Information and Human Capital Management*

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Abstract

An increasingly important organisational design problem for many firms is to recoup general human capital rents while maintaining attractive career prospects for workers. We explore the role of information management in this context. In our model, an information management policy determines the statistic of worker performance that will be available to outside recruiters. Choosing different statistics affects the extent of regression to the mean which, we show, in turn affects the incidence of adverse selection among retained and released workers. Using this observation, we detail how optimal information management policies vary across firms with different human capital management priorities. This view of human capital management via information management has strong implications for labour market outcomes. We discuss the impact on average wages, wage inequality, wage skewness and labour turnover rates.

Keywords: human capital, information disclosure, regression to the mean, adverse selection, turnover, wage distribution, human resource management.

JEL Classification: D82, J24, L21.

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"Google is organized around the ability to attract and leverage the talent of exceptional technologists and business people". Open letter from Google's founders prior to IPO, April 2004.

1 Introduction

It has often been remarked that firms wishing to enhance the general human capital of their employees face the prospect of having wages bid up at the expense of profit. The simplest solution, proposed by Becker (1964), is to have workers pay for such skills up-front. Of course, this is impractical when the sums involved are significant, especially for credit constrained workers at the outset of their careers. As the above quote attests, innovative firms for whom human capital development is especially important must therefore organise in a manner that both attracts and exploits talented workers.[1] This paper explores the role of what might be called information management policies in the context of this organisational design problem. Indeed, we do so in a stylised model that *identifies* organisational design with human capital management via information management. Specifically, organisation design consists of firms choosing and committing to information disclosure policies as part of the initial contracts used to compete for new workers.

The paper makes two contributions. First, we characterise optimal information management policies as a function of technological differences across firms. Our results here are driven by a simple trade-off: policies that best enable firms to exploit talent (by capturing general human capital rents) make it hard to attract employees, and vice versa. Equilibrium policies therefore reflect the relative importance to the firm of attracting versus exploiting talent. Second, we show how optimal information management policies impact on sector-specific and economy wide-wage distributions and turnover rates.[2]

In brief outline the model is as follows. Firms compete to hire workers in each of two periods. Initial contracts consist of a wage offer and disclosure policy. Having chosen a first period employer, workers generate performance statistics which are privately observed by their employer, as well as acquiring skills that are valuable in second period production. Outside firms observe some statistic of this information as determined by the disclosure policy and then make second period wage offers. Having observed these offers, first period employers decide whether to retain their workers (matching the highest outside offer) or to release

[1] We understand 'leveraging of talent' to be a combination of enhancing the human capital of employees *and* exploiting that human capital by retaining some of the rents in terms of higher profits. Simply endowing workers with a large quantity of general human capital is a poor business model unless a way can be found to recapture some of the rents.

[2] Acemoglu (2002) stresses that technological changes are likely to alter the ways in which firms organise production and consequently impact on labour market outcomes. The current paper endorses this view and details such a mechanism.

them. Workers then engage in second period production and the game ends.

This model is designed to exploit familiar ideas, with the predominant forces at work simply being adverse selection and regression to the mean.[3] The latter arises because the employer's best estimates – based on her private information – of worker second period productivity if retained within the firm (*retained* human capital) and if released to join another firm (*general* human capital) are not perfectly correlated. In other words, there is a "match specific" component to productivity; sometimes workers will be expected to be more productive if retained and sometimes more productive if released. In this context, regression to the mean implies that workers with high retained productivity are likely to have lower productivity elsewhere, conversely workers with low retained productivity in their first employment are expected to have higher productivity elsewhere. This provides a reason for some workers to switch jobs purely on the grounds of efficiency. A contribution of the paper is to explore how this 'legitimate' reason for job turnover interacts with the other fundamental force, adverse selection, as firms choose information management policies.

To see how this choice is resolved, note that disclosure polices impact on the future careers of workers and future firm profits. Each possible disclosure policy therefore generates a pair of outcomes: expected future earnings for the worker and expected future profits for the firm. The set of all possible disclosure policies will lead to a set of such possible outcomes. The human capital management policy for our firms corresponds to the best choice from this feasible set, bearing in mind that first period wages can transfer future profit to workers but, because of credit constraints, not necessarily future wages to profit. Firms facing competition to attract workers (*competitive firms*) will seek to maximise efficiency and will therefore choose different disclosure policies to 'technologically advantaged' firms facing limited competition and whose objectives include the transformation of worker rent into profits via adverse selection (*skill-augmenting firms*).

Adverse selection arises when outside employers draw inferences from the current employer's retention decision. A disclosure policy that eliminates the need to make this inference therefore removes adverse selection. This will evidently happen if the first period employer discloses its best estimate of outside productivity. Equally, if the employer discloses its best estimate of inside productivity, then public information is finer than that contained in the retention decision, so once again there is no adverse selection. Since these two policies induce the same adverse selection (and hence the same expected wage), firms will evaluate them on the basis of their efficiency in allocating labour. In Section 3.1, we show that the first policy is best in this respect because the wage auction achieves an efficient allocation. A corollary

[3] Adverse selection can, of course, be traced back to Akerlof (1970). Regression to the mean predates even Galton (1885) who fixed the idea in what Koenker (2001) calls "Arguably, the most important statistical graphic ever produced." Galton's graphic related child and parental height. Tall parents tend to have tall children, though not so tall as themselves. Similarly for short parents. Of course, we are concerned with productivity in first and subsequent employments rather than heights of parents and children but the principal is the same.

of this observation is that competitive firms, seeking to maximise total surplus, will choose to disclose their best estimate of outside productivity. Such policies maximise the amount of wage inequality over all policies which generate no adverse selection.

More generally, we can define the quantity of adverse selection at each realisation of the disclosed statistic as the difference between the wage if there were no private information and its equilibrium value. In Section 3.2, in our joint normal specification of the model, we show that disclosure policies consisting of a garbled report of the firm's best estimate of outside productivity (i.e. estimate plus random noise) generate an amount of adverse selection that is independent of the realisation. This simply means that conditioning on the retention event shifts down the regression line. These policies do not, however, generate the most favourable trade-off between efficiency and adverse selection. Specifically, we identify policies for which the retention event tilts the regression line such that adverse selection is imposed more heavily on those workers which it is efficient for the firm to retain. Evidently, this makes it cheaper to retain workers for a given level of efficiency. We show that the best policies from this perspective take a simple form—disclosure of (the best estimate of) a weighted difference between productivity outside and within the firm.[4]

The above result has implications for labour market outcomes. In Section 3.2, we calculate how wage distributions and labour turnover rates respond, via information management policies, to technological changes in the skill-augmenting sector. A decline in either the mean of estimated general human capital formation or mean match quality, or an increase in the variance of estimated match quality, increases the rate of labour turnover in the skill-augmenting sector. Interestingly, since an increase in the variance of an estimate can be interpreted as an improvement in information, this suggests that observed increases in labour turnover could stem from improved information acquisition within 'innovative' firms. Turning to the distribution of wages, an increase in the "skill-gap" (the expected human capital difference between the skill-augmenting and competitive firms) increases inequality and skews the distribution of wage in the skill-augmenting sector to the left, while an increase in the mean, or a reduction in the variance, of estimated match quality increases inequality but has little impact on skewness. We conclude by noting that the analysis easily extends to economy-wide outcomes and offers a potential (unified) explanation for increases in labour turnover and right skewness in wage distributions.

Related Literature As noted above, our analysis draws on the familiar concepts of adverse selection and regression to the mean (the latter inducing match quality). These concepts have been applied in the labour economics literature, although typically separately. The notion of match quality was introduced by Jovanovic (1979) who shows that a non-degenerate distribu-

[4] In the language of auction theory, the auctioneer discloses a combination of common and private valuations, rather than, e.g., a garbling of the common valuation.

tion of worker-firm match values leads to worker turnover as information about match values accrues over time. In emphasising the dynamics of the learning process, Jovanovic abstracts from general human capital and (hence) adverse selection aspects. In contrast, Greenwald (1986) focuses squarely on adverse selection, highlighting that this force can lead workers to earn less than their marginal products and limit labour turnover.[5] Indeed, in Greenwald's model turnover is limited to such an extent that separations only occur for exogenous reasons. We show that introducing a non-degenerate distribution of match quality into a model of general human capital formation counterbalances the forces of adverse selection. Even when firms hold private information relating to general human capital (the Greenwald case), our model endogenously generates positive labour turnover.

In this sense, our paper is related to Li (2006) who also seeks to explain job mobility in the presence of asymmetric information over worker productivity. Li models the wage determination process as a first price auction. This creates a bidding situation similar to Milgrom and Weber's (1981) analysis of the 'mineral rights' model in which there is a single informed bidder and a number of uninformed bidders. In this setting, the uninformed bidders adopt a mixed strategy which generates positive turnover and a nondegenerate distribution of wages. In our model wages are determined via a second price auction and turnover arises from the non-degenerate distribution of match quality. Notably, this gives an efficiency rationale for turnover that is absent in Li's model. A further difference is that Li assumes the information structure to be exogenously fixed.

Eeckhout (2006) also studies a setting where current employers (exogenously) have superior information to outsiders. In his model there is gradual learning, as in Jovanovic (1979), but over general human capital rather than match quality. This approach contrasts with our model where information asymmetries are endogenous and there is persistence in match-specific values (the latter leads to our regression to the mean effect). A further difference arises in the wage-determination process. In Eeckhout's model wages are determined via a second price auction with two heterogenous bidders − an incumbent and a challenger, each of whom have private information. In our model, wages are pinned down by the behaviour of (interim) identical outside firms. This "competitive fringe" assumption greatly simplifies the analysis.

Although we abstract from internal organisation costs of information management in order to focus on the adverse selection efficiency trade-off most directly, our paper relates to a significant organisational economics literature in which internal organisation costs play a major role. Waldman (1984) (and more recently DeVaro and Waldman (2005)), Ricart-i-Costa (1988) and Blanes i Vidal (2007) argue that, since adverse selection in the labor market can

[5]The fact that workers earn less than their marginal products gives rise to the possibility of firm-sponsored human capital investments. This idea is developed in many subsequent papers including Katz and Ziderman (1990), Chang and Wang (1996) and Acemoglu and Pischke (1998). Acemoglu and Pischke (1999) provide a review that emphasises the role of *exogenous* market frictions.

affect wages,[6] retention rates and thereby profits, firms will have incentives to distort (respectively) promotion, task assignment or delegation decisions. These are examples where organisational design is partly motivated by human capital management issues and, furthermore, impacts through information flows to the labour market.[7]

Finally, our paper is also closely related to a growing literature studying information disclosure (see, e.g., Calzolari and Pavan (2006), Mukherjee (2006), Koch and Peyrache (2004), Albano and Leaver (2005), Almazan, Suarez and Titman (2006)). Like the current paper, this literature highlights that an employer's information management policy forms part of overall compensation as it influences an employee's future career prospects.[8] Typically, however, the focus has been on a choice between full and no disclosure, circumstances in which full disclosure is optimal or moral hazard problems. We do not consider moral hazard, but do allow for more general disclosure policies and focus in greater detail on labour market outcomes.

2 The Model

2.1 Description

The economy consists of N firms, $M < N$ workers and an array of random variables representing information and productivity. Firms compete to hire, or retain, a worker in periods one and two. A first period employer, some firm I, can control information flows to other outside firms. It is convenient to refer to first period employment as training.

Information. If a worker trains at firm I, firm I privately observes a vector-valued 'test statistic' Q_I. Outside firms observe nothing at this stage. The vector Q_I should be thought of as everything the firm knows about its worker; it will generally include first period output in the firm, but for simplicity we assume the value of this production component to be zero.

Productivity. While training at firm I a worker acquires skills that are useful in future production. Let Y_{II} denote the value of a worker's second period output when retained in firm I, $Y_{II'}$ the value of her second period output when released to a different firm I' and Y_I the vector productivities (for all N second period employers) following training at firm I.

[6]Gibbons and Katz (1991) present empirical support for the economic significance of such effects. More recently, Schönberg (2007) finds evidence of adverse selection for college graduates, while Hu and Taber (2005) find a marked effect for white males.

[7]Burguet, Caminal and Matutes (1999) take a different path using similar ingredients. They argue that in certain industries, specifically professional sports, characterised by extreme visibility of performance, incentives are created for restrictive labour practices—such as transfer fees.

[8]Calzolari and Pavan (2006) allow for general disclosure policies, and do not have a labour market application specifically in mind. They do not consider the possibility of retention and assume a monopsonist employer in the second period, leading to somewhat different effects and considerations.

First Period Contracts The N firms compete to hire a worker in the first period through publicly observable contracts. For a given firm I, a contract specifies:

1. A training wage $w_I \geq 0$. The worker is credit constrained.

2. A disclosure policy $T_I = T_I(Q_I)$ from a set of possible disclosure policies Γ_I to be discussed in detail in Section 3. Note that we assume firms cannot disclose what they do not know. We do not consider randomised disclosure policies (Q_I will generally contain noise terms however).

Employment Wage Determination Outside firms compete to hire a worker in the second period and make "take it or lose it" employment wage offers. First period employers then either match the best offer made to their worker or release this worker to join one of the highest outside bidders. We discuss alternative wage determination procedures in Section 2.4.

2.2 Simplifying Assumptions

In order to simplify the analysis of the employment wage determination process, we impose the following assumption on the joint distribution of test statistics and productivities.

Assumption 1. *For any pair of firms I and I', (Q_I, Y_{II}) and $(Q_I, Y_{II'})$ have identical distributions.*

Outside firms are therefore *interim identical*. For any given disclosure policy adopted by the first period employer, outside firms all take the same view of the worker's likely output in their firm in the second period. Given this assumption, we can uniquely define

$$G_I \underset{def}{=} E[Y_{II'}|Q_I], \quad I \neq I'.$$

The random variable G_I is the first period employer's best estimate of the worker's value in an outside employment (her *general* human capital). Since the first period employer holds all of the information relating to this worker in the economy, G_I is also the quantity that outside firms seek to estimate when making their employment wage offers. Similarly, we can define

$$R_I \underset{def}{=} E[Y_{II}|Q_I].$$

The random variable R_I is the first period employer's best estimate of the worker's value in the current, inside employment (her *retained* human capital).[9]

G_I will generally differ from R_I. Experience $Q_I = q$ may reveal that a worker fits especially well with firm I ($E[Y_{II}|Q_I = q] > E[Y_{II'}|Q_I = q]$) or, equally, that there has been a

[9]Our analysis allows Q_I to contain Y_{II} and $Y_{II'}$ but certainly does not rest on this assumption; all that is required is that firm I learns something about its worker's likely inside and outside value during training.

bad match. Differences between G_I and R_I will play an important role in our analysis, with the statistical possibility of a bad match *endogenously* generating labour turnover. It is natural to adopt a framework in which this matching manifests itself through regression to the mean: workers who perform well (badly) in their initial employment will tend to perform worse (better) if they switch jobs. This corresponds to an assumption that the regression 'line' $E[G_I|R_I = x]$ has a slope (derivative) everywhere between zero and one, implying, for instance, that $Cov(G_I, R_I) \geq 0$ and $Cov(R_I - G_I, R_I) \geq 0$. In fact, we will make a somewhat stronger assumption.

Assumption 2. *For each firm I, the pair of random variables $(R_I - G_I, G_I)$ are affiliated with density logconcave in each variable taken separately.*

It follows that, $E[G_I|R_I = r]$, $r - E[G_I|R_I = r]$ and $E[G_I|R_I - G_I = r]$ are all increasing in r.[10] *For any $w \in \mathbb{R}$, $E[G_I|R_I \leq w] \leq E[G_I]$ and $E[G_I|R_I \geq w] \geq E[G_I]$.*

Regression to the mean introduces a "genuine reason for sale" which counterbalances the standard Akerlof lemons effect and tends to protect the market for experienced workers from complete collapse. Given regression to the mean, in the absence of any further information disclosure, an outside firm need not conclude that any worker it can hire at a given wage will generate a loss at that wage; rather, a released worker may simply have been a bad match. A further implication of regression to the mean is that efficiency in the allocation of labour requires a positive turnover of workers; to maximise career productivity, a selection of workers *should* switch jobs in the second period.

With Assumption 1 in hand, characterising employment wage determination is relatively straightforward. Since outside employers are interim identical, employment wages will be set in Bertrand competition, and hence equal the expected productivity of a worker in an outside firm conditional on the publicly available information. This information includes the event that the worker is released by her current employer.[11] The equilibrium employment wage when a worker is employed by firm I and $T_I = T_I(Q_I) = t$ is realised is defined implicitly by

$$w_{T_I}(t) = E[G_I|T_I = t, R_I \leq w_{T_I}(t)], \tag{1}$$

whenever such a $w_{T_I}(t)$ exists.[12] The notation $w_{T_I}(t)$ denotes the wage payable under disclosure policy $T_I = T_I(Q_I)$ when $T_I = t$ is realised (we use T_I to denote both the disclosure policy and the random variable that it generates); $w_{T_I}(T_I)$ therefore denotes the random wage which

[10] For a proof of this claim, see the Appendix.

[11] The relevance of this event to employers bidding for G_I (common values) is familiar from auction theory.

[12] At this level of generality, we cannot rule out (perverse) cases where the implicit function theorem fails. In such cases, the equation does not define the function w_{T_I}, however, the condition is still required to hold. Also, it is possible that there is no w such that $w = E[G_I|T_I = t, R_I \leq w]$, in which case we set $w_{T_I}(t) = \inf \text{supp } G_I$.

will be generated by the disclosure policy. We will write the expected employment wage as

$$W_{T_I} = E[w_{T_I}(T_I)]. \tag{2}$$

It is important to note that we have not assumed that all firms are identical. Of course, firms are not all interim identical because a first period employer has private information about its worker. Neither have we assumed that the firms are ex-ante identical since, under Assumption 1, the joint distribution of (Q_I, Y_I) can differ across first period employers. We take the view that certain firms, typically innovative or in some other way privileged, naturally enable workers to acquire more skills.[13] As such, we do not assume that $E[G_I] = E[G_{I'}]$ for all I, I'. Rather, we make the next simplest assumption which is to distinguish between "skill-augmenting" and "competitive" firms. When we wish to invoke this distinction we will refer to a typical skill-augmenting firm as firm K and a typical competitive firm as firm J (I continues to denote a generic firm).

Assumption 3. *There are $N_1 < M$ skill-augmenting firms and $N - N_1$ competitive firms in the economy. Competitive firms are exchangeable: for each pair of competitive firms J, J', (Q_J, Y_{JI}) is equal in distribution to $(Q_{J'}, Y_{J'I})$. For each skill-augmenting firm K, (G_K, R_K) has the same distributions as $(G_J + \Delta_K, R_J + \Delta_K)$ for some $\Delta_K > 0$. In other words skill augmenting firms, simply add Δ_K to the general human capital of their employees.*

Just as Assumption 1 simplifies second period labour market competition, Assumption 3 simplifies first period labour market competition. Skill-augmenting firms are advantaged and in short-supply, and will (therefore) all hire one worker at the prevailing wage. This leaves the remaining $N - N_1$ exchangeable firms to Bertrand compete for the $M - N_1$ free workers. It is this Bertrand competition that determines the prevailing wage. Our concern will be to explore how the employment policies of different firms vary with the size of the skill gap. We remark that the skill gap is treated here as exogenous but in a natural variant of the model it could arise from firms choosing to invest in general human capital.

When discussing labour market outcomes, it will be of interest to consider a variant of Assumption 3 in which N_1 is a variable parameter which may exceed the number of workers M. In this event (corresponding to a high demand for labour in the skill-augmenting sector), the employment wage will be set by skill-augmenting firms themselves.

[13] The quote heading this article hints that Google may be one such a firm. Although the history of Silicon Valley is still in the making, there are analogies with high tech industries of the early industrial revolution. Tweedale (1996) discusses human capital in the Sheffield steel industry during the 19th Century and quotes "... [when a melter] knocked the end off the cold ingot [he] saw in the fractured surface more than a college full of analysts could tell him ... [and] ...could distinguish ... a variation in hardness corresponding to a fiftieth part of one percent of carbon." "Firms were very secretive." "Some of these melters became very wealthy men."

Assumption 3′. *There are N_1 exchangeable skill-augmenting firms and $N - N_1$ exchangeable competitive firms in the economy. For each skill-augmenting firm K, the skill gap $\Delta = E[G_K] - E[G_J]$ is positive.*

Assumption 3′ differs from Assumption 3 in that all the skill augmenting firms are identical. This will serve to make wage setting Bertrand-competitive in the case where $N_1 > M$.

2.3 Equilibrium

Our simplifying assumptions enable us to characterise equilibria piecemeal by solving two maximisation problems, one for a representative competitive firm J and another for a skill augmenting firm K. To state these problems we will introduce two final pieces of notation. The first is expected second period profit, equal to output less employment wages in the event that the worker is retained (which occurs if the profits from doing so are positive), and which we write as

$$\Pi_{T_I} = E[(R_I - w_{T_I}(T_I))^+], \tag{3}$$

where $(x)^+$ denotes x when positive, zero otherwise. The second is the feasible set, $\Omega(\Gamma_I)$. This set is the main object of our analysis and consists of the expected employment wage-second period profit pairs (W_{T_I}, Π_{T_I}) that can be achieved for a given set of disclosure policies, Γ_I.

Competitive firms attempt to hire one of the $M - N_1$ 'free' workers in the first period by offering to pay their entire expected second period profit in training wages: $w_J = \Pi_{T_J}$. Thus, the problem facing a competitive firm J when choosing a disclosure policy is simply one of expected surplus maximisation

$$\max_{(W_{T_J}, \Pi_{T_J}) \in \Omega(\Gamma_J)} W_{T_J} + \Pi_{T_J}. \tag{4}$$

This behaviour by competitive firms pins down a worker's outside-option. Any worker turning down a training contract at a skill-augmenting firm can receive the solution to (4) at a competitive firm. Denoting this equilibrium outside-option by $\bar{U}$ (suppressing the dependence on Γ_J), the problem facing a skill-augmenting firm K (or indeed any other) can be written as

$$\max_{(W_{T_K}, \Pi_{T_K}) \in \Omega(\Gamma_K)} W_{T_K} + \Pi_{T_K} - \bar{U} + (\bar{U} - W_{T_K})^-, \tag{5}$$

where $(x)^-$ denotes x when negative, zero otherwise. Notice that when $\bar{U} > W_{T_K}$, the maximand in (5) differs from that in (4) only by a constant, and when $\bar{U} \leq W_{T_K}$ it coincides with (3); the firm chooses the training wage and disclosure policy to maximize its second period profits.

We define an equilibrium as an array of training contracts for competitive firms $\{w_J, T_J\}_J$ each satisfying wage consistency (1) and surplus maximisation (4), and an array of training contracts for skill augmenting firms $\{w_K, T_K\}_K$ each satisfying wage consistency and (worker participation constrained) profit maximisation (5). The maximisation problems are entirely straightforward, save for establishing the feasible set. Before going on to discuss $\Omega(\Gamma_I)$ in detail, we conclude this Section with a brief discussion of key modelling choices.

2.4 Discussion of Assumptions

Minimum Wages The existence of a lower bound on the initial (training) wage offered to workers plays a central role in our analysis. Specifically, it is a firm's desire to claw back future rents from a credit constrained worker which drives its information management policy. To simplify the analysis, we abstract from any lower bound on second period wages. Note that if there were such a bound, it would be necessary to specify what happened to workers whose ex-post competitive wage fell below this bound. One could assume some form of employment protection whereby workers who are not bid away at the minimum wage retain their position in their current employment, or more interestingly, *unemployment*. Thus extended, our framework would generate predictions not only about labour turnover and wage inequality but also flows into unemployment. It is one of a number of possible extensions left for future research(ers).

Employment Wage Determination The model of employment wage determination is that outside firms bid up wages and the current employer gets to retain the worker by matching the best outside offer. Equivalently, there is an ascending open auction in which firms bid up wages until all but one firm drops out of the bidding. We briefly discuss two alternatives.

One alternative is for contracts to specify the employment wage function rather than the disclosure policy. If the function w_{T_I} is part of the initial contract (alongside the training wage) and the performance realisation $(T_I(Q_I))$ is explicitly disclosed, then the same results obtain.[14] As noted above, another alternative that does deliver somewhat different results is proposed by Li (2006). Li's first price auction model would appear to be appropriate in cases where final wage offers can be made by either side of the market, but not credibly communicated to the other side before the wage round must be concluded.

3 Analysis

We proceed in two stages. First in Section 3.1 we establish some benchmark results under our general distributional assumptions for (G_I, R_I) but with a highly restricted set of available

[14] Providing the wage function is monotone, the contract is public information and the employment wage is observable, it would be immaterial whether the performance realisation $(T_I(Q_I))$ was also explicitly disclosed. Note however, that it is possible for a disclosure policy to give rise a wage function $w_{T_I}(t)$ that is *not* monotone in t.

disclosure policies. Specifically, we focus on the case where $\Gamma_I = \{G_I, R_I, \varnothing_I\}$ in which firms choose between disclosing everything of interest to their competitors for labour G_I, disclosing the realised productivity of the worker in their current employment (more strictly, the estimate of future productivity within the firm), and disclosing nothing. Most of the related literature also restricts attention to these policies. Our analysis clarifies the forces at work and fixes some general features of the feasible set. Then, in Section 3.2, we specialise to the joint normal case. This allows us to explicitly trace through the impact of information management on labour market outcomes when there is a rich set of alternative disclosure policies.

3.1 General Distribution, Restricted Disclosure Policies

3.1.1 Disclosure Policies, $\Gamma_I = \{\boldsymbol{G_I}, \boldsymbol{R_I}, \varnothing_I\}$

Here we restrict the policy space to the following three more or less natural disclosure policies.

1. G_I-disclosure, firm I discloses its best estimate[15] of the worker's general human capital: $T_I(Q_I) = E[Y_{JI}|Q_I] = G_I$.

2. R_I-disclosure, firm I discloses its best estimate of the worker's productivity if retained within the firm $T_I(Q_I) = E[Y_{II}|Q_I] = R_I$.

3. $\varnothing_I-$disclosure,[16] firm I discloses no information: $T_I(Q_I) = \varnothing_I$.

3.1.2 The Feasible Set

Characterising the feasible set amounts to ranking W_{T_I} and Π_{T_I} for the disclosure policies in Γ_I. We start with employment wages, and first define the *degree of adverse selection* when $T_I = t$ is realised

$$AS_{T_I}(t) = E[G_I \mid T_I = t] - E[G_I \mid T_I = t, R_I \leq w_{T_I}(t)]. \tag{6}$$

The quantity $AS_{T_I}(t)$ measures how much lower the employment wage is when outside firms condition on the employer's retention behaviour in addition to the realisation $T_I = t$. Expected adverse selection equals the expected shortfall in employment wages from outside productivity,

$$E[AS_{T_I}(T_I)] = E[G_I] - W_{T_I}. \tag{7}$$

[15]Note that the same results would be achieved by disclosing all of the available information in the vector Q_I. Throughout we restrict our attention to scalar disclosure statistics.

[16]We retain the subscript since the type of the firm is informative: $W_{\varnothing_K}$ will not in general equal $W_{\varnothing_J}$.

G_I-**disclosure**

$$w_{G_I}(G_I) = E[G_I | G_I, R_I \leq w_G(G_I)] = G_I. \tag{8}$$

Notice that there is no adverse selection under general disclosure: $AS_{G_I}(g) = 0$. This is because, having observed $G_I = g$, outside firms have no reason to pay attention to the employer's retention behaviour. Taking expectations over the random variable $w_{G_I}(G_I)$, the expected employment wage is simply expected general human capital

$$W_G = E[G_I]. \tag{9}$$

R_I-**disclosure**

$$w_R(R_I) = E[G_I | R_I, R_I \leq w_R(R_I)] = E[G_I | R_I]. \tag{10}$$

Again, there is no adverse selection, $AS_{R_I}(r) = 0$; in this case because the disclosed statistic $R_I = r$ supplies finer information than the event that the worker is released, $R_I \leq w_R(r)$. However, there is now regression to the mean, with $r - E[G_I | R_I = r]$ increasing in r. Intuitively, outside firms anticipate that low (high) values of firm I productivity may be due to a negative (positive) match and that productivity in a new match will tend to regress to the ex-ante expected value. By the law of iterated expectations, the expected employment wage is still equal to expected general human capital

$$W_R = E[(E[G_I | R_I])] = E[G_I]. \tag{11}$$

$\varnothing_I-$**disclosure**

$$w_{\varnothing_I} = E[G_I | R_I \leq w_\varnothing]. \tag{12}$$

There is now adverse selection, $AS_{\varnothing_I} > 0$. However, in contrast to Akerlof's (1970) Lemons model or Greenwald's (1986) application to the labour market, $w_{\varnothing_I}$ does not collapse to the lower support of G_I (even in the absence of a minimum wage) because outside firms anticipate that low values of firm I productivity will partly be redressed by regression to the mean.

Using the above wage comparisons, we now state two results which characterise the feasible set $\Omega(\{G_I, R_I, \varnothing_I\})$.

Proposition 1. *For any firm I, G_I-*disclosure *generates maximum expected surplus.*

Proof. Under G_I-disclosure, $w_{G_I}(G_I) = G_I$ and so, from (3), $\Pi_{G_I} = E[(R_I - G_I)^+]$. Summing Π_{G_I} and W_{G_I} gives $E[G_I] + E[(R_I - G_I)^+]$ which is clearly the maximum achievable expected surplus. ■

Under G_I-disclosure a first period employer releases its worker whenever $R_I \leq G_I$. Since this implies that the worker is released if and only if there is a negative match, labour is always efficiently allocated across firms. The same cannot be said of the two other disclosure policies. Under R_I-disclosure, firm I releases its worker whenever $R_I < E[G_I]$ and so it is possible for the worker to be released following a positive match (because G_I is low) and retained following a negative match (because G_I is high). As we now show, $\varnothing_I-$disclosure is less efficient still.

Proposition 2. *For any firm I,*

i. *R_I-disclosure generates $W_{R_I} = W_{G_I}, \Pi_{R_I} \leq \Pi_{G_I}$;*

ii. *$\varnothing_I-$disclosure generates $W_{\varnothing_I} \leq W_{G_I}, \Pi_{\varnothing_I} \geq \Pi_{G_I}$ with*

$$W_{\varnothing_I} + \Pi_{\varnothing_I} \leq W_{R_I} + \Pi_{R_I} \leq W_{G_I} + \Pi_{G_I}.$$

Proof. The ranking of expected employment wages $W_{\varnothing_I} < W_{R_I} = W_{G_I}$ follows from (9), (11) and (12). The profit ranking $\Pi_{R_I} \leq \Pi_{G_I}$ follows from Proposition 1 and the fact that $W_{R_I} = W_{G_I}$.

To establish $\Pi_{\varnothing_I} \geq \Pi_{G_I}$, note since $E[G_I] \geq w_\varnothing$, it is immediate that $\Pi_{\varnothing_I} = E[(R_I - w_\varnothing)^+]$ $\geq E[(R_I - E[G_I])^+]$. It suffices therefore to establish $E[(R_I - E[G_I])^+] \geq E[(R_I - G_I)^+]$. The result follows because the variation in G_I tends to cancel the variation in R_I and convex functions 'like' variation. More precisely, note that $E[R_I - E[G_I]|R_I - G_I = x] - E[R_I - G_I|R_I - G_I = x] = E[G_I - E[G_I]|R_I - G_I = x]$ is increasing in x by Assumption 2. This fact, together with the equality of means, implies the random variable $E[R_I - E[G_I]|R_I]$ is riskier than $E[R_I - G_I|R_I]$. Using the convexity of $(x)^+$ gives the result. To establish $W_{\varnothing_I} + \Pi_{\varnothing_I} \leq W_{R_I} + \Pi_{R_I}$ note that under R_I-disclosure, firm I retains the worker in the event $E[R_I - G_I|R_I] \geq 0$. Hence the R_I-disclosure allocation solves the following optimal allocation problem

$$\max_{0 \leq p(\cdot) \leq 1} E[E[R_I - G_I|R_I]p(R_I)],$$

where p is any probability of retention based on R_I. The $\varnothing_I-$disclosure efficiency level

$$E[(R_I - G_I).1\{R \geq w_\varnothing\}] = E[E[R_I - G_I|R_I].1\{R_I \geq w_\varnothing)]$$

is smaller by revealed preference. ■

The feasible set, $\Omega(\{G_I, R_I, \varnothing_I\})$ as derived in Propositions 1 and 2, is illustrated in Figure 1, where downward sloping lines depict points of equal expected surplus. A commitment to G_I- disclosure generates higher expected surplus for firm I than R_I-disclosure because, as noted above, it results in more efficient retention behaviour. Bertrand competition between outside firms ensures that this expected surplus is split between firm I and its worker. Since the expected employment wage is the same in both cases, firm I must be strictly worse off under R_I-disclosure by virtue of the "smaller pie". Inefficient retention behaviour creates an even "smaller pie" under $\varnothing_I-$disclosure. Intuitively, adverse selection depresses wages and causes excess recruitment relative to R_I-disclosure. The key difference now is that, although expected surplus is smaller, the worker receives a smaller share. Proposition 2 tells us that adverse selection drives the expected employment wage $W_{\varnothing_I}$ sufficiently far below W_{G_I} to leave firm I better off.

Notice that, under $\varnothing_I-$disclosure, adverse selection is ameliorated by regression to the mean. A better policy for the firm would therefore be achieved by "turning off" the regression to the mean effect. In fact, the best policy from this perspective would be one which induces severe adverse selection for a worker the firm wishes to retain, but not for one the firm wishes to release (so as to avoid up front transfers). We show how a policy along these lines can be achieved in Section 3.2, where we consider disclosure policies that combine R_I and G_I.

3.1.3 Equilibrium Contracts and Labour Market Outcomes

In addition to characterising contracts (which are typically hard to observe), we are also interested in their consequences for observable labour market outcomes. The following all depend heavily on the disclosure policy and are therefore characterised alongside equilibrium contracts for different firms J, K:

1. Probability of labour turnover;
2. Unconditional wage distribution for workers;
3. Conditional wage distributions for retained and released workers.

The following result holds regardless of Γ_J (providing G_J-disclosure is in this set).

Proposition 3. *For each competitive firm J with $G_J \in \Gamma_J$,*

i. Contracts: G_J-disclosure *and a training wage of* $w_J = \Pi_{G_J}$.

ii. Labour market outcomes: *Labour turnover takes place with probability* $\Pr[R_J < G_J]$. *The distribution of employment wages is identical to the distribution of G_J. If G_J and $(R_J - G_J)$ are independent, the distribution of wages is the same for both retained and released workers; if G_J and $(R_J - G_J)$ are affiliated the distribution of wages for retained workers first degree stochastically dominates that for released workers.*

Proof. A competitive firm J chooses G_J-disclosure since this maximises expected surplus. Bertrand competition (zero profits) ensures that $w_J = \Pi_{G_J} = E[(R_J - G_J)^+]$. The labour market outcomes follow immediately from the choice of disclosure policy. ■

Proposition 3 is intuitive, the more striking results will appear when we contrast with the situation of skill augmenting firms.

Behaviour by competitive firms pins down $\bar{U} = E[G_J] + E[(R_J - G_J)^+]$. This observation, together with Proposition 2, enables us to solve the maximisation problem in (5), and hence characterise the equilibrium behaviour of, and resulting labour market outcomes for, skill-augmenting firms with available disclosure policies $\Gamma_K = \{G_K, R_K, \varnothing_K\}$.

Proposition 4. *For a skill augmenting firm K with* $\Gamma_K = \{G_K, R_K, \varnothing_K\}$,

1. *If* $E[G_K]$ *is small* ($E[G_K] \leq E[G_J] + E[(R_J - G_J)^+]$ *suffices*), *then*

i. Contracts: G_K-disclosure *and a training wage of* $w_K = \max\{\bar{U} - E[G_K], 0\}$.

ii. Labour market outcomes: *Labour turnover takes place with probability* $\Pr[(R_K - G_K) < 0]$. *The distribution of employment wages is identical to the distribution of* G_K *and, if* G_K *and* $(R_K - G_K)$ *are independent, is the same for both retained and released workers.*

2. *If* $E[G_K]$ *is sufficiently large,* ($E[G_K] > E[G_J] + E[|R_J - G_J|]$ *suffices*), *then*

i. Contracts: $\varnothing_K-$disclosure *and a training wage of* $w_K = \max\{\bar{U} - W_{\varnothing_K}, 0\}$.

ii. Labour market outcomes: *Labour turnover takes place with positive probability (less than* $\Pr[(R_K - G_K) < 0]$*). The distribution of employment wages is degenerate at* $W_{\varnothing_K} < E[G_K]$ *for both retained and released workers.*

Proof. If $E[G_K] \leq \bar{U}$, then G_K-disclosure maximises surplus and the training wage $w_K = \bar{U} - E[G_K]$ just meets the worker participation constraint. Therefore this policy maximises firm K expected profit subject to the worker participation constraint. If $E[G_K] > \bar{U}$, then G_K-disclosure with training wages $w_K = 0$ remains efficient but the worker receives some of the surplus in excess of the participation constraint. In a neighbourhood where $E[G_K] - \bar{U}$ is positive but small, the surplus paid to the worker remains less than the efficiency loss of switching to another disclosure policy.

If $E[G_K] - \bar{U}$ is positive and large enough, the extra surplus paid to the worker under G_K-disclosure will exceed the efficiency loss under null disclosure. To verify this consider the two cases (a) $w_{\varnothing_K} \geq \bar{U}$, (b) $w_{\varnothing_K} < \bar{U}$. For case (a) proposition 2(ii) establishes that profit is higher under null disclosure, training wages are set at zero. In case (b) firm profit is $E[(R_K - w_{\varnothing_K})^+] - (\bar{U} - w_{\varnothing_K}) \geq E[R_K - w_{\varnothing_K}] - \bar{U} + w_{\varnothing_K} = E[R_K] - \bar{U}$. Hence, it suffices that $E[R_K] - \bar{U} \geq E[(R_K - G_K)^+]$. Equivalently, $E[R_K - G_K] + E[G_K] - \bar{U} \geq E[(R_K - G_K)^+]$, or $E[G_K] - \bar{U} \geq -E[(R_K - G_K)^-] = E[(G_K - R_K)^+]$. Substituting for $\bar{U}$, $E[G_K] \geq E[G_J] + E[(R_J - G_J)^+] + E[(R_K - G_K)^+]$. The result follows since, by Assumption 3, $R_J - G_J$ and $R_K - G_K$ have the same distributions. ■

Figure 2 displays the situation. Suppose the worker's outside-option is at the level of point A (above W_{G_K}). In this case, even the high expected employment wage under G_K-

disclosure, fails to (strictly) satisfy the worker's participation constraint. To hire the worker, a skill augmenting firm K must surrender expected profit by paying a positive training wage. It will adopt a policy of G_K-disclosure, since this maximises the "pie" and, with the worker's share fixed, leaves the largest possible share for the firm.

Alternatively, suppose the worker's outside-option is at the level of point B (below but in the neighbourhood of W_{G_K}). In this case, the expected employment wage under G_K- disclosure more than meets the worker's outside-option. The ideal strategy for firm K would be to offer a negative training wage that held the worker to her outside-option and increased expected profit by $W_{G_K} - \bar{U}$. However, given worker credit constraints, this is not possible. With the firm unable to claw back rent via the training wage, switching to a disclosure policy that generates adverse selection starts to look attractive. Unfortunately for the firm, switching to $\varnothing_K-$disclosure destroys surplus. Once it has compensated the worker for the shortfall in utility ($\bar{U} - W_{\varnothing_K}$) by paying a positive training wage, the remaining level of expected profit is less than that achievable under G_K-disclosure; i.e. in Figure 2, point B lies to the *left* of Π_{G_K}. In contrast, suppose the worker's outside option is at the level of point C (some distance below W_{G_K}). Now the firm will choose $\varnothing_K-$disclosure. In this case the rent to be recouped is large enough to justify the destruction of surplus; i.e. point C lies to the *right* of Π_{G_K}.

Proposition 4 takes a restricted set of polices for comparison. This, it shares with most of the disclosure literature. The implications for labour market outcomes are rather stark, especially in that the distribution of wages for workers in the K firms becomes degenerate. We now allow for a wider class of disclosure policies by specialising to a joint normal distribution.

3.2 Joint Normal Distribution, Arbitrary Disclosure Policies

For any firm I, the random variables (G_I, R_I) are now assumed to be joint normally distributed. In some of what follows (namely where we calculate wages), we will also assume that G_I and $(R_I - G_I)$ are independent.[17] To avoid confusion, we will term the former case 'joint normality' and the latter the 'independent joint normal' model.

3.2.1 Disclosure Policies, Γ_I joint normal.

We also limit the set Γ_I to disclosure policies such that (G_I, R_I, T_I) are joint normally distributed with T_I scalar. This assumption rules out mixed strategies (e.g. disclose G_I with probability p, R_I with probability $1-p$), conditional strategies (e.g. disclose R_I if $G_I \geq 0$) and partitional strategies (e.g. disclose either that $G_I \geq 0$ or $G_I < 0$). It does, however, close the model in a natural and interpretable way.

With (G_I, R_I, T_I) joint normal, a convenient parameterisation is in terms of the linear combination $T_I = aG_I + bR_I + cX_I$, where X_I is a unit variance, independent noise term avail-

[17] All calculations are available from the authors as Mathematica Notebook files.

able via Q_I. Since the random variable T_I can always be rescaled to have any chosen mean and variance without altering its information content, only two of the parameters a, b and c are free. It is convenient to set $a = 1 - b$, implying that disclosure policies are characterised by the two parameters b and c:

$$T_I = (1-b)G_I + bR_I + cX_I. \tag{13}$$

The above parameterisation simplifies the characterisation of the feasible set. However, it will also be useful to map from these parameters to their associated regression coefficients. In what follows, we will use two simple and two multiple regression coefficients. The simple coefficients are on T_I in the regression of G_I (R_I) on T_I, which we denote by $\beta_{G_I T_I}$ ($\beta_{R_I T_I}$). Normalising $Var(G_I) = 1$, denoting $Var(R_I - G_I)$ by σ^2 and assuming $Cov(G_I, R_I) = 1$, these coefficients write as

$$\beta_{G_I T_I} = \frac{1}{(1 + b^2\sigma^2 + c^2)}$$

and

$$\beta_{R_I T_I} = \frac{1 + b\sigma^2}{(1 + b^2\sigma^2 + c^2)}.$$

The multiple coefficients are on T_I (R_I) in the multiple regression of G_I on T_I and R_I, which we denote by $\beta_{G_I T_I . R_I}$ ($\beta_{G_I R_I . T_I}$) and write as

$$\beta_{G_I T_I . R_I} = \frac{(1-b)\sigma^2}{(1+\sigma^2)(1 + b^2\sigma^2 + c^2) - (1 + b\sigma^2)^2}$$

and

$$\beta_{G_I R_I . T_I} = \frac{(1 + b^2\sigma^2 + c^2) - (1 + b\sigma^2)}{(1+\sigma^2)(1 + b^2\sigma^2 + c^2) - (1 + b\sigma^2)^2}.$$

The three disclosure policies discussed in Section 3.1 are easily stated under either parameterisation. G_I-disclosure corresponds to $b = c = 0$, giving $\beta_{G_I T_I} = \beta_{R_I T_I} = 1 = \beta_{G_I T_I . R_I} = 1$ and $\beta_{G_I R_I . T_I} = 0$. R_I-disclosure corresponds to $b = 1, c = 0$, giving $\beta_{G_I T_I} = 1/(1+\sigma^2)$ and $\beta_{R_I T_I} = 1$ with the remaining coefficients undefined.[18] Finally, $\varnothing_I-$disclosure corresponds to $c \to \infty$, giving $\beta_{G_I T_I} = \beta_{R_I T_I} = \beta_{G_I T_I . R_I} = 0$ and $\beta_{G_I R_I . T_I} = 1/(1+\sigma^2)$.

In addition to disclosing G_I, R_I or X_I, our framework permits firm I to *combine* these random variables. It is worth highlighting the following cases:

1. Garbling G_I with $b = 0, c \neq 0$ ($\beta_{G_I T_I . R_I}, \beta_{G_I R_I . T_I} > 0$).
2. No garbling: Linear combinations of G_I and R_I
   (a) Weighting $(R_I - G_I)$, with $b > 1, c = 0$ ($\beta_{G_I T_I . R_I} < 0$, $\beta_{G_I R_I . T_I} > 0$).

[18] A singularity occurs at $T_I = R_I$.

(b) Weighting G_I, with $1 > b > 0, c = 0$ ($\beta_{G_I T_I . R_I} > 0$, $\beta_{G_I R_I . T_I} < 0$).

(c) Differencing G_I and R_I with $b < 0, c = 0$ ($\beta_{G_I T_I . R_I}, \beta_{G_I R_I . T_I} > 0$).

Under each of these policies firm I's retention behaviour conveys information and so there is adverse selection for outsiders in recruitment, $AS_{T_I}(t) \neq 0$.

3.2.2 The Feasible Set

Our first result expresses $w_{T_I}(t)$ in terms of the regression coefficients, the conditional standard deviation of the random variable $[R_I | T_I = t]$, denoted by $\sigma_{R_I|T_I}$, and the unit normal hazard function h.[19]

Proposition 5. *Under joint normality, the equilibrium employment wage satisfies*

$$w_{T_I}(t) = \beta_{G_I T_I} t - \beta_{G_I R_I . T_I} \sigma_{R_I|T_I} h \left(\frac{\beta_{R_I T_I} t - w_{T_I}(t)}{\sigma_{R_I|T_I}} \right) \tag{14}$$

where finite. Equilibrium adverse selection therefore satisfies

$$AS_{T_I}(t) = \beta_{G_I R_I . T_I} \sigma_{R_I|T_I} h \left(\frac{\beta_{R_I T_I} t - w_{T_I}(t)}{\sigma_{R_I|T_I}} \right). \tag{15}$$

Proof. See Appendix. ∎

The employment wage function takes a particularly simple form for garblings of G_I, i.e. disclosures of G_I plus noise. In this case, adverse selection is constant and equilibrium employment wages equal expected outside productivity conditional only on T_I less this constant. To see this note that if T_I is such a garbling, since $R_I - G_I$ is uncorrelated with G_I, it is uncorrelated with the garbling T_I, hence $\beta_{(R_I - G_I)T_I} = 0$, and therefore $\beta_{R_I T_I} = \beta_{G_I T_I}$. Substituting this into the wage equation yields

$$AS_{T_I}(t) = \beta_{G_I R_I . T_I} \sigma_{R_I|T_I} h \left(\frac{AS_{T_I}(t)}{\sigma_{R_I|T_I}} \right), \text{ for all } t,$$

which implicitly defines $AS_{T_I}(t)$ as a constant. We can write this constant as

$$AS_{T_I}(0) = \sigma_{R_I|T_I} k(\beta_{G_I R_I . T_I}). \tag{16}$$

where $k(x)$ is the iteration $k(x) = xh\left(xh\left(...\right)\right)$, this evidently has a fixed point at zero, the only other is at a point we denote $k \approx 0.302$. It follows that

[19] The conditional standard deviation writes as $\sigma_{R_I|T_I} = ((1+\sigma^2) - \left(1 - b + (1+\sigma^2)b\right)^2)^{1/2}$.

Corollary 1. *Under joint normality, for T_I any garbling of G_I, the equilibrium employment wage satisfies*

$$w_{T_I}(t) = \beta_{G_I T_I} t - k\sigma_{R_I|T_I} \approx \beta_{G_I T_I} t - 0.3\sigma_{R_I|T_I}. \quad (17)$$

The amount of adverse selection is, unsurprisingly, increasing in $\sigma_{R_I|T_I}$ which is a measure of how much uncertainty is left to be attributed to the retention decision. As T_I garbles G_I more, $\sigma_{R_I|T_I}$ increases. In general, for disclosure policies other than garblings of G_I, of course, adverse selection is not independent of the realised disclosure. Indeed, this fact is crucial to the design of information management polices: the trick is to determine a disclosure policy which imposes adverse selection disproportionately on those workers it is efficient to retain. Note however that, for any given disclosure policy, the *sign* of adverse selection is constant for all t (it is equal to $\beta_{G_I R_I . T_I}$). Moreover at the realisation $T_I = 0$, equation (16) remains valid for any disclosure policy for which there is finite adverse selection. Hence, at the mean realisation of the disclosed statistics, realised wages are ranked according to the conditional standard deviations $\sigma_{R_I|T_I}$.

Proposition 5 solves for the employment wage in terms of a calculable function. Given this function, the feasible set $\Omega(\Gamma_I)$ can also be calculated. Following the discussion in Section 3.1.3, our primary interest lies in the upper boundary of $\Omega(\Gamma_I)$ below $E[G_K]$. Recall that with reservation utility $\bar{U}$ below $E[G_K]$, firm K will seek to switch away from G_K-disclosure to a policy that drives the expected employment wage down to $\bar{U}$. The most attractive policy is the one that achieves this expected employment wage while generating the highest expected second period profit Π_{T_I}; that is, the most efficient policy that achieves $W_{T_I} = \bar{U}$. For this reason, we refer to the upper boundary of $\Omega(\Gamma_I)$ as the *efficiency frontier*. Our next result (calculated using (14) with G_I and $(R_I - G_I)$ assumed independent) shows that the efficiency frontier does not consist of policies which garble G_I with noise, rather G_I is combined with R_I.

Proposition 6. *In the independent joint normal model, for any firm I, the efficiency frontier of the set $\Omega(\Gamma_I)$ is generated by the disclosure policies $T_I = (1-b)G_I + bR_I$, with $b < 1$, $c = 0$.*

1. *With $1 > b > 0$, expected employment wages W_{T_I} are greater than $E[G_I]$.*
2. *With $b = 0$, expected employment wages equal $E[G_I]$.*
3. *With $b < 0$, expected employment wages are less than $E[G_I]$.*
4. *A policy with $b = 1, c = 0$ is on the lower boundary of the set.*
5. *A policy with $b > 1, c = 0$ induces extreme adverse selection, expected employment wages are infinite.*

Before turning to equilibrium contracts and labour market outcomes, it is worth pausing to discuss features of the feasible set and, in particular, its efficiency frontier plotted in Figure

3 (for values of $b \in [1/3, -4/3]$). We first consider what is required for a disclosure policy to drive the expected employment wage below $E[G_K]$, then how a given reduction in W_{T_I} can be achieved most efficiently.

To drive the expected employment wage below $E[G_I]$, firm I must ensure that expected adverse selection is positive. Since the sign of $AS_{T_I}(t)$ is the same for all realisations of T_I, this requires that $AS_{T_I}(t)$ be positive for some t. From (15), $AS_{T_I}(t)$ is positive only if $\beta_{G_I R_I . T_I} > 0$, giving a simple and intuitive condition. Firm I will create adverse (rather than positive) selection − i.e. depress $w_{T_I}(t) = E[G_I | T_I = t, R_I \leq w_{T_I}(t)]$ below $E[G|T = t]$ − if and only if a lower value of R_I is bad news for G_I given T_I.

One might think that this condition will hold whenever retention behaviour is informative. As Figure 3 illustrates, this is not the case; part of the feasible set lies *above* $E[G_I]$. The unifying feature of these policies with $\beta_{G_I R_I . T_I} < 0$ is that G_I is combined with R_I, with more weight on G_I.[20] Of course, as Figure 3 also illustrates, there are many policies that *do* satisfy this condition and hence drive the expected employment wage below $E[G_K]$. Indeed, of the four types of 'combined' policies listed above, only the third fails. The question is therefore why some of these policies are more efficient than others, and in particular why the fourth type ($b < 0, c = 0$) traces out the efficiency frontier below $E[G_I]$?

To see the answer, note that, even when two disclosure policies generate the same expected employment wage, the *distribution* of adverse selection over t may vary. Figure 4 illustrates, depicting two disclosure policies that generate the same expected adverse selection (the area under both quantile functions is ≈ 0.47) but with very different distributions. A garbling of G_I (policy C) depresses wages uniformly: AS_{T_I} is constant at every quantile of $T_I = G_I + \sqrt{5}/2X_I$. In contrast, differencing R_I and G_I (policy D) imposes a lot of adverse selection at low quantiles of $T_I = 3/2G_I - 1/2R_I$ and little adverse selection at high quantiles (and indeed none at $p = 1$). This is efficient, as low quantiles are associated with a good matches, while high quantiles are associated with bad matches. Since this policy depresses wages most when retention is efficient and least when retention is inefficient, it generates a higher surplus than the policy where wages are depressed uniformly (in Figure 3 the wage-profit pair associated with policy C lies to the left of the pair associated with policy D).

The above logic explains why the first type of policy is less efficient than the fourth, and indeed why a garbling of a differenced estimate of inside and outside productivity ($b < 0, c \neq 0$) lies inside the efficiency frontier. All that remains is to consider the second type of policy ($b > 1, c = 0$). The reason why this type of policy fails to trace out the efficiency frontier is simple. By weighting the disclosure statistic towards $R_I - G_I$, that is match quality, the firm eliminates regression to the mean. This leaves adverse selection to hit with full force, depressing wages not simply below $E[G_I]$ but as far as the lower support.

[20]With no noise ($c = 0$), any $b \in (0, 1)$ will generate positive selection. With noise, the range of policies becomes more tightly bounded above 0 and below 1.

Having discussed the important features of the feasible set we now turn to equilibrium contracts and labour market outcomes.

3.2.3 Equilibrium Contracts

We start by stating that firms never adopt disclosure policies which induce a negative conditional correlation between estimates of inside productivity and outside productivity. Intuitively, this makes sense since, if such a negative correlation were present, then the event that a worker is not retained becomes 'good news' regarding the outside productivity of the worker. This is the opposite of a winners' curse and the positive rather than adverse selection effect would serve to drive up the wage offers of competing employers, making it more expensive to retain workers.

Proposition 7. *Under joint normality, neither competitive nor skill augmenting firms ever choose a disclosure policy with* $\beta_{G_I R_I . T_I} < 0$.

Proof. The fact that each competitive firm J chooses G_J-disclosure follows from Proposition 1. Suppose the skill-augmenting firm chooses $\beta_{G_K R_K . T_K} < 0$. Then expected second period profit is

$$\begin{aligned} E[(R_K - w_{T_K}(T_K))^+] &= E[(R_K - E[G_K|T_K] - AS_{T_K}(T_K))^+] \\ &\leq E[(R_K - E[G_K|T_K])^+] \leq E[E[(R_K - G_K)^+|T_K]] = E[(R_K - G_K)^+], \end{aligned}$$

where the first inequality follows from $AS_{T_K}(T_K) \leq 0$ and the second follows from application of Jensen's inequality. A disclosure policy with $\beta_{G_K R_K . T_K} < 0$ therefore leads to lower expected second period profit than general disclosure. ■

The nature of the disclosure policies chosen by skill-augmenting firms is described as follows, where $\bar{U} = E[G_J] + E[(R_J - G_J)^+]$.

Proposition 8. *In the independent joint normal model, for a skill-augmenting firm K,*

1. *If* $E[G_K]$ *is small (*$E[G_K] \leq \bar{U}$ *suffices), then contracts are* G_K-*disclosure and a training wage of* $w_K = \max\{\bar{U} - E[G_K], 0\}$.
2. *If* $E[G_K]$ *is large (*$E[G_K] > \bar{U}$ *suffices), then contracts are a disclosure policy* $T_K = (1-b)G_K - bR_K$*, with b increasing in* $E[G_K]$*, and a training wage of* $w_K = 0$.

This result follows directly from the calculation of the efficiency frontier. It is helpful to compare the equilibrium contracts chosen by a skill augmenting firm when Γ_K is joint normal with the case discussed in Section 3.1 where $\Gamma_K = \{G_K, R_K, \varnothing_K\}$. The first part of the result is simply a restatement of the first part of Proposition 4: if the general skills acquired at firm K are expected to be low, then firm K chooses G_K-disclosure to meet the worker's reservation utility in the most efficient manner possible. However, if firm K is advantaged, so that the general skills acquired at firm K are expected to exceed the worker's reservation utility (as pinned down by the competitive fringe), then the firm will switch to a policy that generates adverse selection. Of course, it is in the firm's interest to depress wages as efficiently as possible and so the disclosure policy will be a (noiseless) difference of inside and outside productivity. As the size of the skill gap increases, firm K claws back rent from the worker by increasing expected adverse selection (decreasing b further below zero thereby increasing $\beta_{G_K R_K . T_K}$).

3.2.4 Labour Market Outcomes

This section traces the map from technological differences, via human capital management policies through information management to labour market outcomes. We start by discussing the skill augmenting sector, and then turn to outcomes for the wider economy.

Comparative Statics of Sector-Specific Outcomes With $Var(G_K)$ normalised to 1, the technological position of a skill augmenting firm K is characterised by three parameters: expected general human capital formation $E[G_K]$, expected match quality $E[R_K - G_K]$ and the variance of match quality $Var(R_K - G_K)$. The following result describes how changes in these parameters impact on labour market outcomes in the skill-augmenting sector (holding the technological position of the competitive sector fixed).

Proposition 9. *In the independent joint normal model,*

1. *If $E[G_K]$ is small ($E[G_K] \leq \bar{U}$ suffices),*

i. *the probability of labour turnover is independent of $E[G_K]$ and $Var(R_K - G_K)$ and is decreasing in $E[R_K - G_K]$;*

ii. *the distribution of employment wages is identical to the distribution of G_K.*

2. *If $E[G_K]$ is large ($E[G_K] > \bar{U}$ suffices)*

i. *the probability of labour turnover is increasing in $Var(R_K - G_K)$ and decreasing in $E[G_K]$ and $E[R_K - G_K]$;*

ii. *the distribution of employment wages has mean $\bar{U}$ but is no longer normal, with inequality decreasing in $Var(R_K - G_K)$ and increasing in $E[G_K]$ and $E[R_K - G_K]$.*

Proposition 9 is illustrated in Figures 5 and 6 (plotted for $E[G_J] = E[R_J - G_J] = 0$, $Var(G_J) = Var(R_J - G_J) = 1$, implying $\bar{U} = E[(R_J - G_J)^+] = 1/\sqrt{2\pi}$). We start by discussing the consequences of technological changes in the skill-augmenting sector for labour turnover.

Our analysis of the general model established that, for values of $E[G_K] \leq \bar{U}$, labour turnover occurs with probability $\Pr[R_K < G_K]$ and is therefore independent of $E[G_K]$ by Assumption 3. Figure 5 Panel a plots the case where match quality is distributed symmetrically around zero, giving rise to a turnover rate of 50% (the top line). Consider a technological change that increases $E[G_K]$ above $\bar{U}$. A skill-augmenting firm will respond by adjusting its disclosure policy (decreasing b) to claw back the associated rent from its worker. The adverse selection associated with this change in organisational design depresses labour turnover.[21]

As one might expect, labour turnover also decreases with a change in technology that 'improves matching' ($E[R_K - G_K]$). Here, however, endogenous organisational design *dampens* the effect. Figure 5 Panel b illustrates by plotting the turnover rate against $E[R_K - G_K]$, holding $E[G_K] = Var(R_K - G_K) = 1$. If $E[G_K] \leq \bar{U}$ the turnover rate is equal to $\Pr[(R_K - G_K) < 0]$ which is evidently decreasing in $E[R_K - G_K]$. With $E[G_K] > \bar{U}$, however, firm K will seek to impose adverse selection. Suppose that $E[R_K - G_K]$ declines below 1 but that firm K (sub-optimally) leaves its disclosure policy fixed at $b \approx -0.37$. Labour turnover increases but at a slower rate than $\Pr[(R_K - G_K) < 0]$ (compare the middle and the highest line in the Figure). In other words, adverse selection mutes the effect of a decline in $E[R_K - G_K]$ on labour turnover. This dampening effect becomes stronger if firm K adjusts its disclosure policy to keep its worker at $\bar{U}$ (the bottom line in the Figure). As $E[R_K - G_K]$ declines, regression to the mean ameliorates adverse selection. *Larger* deviations (more negative b) from G_K-disclosure are therefore necessary to generate sufficient adverse selection and these adjustments depress labour turnover further below $\Pr[(R_K - G_K) < 0]$.

Figure 5 Panel c illustrates the impact of $Var(R_K - G_K)$, holding $E[G_K] = 1$, $E[R_K - G_K] = 0$. Again, with $E[G_K] > \bar{U}$, firm K will seek to impose adverse selection. Suppose that $Var(R_K - G_K)$ declines below 1 but that firm K (sub-optimally) leaves its disclosure policy fixed at $b \approx -0.64$. Labour turnover decreases further below $\Pr[(R_K - G_K) < 0]$ (compare the bottom and highest line in the Figure). This effect is muted, however, if firm K adjusts its disclosure policy to keep its worker at $\bar{U}$ (the middle line in the Figure). Since poorer information about match quality reduces the regression to the mean effect, adverse selection hits harder. *Smaller* deviations (less negative b) from G_K-disclosure are necessary to generate sufficient adverse selection and this depresses labour turnover less below $\Pr[(R_K - G_K) < 0]$.

Turning to the distribution of employment wages: for values of $E[G_K] \leq \bar{U}$, the distribution of employment wages is identical to the distribution of G_K. Given our assumption that G_K and $(R_K - G_K)$ are independent, the distributions for retained and released workers are identical. For higher values of $E[G_K]$, firm K adjusts its disclosure policy to keep the expected employment wage equal to $\bar{U}$. Since adverse selection is greater at lower quantiles of T_K (recall Figure 4), the distribution of employment wages is no longer normal, but becomes negatively

[21]Notice that the probability of labour turnover is convex in $E[G_K]$, implying that the model generates empirically plausible levels of job mobility even in the presence of a substantial skill gap.

skewed.

Figure 6 Panel a illustrates. With $E[G_K] = 1/\sqrt{2\pi}$, firm K chooses G_K-disclosure and so the distribution of employment wages following training at firm K simply reflects the distribution of general human capital (i.e. $N[1/\sqrt{2\pi}, 1]$). If $E[G_K] = 2$ but firm K chooses G_K-disclosure, then the distribution of employment wages is translated to $N[2, 1]$. Of course, it is optimal for the firm to alter its disclosure policy, in this case to $b \approx -2$. This adjustment drives the mean employment wage back down to $\bar{U}$ and, with adverse selection hitting hardest on the low T_K quantiles, skews the distribution to the left.

The remaining panels in Figure 6 hold expected general human capital formation fixed and vary the distribution of match quality $(R_K - G_K)$. Suppose that $E[G_K] = Var(R_K - G_K) = E[R_K - G_K] = 1$ and that firm K chooses a disclosure policy with $b \approx -0.37$. If $E[R_K - G_K]$ declines, so that the expected retained human capital is lower, but firm K (sub-optimally) leaves its disclosure policy fixed then there is less adverse selection. As Panel b illustrates, this change in adverse selection both compresses, and increases the mean of, the distribution of employment wages. Since the expected employment wage now exceeds the worker's reservation utility, it is optimal for the firm to alter its disclosure policy, here to $b \approx -1.51$. This adjustment reintroduces adverse selection and skews the distribution of employment wages to the left.

Finally, consider the impact of a change in $Var(R_K - G_K)$. Suppose that $E[G_K] = Var(R_K - G_K) = 1$, $E[R_K - G_K] = 0$ and that firm K chooses its optimal disclosure policy with $b \approx -0.64$. If $Var(R_K - G_K)$ declines but firm K (sub-optimally) leaves its disclosure policy fixed there is *more* adverse selection. As Panel c illustrates, this change in adverse selection disperses, and decreases the mean of, the distribution of employment wages. Since the expected wage is below $\bar{U}$, it is optimal for the firm to alter its disclosure policy, now to $b \approx -0.30$. This adjustment removes adverse selection, reducing the left skewness of distribution of employment wages. Indeed, as Panel c makes clear, the overall effect of a decrease in the variance of $R_K - G_K$ resembles a mean-preserving spread in wages.

Note that one can interpret an increase in the variance of an estimate as an improvement in information. This follows since conditioning on extra information produces a mean preserving spread of conditional expectations: $E[Y_{KK} - Y_{KJ}|Q_K, Q'_K]$ is a mean preserving spread of $E[Y_{KK} - Y_{KJ}|Q_K]$. An increase in $Var(R_K - G_K)$ therefore follows from technological changes that give firm K a better idea of worker match quality. Improvements in information about match quality therefore compress wage distributions. This contrast with improvements in information about general human capital (when firms are competitive).

Implications for Economy-wide Outcomes We will *not* attempt a comprehensive explanation of the stylised facts concerning changes in turnover rates and wage inequality which have been argued to have occurred since the 1980's. The reader is referred to Katz and Autor (1999) or Acemoglu (2002), both of which provide excellent introductions to the wide-ranging empirical literature. This literature has already recognised that institutional and organisational changes might interact with demand, supply and technology changes and thereby play a role in explaining labour market outcomes.[22] We can add that if innovations take time to diffuse through the economy, technical change will also generally impact on labour market outcomes by altering the distribution of firm competitiveness within an industry. Our model evidently supplies one specific framework within which to explore some of these interacting effects.

Consider first the competitive benchmark. If all firms are competitive, then employment wage inequality is determined by the riskiness of the random variable $G_I = E[Y_{II'}|Q_I]$; the more informative is Q_I about productivity, the higher is employment wage inequality. Given the absence of adverse selection, labour turnover is high.

Suppose as a comparative statics exercise, we adopt *Assumption 3′* and firms are transformed one by one, from J-type to K-type in the independent joint normal model. Starting from all firms being competitive (J-firms), the wage distribution of workers will be uniform across the economy and turnover rates will be high. Transforming the firms progressively into K-types will alter the distribution of wages, and generally reduce labour turnover. According to the results of section 3.2.4, the wages of workers conditional on being in a K-firm will show more inequality and be skewed to the left relative to workers in competitive firms. However, as the number of K-firms grows, the competitive wage will eventually be determined by the marginal K-firm, turnover will increase and the distribution of wages will revert to its initial pattern but translated to the right. During this latter phase, turnover of workers in skill enhancing firms increases and their wage distribution skews to the right, relatively.

So far, we have limited the discussion to a single pool of ex-ante identical workers in which there were a mix of J-firms and K-firms. However, the labour literature has increasingly emphasised the role of skill-biased technology.[23] Consider an interacting multisector version of our model in which high tech firms (of both J and K type, call them HJ and HK types) employ predominantly ex-ante high productivity skilled workers and low tech firms (again of both J and K type, call them LJ and LK types) employ predominantly ex-ante low productivity unskilled workers. Now suppose that technological change transforms some LK firms into HK firms. It is natural to think of this as an innately able entrepreneur becoming technically proficient, or as good business practice being transferred from simple to complex activities. This transformation reduces competition for LK firms wishing to employ unskilled labour but increases it for HK firms wishing to employ skilled labour. The endogenous organisational response of HK firms shifts the mean employment wage distribution for skilled workers to the right as adverse selection policies are driven out and furthermore skews it to the right. Turnover of these workers also increases. On the other hand, for employers of un-

[22]See Acemoglu (2002).

[23]See Violante (forthcoming), Acemoglu (2002) and Hornstein et al (2005) for surveys of this literature.

skilled workers, the effects go in the opposite direction, wages are reduced, skewed to the left and turnover decreases.

4 Concluding Remarks

Our starting premise was to identify organisational design with human capital management via information management. Our model has allowed us to characterise optimal information management policies. These policies are determined according to whether the employer is constrained principally by the need to attract workers (participation constraints) or by an inability to fully leverage acquired general human capital talent (credit constraints). As has been recognised since Akerlof (1970), the distribution of information can have striking, apparently disproportionate, effects on market outcomes. Our analysis has also highlighted that, where organisational responses to technological change impact through information flows, the consequences for wages and turnover rates may appear to be disproportionately large.

We have, of course, taken a somewhat narrow view of organisational design, even given our exclusive focus on information management. In particular, we have abstracted from endogenous information acquisition.[24] For the purposes of inducing adverse selection, acquiring more information with a fixed amount disclosed is akin to disclosing less with a fixed amount acquired. In other words, firms can manage information simply by getting to know their workers better. Skill augmenting and competitive firms will generally take a very different view. For competitive firms, information privately acquired about their worker's general human capital becomes a hot potato—something to be passed on to the market as quickly as possible. In contrast, for skill-augmenting firms, incentives to acquire private information about worker productivity are more nuanced and one would expect to see deliberate policies designed to generate such information. These differential incentives are likely to accentuate the increased wage inequality for skill augmenting firms identified in the paper.

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Appendix

Proof of statement in Assumption 2. The statement is: $E[G_I|R_I = r]$, $r - E[G_I|R_I = r]$ and $E[G_I|R_I - G_I = r]$ are all increasing in r and, for any $w \in R$, $E[G_I|R_I \leq w] \leq E[G_I]$ and $E[G_I|R_I \geq w] \geq E[G_I]$. Let $S_I = R_I - G_I$ and denote the density of (S_I, G_I) as $f(s, g)$. The density of (R_I, G_I) is therefore $f(r - g, g)$ it follows that from affiliation and log concavity that both $f(s, g)$ and $f(g, r - g)$ are TP_2, i.e. both (S_I, G_I) and (R_I, G_I) are affiliated. This implies $E[G_I|R_I = r]$ and $E[R_I - G_I|R_I = r]$ are increasing in r as required. Also, for all w, $E[G_I|R_I \leq w] \leq E[G_I]$. ■

Proof of Proposition 5. By the law of iterated expectations

$$w_{T_I}(t) = E\left[G_I|T_I = t, R_I \leq w_{T_I}(t)\right] = E\left[E\left[G_I|T_I = t, R_I\right]|T_I = t, R_I \leq w_{T_I}(t)\right].$$

Using the regression equation

$$E\left[G_I|T_I = t, R_I\right] - \mu_G = \beta_{GT.R}\left(t - \mu_T\right) + \beta_{GR.T} R_I$$

and $\mu_T = 0$, we have

$$\begin{aligned} w_{T_I}(t) &= E\left[\mu_G + \beta_{GT.R} t + \beta_{GR.T} R_I | T_I = t, R_I \leq w_{T_I}(t)\right] \\ &= \mu_G + \beta_{GT.R} t + \beta_{GR.T} E\left[R_I|T_I = t, R_I \leq w_{T_I}(t)\right]. \end{aligned}$$

Since the conditional random variable has a normal distribution: $[R_I|T_I = t] \sim N\left(E[R_I|T_I = t], \sigma^2_{R|T}\right)$, we can write $[R_I|T_I = t]$ in terms of a standard normal random variable Z

$$[R_I|T_I = t] \equiv E[R_I|T_I = t] + \sigma_{R|T} Z.$$

Using Z,

$$\begin{aligned} w_{T_I}(t) &= \mu_G + \beta_{GT.R} t + \beta_{GR.T} E\left[R_I|T_I = t, R_I \leq w_{T_I}(t)\right] \\ &= \mu_G + \beta_{GT.R} t + \beta_{GR.T} E[R_I|T_I = t] + \beta_{GR.T} \sigma_{R|T} E[Z|Z \leq \frac{w_{T_I}(t) - E[R_I|T_I = t]}{\sigma_{R|T}}]. \end{aligned}$$

Using the regression equation $E\left[R_I|T_I = t\right] - \mu_R = \beta_{RT}\left(t - \mu_T\right)$ and $\mu_R = 0$ (?), we have

$$w_{T_I}(t) = \mu_G + t\left(\beta_{GT.R} + \beta_{GR.T}\beta_{RT}\right) + \beta_{GR.T}\sigma_{R|T} E[Z|Z \leq \frac{w_{T_I}(t) - E[R_I|T_I = t]}{\sigma_{R|T}}]$$

or using Cochrane's identity $\beta_{GT} = \beta_{GT.R} + \beta_{GR.T}\beta_{RT}$,

$$w_{T_I}(t) = E[G_I|T_I = t] + \beta_{GR.T}\sigma_{R|T} E[Z|Z \leq \frac{w_{T_I}(t) - E[R_I|T_I = t]}{\sigma_{R|T}}].$$

Noting that since $\phi'(x) = -x\phi(x)$,

$$\frac{\int_{-\infty}^{z} \phi'(x)dx}{\Phi(z)} = \frac{\phi(z)}{\Phi(z)} = \frac{\phi(-z)}{1 - \Phi(-z)} = h(-z) = -\frac{\int_{-\infty}^{z} x\phi(x)dx}{\Phi(z)} = -E[Z|Z \leq z]$$

gives the required expression for $w_{T_I}(t)$. ■

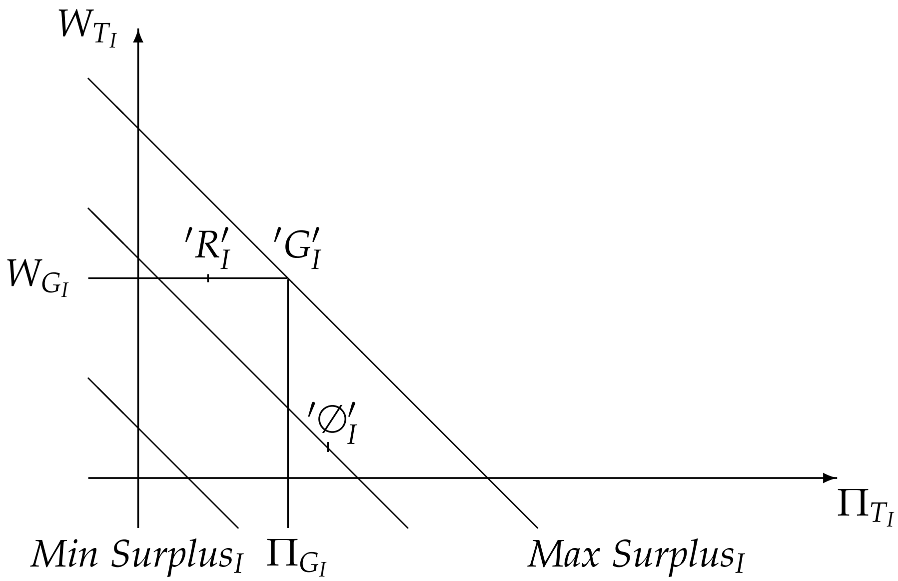


Figure 1: The Feasible Set, $\Gamma_I = \{G_I, R_I, \emptyset_I\}$.

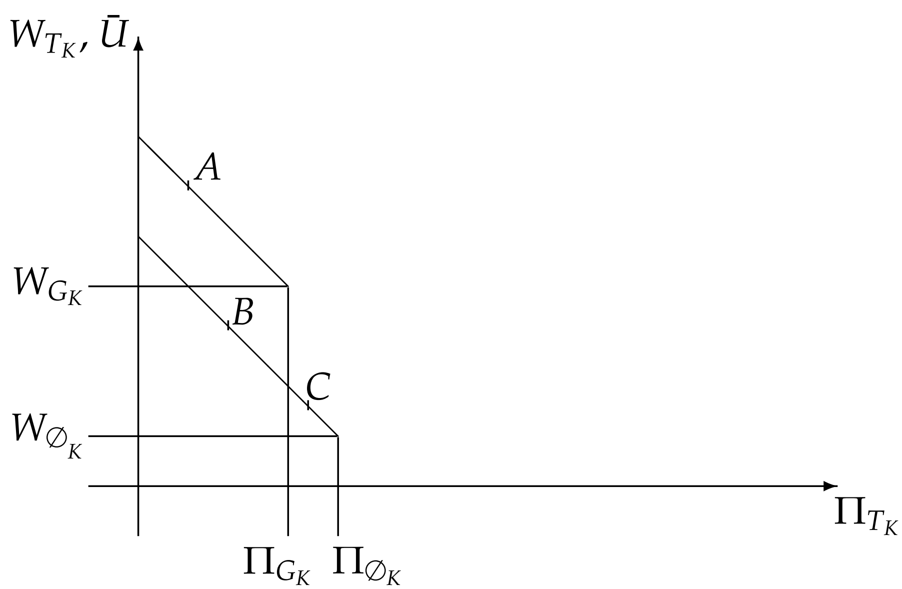


Figure 2: Disclosure Policies given Reservation Utility Constraints.

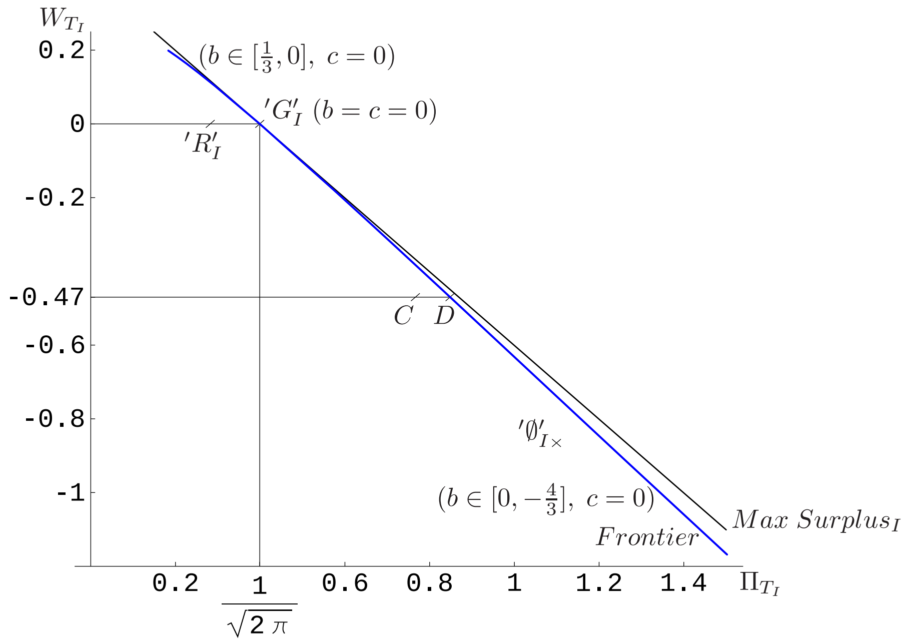


Figure 3: The Efficiency Frontier, plotted for $G_I \sim N[0,1]$, $R_I \sim N[0,2]$.

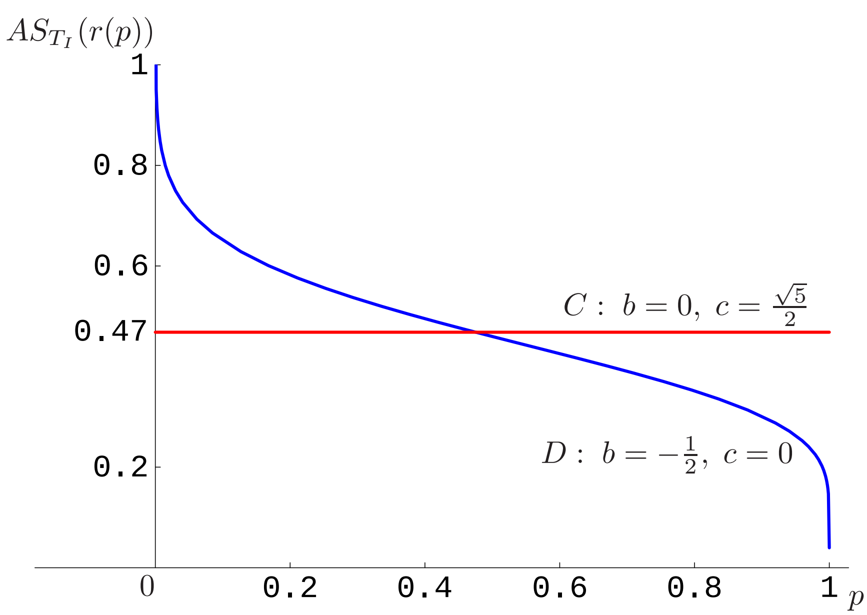
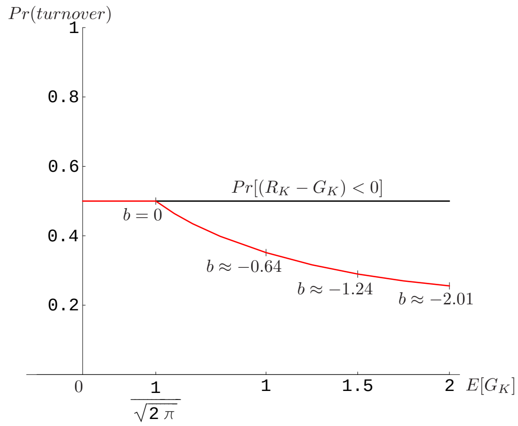
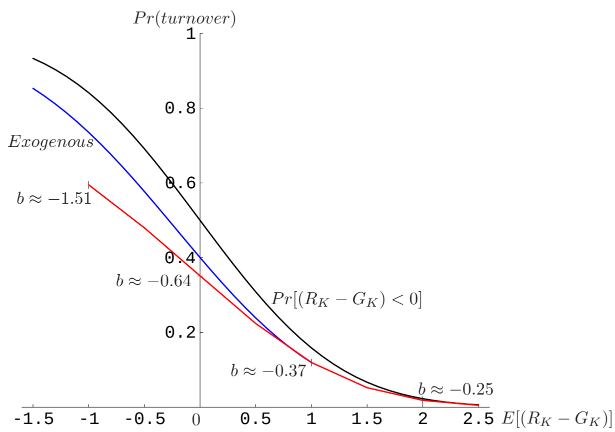


Figure 4: Adverse Selection at Quantiles of T_I, plotted for $G_I \sim N[0,1]$, $R_I \sim N[0,2]$.

Panel a: Plotted for $Var(G_K) = Var(R_K - G_K) = 1,\ E[R_K - G_K] = 0,\ \bar{U} = \frac{1}{\sqrt{2\pi}}$.



Panel b: Plotted for $E[G_K] = Var(G_K) = Var(R_K - G_K) = 1,\ \bar{U} = \frac{1}{\sqrt{2\pi}}$.



Panel c: Plotted for $E[G_K] = Var(G_K) = 1,\ E[R_K - G_K] = 0,\ \bar{U} = \frac{1}{\sqrt{2\pi}}$.

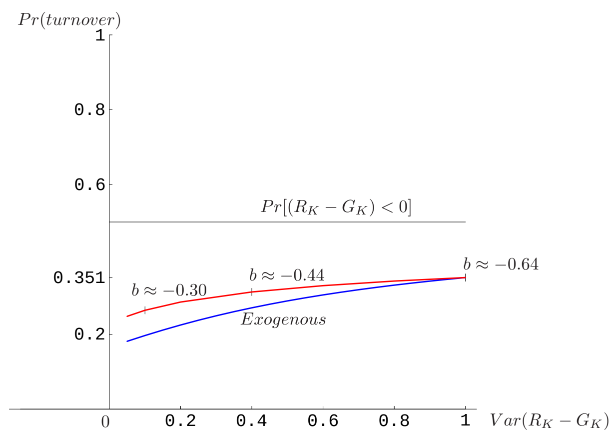
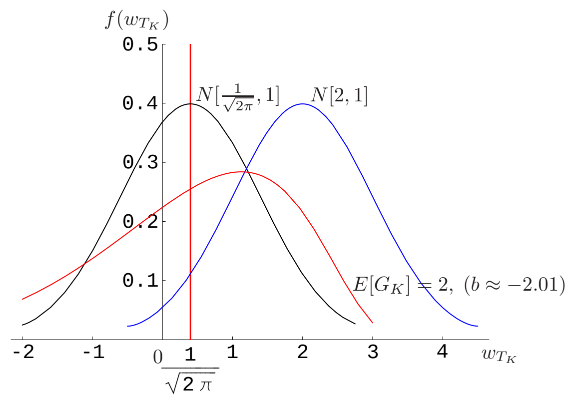
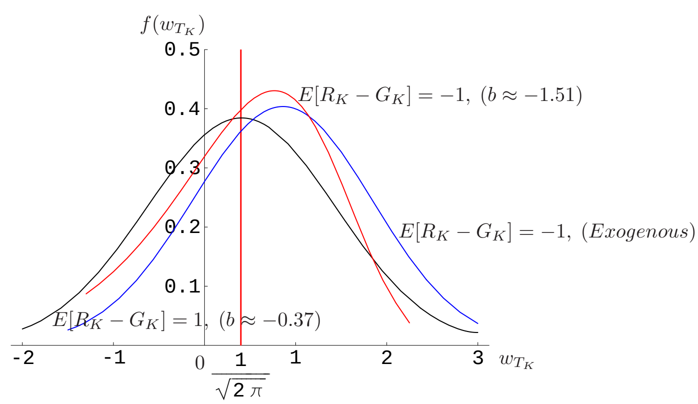


Figure 5: The Probability of Labour Turnover

Panel a: Plotted for $Var(G_K) = Var(R_K - G_K) = 1,\ E[R_K - G_K] = 0,\ \bar{U} = \frac{1}{\sqrt{2\pi}}$.



Panel b: Plotted for $E[G_K] = Var(G_K) = Var(R_K - G_K) = 1,\ \bar{U} = \frac{1}{\sqrt{2\pi}}$.



Panel c: Plotted for $E[G_K] = Var(G_K) = 1,\ E[R_K - G_K] = 0,\ \bar{U} = \frac{1}{\sqrt{2\pi}}$.

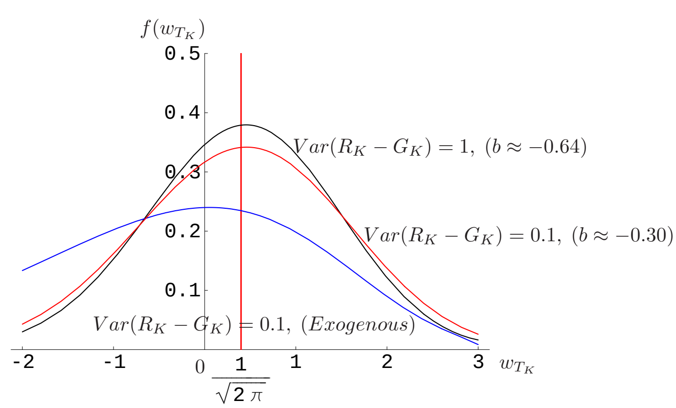


Figure 6: The Distribution of Employment Wages