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

Rachel Heath*

October 5, 2011

Abstract

I argue 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 the referral provider if the recipient has low output. I test the model's predictions using household survey data that I collected in Bangladesh. I can control for correlated wage shocks within a network and correlated unobserved type between the recipient and provider. I reject the testable implications of models in which referrals help firms select unobservably good workers or are solely a non-wage benefit to providers.

JEL CODES: O12, J33, D22

*Department of Economics, University of Washington and the World Bank; rmheath@uw.edu. I am indebted to Mushfiq Mobarak, Mark Rosenzweig and Chris Udry for their guidance and suggestions. I also thank Treb Allen, Priyanka Anand, 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 Morten, 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 my own.

1 Introduction

Firms in both developed and developing countries frequently use referrals from current workers to fill job vacancies. 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. 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. The referral allows the firm to provide incentives for effort without the expectation of a long-run relationship between the worker and the firm required by delayed compensation or efficiency wage models. 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 (1990) shows that in a principal-agent set-up, principals can use agents' ability to monitor each other to reduce moral hazard. Bryan et al. (2010) provide evidence of this social pressure in microfinance,[1] which supports one of the primary assumptions of my model: the recipient works hard if the provider has monetary gain from her doing so. More broadly, this paper illustrates that firms can benefit from social ties between workers.

[1]Specifically, they offer a reward to a referral provider if the referral recipient repays back a loan, which increases loan repayment rates. In one of the treatment arms 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.

The 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. The wage histories of the referral provider and recipient can be matched if they live in the same *bari* (extended family residential compound).

I use these matched provider-recipient pairs to confirm the key testable premise of the model: the provider is punished when the recipient performs poorly, so that the referral pair has positively correlated wages. I allow for correlated unobservable types of the provider and recipient 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). Detailed data on the type of work done by each respondent allow me to control for factory or industry-level wage shocks to position and machine type or within-factory shocks to a production team.

This joint contract between the firm and referral pair has further testable implications for the wage variance and observable skills of the provider and recipient. A provider's wage is tied both to her own output and that of the recipient. Therefore the wage variance of a provider will exceed that of other workers of the same observable skill. Furthermore, since the wages of observably higher skilled workers are higher relative to a limited liability constraint which is the same for every worker, firms can levy higher punishments on higher skilled workers and referral providers are thus observably better skilled than non-providers. Recipients, by contrast, are observably lower skilled than other hired workers, since referrals allow the firm to hire workers it would not otherwise.

Theoretical literature on referrals has focused on their role in reducing search costs (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 search costs could be another reason that Bangladeshi garment factories use referrals, they alone 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.[2]

[2]Simon and Warner (1992), Dustmann et al. (2009), and Pinkston et al. (2006) do find some evidence of differential

The empirical evidence that the provider's wage reflects the recipients output confirms that the provider has incentive to prevent the recipient from shirking. Previous literature arguing that referrals provide information about recipients either proposes that the workers are passive and the firm infers information about the recipient based on the provider's type (Montgomery, 1991) or must assume that the provider and firm's incentives are aligned without having the data to validate the assumption.[3] This assumption may not always hold: referral providers may favor less qualified family members (Beaman and Magruder, 2010) or refer workers who leave once a referral bonus is received (Fafchamps and Moradi, 2009).

This paper suggests a context where strong network ties are important in labor markets. While in some contexts weak ties may be more able to provide non-redundant information about job vacancies than close ties (Granovetter, 1973), 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 results then suggest 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).

The rest of the paper proceeds as follows. In section 2, I provide information about labor in the garment industry that is relevant to the 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 in that environment. Section 5 describes the data and 5 empirical strategy. I give my main results in section 6 and discuss alternative explanations for which firms might use referrals in section 7. Section 8 concludes.

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.

[3]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.

2 Labor in the Garment Industry in Bangladesh

The labor force of the Bangladeshi garment industry has experienced explosive yearly growth of 17 percent since 1980. 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 such as dyeing machines is used to produce the cloth that will be sewn into garments, the garments themselves are typically assembled and sewn by individuals at basic sewing machines. Production usually takes place in teams, which typically consist of helpers (entry-level workers who cut lose threads or fetch supplies), operators (who do the actual sewing), a quality control checker, and a supervisor.

Since the quality of a garment can only be determined if a quality checker examines it by hand, it is prohibitively costly for firms to observe workers' effort perfectly, creating the potential for moral hazard. Firms' ability to assess effort is further complicated when new orders with uncertain difficulty come in or if a worker's output is affected by others on her team. However, factory managers do use reports from quality checkers to acquire noisy signals of the workers' effort and give raises to the workers they believe have performed well.

Workers are typically paid a monthly wage; 88 percent of workers in the sample receive one.[4] 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 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.

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. Referrals are common: 32 percent of workers received a referral in their current job. Sixty-five percent of referrals came from relatives, most of which (and 45 percent of referrals overall) occurred between

[4]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 piece rates are not worth the administrative cost, especially since they would have to redefine a new piece with each order.

member living in the same extended family compound, called a *bari*. Receiving 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.

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 worker in my data has 38 months of total experience in the garment industry. A worker's experience is often interrupted as workers spend time out of the labor force in between employment spells, usually to deal with care-taking of children, sick or the elderly. Thirty-one percent of current workers spent time out of the labor force before their current job. Even garment workers who work continuously tend to switch factories frequently, as competing factories get large orders and expand their labor force rapidly by poaching workers from other factories. By twelve months after the time of hiring, for instance, only 64 percent of all hired workers who are still working in the garment industry remain in that factory.

3 Model

Output is 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 $x_h > x_l$. There is one period of work, which reflects the short employment spells described in section 2. Firms offer a menu of wages before work takes place, specifically,

$$w = \begin{cases} w_h & \text{if} \quad X = x_h \\ w_l & \text{if} \quad X = x_h \end{cases}$$

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 $\alpha_h > \alpha_l$. Labor markets are competitive, so that wage competition between firms bids wages up to a worker's expected production.

Low effort has zero cost to workers, while high effort costs c. Workers are risk neutral[5] and utility

[5]This assumption is made for analytical tractability. Adding risk aversion would only compound the moral hazard

is separable in expected earnings and effort cost, yielding an incentive compatibility constraint for high effort

$$\alpha_h w_h + (1-\alpha_h)w_l - c \geq \alpha_l w_h + (1-\alpha_l)w_l \tag{1}$$

There is also a limited liability constraint; wages cannot drop below $\underline{w}$ in any state of the world.[6]

The firm's formal maximization problem is given in appendix A. For a worker of observable quality θ, the firm has three options: (i) hire and induce high effort, (ii) hire but settle for low effort, or (iii) not hire the worker. If θ is sufficiently high, a firm can offer a $\{w_h, w_l\}$ contract that satisfies the IC and LL constraints and still pays the worker her expected output:

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

$$w_h(\theta) = \theta + \alpha_h x_h + (1-\alpha_h)x_l + \frac{(1-\alpha_h)c}{\alpha_h - \alpha_l} \tag{3}$$

But as θ falls, $w_l(\theta)$ does as well, and eventually the firm's desired w_l is below $\underline{w}$. For those workers, the firm would have to induce high effort by paying

$$w_l = \underline{w} \tag{4}$$

$$w_h = \underline{w} + \frac{c}{\alpha_h - \alpha_l} \tag{5}$$

which would pay higher expected wage than the worker's output. Therefore it is not profitable for the firm to induce high effort in these workers, even though their expected production is higher than the minimum wage $\underline{w}$, as shown in figure 2. In the baseline case shown in this figure, parameter values are such that case (ii) of the firm's maximization problem never applies: no workers can be profitably hired if they are working at low effort.[7] Call the minimum observable quality of worker whom the firm would hire without a referral $\underline{\theta}_{NR}$.

Workers with $\theta < \underline{\theta}_{NR}$ would be hired if the firm could lower the worker's wage after low output below $\underline{w}$, which would allow the firm to satisfy the IC constraint for high effort without paying

problem and reinforce the importance of referrals in providing incentives for high effort.

[6]Even if there is no legal minimum wage, if workers are credit constrained and cannot post bonds that the firms will take after a bad outcome, then $\underline{w} = 0$.

[7]That is, consider the minimum $\underline{\theta}_{high}$ for whom high effort is profitable: $\underline{\theta}_{high} + \alpha_h x_h + (1-\alpha_h)x_l = \underline{w} + \frac{c\alpha_h}{\alpha_h - \alpha_l}$. Case (ii) will never apply if the output for the worker of this $\underline{\theta}_{high}$ is below the minimum wage the firm would have to pay a worker with low effort: $\underline{\theta}_{high} + \alpha_l x_h + (1-\alpha_l)x_l < \underline{w}$.

prohibitively high expected wage. One way that firms could do this is through a referral. Suppose that a current employee in the firm offers to serve as a referral provider (P) to a potential worker, the referral recipient (R). I assume that both P and R are part of a network whose members are playing a repeated game that allows them to enforce contracts with each other that maximize the groups' overall pay-off (Foster and Rosenzweig, 2001). Then a provider is willing to allow her own wages to be decreased by some punishment p if the recipient has low output, since the recipient will eventually have to repay her.[8] Specifically, then, the provider receives wages:

$$w = \begin{cases} w_h^P & \text{if P and R both have high output} \\ w_h^P - p & \text{if P has high, R has low} \\ w_l^P & \text{if P has low, R has high} \\ w_l^P - p & \text{if both P and R have low output} \end{cases}$$

The recipient receives w_h^R if she has high output and w_l^R if she has low. The firm can use the ability to punish the provider to satisfy the recipient's IC constraint for high effort, as long the provider's wage net of p does not drop below $\underline{w}$. As figure 3 shows, the firm can use this punishment to satisfy the recipient's IC constraint without the need to raise w_h^R as high as it would need to be absent a referral.

The firm will hire a recipient with $\theta_R < \underline{\theta}_{NR}$ if θ_P is high enough so that the workers' joint output exceeds the wages the firm must pay in order to satisfy IC constraints for both the recipient and provider without dropping either the recipient's wage or the provider's wage net of p below $\underline{w}$.

$$\theta_P + \theta_R + 2(\alpha_h x_h + (1-\alpha_h)x_l) \geq \alpha_h w_h^P + (1-\alpha_h)w_l^P + \alpha_h w_h^R + (1-\alpha_h)(w_l^R - p) \qquad (6)$$

[8] 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 point is that the referral can be beneficial for them both.

where

$$w_h^P \geq w_l^P + \frac{c}{\alpha_h - \alpha_l} \qquad (IC, P)$$

$$w_h^R \geq (w_l^R - p) + \frac{c}{\alpha_h - \alpha_l} \qquad (IC, R)$$

$$w_h^P, (w_h^P - p), w_l^P, (w_l^P - p) \geq \underline{w} \qquad (LL, P)$$

$$w_h^R, w_l^R \geq \underline{w} \qquad (LL, R)$$

$$\alpha_h w_h^P + (1 - \alpha_h) w_l^P + \alpha_h w_h^R + (1 - \alpha_h)(w_l^R - p) \geq \alpha_h w_h(\theta_P) + (1 - \alpha_h) w_l(\theta_P) \qquad (IR)$$

If (6) holds while satisfying IC, IR, and LL constraints given above, then the firm hires the pair. Figure 3 depicts the minimum observable quality recipient $\underline{\theta}_R(\theta_P)$ that can be hired by a provider of observable quality θ_P. This is the would be the recipient of observable quality θ_R for which both worker's LL and IC constraints bind with equality, making 2 also just bind. For $\theta_R > \underline{\theta}_R(\theta_P)$, the competitive labor market implies that the pair will be paid their combined output; otherwise another firm would offer the pair a higher wage that is still below their combined output and the pair would go there.

The joint contract offered to the provider and recipient generates several testable implications about the observable quality and the wages of providers and recipients.

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

2. $Var(w^P|\theta) > Var(w|\theta)$. A provider's wage reflects not just her own output, but the recipient's as well.[9] For proof, see appendix B.2.

3. $E(\theta|hired\ with\ referral) < E(\theta|hired)$. 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. For proof, see appendix B.1.

[9]The proof of this result requires an added assumption that there is a trivial cost to the firm for increasing the distance between w_h and w_l, so that a non-provider's wage is the $w_h(\theta)$ and $w_l(\theta)$ that just satisfy the worker's IC constraint for high effort given in equation (1). 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.

4. $E(\theta|hired\ and\ made\ referral) > E(\theta|hired)$. A firm's scope to punish a provider is increasing in θ, so the higher θ_P, the lower is the minimum $\underline{\theta}_R(\theta_P)$ from that worker. This result is also discussed in appendix B.1.

While the above predictions all apply regardless of whether it is ever profitable to hire workers at low effort, figure 4 shows that if the output from low effort is relatively close to the output at high effort, then sometimes workers who would be prohibitively expensive to hire at high effort are hired at low effort. These workers have observable quality in the region $\underline{\theta}_{NR} \leq \theta \leq \underline{\theta}_{high}$. However, even though these workers would be hired without a referral, the availability of a referral allows the firm to satisfy IC constraints for high effort for some of these workers. In that case, the referral switches them from a flat wage that low-effort workers receive regardless of output to the

$$w_l^R = \underline{w}$$
$$w_h^R = \underline{w} - p + \frac{c}{\alpha_h - \alpha_l}$$

wage offer received by workers with a referral.

5. $Var(w^R|\theta) > Var(w|\theta)$. The firm satisfies R's IC constraint both by punishing the provider and putting a wedge between the recipient's w_l^R and w_h^R, yielding higher wage variance than non-recipients, who receive the same wage regardless of output. For proof, see appendix B.3.

I will also test this prediction in section 6.2.

Due to the assumption of perfectly enforceable contracts between the provider and recipient, the model does not give strong predictions on the wage levels of providers and recipients compared to workers of the same θ who have not given or received a referral. That is, the firm and referral pair are indifferent between various divisions of average wage between the recipient and provider that satisfy the IC and LL constraints.[10]

[10]If contracts between the provider and recipient were not perfectly enforceable–say, there is some probability that the recipient moves away from the bari before repaying the provider for a punishment–then the provider and recipient would have separate IR constraints to participate in the referral. The firm would then need to raise the provider's average wage to higher than it would be before the referral. Given that this constraint is filled, the division of wages between the provider and recipient would depend on the relative bargaining power of each.

4 Data and Summary Statistics

The data for this paper come from a household survey that I conducted, along with Mushfiq Mobarak, of 1395 households in 60 villages in four subdistricts outside of Dhaka, Bangladesh.[11] The survey took place from August to October, 2009. Households with current garment workers were oversampled, yielding 972 garment workers in total in the sample. Each sampled garment worker was asked about her entire employment and wage history, yielding a retrospective panel of a worker's monthly wage and other outcomes in each of her factories, positions, and referral relationships since she began working. Since I know the timing of worker's decisions to leave the labor force temporarily, I can use these decisions as a proxy for the worker's decision to leave the labor force permanently and thus get some idea of whether attrition is an issue in the retrospective panel. I also know how much time workers spent out of the labor force between jobs, so that I can also control for actual experience when constructing measures of a worker's observable skill in the 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 and other communal spaces. The median number of bari members in sampled baris was 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 identity 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 most literally translates as "recommendation." However, given that I do not know 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.

[11] Specifically, Savar and Dhamrai subdistricts in Dhaka District and Gazipur Sadar and Kaliakur in Gazipur District. For use in other projects, 44 of the villages were within commuting distance of garment factories, and 16 were not. Details of the sampling procedure and survey are given in Heath (2011).

The survey form allowed the respondent to name at maximum one referral provider per employment spell.[12]

Table 1 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. 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. I examine whether this holds among the 45 percent of referrals in the sample that are between bari members, which is the sample where I can match provider and recipient. To allow for correlated unobservable types between the provider and recipient and correlated shocks between bari members working at the same time, I exploit two different control groups: the referral pair's wages at times when they are not working in the factory where the referral has taken place, and the wages of bari members working in the same factory at the same time (but between whom there was not a referral). That is, I identify 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?

Specifically, I first obtain 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

[12] 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.

each worker's θ. I also include an industry-wide time trend so that the residuals do not capture differences in wages over time.

$$log(w_{ift}) = \beta_0 + \delta_f + \gamma \times t + \beta_1 experience_{ift} + \beta_2 experience_{ift}^2 + \beta_3 male_{ift} + \beta_4 education_{ift} + \varepsilon_{ift} \quad (7)$$

The residual from this regression $\tilde{w}_{ift}$. Then I run a regression where the unit of observation is the wage residual $\tilde{w}$ of any pair of bari members i and j that are both working in the garment industry at the same time t. Specifically, I regress the $\tilde{w}_{ift}$ of one of the pair on the $\tilde{w}_{jft}$ of the other, and allow the effect of $\tilde{w}_{jft}$ to vary based on whether i and j are in the same factory, whether there has ever been a referral between i and j, and the interaction between $\tilde{w}_{jft} \times same\ factory_{ijt} \times referral_{ijt}$

$$\begin{aligned} \tilde{w}_{ift} = & \gamma_1\ \tilde{w}_{jft} \times same\ factory_{ijt} + \gamma_2\ \tilde{w}_{jft} \times same\ factory_{ij} \times referral_{ijt} \\ & + \gamma_3\ \tilde{w}_{jft} + \gamma_4\ \tilde{w}_{jft} \times ever\ referral_{ij} + u_{ift} \end{aligned} \quad (8)$$

The test for punishment of the provider based on performance of the recipient is $\gamma_2 > 0$ and is valid if the $\tilde{w}_{jt} \times referral_{ijt}$ is uncorrelated with the error term u_{ift}, conditional on the $same\ factory_{ijt}$ and $ever\ referral_{ij}$ terms. That is, the only reason that two members of a referral pair have differentially stronger correlation in wages when they are in the same factory together is due to the referral. One might be concerned that this condition fails due to wage shocks to observable job characteristics within the factory–namely, to production team, position, or machine type. That is, the referral pair may do similar work and a within-factory or industry-wide wage shock to that type of work leads to differentially stronger wage correlation between the bari pair relative to other bari members working in the same factory. For instance, the provider might have trained the recipient to sew using a specialized type of machine and the factory gets a large order that necessitates heavy use of that machine, prompting both the provider and recipient's wages to increase at the same time. To address this concern, I allow for within-factory and industry-wide wage shocks to machine or position by including interactions of $\tilde{w}_{jft}$ and $\tilde{w}_{jt} \times same\ factory_{ijt}$ with indicators for $same\ machine_{ijt}$ and $same\ position_{ijt}$ and verify that the coefficient on $\tilde{w}_{jft} \times same\ factory_{ijt} \times referral_{ij}$ remains positive 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 $\tilde{w}_{jt} \times same\ factory_{ijt} \times referral_{ij}$ in equation 8 to test whether 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). If so, it is unlikely 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 on the same team.

This test requires retrospective wage data in order to compare the wages of a provider and recipient in the same factory to their wages when they are not in the same factory. While using retrospective wage data from current garment workers raises the possibility of attrition bias–if one member of a referral pair drops out of the garment industry then I cannot include their wages here–a very particular 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 strongly correlated than they would without attrition, either the provider or recipient would have to drop out of the labor market when they received a wage shock in the opposite direction of the other. 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.[13]

5.2 Wage Variance

Predictions 2 and 5 pertain to the wage variance of recipients and providers wage, conditional on their observable quality. So I first condition out observable measures of skill by estimating a wage equation for worker i in factory f:

$$log(w_{if}) = \beta_0 + \delta_f + \beta_1 experience_{if} + \beta_2 experience_{if}^2 + \beta_3 male_{if} + \beta_4 education_{if} + \varepsilon_{if} \qquad (9)$$

[13] 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. That is, in a probit regression where the dependent is one if the worker leaves the labor force temporarily in a particular month (conditional on working in the previous month), the wage residual of the recipient has no effect on whether a provider leaves the labor force temporarily, and similarly the wage residual of a provider has no effect on whether a recipient leaves the labor force temporarily.

Since this test does not require past wages that allow multiple observations per worker–unlike in the test for punishment of the provider–I use only current wages in estimating (9) 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 the friends they have referred alone in the factory. I then test whether the squared residual $\hat{\varepsilon}_{if}^2$ (an estimate for wage variance) increases if the worker made or received a referral.

$$\hat{\varepsilon}_{if}^2 = \alpha_1 x_{if}' \hat{\beta} + \alpha_2 \; made \; referral_{if} + \alpha_3 \; referred_{if} + u_{if} \tag{10}$$

I do this test conditional on the worker's fitted wage $x_{ift}'\hat{\beta}$, since many theories of the labor market would predict that wage variance is higher among high-skilled groups (Juhn et al., 1993). 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 3 and 4, which relate to the observable quality (θ in my model) of providers and recipients, I consider separately two measures of skill: experience and education[14]. So for each worker-employment spell, I estimate:

$$educ_{if} = \beta_0 + \delta_f + \beta_1 referred_{if} + \beta_2 made \; referral_{if} + \beta_3 male_{if} + \varepsilon_{if} \tag{11}$$

$$experience_{if} = \beta_0 + \delta_f + \beta_1 referred_{if} + \beta_2 made \; referral_{if} + \beta_3 male_{if} + \varepsilon_{if} \tag{12}$$

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.

[14]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 the work from a pattern rather from than watching it be done.

6 Results

6.1 Punishment of Provider

Table 2 reports results from equation (8), a regression of one bari member's residual wage $\tilde{w}_{it}$ on the residual wage $\tilde{w}_{jt}$ of another bari member working in the garment industry at the same time, and on interactions of $\tilde{w}_{jt}$ with whether i and j were in the same factory, whether there has ever been a referral between i and j, and an interaction between the indicator for same factory and whether there has been a referral between i and j. 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 (8). 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.

To help interpret the regression coefficients, consider three bari members working in the garment industry: P once referred R into factory A-1 Apparel, while C worked at A-1 Apparel at the same time but has not been in a referral relationship with either of them. 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. This positive coefficient is evidence of either correlated unobservable quality or correlated shocks with a bari. The coefficient on $\tilde{w}_{jt} \times ever\ referral_{ijt}$ confirms that the correlation in unobservables or shocks between the referral pair is stronger than between bari members who have not participated in a referral. 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 $\tilde{w}_{jt} \times same\ factory_{ijt}$ 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 $\tilde{w}_{jt} \times ever\ referral_{ijt}$ term to account for

correlated unobservables between the two–yielding a positive coefficient on the variable of interest, $\tilde{w}_{jt} \times referral_{ijt} \times same\ factory_{ijt}$. So if R's wage in A-1 Apparel 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 Apparel versus elsewhere.

Column (2) adds controls for $\tilde{w}_{jt} \times same\ machine_{ijt}$ and $\tilde{w}_{jt} \times same\ factory_{ijt} \times same\ machine_{ijt}$. 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 wage effects lowers the coefficients on $\tilde{w}_{jt}$ and $\tilde{w}_{jt} \times same\ factory_{ijt}$, suggesting that part of the wage correlation between bari members is explained by wage shocks to the type of machine they are using. 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 returns; 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, suggesting that a tendency of referred worked to work in the same position is not driving their wage correlation. 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 the variable $referral_{ijt}$ reported by the participants may not perfectly capture the notion of a referral modeled theoretically, such misclassification would likely bias the $\tilde{w}_{jt} \times referral_{ijt} \times same\ factory_{ijt}$ coefficient towards zero. 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 regression (8), then the wages of the control pairs also reflect wage effects of a referral, and the estimated wage effects of a referral are smaller than they would be otherwise.

6.2 Unexplained Wage Variance

Table 3 gives the results from regression (10), which tests whether the unexplained wage variance–the residual $\hat{\epsilon}_{if}^2$ from a first stage wage regression–varies with fitted wage $x'_{if}\hat{\beta}$ and whether the worker has made or received a referral. Column (1) 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 (2) 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.

6.3 Observable Quality

Table 4 reports results from regressions (11) and (12), 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 the 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.[15] 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

[15]That is, a worker's observable quality is increasing in her position level, and section 2 points out 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.

other garment workers in the same bari. These results confirm that bari members with mid-range values of θ constitute the control group for the referral pairs in equation (8); they are good enough not to need a referral, but not observably good enough to be able to give one.

7 Alternative Explanations

Taken together, my empirical results indicate that the provider's wage reflects the recipient's output and explain that the referral pairs a worker that the firm has leverage over with a worker who might not be hired otherwise. 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.

However, if firms do know more about referred workers upon hiring, there should be evidence that after hiring a firm learns 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 for home temporarily or to another firm, so if a similar pattern holds among workers who drop out of the labor force permanently then turnover is the same between providers and recipients.[16]

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 5 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.[17]

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–the odds ratio on an EPZ dummy in a logit for whether the worker leaves is 0.472 ($P < .001$)–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

[16] An extension of the theoretical model that incorporates a participation decision (Heath, 2011) yields an ambiguous prediction on the average difference in turnover of recipients versus non-recipients. If the provider is currently with the firm, the recipient is more likely to accept her offer than a non-referred worker of the same θ. However a firm is more likely to dismiss a recipient whose provider has left the firm. These patterns are confirmed empirically: the odds ratio for departing the firm for a recipient is 0.529 (P = 0.062), but the odds ratio for departure for a recipient whose provider has left is 1.935 (P = 0.047).

[17] Dustmann et al. (2009) include referrals in a search model which predicts that 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 consistent with the two-period moral hazard model of appendix C, where recipients are more likely to receive wage contracts that offer the potential of wage increases in the second period.

factories. A natural extension to the moral hazard model detailed in this paper would likely 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 distinguish among the many applicants. In fact, 25.0 percent of EPZ workers (vs. 34.5 percent of non-EPZ workers) were referred ($P = 0.012$), 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 solely as a non-wage benefit for existing workers.[18] 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 scarce 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 "fee" for the referral (as reflected in the lowering of the provider's wages) is decreasing in the quality of the recipient.

In this model, however, those workers hired with a referral would always receive the minimum wage, since the firm would actually prefer to pay them less than the minimum. So the wages of referral recipients would certainly not increase with tenure relative to non-recipients. Furthermore, if there is any reason that firms pay better workers more with tenure (for instance, if they build up firm-specific human capital more quickly), then the wages of referral recipients would actually decrease with tenure. This prediction stands in contrast to the two-period moral hazard model presented in appendix C, in which the wages of referral recipients actually rise with tenure in order to provide them incentives for high effort. Table 6 indicates that referred workers' wages do rise with tenure. Using the same time window as in the test for learning (3, 6, or 12 months after hiring), the interaction of a referred dummy with tenure is positive for each choice of window. This

[18] Note that the moral hazard model presented in this paper also contains an element of this type of explanation for referrals: the referral provider might agree to a referral that decreases her current wage, since the recipient will agree to repay her in the future. The question, then, is whether the empirical results could be explained by a model of referrals as a non-wage benefit in an environment where effort is perfectly observable.

result suggests that referral recipients are not merely hired as favors to the referral provider.

8 Conclusion

The results of this paper indicate 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 a provider's wage reflects a recipient's performance. The joint contract allows the firm to hire observably lower skilled workers than it would otherwise hire.

While the empirical work was limited to the garment industry in Bangladesh, there is little reason to believe that firms' potential to use referrals to solve moral hazard is limited to this context. Many labor markets, particularly in the developing world, are also characterized by the high turnover that makes effort difficult to induce using long-term contracts. Anthropological evidence from some of these labor markets points out that referral recipients work hard because their providers are held responsible for their performance, fitting with the model presented here (Grieco 1987; kyung Kim 1987).

Furthermore, the ability of referrals to induce effort is also likely relevant in certain lower skilled labor markets with developed countries. For instance, sociologists have pointed out the tendency of employers of immigrants to hire relatives of existing workers (Suarez-Orozco, 2001). Given the high mobility of immigrants, firms likely would worry that new a new immigrants would remain in a location for long enough to fear the repercussions of low effort in a particularly. However, the presence of a referral provider who is more established in a location can allow the firm to hire newer immigrants.

These 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 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 the referral.

References

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

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

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

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.

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.

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.

Rachel Heath. *Why Do Firms Hire Using Referrals? Evidence from Bangladeshi Garment Factories*. PhD thesis, Yale University, 2011.

C. Juhn, K.M. Murphy, and B. Pierce. Wage inequality and the rise in returns to skill. *Journal of Political Economy*, pages 410–442, 1993.

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.

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.

M.M. Suarez-Orozco. *Interdisciplinary perspectives on the new immigration*. Routledge., 2001.

H. Varian. Monitoring agents with other agents. *Journal of institutional and theoretical economics*, 146:153–174, 1990.

A Firm's Problem, Baseline Case with No Referral

For a worker of a given observable quality θ, the firm can choose between hiring the worker and inducing high effort, hiring the worker but accepting low effort, or not hiring the worker:

$$
\begin{aligned}
\pi = \max\Big(0,\ & \\
& \max \quad \theta + \alpha_h x_h + (1-\alpha_h)x_l - \alpha_h w_h + (1-\alpha_h)w_l \\
& \quad \text{subject to} \quad \alpha_h w_h + (1-\alpha_h)w_l - c \geq \alpha_l w_h + (1-\alpha_l)w_l && (IC) \\
& \qquad\qquad\quad\ \ w_h, w_l \geq \underline{w} && (LL) \\
& \qquad\qquad\quad\ \ \theta + \alpha_h x_h + (1-\alpha_h)x_l = \alpha_h w_h + (1-\alpha_h)w_l, && (zero\ profit) \\
& \max \quad \theta + \alpha_l x_h + (1-\alpha_l)x_l - \alpha_l w_h + (1-\alpha_l)w_l \\
& \quad \text{subject to} \quad w_h, w_l \geq \underline{w} && (LL) \\
& \qquad\qquad\quad\ \ \theta + \alpha_l x_h + (1-\alpha_l)x_l = \alpha_l w_h + (1-\alpha_l)w_l && (zero\ profit)\Big)
\end{aligned}
$$

B Proofs

Proposition B.1. *Workers with $\theta_R < \underline{\theta}_{NR}$ can be profitably hired by the firm if they have a referral from a provider of sufficiently high θ_P.*

Proof.

The firm will only hire a non-referred worker whose θ satisfies the worker's IC without dropping w_l below $\underline{w}$ (thereby paying the worker more than her expected output). Formally,

$$\theta_{NR} + \alpha_h x_h + (1-\alpha_h)x_l \geq \underline{w} + \frac{c\alpha_h}{\alpha_h - \alpha_l}$$

So the minimum θ hired without a referral is:

$$\underline{\theta}_{NR} = \underline{w} + \frac{c\alpha_h}{\alpha_h - \alpha_l} - \alpha_h x_h - (1-\alpha_h)x_l$$

Now suppose a worker has a referral from a provider with $\theta_P = \underline{\theta}_{NR} + \delta$. The minimum θ necessary

for that worker to be hired is:

$$\underline{\theta}_R + \alpha_h x_h + (1-\alpha_h)x_l = \underline{w} - \Big(\underbrace{\underline{\theta}_{NR} + \delta - \alpha_h x_h - (1-\alpha_h)x_l - \frac{\alpha_h c}{\alpha_h - \alpha_l}}_{w_l^P} - \underline{w}\Big) + \frac{\alpha_h c}{\alpha_h - \alpha_l}$$

$$\underline{\theta}_R = \underline{\theta}_{NR} - \delta$$

So for any $\delta > 0$, there will be some range of θ_R accepted below $\underline{\theta}_{NR}$.

If the case in figure 4 applies (some non-referred workers are exerting low effort), then the same reasoning above applies for a recipient who would be hired at low effort without a referral, and the minimum θ_R hired from a provider of $\theta_P + \delta$ is $\underline{\theta}_{high} - \delta$. And some recipients who would not be hired without a referral (even with low effort) can be profitably hired with a referral. Consider a recipient of observable quality $\theta_R = \underline{\theta}_{NR} - \epsilon$. She can be hired if the provider is of high enough observable quality ($\theta_P = \underline{\theta}_{high} + \delta$) so that:

$$\begin{aligned}
&\underline{\theta}_{NR} - \epsilon + \alpha_h x_h + (1-\alpha_h)x_l \geq \\
&\quad \underline{w} - \Big(\underline{\theta}_{high} + \delta - \alpha_h x_h - (1-\alpha_h)x_l - \frac{\alpha_h c}{\alpha_h - \alpha_l} - \underline{w}\Big) + \frac{\alpha_h c}{\alpha_h - \alpha_l} \\
&\underline{w} - \alpha_l x_h - (1-\alpha_l)x_l - \epsilon + \alpha_h x_h + (1-\alpha_h)x_l \geq \\
&\quad \underline{w} - \Big(\underline{w} + \frac{\alpha_h c}{\alpha_h - \alpha_l} - \alpha_h x_h - (1-\alpha_h)x_l + \delta - \alpha_h x_h - (1-\alpha_h)x_l - \frac{\alpha_h c}{\alpha_h - \alpha_l} - \underline{w}\Big) + \frac{\alpha_h c}{\alpha_h - \alpha_l} \\
&\delta \geq \epsilon + \frac{\alpha_h c}{\alpha_h - \alpha_l} - (\alpha_h - \alpha_l)(x_h - x_l)
\end{aligned}$$

So for any $\epsilon > 0$, if δ is high enough to satisfy the above inequality, the referral will be profitable. Notice that this result also implies that providers have on average higher values of θ than other hired workers, since the higher θ_P, the lower is the $\underline{\theta}_R(\theta_P)$ needed for the referral to be accepted.

□

Proposition B.2. $Var(w^P|\theta) > Var(w|\theta)$

Proof. Without a referral, the wage distribution of a worker of observable quality θ_P will be:

$$w = \begin{cases} \theta + \alpha_h x_h + (1-\alpha_h)x_l + \frac{(1-\alpha_h)c}{\alpha_h - \alpha_l} & \text{with probability} \quad \alpha_h \\ \theta + \alpha_h x_h + (1-\alpha_h)x_l - \frac{\alpha_h c}{\alpha_h - \alpha_l} & \text{with probability} \quad 1-\alpha_h \end{cases}$$

yielding variance $\alpha_h(1-\alpha_h)\frac{c}{\alpha_h-\alpha_l}$ If this worker gives a referral, then she will receive some punishment p (whose level depends on the θ_R) if the recipient has low output. Her observed wage distribution will then be:

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

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. □

Proposition B.3. *If there is a range of workers who are hired but with low effort, then for these workers* $Var(w^R|\theta) > Var(w|\theta)$

Proof. Consider a worker with observable quality θ_R, where $\underline{\theta}_{NR} \geq \theta_R \geq \underline{\theta}_{high}$. That worker will be hired with a referral and given incentives for high effort if her output net of wages after satisfying an IC for high effort is positive

$$\theta_R + \alpha_h x_h + (1-\alpha_h)x_l \geq \underline{w} - \left(\theta_P - \alpha_h x_h - (1-\alpha_h)x_l - \frac{\alpha_h c}{\alpha_h-\alpha_l} - \underline{w}\right) + \frac{\alpha_h c}{\alpha_h-\alpha_l}$$
$$\theta_R \geq 2(\underline{w} + 2\frac{\alpha_h c}{\alpha_h-\alpha_l} - \alpha_h x_h - (1-\alpha_h)x_l) - \theta_P$$

which is true for θ_P sufficiently high. The value of θ_P which satisfies the above with equality would then yield a punishment p of

$$\begin{aligned} p &= 2(\underline{w} + \frac{\alpha_h c}{\alpha_h-\alpha_l} - \alpha_h x_h - (1-\alpha_h)x_l) - \theta_R - \frac{\alpha_h c}{\alpha_h-\alpha_l} - \underline{w} \\ &= \underline{w} + \frac{\alpha_h c}{\alpha_h-\alpha_l} - \theta_R - \alpha_h x_h - (1-\alpha_h)x_l \end{aligned}$$

We know this p is below the $\frac{c}{\alpha_h-\alpha_l}$ needed to satisfy R's IC constraint with $w_l^R = w_h^R$:

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

which is true because R would have been hired without the referral, so $\theta_R + \alpha_l x_h - (1-\alpha_l)x_l \geq \underline{w}$, implying that $\theta_R + \alpha_h x_h - (1-\alpha_h)x_l \geq \underline{w}$ as well. So $w_l^R < w_h^R$ for some accepted referrals, and thus $Var(w^R|\theta) > Var(w|\theta)$. □

C Two-Period Model

The baseline model in section 3 is the simplest set-up that illustrates the moral hazard problem faced by firms, explains how referrals can serve to improve firms profits, and yields testable predictions on the observable quality and wages of providers and recipients. However, its timing of wage offers do not correspond to the reality faced by workers in most industries throughout the world. Namely, rather than receiving a menu of wages depending on output (as in the baseline model), workers receive a initial salary, with the potential for wage increases if they perform well. In this section, I show that predictions of the one period model all apply in a two period model where firms must offer first period wages before first period output is observed.

Specifically, the set-up is the same as the one-period case in section 3 except that there are two periods of production and there is a non-negativity constraint on wages: firms cannot lower wages in between periods 1 and 2. If firms offer workers a sufficiently high enough wage in period 2 after a high outcome is observed in period 1, then workers will exert high effort in period 1. So the firm offers a wage offer $\{w_1, w_{2h}, w_{2l}\}$, where the worker receives w_{2h} after high output in period 1 and w_{2l} after low output in period 1, and the IC constraint for high effort becomes:

$$w_{2h} \geq w_{2l} + \frac{c}{\alpha_h - \alpha_l}$$

And firms find it optimal to give incentives for high effort as long as production from one period of high effort and one period of low is greater than both the wage it would have to pay to provide incentives for high effort (given that w_1–and thus w_{2l}–must be at least $\underline{w}$) and the output net of wages it would get if the worker worked at low effort both periods:

$$2\theta + \alpha_h x_h + (1-\alpha_h)x_l + \alpha_l x_h + (1-\alpha_l)x_l \geq 2\underline{w} + \frac{c\alpha_h}{\alpha_h - \alpha_l} \tag{13}$$

So the minimum θ hired without a referral is:

$$\underline{\theta}_{NR} = \underline{w} + \frac{1}{2}\Big(\frac{c\alpha_h}{\alpha_h - \alpha_l} - (\alpha_h x_h + (1-\alpha_h)x_l + \alpha_l x_h + (1-\alpha_l)x_l)\Big) \tag{14}$$

Now suppose a worker has a referral from a provider with $\theta_P = \underline{\theta}_{NR} + \delta$. The minimum θ necessary for that worker to be hired is:

$$\begin{aligned}
&2\underline{\theta}_R + \alpha_h x_h + (1-\alpha_h)x_l + \alpha_l x_h + (1-\alpha_l)x_l \\
&\quad = 2\underline{w} - \Big(2(\underline{\theta}_{NR} + \delta) + \alpha_h x_h + (1-\alpha_h)x_l + \alpha_l x_h + (1-\alpha_l)x_l - \frac{\alpha_h c}{\alpha_h - \alpha_l} - \underline{w}\Big) + \frac{\alpha_h c}{\alpha_h - \alpha_l} \\
&\underline{\theta}_R = \underline{\theta}_{NR} - \delta)
\end{aligned}$$

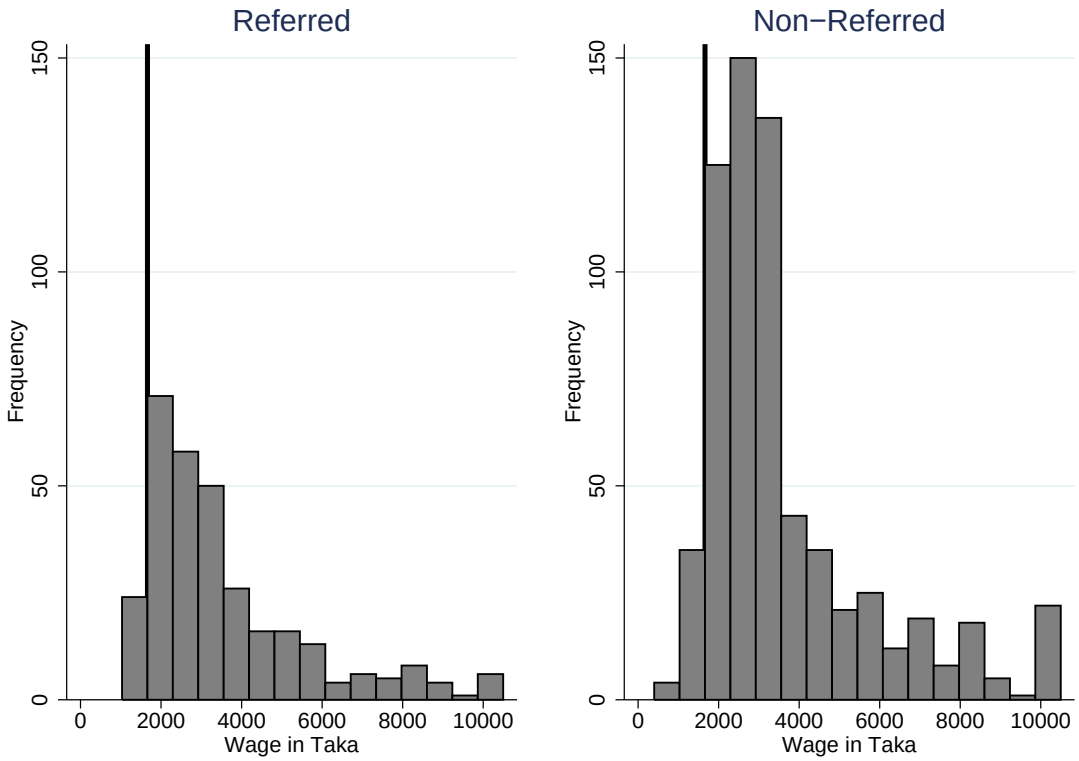
So for any $\delta > 0$, there will be some range of θ_R accepted below $\underline{\theta}_{NR}$.

Suppose now that some workers are hired at low effort. That is, there is a range of θ below the value of $\underline{\theta}_{NR}$ given in (14), but where:

$$2\theta + 2\alpha_l x_h + 2(1-\alpha_l)x_l \geq 2\underline{w} \tag{15}$$

Take a θ_R in this range, by the same reasoning above, high output is profitable as long as the firm has a referral from a worker with sufficiently high θ_P.

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



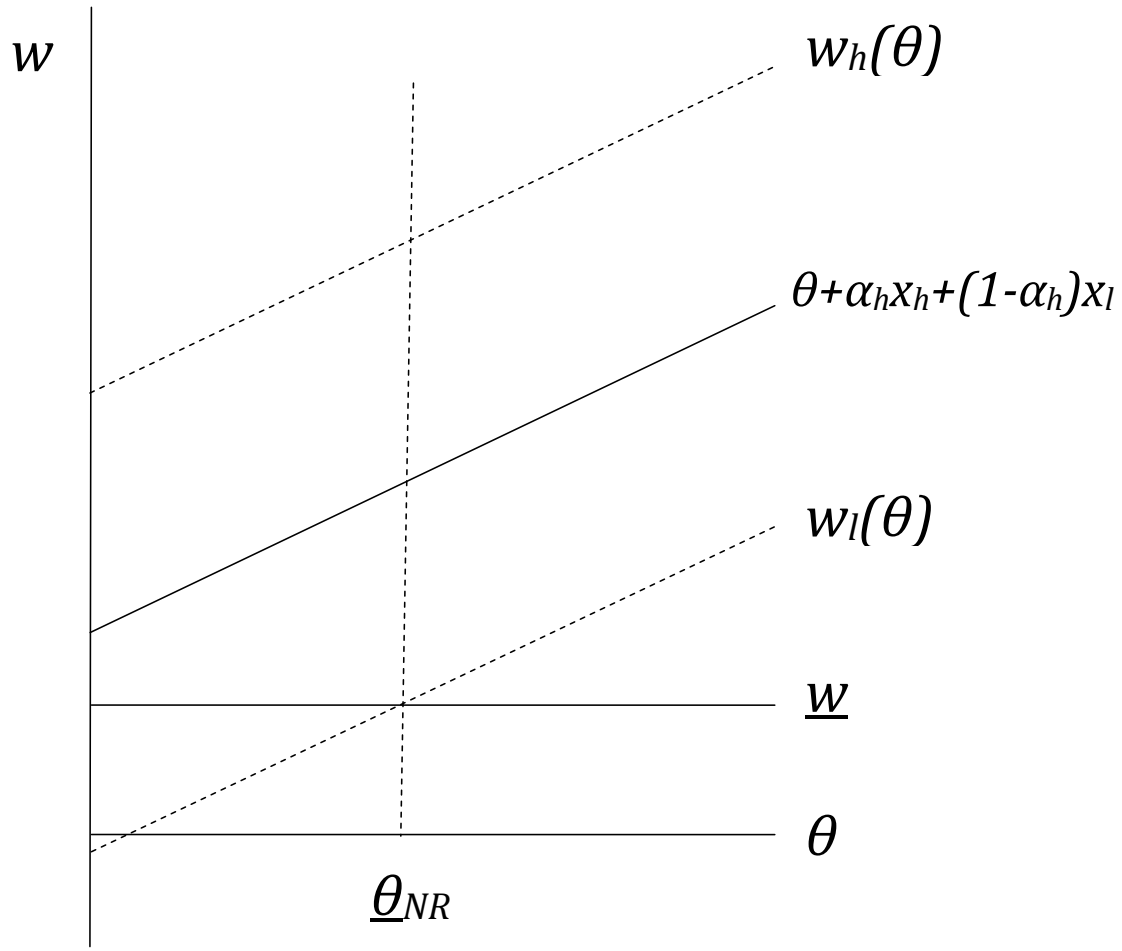


Figure 2: Wages, observable quality, and hiring

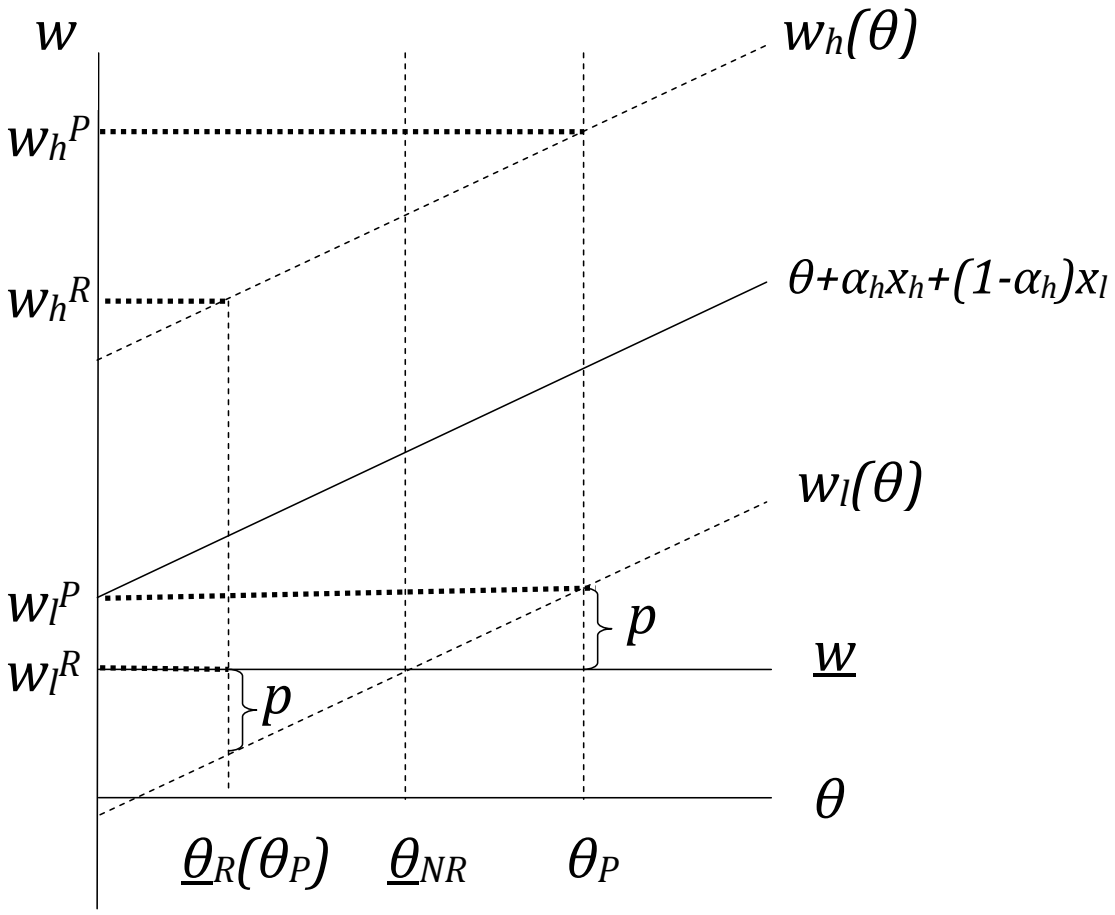


Figure 3: Joint wage contract offered to provider and recipient

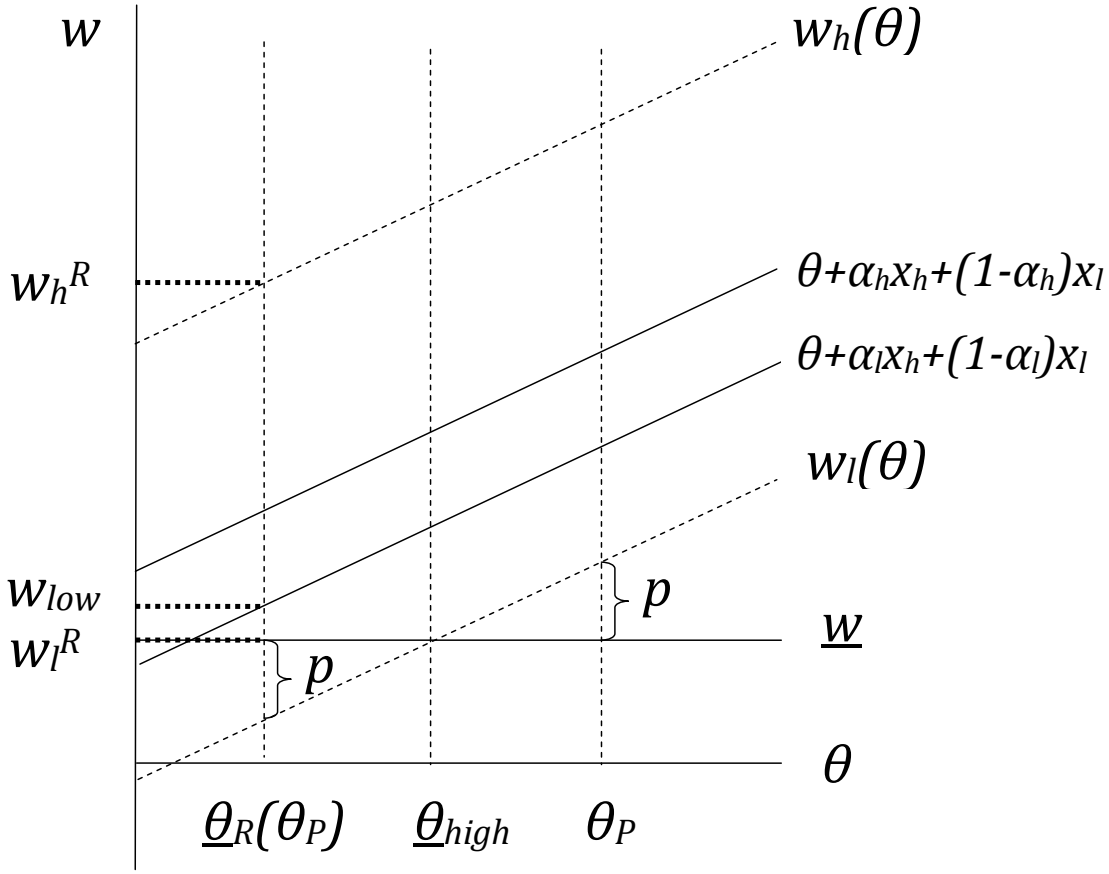


Figure 4: Recipient at high effort vs. non-recipient at low effort

Table 1: Summary Statistics, Recipients, Providers and Other Workers

	recipient	provider[a]	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
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) Workers who both received and gave referrals appear in both of the first two columns.
(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 maneuvers that she knows

Table 2: 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]	
$\tilde{w}_{jt} \times same\ factory_{ijt} \times same\ team_{ijt}$				-0.1602
$\times referral_{ijt}$				[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 $\tilde{w}_{ift}$ of a bari member and the wage residual $\tilde{w}_{jft}$ of another bari member working in the garment industry in the same month. Residuals are from the first stage wage regression given by equation 7

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 3: Unexplained variance, providers and recipients

Dependent Var: $\hat{\epsilon}_{if}^2$ from first stage wage regression		
	(1)	(2)
$x'_{if}\hat{\beta}$	0.0490***	0.0570***
	[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
Observations	939	939
R-squared	0.023	0.026

*Stars indicate significance: *** p<0.01, ** p<0.05, * p<0.1. The dependent variable is a worker's squared wage residual from equation 9, which is then regressed on the worker's fitted wage $x'_{if}\hat{\beta}$ from the same regression, along with dummy variables for referred and made referral.*

Table 4: 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; Unit of observation is a worker-factory spell.*

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 5: 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 6: Wages with tenure

Dep. Var. is log(wage)			
Time since hired	3 months	6 months	12 months
referred	-0.0602**	-0.0583*	-0.0387
	[0.029]	[0.032]	[0.044]
tenure	-0.0027*	-0.0020	-0.0011
	[0.001]	[0.001]	[0.001]
tenure×referred	0.0049*	0.0052**	0.0038***
	[0.003]	[0.002]	[0.001]
Observations	7375	10715	13917
R-squared	0.282	0.270	0.303

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

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