately:

Lemma 1 *Under μ^{Full}, the worker is efficiently allocated, expected second period wages are $E[w^{Full}] = E[G] + k$ and expected second period profits for the employer are $E[\pi^{Full}] = E[M|M \geq 0] \Pr[M \geq 0]$.*

Competition to recruit workers in period 1 ensures that any anticipated profits are passed on to the worker in the form a first period wage. Since full information maximizes allocative efficiency, it is straightforward that if it also allows for an efficient level of training then full information can form part of an equilibrium. Thus, we can write the following.

Proposition 2 *(i) When $c \geq a$ there exist equilibria where first period contracts that set $w_t = E[\pi^{Full}]$, offer no training (that is, $k = 0$), and full disclosure are offered and taken up by workers. (ii) When $a > c$ and $E[M|M \geq 0] \Pr[M \geq 0] > c$, there exist equilibria where first period contracts that set $w_t = E[\pi^{Full}] - c$, offer training (that is, $k = a$), and full disclosure are offered and taken up.*

In fact under the conditions of this proposition, in any equilibrium the worker must earn lifetime earnings of $E[G]+E[\pi^{Full}]$ in case (i) and $E[G]+E[\pi^{Full}]+a-c$ in

case (ii). In both cases this lifetime earning reflects the greatest attainable surplus. In these cases it can be achieved through full disclosure, and first period competition ensures that the worker earns it all in expected lifetime earnings.

3.2 Full information on bad matches

However, there are other information structures that ensure a fully efficient allocation so that total surplus is maximized, while, at the same time ensuring higher second-period profits for the training firm. Such an information structure might allow for efficient training to be provided while respecting that wages should be non-negative. As described in the introduction, since such an information structure plays a key role in our analysis, we give it a name.

Definition 1 *The full information on bad matches (FIBM) information structure has the following form:* $\mu^{FIBM}(G, M) = (G, M)$ *if* $M < 0$*, and* $\mu^{FIBM}(G, M) =$ *"*$M \geq 0$*" otherwise.*

We write the associated wage as w^{FIBM}, and define it as follows:

$$w^{FIBM}(G, M) := \left\{ \begin{array}{cc} G + k & \text{if } M < 0 \\ \min \mathcal{G} + k & \text{otherwise} \end{array} \right\}.$$

First consider, the case in which the worker turns out to be a bad match. In this case, the wage is determined just as under full information: potential rival employers observe G directly, and, so, bid the wage up to this value.

Next suppose that the worker is well-matched with the current firm. Under the FIBM information structure this is the only thing that rival employers about the worker is that the worker is worth more inside the firm. Consequently, rival employers understand that if they make an offer and the current employer does not wish to retain the worker at this wage, then this offer is too high. This leads rival employers to bid lower; at the lowest possible general human capital realization $G = \min \mathcal{G}$, rival employers need no longer be concerned that the worker produces

less than their offer and so this provides a floor to how low wages can fall.[16]

Given w^{FIBM}, we can establish the following. In particular, note that if the worker is a poor match at the current firm then the worker moves on to a new firm and is efficiently allocated just as under full disclosure. Instead, if the worker is well-matched at the current firm (that $M \geq 0$) is then since the wage, $\min \mathcal{G} + k$, is below the worker's productivity at the firm, $G + M + k$, the worker is necessarily retained as is efficient.

Lemma 3 *Under μ^{FIBM}, the worker is efficiently allocated, expected second period wages are $E[w^{FIBM}] = E[G|M < 0] \Pr[M < 0] + \min \mathcal{G} \Pr[M \geq 0] + k$ and expected second period profits for the employer are $E[\pi^{FIBM}] = (E[G + M|M \geq 0] - \min \mathcal{G}) \Pr[M \geq 0]$.*

Note that since both the full and FIBM information structures lead to an efficient allocation, it is necessarily the case (and can readily be verified) that $E[w^{FIBM}] + E[\pi^{FIBM}] = E[w^{Full}] + E[\pi^{Full}]$.

Just as in our analysis of full disclosure, competition to recruit workers ensures that anticipated profits are passed on to the worker, and so if FIBM allows for efficient training, it can form part of an equilibrium.

Proposition 4 *(i) When $c \geq a$ there exist equilibria where first period contracts that set $w_t = E[\pi^{FIBM}]$, offer no training (that is, $k = 0$), and FIBM as the information structure are offered and taken up by workers. (ii) When $a > c$ and $E[\pi^{FIBM}] > c$,*

[16] This argument is slightly imprecise. For example, consider the example of Section 2.1 then if rival employers know that $M = 3$ they can be sure that any offer below 8 would lead the worker to be retained. However, analogous with the typical selection for asymmetric Bertrand competition in undergraduate IO, it is natural to suppose that the wage offer is 5: a wage offer below 5 could be ruled out, for example by trembles from the current employer and coupling this with competition between rival employers rules out wages in the range $[5, 8)$.

Moreover this assumption on $w^{FIBM}(G, M)$ when $M \geq 0$ is consistent with Bar-Isaac, Jewitt and Leaver (2020) who consider a Gaussian distribution for productivity and information and so allow for environments in which there is always some probability that the worker will be retained. There, there is an information structure in which the wage is always uniquely determined, and outcomes are, essentially, arbitrarily close to outcomces of this information structure with this selection for wages.

there exist equilibria where first period contracts that set $w_t = E[\pi^{FIBM}] - c$, offer training (that is, $k = a$), and FIBM as the information structure offered and taken up.

Comparing Propositions 2 and 4, and noting that case (ii) of Proposition 4 ensures maximal surplus when it applies, the following result is immediate.

Corollary 5 *When $a > c$ and $E[\pi^{FIBM}] > c > E[\pi^{Full}]$ then there are equilibria with FIBM but not with full information.*

Moreover, there exist parameters where this corollary applies since $E[\pi^{FIBM}] - E[\pi^{Full}] = (E[G|M \geq 0] - \min \mathcal{G}) \Pr[M \geq 0] > 0$ in general (though it may take the value 0 if, for example $\mathcal{G}$ is a singleton).

Again, just as in Section 3.1, when the conditions of Proposition 4 apply then the worker's expected lifetime earnings are equal to the maximal total expected surplus, which can be attained through FIBM.

3.3 Other equilibrium Information structures

As case (i) of Proposition 2 and of 4 indicate, there may be may be many information structures consistent with maximize the total expected surplus and that may arise with equilibrium. Full information and FIBM are two, for example, in case that training is inefficient but there are many others. For example, it should be clear that the information structure that reports only the general human capital, G, rather than both (G, M) is equivalent to full information; an information structure that reports M rather than "$M \geq 0$" leads to identical outcomes as $FIBM$.

However, under the reasonable assumption that second period wages do not fall below $\min \mathcal{G}$, the following result arises since, in the second period, the employer is indifferent to wages of workers who leave and the wages of retained workers is minimized.

Proposition 6 *Under all information structures that ensure an efficient allocation of workers to firms, FIBM maximizes the employer's second period profits.*

Consequently, FIBM is natural to focus on, not only because it has a natural counterpart in outplacement activities but because if it does not allow for efficient training, then training provision would require allocative distortion as a second-best solution in the spirit of Lipsey and Lancaster (1956), and the characterization of equilibrium information disclosure may be sensitive to specific parametric assumptions, and, in that sense, casuistic.

Consider the example in Section 2.1. Suppose that $a > c > 2\frac{1}{4}$, then training is efficient but cannot be implemented through a contract that imposes FIBM. Consider, instead, a "worst" information structure that reveals information only on a worker with low general productivity who is a bad match; that is $\mu^{worst}(5,-3) = (5,-3)$ and $\mu^{worst} = \{(5,3),(10,3),(10,-3)\}$ otherwise. Then, it can be calculated that $\pi_{worst} = 3\frac{1}{4}$, and, thus, training can be provided at a higher range of training costs; however, it can also be verified that the misallocation induced reduces surplus relative to the efficient allocation by $\frac{3}{4}$ (a high-general-ability, bad match that reduces surplus by 3 occurs with probability $\frac{1}{4}$) and so $a > c$ is not sufficient for training to be provided but $a - c$ must be greater than the costs of the induced misallocation.[17] With other parameterizations, there is no way to provide training that is more costly than $E[\pi^{FIBM}]$.[18]

4 FIBM and wages

We begin by considering the implication of FIBM for average wages of retained rather than released workers. Under the FIBM information structure, all retained workers are retained at a wage of $\min \mathcal{G} + k$, while workers who move on to new firms earn, on average, $E[G] + k$. This leads, immediately, to the following result.

[17] Of course, this may be more misallocation than needed. As long as $(a - c)$ is larger than the cost of misallocation, and $3\frac{1}{4} > c > 2\frac{1}{4}$, the equilibrium will feature an outcome in which the worker goes to a training firm that offers a training wage $w_t = 0$, and provides training. Allowing for random information structures, it is clear that equilibrium would feature an outcome equivalent to a convex combination of FIBM and "worst" that ensures $\pi = c$.

[18] For example, adapt the example in Section 2.1 to suppose that M is equally likely to take the values 6 and -6 (rather than 3 and -3) while maintaining that G is equally likely to take the value 5 or -5.

Proposition 7 *Under FIBM, there is adverse selection, but workers who stay at the training firm earn less than workers who move on to new firms.*

At first blush, in the context of the previous literature on asymmetric information in labour markets, it may seem surprising that released workers earn more than retained workers. However, it is consistent with the following observations: (i) firms might be concerned with keeping down the wages of its own workers, but less concerned about the wages of workers that it is less interested in retaining, and (ii) people who move on often earn more than people who stay on at a firm.[19]

In earlier work, Bar-Isaac, Jewitt and Leaver (2020), we highlighted the possibility of positive or negative selection of those workers who leave a firm compared to those who stay, and that those who leave a firm might earn more or less than those who stay in the firm. This work allowed for a wide range of possibilities and implications associated with labour markets

One approach is to characterize whether there are, indeed, limits on outcomes. This is, broadly, the approach that follows Bergemann, Brooks and Morris (2015) and Bergemann and Morris (2016), as well as a subsequent literature that addresses the outcomes that can be achieved in different games without knowing fine details of the information structure.[20] This is also the approach in Bar-Isaac, Jewitt and Leaver (2020), who also parameterize the information structure and, further, provide conditions under which certain relevant outcomes (such as lower wages for those who are retained) arise.

In itself, this speaks to a literature following Gibbons and Katz (1991), which tests for adverse selection in labour markets by comparing outcomes for different selections. This literature has sometimes had mixed results. Schönberg (2007) finds evidence of adverse selection for college graduates, while Hu and Taber (2011) find a marked effect for white males, though these authors suggest less asymmetry for other groups; see, also, Pinkston (2009), Kahn (2013) and Friedrich (2019). In a recent

[19] See, for example, Lang and Weinstein (2016) or Bidwell (2011), whose finding that external hires by a large investment bank are, on average, paid 18 percent more than internal promotions to identical positions is consistent with this result.

[20] For surveys on the evolving literature on information design, see Bergemann and Morris (2019) and Kamenica (2019).

contribution, Lang and Weinstein (2016) suggest that to reconcile findings, one must move away from the standard model; introducing multi-dimensional and, specifically, match-specific types is one means of doing so and can explain some of these results, which have been interpreted as inconsistent with asymmetric information as a key driving force.

However, assessing whether the wages of retained workers are higher or lower than the wages of those who leave requires knowledge of the parameters of the information structure that may be difficult for researchers to observe. Indeed, this is the motivation for seeking "robust" outcomes. An alternative approach is to ask whether theory can provide any guidance as to what sort of information structures arise. The contribution of the present paper rests squarely on this question.

Our analysis suggests that when information structures are endogenously determined through competition between training firms, if asymmetric information arises, it imposes adverse selection on the workers who are retained. It does so by providing the outside labour market with more information about the general capabilities of workers who are a poor fit for the current employer than about those who are well-matched. In particular, it stresses that well-matched workers are, indeed, well-matched. This has stark implications for wages as Proposition 7 has illustrated.

5 Discussion

5.1 Commitment to an information structure

We have assumed that firms can commit to information structures before observing any characteristics of workers. This kind of ex-ante commitment to information disclosure is not unusual in theoretical models of information disclosure; Kamenica and Gentzkow (2011) is a recent influential example. Clearly, it requires some discussion in the context of any application. First, we defend it as reasonable, to some extent, in the labour market application before questioning its importance for qualitative insight.

In practice, different information structures do arise, in many instances as a result

of firm procedures that are largely fixed across different trainees and that arise out of explicit firm decisions. For example, firms vary in their human resources practices and the nature and amount of information they collect on employees (for example, in the intensity and frequency with which employees are reviewed, and in the assessment criteria). Indeed, it should be immediately apparent that our analysis would apply if the information structure referred to information that was collected within the firm and all such information was available externally. In practice, internal HR procedures do choose to highlight and examine particular aspects of performance.

The information available to rival firms also varies; for example, in the software industry, the information about programmers that outsiders observe can differ dramatically depending on whether the project is open- or closed-source (as discussed, for example, in Lerner and Tirole (2005), Spiegel (2009), and Blatter and Niedermayer (2008)), and firms credibly commit (either contractually or, often, through reputational concerns) to the amount of time a programmer can spend on open source. Similarly, firms can limit the extent to which a consultant or lawyer has direct access to and contact with clients; they can publicize the kind of work that the worker is engaged in by, for example, allowing public websites or blogs; or they can even institute explicit rules and restrictions for social interactions (Liebeskind, 1997). These tend to be organizational rules or standard terms in contracts rather than terms tailored to individual employees. More broadly, choices over production technologies (such as whether to require team or solo production) and the design of the organization (including layers of hierarchy and promotion criteria, as discussed by Waldman (1984)) will affect the information structure and, specifically, the information available to potential rival employers. Further, in many industries, firms advise employees and presumably provide more-detailed references when things do not work out. Indeed, there is an industry to help in such outplacement activities. Here, we abstract from considering the direct costs of such choices when deciding which kind of and how much information to collect and make public. And while, in reality, commitment may be partial and imperfect, we simplify the analysis and highlight mechanisms by making the somewhat extreme assumption of perfect commitment.

Another standard response to the commitment assumption is to wave hands fu-

riously (or generate reams of algebra) and rely on a firm's reputation as a means to ensure appropriate commitment. While we are not averse to such an argument (and, historically, have not been averse to generating such impenetrable algebra), it is also worth noting our belief that the central intuitions may not depend crucially on a firm's ability to commit to an information structure.

In the case of the running example, while FIBM is not a sustainable information structure without commitment, an information structure that reveals information only about the worst possible type (a bad match of low general ability) is sustainable without commitment. In the case of the worst productivity at the firm $(5, -3)$, a training firm loses nothing by revealing this outcome. Moreover, if this is what outside employers anticipate, and if the training firm discloses nothing otherwise, the wage it would pay its worker is 5—as low a wage as is feasible given that the worker's general productivity never falls below 5. Note that this "worst" information structure has the feature that retained workers earn no more than workers who move on and adverse selection operates, so wages for many workers are below their general productivity. More generally, one might expect that since bad matches are less productive for the training firm, it is more willing to reveal information about them, leading to qualitatively similar results.

It might also be the case that firms cannot commit easily to information structures but might be able to commit to other aspects of organizational design. One such celebrated aspect of organizational design is the up-or-out contract and a hierarchy that (approximately) fixes promotion rates; this is common, not only in the academic tenure system (where promotion rates are generally flexible), but also in partnership tracks in law firms and similar professional firms.[21] Suppose that a firm is committed to retain only half of the workers it trains; then, evidently, in the example in Section 2.1, FIBM can be sustained as the training firm would seek to retain the well-matched workers—of type $(10, 3)$ and $(5, 3)$—and so may reveal little additional information about them. Instead, the firm would release the poorly matched workers who are less productive, and there would be no loss from revealing all the information about

[21] The ability of up-or-out contracts to effectively commit employers to future wages is familiar from Kahn and Huberman (1988) and Waldman (1990).

them.

5.2 Commitment to training

In our analysis, we have assumed that firms contract on training provision—that is, firms can commit to provide training. This is a strong assumption, not only in application, but also in the context of a literature in labour theory that seeks to understand how training could be provided in the absence of such commitment. The more recent literature relaxes full commitment to training and focuses on dynamic considerations: Morrison and Wilhelm (2004) and Bar-Isaac (2007), in a related anaylsis, highlight the role of the partnership firm in creating a commitment for a mentor's effort, and Garicano and Rayo (2017) consider the provision of training over time. An earlier literature, one we build on here, is focused on shorter-run considerations. Acemoglu and Pischke (1999b), in particular, and as mentioned above, highlight the role of labour market frictions in compressing the structure of wages. We build on this insight below.

As noted above, in our model, training has an identical effect on all workers and augments their ability by the same fixed component. Consequently, rival wage offers fully compensate for this augmentation of training. If, instead, training has different implications for different types of workers or stochastic and privately-observed effects, then the extent to which rivals will compensate a worker for her augmented skills will depend on publicly available information.

This is easy to understand in the context of the example in Section 2.1. Suppose that training has no effect on low-human-capital types, and, instead, raises the productivity of high-human-capital types. That is, the augmentation of human capital arises only when the natural general human capital of the worker is equal to 10. With no commitment to training, there will be no training under full disclosure, even if training is efficient (which in this case would require that $a > 2c$, where the 2 arises since training is effective only half of the time). However, under FIBM, if the training firm chooses to train, then it anticipates retaining all well-matched workers (whether of high or low general human capital) at a wage equal to 5 (the general productivity

at the low-type level). Since all types are equally likely, there is a $\frac{1}{4}$ probability that the worker is well-matched and of high general human capital; and so as long as $a > 4c$, even without commitment to training, training is provided under FIBM, though it is never provided under full disclosure, and a worker can anticipate that a firm offering FIBM will provide training. Since FIBM maintains the efficiency of the allocation and provides training in this case, there is no way for a rival training firm to profitably offer a more attractive package to the worker.

As an alternative example, assume that the worker is known to be of low quality and that training has a stochastic and privately-observed effect. Specifically, say that the worker is known to be equally likely to be a $(5, 3)$ or $(5, -3)$ type; but now suppose that general training has a stochastic effect and is equally likely to have no effect or to raise the general human capital to 10. Under full disclosure but with no commitment to training, the firm will not train the worker; however, under FIBM the firm will be able to retain a good match—whether of high or low human capital—at a wage of 5, and so expects to earn an additional 5 with probability 1/4 (the probability that training is effective and the worker is a good match) if it provides training.

It is worth noting that, in this subsection, there has been no mention of the non-negativity of the first-period training wage. With no commitment to training, even when the non-negativity constraint does not bind, there is a role for information structures that create adverse selection in the second period. This is because when there is no commitment to training, the training firm must anticipate a sufficient second-period return to induce such training. Indeed, a lack of commitment to training (with much of it informal), coupled with fairly high training wages and approaches to outplacement that resemble FIBM, might capture features of the professional services industry in a more compelling way than would the baseline model with commitment to training.

5.3 Other aspects

In our analysis, we assume that the training firm knows the worker's general productivity and match value perfectly. If it is costless to learn about the worker's type, then the analysis in an earlier working paper version of this project (Bar-Isaac, Jewitt and Leaver (2014)) suggests that this assumption is without loss of generality: although it may not be the case for a fixed information structure, when a firm can vary the disclosure policy at the same time that it acquires information, it can increase efficiency with no impact on adverse selection. Consequently, there is nothing to lose but, potentially, something to gain from gathering all available information. Of course, in practice, internal review systems do come with costs. To the extent that it is easier to commit to gathering particular kinds of information than to disclosing them, the discussion in Section 5.1 suggests that firms might choose to focus their internal review systems on evaluating and stressing the worker's fit with the firm rather than on the more transferable skills.

Perhaps the greatest weakness of the above analysis is the treatment of workers who are not active agents in the analysis. Workers are assumed to have no information about their own abilities initially. Further, they take no actions that affect their productivity; that is, there is no moral hazard. There are two aspects of moral hazard that may be relevant. A familiar one is actions that raise the worker's output either in the current period or as investments in general human capital. Information structures can act to provide incentives for workers to exert effort, as in the literature on career concerns following Holmstrom (1999) and Dewatripont, Jewitt, and Tirole (1999). Such concerns are likely to lead to information structures that balance providing incentives to the worker and transferring surplus to induce the training firm to invest in training, as in Bar-Isaac and Lévy (2020). More specific to our analysis, note that with an information structure such as FIBM, since bad matches expect higher earnings than good matches expect, a worker might prefer to be viewed as a bad match. Over a long training period (for example, a partnership track that may last a decade or more), it may not be easy for a worker to dissimulate her type. In addition, trying to reduce the training firm's perception of only the match value and

not the general ability may be difficult. Indeed, the willingness to engage in such behavior might vary (Frankel and Kartik, forthcoming and references therein) and, frankly, might be viewed as a negative general-human-capital trait.

More broadly, in an ongoing relationship, a worker may resent being "punished" for being a good fit. Wage determination might not simply reflect the outside option, and the importance of maintaining goodwill may mitigate and interact with the forces that we have outlined here, leading to outcomes that are not as extreme as the ones that we have characterized. Moreover, while a training and one work period are clearly analytically convenient, many periods of work suggest that a worker may want to start afresh if offered a wage well below her productivity or, perhaps, to set up on her own and establish a new firm. These options would increase with higher human capital, regardless of information disclosure, but may involve some costs, and, thus, are unlikely to fully overwhelm the effects we describe.

There are other natural questions and extensions that one could consider. In the above analysis, training is a discrete binary decision and related solely to general productivity. There is, of course, a rich tradition that considers much more nuanced training decisions and choices regarding both specific and general human training.[22] Our hope, however, is to provide a simple and clear setting in which to illustrate forces. Moreover, by allowing firms to choose any information structure, we are likely allowing for more flexibility than is possible in practice. The extent to which firms have discretion over the information available to rival employers or can affect it is likely to vary by industry.[23]

Finally, in our analysis we have assumed that all firms are identical. In practice

[22] On this latter aspect, note that, to the extent that firm-specific training creates additional surplus that, through competition, would, otherwise lead to higher training wages, it can relax the non-negativity constraint. Therefore, opportunities for firm-specific training might be complementary to the provision of general training. Stevens (2012), Kessler and Lulfesmann (2006) and Balmaceda (2007) also highlight strategic complementarity between firm-specific and general training though through different mechanisms. All these approaches rely in some way on an imperfect labour market. Our analysis suggests that there may be additional interactions through the implications for the distribution of match values.

[23] In work that is related in spirit, Burguet, Caminal and Matutes (1999) argue that in certain industries characterised by extreme visibility of performance, specifically professional sports, incentives are created for restrictive labour practices such as the imposition of transfer fees.

and anecdotally in professional services, some firms might provide more opportunities to augment general human capital (offering "better training") and, thus, be relatively more attractive. Some firms are particularly desirable as starting points for a career, and part of their offering is not only training but, as suggested in Footnote 1, access to help in securing a career beyond the firm. This is easy to interpret in the context of our analysis.[24]

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