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Internal Labor Markets in Equilibrium*

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Abstract

Traditional models of promotion have difficulty explaining why many firms do not favor internal employees for advancement. I develop a new model to explain this phenomenon. My model generates an equilibrium where some, but not all, ex ante identical firms recruit strictly internally. These firms employ higher quality entry-level workers, since they hire supervisors exclusively from their lower ranks. The scarcity of high-quality workers limits the use of this strategy. I derive several testable predictions on wage-tenure profile differences across firms with varying recruitment practices and confirm these predictions using matched employer-employee data from the United Kingdom.

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1 Introduction

Typical models of promotion focus on the provision of incentives within the firm. In the classic tournament setting of Lazear and Rosen (1981), workers are motivated to exert the optimal effort by a prize that goes to the worker who produces the highest output. However, these models have difficulty explaining the empirical finding that many firms do not favor their own workers for advancement. In my data set, 71% of workers are employed at an establishment that gives no preference to internal candidates, in spite of the fact that such favoritism is necessary in order to effectively incentivize employees in a tournament setting (Chan, 1996).

I develop a model in which some firms adopt internal promotion to avoid a costly search for higher-level employees on a frictional market. These firms instead focus their recruitment on lower-level workers who appear promising *ex ante*. Because talented workers are employed at the lower ranks of the firm, foregoing search does not substantially reduce worker quality in its higher-level positions. It is this synergy which drives the formation of internal labor markets. The fact that talent is scarce limits the viability of this strategy. In equilibrium the number of firms that adopt this policy is limited by the number of workers in the labor pool who appear promising *ex ante*. This model produces several predictions on how the wages and workforce compositions vary across establishments with differing promotion policies, which I confirm in the empirical section.

Put another way, my model illustrates that hiring selectivity and internal promotion are complementary strategies.¹ Both recruiting internally and externally for high-ranking positions can be successful and equally profitable provided that it is combined with the proper recruitment strategy at the lower-levels. By closing the model I can determine the equilibrium distribution of these strategies.

The intuition behind the model is quite simple. Imagine a world where talent is both scarce and valuable. Because firms can extract rents from workers, they would like to hire

¹For a comprehensive review of the literature on complementary firm practices, see Brynjolfsson and Milgrom (2013).

the most talented employees and place them in their most productive positions. However, due to the scarcity of talent, some firms will be forced to fill their best positions with lower quality workers. By “locking in” promising young workers and foregoing external search, the firm can increase the likelihood of having high-quality workers at upper-level positions without the costs of external recruitment.² Of course, many firms would like to adopt this strategy and competition will bid up the wages for promising young workers. Given this, some firms choose to wait and attempt to hire workers who, although initially less promising, turn out to be high quality.

I model an overlapping generations economy with two types of workers who differ in their ability to be supervisors.³ Workers’ true types are unknown, however they possess a publicly observable signal that is correlated with their qualification for supervisory tasks. Firms are ex-ante identical and employ workers in entry-level and supervisory positions. A supervisor is required in order for entry-level workers to produce. “Qualified” supervisors provide extra production for the firm.⁴ Information is incomplete, so firms can extract rents by identifying qualified supervisors. The firm employs two young workers at the entry-level job and must decide whether to spend resources evaluating outside workers for its supervisor position, or limit its search internally.⁵ In equilibrium firms that focus internally always hire more entry-level workers with high signals. Labor market competition for these workers causes their wages to be bid above their marginal entry-level product. As a necessary and scarce input for the internal strategy, workers extract the strategy’s rents.

Consequently, entry-level workers at internally-focused firms initially earn higher wages than those at firms which focus externally. This difference is short lived; because talent is

²This intuition is similar to that of Li and Rosen (1998), though their model deals with risk aversion in incomplete markets.

³As I abstract from incentive provision and focus on the match of workers to jobs, my model is most closely related to the job assignment models of Gibbons and Waldman (1999, 2006). While these models typically consider a single firm in a vacuum, I model many firms which differ in their promotion policy and have equilibrium turnover. For another job assignment model with equilibrium turnover, see Ghosh (2007).

⁴Equivalently, qualified supervisors could make the entry-level workers more productive.

⁵Fixed firm hierarchies and slot constraints for higher level jobs are common assumptions in the promotion literature. See, for example, Waldman (2003), Waldman (2011), DeVaro and Waldman (2012), and Smeets, Waldman, and Warzynski (2013).

scarce, the best workers eventually move to supervisory jobs either inside or outside their original firm. The most senior employees at entry-level jobs earn identical wages, regardless of their firm's recruitment strategy. Because their window for promotion has ended and they were revealed to be unqualified for supervisory tasks, they provide no value to the firm above their entry-level task production. Therefore, in a cross-section of *entry-level* workers, we should observe a lower return to tenure at internally-focused firms than at externally-focused firms. These predictions are confirmed using a matched employer-employee data set from the United Kingdom.

While there is a vast literature on promotions and internal labor markets, there has been little theoretical or empirical work on how promotion policies differ across firms.⁶ Tsoulouhas, Knoeber, and Agrawal (2007) show that firms should set rules that favor internal candidates unless outside candidates are of significantly higher innate ability.⁷ Bayo-Moriones and Ortin-Angel (2005) find, among Spanish industrial plants, that establishments that are likely to rely on specific capital and that face higher information asymmetries are more likely to promote internally. They find little evidence that promotions are used more frequently in establishments where providing individual incentives appears more important. DeVaro and Morita (2013) model how exogenous firm productivity differences can drive various aspects of organizational structure. In their theoretical model, firms that receive exogenously high value from managers create a more bottom-heavy organizational structure. Thus, the best managerial candidate is likely to be internal due to the larger pool of internal workers. They find empirical support for their theory using establishment characteristics obtained from a questionnaire of managers which is included in my data.⁸

My approach differs in that I do not rely on any exogenous firm characteristics to drive differences in firm practices. Many firm characteristics are actually choices made by the firm simultaneously with recruitment policy, or are outcomes of the set of human resource

⁶For recent surveys of the promotion literature, see Lazear and Oyer (2013) and Waldman (2007)

⁷See also Kräkel and Schöttner (2012) for a discussion of the conflict between selection and incentives presented by external hiring when workers are heterogeneous

⁸Consistent with this, Martins and Lima (2006) present evidence that firms who have more external hires among their top-management are less productive.

policies the firm chooses to adopt. For example, in my model firms that adopt an internal-focus may have higher productivity when measured on an output per worker basis because they also choose to recruit higher quality workers. While previous literature has suggested that homogenous firm models may not be able explain differences in internal labor market practices, my model shows that heterogeneity is not always necessary.⁹ All firm heterogeneity in my model is endogenous and generated by two exogenous factors, the distribution of worker quality in the labor force and an external recruitment cost common to all firms. Consequently, my testable predictions are on equilibrium wage correlations rather than firm characteristics.

More generally, this article contributes to a growing literature on the impact of external market forces on internal labor markets. Waldman (1984) first considered how the act of being promoted can be a signal of worker ability when information is incomplete. Zájbojník and Bernhardt (2001) incorporated this framework into a “market-based” tournament. In this setting, promotion triggers higher outside offers due to changes in market beliefs, and thus the “prize” is endogenously determined.¹⁰ Chan (1996) considers how the option to hire externally impacts the ability to provide incentives in a promotion tournament. He shows that allowing firms to hire from outside causes the number of players in a promotion tournament to expand dramatically, lowering the incentives of the internal employees. The solution is to use lower requirements when evaluating, and thus give preference to, the internal employees for promotion. Chan (2006) finds empirical support for this model using personnel records from a U.S. financial company. Waldman (2003) analyzes the commitment problem where the *ex post* optimal hiring rule over-hires outsiders, thus providing inefficient incentives relative to the *ex ante* optimal rule. Chen (2005) models the decision to recruit externally to prevent a collusive shirking equilibria.

The rest of the paper is outlined as follows. In Section 2, I formally derive my model of promotion and internal labor market creation. I characterize equilibria in which recruitment

⁹See, for example, the discussion of hiring practices in Oyer and Schaefer (2011).

¹⁰For more recent work, see Ghosh and Waldman (2010), Zájbojník (2012), DeVaro and Waldman (2012), and Waldman (2013).

practices are heterogeneous, and derive testable predictions from the set of properties these equilibria share. Section 3 describes the data. In Section 4, I test the predictions of my model and discuss alternative theories. Section 5 concludes.

2 A Model of Endogenous Recruitment Practices

In this section I will develop a simple equilibrium model in which ex ante homogenous firms adopt heterogeneous recruitment policies. Firms must choose between two technologies to fill a supervisor position. The “internally-focused” technology only evaluates candidates at entry-level positions inside the firm, while the externally focused technology evaluates candidates both inside and outside the firm. The “externally-focused” technology is more costly as it requires evaluating more candidates overall. In equilibrium, firms will adopt the former technology only when hiring ex ante observably high-quality entry-level workers. Competition for these workers drives their wages above marginal product; they capture the firm’s cost saving from adopting a cheaper recruiting technology.

2.1 Primitives

I use a simple overlapping generations framework. A continuum of heterogeneous workers is born each period. Workers live two periods (young, then old) and have an unknown (to both the worker and the market) type. The type takes two forms and determines whether the worker is qualified to perform supervisory tasks. Conditional on their type and task, workers are equally productive across all firms. While individual workers’ types are initially unknown, the market and worker observe a signal of their quality. A worker with a high-signal (H) has probability $p_H < 1$ of being qualified for supervisory tasks, while a worker with a low signal has probability $p_L < p_H$ of having that qualification. A fraction $h < \frac{1}{2}$ of workers have high signals and $p_H h + p_L(1 - h) < \frac{1}{2}$, which ensures that qualified old workers are never in excess supply. All cohorts are identical.

Firms are infinitely lived and ex ante identical. They consist of two tasks: entry-level and supervisory. Old workers produce θ at the entry-level task. Young workers require

supervision; they produce θ at the entry-level task if the firm employs a supervisor and 0 otherwise.¹¹ Only old workers may be employed at the supervisory position. A supervisor fosters production by young workers and also produces, himself. A qualified supervisor produces $(\lambda + 1)\theta$, $\lambda > 0$, while an unqualified supervisor produces θ .¹² Supervisors may not monitor more than two young workers, and firms may employ only one supervisor.

There exists a large set of potential entrants, but in order to enter they must purchase a factory.¹³ A continuum of identical factories are born each period and fully depreciate at the end of the period. I normalize the set of factories to be of measure 1. Factories cost r which is endogenously determined by the market. The set of workers born each period is of measure N . I will restrict attention to the case where $N < 2$ but $N \approx 2$. This is to avoid an indeterminacy of wages when labor supply and demand are inelastic and exactly equal.¹⁴

While firms do not, on their own, know the types of old workers, they may adopt one of two technologies which provides them with some information. Firms which adopt the “internally-focused” technology learn the quality of their own employees after one period of employment. This technology is costless. Alternatively, firms may become “externally-focused” at cost m . Externally-focused firms learn the quality of their own old entry-level employees and may also discover a qualified worker outside the firm when their entry-level employees are both unqualified.¹⁵ This discovery probability ϕ is determined endogenously,

$$\phi = \frac{s^q}{s^{nq}} \quad (1)$$

¹¹Assuming that workers are equally productive at the entry-level task is inconsequential. Allowing qualified workers to be more productive entry-level workers reinforces the main results.

¹² $\lambda\theta$ thus represents the surplus from employing a qualified worker at a supervisor position.

¹³The inclusion of factories is simply a device to allow a free-entry equilibrium with zero profits. It can be viewed as analogous to an endogenous sunk cost of capital acquisition for vacancy creation in a search model context. I could, alternatively, fix the number of firms and allow them to earn profits without altering the results.

¹⁴I could alternatively set $N > 2$. This would lower the wages of at least some workers to their outside option, but not fundamentally alter the characteristics of equilibrium.

¹⁵Note that firms pay the technology cost m regardless of whether they end up needing to hire externally. This is not altogether unrealistic. Firms frequently announce positions and simultaneously announce whether they will conduct an internal search or an external search, before interviewing candidates. All of my results would hold under an alternative framework in which firms make no initial technology choice, and pay m to acquire information on external candidates after they learn the quality of their internal employees. In this setting, firms which hire high-quality entry-level employees are forced to pay m less often, and these workers would capture this expected cost savings in their initial wage contracts.

where s^q is the measure of the set of workers who are qualified and were not promoted internally and s^{nq} is the measure of the set of externally-focused firms who did not employ a qualified entry-level worker in the previous period.¹⁶

Because of information asymmetries, there is a surplus when qualified supervisors are employed by firms which know they are qualified. These wages are determined by Nash bargaining, with β being the share that goes to the worker. If bargaining breaks down, the firm either promotes an unqualified internal candidate or makes a competitive offer to an external worker of unknown type, while the worker may gain employment at a firm which does not know her type.

Information for young workers is symmetric. Firms offer a series of signal- and co-worker signal-contingent wage contracts to young entry-level workers. Young workers observe all contracts and accept those which maximize their expected lifetime utility. Firms simultaneously offer simple wage contracts to old workers for unsupervised entry-level positions.¹⁷ Old workers (who are not employed as supervisors) accept the wage contract which maximizes their utility. When indifferent, they remain with their current employer.¹⁸

The timing of a period in the model is as follows. First, the market for factories opens. Once that market has cleared, firms learn the quality of their previous period entry-level workers. Firms promote a qualified entry-level worker if one exists.¹⁹ A fraction ϕ of externally-focused firms without a qualified internal candidate then learn about a qualified external candidate.²⁰ Firms Nash-bargain for wages with internally promoted and informed external hires. Firms who remain with a supervisory vacancy fill them by making competitive wage offers to external workers of unknown type or promoting unqualified internal workers.²¹ After this, the market for entry-level workers (young and old) opens and market

¹⁶ $\phi=1$ whenever $s^q > s^{nq}$.

¹⁷Recall that old workers do not require supervision and so there is no trade-off between employing young and old workers for these positions.

¹⁸This could be viewed as workers having ε -sized moving costs.

¹⁹Ties are broken by coin flip.

²⁰For simplicity, each worker is discovered by at most one firm. Relaxing this assumption would allow for some competition for supervisors and thus effect some supervisor wages, but would not alter the main theoretical results.

²¹I assume that firms do not observe the promotion decisions of other firms until after all hiring markets

entry-level wages are determined. Simultaneously with this market, firms choose their supervisor recruiting focus (internal or external) for the following period. Finally, production takes place, cohorts age, and the next period begins.

2.2 Equilibrium

To be more precise, I will define equilibrium in the following manner:

Definition 1. Equilibrium is a set of period-specific wages W , recruitment technologies T , old worker type beliefs Ω , and a vector of period-specific factory costs r such that

1. Each technology decision in T maximizes each firm's profits given W in each period
2. The excess demand and excess supply for workers is non-positive in all periods given T
3. Ω is defined by Bayes' Rule whenever possible
4. The excess demand and excess supply for factories is non-positive in all periods given W

Definition 2. A steady state equilibrium is an equilibrium in which the set of firms whose entry-level workforce composition and recruitment technology varies over time is of measure 0

As is standard with these types of dynamic models, I will restrict attention to steady state equilibria for simplicity. This allows me to focus on whether my equilibrium conditions hold in just one period of the model.

Definition 3. A trivial equilibrium is an equilibrium in which, in some period, the set of firms which adopt an internal focus or the set of firms which adopt an external focus is of measure 0

have closed. This is important, as the promotion decision could provide information to the market, which could in turn raise the wages of qualified supervisors. There is an extensive literature studying promotions as signals. See, for example, Waldman (1984), Zájbojník and Bernhardt (2001) and DeVaro and Waldman (2012). While analyzing the organization of promotion practices when promotions act as signals would be interesting, it is beyond the scope of this paper.

Trivial equilibria may exist in theory, but they do not exist in the data. I observe heterogeneity in recruitment practices across all industries and occupation groups, so I will not consider any equilibria which cannot replicate this fact.

Definition 4. A talent-scarce equilibrium is an equilibrium in which, in some period, the set of qualified old workers who are employed to entry-level tasks is of measure 0

Put another way, in a talent-scarce equilibrium, not all firms that hire externally will be able to find a qualified supervisor. I will focus on talent scarce equilibria as they are likely a more accurate reflection of the labor market. Conversations with employers frequently focus on methods to attract and retain talent. Further, any equilibria which is not talent scarce represents an ex post inefficient allocation of labor, and provided m is not too high, there always simultaneously exists an efficient talent-scarce equilibrium.²² Nonetheless, as I show in Appendix B, equilibria without talent scarcity generate the same predictions as talent-scarce equilibria.

I will proceed by assuming the existence of a non-trivial, talent scarce equilibria, and work backward through a workers lifespan to characterize its properties. I will then conclude this subsection with an existence proof. The key decisions of the firm are the composition of the entry-level workforce (high-signal or low-signal) and the selection of a recruiting technology.

First, old workers in entry-level tasks all produce θ , which determines their wage as the market is competitive. Note that since workers always break ties in wage at the same position in favor of the incumbent, all old workers who do not obtain supervisory positions remain employed at their original firms as entry-level workers.

As talent is scarce, all workers who are not promoted or discovered by an externally-focused firm are unqualified. If a firm attempts to fill their supervisor position with an

²²Generally, equilibria which are not talent scarce involve either prohibitively high costs of external focus (m) or a large number of firms adopting an internal focus with the intention to hire a random external worker whenever their internal workers are unqualified. Since the average quality of random external workers is not too low, this decreases the value of identifying a qualified worker outside the firm with certainty, which reinforces the decision to adopt an internal focus. By changing these firms from internally- to externally-focused, talent becomes scarce and the value of random hiring decreases to 0. Thus, the firms are unwilling to switch back to an internal focus. A sufficient condition for the co-existence of a talent-scarce equilibrium for every non-talent-scarce equilibrium is $(1 - p_H)^2(1 - \beta)\lambda\theta > m$. I note, however, that the talent-scarce equilibrium in these cases may be trivial.

external hire at this stage, they will receive an unqualified worker with certainty. As unqualified workers produce θ in a supervisor's position, and firms must pay unqualified workers θ in order to entice them from entry-level positions, they receive no added profits. Since firms promote internally when they are indifferent between external and internal candidates, this means that the only workers hired from outside the firm are those whose type is discovered by externally-focused firms.²³

If a firm promotes an unqualified supervisor, she earns θ . An unqualified supervisor's value is identical inside and outside the firm. For qualified supervisors, the firm's private information about these supervisors' types generates a surplus. If bargaining breaks down, the firm must hire a unqualified supervisor at wage θ , while the worker must enter the market, where they will be thought to be unqualified with certainty and also earn θ . Thus the Nash bargaining solution dictates a qualified worker's wage as a supervisor will be

$$w_q^s = \beta\lambda\theta + \theta \tag{2}$$

where β is the share of the surplus that goes to the worker from bargaining. The superscript represents that the wage is for a supervisory job, while subscript denotes the worker is qualified. The firm thus receives a profit of $(1 - \beta)\lambda\theta$. The source (internal promotion or external recruitment) does not affect wages or payoffs.

Given this profit-level, the firm's entry-level employment decision is to choose a young entry-level workforce and supervisor recruitment strategy to maximize their expected profits. Note that a firm's recruitment policy does not impact the utility of its entry-level workers. When talent is scarce, qualified workers who are not promoted are always able to obtain a supervisor position outside of the firm, and unqualified workers are indifferent between entry-level and supervisory employment.²⁴ Therefore, young worker's strategies are to simply

²³Internally-focused firms never fill their supervisor position from outside the firm because they cannot discover outside candidates. However, less than 1% of firms in my data report that they never make external hires. All of my results would hold if I relaxed this assumption and instead allowed firms who adopted an external focus to have a higher arrival rate of external qualified candidates than internally-focused firms.

²⁴It would be possible to modify the model so that worker's valued internal promotion over external employment by, for instance, allowing them to form a specific capital that can only be used in the supervisor's

accept the highest paying entry-level job.

Suppose a firm employs one young entry-level worker of type j and one young entry-level worker of type k while adopting an internal focus.²⁵ Their expected profits from these workers would be

$$\pi_{jk}^i = 2\theta + [1 - (1 - p_j)(1 - p_k)](1 - \beta)\lambda\theta - w_j^n - w_k^n - r \quad (3)$$

where the superscript i denotes an internal focus and w_j^n and w_k^n represent the market wages for entry level workers of signal-type j and k respectively. The first term is the productivity of its workers during the entry-level task, the second term is the probability one of its internal workers will be qualified multiplied by the firm's share of the surplus when it employs a qualified supervisor, and the final terms are the costs of labor and capital. If the firm instead adopts an external focus, their expected profits would be

$$\pi_{jk}^e = 2\theta + ([1 - (1 - p_j)(1 - p_k)] + [(1 - p_j)(1 - p_k)\phi])(1 - \beta)\lambda\theta - w_j^n - w_k^n - r - m \quad (4)$$

where the superscript e denotes an external focus. Taking the difference of (2) and (3), a firm finds it optimal to adopt an external focus so long as

$$(1 - p_j)(1 - p_k)\phi(1 - \beta)\lambda\theta \geq m \quad (5)$$

The left-hand side represents the gain from adopting an external focus; whenever both entry-level employees are unqualified, they discover a qualified supervisor with probability ϕ . The right-hand side is the cost of adoption, m .

position. It is straightforward to show in such a model that all workers are willing to compensate the firm exactly for the added probability of internal promotion they receive, and thus the equilibrium sorting patterns I show in this section are undisturbed.

²⁵While firms have the incentive to hire young entry-level workers they cannot supervise to learn about their type, because each additional entry-level worker has a decreasingly positive impact on the probability of finding a qualified supervisor internally, no firm would ever be willing to pay the market wage for a third worker.

Note that the left-hand side of (5) is decreasing in p_j and p_k . This is the key result of the model; a firm is always more willing to adopt an external focus when it employs low-signal entry-level workers. Entry-level hiring selectivity and internally-focused recruitment are complimentary strategies. Thus in any non-trivial equilibrium, the firms which adopt an internal focus will be the ones which employ the ex ante higher quality entry-level workers.

To close the model, firms select their entry-level employees signal-type and supervisor recruitment strategy jointly to maximize their profits. Competition for labor ensures that firms earn equal (zero) profits in equilibrium. Strategies that yield cheaper supervisor recruitment and higher expected supervisor quality lead to higher wages for the workers required to implement that strategy. In equilibrium firms are indifferent between all hiring strategies that exist in the market. Finally, r is determined by the value of an external focus without entry-level employees, which makes firms indifferent towards entry.

Definition 5. A full-sorting equilibrium is an equilibrium in which the set of young high-signal workers at externally-focused firms and the set of young low-signal workers at internally-focused firms is of measure 0.

Proposition 6. *There exists a steady-state, talent-scarce, full-sorting equilibrium if and only if $(1 - p_L)^2\phi - (p_H - p_L)^2 \geq \frac{m}{(1-\beta)\lambda\theta} \geq (p_H - p_L)^2 + (1 - p_L)[(1 - p_H) - (p_H - p_L)]\phi$ and $h < \frac{1-2p_L}{1-2p_L+p_H^2}$, where $\phi = \frac{hp_H^2+(1-h)p_L^2}{(1-p_L)^2(1-h)}$* ²⁶

The full-sorting equilibrium illustrates the implications of the model most clearly.²⁷ Recruitment policies are tied to entry-level worker quality, and vice versa. Firms either hire two high-signal workers and adopt an internal focus, or hire two low-signal workers and adopt an external focus. The number of internally-focused firms is perfectly determined by the number of high-signal workers. Interestingly, for a wide range of parameters the internally-focused firms will be able to hire better supervisors on average, despite spending less resources and

²⁶Proofs of this and all other results are in the appendix.

²⁷The reason that not all equilibria are full-sorting is primarily because of diminishing returns. The second high-signal entry-level worker raises the probability of employing a qualified supervisor by the less than the first. Since these workers are identical they must be paid identical wages, thus there can be cases where the value of a second high-signal worker to an internally-focused firm is equal to or less than that of one high-signal worker to an externally-focused firm.

evaluating less candidates.²⁸ Because the ex ante highest quality workers are already inside the firm, constraining themselves to an internal search has little negative impact. However, competition for the scarce high-signal workers necessary to implement this strategy raises these workers wages. The externally-focused firms benefit from hiring lower wage entry-level workers, even if they obtain worse supervisors in equilibrium.

The conditions for existence of the full-sorting equilibrium are intuitive. When m is too high, low-signal hiring firms feel pressure to become internally-focused, and are willing to hire a single high wage high-signal worker in order to decrease the opportunity cost of focusing internally. When m is too low, the benefits of an internal focus decrease for the high-signal hiring firms. They find it beneficial to adopt an external focus, in which case they would prefer to replace a relatively expensive high-signal worker with a less costly, albeit less promising, low-signal worker. The condition on h simply assures that talent is scarce under full sorting.

The full-sorting equilibrium is not unique. Other non-trivial, talent-scarce equilibria can exist.²⁹ Equation (5) shows, however, that any talent-scarce equilibrium must involve the sorting of high-signal workers into internally-focused firms. I will use the full sorting equilibria below to illustrate the intuition behind my empirical predictions, but prove them formally for all non-trivial, talent-scarce equilibria.

2.3 Predictions

As hiring and selection are at the forefront of the model, it is not surprising that in these elements promotion practices have the starkest effect. I will illustrate the implications using the full-sorting equilibrium. In the appendix, I prove these propositions for all equilibria.

First, consider the wages of young entry-level workers. Internally-focused firms hire two

²⁸A sufficient condition for this to be the case is $(1 - 2p_H - p_L^2) > 0$

²⁹Generally, when the cost of an external focus is high (i.e. m is large), other equilibria that exist will involve some firms adopting an internal focus when hiring low-signal workers. When the cost of an external focus is low, some firms will adopt an external focus when hiring high-signal workers. The probability of finding a qualified external supervisor then adjusts to make firms indifferent between technology choices using the same signal worker. Necessary and sufficient conditions for the existence of other talent-scarce equilibria are available upon request.

high-signal workers and earn zero profits in equilibrium. Setting equation (3) equal to zero yields the wages for young high-signal workers,

$$w_H^n = \theta + \frac{1}{2} [1 - (1 - p_H)^2] (1 - \beta)\lambda\theta - \frac{r}{2} \quad (6)$$

Externally-focused firms hire two young low-signal workers. Applying the zero profit constraint to (4),

$$w_L^n = \theta + \frac{1}{2} [1 - (1 - p_L)^2 + (1 - p_L)^2\phi] (1 - \beta)\lambda\theta - \frac{r + m}{2} \quad (7)$$

Taking the difference,

$$w_H^n - w_L^n = \frac{1}{2} [(1 - p_L)^2(1 - \phi) - (1 - p_H)^2] (1 - \beta)\lambda\theta + \frac{m}{2} \quad (8)$$

This difference is strictly positive. In equilibrium, internally-focused firms will pay their young entry-level employees higher wages than externally-focused firms. There are two reasons for this. The first term expresses the difference in supervisor quality across the two strategies. When p_H is high and p_L is low this is positive; the internal focus strategy produces better quality supervisors which produces a rent for the firm that is passed back to the workers through wage competition. When p_H and p_L are relatively close this is negative; focusing on a narrower set of candidates decreases the expected supervisor quality, and the firm must be compensated through lower wages. The second term represents a cost savings to the firm from adopting an internal focus. Entry-level labor market competition sends this savings to the high-signal workers required to implement it. Even if the first term is negative, in equilibrium the entire expression must be positive, otherwise the firm would find it optimal to adopt an external focus. Proposition 7 formalizes this result for all non-trivial, talent-scarce equilibria.

Proposition 7. *In any steady-state, non-trivial, talent-scarce equilibrium, the average wage of young entry-level workers is higher at internally-focused firms than externally-focused*

firms.

The initial wages for entry-level workers at internally-focused firms are higher. They employ high-signal workers who provide higher expected future profits to the firm, which are sent to the worker because of labor market competition. However, old workers at entry-level positions do not provide any additional value beyond production. As I showed earlier, once the firm has learned their type and chosen not to promote them, their wage must be θ . This leads to the following proposition.

Proposition 8. *In any steady-state, non-trivial, talent-scarce equilibrium, the average wage of old entry-level workers is identical across firm recruitment policies.*

From these two propositions we can derive three predictions to take to the data:³⁰

1. In a cross-section of entry-level workers, we should observe higher wages being paid to the most recent hires at firms that adopt an internal focus.
2. In a cross-section of entry-level workers, we should observe a lower return to tenure among workers employed at firms that adopt an internal focus.
3. In a cross-section of entry-level workers, we should observe no wage differences associated with a firm's recruitment policy among the most senior workers.

Predictions 1 and 3 follow directly from the previous two propositions. The second is implicit – the return to tenure in the model is the observed difference between old and young workers, given that there is no turnover of workers from entry-level to entry-level. Since the wages of workers at internally-focused firms start higher, their observed return to tenure must be lower than those at externally-focused firms.³¹ Note here that I limit the analysis to a

³⁰Note that the model also predicts that entry-level wages at all employers will decline absolutely with tenure which is clearly not true in the data. This is not uncommon in models of promotion (e.g. Ghosh and Waldman, 2010), and the explanation for this necessarily comes from outside the model.

³¹In an earlier version of this paper, I showed a second reason for this result. If qualified workers are more productive at the entry-level task, then high-signal workers also earn higher wages because they are more productive in expectation. In a talent scarce equilibrium, all workers who remain at the entry-level are unqualified. Thus the observed return to tenure at internally-focused firms reflects both a decrease in the option value to the firm these workers provide and a decrease in their productivity as the highest producers move to supervisory jobs.

cross-section of *entry-level* workers. The return to tenure for all workers is ambiguous as it depends on the size of the surplus from having a qualified supervisor.

I emphasize that the model does not create a prediction of *causality* between recruitment policies and hiring selectivity. My model does not differentiate between whether firms adopt an internal focus because they hire *ex ante* high quality workers, or whether they hire *ex ante* high quality workers because they intend to focus internally. The practices are determined jointly as neither would be optimal without the other. The predictions are the expected wage patterns as an outcome of implementing these two complementary strategies.

3 Data

The data come from the Worker Employment Relations Survey (WERS) 2004, a matched employer-employee data set from the United Kingdom. The survey was conducted by the Department of Trade and Industry, the Economic and Social Research Council, the Advisory, Conciliation and Arbitration Service, and the Policy Studies Institute. It is the fifth such survey in this series, which aims to study conditions in the workplace throughout Great Britain.

The survey of each establishment took place in four parts. First, the Management Questionnaire (MQ) was administered in a roughly two-hour face-to-face interview with a management representative. The Employee Representative Questionnaire (ERQ) was conducted in person with both a union and non-union employee representative, when available. This interview typically lasted 45 minutes. The Supplemental Employee Questionnaire (SEQ) was distributed to a random sample of 25 employees at the establishment to gather basic information on the establishment's employees. This questionnaire was self-administered. In establishments with fewer than 25 employees, all of the establishment's employees were surveyed. Finally, a Financial Questionnaire (FQ) was completed by the establishment's financial manager on the establishment's recent financial performance. For this paper, data from the MQ and SEQ are linked to form a sample of employees matched with characteristics of their employing establishments, as reported by management.

One shortcoming of the SEQ is that many of the variables are categorical. This is particularly problematic for the wage and income data. The survey asks the workers for their weekly income, hourly wage, and number of hours they work per week. Workers are given the choice of 14 weekly income categories, but only 4 wage categories. The wage categories are also very unbalanced. The third highest (second lowest) category is for hourly wages between £4.50–£5.00, while the second highest category has a range of £5.00-£15.00.

I impute hourly wages by dividing the midpoint of the weekly income categories by the continuously measured weekly hours variable. For the unbounded category, which is weekly income of £871 or more, I use the value 950. I include an indicator in any regression that involves wages for whether the wage was imputed from a top-coded income.³² This requires that the measurement error due to the categorical transformation is orthogonal to the estimated value, so that the mean is roughly equal to the midpoint of each category, and that hours worked is orthogonal to any deviations in income from the midpoint. While the assumption is strong, it is commonly made.³³

The data consist of 22,451 workers surveyed from 2,295 unique establishments. Included in these data are 4-digit occupation and industry codes, as well as a variety of questions in the MQ that are linked to the specific 1-digit occupation codes within that establishment. In order to focus on establishment practices, rather than the results of collective bargaining, I drop all union members from the data set.³⁴ I also eliminate all workers who work less than 30 hours per week or whose imputed wages are less than £1/hour. I drop all workers who do not have a valid response for ethnicity, gender, age, education, occupation, and supervisor status, and anyone employed at an establishment that does not have a valid industry code.

³²In practice, this affects only 6.5% of my final weighted sample, and less than 1.5% of my final weighted sample of “entry-level” workers.

³³As a robustness check, I used ordered probits with the cut points constrained to match the actual (log) income categorical cutoffs in the survey. I exploit the fact that $\ln(\text{Wage}) = \ln(\text{Weekly Income}) - \ln(\text{Hours})$, by controlling for the log of hours worked and constraining the coefficient on this variable to be equal to one. Thus all coefficients are identified and are marginal wage effects. This requires an alternative, but equally strong assumption that errors in wage are distributed log-normally. This approach yields similar results, though my tests have less power than the midpoint approach. These results are available upon request.

³⁴I do this as it is the finest definition of union membership that I have, and therefore will allow me to keep the most observations. Using alternative definitions of union influence, as well as including all union members in my regressions, does not meaningfully affect the results.

After modifying my sample in this way, I am left with 9,348 unique workers from 1,533 different establishments.

Following DeVaro and Morita (2013), I ascertain an establishment’s promotion and recruitment policies from a question in the MQ which asks “Which of these statements best describes your approach to filling vacancies at this workplace?” Managers then chose whether internal candidates or external candidates were either hired exclusively, given preference, or that both types of candidates were given equal opportunity. Roughly 93% of the establishments weighted by employment in the survey reported that they either gave preference to internal candidates or gave no preference to either type. I classify an establishment as internally-focused if they report favoring internal candidates or that only internal candidates were considered.

The model’s predictions are focused only on a subset of the jobs that are observed at a firm: entry-level and supervisory positions. I classify “entry-level” jobs as non-managerial and non-supervisory jobs, while managers and supervisors correspond to my model’s supervisory job.³⁵ In Table 1, I present summary statistics for each sub-sample using the weights provided by the survey makers for the SEQ. Education in the survey is given in terms of certificates earned through the UK schooling system. In the table, I reduce the seven categories given in the survey to five, though I use all seven as controls in regressions that use worker characteristics.³⁶ While worker characteristics are somewhat different between internally-focused and externally-focused establishments, the distribution of occupations is quite similar. In both sub-samples, workers at internally-focused establishments are more educated and earn higher wages. I can reject the equality of the distribution of education

³⁵This is slightly different from DeVaro and Morita (2013). They classify professionals as high level jobs, and do not have access to information on supervisors, since it is only available at the worker level. My classification is more appropriate in this setting, since it is unlikely that one would be promoted into the position of lawyer, while one could be promoted from a lawyer to a managing partner. Reclassifying professionals as supervisory jobs yields similar results.

³⁶Workers were asked to check each of the categories of education certifications they possessed. The seven categories are: no academic qualifications, GCSE grades D-G and equivalents, GCSE grades A-C and equivalents, 1 GCE ‘A’ level grades A-E or 1-2 SCE Higher grades A-C or AS levels, 2 or more GCE ‘A’ levels A-E or 3 or more SCE Higher grades A-C, First Degree, and Higher (Postgraduate) Degree. Respondents were also given the option to choose “other academic certification.” I do not use that category since it is indeterminate whether that certification is higher or lower than the others chosen by the respondent.

using a Kolmogorov-Smirnov test. The differences in worker occupations appears to be small. The biggest differences are among professionals, skilled trades, and personal service, which encompasses occupations such as nurses, hairdressers, and travel agents. Workers at internally-focused establishments are more likely to be classified as professionals while being less likely to be in the latter two, particularly at the entry-level.

While there is no way to directly test in the survey for whether firms who report favoring internal candidates actually practice more frequent internal promotion, the observed distribution of tenure in Table 1 supports this notion. Supervisors are more likely to have less than one year of tenure with the establishment at externally-focused establishments than internally-focused establishments, indicating they are employing a higher fraction of external hires.³⁷ Although the distribution of tenure among internally-focused supervisors as a whole does not stochastically dominate that of externally-focused supervisors, this is not necessarily implied by an internal promotion strategy. There could be other reasons outside the model that supervisors at establishments that do not favor internal promotion may have more supervisors with very high levels of tenure.³⁸

Table 2 shows descriptive statistics at the establishment level, using weights designed to be representative of the average worker's place of employment.³⁹ Consistent with previous studies (DeVaro and Morita, 2013), internally-focused establishments are larger and appear to be part of firms which employ more people in the United Kingdom. This latter difference is not statistically significant. There is no difference in the age of the establishment across recruitment policies, suggesting that the decision is not related to being part of a newer,

³⁷This difference is statistically significant at the 5% level. Additionally, by combining the lowest two tenure bins we can see that managers and supervisors at externally-focused establishments are also more likely to have less than two years of tenure at the establishment. This latter difference is significant at the 10% level.

³⁸For instance, if firms that favor internal promotion successfully recruit higher quality supervisors, they may have more market opportunities outside the firm later in their careers. Additionally, recent work by Ke, Li, and Powell (2014) shows that the optimal behavior of a firm which practices strict internal promotion may also include forced attrition policies at the management level to increase promotion opportunities for young workers.

³⁹The alternative set of establishment weights, which are designed for analysis of the average establishment, weight small workplaces much more highly due to their prevalence in spite of the low fraction of employment they represent.

more innovative establishment. The percentage of the establishment’s employees who are trade union members and the yearly turnover are also identical across recruitment policies. Internally-focused establishments are much more likely to offer incentive pay to at least some employees. The table lists the distribution for the largest non-managerial 1-digit occupation code at the establishment. While these statistics vary between the internally-focused and externally-focused establishments, there is no single type of occupation that is unrepresented in one of the recruitment strategies. The lowest representation is for the Personal Service category in internally-focused establishments, which makes up 4% of that type.

4 Testing the Model Empirically

4.1 Main Results

I first test whether entry-level job workers at internally-focused establishments earn higher wages initially and have a lower observed return to tenure.⁴⁰ I estimate the following equation

$$\ln \text{Wage}_i = \beta_0 + \beta_1 X_i + \beta_2 * \text{Internal}_i + \beta_3 * \text{Tenure}_i + \beta_4 * \text{Internal}_i * \text{Tenure}_i + \epsilon_i \quad (9)$$

where X_i is a vector of controls and Internal is an indicator for whether the establishment gives preference to internal candidates.⁴¹ My model predicts that $\beta_2 > 0$ and $\beta_4 < 0$. I transform the tenure categories into a continuous variable using the midpoints of the bins, and include a dummy variable for those who are in the top bin.⁴² I use my sample of entry-level job workers, which consists of non-managerial and non-supervisory workers.

Table 3 shows the results of this regression. The first column contains only the internal

⁴⁰While there has been a substantial literature interested in estimating the causal returns to tenure (e.g. Altonji and Williams, 2005), my model’s predictions do not refer to differences in the causal return to tenure. They are instead wage differences based on changes in the equilibrium occupational sorting patterns within a worker’s life-cycle in the firm. While estimating differences in the causal return to tenure may be of additional interest, conventional methods of estimating such require panel data on worker wages which are not available in the WERS 2004. See Altonji and Shakotko (1987) and Topel (1991).

⁴¹In order to ease the comparison across recruitment policies, I do not allow tenure to enter the wage regression non-linearly as is standard in the literature. Results using non-linear specifications are generally consistent with the model.

⁴²The results are robust to using both the upper or lower bounds of the bin, alternatively, to define tenure. Specifications using the tenure categories are also generally supportive of the model.

dummy, tenure, and the tenure interaction with no additional controls. The coefficients on both internal and the interaction match up with the prediction and are jointly significant at the 1% level. Non-managerial, non-supervisory workers at establishments that give preference to internal candidates earn on average 14% more than those at establishments that do not, conditional on tenure. The relevant comparison for the model, however, is for workers at identical jobs. Therefore, column 2 controls for 3-digit occupation code from the UK Standard Occupation Classification 2000 system (SOC2000) and 3-digit industry code from the UK Standard Industry 2003 system (SIC2003). Consistent with the predictions, the premium paid by internally-focused establishments is 6%, but these non-managerial, non-supervisory workers have a 0.8 percentage point lower observed return to tenure.⁴³ Both coefficients are statistically significant. The return to tenure at internally-focused establishments is only slightly more than half that at externally-focused establishments.⁴⁴

In column 3, I replace the industry and occupation codes with controls for education, ethnicity, gender, and age.⁴⁵ Both coefficients of interest have the right sign and are significant. Column 4 adds the industry and occupation codes back into the regression with the worker controls. The worker controls do not substantially alter the results when compared to the regression with just the industry and occupation codes, though the tenure interaction is now somewhat stronger. Given that my predictions are on equilibrium sorting patterns and these controls are observable correlates of ability, we would expect these controls to reduce the magnitude of the coefficients on both internal and the interaction. This is indeed the case

⁴³The return to tenure at both internally-focused and externally-focused establishments is lower than typical ordinary least squares estimates (Altonji and Williams, 2005). This is likely due to the sample selection excluding supervisors, who have both longer tenure and higher wages.

⁴⁴It is likely that there are things outside the model that would cause differences in the return to tenure at the industry and occupation level. The results are robust to interacting tenure with both sets of codes. The model is also robust to controlling for the top-heaviness of the hierarchy through the fraction of workers who are employed as managers at the establishment. This was previously noted as a difference between establishments with different promotion practices by DeVaro and Morita (2013).

⁴⁵The education controls include 6 dummies to represent, from lowest to highest achievement: No academic qualifications, GCSE grade D-G equivalent, GCSE grade A-C equivalent, 1 GCE A-level equivalent, 2 or more GCE A-level equivalents, Bachelor's degree equivalent, and graduate degree. The ethnicity controls are 16 dummies that represent British, Irish, other white, white and Black Caribbean, white and Black African, white and Asian, other mixed, Indian, Pakistani, Bangladeshi, other (South) Asian, Caribbean, African, other Black, Chinese, other ethnic group, and those who coded multiple of these.

for the internal coefficient. Comparing column 3 to column 1 and column 4 to column 2, the observed effect of being at an internally-focused firm is smaller, and significantly so in the former case at the 10% level. The coefficient on the interaction moves in the wrong direction when comparing column 1 to column 3, though this change is not statistically significant. There is virtually no change in the interaction term when comparing 2 to 4.

Finally, in column 5, I add controls for the region of the establishment and the log number of its employees.⁴⁶ The establishment-size wage premium has been well documented and, as seen in the descriptive statistics, establishments that focus internally are larger on average than those that do not. One concern is that the internal variable is simply proxying for establishment size. Though establishment size does appear to have a positive impact on wages, adding this control has little effect on the coefficients of interest. Alternatively using firm size in the UK, as well as interacting tenure with establishment size does not affect the results.

My model makes a specific prediction about the wages of the most senior entry-level job workers. The higher wages at internally-focused firms are due to the higher expected future value they will bring the firm upon promotion. However, since talent is scarce, any old worker who remains in an entry-level job at any type of firm must be unqualified. Further, old workers die at the end of the period; even if they were qualified their impending mortality precludes any future value to the firm. Thus, the wages paid to workers at entry-level jobs should be identical at both types of firms.

In Table 4, I test this using the samples of non-managerial, non-supervisory workers with the most seniority. Column 1 and 2 use the highest tenure bin, which is ten years or higher. Controlling for industry and occupation, there is no statistically significant difference in wages across recruitment policies for this tenure group. The results are virtually unchanged when controlling for worker characteristics, and establishment size and location.⁴⁷ Given that

⁴⁶The results are robust to using levels instead of logs.

⁴⁷I note that the reduced sample size increases the standard error of the estimate, thus making it harder to find significance. However, even if I were to obtain estimates with the same precision as the comparable main results in table 5 (i.e column 2 and column 5 for Table 4's column 1 and 2, respectively), a standard t -test would still fail to reject at the 10% level.

this tenure bin is unbounded above, there is some concern that there may be large differences in tenure within this category that are masking a true difference in the correlation between wages and recruitment policies. This is less of a concern when using the second highest tenure bin, which is bounded between five and ten years. In columns 3 and 4, I show that there is similarly no statistically significant difference in wages across recruitment policies for this group.

4.2 Sorting and Productivity Differences

Much of the predicted wage differences between workers at internally- and externally-focused establishments are due to sorting. If one could observe the signal received by the market, the entry-level jobs at internally-focused establishments would be primarily populated by workers with the high signal, while those jobs at externally-focused establishments would be primarily populated by workers with the low signal. Workers at supervisory jobs in internally-focused establishments would also primarily have the high signal, since they are chosen only from the population of entry-level workers at such establishments. However, the supervisory jobs at externally-focused establishments would also be populated by high-signal workers hired away from internally-focused establishments, meaning we would expect the degree of sorting to be less. Unfortunately, there is no such question in the survey. Instead, I use ordered logits to look for sorting on education, an observable characteristic that is correlated with higher levels of productivity and presumably a better market signal.

The first column of Table 5 looks at all workers controlling only for the employer's recruitment policy. Workers at internally-focused establishments are significantly more likely to have higher levels of education than those at externally-focused establishments. This is true even when controlling for industry, occupation, geography and other worker characteristics. The third and fourth columns break the sorting down by job type. While both supervisory and entry-level job workers are more likely to have higher levels of education at internally-focused establishments, this effect is only statistically significant for the latter. To test the hypothesis that there is more sorting on education in entry-level jobs than

supervisory jobs, I estimate an ordered logit that fully nests both job types. Though not statistically significant, the interaction between entry-level job status and working at an internally-focused establishment is positive, which is consistent with the theory.

One major concern is that internal could be proxying for establishment-level productivity differences. The WERS FQ offers three different measures of establishment level productivity: profits, value added, and the capital/labor ratio. Capital/labor ratio and profitability, in particular, have been shown to be positive correlates of the wage, at least at the industry level (Dickens and Katz, 1986). Unfortunately, the response rate to the FQ was much lower than other parts of the survey; less than half of the participating companies returned a FQ. This severely reduces the sample size. Only 1,791 of my non-managerial non-supervisory workers work at an establishment with a valid entry for capital/labor ratio.

Table 6 shows the results of adding these controls to the log wage regressions of non-managerial, non-supervisory workers.⁴⁸ The results provide further support for the model.⁴⁹ Though the coefficient on internal is insignificant when controlling only for value added, it is estimated with less precision due to the smaller sample size, and is not statistically significantly different from the estimate in column 5 of Table 3. The interaction between

⁴⁸There are a few theoretical problems with adding firm productivity measures to a wage regression. In a competitive market, wages are equal to marginal product. If the production function is Cobb-Douglas, log wage is a linear function of just the log of the capital/labor ratio. Value added (revenue - variable cost) divided by labor is just a linear transformation of the capital/labor ratio, as is profits less fixed costs divided by worker. In this setting, this type of regression would simply be of wage on wage. My model's setting is slightly different, in that young workers at entry-level jobs earn wages above their marginal product in equilibrium, but this rent disappears for old workers and it is still unclear what further controls in the regression could account for. Despite these concerns, this is a regression which is frequently estimated, and can still provide some insight into the robustness of my main results.

Another possible concern is that these productivity differences are outcomes of firm hiring policy, rather than firm characteristics. Any difference in the productivity measures I use, however, must come from factors outside my model. Each firm in equilibrium earns equal profits (0) and employs the same amount of capital (one factory). Firms do vary in size in my model, but since I control for log establishment size and because ratios are linear in logs, these differences will not confound my results.

⁴⁹Table 6 reports results using logs of these productivity controls. Roughly 25% of the sample of non-managerial, non-supervisory workers whose establishment reported their profits were employed by an establishment that had negative profits. A smaller portion of workers also worked for a firm who reported negative value added. To avoid dropping these workers and thus creating a selected sample, I re-code all profits per full time worker and value added per full time worker that were less than 1 to be equal to 1, and include a dummy variable indicating whether a worker's establishment had been re-coded in such a way in each specification where that variable was included. The results are robust to instead adding a constant to the variable before taking logs so as to make all values positive, or to simply using the levels of the productivity measures.

being at an internally-focused establishment and tenure is always significant and is larger, though not significantly so, than estimates seen without these controls previously. Given that each of these three measures is a noisy measure of the firm's productivity, the best specification would be to control for all three simultaneously.⁵⁰ Under this specification in column (4) both coefficients of interest are large and statistically significant.

4.3 Cross-Industry Differences

It is difficult to generate definite predictions on cross-industry differences because there can be both differences in the composition of the equilibrium for different parameterizations and multiple equilibria for the same set of parameters. However, if we restrict attention to just full-sorting equilibria, there are two clear predictions: industries in which there are more high-signal workers will have more establishments who adopt an internal focus, and industries in which there are more frictions (as measured by the cost of search plus the difference in expected productivity of externally and internally-focused firm supervisors) will have higher entry-level internal-focus wages. Of course any assumptions on what constitutes a high-signal and what constitutes frictions will be necessarily *ad hoc*. Still, it is interesting to see if the metrics at the industry-level look reasonable.

Table 7 shows the fraction of establishments in each industry, using the main sections of the SIC2003, who give preference to internal candidates.⁵¹ The industries with the highest fraction of internally-focused establishments, finance and manufacturing, seem quite logical. In both industries there are many observable characteristics that could differentiate high- from low-potential young employees. In the finance industry this could come in the form of elite graduate and undergraduate degrees. In manufacturing it can come in the form of certifications and apprenticeships. The lower end of the spectrum includes education, personal service, and hotels and restaurants which are unlikely to have such observable predictors.⁵²

⁵⁰I am indebted to Michael Waldman for pointing this out.

⁵¹These estimates use the employment weights provided by the WERS discussed previously.

⁵²For example, the large productivity gains among teachers associated with small early gains in experience likely represent the discovery and sorting out of teachers who possess unobservably poor skills. These gains

In Table 8, I estimate the entry-level internal-focus premium and the interaction between internal and tenure separately for each industry. The estimates are all fairly imprecise given the severely reduced sample sizes, however the point estimates can still be of interest. In spite of being the industry with the largest fraction of establishments favoring promotion, there is no entry-level internal-focus premium paid at finance establishments. This likely reflects the competitiveness of the industry's labor market; when there are few frictions the benefit to avoiding them, which is passed back to entry-level workers through higher wages, is small. Instead, the largest internal-focus premium appears in wholesale and retail trade. This could, for instance, be due to specialization in the knowledge of products making it costly to identify outside alternatives.

Table 8 presents two interesting tests of the full-sorting equilibrium. First, in industries that pay higher internal-focus premiums to entry-level workers, there should be larger negative interaction between recruitment policy and tenure. This is necessary to ensure that all experienced entry-level workers are paid the same. Second, if the surplus sharing at the supervisory-level is fairly equitable, in industries with a large entry-level internal-focus premium, internally-focused establishments should also be observed as paying higher wages to supervisors. This is because the internal-focus premium represents the extra potential profits from the strategy to the firm. If they are large, it is likely they are large because the establishment is able to employ better quality supervisors than those that look externally, which should be reflected in their salaries. I estimate these wages for managers and supervisors in column 3. The results are supportive in both cases. The correlation between columns (1) and (2) of Table 8 is strongly negative, while the correlation between column (1) and (3) is positive.

Given that the sample sizes are small and the estimates are rarely significant, I caution placing too much weight on the strength of the results of the cross-industry regressions.

can be as large if not larger than that for formal training (Clotfelter, Ladd, and Vigdor, 2007).

It may be surprising that health and social work, which includes the medical professions, also has a low rate of internal-focus, but this industry is likely organized in a somewhat unique way, due to the medical residency system, etc.

However, they do largely support the model, and in particular the full-sorting equilibrium. There is no evidence here to suggest the underlying story is incorrect.

4.4 Alternative Explanations

Given that my theory is meant to be complementary to existing theories of promotion, it is important to analyze whether it is necessary. In this section I consider whether one could obtain identical predictions from a more conventional model of promotion. In each case I find that an additional component that induces sorting would be required.

Starting with the most classic model, my results may seem somewhat consistent with a Lazear-Rosen (1981) tournament story. In a typical tournament as incentives model, those who do not get promoted receive lower wages as a punishment to induce higher effort in the initial period. The first dilemma is how to classify the different recruitment practices. If we suppose the firms that prefer internal candidates are practicing a tournament and those that do not are not using promotions to incentivize workers, then the lower return to tenure from promotion “losers” is consistent with trying to offer a prize-spread to induce effort. Problematically for this story, Table 4 shows that the most senior non-promoted workers are paid identical wages across recruitment practices. Thus, working in a promotion tournament is a dominant strategy. One can earn a higher initial wage, exert zero effort, and be paid the same as those who did not enter the tournament. Both types of practices cannot exist in this scenario without a sorting mechanism.⁵³

Alternatively, we could suppose that both types of policies represent a tournament but each policy is organized differently. As shown by Chan (1996, 2003), when firms can engage in external recruitment the increased competition reduces the incentives for workers to engage in high effort; they have a lower chance of winning the tournament for every effort level. The firm has two options: either give preference to internal candidates or increase the prize of the tournament through a larger spread between the winners and losers. To investigate whether

⁵³This could perhaps be rectified if the promotion tournament firms fired workers who shirked. Ignoring whether this would be optimal, while I cannot observe firing rates by occupation in the data, there is no evidence that firings, layoffs, or turnover overall is higher among internally-focused establishments.

firms that do not give preferences to internal candidates offer a higher spread, I estimate the differences in wages for managers and supervisors by firm recruitment policy in Table 9. If anything this evidence suggests that internally-focused establishments pay higher wages to their supervisors.⁵⁴ Given that the most senior entry-level workers are paid identical wages across different recruitment policies, there is no evidence of a larger spread, and thus this tournament approach alone seems insufficient.⁵⁵

The promotions as signals approach could provide an explanation for the higher initial wages paid at firms that prefer to promote internally. As originally noted by Bernhardt (1995), when promotion acts as a signal of high ability to the market, non-promotion must also act as a signal of low ability. If a firm's favorable promotion practice reveals more negative information on low ability workers to the market than one that does not frequently promote internally, the premium could account for risk-aversion on the part of workers who are more likely to face this negative shock. However, the fact that long-tenured entry-level workers appear to be paid equally across recruitment strategies is inconsistent with this approach. Another mechanism is again necessary.⁵⁶

One might also think that firms may favor internal candidates because they require specific human capital for their operation.⁵⁷ If workers at internally-focused firms obtain

⁵⁴Note that in the first columns I do not control for tenure, since workers with identical tenure are not directly comparable; externally-focused firms will be hiring supervisors more often from outside the firm.

⁵⁵One may worry that this approach is confounded by the fact that I cannot observe separately who was promoted internally and that firms offer different salaries to external and internal hires. However, the interaction between tenure and internal shows that even among the most senior employees, whose longevity with the firm suggests they were promoted internally, supervisors are not paid more at firms which do not give preference to internal candidates. Further the weight of empirical evidence from other studies suggests that external hires are paid *more* than internal hires, which would suggest that the Table 9 *understates* the positive gap in wages between firms that give preference to internal candidates and those that do not. See Murphy and Zábajník (2007), Bidwell (2011), and Kampkötter and Sliwka (2014). Hassink and Russo (2008) also find that external hires earn more than the average worker at a firm, but less than workers who recently changed jobs within a firm.

⁵⁶One additional way to address the issue of incentives is to look at the interaction between incentive pay and promotion policy. While there are conflicting ideas as to whether tournaments and monetary incentives are complements or substitutes (e.g. Kwon, 2006 and Frederiksen and Takats, 2011), I observe that my predicted wage patterns hold regardless of whether the establishment offers incentive pay.

⁵⁷For an example of the importance of specific human capital and promotion, see Murphy and Zábajník (2004, 2007). They show that one can explain recent increases in the compensation to, and reduction in internal promotion of, CEOs with a decrease in the relative importance of specific versus general human capital.

specific human capital and those at externally-focused firms invest in general human capital, the former will have a lower observed return to tenure than the latter since the market only rewards general human capital. Thus, internally-focused firms would have to offer higher wages in order to attract workers. However, for this model to work, it would have to be that workers at externally-focused firms are eventually paid more, so that the lifetime expected wages are the same. This is again contradicted by the results of Tables 4 and 9, which show that long-term employees of internally-focused establishments do not earn less than similar workers at externally-focused establishments at any task.

5 Summary and Conclusion

In this paper, I developed a new model of promotions in equilibrium, which explains heterogeneity in recruitment practices across firms. Firms must choose whether to invest in a technology that provides information on external candidates. Those that do not make this investment rely more heavily on internal promotion. As a consequence, they are more selective in their entry-level hiring. In addition to being good entry-level workers, they must also be good candidates for supervisory tasks. The viability of such a strategy is limited by the number of such workers in the labor force. An internal promotion strategy always requires better skilled candidates than one that looks externally.

My model predicts that workers at entry-level jobs at firms that favor internal promotion should have higher wages, but lower observed returns to tenure. Internally-focused firms are willing to pay a premium for entry-level workers who are likely to become good supervisors since their future profits are more directly tied to the skills of their entry-level employees. Once the uncertainty has been resolved, this premium disappears. There are no differences in the wages of the most senior workers in jobs that differ only in their firm's recruitment policy. I confirm these predictions in the data. Also consistent with my model is sorting on observables, where educated workers are more likely to be employed at internally-focused establishments than externally-focused establishments. These results cannot be explained by the conventional promotions as incentives or specific human capital models alone and are

not driven by differences in establishment-level productivity.

The results suggest the further study of other complementary strategies. Given that internally-focused firms require a highly qualified workforce at the entry-levels, it would be of interest to understand how their hiring methods (e.g. vacancy advertising, employee referrals, etc.) differ from those that look externally. Also, given that their lower ranked workforce is more skilled, a firm that prefers to promote internally may also use different production technologies, such as span of control or diversity in assigned tasks. This is certainly an avenue for future research.

My model also provides a potential explanation for inequality outcomes. Workers at internally-focused firms, who have good observables in equilibrium, have a higher chance of earning a supervisory job even when they are revealed to not be of high ability. Applying this to the statistical discrimination literature, if blacks have poorer characteristics than whites that are observable to employers but not to the econometrician then, even conditional on other observables and ability, blacks may perform poorer than whites in the long run. This is consistent with evidence presented by Altonji and Pierret (2001).

Overall, while incentives may play an important role in the labor market within a firm, incentivizing workers to enter the firm is important when looking across firm promotion practices. Emphasizing internal promotion cannot be successful without selective hiring at the lower ranks. The quality of the labor pool is thus a constraint on the number of firms who can profitably implement an internal labor market.

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A Proof of Main Results

A.1 Proof of Proposition 6

Proof. In the full-sorting equilibrium, every firm either employs two high-signal workers or two low-signal workers. The two high-signal worker firms adopt an internal-focus, while the two low-signal worker firms adopt an external-focus. Thus,

$$\phi = \frac{hp_H^2 + (1-h)p_L^2}{(1-p_L)^2(1-h)}$$

rearranging shows that $h < \frac{1-2p_L}{1-2p_L+p_H^2}$ ensures $\phi < 1$ and thus talent-scarcity. This then determines the value of entry (externally-focused with no employees), and thus the price of factories r ,

$$r = \frac{hp_H^2 + (1-h)p_L^2}{(1-p_L)^2(1-h)}(1-\beta)\lambda\theta$$

In a full-sorting equilibrium, firms that hire two low-signal workers must prefer an external focus. The profits for a two low-signal externally-focused firm are

$$\pi_{LL}^e = 2\theta + [1 - (1-p_L)^2 + (1-p_L)^2\phi](1-\beta)\lambda\theta - 2w_L^n - r - m$$

Setting profits equal to zero and re-arranging terms yields the equilibrium low-signal entry-level wage,

$$w_L^n = \theta + \frac{1}{2} [1 - (1-p_L)^2 + (1-p_L)^2\phi](1-\beta)\lambda\theta - \frac{r+m}{2}$$

Substituting ϕ into (5) from the main text, the firm adopts an external-focus so long as

$$(1-p_L)^2 \frac{hp_H^2 + (1-h)p_L^2}{(1-h)}(1-\beta)\lambda\theta \geq m$$

Firm's that employ high-signal workers adopt an internal focus. Their profits are

$$\pi_{HH}^i = 2\theta + [1 - (1-p_H)^2](1-\beta)\lambda\theta - 2w_H^n - r$$

Setting this equal to 0, high-signal entry-level equilibrium wages are

$$w_H^n = \theta + \frac{1}{2} [1 - (1-p_H)^2](1-\beta)\lambda\theta - \frac{1}{2}r$$

Again, substituting ϕ into (5), the firm adopts an internal focus so long as

$$(1-p_H)^2 \frac{hp_H^2 + (1-h)p_L^2}{(1-p_L)^2(1-h)}(1-\beta)\lambda\theta \leq m$$

In order to be an equilibrium, it must be that at these wages, firms would make non-positive profits if they instead hired one high-signal and one low-signal worker. For a firm which adopted this hiring strategy and an external focus, their profits would be

$$\pi_{HL}^e = 2\theta + [1 - (1-p_L)(1-p_H) + (1-p_L)(1-p_H)\phi](1-\beta)\lambda\theta - w_L^n - w_H^n - r - m$$

Substituting for equilibrium wages, the profits would be non-positive so long as,

$$\begin{aligned} (p_H - p_L)^2(1 - \beta)\lambda\theta + (1 - p_L)[(1 - p_H) - (p_H - p_L)]\phi(1 - \beta)\lambda\theta &\leq m \\ (p_H - p_L)^2(1 - \beta)\lambda\theta + [(1 - p_H) - (p_H - p_L)]\frac{hp_H^2 + (1 - h)p_L^2}{(1 - p_L)(1 - h)}(1 - \beta)\lambda\theta &\leq m \end{aligned}$$

Likewise, if the firm chooses to adopt an external focus, their profits would be

$$\pi_{HL}^i = 2\theta + [1 - (1 - p_H)(1 - p_L)](1 - \beta)\lambda\theta - w_H^n - w_L^n - r$$

which are non-positive so long as,

$$\begin{aligned} (p_H - p_L)^2(1 - \beta)\lambda\theta + m &\leq (1 - p_L)^2\phi(1 - \beta)\lambda\theta \\ \frac{hp_H^2 + (1 - h)p_L^2}{(1 - h)}(1 - \beta)\lambda\theta - (p_H - p_L)^2(1 - \beta)\lambda\theta &\geq m \end{aligned}$$

This leaves us with five total conditions to assure the existence of such an equilibrium. However, note that since

$$\frac{hp_H^2 + (1 - h)p_L^2}{(1 - h)} - (p_H - p_L)^2 < \frac{hp_H^2 + (1 - h)p_L^2}{(1 - h)}$$

non-positive profits for a one high- and one low-signal entry-level worker with an internal focus implies that a firm which employs two low-signal workers should always adopt an external focus. Note also that,

$$(1 - p_H)^2\phi - (p_H - p_L)^2 + (1 - p_L)[(1 - p_H) - (p_H - p_L)]\phi = -(p_H - p_L)^2(1 - \phi)$$

and thus whenever a firm with one high- and one low-signal workers finds it non-profitable to adopt an internal focus, all firms which employ two high-signal entry-level workers will prefer an internal focus to an external focus. Thus, the conditions reduce to the two sets of inequalities listed in the proposition. Finally, to see that this set of viable values of m is non-empty, note that

$$(1 - p_L)^2\phi - 2(p_H - p_L)^2 - (1 - p_L)[(1 - p_H) - (p_H - p_L)]\phi = 2(p_H - p_L)[\phi(1 - p_L) - (p_H - p_L)]$$

and,

$$\phi - (p_H - p_L) = \frac{hp_H^2 - (1 - h)(p_H - p_H p_L - p_L)}{(1 - h)(1 - p_L)}$$

which is positive for a large range of parameters. \square

A.2 Proof of Proposition 7

Proof. There are two parts to this proof. First, I show that in any talent-scarce, non-trivial equilibrium, a higher fraction of young entry-level workers at internal-focus firms are high-signal than at external-focus firms. Second, I show that the wages of high-signal workers must always be higher than for low-signal workers.

The first part follows directly from equation (5) in the text. There are three firm hiring

strategies that can exist in equilibrium: two high-signal, one high-signal and one low-signal, and two low-signals. Recall a firm adopts an external focus whenever

$$(1 - p_j)(1 - p_k)\phi(1 - \beta)\lambda\theta \geq m$$

Now, note that

$$(1 - p_H)^2 < (1 - p_H)(1 - p_L) < (1 - p_L)^2$$

Thus, in any non-trivial, talent-scarce equilibrium, it must be that at least one firm which has two low-signal entry-level employees adopts an external focus. There always exists such a firm because $h < \frac{1}{2}$. Suppose there exists a firm which adopts an internal focus and hires two low-signal entry-level employees. From the inequality, it must be that any firm which hires a high-signal entry-level employee adopts an internal focus, and internal-focus firms then have a higher proportion of high-signal entry-level employees. Now suppose that there exists a firm which hires one high- and one-low signal entry-level worker and adopts an external focus. From the inequality, it must be that all firms which hire two low-signal entry-level employees adopt an external focus, and all firms which hire two high-signal entry-level employees adopt an internal focus.⁵⁸ Thus, there is again a higher proportion of high-signal workers in entry-level positions at internally-focused firms. Finally, suppose that a firm hires two high-signal workers and adopts an external-focus. The inequality implies that all firms which employ low-signal entry-level workers must also adopt an external focus.

For the second part, suppose not and that $w_L^n \geq w_H^n$. The inequality implies that there must exist a firm that employs at least low-signal entry-level worker and adopts an external focus. Consider the profits of such a firm,

$$\pi_{Lk}^e = 2\theta + ([1 - (1 - p_L)(1 - p_k)] + [(1 - p_L)(1 - p_k)\phi]) (1 - \beta)\lambda\theta - w_L^n - w_k^n - r - m$$

If the firm were to instead employ a high-signal worker, its profits would be

$$\pi_{Hk}^e = 2\theta + ([1 - (1 - p_H)(1 - p_k)] + [(1 - p_H)(1 - p_k)\phi]) (1 - \beta)\lambda\theta - w_H^n - w_k^n - r - m$$

Taking the difference,

$$\pi_{Hk}^e - \pi_{Lk}^e = (1 - p_k)(p_H - p_L)(1 - \phi) + (w_L^n - w_H^n) > 0$$

Thus switching from a low-signal to a high-signal worker would generate a positive profit, which is a contradiction. \square

A.3 Proof of Proposition 8

This proposition was partially proved in the text. Old entry-level workers produce θ and are valued at θ by all firms. As the market is competitive, this is their wage.

B Equilibria Without Talent Scarcity

While equilibria without talent scarcity generally behave the same as talent-scarce equilibria, there are a few important differences. First, as some old workers who are not discovered

⁵⁸If no firms hire two high-signal workers, then some firms which hire one high- and one low-signal entry-level worker must adopt an internal focus in order for the equilibrium to be non-trivial.

by externally-focused firms are qualified, and these workers are in excess supply, firms earn a profit by hiring random external workers. Denote this profit as $\Gamma \equiv \phi^{-1}\lambda\theta$.⁵⁹ The total surplus from employing a worker who is known to be qualified is then $\lambda(\theta - \Gamma)$. Second, as qualified workers are not guaranteed a supervisor job, workers value jobs with ex ante low quality co-workers higher than those with high quality co-workers, as these entail a greater chance of obtaining a supervisor job when qualified (fewer ties). When the workers receive a very large share of the surplus this can be very valuable, and high-signal workers may be willing to earn less than their marginal product to avoid having a high-signal co-worker.

This appendix will proceed as follows. I will first prove that firms always hire two entry-level young workers. I will then show that firms which adopt an internal focus will always have higher quality entry-level workers than firms which adopt an external focus. I will conclude with a proof that the total wages paid to workers (and thus the average) will always be higher at internally-focused firms.

Lemma 9. *In any non-trivial equilibrium without talent scarcity, all young workers are employed at entry-level positions.*

Proof. Suppose not, and that there was worker with signal j who is unemployed. Given our assumptions on the size of the set of workers and factories, this can only be the case if some firms employ only one entry-level young worker. In order for there to be a non-positive excess supply of young workers, it must be that this worker is indifferent between employment and unemployment. Denote ϕ^{-1} as the probability that qualified worker who is not promoted internally is discovered by an externally-focused firm in equilibrium. The utility of an unemployed worker is simply

$$p_j\phi^{-1}\beta(\lambda\theta - \Gamma) + \theta$$

the first part of the probability of being discovered multiplied by the gain in wages over the wages of workers who are undiscovered, while the second part is the wage of undiscovered old workers. The utility for a worker with signal j who is employed without a co-worker is,

$$w_j + p_j\beta(\lambda\theta - \Gamma) + \theta$$

which represents that this worker always receives a supervisory job when they are qualified. Equating these utilities yields the equilibrium wage,

$$w_j = -p_j(1 - \phi^{-1})\beta(\lambda\theta - \Gamma)$$

⁵⁹For simplicity, I assume that firms do not observe the workers' initial labor market signals or the hiring strategy of their previous period employer. Allowing firms to obtain this information will raise the wage for workers who had both a high-signal and a high-signal co-worker as they are more likely to be qualified. This in turn increases the size of the surplus associated with identifying workers who were ex ante unlikely to be qualified, meaning that firms are not willing to break ties on promotion decisions by coin-flip. They earn a strictly higher profit from promoting a low-signal worker over a high-, since the latter has a worse outside option in bargaining. As there is no differential effect by recruitment policy relaxing this should have, in principal, little impact on the results.

Firm profits from hiring a single j -signal worker with an external focus are

$$\begin{aligned}\pi_j^e &= \theta + (1 - \beta)(\lambda\theta - \Gamma) + \Gamma - r - m - w_j \\ &= \theta + (1 - \beta)(\lambda\theta - \Gamma) + \Gamma - p_j(1 - \phi^{-1})\beta(\lambda\theta - \Gamma) - r - m\end{aligned}$$

Because talent is not scarce, the firm always obtains a qualified supervisor. They can alternatively employ a second worker with signal j . The worker's utility under this scenario is

$$w_{jj} + p_j \left[1 - \frac{1}{2}p_j(1 - \phi^{-1}) \right] \beta(\lambda\theta - \Gamma) + \theta$$

The worker requires additional compensation to accept a coworker as there is now a p_j^2 chance both workers are qualified, in which case he does not get promoted with probability $\frac{1}{2}$. Equating the worker's utilities,

$$\begin{aligned}w_{jj} &= w_j + \frac{1}{2}p_j(1 - \phi^{-1})\beta(\lambda\theta - \Gamma) \\ &= -\frac{1}{2}p_j(1 - \phi^{-1})\beta(\lambda\theta - \Gamma)\end{aligned}$$

Finally, the firm's profits from this strategy would be

$$\begin{aligned}\pi_{jj}^e &= 2\theta + (1 - \beta)(\lambda\theta - \Gamma) + \Gamma - r - m - 2w_{jj} \\ &= 2\theta + (1 - \beta)(\lambda\theta - \Gamma) + \Gamma - r - m + p_j(1 - \phi^{-1})\beta(\lambda\theta - \Gamma)\end{aligned}$$

This is strictly greater than π_j^e , and thus cannot be an equilibrium. \square

Lemma 10. *In any non-trivial equilibrium without talent scarcity, a higher proportion of young entry-level workers at internally-focused firms have a high-signal than externally-focused firms*

Proof. This follows from a re-statement of inequality (5). A firm chooses to adopt an internal focus only if

$$(1 - p_j)(1 - p_k)(\lambda\theta - \Gamma) \geq m$$

Where the left-hand side is the gain from adopting an external-focus (a qualified supervisor with certainty) and the right-hand side is the cost. As the left-hand side is decreasing in the p_j and p_k it must be that firms which adopt an internal focus will have higher quality entry-level employees than those which adopt an external focus. \square

Proposition 11. *Young entry-level workers at internally-focused firms will earn, on average, (weakly) higher wages than young entry-level workers at externally-focused firms*

Proof. Note that in equilibrium firms earn zero profit, so all revenues must be paid out as either wages, r , or m . Externally-focused firms receive a qualified supervisor with certainty. Their profits from hiring one entry-level worker with signal j and one entry-level worker with signal k are

$$\pi_{jk}^e = 2\theta + \lambda(1 - \beta)(\lambda\theta - \Gamma) + \Gamma - r - m - w_{jk} - w_{kj}$$

where w_{jk} is the equilibrium wage paid to a worker with signal j and co-worker signal k . Thus their total wages are

$$w_{jk} + w_{kj} = 2\theta + \lambda(1 - \beta)(\lambda\theta - \Gamma) + \Gamma - r - m$$

Note that this is independent of entry-level worker signal quality, as workers have no impact on the probability of obtaining a qualified supervisor.

Now consider the profits of a firm which adopts an internal focus,

$$\pi_{jk}^i = 2\theta + [1 - (1 - p_j)(1 - p_k)](1 - \beta)(\lambda\theta - \Gamma) - w'_{jk} - w'_{kj} - r$$

The total wages are then

$$w'_{jk} + w'_{kj} = [1 - (1 - p_j)(1 - p_k)](1 - \beta)(\lambda\theta - \Gamma) + \Gamma - r$$

Taking the difference between $w_{jk} + w_{kj}$ and $w'_{jk} + w'_{kj}$,

$$m - (1 - p_k)(1 - p_k)(1 - \beta)(\lambda\theta - \Gamma)$$

This expression is weakly negative as firms only adopt an internal focus when $(1 - p_j)(1 - p_k)(\lambda\theta - \Gamma) \leq m$ \square

Table 1: Descriptive Statistics - Workers

	Entry-Level		Supervisory	
	(1)	(2)	(3)	(4)
	Internal	External	Internal	External
Tenure				
< 1 year	0.26 (0.44)	0.27 (0.45)	0.11 (0.31)	0.13 (0.34)
1-2 years	0.16 (0.37)	0.17 (0.38)	0.12 (0.33)	0.13 (0.33)
2-5 years	0.29 (0.45)	0.28 (0.45)	0.33 (0.47)	0.28 (0.45)
5-10 years	0.17 (0.38)	0.14 (0.35)	0.21 (0.41)	0.21 (0.41)
> 10 years	0.12 (0.32)	0.13 (0.34)	0.23 (0.42)	0.25 (0.43)
Education				
None	0.18	0.23	0.08	0.14
GSCE	0.36	0.40	0.34	0.35
GCE	0.17	0.13	0.16	0.16
First Degree (BSc, BA, etc.)	0.24	0.18	0.32	0.28
Higher Degree (MSc, PhD, etc.)	0.06	0.05	0.11	0.08
Wage (Imputed)	8.76 (3.99)	7.75 (3.54)	12.76 (5.28)	11.27 (5.15)
Occupation (1-digit SOC2000)				
Professionals	0.13	0.09	0.10	0.11
Technical Operations	0.19	0.16	0.12	0.13
Administrative	0.24	0.22	0.12	0.12
Skilled Trades	0.07	0.11	0.04	0.08
Personal Service	0.03	0.07	0.02	0.04
Sales	0.11	0.09	0.05	0.05
Process and Machine Operatives	0.13	0.12	0.05	0.03
Elementary Occupation	0.10	0.13	0.05	0.05
Managers			0.44	0.39
Observations	1798	3591	1334	2625

Source: WERS 2004 SEQ. Means and standard deviations are reported using weights provided with data.

Table 2: Descriptive Statistics - Employers

	(1)	(2)	(3)
	All	Internal	External
Vacancy Policy			
Internal Only	0.00 (0.06)	0.01 (0.12)	0.00 (0.00)
Internal Preferred	0.28 (0.45)	0.99 (0.12)	0.00 (0.00)
No Preference	0.66 (0.47)	0.00 (0.00)	0.93 (0.26)
External Preferred	0.01 (0.09)	0.00 (0.00)	0.01 (0.10)
External Only	0.04 (0.20)	0.00 (0.00)	0.06 (0.24)
Employees at Establishment	477.16 (1157.40)	595.55 (1432.05)	429.83 (1024.27)
Employees in UK	8902.53 (17430.74)	10465.74 (18358.91)	8257.95 (17000.89)
Establishment Age	41.21 (60.69)	41.28 (55.48)	41.19 (62.68)
Percent Union Members	0.25 (0.31)	0.25 (0.31)	0.25 (0.31)
Prior Year Turnover	0.21 (0.20)	0.21 (0.20)	0.21 (0.20)
Offers Incentive Pay	0.48 (0.50)	0.61 (0.49)	0.42 (0.49)
Largest Occupation (1-digit SOC2000)			
Professionals	0.13	0.10	0.14
Technical Operations	0.14	0.09	0.15
Administrative	0.14	0.19	0.12
Skilled Trades	0.07	0.08	0.07
Personal Service	0.09	0.04	0.11
Sales	0.15	0.19	0.14
Process and Machine Operatives	0.14	0.17	0.13
Elementary Occupation	0.14	0.14	0.14
Observations	1533	422	1111

Source: WERS 2004 MQ. Means and standard deviations are reported using employment weights provided with data

Table 3: Non-Managerial, Non-Supervisory Workers - Internal-Focus and Return to Tenure

	(1)	(2)	(3)	(4)	(5)
	Log Wage				
Internal	0.136*** (0.032)	0.060*** (0.021)	0.102*** (0.024)	0.052*** (0.019)	0.041** (0.018)
Tenure	0.021*** (0.004)	0.020*** (0.003)	0.018*** (0.003)	0.013*** (0.003)	0.012*** (0.003)
Internal * Tenure	-0.010 (0.006)	-0.008* (0.004)	-0.012** (0.005)	-0.009** (0.004)	-0.008** (0.004)
Log Establishment Size					0.021*** (0.004)
Worker Characteristics	No	No	Yes	Yes	Yes
Occupation FE	No	Yes	No	Yes	Yes
Industry FE	No	Yes	No	Yes	Yes
Geographic FE	No	No	No	No	Yes
Observations	5389	5389	5389	5389	5389
<i>F</i> -statistic	9.911***	4.044**	9.020***	3.931**	2.936*

Robust standard errors are clustered at the establishment level. *F*-statistic tests joint hypothesis of internal dummy and tenure interaction. Worker characteristics include 6 education dummies, 16 ethnicity dummies, 8 age dummies, and a gender dummy. Occupation fixed effects use the UK Standard Occupation Classification 2000 (SOC2000) 3-digit system. Industry fixed effects use the UK Standard Industry Classification 2003 (SIC2003) 3-digit system. Geographic fixed effects are indicators for Government Office Region. Indicators are included for all top-coded variables, including an interaction between the tenure top-code and the internal dummy

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 4: Log Wage Regressions for Non-Managerial, Non-Supervisory Workers with High Seniority

	(1)	(2)	(3)	(4)
	10+ Years Tenure		5-10 Years Tenure	
	Log Wage	Log Wage	Log Wage	Log Wage
Internal	0.030**	0.027	0.012	0.029
	(0.037)	(0.039)	(0.030)	(0.026)
Log Establishment Size		0.025**		0.015
		(0.011)		(0.010)
Worker Characteristics	No	Yes	No	Yes
Occupation FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Geographic FE	No	Yes	No	Yes
Observations	691	691	866	866

Robust standard errors are clustered at the establishment level. Sample for column 1 and 2 are non-managerial non-supervisory workers with greater than 10 years of tenure.

Sample for columns 3 and 4 are non-managerial, non-supervisory workers with between five and ten years of tenure. Worker characteristics include 6 education dummies, 16 ethnicity dummies, 8 age dummies and a gender dummy. Occupation fixed effects use the UK Standard Occupation Classification 2000 (SOC2000) 3-digit system. Industry fixed effects use the UK Standard Industry Classification 2003 (SIC2003) system. Geographic fixed effects are indicators for Government Office Region. Indicators are included for all top-coded variables.

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 5: Ordered Logit Regressions on Highest Educational Attainment

	(1)	(2)	(3)	(4)
	All Workers	All Workers	Entry-Level	Supervisory
Internal	0.338***	0.120*	0.151*	0.070
	(0.095)	(0.063)	(0.082)	(0.092)
Log Establishment Size		0.120***	0.081***	0.179***
		(0.023)	(0.028)	(0.034)
Worker Characteristics	No	Yes	Yes	Yes
Occupation FE	No	Yes	No	Yes
Industry FE	No	Yes	Yes	Yes
Geographic FE	No	Yes	Yes	Yes
Observations	9348	9348	5389	3959

Robust standard errors are clustered at the establishment level. Worker characteristics include 16 ethnicity dummies, 8 age dummies, and a gender dummy. Occupation fixed effects use the UK Standard Occupation Classification 2000 (SOC2000) 3-digit system. Industry fixed effects use the UK Standard Industry Classification 2003 (SIC2003) 3-digit system. Geographic fixed effects are indicators for Government Office Region. Indicators are included for all top-coded variables.

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 6: Non-Managerial Non-Supervisory Workers - Establishment Productivity Measures

	(1)	(2)	(3)	(4)
	Log Wage	Log Wage	Log Wage	Log Wage
Internal	0.061*	0.033	0.060*	0.061*
	(0.031)	(0.029)	(0.032)	(0.034)
Tenure	0.014***	0.014***	0.015***	0.017***
	(0.004)	(0.004)	(0.005)	(0.006)
Internal * Tenure	-0.013**	-0.013**	-0.015**	-0.016***
	(0.005)	(0.005)	(0.006)	(0.006)
Log Establishment Size	0.024***	0.032***	0.021***	0.027***
	(0.007)	(0.006)	(0.010)	(0.007)
Log Profits / Worker	0.010			0.022
	(0.009)			(0.016)
Log Value Added / Worker		0.016*		0.003
		(0.009)		(0.023)
Log Capital / Worker			0.020**	0.021**
			(0.010)	(0.010)
Worker Characteristics	Yes	Yes	Yes	Yes
Occupation FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Geographic FE	Yes	Yes	Yes	Yes
Observations	2206	2405	1791	1674
<i>F</i> -statistic	2.967*	3.318**	3.071**	3.666**

Robust standard errors are clustered at the establishment level. *F*-statistic tests joint hypothesis of internal dummy and tenure interaction. Establishments with profits or value added per worker less than one were re-coded as 1 before taking logs. An indicator for whether an establishment was re-coded in such a way is included in all specifications with that variable. Worker characteristics include 6 education dummies, 16 ethnicity dummies, 8 age dummies, and a gender dummy. Occupation fixed effects use the UK Standard Occupation Classification 2000 (SOC2000)3-digit system. Industry fixed effects use the UK Standard Industry Classification 2003(SIC2003) 3-digit system. Indicators are included for all top-coded variables including an interaction between the tenure top-code and the internal dummy.

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 7: Internally-Focused Establishments by Industry

	(1)	(2)
	Sample	Internal
Manufacturing	0.15	0.43
Electricity	0.00	0.37
Construction	0.04	0.21
Wholesale and Retail Trade	0.16	0.32
Hotels and Restaurants	0.04	0.21
Transport, Storage, and Communication	0.07	0.38
Finance	0.05	0.55
Real Estate and Rental	0.15	0.31
Public Administration	0.06	0.24
Education	0.08	0.08
Health and Social Work	0.15	0.14
Other Personal Service	0.05	0.19
Observations	1533	422

Source: WERS 2004 MQ. Industry estimates use employment weights provided with the data.

Table 8: Internal-Focus Premium, Tenure Interaction, and Supervisory Wages by Industry

	(1)	(2)	(3)
	Internal	<u>Entry-Level</u> Internal * Tenure	<u>Supervisory</u> Internal
Manufacturing	0.012 (0.041)	0.001 (0.007)	0.016 (0.064)
Electricity	0.066 (0.464)	0.017 (0.058)	1.039 (1.087)
Construction	0.038 (0.084)	-0.020 (0.019)	0.204** (0.102)
Wholesale and Retail Trade	0.198*** (0.059)	-0.022* (0.011)	-0.083 (0.085)
Hotels and Restaurants	-0.046 (0.099)	0.014 (0.025)	0.124 (0.134)
Transport, Storage, and Communication	0.045 (0.080)	-0.018 (0.021)	0.004 (0.116)
Finance	-0.038 (0.073)	0.000 (0.017)	-0.028 (0.089)
Real Estate and Rental	0.049 (0.051)	-0.003 (0.012)	0.114** (0.053)
Public Administration	-0.086 (0.061)	0.023 (0.015)	-0.019 (0.133)
Education	0.153 (0.132)	-0.028 (0.047)	0.494** (0.223)
Health and Social Work	0.008 (0.086)	0.009 (0.015)	-0.312** (0.133)
Other Personal Service	0.040 (0.068)	-0.004 (0.014)	0.078 (0.185)
Correlation with Column (1)		-0.74	0.27

Robust standard errors are clustered at the establishment level. Column 1 and 2 estimates the coefficient on internal and the interaction between internal for entry-level workers controlling for worker characteristics, log establishment size and geographic FE separately by industry. Column 3 estimates the coefficient on internal for supervisory workers controlling for worker characteristics and geographic FE separately by industry. Column 3 does not control for tenure. The left-hand side for all regressions is log wage.

*p<.1, ** p<.05, *** p<.01

Table 9: Log Wage Regressions for Managerial and Supervisory Workers

	(1)	(2)	(3)	(4)	(5)
	Log Wage	Log Wage	Log Wage	Log Wage	Log Wage
Internal	0.074*** (0.025)	0.020 (0.018)	0.009 (0.016)	0.032 (0.031)	0.001 (0.028)
Tenure				0.008** (0.003)	0.006** (0.003)
Internal * Tenure				-0.002 (0.006)	0.004 (0.005)
Log Establishment Size			0.029*** (0.005)		0.028*** (0.005)
Worker Characteristics	No	No	Yes	No	Yes
Occupation FE	No	Yes	Yes	Yes	Yes
Industry FE	No	Yes	Yes	Yes	Yes
Geographic FE	No	No	Yes	No	Yes
Observations	3959	3959	3959	3959	3959

Robust standard errors are clustered at the establishment level. Worker characteristics include 6 education dummies, 16 ethnicity dummies, 8 age dummies, and a gender dummy. Occupation fixed effects use the UK Standard Occupation Classification 2000 (SOC2000) 3-digit system. Industry fixed effects use the UK Standard Industry Classification 2003 (SIC2003) 3-digit system. Geographic fixed effects are indicators for Government Office Region. Indicators are included for all top-coded variables.

* $p < .1$, ** $p < .05$, *** $p < .01$