Why do Firms Hire using Referrals? Evidence from Bangladeshi Garment Factories

Rachel Heath*

[Job Market Paper]

November 17, 2010

Abstract

This paper argues that firms use referrals from current workers to mitigate a moral hazard problem. I develop a model in which referrals relax a limited liability constraint by allowing the firm to punish both the referral recipient and referral provider if the recipient has low output. This punishment implies that there is positive correlation between the provider's and recipient's wages at a given time and that the wage variance of providers is higher than that of observably similar non-providers. The model also predicts that providers are observably higher skilled than other workers, since their wages are higher relative to a fixed limited liability constraint. By contrast, referral recipients should be observably lower skilled than other workers, because the referral allows the firm to get positive profits from workers it wouldn't otherwise hire. Finally, providers should have lower turnover than other workers, since the firm's ability to induce effort in the recipient depends on the provider being present in the firm. I confirm these predictions using data that I collected from a household survey of garment workers in Bangladesh. My test for punishment of the provider based on performance of the recipient rules out that the positive correlation in wages is due to correlated temporal shocks or correlated unobservable type between the recipient and provider. I find that the data are inconsistent with models in which referrals are used to select good types of workers or as a non-wage benefit to providers.

JEL CODES: O12, J33, D22

*I am indebted to Mushfiq Mobarak, Mark Rosenzweig and Chris Udry for their guidance and suggestions. I thank Treb Allen, Joe Altonji, David Atkin, Gharad Bryan, Rahul Deb, James Fenske, Tim Guinnane, Lisa Kahn, Dean Karlan, Mark Klee, Fabian Lange, Richard Mansfield, Tyler McCormick, Melanie Morton, Nancy Qian, Vis Taraz, Melissa Tartari and other friends and seminar participants for helpful feedback. The employees of Mitra and Associates in Dhaka provided invaluable help with data collection. All remaining errors are of course my own.

1 Introduction

Firms in both developed and developing countries frequently use referrals from current workers to fill job vacancies.[1] However, little is known about why firms find this practice to be profitable. Since hiring friends and family members of current workers can reinforce inequality (Calvo-Armengol and Jackson, 2004), policy measures have been proposed to promote job opportunities to those who lack quality social networks. For instance, policymakers who believe referrals reduce search costs might require companies to publicize job openings or facilitate the spread of job information. Such measures will succeed only if they address the underlying reason firms hire using referrals.

I argue that firms use referrals to mitigate a moral hazard problem. I develop a model in which a limited liability constraint increases a firm's cost of providing incentives for effort. A referral provider agrees to allow the firm to dock her own wages if the recipient performs poorly, relaxing the limited liability constraint on the recipient's wages. If the social network can enforce contracts between its members, the recipient will have to repay the provider later, so she acts as though the punishment is levied on her own wages.[2] The referral allows the firm to provide incentives for effort without the expectation of a long-run relationship between the worker and the firm, as delayed compensation or efficiency wage models require. A mechanism that allows firms to induce effort in short employment spells is important in this paper's empirical setting, the Bangladeshi garment industry, where there is frequent churning of workers between firms, workers often drop in and out of the labor force, and careers are relatively short.

The contract between the firm, provider, and recipient in my model is analogous to group liability in microfinance. In both cases, a formal institution takes advantage of social ties between participants to gain leverage over a group of them. Varian (1991) shows that principals can use agents' ability to monitor each other to increase effort of the agents.

[1]Moveover, it appears that correlation in job outcomes between network members is not spurious; the size or quality of a worker's social network is causally linked to her job access. Recent papers have used various strategies to identify exogenous variation in a worker's network. Munshi (2003) uses rainfall shocks at past times to instrument for the size of Mexican migrants' network in the United States. Magruder (2010) examines one specific node of the network, the parent-child link, and exploits geographic specificity (fathers living apart from sons can't help the sons) and gender-segregation of jobs (fathers in certain industries cannot help their daughters). Beaman (2008) use administratively assigned refugee settlement locations. Laschever (2005) uses randomly assigned military service units in World War I. Bayer et al. (2008) identify referrals indirectly by examining neighborhood effects on job outcomes, assuming that individuals choose the broad residential area in which they live, but not the exact block, so that additional correlation between members of the same block is due to job referrals between neighbors.

[2]Sociologists and anthropologists have noticed this phenomenon, arguing that referral recipients work particularly hard because the referral provider is "held responsible for" their behavior (kyung Kim 1987; Grieco 1987).

Bryan et al. (2010) provide experimental evidence of this social pressure in microfinance: offering a reward to a referral provider if the recipient pays back a loan increases loan repayment rates.[3] Their results provide evidence of one of the key assumptions of my model: the recipient works hard if the provider has monetary gain from her doing so.

My model generates several predictions on the labor market outcomes of referral providers and recipients, which I test using household survey data that I collected from garment workers in Bangladesh. I construct a retrospective panel for each worker that traces her monthly wage in each factory, position, and referral relationship. I can match the wage histories of the referral provider and recipient if they live in the same *bari* (extended family residential compound).

I use these matched provider-recipient pairs to confirm the key premise of my model: the provider is punished when the recipient performs poorly, so that the referral pair has positively correlated wages. Specifically, I show that the monthly wages (conditional on observables) of a referral pair are more strongly correlated than the wages of bari members working in the same factory at the same time between whom there was no referral. I then allow for correlated unobservables by conducting a difference-in-difference test to verify that the correlation in wages of the provider and recipient, relative to the wage correlation of other bari members, is stronger when they are working in the same factory (versus when they are not). I further confirm that the stronger correlation between the provider and recipient persists when I allow for factory or industry-level shocks to position and machine type, and when I look at providers and recipients not on the same production team. These results suggest that complementarities in production between workers in the same social network are unlikely to be driving the wage correlation between the provider and recipient.

This joint contract between the firm and referral pair has other testable implications. Since the providers's output is now tied both to her own output and that of the recipient, the variance of a provider's wage will exceed that of an observably similar non-provider. Since the firm has more room to dock the wages of an observably skilled worker, providers are observably higher skilled (as measured by education and experience) than other workers in the same firm. Recipients, by contrast, are observably worse than other workers in the same firm; the firm can use the referral to earn positive profits from workers it would not otherwise hire. Finally, the provider has lower turnover, since the firm can only provide incentives for effort to the recipient if her provider is present in the firm.

Theoretical literature on referrals has focused on their role in reducing search costs

[3] They do not tell the participants about the reward until after the referral has been made, so they can tell that the effect is due to social pressure and not selection.

(Mortensen and Vishwanath 1994; Calvo-Armengol and Jackson 2004; Kuzubas 2009) or in providing information on the worker's unobserved type (Montgomery 1991; Galenianos 2010). While my model does not explicitly consider search costs, they are likely another reason why firms in the garment industry use referrals.[4] However, search costs cannot explain the empirical result that firms tie the provider's wages to the recipient's performance. While a selection model could explain this result – the firm rewards providers who refer good types – it would also imply that firms learn more about non-referred workers after hiring than about recipients. However, I find no evidence of this learning, either through dismissals or wage updating.[5]

The joint liability in my model between the firm, the provider, and recipient insures that the provider has incentive to prevent the recipient from shirking because the provider's own wage is tied to the recipient's performance. Previous literature arguing that referrals provide information about recipients either propose that the workers are passive and the firm infers information about the recipient based on the provider's type (Montgomery, 1991) or assume that the provider and firm's incentives are aligned without having the necessary data to validate the assumption.[6] Experimental evidence from Beaman and Magruder (2010) and a historical example from Fafchamps and Moradi (2009) suggest that this assumption should not be taken for granted. Beaman and Magruder find that a referral provider offered a fixed finder's fee is more likely to refer family members; a provider offered a reward based on the referral recipient's performance is more likely to choose a coworker. Fafchamps and Moradi provide evidence that the policy of the British colonial army in Ghana to remunerate referral providers of successfully accepted recruits led to recipients leaving the army once the provider received the bonus. Both results suggest that a provider may have different objectives than the firm unless given the proper incentives.

My results suggest a context where strong network ties are important in labor markets. Granovetter (1973) argued that weak ties (acquaintances with whom one doesn't share

[4]In fact, while my model considers only one firm, there are implicitly search frictions in the background in order to sustain the result that workers with the same observable skill may earn different wages in a different firm if they are in different referral relationship there.

[5]Simon and Warner (1992), Dustmann et al. (2009), and Pinkston et al. (2006) do find some evidence of differential learning about referral recipients. They study developed country labor markets, where the prevalence of heterogeneous higher-skilled jobs likely make match-quality more important. They also lack the matched provider-recipient pairs that provide evidence of moral hazard; therefore it's also possible that referrals address moral hazard in their scenario as well.

[6]For instance, Kugler (2003) assumes that referral recipients have a lower cost of effort due to peer pressure from providers. Simon and Warner (1992) and Dustmann et al (2009) posit that the provider truthfully reports the recipient's type, which lowers the variance in the firm's prior over the recipient's ability.

many mutual network links) are more valuable in job search because they are more likely to provide non-redundant information about job vacancies than close ties. By contrast, the existence of networks in my model allows one member to be punished for the actions of another. This mechanism depends on strong ties to enforce implicit contracts through mutual acquaintances and frequent interactions. Indeed, almost half of the referrals in my data are from relatives living together in the same extended family compound. My work then suggests that strong ties are important for job acquisition in markets where jobs are relatively homogeneous but effort is difficult to induce through standard mechanisms. Indeed, studies in the U. S. have found that job seekers of lower socioeconomic status are more likely to use referrals from close relatives (Granovetter, 1983).

Workers in the Bangladeshi garment industry are predominantly female, and women's work outside the home has been shown to have beneficial social effects. Income controlled by women is spent differentially on health and education than income controlled by men (Luke and Munshi 2005; Duflo 2003). Anderson and Eswaran (2009) argue additionally that women's earned income, particularly from employment outside of the household, increases her autonomy. Mbiti (2008) shows that shocks to demand for female labor lead women to delay marriage and decrease dowries. Since the garment industry can potentially contribute to key goals of development policy, it is a particularly important context in which to study job access.

The rest of the paper proceeds as follows. In section 2, I provide information about labor in the garment industry that is relevant to understanding my model and empirical results. Section 3 lays out a theoretical model of moral hazard under limited liability and shows how referrals can increase firm's profits. Section 4 describes the data I will use to test empirically the predictions of the model and provides some summary statistics of key variables. Section 5 explains my empirical strategy. I give results in section 6. Section 7 discusses alternative explanations for why firms might use referrals. Section 8 concludes.

2 Labor in the Garment Industry in Bangladesh

The Bangladeshi garment industry has experienced explosive growth in the past 30 years. In 1983 there were 40,000 people employed in the industry; since then an average yearly growth rate of 17 percent has resulted in a current employment of over 3 million (Bangladesh Garment Manufacturers and Exporters Association, 2010), an average yearly growth rate of 17 percent. It has become an integral part of Bangladesh's economy, constituting 13 percent of GDP and 75 percent of export earnings (Bangladesh Export Processing Bureau, 2009). Garment production is labor-intensive. While specialized capital (e.g. dyeing machines, weaving machines) is used to produce the cloth that will be sewn into garments, the garments themselves are mostly assembled and sewn by individuals at basic sewing machines.

Production takes place in teams. Based on my experience in these factories, a typical team consists of several helpers, a core group of operators, a quality control checker, and a supervisor. The operators do the actual sewing; each is assigned to a specific portion of the final garment. For instance, to make a blouse, one worker might attach the front and the back to make a shoulder seam, another might attach the collar, another might sew on the pocket, and so forth. The helpers are not assigned to sew specific parts of the garment; they perform tasks that aid the operators, such as bringing them materials or cutting loose threads.

There are several reasons why it would be prohibitively costly for firms to observe workers' effort perfectly, creating the potential for moral hazard. First, the quality of a garment can be determined only if the quality checker examines it by hand. Second, new orders come in frequently and each worker's assignment changes based on the structure of the new garment. So firms do not always know the difficulty of a worker's task; a worker with low output might have drawn a tough assignment or might be shirking. Third, team production complicates the assessment of each member's productivity, since a worker's output is affected by the pace of others around her.

However, factory managers do acquire noisy signals of the workers' effort and give raises to the workers they believe have performed well. A worker's manual dexterity and attention to detail matter. So does her cognitive ability; while literacy and numeracy are not strictly required (except for supervisors, who need to keep written records), employers say that educated workers are more likely be proficient "floaters." Floaters are individuals who fill in in various parts of the production chain when other workers are absent or after a special order has come in. An educated worker can more easily learn new work from a pattern than from than watching it be done.

Workers are typically paid a monthly wage; 88 percent of workers in my sample receive one.[7] The official minimum wage in Bangladesh at the time of the survey (August to October, 2009) was 1662.5 taka per month, around 22 U.S. dollars. The minimum wage does appear to be binding: only 9 out of 972 of the workers in my sample reported earning below the minimum wage, and figure 1 shows evidence of bunching in the wage distribution around the minimum wage. Anecdotally, even if the government does not have

[7]Explicit piece rates are therefore rare; only 10 percent of workers in my sample are paid per unit of production. Since firms would have to monitor workers under a piece-rate regime anyway to monitor the quality of their work, managers told me that it's not worth the administrative cost of paying piece-rates, especially since they would have to redefine a new piece with each order.

the resources to enforce the minimum wage, upstream companies fear the bad publicity that will result if they are found to be paying below the minimum wage. While the implications of the model hold even if the limited liability constraint is simply that wages cannot be negative, if there is a $\underline{w}$ strictly greater than zero that serves as a lower bound on wages, then gains from referrals will be even greater.

[Figure 1 about here.]

There is rarely a formal application process for jobs in the garment industry. After hearing about a vacancy, hopeful workers show up at the factory and are typically given a short interview and sometimes a "manual test" where they demonstrate their current sewing ability. Table 1 gives the distribution of reported ways that surveyed workers received their current job. Referrals are common: 32 percent of current workers received a referral. Table 2 indicates that more than half of referrals came from relatives, most of which (and 45 percent of referrals overall) occurred between member living in the same extended family compound, called a *bari*[8]. Table 3 shows that having received a referral is more common in entry level positions: 43 percent of helpers (vs. approximately 30 percent of operators and supervisors) received referrals. By contrast, 44 percent of supervisors, 25 percent of operators, and only 10 percent of helpers have provided referrals.[9]

[Table 1 about here.]

[Table 2 about here.]

[Table 3 about here.]

A final important characteristic of the labor market in Bangladeshi garment factories is the relatively high turnover and short time that most workers spend in the labor force, which together imply that the average time that a worker spends in particular factory is low. The median female in my data has been working in the garment industry for 30 months and the median male has been working for 44 months. The shorter career length for females reflects obligations they have at home, such as taking care of children, sick, or elderly. Females are also more likely to take time out of the labor force between factories; out of the past employment spells of current workers, 37 percent of females and 26 percent of males spent time out of the labor force between jobs.

There also tends to be a lot of switching between factories, particularly among male workers. Figure 2 gives the percent of hired workers who are still remaining in the factory

[8]The bari was also the sampling unit for the survey. See section 4.1.

[9]These differences remain almost as large when controlling for tenure, so they are not driven by the fact that operators on average have remained with their current firm for longer than operators or helpers.

after a given tenure. Since the graph is constructed from the labor histories of current garment workers, it captures only departures to other factories, not decisions to leave the labor force and is thus an underestimate of overall turnover. Even so, departures are common. By twenty months after the time of hiring, for instance, only 41 percent of all hired males and 51 percent of all hired females who are still working in the garment industry remain in that factory. Many of these switches are likely due to demand shocks. A factory gets a large order and needs to expand its labor force–and doesn't have time to train new workers–so it raids other factories by offering to beat their wages. Turnover is particularly high among workers in entry level positions; a helper is 26 percent more likely to leave a factory in a given month than an operator or supervisor.

[Figure 2 about here.]

3 Model

The model posits that effort is unobserved and the mapping from effort to output is noisy, so the firm must make its desired effort level incentive compatible for the worker. A limited liability constraint forces the firm to satisfy this incentive compatibility constraint without dropping the worker's wage below some minimum level $\underline{w}$ in any state of the world. The optimal expected wage that a firm would pay a worker, absent the limited liability constraint, is increasing in her observable skill level. A firm can therefore offer a high skilled worker a wage contract that satisfies the incentive compatibility constraint and yields the optimal expected wage without violating the limited liability constraint. However, the limited liability constraint forces the firm to pay lower skilled workers more than the optimal expected wage in order to provide incentives for high effort. The amount of additional pay relative to the optimal wage increases as the workers skill level decreases and will cause the firm not to hire observably bad workers that it would hire absent the limited liability constraint.

A referral allows firms to take advantage of the non-binding limited liability constraint for observably good referral providers by transferring punishment from the recipient to the provider once the recipient's low wage reaches the limited liability constraint. This pairing allows the firm to make high effort incentive compatible for the recipient without having to pay her a prohibitively high expected wage. I assume that the provider and recipient both belong to a network that can enforce contracts between its members, implying that the punishment compels the recipient to work harder because she will eventually have to repay the provider. The firm can thus hire certain observably low skilled workers it could not otherwise hire without a referral.

The profitability of referrals is driven by the firm's greater scope to punish providers than recipients. In the baseline model, the mechanism is that firms want to pay observably better workers more relative to fixed $\underline{w}$. In appendix C, I show that the predictions of my model would also hold if there are two periods of work and the firm cannot reduce workers' wages between periods 1 and 2.[10]

3.1 Set-up

Let output be given by $y = \theta + X$, where θ is a worker's observable quality and X is a binary random variable, $X \in \{x_h, x_l\}$, with $x_h > x_l$. Workers can choose between two effort levels, e_h or e_l. If the worker chooses e_h, the probability of x_h is α_h. If a worker chooses e_l, the probability of x_h is α_l, with $\alpha_h > \alpha_l$.

Low effort has zero cost to workers, while high effort costs c. Workers are risk neutral[11] and utility is separable in expected earnings and effort cost, giving her expected utility

$$\begin{aligned} EU(e_h) &= \alpha_h w_h + (1-\alpha_h) w_l - c \\ EU(e_l) &= \alpha_l w_h + (1-\alpha_l) w_l \end{aligned}$$

There is also a limited liability constraint: $w_l \geq \underline{w}$. One possibility is $\underline{w} = 0$: the firm can't charge workers to work[12]. The gains from referrals will be even greater if there exists a $\underline{w}$ which is strictly greater than zero. For instance, there is a legally enforced minimum wage, as suggested by figure 1.

The timing of the game is as follows:

1. Firm offers worker a $\{w_h, w_l\}$ contract

2. Worker receives a random draw from a distribution of outside options $\eta \sim U[0, \bar{\eta}]$[13]

[10] That is, the baseline model predicts that a high-skilled provider who has low output and whose referral recipient does as well will earn the minimum wage $\underline{w}$. Since this prediction is not literally true – high skilled workers are rarely observed earning the minimum wage – I show that the intuition of the one-period model carries through in the two period case, which only predicts the workers with low output don't get raises.

[11] This assumption is made for analytical tractability. Realistically, workers are risk averse. Adding risk aversion will only compound the moral hazard problem and reinforce the importance of referrals in providing incentives for high effort.

[12] One reason for this constraint is that workers are credit-constrained, so they can't post bonds that the firms will take after a bad outcome.

[13] To correspond with workers' tendency to drop out of the labor market temporarily, η can be interpreted as the maximum of the worker's value of work at home or at another factory. The assumption that η is independent of θ can be relaxed: presumably the worker's wage at another factory is a function of her observable quality θ, leading higher θ workers to have a higher expected outside option. The key assumption

3. Worker chooses whether to work and her effort level if she does choose to work

4. Work takes place and then worker paid w_h or w_l, according to the realized output

There is only one period of work, so firms cannot use the prospect of future rewards (or the threat of firing) to elicit effort from a worker. Instead, the wage contract $\{w_h, w_l\}$ must make the firm's desired effort level incentive compatible for the worker.

3.2 Non-Referred Workers

After receiving an η draw, the worker exerts high effort if $EU(e_h) > Max(\eta, EU(e_l))$, low effort if $EU(e_l) > Max(\eta, EU(e_h))$, and does not work if her expected utility from both low and high effort is below η. The firm offers a $\{w_h, w_l\}$ contract that maximizes the worker's probability of deciding to work after receiving the η shock, times the output net of wages that the firm would get if the worker chooses to work. For a given worker of observable type θ, the firm gets profits from high effort:

$$\begin{aligned}\pi_{high} = & \max_{w_h, w_l} \quad Pr\Big(\alpha_h w_h + (1-\alpha_h) w_l - c \geq \eta\Big) && (1)\\ & \qquad\qquad \times \Big(\theta + \alpha_h(x_h - w_h) + (1-\alpha_h)(x_l - w_l)\Big) \\ \text{subject to} \quad & \alpha_h w_h + (1-\alpha_h) w_l - c \geq \alpha_l w_h + (1-\alpha_l) w_l && (IC)\\ & w_h, w_l \geq \underline{w} && (LL)\end{aligned}$$

If the firm is willing to settle for low effort, it can just set a single wage w_{flat},[14] giving it profit:

$$\begin{aligned}\pi_{low} = & \max_{w_{flat}} \quad Pr\Big(w_{flat} \geq \eta\Big) \times \Big(\theta + \alpha_l x_h + (1-\alpha_l) x_l - w_{flat}\Big) && (2)\\ \text{subject to} \quad & w_{flat} \geq \underline{w} && (LL)\end{aligned}$$

in this case is that the mean of the distribution of η does not increase one-to-one in θ. One specific distribution of outside options that yields this result is a value of work at home that is independent of θ, while the worker's wage in an alternative factory is drawn from distribution with mean θ. This assumption will yield the theoretical prediction that observably better workers are less likely to leave the firm in a given period. This prediction is confirmed in my data; the higher a worker's fitted wage based on observable characteristics, the lower the probability that the worker leaves for another factory or home.

[14] Since the worker and firm are both risk-neutral, both would theoretically be indifferent between any linear combination of w_h and w_l that give expected wage w, but I examine the particular solution where w is constant for simplicity.

Throughout, I will assume that the output from high effort, net of effort cost, is higher than the output from low effort:

$$\alpha_h x_h + (1-\alpha_h)x_l - c > \alpha_l x_h + (1-\alpha_l)x_l \tag{3}$$

Condition (3) implies that absent the limited liability constraint, the firm would choose to induce high effort from all workers.

To illustrate the firm's choice of wages as a function of θ, it is useful to define the optimal expected wage $w^*(\theta; e_h)$ that the firm would pay a worker exerting high effort, in the absence of a limited liability constraint:

$$\begin{aligned} w^*(\theta; e_h) &= argmax_w \Big\{ Pr(w - c \geq \eta)(\theta + \alpha_h x_h + (1-\alpha_h)x_l - w) \Big\} \\ &= \frac{1}{2}(\theta + \alpha_h x_h + (1-\alpha_h)x_l + c) \end{aligned} \tag{4}$$

Since the firm doesn't know the worker's outside option when making an offer, it pays higher θ workers more in order to increase the probability that the worker will remain with the firm even after receiving an outside option η. For workers with sufficiently high θ, the firm can satisfy the IC constraint

$$w_h \geq w_l + \frac{c}{\alpha_h - \alpha_l} \tag{5}$$

while still offering average wage $w^*(\theta; e_h)$. That is, the firm offers a wage contract $\{w_h, w_l\}$ where

$$w_h(e_h) = \frac{1}{2}(\theta + \alpha_h x_h + (1-\alpha_h)x_l + c) + \frac{(1-\alpha_h)c}{\alpha_h - \alpha_l} \tag{6}$$

$$w_l(e_h) = \frac{1}{2}(\theta + \alpha_h x_h + (1-\alpha_h)x_l + c) - \frac{\alpha_h c}{\alpha_h - \alpha_l} \tag{7}$$

The LL does not bind if θ is high enough that the w_l in (7) is at least $\underline{w}$; define $\underline{\theta}_{unc}$ as the minimum θ where this relationship holds. Figures 3 and 4 graphically explain the relationships between θ, wages, and the firm's profits. In both, the lines $w_h(\theta; e_h)$ and $w_l(\theta; e_h)$ denote the high and low wages that yield expected wage $w^*(e_h; \theta)$ and are spread enough apart to satisfy the incentive compatibility constraint. For $\theta \geq \underline{\theta}_{unc}$, $w_h(\theta; e_h)$ and $w_l(\theta; e_h)$ are the optimal values given in (6) and (7).

For workers with $\theta < \underline{\theta}_{unc}$, however, if the firm wants high effort it must offer the worker $w_l = \underline{w}$ and $w_h = \underline{w} + \frac{c}{\alpha_h - \alpha_l}$ in order to satisfy the incentive compatibility without violating the limited liability constraint, even though the wage contract pays the worker more than $w^*(\theta; e_h)$ in expectation. These wages are not a function of θ, but since the optimal wage $w^*(\theta; e_h)$ is decreasing in θ, the amount that the firm has to increase wages due to the limited liability constraint increases as θ decreases. For some range of θ just below $\underline{\theta}_{unc}$, $\pi_{high} > \pi_{low}$, so high effort is still optimal. However, once θ drops sufficiently below $\underline{\theta}_{unc}$, the distortion from the limited liability constraint is severe enough that $\pi_{high} < \pi_{low}$, so high effort is no longer worthwhile. Let $\underline{\theta}_{high}$ be the minimum θ for which high effort is more profitable than low effort.

Depending on parameter values (the difference in output between high and low effort, relative to $\underline{w}$), the firm may or may not find it profitable to hire workers at low effort ($\theta < \underline{\theta}_{high}$). Denote as $\underline{\theta}_{NR}$ the minimum θ of a worker hired without a referral. In figure 3 it is profitable to hire some workers at low effort: there is a region of the graph ($\underline{\theta}_{NR} \leq \theta \leq \underline{\theta}_{high}$) where the profits with low effort are greater than zero and the profits with high effort. In figure 4, by contrast, all $\theta < \underline{\theta}_{high}$ yield negative profits for the firm, so workers are hired only at high effort. In section 3.4, I describe the model's additional testable implications on recipients versus non-referred workers if the scenario described in figure 3 applies.

[Figure 3 about here.]

[Figure 4 about here.]

3.3 Referrals

In both figure 3 and figure 4, there are some values of $\theta < \underline{\theta}_{high}$ where high effort is not profitable to induce with $w_l \geq \underline{w}$, but would be profitable with a lower $\underline{w}$. This is true as long as the π_h curve crosses zero where the limited liability constraint is binding; relaxing the constraint will increase profits, allowing the firm to get positive profits from workers whose values of θ generate negative profits otherwise. One way for the firm to relax the limited liability constraint is to find a referral provider willing to have her own wages docked if the recipient has low output. This decreases the recipient's effective wage after a bad outcome and allows the firm to satisfy the recipient's incentive compatibility constraint with a lower expected wage than it would have to pay without a referral.

My key assumption is that the provider and recipient are part of a network whose members can enforce implicit contracts between themselves. That is, the members of a family or social network are playing a repeated game and have access to social sanctions that ensure that members play strategies which maximizes the group's overall pay-off (Foster and Rosenzweig, 2001). The provider is therefore willing to let the firm dock her own wages if the recipient has low output, knowing that the recipient will eventually reimburse her. Moreover, the referral creates a surplus – a worker is hired who wouldn't be otherwise – so that the provider can be made strictly better off once the reimbursement is made. While I will not model the side payments between the provider and recipient that divide the surplus, the key idea is that the referral can be beneficial for them both.

I will also assume in the baseline case that the firm cannot offer state-contingent punishments. That is, the firm must charge the provider a constant p if the recipient has low output; there is no possibility for the firm to charge the provider a punishment p_h if the recipient has low output and the provider has high output and a different punishment p_l if the recipient and the provider both have low output. With no state contingent punishments, the firm's w_l^P to the provider, net of a punishment p, must be greater than or equal to $\underline{w}$. In appendix B, I show that allowing state contingent punishments (a separate p_h and p_l) would improve the firm's profits but not affect the key predictions of the model.

I consider referral contracts involving only one provider for each recipient. The garment workers I spoke to told me that they usually attribute a referral to one particular provider, even when they have multiple acquaintances in the same factory where they began working.[15] Accordingly, in my model, even if there are two potential providers already working in the firm with high enough θ to take punishment for the recipient, only one provider can actually take the punishment. Referral contracts involving multiple providers would under some circumstances improve profits by allowing the firm to place additional punishment on a second provider once the first's limited liability constraint binds. However, this possibility would not change the key predictions of the model.[16] In my empirical work, I will consider how the existence of these types of contracts would affect my results.

Under these assumptions, the firm offers a joint contract to a referral provider P and referral recipient R: wages $\{w_h^P, w_l^P\}$ to the provider, wages $\{w_h^R, w_l^R\}$ to the recipient, and a punishment p levied on the provider's own wages if R has low output. The firm accepts referrals when its expected profits $\pi_{referral}(\theta_P, \theta_R)$ for a referral from a given θ_P provider and θ_R recipient[17] are greater than its profits from each of the workers hired separately

[15] By contrast, they report that it is not uncommon for one worker to refer more than one worker. Indeed, in my data I see instances where several recipients name the same provider. While I won't explicitly model the joint contract between a provider and multiple recipients, it is clear that a referral provider with a very high θ_P could have scope to bear punishment for several recipients before her wage hits the limited liability constraint. Empirically, there is indeed evidence that providers of multiple referrals have higher θ– on average .918 years more education ($P = .005$) and .155 years more experience ($P = .559$)–than providers of only one referral.

[16] Referral providers would still have a higher average θ than non-providers because the firm would prefer to have only one provider if her limited liability constraint does not bind.

[17] That is, I am assuming that the firm cannot engineer referral pairs; it knows only about the network

(if hired at all, in the recipient's case). The firm's expected profits $\pi_{referral}(\theta_P, \theta_R)$ depend on whether both P and R accept the wages offered to them under the referral contract. If both P and R accept the wage offers, then the firm gets the value of each of their θ's, plus high effort from both.[18] If only either R or P accepts, the firm gets only the output from that worker; if only R accepts, the firm cannot levy a punishment on the provider and revokes the wage offer.[19]

My assumption of an implicit contract between P and R means that even though the firm levies the punishment p on P's wages, R acts as though it is part of her own wage. That is, the recipient's effective wage in the bad state–as reflected in her incentive compatibility constraint and probability of accepting a wage offer–is $(w_l^R - p)$. Meanwhile, the punishment p doesn't affect P's participation decision or incentive compatibility constraint, because R must reimburse her. The participation constraint is that both R and P must get higher expected utility from the referral than the expected utility each would get if there was no referral (if hired). I consider only the case where R would be at low effort without the referral since profitable referrals must shift R from low to high effort. Since P has no chance of being fired as a result of the referral, her PC is satisfied if her

connections that workers reveal to it. Accordingly, the firm sets a contract to maximize its profits from a given (θ_P, θ_R) pair. It is true that if a network has more than one potential provider or recipient, the firm and worker may disagree on the optimal pairing of R and P. For instance, if the firm has one potential R with $\theta_{R1} = \underline{\theta}_{NR}$ and one potential R with θ_{R2} just below $\underline{\theta}_{NR}$, the network's total expected utility is maximized if P refers R2, since then both the R1 and R2 would be hired. The firm, however, would prefer to pair P and R1, since the profits from the referral are increasing in θ_R (and it gets zero profits from hiring R1 by herself). The assumption that the workers choose which network contracts to reveal to the firm seems reasonable, since pairs could separate and go to different firms if one firm tried to implement a pairing they didn't like.

[18]Note also that if R is exerting high effort before the referral, the firm will never want R to switch from high to low effort under the referral. This result comes from my assumption that the value of high effort is independent of the worker's observable quality and the result that observably better workers are more likely to remain with the firm after receiving a wage shock – high effort from the observably better worker is more valuable to the firm than high effort from the observably worse worker, since the observably better is more likely to stay with the firm after getting a wage shock.

[19]I allow the firm to offer a wage contract to the provider contingent on the provider's presence to rule out the following scenario: after the firm offers R a wage contract $\{w_h^R, w_l^R\}$, for certain values of η received by P, the pair's joint surplus would be higher if P left and allowed R to earn $\{w_h^R, w_l^R\}$ with low effort. This scenario would happen if:

$$\alpha_h w_h^P + (1-\alpha_h) w_l^P - c - \eta_P + \alpha_h w_h^R + (1-\alpha_h)(w_l^R - p) - c - \eta_R < \alpha_l w_h^R + (1-\alpha_l) w_l^R - \eta_R$$

We know this would occur for η_P sufficiently close to P's expected utility in the firm, $(\alpha_h w_h^P + (1-\alpha_h) w_l^P - c)$, since R's IC exactly holds with P present. Without P, the IC fails and R gets higher utility from low effort than from high, since her low wage would be w_l^R rather than $w_l^R - p$. If I didn't allow firms to fire R if P chooses not to work, then there would still be gains from referrals and the testable implications of the model would remain, but it would increase the θ_P of the provider, relative to a particular θ_R of the recipient, needed for a referral to be profitable. Intuitively, if it is very bad for the firm to have R without P, then it will be more important to get a higher θ_P provider who is very likely to stay in the firm after receiving her outside option and bear punishment for the recipient.

wages after the referral (after accounting for the p she will be repaid) are at least as high as her wages $\{w_h(\theta_P), w_l(\theta_P)\}$ were beforehand. The PC for R is more complicated if she would have been hired otherwise; under the referral, if P chooses not to work, R may not be profitable for the firm to retain at the $\{w_h^R, w_l^R\}$ it has offered. If R is not profitable at these wages, she will be fired and could end up with lower expected utility than without a referral. Formally the optimal referral contract is given by:

$$
\begin{aligned}
\pi_{referral}(\theta_P, \theta_R) = \max_{w_h^P, w_l^P, w_h^R, w_l^R, p} \; & Pr(\alpha_h w_h^P + (1-\alpha_h) w_l^P - c \geq \eta) \\
& \times Pr(\alpha_h w_h^R + (1-\alpha_h)(w_l^R - p) - c \geq \eta) \\
& \times \Big(\theta_P + \alpha_h x_h + (1-\alpha_h) x_l - \alpha_h w_h^P - (1-\alpha_h) w_h^P \\
& \quad + \theta_R + \alpha_h x_h + (1-\alpha_h) x_l - \alpha_h w_h^R - (1-\alpha_h)(w_l^R - p)\Big) \\
& + Pr(\alpha_h w_h^P + (1-\alpha_h) w_l^P - c \geq \eta) \times Pr(\alpha_h w_h^R + (1-\alpha_h)(w_l^R - p) - c < \eta) \\
& \times \Big(\theta_P + \alpha_h x_h + (1-\alpha_h) x_l - \alpha_h w_h^P - (1-\alpha_h) w_l^P\Big) \\
& + Pr(\alpha_h w_h^P + (1-\alpha_h) w_l^P - c < \eta) \times Pr(\alpha_h w_h^R + (1-\alpha_h)(w_l^R - p) - c \geq \eta) \\
& \times \Big(Max(\theta_R + \alpha_l x_h + (1-\alpha_l) x_l - \alpha_l w_h^R - (1-\alpha_l) w_l^R, 0)\Big)
\end{aligned}
$$

$$
\begin{aligned}
\text{subject to} \quad & \alpha_h w_h^P + (1-\alpha_h) w_l^P - c \geq \alpha_l w_h^P + (1-\alpha_l) w_l^P && (IC, P) \\
& \alpha_h w_h^R + (1-\alpha_h)(w_l^R - p) - c \geq \alpha_l w_h^R + (1-\alpha_l)(w_l^R - p) && (IC, R) \\
& w_h^P, (w_l^P - p) \geq \underline{w} && (LL, P) \\
& w_h^R, w_l^R \geq \underline{w} && (LL, R) \\
& \alpha_h w_h^P + (1-\alpha_h) w_l^P - c \geq \alpha_h w_h(\theta_P) + (1-\alpha_h) w_l(\theta_P) - c && (PC, P) \\
& EU_R(ref) \geq EU_R(no\ ref) && (PC, R)
\end{aligned}
$$

where

$$
\begin{aligned}
EU_R(ref) = \; & Pr(\alpha_h w_h^P + (1-\alpha_h) w_l^P - c \geq \eta) \times Pr(\alpha_h w_h^R + (1-\alpha_h)(w_l^R - p) - c \geq \eta) \\
& \times \Big(\alpha_h w_h^P + (1-\alpha_h) w_l^P - c\Big) \\
& + Pr(\alpha_h w_h^P + (1-\alpha_h) w_l^P - c < \eta) \times Pr(\alpha_h w_h^R + (1-\alpha_h)(w_l^R - p) - c \geq \eta) \\
& \times Max(\theta_R + \alpha_l x_h + (1-\alpha_l) x_l - \alpha_l w_h^R - (1-\alpha_l) w_l^R, 0)
\end{aligned}
$$

and

$$EU_R(no\ ref) = \begin{cases} Pr(w_{flat}(\theta_R) \geq \eta) \times & \\ \quad E(w_{flat}(\theta_R) - \eta | w_{flat}(\theta_R) \geq \eta) & \text{if } \pi_{low}(\theta_R) \geq Max(0, \pi_{high}(\theta_R)) \\ 0 & \text{otherwise} \end{cases}$$

Note that if P leaves and the firm chooses not to fire R, the profits if only R chooses to work are based on R giving low effort, as the firm can only implement a punishment if P is present.

[Figure 5 about here.]

Figure 5 describes graphically the joint contract offered to a provider and recipient. Since the firm can get high effort from the recipient only if the provider is present in the factory, the firm's gains from retaining the provider now include the output from high effort by both the recipient and provider. This shifts up the optimal expected wage for the provider $w^*_P(\theta_R, \theta_P; e_h)$ above the wage $w^*(\theta_P; e_h)$ that a worker of the same θ would get without making a referral.[20] After setting a w^P_l and w^P_h that yield this expected wage, the firm can use any remaining distance between w^P_l and $\underline{w}$ as scope to punish the recipient; this distance on the graph is denoted by p. The firm then uses this p to push the effective wage of the recipient down in the bad state to $\underline{w} - p$. The firm can then set the recipient's wage in the good state to be

$$w^R_h = \underline{w} - p + \frac{c}{\alpha_h - \alpha_l} \tag{8}$$

and satisfy her IC constraint with a lower wage than if there was no referral. The firm offers the recipient this $\{\underline{w} - p, w^R_h\}$ wage contract as long as the corresponding expected wage is not below the optimal wage $w^*_R(\theta_P, \theta_R; e_h)$ for that recipient.[21] If the wage corresponding to that p is lower than $w^*_R(\theta_P, \theta_R; e_h)$, the firm just sets a $\tilde{p}$ such:

$$\alpha_h(\underline{w} - \tilde{p} + \frac{c}{\alpha_h - \alpha_l}) + (1 - \alpha_h)(\underline{w} - \tilde{p}) = w^*_R(\theta_P, \theta_R; e_h) \tag{9}$$

3.4 Testable implications

The model gives predictions on the wage schemes offered to providers and recipients, and the resulting hiring and turnover results that these different wage schemes entail. For

[20] I drop the wage corresponding to low effort from this graph for legibility. Recall that all profitable referrals will include both R and P working at high effort, so only the wage corresponding to high effort is relevant.

[21] This is different than the $w^*(\theta_R; e_h)$ that the firm would like to pay R absent the referral because of the possibility that R reverts to low effort if P leaves. So the firm's optimal wage to R under the referral depends on the probability that P stays, which is a function of θ_P.

proofs, see appendix A. The first testable implication is the main premise of the model, that the firm punishes the provider when the recipient has low output:

1. Because the provider is punished when the recipient's wage has already dropped to $\underline{w}$, the wages of the provider and recipient at a given time are positively correlated.

The next two testable implications relate to the variance in wages. The wage scheme of a provider now reflects not just her own output, but potential punishment p that she may receive based on the performance of the recipient:

2. Providers have higher variance in their wages than non-providers of the same θ.

3. A reduced form test of the model is that wage variance be increasing in θ, unconditional on giving or receiving referrals. The higher a worker's θ, the more likely she is to be eligible to make a referral (and the greater potential punishment if she does), which would lead to higher variance in wages. Relatedly, as θ falls, workers either need referrals (which transfers some of the wage variance needed to fill the IC constraint from themselves to the provider) or will be offered a flat wage for low effort.

Implications 4 and 5 specify the observable types of workers who need referrals and are allowed to give referrals:

4. Because the firm can get positive profits from some observably worse recipients than $\underline{\theta}_{NR}$, recipients on average have lower θ than other hired workers.

5. A firm's scope to punish a provider is increasing in θ, so providers have on average observably higher θ than other hired workers.[22]

Since the firm can induce high effort from the recipient only if the provider is present in the firm, the final prediction says that the firm extra incentive to offer wages that the provider accepts:

6. Conditional on θ, a provider has a higher probability of a accepting a wage offer after receiving an outside offer η.

The model gives an ambiguous predictions on the wage level of the provider. The punishment of the recipient decreases the provider's wage, as observed by the econometrician.

[22]In appendix A, I prove this under the assumption that the availability of *potential* recipients is independent of the potential provider's θ. That is, the mechanism in my model is not that observably better workers are more likely to know other good workers, and thus have their referrals accepted. Instead, holding fixed the quality of the recipient θ_R, the referral is accepted for θ_P sufficiently high.

That is, while I assume that R reimburses P for this punishment, this transfer does not show up in the wage I observe. However, the model also predicts that the firm gives the provider a higher pay-off, $w_P^*(\theta_P, \theta_R; e_h) > w^*(\theta_P; e_h)$, to increase the probability that she remains with the firm after receiving her outside option.

Predictions 1 through 6 apply regardless of whether workers are ever hired at low effort (that is, whether the situation depicted in figure 3 or the one in figure 4 applies). However, if figure 3 applies – that is, some workers are hired at low effort – then recipients will exert higher effort than other hired workers of the same θ, yielding two additional testable implications:

7. Recipients have higher wage levels than other workers of the same θ, $w_R(\theta_P, \theta_R; e_h) > w^*(\theta_R; e_l)$ for all accepted referrals.

8. Recipients have higher wage variance than non-referred workers of the same θ. If the firm reaches the limited liability constraint for the provider before p is high enough to satisfy the recipient's incentive compatibility constraint, it is forced to satisfy the recipient's IC constraint by increasing w_h^R, yielding higher variance for the recipient than a non-recipient receiving a flat wage for low effort.

4 Data and Summary Statistics

4.1 Data

The data for my paper come from a household survey that I conducted, along with Mushfiq Mobarak, of 1395 households outside of Dhaka, Bangladesh. The survey took place from August to October, 2009. The sampling frame of the survey was every bari in 60 villages located in four subdistricts (Savar and Dhamrai in Dhaka District; Gazipur Sadar and Kaliakur in the Gazipur District). An initial census identified the number of garment workers in each household, and households with current garment workers were oversampled, yielding 972 garment workers in total in the dataset.[23]

All current garment workers were also given a garment worker supplement that I use to construct a retrospective panel which traces the evolution of a worker's monthly wage and other outcomes in each of her factories, positions, and referral relationships. The time dimension of my data is important for several of my empirical tests. I use observations of referral providers and recipients in multiple factories to separate wage effects of the

[23]For use in other projects, households with consanguineous marriages and women born between 1975 and 1980 were also oversampled. Details of the sampling strategy are available from author on request.

referral from correlated unobservable types. I can also test the model's predictions on the relationship between referrals and workers' decisions to switch between factories and drop in and out of the labor force. Since I know how much time workers spent out of the labor force between factories, I can also control for actual experience in my empirical tests. This is important in an industry where the returns to experience are high but workers often spend time out of the labor force between employment spells.

The sampling unit for the survey was the bari. A bari is an extended family compound, where each component household lives separately but households share cooking facilities[24] and other communal spaces. In my sample, the median number of bari members is 18, with a first quartile of 9 people and the third quartile of 33. Any time a worker indicated receiving a referral from a bari member who was also surveyed, the identification number of the provider was recorded. Therefore, in employment spells where the surveyed worker received a referral from someone living in the bari and working in the garment industry at the time of the survey, the work history of the recipient can be matched to the work history of the provider.

The word used for "referral" in the survey was the Bangla word *suparish*, which literally translates as "recommendation." However, given that I haven't heard of any factories with policies of making a recommendation/referral official, I did not try to determine whether the factory knew about the bond between workers. That is, I instructed the enumerators to err on the side of coding as a referral any time the recipient found out about the job through a current worker in the factory. The survey form allowed the respondent to name at maximum one referral provider per employment spell.[25]

While the workers in my survey constitute a representative sample of garment workers living in residential baris[26] in the four subdistricts surveyed, the garment factories in these districts are probably not perfectly representative of the garment industry nationwide.[27] For instance, the area I surveyed has a relatively higher concentration of woven factories than the rest of the country. The work in woven factories involves heavier ma-

[24]In fact, *bari* is the Bangla word for "cookstove."

[25]In section 6.1 I argue that if I have coded as a "referral" some instances where the firm does not know about the bond between the provider and recipient or if the firm does actually make referral contracts between multiple providers and recipients, it would only work against me finding the relationship that I do between the provider and recipient's wages.

[26]That is, if there were garment workers living in this four subdistricts that weren't in the baris identified by the survey enumerators, my sample would not be representative of garment workers living in the four subdistricts. However, several people I spoke to knowledgeable about the industry said that the garment factories is these areas did not tend to have dormitories or other non-standard living facilities, so I don't think this departure from representativeness is very severe.

[27]This speculation cannot be confirmed, however, because there are no representative nationwide data on garment workers to my knowledge.

chinery than knitwear factories, so more males are hired in these factories. Accordingly, the garment workers in my sample are 44 percent male, while nationwide the garment industry is estimated to be roughly only around 20 percent male. Additionally, since the workers in my sample are residential, they are probably older and more likely to be married and have children than the national average of garment workers, which includes workers living in dormitories.

4.2 Summary Statistics

[Table 4 about here.]

Table 4 provides information on the personal and job characteristics of workers who have received referrals, those who have given referrals, and those who neither gave nor received referrals.[28] One pattern that emerges from the table is that workers do not seem to use referrals to gain information about unfamiliar labor markets. In fact, those who were born in the city in which they are currently residing are more likely to have received a referral than those who have migrated to their current city. Workers are also no more likely to use referrals in jobs that are further from their current residence, as measured in commuting time.

5 Empirical Strategy

5.1 Testing for Punishment of Provider

The test for punishment of the provider based on performance of the recipient (prediction 1) is whether the recipient's wage (conditional on observable characteristics) predicts the provider's wage (also conditional on observable characteristics) at a given point in time. This test must acknowledge that there are many reasons why the wage of one network member might predict the wage of another, even absent causal wage effects of a referral. For instance, everyone in the network may get sick at the same time, or there may be correlation in the unobservable abilities of network members.

I first address this issue by assuming that the correlation in unobservables (types and shocks) is the same across all bari members. Accordingly, I test whether the wages of the recipient and provider at a given point in time are more strongly correlated than the wages of other bari members working in the same factory between whom there was not a

[28]Workers who both received and gave referrals appear in both of the first two columns.

referral. Formally, I run a regression where the unit of observation is a pair of bari members working in the same factory during the same month. I first obtain wage residuals conditional on observable variables (the θ in my model), since the model's prediction on the wage correlation of R and P is conditional on each worker's θ:

$$log\ w_{it} = x_{it}'\beta + \varepsilon_{it} \tag{10}$$

Call the residual from this regression $\tilde{w}_{it}$. I then regress the $\tilde{w}_{it}$ of one member of a bari member pair on the residual wage $\tilde{w}_{jt}$ of the other at the same time t and on an interaction $\tilde{w}_{jt} \times referral_{ijt}$:

$$\tilde{w}_{it} = \gamma_1 \tilde{w}_{jt} + \gamma_2 \tilde{w}_{jt} \times referral_{ijt} + u_{it} \tag{11}$$

The test for punishment of the provider is $\gamma_2 > 0$ and is valid if:

$$E(u_{it}|\tilde{w}_{jt} \times referral_{ijt}) = E(u_{it}|\tilde{w}_{jt}) \tag{12}$$

That is, the remaining wage residual u_{it} of one member of the referral pair can be correlated with the wage residual of the other, but no more so than the expected correlation between the wage residuals of any two bari members working in the same factory at the same time.

Condition (12) will not hold if the provider and recipient are unobservably more similar to each other than to other bari members. To allow for the provider and recipient to have correlated unobservable types or shocks, I use the wage observations of a referral pair at times when they are working in different factories. That is, if a positive coefficient on $\tilde{w}_{jt} \times referral_{ijt}$ is due only to correlated unobservables, the recipient and provider should look just as similar to each other (relative to other bari members) regardless of whether they are working in the factory where the referral has taken place. So I include the $\tilde{w}_{jt}$ for any bari members working in the garment industry at the same time (not just those in the same factory), and include interactions of $\tilde{w}_{jt}$ with indicators for $same\ factory_{ijt}$ and $ever\ referral_{ij}$, along with an interaction for $\tilde{w}_{jt} \times same\ factory_{ijt} \times referral_{ijt}$. Then, I am identifying the effects of the referral by using a difference-in-difference strategy: are the wages of the referral pair more strongly correlated (relative to the correlation in wages of other bari members) when they are in the same factory versus when they are not?

$$\begin{aligned} \tilde{w}_{it} =& \gamma_1\ \tilde{w}_{jt} \times same\ factory_{ijt} + \gamma_2\ \tilde{w}_{jt} \times same\ factory_{ij} \times referral_{ijt} \\ &+ \gamma_3\ \tilde{w}_{jt} + \gamma_4\ \tilde{w}_{jt} \times ever\ referral_{ij} + u_{it} \end{aligned} \tag{13}$$

I next address the possibility that wage shocks to observable job characteristics within the factory–namely, to production team, position, or machine type–are driving the positive coefficient on $\tilde{w}_{jt} \times referral_{ijt}$ in equation 11 or on $\tilde{w}_{jt} \times same\ factory_{ijt} \times referral_{ijt}$ in equation 13. That is, one might be concerned that the referral pair is likely to be doing similar work and there is a within-factory or industry-wide wage shock to that type of work. For instance, the provider and recipient both sew using the same type of machine, and the factory gets a large order that necessitates heavy use of that machine. I allow for within factory wage shocks to machine or position by including interactions of $\tilde{w}_{jt}$ and $\tilde{w}_{jt} \times same\ factory_{ijt}$ with indicators for $same\ machine_{ijt}$ and $same\ position_{ijt}$ and verify that the coefficients on $\tilde{w}_{jt} \times referral_{ij}$ (in equation 11) and $\tilde{w}_{jt} \times same\ factory_{ijt} \times referral_{ij}$ (in equation 13) remain after allowing for industry-wide or factory-specific shocks to machine type or position.

It is not possible to do the exact same test for the production team, since I know whether two bari members were on the same production team only if there was a referral between the two. However, I can interact an indicator for $same\ team_{ijt}$ with $\tilde{w}_{jt} \times referral_{ijt}$ (in equation 11) and $\tilde{w}_{jt} \times same\ factory_{ijt} \times referral_{ij}$ (in equation 13) to show that the wages of a referral pair who are not on the same production team are still more strongly correlated than the wages of other bari members working together in the same factory (who may or may not be on the same team). This result argues against the possibility that production complementarities are driving the correlation in wages between the provider and recipient, since their wages remain correlated even when they are not working together.

The tests proposed in equations 11 and 13 make use of two separate control groups for a referral pair working in the same factory: a member of the same bari that is not part of the referral and the same pair at times when they are working in different factories. My model helps interpret these groups. Workers with intermediate values of θ can neither give referrals nor need referrals to be hired. If their $\theta > \underline{\theta}_{high}$, so that they are exerting high effort before the referral, they would not agree to a referral, since the binding limited liability constraint raises a worker's wages.[29] However, if their θ is too low (for a given potential recipient θ_R), there is not enough scope to punish the worker and the firm won't accept referrals from that worker either. In section 6.2, I confirm that providers are on average observably better than other garment workers in the same bari and recipients are observably worse.

[29] As in the case examined earlier where the firm and network may agree on which providers to match with which recipients, if the firm tried to force this contract on the worker, she would just leave for a factory where no family worker is working and get higher wages. Alternatively, I can assume that workers can hide their family connections from employers.

The model also helps explain why a provider and recipient might work in different factories if both benefit from the referral. Unless a recipient has another potential provider in a firm making an alternative wage offer, an η draw that surpasses a recipient's wage $w_R(\theta_R, \theta_P; e_h)$ is less likely to come from another firm (compared to an η draw representing an outside option out of labor force) than it would be for worker of the same θ_R without a referral. This implication comes from the model's prediction that a recipient earns more than a non-recipient of the same θ and is confirmed empirically: while there are no average differences in turnover rates between recipients and non-referred workers, a recipient who leaves a factory in which she was referred is more likely to drop out of the labor force temporarily after leaving than to go straight to another factory.[30] Then, while my model does not explicitly consider labor demand, it is realistic to expect that when a former recipient returns to the labor force, the provider's firm may no longer be willing to hire her.

5.2 Wage Variance

Predictions 2, 3, and 8 pertain to the variance in a worker's wage, conditional on her observable quality. So I first condition out observables by estimating a wage equation for worker i in factory f:

$$log\ w_{if} = \beta_0 + \delta_f + x'_{if}\beta + \varepsilon_{if} \tag{14}$$

I use only current wages in this wage equation to avoid concerns about selective attrition. For instance, providers may be less likely to drop out of the labor market after a bad wage shock since they don't want to leave their friends alone in the factory. To assess whether firms use referrals to transfer wage variability from low θ workers to high θ workers, I test whether the squared residual $\hat{\varepsilon}^2_{if}$ (the estimate for wage variance) is increasing in the fitted wage $x'_{if}\hat{\beta}$ (a proxy for θ):

$$\hat{\varepsilon}^2_{if} = \alpha x'_{if}\hat{\beta} + u_{if} \tag{15}$$

The model predicts $\alpha > 0$. I then test whether conditional on the fitted wage, wage variance increases if a worker made or received a referral.

$$\hat{\varepsilon}^2_{if} = \alpha_1 x'_{if}\hat{\beta} + \alpha_2\ made\ referral_{if} + \alpha_3\ referred_{if} + u_{if} \tag{16}$$

[30]Specifically, conditional on leaving a firm, 30.6 percent of recipients drop out of the labor force temporarily, compared to 22.9 percent of non-referred workers (P = .0038). This difference persists when controlling for observable characteristics of the worker.

The model predicts that both recipients and providers have higher wage variance than other hired workers of the same θ, which would yield $\alpha_2 > 0$ and $\alpha_3 > 0$.

5.3 Observable Quality

To test predictions 4 and 5, which relate to the observable quality (θ in my model) of providers and recipients, I consider separately two measures of skill: experience and education. So for each worker-employment spell, I estimate:

$$educ_{if} = \beta_0 + \delta_f + \beta_1 referred_{if} + \beta_2 made\ referral_{if} + \beta_3 male_{if} + \varepsilon_{if} \tag{17}$$

$$experience_{if} = \beta_0 + \delta_f + \beta_1 referred_{if} + \beta_2 made\ referral_{if} + \beta_3 male_{if} + \varepsilon_{if} \tag{18}$$

where experience is measured at the beginning of employment. I include factory fixed effects to compare providers and recipients to other workers in the same factory. The model predicts $\beta_1 < 0$ and $\beta_2 > 0$ in both regressions: providers should have more education and experience than other hired workers, while recipients should have less.

5.4 Probability of Accepting a Wage Offer

Prediction 6 states that a provider is more likely to accept a firm's wage offer than a non-provider of the same θ. A direct test of the model would verify that providers are more likely to accept an initial wage offer, since in the model the decision to accept wages occurs before work takes place. However, I observe only a worker's decision to depart, conditional on having been hired. But since I have monthly data on both turnover and wages, I can examine high frequency wage updating and turnover. Accordingly, in the context of my model, departures can be interpreted as a worker's decision to reject a $\{w_l, w_h\}$ wage offer that she had originally accepted. This empirical test is a reasonable analog to the theoretical model if workers make departure decisions with higher frequency than firms update wages. Figure 6 provides some evidence that workers do begin leaving the firm while under the initial wage offer. By six months, for instance, 20 percent of hired workers have left the firm; meanwhile 78 percent of workers who are still in the firm are earning their initial wage. Indeed, 59 percent of departing workers are still earning their initial wage offer when they leave.

[Figure 6 about here.]

To test for differences in departure probabilities between providers and other hired workers, I estimate a logit where the dependent variable is an indicator for whether the respondent leaves the factory in a particular month, conditional on having been present in the firm through the previous month.[31] I first test whether providers have a lower probability of leaving in a given month:

$$Pr(leave\ factory)_{it} = \beta_0 + \lambda \times tenure + x'_{it}\beta + \gamma 1(made\ referral)_{it} + \varepsilon_{it} \tag{19}$$

The model predicts $\gamma < 0$. However, it is possible that dependable workers who remain with firms for a long time are also allowed to give referrals. To show that permanent unobserved worker heterogeneity is not driving the finding that providers have lower turnover, I estimate a conditional logit with worker fixed effects. I first include a dummy for $1(made\ referral)_{it}$ to verify that providers have lower turnover in the jobs in which they have made referrals.

$$Pr(leave\ factory)_{it} = \beta_0 + \delta_i + \lambda \times tenure + x'_{it}\beta + \gamma 1(made\ referral)_{it} + \varepsilon_{it} \tag{20}$$

For providers who have referred bari members, I can use the recipient's reported start date to determine when the referral was made. Accordingly, I can include an interaction for $1(made\ referral\ of\ bari\ member)_{it} \times 1(post\ referral)_{it}$ to verify that a provider's turnover is lower after a referral has taken place, compared to her turnover in other jobs. I compare this coefficient to the coefficient on $1(made\ referral\ of\ bari\ member)_{it}$ to test whether the provider's turnover is even lower after the referral was made than in the job overall.[32]

5.5 Wage level effects for Recipients

Prediction 7 states that, conditional on observable characteristics, recipients earn more than non-recipients. The higher wages reflect the compensation they receive from the firm for their high effort. Accordingly, I add a dummy variable for *referred* to the wage equation:

$$logw_{ift} = \beta_0 + \delta_f + \lambda t + x'_{ift}\beta + \alpha\ referred_{ift} + \varepsilon_{ift} \tag{21}$$

[31] Since workers who leave the industry permanently are no longer in my data set, I can only consider departures to home temporarily or to other factories. But missing departures to home permanently would only falsely lead to a finding of a lower overall turnover rate for providers if providers were more likely to leave for home permanently. This seems unlikely, since a multinomial logit shows that providers are less likely both to leave for home temporarily and leave for another factory, and there's no reason to believe that the relationship between providing a referral and leaving for home permanently should have the opposite sign as the relationship between making a referral and leaving for home temporarily.

[32] I can't include these two variables in the same regression because then the coefficient on $1(made\ referral\ of\ bari\ member)$ would not be identified: a worker can't have left a firm where she has made a referral before the referral has taken place.

Here I use all wages, since the prediction that recipients are more likely to stay in the labor market after a bad wage shock would bias the coefficient on $referred$ downward. This allows me to include worker fixed effects to (21) to capture time-invariant unobserved person-specific factors.[33]

$$log\ w_{jbft} = \beta_0 + \delta_f + \delta_j + \lambda t + x'_{jbft}\beta + \alpha\ referred + \varepsilon_{jbft} \tag{22}$$

The model again predicts that $\alpha > 0$; recipients should earn differentially more in the jobs in which they have received referrals than in their other jobs.

6 Results

6.1 Punishment of Provider

Table 5 reports results from equation (11), a regression of one bari member's residual wage $\tilde{w}_{it}$ on the residual wage $\tilde{w}_{jt}$ of another bari member and on an interaction $\tilde{w}_{jt} \times referral_{ijt}$. Standard errors are calculated by bootstrapping the two-stage procedure. Specifically, I take repeated samples with replacement from the set of monthly wage observations. For each replicate I first estimate the wages conditional on observables to get the $\tilde{w}_t$'s, construct pairs of wage observations for baris with multiple members chosen in that replicate, and then estimate equation (11). This procedure, analogous to a block bootstrap, preserves the dependent nature of the data by ensuring that if a wage observation is selected, all pairs of wage observations involving that worker will also be in the sample.

Column (1) provides the correlation in wage residuals between two bari members working in the same factory (the coefficient on $\tilde{w}_{jt}$) and the additional effect if there was a referral between the two (the coefficient on $\tilde{w}_{jt} \times referral_{ijt}$). To help interpret the regression coefficients, consider three bari members working in the same factory: P referred R, while C is not in a referral relationship with either of them. The coefficient on $\tilde{w}_{jt}$ tells us that when C's wage goes up by 10 percent, P's wage rises by 3.14 percent. That is, due to common wage shocks, similar skills, or correlated unobserved ability, wage residuals of bari members working in the same factory are correlated, even when there was no referral between the two. However, the coefficient on $\tilde{w}_{jt} \times referral_{ijt}$ indicates that a 10 percent

[33]Unobserved type could theoretically bias the coefficient on $referred$ either up or down. If there is a dimension of observable quality that the firm sees, but I do not, then my model would predict that recipients are unobservably worse on this dimension. However, a selection model would predict that providers have incentives to refer unobservably good types.

increase in R's wage increases P's wage by 2.79 percent more than a 10 percent increase in C's wage would.

Column (2) and (3) show the stronger correlation in wages between the referral pair is not driven by within factory shocks to the machine or position. That is, while the positive coefficients on $\tilde{w}_{jt} \times \textit{same machine}_{ijt}$ and $\tilde{w}_{jt} \times \textit{same position}_{ijt}$ reveal that the correlation in wages of bari members working in the same factory is larger if they are in the same position or using the same machine type, the coefficient on $\tilde{w}_{jt} \times referral_{ijt}$ remains positive and significant when accounting for these effects. Finally, column (4) adds a control for $\tilde{w}_{jt} \times referral_{ijt} \times sameteam_{ijt}$ and shows that the stronger correlation between provider and recipient holds even among recipients who did not begin work on the same production team as the provider.

[Table 5 about here.]

Table 6 broadens the sample to include any bari members working in garment factories at the same time, whether or not they are in the same factory. Returning to the example of P (who referred R into factory A-1 Apparel) and C (who worked in A-1 Apparel at the same time as R and P), the coefficient on $\tilde{w}_{jt}$ indicates that when C's wage increases by 10 percent, P's wage increases by 2.03 percent, even when they are not working together in A-1 Apparel. The coefficient on $\tilde{w}_{jt} \times \textit{ever referral}_{ijt}$ confirms the existence of correlated unobservables or shocks between the referral pair (relative to other bari members). That is, a 10 percent increase in R's wage corresponds to a 1.51 percentage point larger increase in P's wage (relative to the effect of a 10 percent increase in C's wage), even when R and P are not in the factory where the referral has taken place.

The positive coefficient on $\tilde{w}_{jt} \times \textit{same factory}_{ijt}$ establishes that wages of bari members at a given time are more strongly correlated when they are in the same factory. Thus a 10 percent increase in C's wage at A-1 Apparel increases P's wage at A-1 apparel by 1.59 percentage points more than if they were working in different factories. The same factory effect is stronger between the provider and recipient–even after including the $\tilde{w}_{jt} \times \textit{ever referral}_{ijt}$ term to account for correlated unobservables between the two–yielding a positive coefficient on the variable of interest, $\tilde{w}_{jt} \times referral_{ijt} \times \textit{same factory}_{ijt}$. So if R's wage in A-1 goes up by 10 percent, the additional effect on P's wage (relative to a 10 percent wage increase in R's wage in a different factory) is 1.68 percentage points larger than the additional effect on P's wage of a 10 percent increase in C's wage in A-1 versus elsewhere.

Column (2) adds controls for $\tilde{w}_{jt} \times \textit{same machine}_{ijt}$ and $\tilde{w}_{jt} \times \textit{same factory}_{ijt} \times \textit{same machine}_{ijt}$. The coefficients on both interactions are positive, indicating the presence of both industry-wide and factory-specific wage returns to workers using a specific machine type. Allowing for these effects lowers the coefficients on $\tilde{w}_{jt}$ and $\tilde{w}_{jt} \times same\ factory_{ijt}$, suggesting that bari members do tend to use the same machine type. However, there is no evidence that this is differentially the case among referral pairs; the coefficient on $\tilde{w}_{jt} \times referral_{ijt} \times same\ factory_{ijt}$ remains large and very close to statistically significant. Column (3) suggests that there are industry-wide wage returns to position but not factory-specific (the coefficient on $\tilde{w}_{jt} \times same\ position_{ijt}$ is positive, but the coefficient on $\tilde{w}_{jt} \times same\ factory_{ijt} \times same\ position_{ijt}$ is zero); the referral effect $\tilde{w}_{jt} \times referral_{ijt} \times same\ factory_{ijt}$ again remains large and close to statistically significant. Finally, column (4) verifies that the $\tilde{w}_{jt} \times referral_{ijt} \times same\ factory_{ijt}$ coefficient is still significant even among pairs not working on the same production team.

While using retrospective data raises the possibility of attrition bias, a very strange pattern of turnover would be required to bias the $\tilde{w}_{jt} \times referral_{ijt} \times same\ factory_{ijt}$ coefficient away from zero. That is, to make the wages of the provider and recipient appear more correlated than they would without attrition, either the provider or recipient would have to drop out of the labor market when their wages were further from the other's. For instance, the recipient would have to drop out of the labor market when her wages would have been low, but only when the provider has high wages.[34]

One might also be concerned that the indicator for $referral_{ijt}$ does not perfectly captures the notion of a referral modeled theoretically. For instance, in some cases the respondent might have reported having been referred, but the provider only passed along information about the job without notifying the firm of her connection to the recipient. The firm would then not be able to punish the provider based on performance of the recipient. However considering these instances as referrals would bias only the interactions of $\tilde{w}_{jt}$ with $referral_{ijt}$ toward zero. Similarly, if in actuality the firm punishes multiple providers if the recipient has low output but only one is considered to be a provider in regressions (11) and (13), then the wages of the control pairs also reflect wage effects of a referral, and the estimated wages effects of a referral are smaller than they would be otherwise.

[Table 6 about here.]

6.2 Unexplained Wage Variance

Table 7 gives the results from regression (16), which tests whether the unexplained wage variance–the residual $\hat{\epsilon}^2_{if}$ from a first stage wage regression–varies with fitted wage $x'_{if}\hat{\beta}$

[34]Using data on workers' decisions to drop out of the labor force temporarily as a proxy for the decision to leave the labor force permanently, there is no evidence of any of these patterns.

and whether the worker has made or received a referral. Column (1) shows that the variance $\hat{\epsilon}^2_{if}$ is increasing in the fitted wage $x'_{if}\hat{\beta}$, a proxy for observable quality θ.[35] Column (2) indicates that those giving and receiving referrals have higher wage variance than others with their same predicted wage. The coefficient of 0.021 on $referred$ and the coefficient of 0.022 on *made* $referral$ are both large, relative to the average squared wage residual of 0.068. Column (3) includes interactions between *made* $referral$ and position dummies, addressing the potential concern that the variance result for providers is driven primarily by supervisors. If so, we might be concerned that the more capable supervisors are both allowed to give referrals and also manage larger teams or receive wages that are more closely tied to their team's performance, leading to higher wage variance absent effects from the referral. However, there is no evidence that the effect of giving a referral on wage variance is larger among supervisors.

[Table 7 about here.]

6.3 Observable Quality

Table 8 reports results from regressions (17) and (18), which test for differences in education and experience between providers and recipients versus other hired workers in the same factory. Columns (1) and (4) report that referral recipients on average have 0.67 fewer years of education and 0.59 fewer years of experience than other workers in the same factory. By contrast, providers have on average 0.30 more years of education and 0.51 more years of experience than other workers in the same factory. In columns (2) and (5), I include position dummies. While a literal interpretation of my model would say that only a worker's observable quality θ matters in determining her ability to give, or need for, a referral (and not her θ relative to others in the same position) the inclusion of position dummies shows that observable differences in recipients and providers are not only determined by variation in θ across positions.[36] While smaller in magnitude, the results are still negative and significant for recipients and positive (although insignificant) for providers. Columns (3) and (6) show that providers are observably better and recipients are observably worse than other garment workers in the same bari. These results

[35] Alternatively, I can do a Breusch-Pagan test for heteroskedasticity, which consists of an F-test of the joint significance of of the independent variables in explaining the squared residuals. That test strongly rejects homoskedasticity: $\chi^2(1) = 29.31$, $P < .001$.

[36] That is, a worker's observable quality is increasing in her position level, and table 3 shows that giving referrals is more common in higher positions and less common in lower positions. If the results on observable quality did not hold within position, then they would also be consistent with a story in which referrals are a way to make entry level workers feel comfortable, by ensuring that they have an experienced provider around.

confirm that bari members with mid-range values of θ are a reasonable control group for the referral pairs in equations (11) and (13); they are good enough not to need a referral, but not observably good enough to be able to give one.

[Table 8 about here.]

6.4 Turnover

Table 9 presents results of equations (19) and (20). Column (1) establishes that a referral provider has a 1.25 percentage point lower chance of leaving the firm than a non-provider; their departure rate is roughly half the average monthly rate of 2.56 percent. Column (2) shows that workers who have ever provided a referral have lower turnover in the jobs where they have made the referral; column (3) verifies that this pattern also holds among the subsample of providers who referred other bari members. Finally, column (4) shows that workers who have ever made a referral of a bari member have lower turnover after the recipient has begun working, compared to their turnover in other jobs. The coefficient on ($made\ referral\ of\ bari\ member \times post\ referral$) is significantly less than the coefficient on ($made\ referral\ of\ bari\ member$): providers with a recipient present have even lower turnover (relative to their other jobs) than providers overall. So even if a provider would have been more likely to remain in a job even absent the presence of the recipient (say, due to higher match quality in that job), her probability of leaving drops even more after the referral.

[Table 9 about here.]

6.5 Wage level of Recipient

Table 10 reports the results of equations (21) and (22), the effects of receiving a referral on wages. The first column gives the unconditional mean in wages for recipients: they earn 8.56 percent less than non-recipients in the same factory. However, column (2) shows that there is no effect of receiving a referral on wages after controlling for observable differences between recipient and non-referred workers. Column (3) shows that a recipient earns 3.16 percent more in a job in which she has been referred than in her other jobs, although the effect remains statistically insignificant.

[Table 10 about here.]

Recall that if referral recipients work harder than non-referred workers of the same θ, predictions 7 and 8 imply that recipients have higher wage levels and variance than non-referred workers. Empirically recipients do have higher levels (although not statistically significant), and statistically significantly higher wage variance. So there is indeed some evidence that firms can not only use referrals to induce the same effort in low θ workers as in high θ workers, they also receive on average higher effort from recipients than the average worker.

7 Alternative Explanations

Taken together, my empirical results indicate that the provider's wage reflects the recipient's output, explain that the referral pairs a worker that the firm has leverage over with a worker who might not be hired otherwise, show that providers are more likely to remain in a firm, and suggest that recipients work harder than non-recipients. However, there are two alternative stories that would also predict that the firm adjusts the provider's wage based on the recipient's outcome (and the corresponding other empirical findings): the referral provides information about the unobserved worker's type, or the firm offers the ability to make a referral as a non-wage benefit to existing workers. In this section, I argue that there are other patterns in my data that these models do not fit.

7.1 Unobserved Type

Much of the previous literature on referrals assumes that the referral provides information about the recipient's unobserved type. In some of these papers, the mechanism is correlated unobservable types within a network (Montgomery 1991; Munshi 2003); the firm can estimate the recipient's type based on what it has learned about the type of the provider. However, while the correlated unobservables premise of this model would explain why there is correlation between the wages of a referral pair even when they are not working in the same factory, it cannot explain my finding that there is stronger correlation when they are in the same factory together. Alternatively, the provider could be reporting information about the recipient's type (Saloner 1985; Dustmann et al. 2009). Then the correlation in wages between the provider and recipient in the same factory could reflect an incentive compatibility constraint that the firm implements to keep providers from referring bad types: as the firm learns the true type of the recipient, the provider would get rewarded if the recipient has high output or punished if the recipient has low.[37]

However, if this model were true in my context, there should be evidence that after hiring a firm is learning more about non-referred workers than about referral recipients. This learning could be reflected either by dismissing non-referred workers at a greater rate than recipients or by updating their wages more dramatically. Turnover doesn't seem to be the mechanism: there is no difference in the probability that a recipient leaves a factory[38] (for home temporarily or to another firm)[39].

If we instead saw learning reflected in wage updating of the NR workers, their wage variance should grow with tenure relative to the wage variance of recipients (Altonji and Pierret 2001; Foster and Rosenzweig 1993), as firms learn their type and update wages accordingly. To test for this possibility, I examine within-worker wage variance. Specifically, I assess whether the squared difference between worker's wage (conditional on observables) after 3, 6, or 12 months in the firm and the worker's initial wage offer (conditional on observables) varies between recipients and non-referred workers. This short time window yields estimates that are relatively uncorrupted by turnover but is presumably long enough for employers to have begun to observe the worker's type. Table 11 gives the results of this test. The variance of wages of referral recipients is actually growing more with tenure relative to non-referred workers' wages, a fact which is difficult to reconcile with a learning story.[40] It does fit, however, with my moral hazard story, where referral

[37]That is, as with my moral hazard model, there must be imperfect information if punishment is observed in equilibrium. In the context of a model with unobserved type, the recipient herself might not know her own type. Or, alternatively, good workers might sometimes have low output.

[38]My model gives an ambiguous prediction on the recipient's turnover. If the provider accepts the wage offer, the recipient is more likely to accept her offer than a non-referred worker of the same θ. However, since the firm can revoke the offer, then the recipient would have higher turnover if the provider is not present. My empirical results confirm this disparity: the odds ratio for departing the firm for a recipient is .529 (P = .062), but the odds ratio for departure for a recipient whose provider has left is 1.935 (P = .047). The same pattern was found in the study by Fernandez et al. (2000) of a call center in the U. S. That is, they found no average differences in turnover between recipients and non-referred workers, but a recipient is more likely to leave when the provider has left.

[39]One might also be concerned that turnover rates between recipient and non-recipients would in fact be different if I could take into account decisions to leave the labor force permanently. However, since referral recipients are actually more likely to drop out of the labor force temporarily than non-recipients, if they are also more likely to leave the labor force permanently, referral recipients would have actually have higher turnover than non-recipients, a fact which is difficult to reconcile with a learning story.

[40]Dustmann et al. (2009) include referrals in a search model and derive different predictions that should hold if firms have more information about referral recipients upon hiring. Specifically, recipients have higher initial wages than non-recipients, but this effect decreases with tenure. In my data the opposite is true: recipients' wages start out lower but increase more with tenure related to non-recipients. This finding is not inconsistent with a moral hazard model. While my one-period model does not give predictions on turnover, appendix C extends the model to two periods and makes the limited liability constraint a non-negativity constraint on wage changes. Recipients are more likely to receive wage contracts that offer the potential of wage increases in the second period, since the firm can induce high effort from them by threatening to take away both their own and the provider's wage if they have low output.

recipients workers get higher-powered incentive contracts. [41]

[Table 11 about here.]

The factories in my sample that are part of the export processing zone (EPZ) serve as a natural experiment that provides further evidence that referrals relate to effort rather than selection. The EPZ provides firms with perks such as improved infrastructure and tax exemptions, but requires them to give workers benefit packages which include pensions and health care allowance. Labor laws are also more strictly enforced and working conditions tend to be better. Turnover is lower in EPZ factories,[42] suggesting that workers indeed have a revealed preference for jobs in them.

If a position in an EPZ factory is indeed more valuable than other garment jobs, a moral hazard model and a selection model would yield opposite predictions on the prevalence of referrals in EPZ factories. An extension to the moral hazard model detailed in this paper would predict that the non-wage benefits in the EPZ serve as an efficiency wage. Workers work hard out of fear of losing the valuable job, and so fewer workers need referrals for the firms to be convinced they will work hard. However, a selection model would yield the opposite prediction. The more valuable a job is, the more willing applicants the firm has and the more it would need to rely on referrals to among the many applicants. In fact, 25.0 percent of EPZ workers (vs. 34.5 percent of non-EPZ workers) were referred (P=.0123),[43] supporting the moral hazard interpretation.

7.2 Non-Wage Benefit

Another possible explanation for the presence of referrals is that the ability to give a referral is used as a non-wage benefit for existing workers.[44] This mechanism would be relevant in industries in which some institution or market imperfection (such as the minimum wage in the garment industry context) causes job rationing, which would give firms the incentive to offer the jobs to friends or family of existing workers who would be willing to trade off their own wages for the ability to give a referral. The positive correlation between the wages of the recipient and provider would then represent the fact that the

[41] That is, the two-period model in appendix C, predicts that referred workers have increasing wage levels and variance with tenure.

[42] The odds ratio on an EPZ dummy in a logit for whether the worker leaves is .472 ($P < .001$).

[43] The difference remains statistically significant when I control for education, experience, and sex.

[44] This possibility is raised by Bandiera et al. (2009), who demonstrate that managers favor their friends if they are not given performance bonuses. They argue that managers' decisions to help friends, even when not monetarily rewarded for doing so, implies that workers gain utility from their friends' income so that firms can take advantage of workers' social connections to lower their average wage bill.

"fee" for the referral (as reflected in the lowering of the provider's wages) is decreasing in the quality of the recipient.

This model would predict, however, that the provider's own wages would drop after the referral. So I run a wage regression and included a dummy for making a referral and another for post referral. Since I have the post referral variable only for referrals made within bari, I include an interaction for ($made\ referral \times recipient\ in\ bari$) to verify that the post referral variable is not driven by differences in wage levels between providers of referrals of bari members versus non-bari members. Table 12 reports the results. If anything, the provider's wages go up after the referral. The coefficient on ($made\ referral \times recipient\ in\ bari \times post\ referral$) indicates that a provider's wages are 21.4 percent higher after a referral; the effect is close to significant ($P = .143$). In terms of my moral hazard model, this means that the upward force on the provider's wages (the firm pays the provider more because of the increased gains from retaining the provider) exceeds the punishment that is reflected in the provider's wages (as observed to the econometrician). The second column shows that the positive coefficient is not due to differential wage profiles with tenure between providers and non-providers.

[Table 12 about here.]

8 Conclusion

I have argued that referrals can minimize a moral hazard problem caused by firms' inability to perfectly observe workers' effort. Referrals provide incentives for high effort by using the provider's wages as leverage rather than the recipient's future wages, a useful tool in an industry where employment spells are short. I provide empirical evidence from data I collected from the garment industry in Bangladesh that firms hold the provider accountable for the recipient's performance. The joint contract allows the firm to hire observably lower skilled workers who it would not otherwise hire.

My findings have important implications for policy-makers attempting to prevent network referrals from restricting access to jobs to members of certain privileged networks. Attempts to disseminate information will not undo network effects in contexts such as the Bangladeshi garment industry. Firms will still hire an observably bad worker only if they she receives a referral from a current worker who is willing to allow her own wages to be decreased if the recipient performs poorly. Nor is it obvious that policymakers should attempt to minimize the role of referrals in job hiring; referrals are helping firms resolve asymmetric information problems.

Recent literature has demonstrated the importance of social networks in developing economies in a wide range of situations, from spreading information about new crops (Conley and Udry, 2010) to facilitating productive exchange between traders (Fafchamps and Minten, 2002). This paper demonstrates that these efficiency gains from social networks carry over to employment contracts in large firms. While my results suggest that moral hazard is an issue in these firms, referrals allow firms to implement a second-best outcome that leads workers to put forth higher effort than they would without a referral.

References

J.G. Altonji and C.R. Pierret. Employer Learning and Statistical Discrimination. *Quarterly Journal of Economics*, 116(1):313–350, 2001.

S. Anderson and M. Eswaran. What determines female autonomy? Evidence from Bangladesh. *Journal of Development Economics*, 90(2):179–191, 2009.

O. Bandiera, I. Barankay, and I. Rasul. Social connections and incentives in the workplace: Evidence from personnel data. *Econometrica*, 77(4):1047–1094, 2009.

Bangladesh Export Processing Bureau. Annual Report on the Ready Made Garment Industry, 2009.

Bangladesh Garment Manufacturers and Exporters Association. Ready Made Garment Yearbook, 2010.

Patrick Bayer, Stephen Ross, and Giorgio Topa. Place of work and place of residence: Informal hiring networks and labor market outcomes. *Journal of Political Economy*, 116 (6):1150–1196, 2008.

Lori Beaman. Social Networks and the Dynamics of Labor Market Outcomes: Evidence from Refugees Resettled in the U.S. Mimeo, Department of Economics, Nothwestern University, 2008.

Lori Beaman and Jeremy Magruder. Who Gets the Job Referral? Evidence from a Social Networks Experiment. Working Paper, Department of Economics, Nothwestern University, 2010.

T.F. Bewley. *Why wages don't fall during a recession*. Harvard Univ Pr, 2002.

Gharad Bryan, Dean Karlan, and Jonathan Zinman. Making the Most of the Friends you Have: Referrals and Enforcement in a Referrals Field Experiment. Working Paper, Department of Economics, Yale University, 2010.

Antoni Calvo-Armengol and Matthew Jackson. The Effects of Social Networks on Employment and Inequality. *American Economic Review*, 94(3):426–454, 2004.

T.G. Conley and C.R. Udry. Learning about a new technology: Pineapple in Ghana. *The American Economic Review*, 100(1):35–69, 2010.

E. Duflo. Grandmothers and granddaughters: Old-age pensions and intrahousehold allocation in South Africa. *The World Bank Economic Review*, 17(1):1, 2003.

C Dustmann, U Schonberg, and A. Glitz. Referral Based Job Search Networks. Mimeo, 2009.

M. Fafchamps and B. Minten. Returns to social network capital among traders. *Oxford Economic Papers*, 54(2):173, 2002.

M. Fafchamps and A. Moradi. Referral and job performance: evidence from the Ghana Colonial Army. 2009.

R.M. Fernandez, E.J. Castilla, and P. Moore. Social capital at work: Networks and employment at a phone center. *American journal of sociology*, 105(5):1288–1356, 2000.

A.D. Foster and M.R. Rosenzweig. Information, learning, and wage rates in low-income rural areas. *Journal of Human Resources*, 28(4):759–790, 1993.

A.D. Foster and M.R. Rosenzweig. Imperfect commitment, altruism, and the family: Evidence from transfer behavior in low-income rural areas. *Review of Economics and Statistics*, 83(3):389–407, 2001.

Manolis Galenianos. Hiring through referrals, 2010.

Mark Granovetter. The strength of Weak Ties. *American Journal of Sociology*, 78(6):1360, 1973.

Mark. Granovetter. The strength of weak ties: A network theory revisited. *Sociological theory*, 1(1):201–233, 1983.

Margaret Grieco. *Keeping it in the Family: Social Networks and Employment Chance*. Tavistock Publishing, London, 1987.

A.D. Kugler. Employee referrals and efficiency wages. *Labour Economics*, 10(5):531–556, 2003.

Tolga Kuzubas. *Essays on social networks in the labor market*. PhD thesis, University of Minnesota, 2009.

Seung kyung Kim. *Class Struggle or Family Struggle?: The Lives of Women Factory Workers in South Korea*. Cambridge University Press, Cambridge, 1987.

R. Laschever. The doughboys network: social interactions and labor market outcomes of World War I veterans. *Unpublished manuscript, Northwestern University*, 2005.

N. Luke and K. Munshi. Women as Agents of Change: Female Income, Social Affiliation and Household Decisions in South India. 2005.

Jeremy R. Magruder. Intergenerational Networks, Unemployment, and Persistent Inequality in South Africa. *American Economic Journal: Applied Economics*, 2(1):62–85, 2010.

I.M. Mbiti. Monsoon Wedding? The Effect of Female Labor Demand on Marriage Markets in India. Technical report, mimeo, 2008.

James D Montgomery. Social Networks and Labor-Market Outcomes: Toward an Economic Analysis. *American Economic Review*, 81(5):1407–18, 1991.

D.T. Mortensen and T. Vishwanath. Personal contacts and earnings: It is who you know! *Labour Economics*, 1(2):187–201, 1994.

Kaivan Munshi. Networks in the Modern Economy: Mexican Migrants in the United States Labor Market. *Quarterly Journal of Economics*, 118(2):549–599, 2003.

J.C. Pinkston, United States. Bureau of Labor Statistics. Office of Employment, and Unemployment Statistics. *How Much Do Employers Learn from Referrals?* 2006.

G. Saloner. Old boy networks as screening mechanisms. *Journal of Labor Economics*, 3(3): 255–267, 1985.

C.J. Simon and J.T. Warner. Matchmaker, matchmaker: The effect of old boy networks on job match quality, earnings, and tenure. *Journal of Labor Economics*, 10(3):306–330, 1992.

H. Varian. Monitoring agents with other agents. *The New institutional economics: a collection of articles from the Journal of institutional and theoretical economics*, 146:313, 1991.

A Proofs of Testable Implications of Model

Appendices are in progress; please see http://www.econ.yale.edu/ rmh43/ for latest versions.

Proposition A.1. *Controlling for θ, wage variance is higher among workers who have made a referral.*

Proof. First consider the case where $\underline{\theta}_{high} < \theta < \underline{\theta}_{unc}$. A non-provider in this region has a wage $\{w_l, w_h\}$ of $\{\underline{w}, \underline{w} + \frac{c}{\alpha_h - \alpha_l}\}$, which yields wage variance of $\alpha_h(1-\alpha_h)\frac{c}{\alpha_h-\alpha_l}$. A provider in this region now has own wages $\{w_l^P(\theta_P, \theta_R), w_l^P(\theta_P, \theta_R) + \frac{c}{\alpha_h - \alpha_l}\}$ plus a potential punishment, yielding observed wage distribution:

$$w = \begin{cases} w_l^P(\theta_P, \theta_R) + \frac{c}{\alpha_h - \alpha_l} & \text{with probability} \quad \alpha_h^2 \\ w_l^P(\theta_P, \theta_R) + \frac{c}{\alpha_h - \alpha_l} - p & \text{with probability} \quad \alpha_h(1-\alpha_h) \\ w_l^P(\theta_P, \theta_R) & \text{with probability} \quad \alpha_h(1-\alpha_h) \\ w_l^P(\theta_P, \theta_R) - p & \text{with probability} \quad (1-\alpha_h)^2 \end{cases}$$

which yields wage variance $\alpha_h(1-\alpha_h)p\frac{c}{\alpha_h-\alpha_l}$. For any positive p, this is larger than the variance with no referral.

Now consider the case where $\theta > \underline{\theta}_{unc}$. If the provider is earning the w_h and w_l given in equations (6) and (7) that yield the optimal expected wage $w^*(\theta; e_h)$, then $w_l \geq \underline{w}$. That is, the firm could theoretically lower w_l and increase w_h, so that the optimal expected wage remains $w^*(\theta; e_h)$. To pin down the provider's wage, I add the assumption that there is a trivial cost to the firm for increasing the distance between w_h and w_l.[45] Then the wage variance of the provider without the referral is the same as in the case $\underline{\theta}_{high} < \theta < \underline{\theta}_{unc}$, and the same reasoning applies as to why the providers with $\theta > \underline{\theta}_{unc}$ have higher wage variance. □

Proposition A.2. *The average θ of referral providers is higher than the average θ of non-providers.*

Proof. I show that for a fixed θ_R, the profitability of a potential referral (for a R not hired otherwise) is increasing in θ_P, which implies that a greater range of θ_R is accepted from higher θ_P providers. Then if the range of θ's of potential recipients is independent of the provider's θ_P, workers whose referrals have been accepted are of higher θ than other workers. If a worker of type θ_R is not hired without a referral, then:

$$\theta_R + \alpha_h x_h + (1 - \alpha_h) x_l < \underline{w} + \frac{c\alpha_h}{\alpha_h - \alpha_l} \tag{23}$$

But if the firm can lower the worker's wages by some sufficiently large punishment, R would be profitable to hire. Call $\tilde{p}$ the minimum punishment that will cause the firm not to lose money on R:

$$\theta_R + \alpha_h x_h + (1 - \alpha_h) x_l = \underline{w} - \tilde{p} + \frac{c\alpha_h}{\alpha_h - \alpha_l} \tag{24}$$

Consider a potential provider P, receiving individually optimal wages (w_h^P, w_l^P) before the referral. Because the firm is only breaking even on the recipient, it has no incentive to pay the provider any higher wage than it would pay her absent a referral. So the firm will accept the referral if $w_l^P - \tilde{p} \geq \underline{w}$, which happens if:

$$\frac{1}{2}(\theta_P + \alpha_h x_h + (1 - \alpha_h) x_l + c) - \frac{\alpha_h c}{\alpha_h - \alpha_l} - \underline{w} \geq \tilde{p} \tag{25}$$

Because the LHS of the equation is increasing in θ_P, the referral will be accepted for all θ_P above some cut-off $\underline{\theta}_P(\theta_R)$. □

Proposition A.3. *The average θ of hired referral recipients is higher than the average θ of hired non-referred workers.*

Proof. Workers with $\theta \geq \underline{\theta}_{NR}$ are hired with or without a referral. In A.2 I showed that a worker with $\theta < \underline{\theta}_{NR}$ could be hired with a referral from a provider with sufficiently high θ_P. These recipients will reduce the average θ of recipients. □

Proposition A.4. *A provider is more likely to accept a wage offer than a non-provider of the same θ.*

[45] While not fully building in risk aversion, this assumption reflects the fact that workers' utility is decreased by mean-preserving spreads in their wage offers.

Proof. First consider a provider with $\theta_P > \underline{\theta}_{unc}$. Recall that the first order condition for the firm's maximization problem equates the gains from increasing expected wage (the increased probability of receiving the provider's output) with the wage bill to the firm:

$$w = \frac{1}{2}(\theta_P + \alpha_h x_h + (1-\alpha_h)x_l + c)$$

However, the gains from retaining a provider now include the output from high effort from the recipient.

$$w_P = \frac{1}{2}(\theta_P + \alpha_h x_h + (1-\alpha_h)x_l + c + Pr(R\ accepts(w))(\theta_R + \alpha_h x_h + (1-\alpha_h)x_l) - w_R(w_P))$$

By definition, if the firm accepts the referral, the output from the recipient net of wages paid to her is positive. Since the gains from paying the provider high effort (relative to a constant cost) have increased, the firm now pays the provider higher wages, and the provider is more likely to accept these higher wages.
Now consider a provider with $\theta < \underline{\theta}_{unc}$. Without a referral she will earn $\{\underline{w}, \underline{w} + \frac{c\alpha_h}{\alpha_h - \alpha_l}\}$, leaving no scope to punish the recipient. So any scope to punish the recipient would have to raise the provider's wages. □

Proposition A.5. *If there is a region of values of θ ($\underline{\theta}_{NR} < \theta < \underline{\theta}_{high}$) where workers are hired at low effort, wage variance is higher among workers who have received a referral (conditional on θ).*

Proof. Consider a potential recipient with $\theta_R = \underline{\theta}_{NR}$. With no referral, this worker is hired and exerts low effort, and the firm exactly breaks even on her. With a referral, the firm earns positive profits with any punishment that is at least the $\tilde{p}$ defined in (24). At this $\tilde{p}$, the recipient earns $\{\underline{w}, \underline{w} - \tilde{p} + \frac{c}{\alpha_h - \alpha_l}\}$. This wage offer will yield some variance (that is, $p < \frac{c}{\alpha_h - \alpha_l}$) because

$$\underline{\theta}_{NR} + \alpha_l x_h + (1-\alpha_l)x_l = \underline{w} \tag{26}$$

Then, from (3), output from high effort is higher than output from low, and

$$\underline{\theta}_{NR} + \alpha_h x_h + (1-\alpha_h)x_l > \underline{w} \tag{27}$$

That is, the worker's output to the firm is worth more than $\underline{w}$, so the firm will hire the worker even if it has to pay the worker strictly more than $\underline{w}$ in expectation in order to satisfy the IC constraint. So after a good outcome, the worker will earn more than $\underline{w}$, yielding some wage variance. So, for $\theta = \underline{\theta}_{NR}$, the firm will accept referrals that yield nonzero wage variance. Then, in some neighborhood around $\underline{\theta}_{NR}$, the firm will also accept referrals with some wage variance.

□

Proposition A.6. *If there is a region of values of θ where workers are hired at low effort, the wage level is higher among workers who have received a referral (conditional on θ).*

Proof. The relevant region is $\underline{\theta}_{NR} < \theta < \underline{\theta}_{high}$. Non-referred workers in this region earn $max\{\underline{w}, w^*(\theta; e_l)\}$. Referred workers in this region earn either $w^*_R(\theta_R, \theta_P; e_h)$ if the firm can set a large enough p so that it doesn't have to pay the worker more than optimal, or more, if the firm has to increase the expected wage past $w_R^*(\theta_R, \theta_P; e_h)$ in order to satisfy for R's IC for the given p. In either case, R makes at least $w_R^*(\theta_R, \theta_P; e_h)$, which is strictly greater than $max\{\underline{w}, w^*(\theta; e_l)\}$ since R's output is now higher under high effort. Note that empirically, the observed wage doesn't reflect p, creating another reason that recipients' observed wages would be higher. □

B State-contingent punishments

Suppose that for a provider θ_P and a recipient θ_R, the firm is allowed to set state-contingent punishments. That is, rather than a constant p, the firm can set a p_h for when the recipient has low output and the provider has high, and a p_l for when the recipient and provider both have low. The scope for state contingent punishments to improve on the firm's output depends on the correlation in outcomes between P and R. Formally, fix R's effort (either e_h or e_l) and define:

$$\frac{Pr(R\ x_h|P\ x_h)}{Pr(R\ x_h)} = \rho \tag{28}$$

The greater ρ, the more likely that P has low output when R does, and the less chance the firm gets to use the larger punishment p_h. Given this ρ and the possibility of state continent punishments, the incentive compatibility and limited liability constraints become:

$$\begin{aligned}
\text{subject to}\quad & \alpha_h w_h^P + (1-\alpha_h) w_l^P - c \geq \alpha_l w_h^P + (1-\alpha_l) w_l^P && (IC, P)\\
& \alpha_h w_h^R + \alpha_h(1-\rho\alpha_h)(w_l^R - p_h) + (1 - 2\alpha_h + \rho\alpha_h^2)(w_l^R - p_l) - c && \\
& \quad \geq \alpha_l w_h^R + \alpha_h(1-\rho\alpha_l)(w_l^R - p_h) + (1 - \alpha_h - \alpha_l + \rho\alpha_l\alpha_h)(w_l^R - p_l) && (IC, R; P\ e_h)\\
& \alpha_h w_h^R + \alpha_l(1-\rho\alpha_h)(w_l^R - p_h) + (1 - \alpha_h - \alpha_l + \rho\alpha_l\alpha_h)(w_l^R - p_l) - c && \\
& \quad \geq \alpha_l w_h^R + \alpha_l(1-\rho\alpha_l)(w_l^R - p_h) + (1 - 2\alpha_l + \rho\alpha_l^2)(w_l^R - p_l) && (IC, R; P\ e_l)\\
& (w_h^P - p_h), (w_l^P - p_l) \geq \underline{w} && (LL, P)\\
& w_h^R, w_l^R \geq \underline{w} && (LL, R)
\end{aligned}$$

Since R stands to gain from P exerting low effort (which would lower the probability that R gets the harsher punishment p_h), the firm must insure that R wants to work hard even if P is exerting low effort. Otherwise, with P indifferent between high and low effort and R standing to gain from P exerting less effort, R could convince P to work less hard and share her gains with P.[46]

As in the baseline case the punishment (here p_h or p_l) doesn't enter into P's participation decision or IC constraint, since by assumption R reimburses P these amounts. The state contingent punishments allow the firm to push R's wage in the bad state lower than in the case with no state contingent punishments. Previously R's wage in low state could not go any lower than $w_l^R - p_l$ (with p_l the punishment that makes P's LL bind when P

[46]The firm could alternatively push up w_h^P enough so that P strictly prefers high effort, and by more than R's gains from convincing P to exert low effort. However, this is more costly to the firm, since P is more likely to work than R, so it is more likely to have to pay the higher wages.

has low output), while with state contingent punishments it becomes a weighted average of $w_l^R - p_l$ at the lower amount $w_l^R - p_h$. This ability increases the gains from referrals, and allows the firm to accept referrals from potential referral pairs (θ_P, θ_R) it would not have accepted if state contingent punishments were not allowed.

However, the prediction that providers are observably better than other workers is maintained, since for θ_P low enough the firm will still not be able to get a high enough punishment without bumping into the provider's own limited liability constraint. The gains from state contingent punishments are higher if ρ is low, that is, if the fact that the recipient has low output doesn't increase by much the probability that the provider does as well. In the extreme, the provider and recipient have low output in the same period, and so the punishment is always p_l, the same as it was without state contingent punishments.

C An Alternative Limited Liability Constraint

Suppose that there are two periods of work, so that the timing of the game becomes:

1. Firm offers worker a wage contract: $\{w_1, w_{2l}, w_{2h}\}$, where the worker would get w_{2h} if she had x_h in the first period, or w_{2l} if had x_l
2. Worker receives an outside option η and decides whether to work in the first period, and if so, whether to exert high or low effort
3. Worker gets paid w_1, then output is realized
4. Worker receives another η draw and decides whether to work in the second period

The limited liability constraint here is that wages are downwardly rigid: $w_{2l} \geq w_1$.[47] The worker's IC for effort now becomes:

$$\alpha_h EMax(\eta, w_{2h}) + (1-\alpha_h) EMax(\eta, w_{2l}) - c \geq \alpha_l EMax(\eta, w_{2h}) + (1-\alpha_l) EMax(\eta, w_{2l}) \tag{29}$$

That is, a worker in the first period trades off a certain effort cost c with a higher pay-off w_{2h} that may be irrelevant if her η draw is sufficiently high. The firm's profits under high effort in the first period are then:

$$\begin{aligned}
\pi_{high} = \max_{w_1, w_{2l}, w_{2h}} \quad & Pr\Big(w_1 - c + \alpha_h w_{2h} + (1-\alpha_h) w_{2l} - c \geq 2\eta\Big) \\
& \times \Big(\theta + \alpha_h x_h + (1-\alpha_h) x_l - w_1 \\
& + (1-\alpha_h) Pr(w_{2h} \geq \eta)(\theta + \alpha_l x_h + (1-\alpha_h) x_l - w_{2h}) \\
& + (1-\alpha_h) Pr(w_{2l} \geq \eta)(\theta + \alpha_l x_h + (1-\alpha_h) x_l - w_{2l})\Big)
\end{aligned} \tag{30}$$

subject to (29) and $w_1, w_{2h}, w_{2l} \geq \underline{w}$

[47] One potential explanation for this constraint is that wage cuts would be prohibitively costly to workers' morale (Bewley, 2002).

Notice that there is no way for the firm to provide incentives for effort in the last period, so the worker exerts low effort. Under low effort in the first period, the firm's profits are

$$\begin{aligned}\pi_{low} = &\max_{w_1, w_2} \quad Pr\Big(w_1 + w_2 \geq 2\eta\Big) \\ &\qquad\qquad \times \Big(\theta + \alpha_l x_h + (1-\alpha_l)x_l - w_1 \\ &\qquad\qquad + Pr(w_2 \geq \eta)(\theta + \alpha_l x_h + (1-\alpha_h)x_l - w_2)\Big) \\ \text{subject to} \quad & w_1, w_2 \geq \underline{w} \\ & w_2 \geq w_1\end{aligned} \tag{31}$$

As in the one period case, this model will yield the prediction that firms find high effort optimal only from workers with θ sufficiently high. Lower θ workers are less likely to accept a wage offer in the second period, so the promise of higher wages in the second period is less effective as a motivational tool. A referral is profitable precisely because the provider is more likely to accept a second period wage offer. The firm's problem for a referral pair is then:

$$\begin{aligned}\pi_{high} = &\max_{w_1^P, w_{2l}^P, w_{2h}^P, p_l, p_h, w_1^R, w_{2l}^R, w_{2h}^R} \quad q(w_1^P, w_{2h}^P, w_{2l}^P)\Big(\theta_P + \alpha_h x_h + (1-\alpha_h)x_l - w_1^P \\ &+ (1-\alpha_h)Pr(w_{2h}^P \geq \eta)(\theta_P + \alpha_l x_h + (1-\alpha_h)x_l - w_{2h}^P) \\ &+ (1-\alpha_h)Pr(w_{2l}^P \geq \eta)(\theta_P + \alpha_l x_h + (1-\alpha_h)x_l - w_{2l}^P)\Big) \\ &\times r(q(w_1^P, w_{2h}^P, w_{2l}^P), p_l, p_h, w_1^R, w_{2l}^R, w_{2h}^R)\Big(\theta_R + \alpha_h x_h + (1-\alpha_h)x_l - w_1^R \\ &+ \alpha_h Pr(w_{2h}^R \geq \eta)(\theta_R + \alpha_l x_h + (1-\alpha_l)x_l - w_{2l}^R) \\ &+ q(w_1^P, w_{2h}^P, w_{2l}^P)Pr(w_{2l}^R - p_h \geq \eta)(\alpha_l(1-\rho\alpha_h)Pr(w_{2h}^P \geq \eta) \\ &\quad \times (\theta_R + \alpha_l x_h + (1-\alpha_l)x_l - w_{2l}^R + p_h) \\ &+ q(w_1^P, w_{2h}^P, w_{2l}^P)Pr(w_{2l}^R - p_l \geq \eta)(1-\alpha_h-\alpha_l+\rho\alpha_h\alpha_l)Pr(w_{2l}^P \geq \eta) \\ &\quad \times (\theta_R + \alpha_l x_h + (1-\alpha_l)x_l - w_{2l}^R + p_l) \\ &+ q(w_1^P, w_{2h}^P, w_{2l}^P)Pr(w_{2l}^R \geq \eta)(\alpha_l(1-\rho\alpha_h)Pr(w_{2h}^P < \eta) + (1-\alpha_h-\alpha_l+\rho\alpha_h\alpha_l)Pr(w_{2l}^P \leq \eta)) \\ &\quad \times (\theta_R + \alpha_l x_h + (1-\alpha_l)x_l - w_{2l}^R)\Big) \\ \text{s.t.} \quad & w_{2l}^R, w_{2h}^R \geq w_1^R \\ & (w_{2l}^P - p_h), (w_{2h}^P - p_l) \geq w_1^P \\ & w_1^R, w_{2h}^R, w_{2l}^R, w_1^P, (w_{2h}^P - p_h), (w_{2l}^P - p_l) \geq \underline{w} \\ & (IC, R), (IC, P)\end{aligned}$$

where

$$q(w_1^P, w_{2h}^P, w_{2l}^P) = Pr\Big(w_1^P - c + \alpha_h w_{2h}^P + (1-\alpha_h)w_{2l}^P \geq 2\eta\Big)$$

is the probability that the provider works in the first period, and

$$\begin{aligned} r(q(w_1^P, w_{2h}^P, w_{2l}^P), p_l, p_h, w_1^R, w_{2l}^R, w_{2h}^R) = Pr\Big(& w_1^R - c + \alpha_h w_{2h}^R + q(w_1^P, w_{2h}^P, w_{2l}^P)\alpha_l(1-\rho\alpha_l) \\ &\times (Pr(w_{2h}^P \geq \eta)(w_{2l}^R - p_h) + (1 - Pr(w_{2h}^R \geq \eta))w_{2l}^R) \\ &+ q(w_1^P, w_{2h}^P, w_{2l}^P)((1-\alpha_h-\alpha_l+\rho\alpha_h\alpha_l) \\ &\times (Pr(w_{2l}^P \geq \eta)(w_{2l}^R - p_l) + (1 - Pr(w_{2l}^P \geq \eta)w_{2l}^R)\Big) \geq 2\eta) \end{aligned}$$

is the probability that the recipient works in the first period. As in the one period model, the firm offers the recipient a wage contract that is contingent on the provider's presence in the firm. Here, then, the greater the chance that the provider accepts the firm period wage offer, the greater the firm's potential profits from the recipient's output. The incentive compatibility constraint for the recipient (IC, R) is given by:

$$\begin{aligned} &\alpha_h EMax(\eta, w_{2h}^R) \\ &\quad + q(w_1^P, w_{2h}^P, w_{2l}^P)(\alpha_l(1-\rho\alpha_l)Pr(w_{2h}^P \geq \eta)EMax(\eta, w_{2h}^R - p_h) \\ &\quad + q(w_1^P, w_{2h}^P, w_{2l}^P)((1-\alpha_h-\alpha_l+\rho\alpha_h\alpha_l)Pr(w_{2l}^P \geq \eta)EMax(\eta, w_{2h}^R + p_l) \\ &\quad + q(w_1^P, w_{2h}^P, w_{2l}^P)(\alpha_l(1-\rho\alpha_h)Pr(w_{2h}^P < \eta) + (1-\alpha_h-\alpha_l+\rho\alpha_h\alpha_l)Pr(w_{2l}^P \leq \eta)EMax(\eta, w_{2l}^R) \geq \\ &\alpha_l EMax(\eta, w_{2h}^R) \\ &\quad + q(w_1^P, w_{2h}^P, w_{2l}^P)(\alpha_l(1-\rho\alpha_l)Pr(w_{2h}^P \geq \eta)EMax(\eta, w_{2h}^R - p_h) \\ &\quad + q(w_1^P, w_{2h}^P, w_{2l}^P)((1-2\alpha_l+\rho\alpha_l^2)Pr(w_{2l}^P \geq \eta)EMax(\eta, w_{2h}^R + p_l) \\ &\quad + q(w_1^P, w_{2h}^P, w_{2l}^P)(\alpha_l(1-\rho\alpha_h)Pr(w_{2h}^P < \eta) + (1-2\alpha_l+\rho\alpha_l^2)Pr(w_{2l}^P \leq \eta)EMax(\eta, w_{2l}^R) \end{aligned}$$

In this model, recipients not only have higher overall wage variance than non-recipients, but the difference is increasing with tenure in the firm (since the reward for high effort shows up in period 2). This pattern is empirically true in the data, as shown in table 11. The firm satisfies the IC constraint by raising a worker's period 2 wage, but for low θ workers, the amount the firm would have to raise w_{2h} is prohibitively costly (since the promise of second period wages is less appealing for low θ workers less likely to accept a second period offer). But the firm can satisfy the IC of a recipient without having to increase w_{2h} by as much, since the firm can also punish the provider.

List of Figures

Figure 1: Wage Distribution for Referral Recipients and Non-Referred Workers

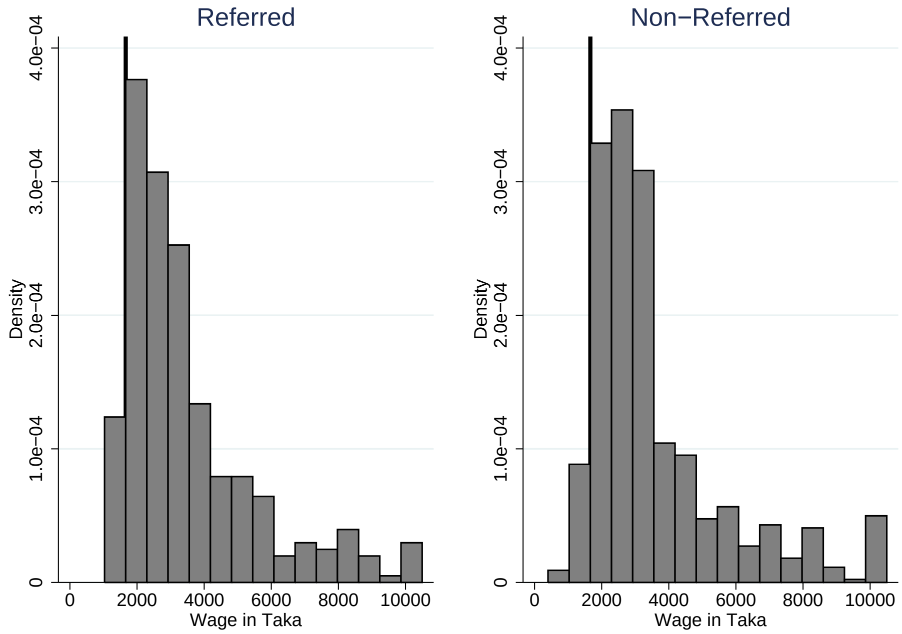


Figure 2: Percent of Hired Workers Remaining as a Function of Tenure

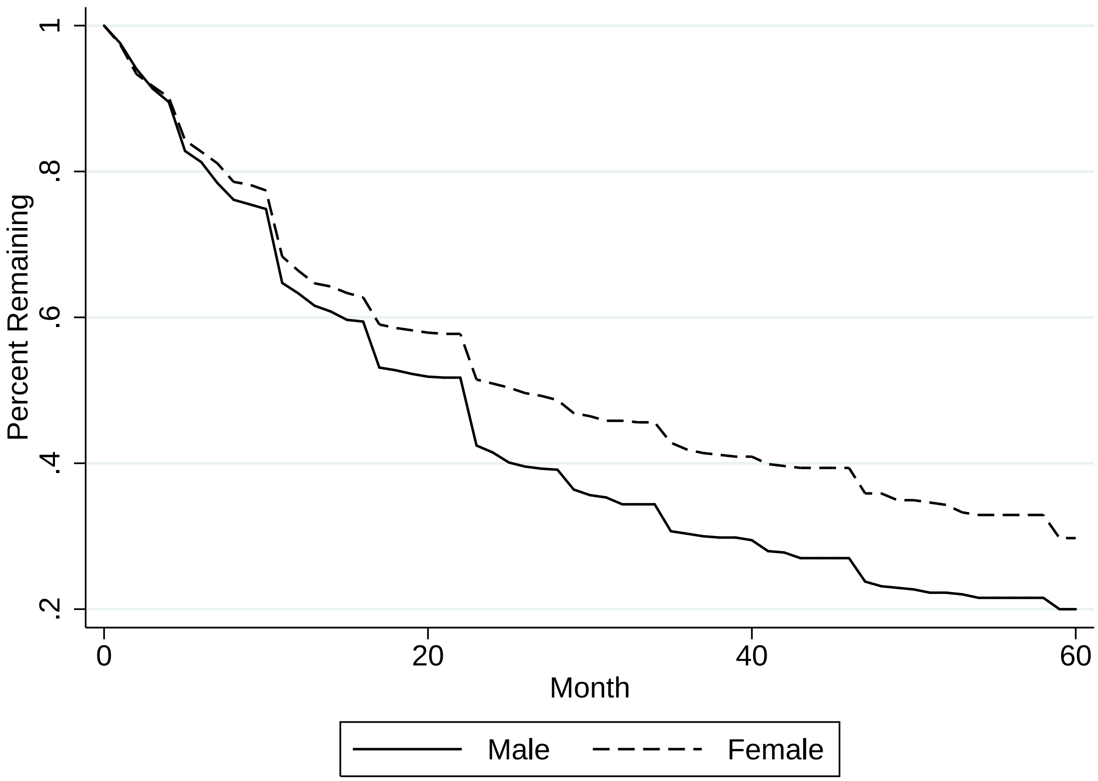


Figure 3: Observable quality, wages, and profit: Case 1 (some workers hired at low effort)

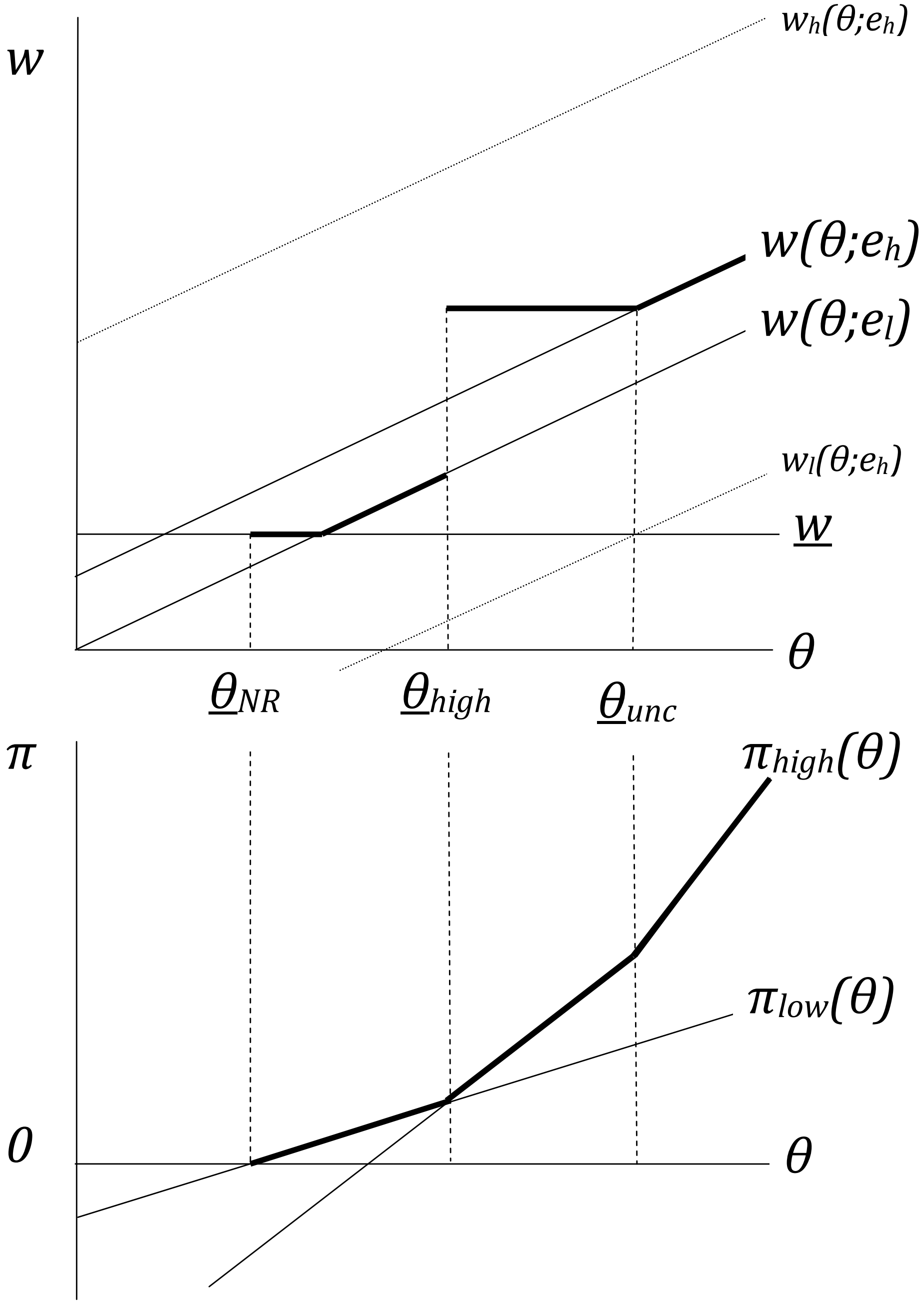


Figure 4: Observable quality, wages, and profit: Case 2 (workers only hired at high effort)

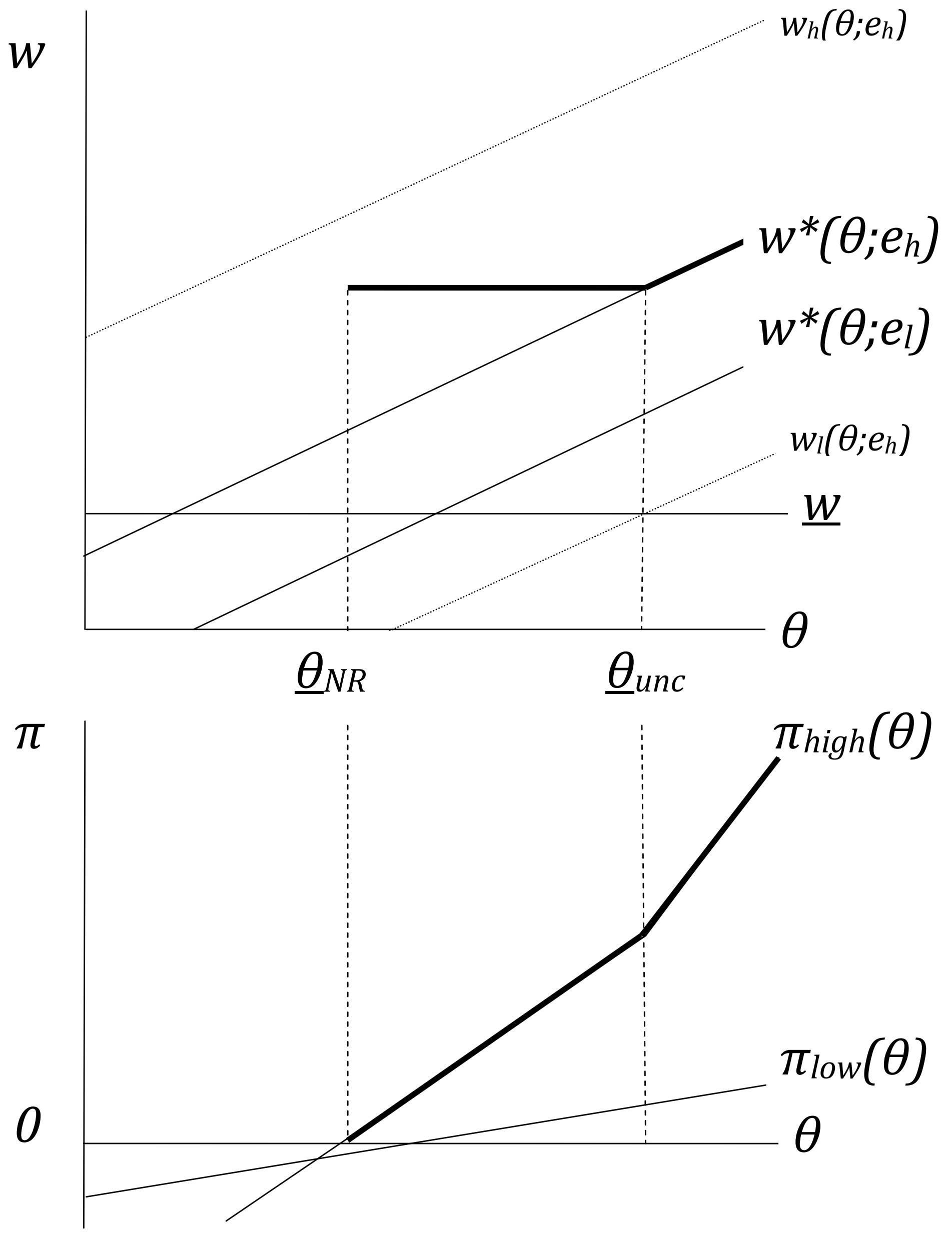


Figure 5: Referral contract, as a function of θ_P and θ_R

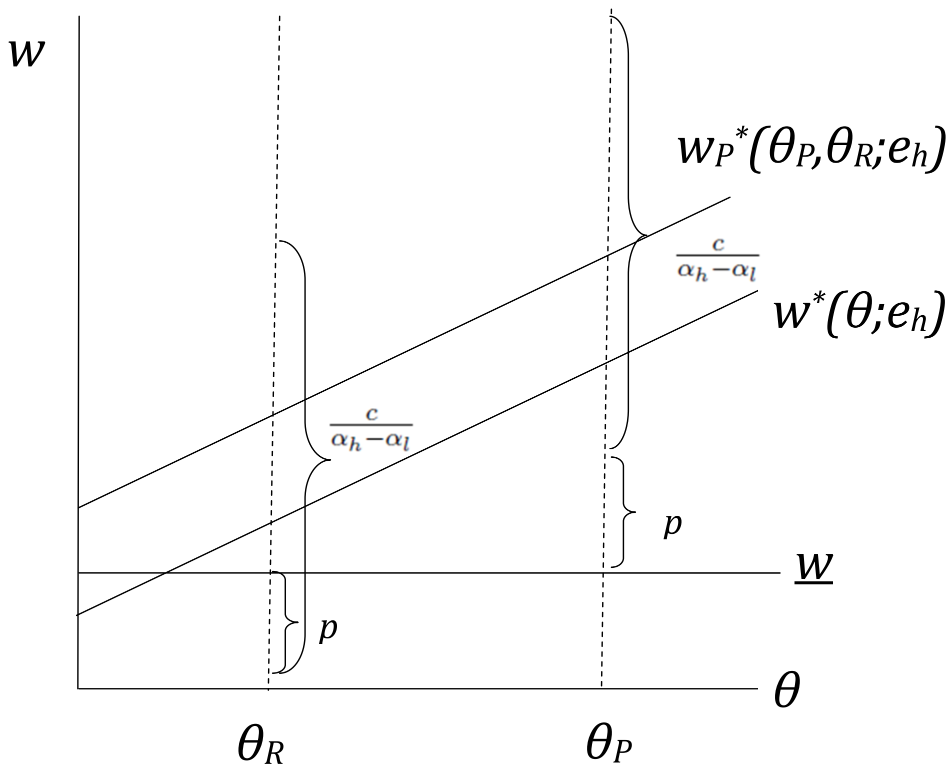
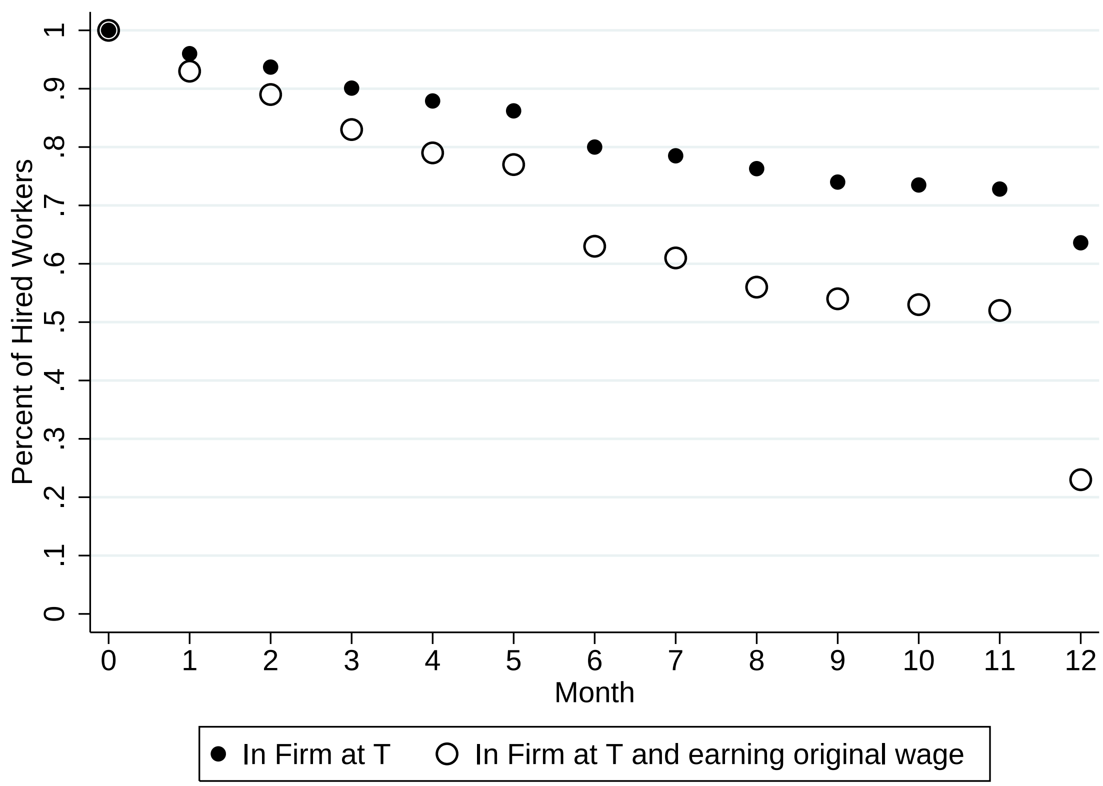


Figure 6: Turnover and Wage Updating with Tenure



List of Tables

Table 1: How current workers report being hired

	Number	Percent
referred by worker in that factory	310	31.8
heard about job from worker in a different factory	48	4.9
heard about job from someone not a garment worker at the time	31	3.2
written advertisement	160	16.4
applied at factory in person	391	40.1
recruited by management	29	3.0
other	5	0.5
Total	974	100

Table 2: Relationship between referral provider and referral recipient

	Number	Percent
Relative, same bari	139	44.8
Relative, different bari	63	20.3
Non relative	108	34.8
Total	310	100

Table 3: Proportion of workers giving and receiving referrals, by position

position	number	% received referral	% made referral
helper	221	43.0	9.5
operator	638	28.2	25.2
supervisor	115	30.4	44.3
Total	974	0.318	0.239

Table 4: Summary Statistics, Recipients, Providers and Other Workers

	recipient	provider	neither	overall
male	0.436	0.609	0.373	0.442
experience (months)	47.030	68.662	43.217	38.453
education (years)	5.354	6.617	5.799	5.909
all correct on arithmetic test[a]	0.425	0.554	0.528	0.504
married	0.736	0.865	0.769	0.769
has a child	0.340	0.457	0.415	0.396
age	26.017	28.448	25.369	25.954
originally from village of current residence	0.112	0.100	0.059	0.077
either parent any education	0.124	0.100	0.107	0.113
good relations with management[b]	0.840	0.853	0.808	0.827
appointment letter[c]	0.330	0.494	0.293	0.344
took manual test at start of employment[d]	0.340	0.463	0.462	0.435
commute time (minutes)	18.170	19.316	18.868	18.775
daily hours of work	11.801	11.805	11.642	11.726
N	306	231	485	967
percent	31.6	23.9	50.2	100

Notes: (a) the arithmetic test consisted of the worker being asked to subtract 7 from 100, and then 7 from that amount, and then 7 from the amount after that (3 rounds).
(b) worker reported "good" or "excellent" relationship, out of possible choices "very bad", "bad", "okay", "good", "excellent"
(c) an appointment letter states that the worker cannot be dismissed without cause
(d) a manual test consists of an employer sitting the worker down in front of a sewing machine, pre-hiring, and asking her to demonstrate the specific skills and manuevers that she knows

Table 5: Correlation between wages of bari members working in same factory together

Dep. Var is wage residual $\tilde{w}_{it}$	(1)	(2)	(3)	(4)
$\tilde{w}_{jt}$	0.3138***	0.1816***	0.2210***	0.3138***
	[0.019]	[0.026]	[0.022]	[0.019]
$\tilde{w}_{jt} \times referral_{ijt}$	0.2782***	0.2175***	0.2382***	0.4011**
	[0.077]	[0.074]	[0.077]	[0.192]
$\tilde{w}_{jt} \times same\ machine_{ijt}$		0.2698***		
		[0.035]		
$\tilde{w}_{jt} \times same\ position_{ijt}$			0.2142***	
			[0.037]	
$\tilde{w}_{jt} \times referral_{ij} \times sameteam_{ijt}$				-0.1575
				[0.209]
Observations	17312	17312	17312	17312
R-squared	0.109	0.109	0.120	0.120

*Stars indicate significance: *** p<0.01, ** p<0.05, * p<0.1*

The unit of observation is a matched pair of the wage residual $\tilde{w}_{it}$ of a bari member and the wage residual $\tilde{w}_{jt}$ of another bari member working in the same factory in the same month

Bootstrap standard errors in brackets, constructed by taking repeated samples of monthly wage observations and then constructing the bari member pairs for each sample chosen (then repeating 1000 times)

Table 6: Correlation between wages of bari members, same factory vs. different factory

Dep. Var is wage residual $\tilde{w}_{it}$	(1)	(2)	(3)	(4)
$\tilde{w}_{jt}$	0.2026***	0.1613***	0.1352***	0.2027***
	[0.008]	[0.010]	[0.010]	[0.008]
$\tilde{w}_{jt} \times ever\ referral_{ij}$	0.1507*	0.1170	0.1297	0.2078***
	[0.079]	[0.088]	[0.074]	[0.088]
$\tilde{w}_{jt} \times same\ factory_{ijt}$	0.1581***	0.0778***	0.1405***	0.1574***
	[0.020]	[0.027]	[0.024]	[0.020]
$\tilde{w}_{jt} \times referral_{ijt} \times same\ factory_{ijt}$	0.1679*	0.1618	0.1623	0.2232*
	[0.102]	[0.110]	[0.109]	[0.127]
$\tilde{w}_{jt} \times same\ machine_{ijt}$		0.1140***		
		[0.024]		
$\tilde{w}_{jt} \times same\ factory_{ijt} \times same\ machine_{ijt}$		0.1384***		
		[0.038]		
$\tilde{w}_{jt} \times same\ position_{ij}$			0.1783***	
			[0.029]	
$\tilde{w}_{jt} \times same\ factory_{ijt} \times same\ position_{ij}$			0.0098	
			[0.039]	
$\tilde{w}_{jt} \times same\ factory_{ijt} \times same\ team_{ijt}$ $\times referral_{ijt}$				-0.1602
				[0.139]
Observations	126744	126744	126744	126744
R-squared	0.055	0.055	0.057	0.058

*Stars indicate significance: *** p<0.01, ** p<0.05, * p<0.1*

The unit of observation is a matched pair of the wage residual $\tilde{w}_{it}$ of a bari member and the wage residual $\tilde{w}_{jt}$ of another bari member working in the garment industry in the same month

Bootstrap standard errors in brackets, constructed by taking repeated samples of monthly wage observations and then constructing the bari member pairs for each sample chosen (then repeating 1000 times)

Table 7: Unexplained variance, providers and recipients

Dependent Var: $\hat{\epsilon}^2_{if}$ from first stage wage regression			
	(1)	(2)	(3)
$x'_{if}\hat{\beta}$	0.0651***	0.0490***	0.0570***
	[0.0183]	[0.0162]	[0.0188]
referred		0.0214**	0.0199**
		[0.0099]	[0.0100]
made referral		0.0220*	0.0332
		[0.0114]	[0.0327]
operator			-0.0163
			[0.0126]
supervisor			-0.00613
			[0.0236]
operator * made referral			-0.0101
			[0.0352]
supervisor * made referral			-0.0200
			[0.0434]
Mean Dep Var	0.069	0.069	0.069
Observations	939	939	939
R-squared	0.017	0.023	0.026

*stars indicate significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$*

Standard errors clustered at level of person; position dummies are indicators for helper, operator, and supervisor

Table 8: Observable Characteristics, Providers and Recipients

	(1)	(2)	(3)	(4)	(5)	(6)
Dep Var	Educ	Educ	Educ	Exper	Exper	Exper
referred	-0.670***	-0.500**	-0.611**	-0.590***	-0.257*	-0.570***
	[0.253]	[0.251]	[0.240]	[0.152]	[0.140]	[0.167]
made referral	0.302	0.094	0.256	0.509***	0.194	0.485**
	[0.287]	[0.268]	[0.287]	[0.178]	[0.163]	[0.189]
Mean Dep. Var.	5.909	5.909	5.909	4.059	4.059	4.059
Position dummies	N	Y	N	N	Y	N
Factory FE	Y	Y	Y	Y	Y	Y
Bari FE	N	N	Y	N	N	Y
Observations	2112	2112	2112	2030	2030	2030
R-squared	0.531	0.546	0.629	0.540	0.622	0.573

*Stars indicate significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$*

Education and experience measured in years, defined at the beginning of a worker spell; Regression includes control for male; position dummies are indicators for helper, operator, and supervisor

Table 9: Probability of leaving firm

	Dep. Var is 1(leave that month)			
	(1)	(2)	(3)	(4)
	logit	cond logit	cond logit	cond logit
made referral	-0.01252 ***	-0.01597***		
	[0.0016]	[0.0010]		
made referral of bari member			-0.01003***	
			[0.0090]	
made referral of bari member $\times$ post referral				-0.0227***
				[0.0013]
Person FE	N	Y	Y	Y
Observations	45716	31214	32212	32212

*Stars indicate significance: *** p<0.01, ** p<0.05, * p<0.1*

Estimates are marginal effects and conditional on tenure; controls: education, experience, male; standard errors in brackets, clustered at person-level

Table 10: Effects of Receiving a Referral on Wages

	Dep. Var is log wage		
	(1)	(2)	(3)
referred	-0.0861**	0.0050	0.0316
	[0.035]	[0.031]	[0.045]
person FE	N	N	Y
controls	N	Y	Y
Observations	4494	4241	4241
R-squared	0.450	0.666	0.827

*stars indicate significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$*

Controls: experience, experience squared, first job, male, education, arithmetic test score, time plus factory FE; standard errors in brackets, clustered at person level

Table 11: Within person wage variance, recipients vs. non-referred workers

Dep. Var. is $(\tilde{w}_i \textit{ at tenure } T - \tilde{w}_i \textit{ at tenure } 0)^2$			
T	3 months	6 months	12 months
referred	0.0190***	0.0360***	0.0388***
	[0.005]	[0.011]	[0.015]
Observations	1775	1473	1026
R-squared	0.013	0.008	0.018

*Stars indicate significance: *** p<0.01, ** p<0.05, * p<0.1*

The dependent variable is the squared difference between the individual's wage (conditional on observables) $\tilde{w}_i$ after 3, 6, or 12 months minus the individual's initial wage offer (conditional on observables). The dependent variable is then regressed on a referred dummy, and also on experience, sex, and education.

Standard errors in brackets, clustered at person level

Table 12: Provider's wages, before and after the referral

Dep. Var. is log(wage)	(1)	(2)
Made referral	0.0187	0.0097
	[0.039]	[0.040]
Made referral × recipient in bari	-0.0814	-0.0509
	[0.116]	[0.117]
Made referral × recipient in bari × post referral	0.2141	0.2492
	[0.143]	[0.153]
Tenure	-0.0015***	-0.0015***
	[0.000]	[0.001]
Made referral × tenure		0.0004
		[0.001]
Made referral × recipient in bari × tenure		-0.0007
		[0.001]
Observations	47567	47567
R-squared	0.320	0.321

*Stars indicate significance: *** p<0.01, ** p<0.05, * p<0.1*

Controls: experience, experience squared, first job, male, education; Standard errors in brackets, clustered at person level