LABOR-TYING AND POVERTY IN A RURAL ECONOMY: EVIDENCE FROM BANGLADESH*

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Abstract

I show that labor-tying is an important channel through which the poor in rural Bangladesh insure themselves against risks. Using a theoretical framework adapted from Bardhan (1983), I analyze the effects of an exogenous increase in the outside options of poor women (through an improvement in their self-employment opportunities) on their and their spouses' participation in tied labor, as well as the general equilibrium effects of the treatment on the terms of the labor contracts in the village. I find that treated women and their spouses are less likely to be in tied-labor contracts. Their wages increase through two channels: (a) due to the switch from tied to casual labor contracts (b) through the general equilibrium effects in the village labor market. Furthermore, I find that the treated households form reciprocal transfer links with wealthier households in the village. These findings imply that poor households may be involved in second-best labor contracts to insure themselves against risks. When their self-employment opportunities improve, they break these ties and move to greater reliance on reciprocal transfer arrangements.

Keywords: tied labor, poverty, rural labor market.

JEL Classification: J43; O12; I32.

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1 Introduction

In rural labor markets, a tied-labor contract involves a long-term relationship between an employer and a worker where the employer provides a steady but low wage to the worker (relative to a casual labor contract that offers a high wage rate during the harvest season). The role of labor-tying on terms of labor contracts has been studied extensively in theoretical studies (Bardhan (1983), Eswaran and Kotwal (1985), Mukherjee and Ray (1995)) and the empirical prevalence of tied-labor has been shown, particularly in South Asia[1] (Bardhan and Rudra (1978)). In developing countries where poor households face substantial amounts of risk and limited insurance opportunities, labor-tying is likely to be an important channel through which they smooth their income, hence their consumption[2] (Morduch (1995)). Yet recent empirical studies have mainly focused on other mechanisms of consumption-smoothing such as informal insurance and pre-cautionary savings[3]. Using survey data that I helped to collect in Bangladesh, I show that tied-labor is an important mechanism through which poor workers smooth their consumption. Furthermore, I test the effects of an experiment that increases the expected income of the poor women living in rural Bangladesh on their involvement in tied labor. In particular, I show that an exogenous improvement in the outside option of poor workers decreases their participation in tied-labor, and allows them to enter labor contracts with higher return but higher income volatility. This change in the level and composition of labor supply within the village has different general equilibrium effects on the returns to tied and casual labor in the male and female labor markets within the village. Finally, I provide evidence that suggests that the treated poor households are changing the mechanisms through which they smooth their consumption. In particular, the households that are exogenously made wealthier are less likely to engage in tied-labor arrangements, but more likely to form reciprocal transfer links with other villagers. Taken all together, the findings show that as poor households (exogenously) get richer, they move from second-best labor contracts (that yield a low return but insure them against risks) to higher yielding yet riskier income generating activities, accompanied with reciprocal transfer arrangements that help smooth their consumption.

In order to formalize the incentives of workers and employers in entering tied-labor arrangements, I adopt the risk-sharing model of labor-tying developed by Bardhan (1983) where a risk-

[1]The existence of tied-labor arrangements have been documented in a variety of settings such as Germany, Egypt, Brazil and Japan in economic history and modern-day empirical studies (Anderson(1990), Lewis and Barnouw (1958), Bhalla (1976), Richards (1979), Smiths (1959)). These types of labor arrangements are often characterized by dependency of the worker on the employer in terms of credit, housing and labor opportunities, in turn receiving a lower wage.

[2]The role of implicit insurance in labor contracts is not limited to rural labor markets in developing countries. The idea that a risk-neutral employer may provide a risk-averse worker with insurance against income fluctuations dates back to Knight (1921). Baily (1974) and Azariadis (1975) model the contractual relationship of the employer-worker as an implicit contract model where the entrepreneurs provide insurance to risk-averse workers; and more recently Guiso et al. (2005 and 2010) show that risk-sharing plays an important role on the wage-profile of workers, depending on the degree of financial development in the economy. I contribute to this literature by showing that a similar relationship between an employer and a worker exists in tied labor contracts in rural labor markets and analyzing how an exogenous improvement in the outside option of the worker changes the terms of her labor contracts.

[3]Key mechanisms highlighted in the literature include reciprocal exchange of loans and gifts (e.g. Udry (1994), Fafchamps and Lund (2003)) and pre-cautionary savings (e.g. Paxson (1992), Rosenzweig and Wolpin (2003)).

averse worker enters into a tied labor arrangement with a risk-neutral employer in order to smooth her income during the lean and peak seasons. Alternatively, the worker can choose to settle down for her expected outside option, which will be a function of her wealth and vulnerability (proneness to risks). The model assumes that tied workers and casual laborers are perfect substitutes in the farm production function during the peak season. Hence, the employer's only incentive in offering tied-labor contracts is to ensure supply of cheap labor during the peak season. In equilibrium, it will be the poorest and most vulnerable workers that enter into tied-labor contracts, while better-off workers will choose to remain self-employed and work for the employer as a casual worker whenever the realized village market wage rate exceeds their expected outside option. This automatically implies that casual workers will receive a higher wage rate on average.

I use this theoretical framework to test the effects of an exogenous increase in the outside option of poorest workers on their participation in tied labor and on the terms of labor contracts in the village economy. The exogenous variation I exploit is the randomized roll-out of the "ultra-poor" program in Bangladesh. The "ultra-poor" program was pioneered by BRAC[4] and targets the poorest women living in villages. It involves a combination of a large asset transfer (livestock or trees), enterprise training and weekly visits by program officers to ensure that the treated females are able to generate income from the assets that they receive. In short, the program improves the self-employment opportunities of treated women. The data used in this paper comes from the randomized evaluation of BRAC's ultra-poor program that I helped carry out in Bangladesh. The program identifies the poorest females living in rural villages, who are often landless laborers. They rely primarily on finding work as agricultural daylaborers or maids, and on the transfers they receive from the rest of the community. This is a setting where seasonal fluctuations in wage earnings are very significant (see Figure 1) and a large proportion of the targeted poor households enter into tied-labor contracts that provide a smoother income profile but lower average wage.

The theoretical model gives the following predictions with respect to an exogenous shock to the outside options of the poorest workers in the economy:

1. In partial equilibrium (assuming there is no effect on the returns to tied or casual labor)

   (a) Treated workers will be less likely to be working for a wage. This depends on two things: (i) whether the amount of increase in the outside option of the treated worker is large enough (ii) the initial level of the outside option of the worker.

   (b) Conditional on remaining in wage-employment, treated workers will be less likely to be in tied-labor contracts and more likely to be in casual labor contracts.

2. In general equilibrium, depending on how the program affects the aggregate distribution workers' outside options, wages for both tied and casual laborers may increase. In that case, the threshold level of outside option below which workers enter into tied contracts also increases.

[4]BRAC, formerly known as Bangladesh Rural Advancement Committee, is the world's largest NGO with operations in Bangladesh and other parts of South Asia and Africa.

3. A corollary of prediction (2) is that the effect of the program on whether treated workers remain in wage-work and the type of contracts they enter will be ambigous in general equilibrium. The direct effect on their outside options and the GE effects through the labor market have opposing effects on their labor market participation.

4. Finally, if workers are matched assortatively by their outside options in reciprocal transfer arrangements, then treated workers will be more likely to enter reciprocal arrangements with wealthier workers to smooth their consumption. This will increase their likelihood to switch from tied to casual labor contracts.

In order to test the predictions of the model empirically, I make use of two key characteristics of the evaluation strategy: First, in order to identify tied and casual workers empirically, I use data on the identity of workers' employers and their food transfer links. The data is unique in the sense that for every business activity that the respondents were engaged in, they were asked to report the identity of their employer and as long as the employer was within the same village (as the respondent), their household id number was recorded. Similarly, respondents were asked to identify the most important 3 households they would borrow food from at times of need. Using these two pieces of information, I can identify which employers were also a borrowing source for the worker: 25% of the poor workers report their employer as a source of food transfers in times of need. I show that this definition of tied labor contracts also correlates with having lower average wage rate and lower wage volatility, in line with the definition of tied labor contracts in the theoretical framework[5].

Second, in order to identify the direct effects of the program on the treated households and the indirect spillover effects on non-treated households via the labor market, I make use of the fact that the program was randomized at the village level and the sample includes both treated and non-treated workers in treatment and control villages. Comparison of treated workers in treatment villages to those workers that were selected for treatment but were not treated in control villages (henceforth "selected workers") allows me to identify the direct effect of the program plus any indirect general equilibrium effects. By comparing the non-treated workers in treatment villages to the relevant group of workers in control villages, I identify the general equilibrium effects of the program on the rest of the community.

I start by analyzing the effects of the program on the treated women. I find that the program has a negative impact on the participation of treated females in the female labor market in the village. They are 5% less likely to be working for another household in the village at followup

[5]Classification of agricultural laborers into categories of "attached" and "casual" is common practice in India. This classification was adopted in the First (1950-51) and the Second (1956-57) Agricultural Labor Enquiries. Yet the distinction between attached and casual laborers was often not clear (see Thorner (1956) and Raj (1962) for criticism of the ambiguous distinctions between attached and casual workers in the Agricultural Labor Enquiries of India). Bardhan and Rudra (1978) use village survey data from different parts of India to show that consumption loans play a big role in labor tying. In 61 to 92 per cent of the cases from different parts of India, tied workers (whom Bardhan and Rudra (1978) refer to as "farm servants") report taking consumption loans from their employers. This is in line with the definition of tied labor I use in my empirical strategy where I identify tied labor contracts as the ones in which the employer is a source of transfers for the worker at times of need.

relative to comparable females in control villages. This suggests that there is an overall fall in the labor supply in the female labor market in the village. In line with prediction 2, conditional on being in wage employment, treated females are 5% less likely to be in tied-labor contracts. Hence there is a greater fall in the supply of tied female workers relative to casual workers. Furthermore, this suggests that the direct effect of the program on the outside options of treated women is larger than the indirect GE effects through the labor markets.

Next, I test predictions 1 and 2 on the spouses of treated females. Although the program is targeted to females, male members of the treated households are also likely to be affected by the increase in the self-employment opportunities of their spouse. At the same time, labor markets are highly segmented by gender in this setting, thus the GE effects of the program are likely to be different on the male and female labor markets[6]. In fact, I find no effect on the participation of male workers living in treated households in wage employment. On the other hand, conditional on being in wage-employment, males in treated households are 8% less likely to be in tied-labor contracts.

In order to test prediction 3 on the GE effects of the program, I use the sample of non-treated female workers. Women in non-treated households do not experience the direct increase their outside options through the program, but will be affected by any GE effects through the female labor market. I find that the hourly wage rate of non-treated female workers who live in treatment villages increases by 16% relative to its baseline level and relative to control villages. Further examination of this effect shows that the increase is coming from casual workers' wages, while the workers that are in tied labor contracts do not experience any increase in their wage rate. The latter finding is not in line with prediction 3, which predicts an increase in tied-labor wage rate as well as an increase in casual labor wage rate. Moreover, there is no effect on the proportion of non-treated female workers who are in tied contracts, which suggests that the program had no impact on the threshold level for tied contracts.

In order to test GE effects on the male labor market, I restrict the sample to male workers living in non-treated households. There is a small positive effect on the wage rate of non-treated male workers: their hourly wage increases by 4%. Further examination shows that this effect is coming mainly from an increase in the wage rate of males under tied-labor contracts. Their average hourly wage increases by 12%, while the effect on wages of casual laborers is only 2% and imprecisely estimated. This is in line with previous findings on the type of labor contracts of treated men: the program lowers the aggregate supply of tied male workers in the village, putting a pressure of the male tied wage rate. There is no similar effect on the male casual labor.

Finally, in order to test prediction 4 on the involvement of treated workers in reciprocal transfer arrangements, I construct measures of wealth and reciprocity of their food exchange links. I find

[6]The male and female labor markets in this setting are rather distinct. In conjunction with findings of Foster and Rosenzweig (1996) in rural India, males are more likely to be involved in physically-demanding jobs, while females often work in jobs that require less physical strength, such as sowing seeds, taking care of livestock, working as a maid etc. Furthermore, hourly wage rate for males is much higher compared to that of females (average wage rate for a male worker is 59% higher at baseline relative to a female worker). Due to these reasons, I analyze the effects on male and female labor markets separately.

that treated households form food exchange links with households that are on average 5% wealthier (wealth measured at baseline so that any effect of the transfers of the program are not included). This implies that an exogenous increase in the income of an agent allows her to form food exchange links with richer households[7]. Furthermore, I find that the treated households are more likely to engage in reciprocal transfers with other households where they reciprocate food transfers in times of need with transfers out to their neighbors (a greater proportion of their food borrowing links are reciprocated by food lending). This suggests that as poor agents get wealthier (in this case by having better opportunities in self-employment and thus higher income in a given period) they change the mechanism through which they smooth their consumption: they switch from entering low-return occupations that yield a low but steady income to informal insurance mechanisms where they exchange transfers with other households.

A striking finding is that although the supply of both male and female tied workers is decreasing as a result of the treatment, only the returns to male tied labor is increasing significantly while the returns to female tied labor is unchanged. I provide evidence on two alternative mechanisms that may explain while the demand elasticity for female tied labor may be lower than that for the male tied labor: First, I consider the availability of substitutes for male and female tied labor in employer households. I find that female members of employer households that hired tied female workers at baseline spend significantly more time doing household chores at followup, which suggests that the employers are substituting hired female tied labor with female family labor. Descriptive statistics show that female household members in employer households work fewer hours relative to the male household members (less than 50% on average). This implies that the opportunity cost of time for female family labor is lower in employer households relative to that of male family labor. As a result, employer households are more likely to substitute female tied workers with household labor, but may choose not to do so for male tied workers. This would explain why the elasticity of demand for male tied workers is lower compared to that for female tied workers.

Second, it is likely that there is a differential importance of non-wage benefits for tied female workers relative to the males. Women in rural Bangladesh often face difficulty accessing services that require them to interact with others in social spaces (there is a large sociological literature on the institution of "purdah" in South Asia that tries to prevent women from being seen by men). As such, women are more likely to need their employer's assistance to guarantee access to services in institutions such as the health centers, markets, courts etc. I find that conditional on visiting a list of such institutions, female tied workers were significantly more likely to receive assistance from others at followup. This potentially implies that the female tied workers receive better assistance

[7]Genicot (2006) proves that under heterogeneity in permanent income and limited commitment, positive assortative matching can be stable. Fafchamps and Gubert (2007) find that the wealth difference between two households (as well as age and geographic distance) is negatively correlated with whether two households have a risk-sharing link with each other. De Weerdt (2004) carries out a similar analysis using data from a village in Tanzania, but finds that difference in wealth (particularly livestock value) increases the probability that either of two households report one another as someone they can rely on in times of need. Attanasio et al. (2009) show in an experimental set-up that individuals with similar risk attitudes and those that are connected via family links are more likely to form risk-sharing groups with each other. I contribute to this literature by showing that an exogenous increase in the income of an agent makes him/her more likely to enter into reciprocal exchange links with wealthier agents.

from their employers in accessing services. If such assistance is part of the compensation from a tied-labor contract, then instead of receiving a higher wage rate (like the male tied workers) they may be receiving a higher level of assistance from their employers.

The rest of the paper is organized as follows: Section 2 presents the theoretical framework and the implied predictions for the study at hand. Section 3 describes the setting of the study, the intervention and the characteristics of the data. Section 4 presents the empirical findings. Section 5 concludes.

2 Theoretical Framework

In this section, I use the simple risk-sharing model[8] of tied-labor based on Bardhan (1983) to derive predictions on the effects of the ultra-poor program[9]. I extend the model to an infinite-horizon setting, in order to allow for comparability with reciprocal transfer arrangements a la Coate and Ravallion (1993). The theoretical framework provides predictions on both the direct and the general equilibrium effects of the program through the village labor market. These predictions will be tested empirically in section 4.

3 Set-up

Preliminaries: There are two types of agents in the economy: a continuum of size $N > 1$ of landless workers and a unit measure of landowners who employ labor. Time is infinite with periods alternating between two stylized "seasons". Every even numbered period, $t = 0,\ 2, 4...$, is a fallow season in which there is no cultivation and hence no employment opportunities for workers. Every odd numbered period, $t = 1, 3, 5..$ is a peak season with demand for labor on the employer's farm. Workers and landowners discount the future at common rate $\beta \in (0, 1)$.

Landowners: Production is stochastic with the labor requirement for each landowner in a peak season in period t being $L_t = A_t x$ where x is the land owned by each employer. All employers are assumed to be identical in their land holdings. The realization of A_t is stochastic and has finite support on $\left[0, \bar{A}\right]$ with (right continuous) distribution function $F(A)$. The shock is perfectly

[8] See Ghatak (2010) for a simple expository version of Bardhan's (1983) model.

[9] In this study, I adopt the Bardhan (1983) framework, however the results would be similar under an efficiency wage approach similar to Eswaran and Kotwal (1995). The key distinction between the two models is that in Eswaran and Kotwal (1995) a tied labor contract provides greater total utility through giving the worker a long-run steady income and employers use tied labor contracts to give incentives to workers in tasks where effort is harder to monitor. As I do not observe the productivity of individual workers, I can not test directly whether the assumptions of the Eswaran and Kotwal (1995) model hold in the data. I test whether tied workers receive higher total utility in terms of income, pce and calories consumed and find no significant difference between tied and casual workers.

correlated across all landowners within a season but iid over time.

Workers: There are N workers in the village economy. Worker i's lifetime utility is given by

$$E\sum_{t=0}^{\infty}\beta^t u(c_t^i), \quad \forall i \in \{1,...,N\} \tag{1}$$

where u is increasing, twice continuously differentiable and strictly concave.

Workers differ in their outside options, which I will interpret as their self-employment opportunities in this context[10]. The outside option of each worker is stochastic and depends on the state of the world that is realized in period t. If the state of the world in period t is "good", the worker receives a payoff y^i. However, with probability p_k the state of the world is "bad" and the worker receives 0. Hence each agent is index by (i,k). p_k is indexed such that higher k means higher p_k so that $0 < p_1 < p_2 < ... < p_N < 1$. p_k can be interpreted as the vulnerability of the worker where a higher p_k implies that the worker is more prone to risks. This implies that the expected utility of worker (i,k) in autarky (self-employment) will be: $(1-p_k)\cdot u(y^i) + p_k \cdot u(0)$. Without loss of generality, I normalize $u(0) = 0$ so that the expected outside option of agent (i,k) is $(1-p_k)\cdot u(y^i)$. Let $\widetilde{y}_k^i$ denote the expected outside option of agent (i,k) so that $\widetilde{y}_k^i = (1-p_k)\cdot u(y^i)$. Furthermore, I assume that the cumulative distribution function of $\widetilde{y}_k^i$ amongst the agents is given by $G(\widetilde{y}_k^i)$.

Equilibrium concept: In each productive season, the wage is competitively determined by the forces of supply and demand. A stationary competitive labor market equilibrium is a wage function $W(A)$ such that labor demand and labor supply are equated for each realization of $A \in \left[0, \bar{A}\right]$. Each worker and landowner takes the function $W(A)$ as given and optimizes accordingly. In equilibrium, workers and landowners beliefs about $W(A)$ are fufillled, i.e. there are rational expectations.

4 Labor Demand

A landowner can offer two types of contracts to his workers: tied-labor contracts and casual-labor contracts.

In a tied-labor contract the employer pays a fixed amount z every period to the worker, while the worker in exchange commits her labor to the employer in both peak and lean seasons (i.e. she

[10]More generally, any source of income that is alternative to working for the employer is part of the outside option of the worker. For example, opening up of a factory that employs the workers at a steady wage in both seasons would yield to a similar increase in the outside options of the workers as an increase in their self-employment opportunities.

cannot pick up any alternative employment opportunities while she's in a tied labor contract).

In a casual labor contract the employer will have to pay the competitively determined wage rate $W(A)$ which depends on the realized productivity shock.

Let ℓ_t be the number of tied laborers hired by the landowner. The net profit of the employer in each peak-season period will be given by:[11]

$$\pi_t = \left\{ \begin{array}{cc} A_t x - z\ell_t & if\ A_t x \leq \ell_t \\ A_t x - z\ell_t - (A_t x - \ell_t) \cdot W(A_t) & if\ A_t x > \ell_t. \end{array} \right\} \tag{2}$$

The decision to hire tied laborers is made ex ante, before the realization of A. Since the landowner's problem is stationary, this will be fixed over time.

Thus

$$\ell^* \in \arg\max_{\ell \geq 0} \left\{ \frac{\beta}{1-\beta^2} x - \frac{z\ell}{1-\beta} - \frac{\beta}{1-\beta^2} \int_{\frac{\ell}{x}}^{\overline{A}} (Ax - \ell) W(A) \cdot dF(A) \right\}. \tag{3}$$

Note that the landowner is taking the spot wage function $W(A)$ as given. The first order condition for (3) yields:

$$\frac{z}{1-\beta} = \frac{\beta}{1-\beta^2} \int_{\frac{\ell^*}{x}}^{\overline{A}} W(A) \cdot dF(A) \tag{4}$$

This gives the time invariant demand for tied labor, ℓ^*, given wages z and $W(A)$. The latter will be determined in market equilibrium.

5 Labor Supply

Workers decide whether to enter into a tied-labor contract or to remain self-employed at date 0.

If worker (i,k) enters into a tied labor contract with a landowner, she receives z in every period from the landlord, in return to committing her labor to the employer in both peak and lean seasons (i.e. she is bound not to undertake any alternative employment opportunities while she's in a tied labor contract).

If she chooses to remain self-employed, then she can choose to work for the employer (under a casual contract) in any peak period where the realized spot wage rate $W(A)$. She will choose to do this only when this wage exceeds her expected outside option $\widetilde{y}_k^i$. We assume that the productivity shock A_t is realized before the worker makes her decision between being a casual worker or remaining self-employed[12].

[11] Note that in the case when $Ax \leq L_t$, (2) implies that the employer may make a loss in a given peak-season period. This is because his decision on how many tied workers he will hire is based on his lifetime profits. The number of tied workers he hires/pays for need not yield non-negative profits in a given period, if the realization of A is too low.

[12] Note that workers are heterogenous *ex ante* in terms of their expected outside options, but once they decide to enter into a labor contract (either tied or casual) with the employer, they are homogenous as the marginal product of each worker is the same. This *ex post* (conditional on entering into the labor market) homogeneity of workers is

In order to simplify the analysis, I make the following assumption:

Assumption 1: There are no alternative insurance mechanisms available for the workers so that any worker (i,k) that doesn't enter tied-labor is forced to self-insure.

I will relax Assumption 1 further on by considering reciprocal transfer arrangements among workers.

Workers whose expected outside options satisfy the following inequality will choose to enter into tied-labor contracts:

$$\frac{u(z)}{1-\beta} \geq \frac{\widetilde{y}_k^i}{1-\beta^2} + \frac{\beta}{1-\beta^2} E[\max\{\widetilde{y}_k^i, u(W(A))\}] \tag{5}$$

where expectations on the right hand side are taken with respect to A. The left-hand side of (5) is the life-time utility from entering tied-labor. Alternatively, during every even numbered period (lean season) she receives her expected outside option, $\widetilde{y}_k^i$, and in every odd numbered period she may choose to work as a casual laborer if the realized spot market wage rate (W) is higher than her expected outside option. As long as the expected utility from self-employment ($\widetilde{y}_k^i$) satisfies (5) in period 0, it will be optimal for the worker to enter a tied-labor contract and to remain a tied worker thereafter.

The level of $\widetilde{y}_k^i$ that satisfies (5) with equality will be denoted as $\widehat{y}$. This will depend on labor market conditions as expressed by the payment for tied labor, z, and the wage function for casual labor $W(\cdot)$.

The supply of workers who want to be in tied-labor contracts (henceforth "tied workers") is then given by all those whose outside option is below this critical threshold. This defines labor supply into tied labor as:

$$S = NG(\widehat{y}) \tag{6}$$

As with the demand for tied labor this is time invariant.

6 Equilibrium in the Labor Market

The equilibrium wage function can now be determined using a fixed point argument based on equating labor demand and labor supply for tied labor along with the decision of non-tied laborers to be self-employed or casual laborers.

Given any wage function and value of z, we must have that:

$$NG(\widehat{y}) = \ell^*$$

However, both sides of this depend on the shape of the wage function $W(A)$ which is determined ex post. We now turn to this.

the economic intuition behind imposing equal c and $W(A)$ levels for any tied and casual worker respectively.

Consider any peak season ($t = 1, 3, 5...$). There are two cases to consider.

If $A_t x \leq \ell^*$, there is no demand for casual workers in the spot market and the casual wage falls to zero. Thus $W(A) = 0$ for all

$$A \leq \frac{NG(\widehat{y})}{x}$$

In this case, spot workers earn their outside option y.

Now consider what happens when $A_t x > \ell^*$. In this case, there is positive demand for spot labor. However, the market wage needs to clear the labor market. Suppose that $W(A) > u^{-1}(\widehat{y})$. Then the wage must solve:

$$A_t x - \ell^* = N\left[G\left(u\left(W\left(A\right)\right)\right) - G\left(\widehat{y}\right)\right] \tag{7}$$

or:

$$W(A) = u^{-1}\left(G^{-1}\left(\frac{A_t x - \ell^*}{N} + G\left(\widehat{y}\right)\right)\right) \tag{8}$$

Thus:

$$W(A) = \begin{cases} u^{-1}\left(G^{-1}\left(\frac{A_t x - \ell^*}{N} + G\left(\widehat{y}\right)\right)\right) & \text{if } Ax > \ell^* \\ 0 & \text{otherwise.} \end{cases} \tag{9}$$

(Observe that $W(A) > u^{-1}(\widehat{y})$ as hypothesized.)

Now we can solve for the equilibrium. Using (4), (5), (7) and plugging in $\ell^* = NG(\widehat{y})$, we have that

$$\frac{z^*}{1-\beta} = \frac{\beta}{1-\beta^2}\int_{\frac{NG(\widehat{y})}{x}}^{\bar{A}} W^*(A) dF(A) \tag{10}$$

$$\max\{0,\ A_t x - NG\left(\widehat{y}\right)\} = N\left[G\left(u\left(W^*\left(A\right)\right)\right) - G\left(\widehat{y}\right)\right] \tag{11}$$

$$\frac{u\left(z^*\right)}{1-\beta} = \frac{\widehat{y}}{1-\beta^2} + \frac{\beta}{1-\beta^2}\left[F\left(\frac{NG(\widehat{y})}{x}\right)\widehat{y} + \int_{\frac{NG(\widehat{y})}{x}}^{\bar{A}} u(W^*(A)) dF(A)\right] \tag{12}$$

This gives three equations in three unknowns: $\widehat{y}$, z^* and $W^*(A)$. It is the properties of these equations which are of interest.

7 Comparative Statics

In this section, I consider the effects of an exogenous increase in the outside options of a group of workers at the bottom of the distribution (of outside options) in the village (such as the ultra-poor program). At the individual level, the program shifts the outside option of treated worker upwards. At the aggregate level, it potentially changes the shape of the distribution function $G(.)$.

First, in partial equilibrium (assuming that z, $W(A)$ and $\widehat{y}$ remains unaffected), the rise in the outside option worker (i, k) implies that her labor supply into wage work may be affected in two different ways: (i) If the program moves her outside expected outside option above the utility from casual wage-work, $u(W(A))$, she will choose to remain self-employed and not enter into any

type of wage-work. (ii) If she was employed in a tied contract, she may switch to a casual contract instead, if the program moves her outside option above $\widehat{y}$ but below $u(W(A))$. Both of these effects will be more likely for workers that had higher expected outside option to start with.

Of course in general equilibrium, the shift in the distribution of outside options of workers in the economy may lead to a change in the wage level(s) and the threshold level to enter into tied contracts. To analyze this, I consider the effect of a second order stochastic shift in the distribution of outside options. Thus, I index the distribution function by λ where:

$$\left\{ \begin{array}{ll} G_\lambda(y;\lambda) \leq 0 & if\ y \leq \widetilde{y} \\ G_\lambda(y;\lambda) \geq 0 & if\ y \geq \widetilde{y} \end{array} \right\} \tag{13}$$

for some $\widetilde{y} \in (0, \overline{y})$. Figure 3 demonstrates the effect of λ on the distribution of outside options graphically. The line AB corresponds to the distribution of outside options before the shift, and $A^{'}B$ to the distribution after the shift.

We are interested in the effect of a shift λ of the form (13) in the distribution of outside options, $G(.)$, on the equilibrium levels of $W^*(A)$, z^* and $\widehat{y}$.For simplicity, I assume that A_t is always high enough so that the spot labor market is active. This implies that the first term in (11) will always be non-zero. In practice, casual contracts are abundant in the harvest season, hence focusing on this is not a far-streched assumption.

Proposition 1 *If* $u(W(A)) \leq \widetilde{y}$ *then* $\frac{dW}{d\lambda} \geq 0$, $\frac{dz}{d\lambda} \geq 0$ *and* $\frac{d\widehat{y}}{d\lambda} \geq 0$.

Proof. See Appendix A. ■

Proposition 1 implies that as long as the highest outside option among treated workers was at least as large as the utility from casual employment, the shift in distribution of outside options will lead to an increase in wage rates in both tied and casual contracts. If $u(W(A)) \leq \widetilde{y}$, then the aggregate impact of the program lowers the supply of both treated and casual workers, which leads to a rise in wages of both types of workers. Figure 3 demonstrates this. On the other hand, if $u(W(A)) > \widetilde{y}$, this is not necessarily the case. The increase in tied and casual wage rates has opposing affects on the threshold level $\widehat{y}$. Proposition 1 implies that the final effect is a rise in the threshold level.

Corollary 2 *The total effect of the program on participation of treated workers in both tied and casual labor is ambigous. If any treated workers switch from tied to casual contracts, they are likely to be those that had higher outside options to start with.*

Corollary 1 follows immediately from proposition 1 and the previous discussion on partial effects of the program. The increase in the outside option of treated workers induced by the program implies that (in partial equilibrium) they will reduce their labor supply into wage-work, and will be likely to quit tied contracts for casual ones. On the other hand, the GE effects of the program imply that the rise in casual wage rate will increase the attractiveness of wage-work for treated workers. Moreover, the resulting increase in $\widehat{y}$ implies that it is not clear whether any

treated workers will make the transition from tied to casual contracts. However, if any treated workers make this transition, it will be the ones that had higher outside options and hence were closer to $\widehat{y}$ to start with.

To summarize, the predictions of the model on key variables are as follows:

Prediction 1: In partial equilibrium:

(i) Treated workers will be less likely to be working for a wage.

(ii) Treated workers will be less likely to be in tied-labor contracts and more likely to be in casual labor contracts. Treated workers that had higher outside options and thus were closer to $\widehat{y}$ to start with will be more likely to make the transition from tied to casual employment.

Prediction 2: In general equilibrium, wages for both tied and casual laborers may increase. In that case, the threshold level of outside option below which workers enter into tied contracts will also increase.

Prediction 3: A corollary of prediction (2) is that the effect of the program on whether treated workers remain in wage-work and the type of contracts they enter will be ambigous in general equilibrium.

Until now, the outside option of worker (i, k) was assumed to be self-insurance. In other words, if worker (i, k) does not enter a tied-labor arrangement, then her consumption is determined by her individual income alone. In practice, there may be alternative mechanisms that the workers can engage in to smooth their consumption (e.g. formal insurance, pre-cautionary savings, reciprocal transfer contracts with other villagers etc.). As long as the access of worker (i, k) to such alternative mechanisms is increasing in her outside option (i.e. self-employment opportunities), the predictions of the model will be reinforced. For example, if workers with higher outside options can insure themselves better by purchasing formal insurance from an NGO, then they will be less likely to enter into tied-labor contracts relative to workers with low outside options. An increase in outside option of poor workers will enable them to switch from tied-labor to casual labor more readily as they will now be able to insure themselves against the risks associated with a casual labor contract by purchasing formal insurance.

An important alternative mechanism that has received a lot of attention in the literature is informal insurance (Coate and Ravallion (1993)) where agents may enter into reciprocal transfer arrangements with one another. Kocherlakota (1996) and Ligon et al (2002) derive the terms informal insurance contracts under limited commitment where any contract has to be ex post preferred by the agent to autarky. Genicot (2006) extends the analysis to allow for heterogeneity in permanent income (or wealth) of agents and shows that depending on the type of correlation between the income shocks received by the agents, positive assortative matching may be stable in equilibrium.

In terms of the model outlined above, allowing for workers to enter reciprocal transfer arrangements will increase their outside options and make tied-labor less attractive. However, if workers are matched assortatively so that workers with higher incomes choose to enter into reciprocal transfer arrangements with richer workers, the effect of reciprocal transfer arrangements on the outside options of workers will be decreasing in the outside option of the workers (i.e. poorer workers will not be able to insure themselves as good as the rich workers via informal insurance mechanisms). In this case, the predictions of the model will be the same as before.

Prediction 4: Effect on Insurance Arrangements - If workers are matched assortatively by their outside options in reciprocal transfer arrangements, an increase in the outside option of worker (i, k) will enable her to enter into reciprocal transfer arrangements with wealthier workers and increase her expected utility from such contracts. As a result, treated workers will switch from tied-labor to reciprocal transfer arrangements.

If workers are matched assortatively by their outside options in reciprocal transfer arrangements, then treated workers will be more likely to enter reciprocal arrangements with wealthier workers. Having richer partners implies the expected outside option of the worker during the lean season will be even higher - both because their individual outside option is improved by the program and they can sustain reciprocal transfer arrangements with wealthier partners. Hence their likelihood to switch from tied to casual labor contracts will be even higher than in the case where outside option is limited to self-insurance.

8 Data description

8.1 Setting of the Study and Survey Design

The data used in this study comes from a data collection exercise implemented in order to evaluate the effects of BRAC's ultra-poor program in Bangladesh. BRAC's ultra poor program is a multi-faceted package that aims to lift the poorest women in rural Bangladesh out of poverty. It combines asset transfer, skills training, weekly support visits, a savings scheme, health support, and training on legal, social and political rights[13]. The most important aspect of the program is to transform the self-employment opportunities of treated households. In order to do so, the program combines a large asset transfer, with enterprise training and weekly visits by BRAC officers to ensure that the beneficiaries are able to generate income from the assets that they receive.

I started working with BRAC in 2006, thinking about how to look at the ultra-poor program and its effects on the livelihood of the poor households in rural Bangladesh. The evaluation strategy was designed to exploit the roll-out of the program across the country. The timing of the roll-out was randomly chosen at the branch office level. A branch office covers a large area with a radius of approximately 4km. The ultrapoor program determined 40 branch offices that would implement the ultra-poor program. Standard procedures to identify who would be the

[13]see Table B4 in Appendix B for details of the program.

beneficiaries of the program were carried out in all these branches in the same way. Following the identification of potential beneficiary households, 20 branch offices were randomly selected to receive the program in 2007, the rest in 2011. All villages in treatment branches were treated in 2007.

In order to identify the poorest females in rural Bangladesh, the program carries out a detailed procedure: First, prior to asset transfer, the program identifies a village, or cluster of households that form a natural geographical unit. These villages consist of 387 individuals that live in 90 households on average[14]. There are 1409 such villages in the sample.

The program carries out a participatory wealth ranking exercise in every village during which the community allocates every household in the village into 5-6 wealth ranks. For the purpose of the current study, I aggregate these wealth ranks into 3 groups: the bottom rank (henceforth "the poor"), the middle classes and the top wealth rank. After further assessment of their demographic and economic characteristics, the program selects roughly half of the households in the bottom wealth rank to be treated while the rest of the poor remain untreated based on certain pre-determined criteria[15]. This selection procedure and all the steps of identification outlined above were carried out in the same way in treatment and control villages.

In every village that was part of the study, an initial census of all households was carried out between April 2007 and January 2008. This census allows me to identify the identity as well as wealth, occupation, education and demographic characteristics of all the households that live in any village that is part of the study. This is an essential component of my identification strategy, as it allows me to identify characteristics of every household that the respondent interacts with within the village.

Following the census of all households in the village, a detailed questionnaire was carried out on a smaller sample that included all poor households and a random sample of the rest of the village. Households in this sample were surveyed at baseline (between April 2007 and February 2008) and two years after (January-December 2009). The poor households eligible for treatment were selected at the same time in both treatment and control branches, using the same method outlined above. The only difference between them is that the poor in treated branches receive the assets immediately whereas the poor in control branches will receive them in 2011. Selected households and non-selected households in treatment and control villages were not significantly different in terms of observable characteristics at baseline. (Balancing tables that show the normalized differences of key characteristics of poor households in treatment and control

[14]Due to the high population density in rural Bangladesh, "village"s in administrative terms are often contiguous. The villages as defined by the program and used in this study are smaller than an administrative village, but they form a natural social and economic unit. For example, when respondents were asked to report up to 3 households they would borrow food from if they ever faced food shortage in their household, on average 93 percent of the links they reported were within the same cluster that was defined by the program

[15]There are three exclusion criteria, all of which are binding. Households who are already borrowing from an NGO providing microfinance, who are recipients of government anti-poverty programs, who have no adult women in their members, are excluded from the program.To be selected a household has to satisfy three of the following five inclusion criteria: (i) total land owned including homestead is not more than 10 decimals; (ii) there is no adult male income earner in the household; (iii) adult women in the household work outside the homestead; (iv) school going-aged children have to work; and (v) the household has no productive assets.

villages by selection status are provided in Appendix B.)

The survey questionnaire measures a rich set of individual outcomes, including occupational choices, income and expenditure, business and household assets, health, business skills, and empowerment. It also contains questions on social and economic networks of the household, related to each outcome. The main survey modules were directed towards the main female in the household, as the program is targeted towards women. In cases where the main female was different from the household head, the household head was also surveyed for the business activities and land modules.

Respondents are asked to list all the households they interact with in each of the surveyed activities, thus for instance in the business activities module, the respondent lists all the households he/she works for. For respondents that reported employing other households, only one worker was reported per business activity. This implies that for employment links I can identify all employers of worker households, but I can not identify all workers of employer households. That is why for the majority of the results that follow, I will be considering the effects of the program from the workers' perspective.[16]

Food exchange is a very important form of interaction in this setting. At baseline, more than 90% of the poor households report receiving food transfers from other households at times of need. The question used to identify the food transfer links is the following: "Does your household ever borrow/lend rice or other food items from/to other households?" If the answer to this question is "yes", the respondent is asked "If you *had to* borrow food from another household, who would be the main 3 households her household would normally ask for rice or other food items"[17]. Furthermore, the respondents were asked whether they were expected to pay back the amount of food borrowed (or whether they expected to receive to be repayed for the food they have lent to others). 78% reported that returning the food was state-contingent (i.e. depended on whether they could), 9% said they would return the food borrowed whenever they could and the rest said they did not have to return it. This shows that these types of relationships are mainly state-contingent, similar to informal insurance links reported for loans by Udry (1994). Moreover, 99% of the respondent said they never had to pay interest for these food borrowing transactions.

8.2 Characteristics of Selected Poor at Baseline

Table 1 gives summary statistics on the key characteristics of the selected poor households and the rest of the village at baseline. Column (1) provides the descriptive statistics for the poor households that were selected to be beneficiaries of the program, column (2) for the other poor households that were ranked at the lowest wealth rank by the community but not selected by the program, column (3) for the households that were ranked in the middle wealth ranks (between

[16]The respondents also reported any links they have in terms of family, land, credit, asset sales and transfers. Only 15% of selected-poor households reported having loans in cash from other households and 5% reported renting land from others. The two types of interactions that were most important for the selected-poor households were food exchange and employment links.

[17]This method of identifying informal insurance partners is commonly adopted in the literature. For examples see Fafchamps and Lund (2003), De Weerdt and Dercon (2006), Barr and Genicot (2007)

the lowest and the top rank) and column (4) for the wealthy households chosen to be in the top wealth rank by the community. The first row in Table 1 provides the wealth (defined as total value of household assets including land, livestock, other productive assets and household durables) of households in each wealth rank. As a reality check, one can see that the community's grouping of the villagers into wealth groups matches with the relative wealth of households in each rank. Strikingly, the poor that were selected by the program have on average 42 percent as much wealth as the households chosen as poor by the community but not selected by the program (henceforth the "non-selected poor"). Their total per capita expenditure is also lower than the non-selected poor.

As mentioned above, one of the selection criteria that increases the likelihood of being a beneficiary of the program is to not have a working male member in the household. Corresponding to this, row 3 in Table 1 shows that only 58% of the selected-poor households had male households heads. This increases to 77% for the non-selected poor and nearly 100% for the wealthier classes. Further examination shows that 75% of female-headed households were widowed and 19% were divorced or separated from their husband. Of the remaining, only 5% were actually married and living with their spouse. It's not easy for a once-married woman to re-marry in this setting, so this shows that being a female-headed household is not a choice but more likely to be a consequence of some event that happened in the past and is likely to have important consequences for the livelihood of these households. Descriptive statistics provided in Table B1 in Appendix B show that female-headed poor households have significantly lower wealth, fewer working age household members and lower human capital (education and health) measures compared to the male-headed poor households[18].

Table 1 also shows that the selected-poor households are more likely to be working for another household at baseline relative to higher wealth ranks (74% of the selected poor do so, as opposed to 67% for non-selected poor and 40% for middle classes). Conditional on working for another household, 49% of the time their employer is a household that lives in the same village. The rest either migrates temporarily to different parts of the country or works for an employer nearby but outside the village. As I will be analyzing employment relationships within a village only, this implies that the results presented will be based on half of the employment links that the poor have. As such, they should be interpreted as an analysis of employment contracts within a village, and not as an analysis of the universe of employment contracts available. The types of jobs that the poor are involved in are limited. Women either work as a maid or as an agricultural laborer and men work mainly as agricultural laborers, at times working as day-laborers in non-agricultural tasks (such as construction work).

Finally, Table 1 also shows that 93% of the selected poor households report receiving food transfers at times of need from other households. The proportion of respondents that report

[18]Drèze and Srinivasan (1997) show that the correlation between being female-headed and the poverty level of the household is very sensitive to controlling for economies of scale (i.e. small household size). They show that per capita expenditure measures of poverty are not significantly different between male and female headed households, but for a *given* household size and child-adult ratio female-headed households have lower per capita expenditure than male-headed households.

having to borrow food from others diminishes by wealth class of the respondent to 83% for middle class and only 42% for the top class. This implies that informal support networks are very important for the poor's livelihood and the rich are more likely to have alternative mechanisms for smoothing their consumption. The next row shows the proportion of respondents that report ever giving out food transfers. Only 44% of the poor report giving out food transfers, implying that more than half of their food borrowing links are *not* reciprocated by food lending. In fact, only 37% of their food borrowing links are reported as also food lending links at baseline. This suggests that the poor households are likely to be reciprocating food borrowing through other channels, potentially through their labor contracts. The final row in Table 1 shows that the poor are not nearly as able as the rich to smooth their consumption. When asked "Is your household able to afford at least 2 meals a day", only 42% of the selected poor households responded "Yes" while the corresponding figure was 54% for the non-selected poor, 81% for the middle class and 97% for the top class households.

8.3 Labor Contracts of The Poor

In order to identify tied labor contracts I look at the overlap between employment and food borrowing links. 25% of the selected-poor report one or more of their employers as a food borrowing source in times of crisis. This decreases to 23% for the non-selected poor and to 15% for the middle class households. For the rest of the analysis I define all employment contracts where the employer is reported as a food borrowing source at times of need as a "tied-labor" contract, and all other employment relationships as a "casual-labor" contract. This definition corresponds to the tied-labor contracts in the theoretical framework in section 2 where the employer acts as an insurance provider. Furthermore, to empirically test whether the fact that the worker reports the employer as a source of food transfers correlates with other characteristics of the contract, I look at the following correlations: (1) the correlation between reporting an employer as a borrowing source and the average wage received from employers (2) the correlation between reporting an employer as a borrowing source and the volatility of the wage earnings.

In order to test the first correlation at baseline, I regress the average wage rate received by any worker in the household on a dummy variable for whether any worker in the household was in a tied-labor contract, controlling for the wealth and human capital measures of the household, the wealth rank of the employer, and demographic characteristics of worker's household. Table 2 provides the results of this regression. Households in tied labor contracts have on average 4.5% lower earnings per hour (calculated by dividing total earnings by total hours spent working). In column (2) of Table 2, the dependent variable is the daily wage[19] that the worker receives, which shows a very similar correlation. The measure of earnings used in columns (1) and (2) are the

[19]As part of the survey questionnaire, the respondents were asked to report the total income and total hours spent on any activity during the past year. In addition to that they were asked to report the daily wage they received on a typical day. The dependent variable in column (1) of Table 2 is the ratio of total income from wage employment to total hours spent in wage employment, while the dependent variable in the second column is the daily wage received on a typical working day.

total of earnings in cash and in kind. Next, I examine the correlation of being in a tied contract with earnings in cash and in kind separately. As tied workers are likely to receive more transfers from their employers, I expect being in a tied contract to be positively correlated with earnings in kind and negatively with earnings in cash. The results provided in columns (3) and (4) of table 2 confirms this: the coefficient of "tied worker" in column (3) of Table 2 shows that being in a tied labor contract is correlated positively with earnings in kind. On Average, a tied worker has 26% higher daily wage in kind compared to a casual worker. On the other hand, column (4) shows that being a tied worker is correlated negatively with earnings in cash. On average, tied workers earn 28% lower daily wages in cash. In total their daily wage is 4.2% lower than that of casual workers.

In order to test the correlation between being in a tied-labor contract and the volatility of wages, I use the following information: the respondents were asked to report for each business activity whether their earnings varied across the year and if so which months were the months of minimum and maximum income. For the months of minimum/maximum earnings, they were asked to report the level of earnings. Using this information, I construct monthly total earnings from wage employment and estimate:

$$y_{it} = \alpha + \beta \text{tied}_i + \delta \text{season}_t + \lambda \text{tied}_i \times \text{season}_t + \gamma' X_{it} + \epsilon_{it} \tag{14}$$

where the dependent variable is log average earnings of respondent i from wage employment in season t, $tied_i$ is a dummy variable for whether the respondent was in a tied-labor contract and $season_t$ is a dummy variable for whether the season was a peak season, lean season or neither. As Figure 1 demonstrates, months 2 and 8 are the two harvest seasons therefore they are defined as the peak season, months 5, 6 and 7 are defined as lean season and the rest as "normal" season. The coefficient δ gives the difference between wage earnings of the respondent in each season relative to the normal season and the coefficient λ gives the differential change in wages of tied workers in that season. Table 3 provides the results of this estimation. As expected, monthly wage earnings are higher and lower during the peak and lean seasons respectively, relative to the normal season. This is so for both female and male wages. Female workers in tied contracts earn 41% more during the lean season relative to casual workers. This correlation is precisely estimated at conventional levels. Similarly male workers in tied contracts earn 25% more during the lean season, but this is imprecisely estimated. These correlations show that, in line with the characteristics of a tied-labor contract in the theoretical framework, workers that have tied labor contracts according to my empirical definition have lower wages on average, yet they have smoother wage income profiles.

9 Empirical Analysis

To test whether the effects of the program are in line with the predictions of the model presented in section 2, I use the following identification strategy:

$$y_{it} = \alpha + \beta T_i + \delta R_t + \lambda T_i R_t + \gamma' X_{it} + \epsilon_{it}, \tag{15}$$

where y_{it} is outcome of interest for household i in period t, $T_i = 1$ if household i lives in a treated village and $= 0$ if they live in a control village, $R_t = 1$ after the program and 0 otherwise. The parameter of interest is λ, the difference in difference between treatment and control before and after the program. The standard errors are clustered at the village level in all the regressions[20]. Under the identifying assumption that the control villages represent a valid counterfactual for the treated villages in the absence of the program, namely that trends in all outcomes of interests are the same in treatment and control, λ identifies the causal effect of the treatment.

9.1 Direct Effects on Treated Women

I start by testing the effects of the program on the beneficiaries that are directly affected by the treatment, that is the main female respondent in treated households. I start by testing **prediction 1(i)**, on labor supply of treated women into wage employment. In order to do so, I restrict the sample to the treated women in treatment villages, and women that were selected as beneficiaries by the program in control villages (who will be treated in 2011). Hence the estimate for λ gives me the difference-in-difference estimate for the direct effect of the program on treated women. Table 4 provides the results where the estimates for the coefficient of interest λ are given in the row "treat × post". Column (1) shows that females in treated households are 5% less likely to be working for another household in the village after the treatment, relative to control households. This effect is significantly estimated at conventional levels. Column (2) of Table 4 shows that females in treated households work on average 72 hours less per year for other households. This effect is precisely estimated at conventional levels and corresponds to a 22% decrease in the hours spent in wage employment by selected poor females. These findings imply that the labor supplied for wage employment by treated females is decreasing, both on the extensive and the intensive margins.

Next, I test **prediction 1(ii)** on the participation of treated women in tied versus casual labor. Column (1) in Table 5 shows that conditional on being in wage employment (i.e. sample restricted to females that report working for another household within the village in either survey wave), treated females are 5% less likely to be in a tied-labor contract. This implies that supply of labor

[20] I cluster the standard errors at the village level due to two reasons: First, the employment links I analyze are formed within the village hence the terms of the labor contracts of workers from the same village are likely to be correlated. Second, the descriptive statistics imply that food exchange links are formed almost entirely (more than 90% of the time) within the same village. Therefore not adjusting the standard errors for correlations at the village level may lead to a large bias in the standard errors.

by treated females into tied labor contracts is falling [21].

In order to test whether the change in the terms of treated women's labor contracts is in line with them switching from tied to casual labor contracts, I analyze the change in the wage rate and the volatility of the earnings of treated women. In order to identify the effect of the program, I estimate difference-in-difference specifications similar to (15) above, and in order to identify the differential changes in contracts of tied vs casual workers I estimate heterogenous diff-in-diff specifications where I use "whether a worker was in a tied contract at baseline" as the interaction term. More specifically, the specification I estimate for the heterogenous effects is:

$$y_{it} = \alpha + \beta_1 T_i + \beta_2 R_t + \beta_3 Z_{i0} + \beta_4 T_i Z_{i0} + \beta_5 R_t Z_{i0} + \lambda_1 T_i R_t + \lambda_2 T_i R_t Z_{i0} + \gamma' X_{it} + \epsilon_{it}, \qquad (16)$$

where y_{it}, T_i, R_t and X_{it} will be the same as in (15) and Z_{i0} will be whether the female respondent in household i was in a tied-labor contract at baseline. The parameters of interest are now λ_1 and λ_2: λ_1 will be the difference in difference between treatment and control households with $Z_{i0} = 0$ before and after the program; λ_2 will be the additional effect of the program on those households with $Z_{i0} = 1$. The estimates for $\lambda_1 + \lambda_2$, the total impact of the program on households with $Z_{i0} = 1$, are also reported[22].

Column (2) of Table 5 shows that the wages of female workers after the program are higher. The difference in difference estimate for treated female workers is 0.72 and significant, which corresponds to a 16% increase in the wages of treated women who work for other households in the village. Column (3) shows that this effect is similar for both casual and tied workers. The wage rate for women in casual labor contracts increases by 0.57 Takas per hour, while the wage rate for tied workers increased by 0.95 Takas per hour. The difference between the two is not significantly estimated. Since the wage rate is observed only for those women who report working for a wage, these effects on the wage of treated women could be the result of two different effects: (1) The fall in the supply of female workers in the village could lead to an increase in the wage level, as predicted by the model (2) It could be that the women who decide to stay in wage employment are the ones who had higher wages to start with and therefore the difference-in-difference estimate is positive and significant. In order to determine which of these two channels the effect is coming from I will focus on the effects on non-treated poor females[23] in Section 4.3.

Next, I analyze the effect on the "volatility" of wage earnings. The measure of volatility that I use is the ratio of minimum to maximum monthly earnings of the respondent from wage employment, so a smaller value means higher volatility. Results in column (4) of Table 5 show that the ratio of minimum to maximum monthly earnings decreases by 0.03, which implies that the volatility of earnings is increasing for treated females. However this effect is imprecisely estimated.

[21] The result is the same when I run the same regression on the full sample of selected-poor women, coding the dependent variable to 0 if the respondent is *not* working for any household in the village. The difference-in-difference estimate in this case is -0.02 and significant, which implies that there is a significant fall in the incidence of tied-labor among treated women.

[22] The estimates for β_3, β_4, β_5 and γ' are not reported for brevity.

[23] If it is the case that the estimated effect on wages of treated women is due to the second channel, then there should be no effect on the wages of non-treated women

Column (5) of Table 5 shows that the effect of volatility of wage earnings is higher for women in tied contracts. The differential effect on women who were in tied contracts at baseline is -0.03, which is consistent with them switching to casual contracts. These effects on the labor contracts of female workers is in line with them switching from tied to casual labor contracts and with the program having GE effects on the female labor market. Following discussion in section 4.3 on the effects on contracts of non-treated females (who experience any GE effects through the labor market, but are not affected by the direct effect of the program on their outside options) will shed light on the relative magnitude of these two channels.

In the following discussion, I will analyze the heterogeneity of these effects on treated women. The second part of **Prediction 1(ii)** predicts that the direct effect of the program should be higher for women that face lower risks in their outside options, i.e. for women with lower p_k. A good proxy for this is the gender of the household head. Female-headed households are likely to have higher vulnerability (higher p_k)) as they have fewer income-earning members in the household and any negative shocks to their health or to their business activity will have a greater cost. For example, if p_k is a function of q where q is the probability that any one of the working-age members will receive a negative health shock and will not be able to work in period t, then the probability that there will be no working age member available in period t will be q^n where n is the number of working age members in the household. If the asset transferred is associated with a production function that requires at least one person to take care of the asset (which is likely to be the case with typical assets transferred such as livestock or trees) then female-headed households that have fewer working age members will be more prone to risks to their outside option. Hence they may choose to stay in tied employment even though they receive the same asset transfer as male-headed households.

Table 6 presents the results for treated females who live in female-headed households (Panel A) and male-headed households (Panel B). Column (1) shows that the effect on being in tied-labor as opposed to casual labor is very different for the two types of households. Females in male-headed households are 9% less likely to be in tied labor after the treatment. This effect is precisely estimated at 5% significance. On the other hand, the effect for female-headed households is insignificant and in the opposite direction. This implies that females in male-headed households switch from tied to casual employment more readily than females where they are the head of the household. This is in line with the intuition explained previously, where female-headed households face greater risks and therefore choose to stay in tied employment. The increase in the expected outside option of treated women in female-headed households is not enough to move them above the threshold level to terminate tied-labor contracts.

Looking at the wages of females in female vs male headed households (column (2) of Table 6), both types of households experience a significant increase in their wages. However column (3) shows that the effect on the wages of treated women in male and female-headed households comes through different channels. Column (3) in Panel A shows that females in female-headed households have higher wages in both casual and tied labor contracts (the increase is smaller for those in tied labor but the difference between the increase in tied and causal labor is insignificant).

On the other hand, Panel B shows that the increase in wages of females in male-headed households is coming mainly from those that were in tied labor at baseline. This implies that the effect for the latter group is due to them switching from tied to casual labor contracts. The results on volatility confirms this: The volatility of wage income for females in female-headed households does not change (Panel A, Column (5)), while the volatility of wage income for females in male-headed households that were in tied labor contracts increases significantly (Panel B, Column (5)). This is consistent with them switching from tied to casual labor contracts and as a result experiencing a higher wage rate at expense of higher wage volatility.

To sum up, the analysis of the effects of the program on treated females implies that: (1) Total supply of female wage workers goes down. (2) The composition of female wage workers changes so that there are fewer tied workers and more casual workers. (3) Treated women who live in male-headed households and are less vulnerable to negative shocks are much more likely to switch from tied to casual labor contracts. Next, I analyze the indirect effects of the program on men who live in treated households.

9.2 Spillover Effects on Men in Treated Households

Even though the program targets women, men who are part of the same household as treated women are also likely to experience an increase in their outside option through the increase in the self-employment income of the household. Therefore, in this section I will test **Prediction 1(i)** and **Prediction 1(ii)** on males who live in treated households, using the same identification strategy as above.

Table 7 tests **Prediction 1(i)** on males in treated households. I find that the amount of labor supplied in the village labor market by males in treated households is not affected by the program. Column (1) of Table 7 shows that the difference-in-difference estimate for the likelihood of being in wage employment for treated men is 0.009 and imprecisely estimated. Column (2) shows that the effect of the program on the hours spent in wage employment by men who live in treated households is 15, but imprecisely estimated. These findings show that the program has practically no effect participation in wage employment in the village by men in treated households[24]. Going back to the discussion in section 2.3, given that the average wage rate of males is more than 50% higher relative to that of females, it is not surprising that the males' outside options do not change enough to move them over $u(W^e)$.

Table 8 provides results on the labor contracts of males who live in treated poor households. In column (1) of Table 8, I test **Prediction 1(ii)** on the composition of treated men's labor contracts. In line with the prediction of the model, males who live in treated households and experience an increase in their outside options are 8.5% less likely to be in tied labor contracts footnoteWhen I estimate the same model on the full sample of males in treated households, unconditional on

[24] As mentioned earlier, the effect on treated households includes the direct effect of the program and any indirect general equilibrium effects (GE). As such, if there was an increase in male wages, this could be partly why there is no effect on males' labor supply. However, results in section 4.3 will show that there were no GE effects on males' wages for casual labor.

being in wage employment (i.e. recoding the dependent variable so that it takes the value 0 for any male who is *not* working for a wage) the difference-in-difference estimate is -0.015 and significant at 10% level. This implies that the improvement in their spouse's self-employment opportunities allows them to terminate tied labor contracts and enter employment opportunities with higher returns but more risk. Column (2) of Table 8 shows that the wages of males in treated households increases by 0.44 Takas per hour on average. However, column (3) shows that this effect is coming mainly from males that were in tied contracts at baseline. Column (3) shows that the wages of males in treated households that were in tied contracts at baseline increases by 1.35 Takas per hour. This corresponds to a 14% increase relative to their wage at baseline. The effect on men that were in casual contracts at baseline is only 0.29 and imprecisely estimated. This implies that the effect on males' wages is coming mainly from switching from tied to casual labor contracts. Consistent with this, column (5) of Table 8 shows that the volatility of wage earnings of males that were in tied contracts has increased (although this effect is imprecisely estimated). These findings are in line with men in treated households switching from tied to casual labor contracts.

9.3 General Equilibrium Effects Through the Labor Markets

In order to identify the GE effects of the program, I test the effects on non-treated households who do not experience a direct increase in their self-employment opportunities. Therefore, any effect on their labor contracts will be an indirect effect of the program through the village labor market. To identify the indirect GE effects of the program, I restrict the sample to the non-selected poor (households that were ranked in the bottom wealth group by the community but not selected as beneficiaries by the program) in treatment and control villages. As the descriptive statistics presented in Table 1 demonstrated, this group of households is second most likely to be working for a wage for other households in the village (after the selected-poor), hence they are most likely to be affected by any GE effects through the labor market.

I will be testing the GE effects of the program on females and males separately as the labor markets for the two are likely to be different in this setting. Foster and Rosenzweig (1996) show that male and female workers in rural India work in different types of jobs, depending on their comparative advantage. This is similar in rural Bangladesh where men often work in physically-demanding jobs, while women work in jobs that require less physical strength, such as sowing seeds, taking care of livestock, working as a maid etc. Furthermore, hourly wage rate for males is much higher compared to that of females (average wage rate for a male worker is 59% higher at baseline relative to a female worker). Due to these reasons, I analyze the effects on male and female labor markets separately. The identification strategy is same as the difference-in-difference methodology in (15) and (16).

I start by testing the effects on labor contracts of non-treated females. **Prediction 2** implies that under certain conditions, the program is likely to lead to an increase in the incidence of tied-labor among non-treated workers (due to the increase in $\widehat{y}$) and the wage rates for both tied and casual workers. Table 9 presents the results on effects of the program on labor contracts of female

workers in non-treated households. First, there is an insignificant fall in incidence of tied-labor among the untreated poor females. They are 3.5% less likely to be in tied-labor contracts, but this effect is imprecisely estimated at conventional levels.

Second, results in columns (2) and (3) show that the wage rate is significantly higher for females in casual contracts, but not for females in tied-labor contracts. Column (2) shows that the average wage rate for non-treated women who live in treatment villages increased by 0.87 Taka per hour, corresponding to a 15% increase. Column (3) shows that this effect is coming mainly from women that were in casual contracts at baseline. The effect on the wages of women that were in tied contracts at baseline is only 0.30 Taka per hour and imprecisely estimated, while the wages of women in casual contracts increases by 0.9 Taka per hour. Although the difference between tied and casual workers is not precisely estimated, the coefficient is negative and the total effect on wages of workers that were in tied contracts at baseline is nearly 0. This implies that although the supply of both casual and tied female workers in the village falls, only the wages for casual female workers increases and the wages were tied female workers remains practically unchanged. Finally, columns (4) and (5) of Table 9 show that there is no effect on the volatility of the wage earnings of non-treated women. This is consistent with the findings that the non-treated women are not significantly more likely to change the type of their labor contracts. Taken together, the results in Table 9 show that those females who don't directly benefit from the program enjoy higher wages as a result of the fall in the labor supplied by treated female for wage employment.

In order to estimate the GE effects on the male labor market, I limit the sample to male workers from non-selected poor households. Table 10 presents the results. Column (1) in Table 10 shows that there is no effect on the incidence of tied labor among male workers that are not treated. The difference-in-difference estimate is practically 0. On the other hand, column (2) in Table 10 shows that there is a small positive effect on the wage rate of male workers. The difference-in-difference estimate for the average effect on wage rate of non-treated males is 0.34 Takas per hour and imprecisely estimated. Column (3) shows that this effect is coming only from males in tied labor contracts. The wages of non-treated males that were in tied contracts at baseline is increased by 1.07 Takas per hour, corresponding to a 13% increase relative to the baseline wage level for tied male workers. Finally, columns (4) and (5) show that, consistent with them staying in tied labor contracts, there is no effect on the volatility of their wage earnings. These findings are in line with the effects on the labor contracts of treated male workers: due to the fall in the supply of tied male workers, the wages for tied male workers increases, but there is not effect on the wages for casual male workers.

9.4 Changing Pattern of Insurance

In this section, I test **Prediction 4** on whether the treated households are more likely to enter reciprocal transfer arrangements to insure themselves against risks. As reported earlier, at baseline, only 37% of the selected poor's food borrowing links were reciprocated by food lending, much lower than that of middle (62%) or top class (73%) households.

Table 11 presents results on the wealth and reciprocity of treated poor households' food exchange network. In column (1), I estimate the effect on average wealth of households that are part of the respondent's food exchange network (I use wealth as defined at baseline in order to control for any increase in wealth of network members through the treatment). The results show that on average the treated households exchange food with households that are 4.5% wealthier. This implies that treated households who experience on exogenous increase in their self-employment opportunities, hence their income, are likely to form food exchange links with wealthier households. Column (2) of Table 11 shows that the proportion of their borrowing links that are reciprocated by lending increases by 6.8%. This corresponds to an 18% rise in the degree of reciprocity of their food borrowing links relative to baseline. The next four columns of Table 11 breaks down this aggregate reciprocity into reciprocity of their borrowing links with households from the top wealth rank, middle and bottom wealth ranks respectively. One may think that the effect is partly the effect of the program bringing treated households together and enabling them to build tighter social networks with each other. However results in columns (3)-(6) show that the reciprocity of food exchange with top, middle and non-treated poor households increases while the reciprocity with selected poor households is unaffected.

Taken together, these findings and the findings on incidence of tied-labor among the treated households suggest that the treated poor are likely to engage less in tied-labor and more in reciprocal transfer arrangements in order to smooth their consumption. This is consistent with the discussion in section 2 - the fact that treated poor households that are wealthier and have better earnings are matching with wealthier households in reciprocal exchange links is consistent with them being able to enter into better informal insurance arrangements. The increase in outside options of the treated households enables them to switch from tied labor contracts to a combination of casual labor contracts (with higher yield but more risk) and reciprocal transfer arrangements with other, wealthier households.

9.5 Interpretation of Results

The findings on male and female labor contracts showed that the fall in the labor supply of female workers has led to an increase in wage rate for casual female workers, but the wage rate for tied female workers has been affected much less. On the other hand, in the male labor market there hasn't been an impact in total supply of male workers but the supply of tied workers has diminished, leading to an increase in the returns to supply of casual laborers. The finding that although the supply of tied workers in both the male and female labor markets is being reduced, the returns to tied labor for males is increasing while the returns to tied female labor is not changing suggests that there may be different demand structures for male versus female tied laborers. A key assumption behind the predictions of the theoretical model in Section 2 was that tied labor and casual labor are perfect substitutes during the peak season, and the tied workers are not put to any use by the employer during the lean season. In practice, this is not likely to be the case and tied workers are likely to be (occasionally) employed in various non-agricultural activities during

the lean season, while both tied and casual workers are likely to be employed on farm work during the peak season. The findings suggest that the elasticity of demand for female tied workers is much higher than that for tied male workers.

One possible mechanism behind this could be the availability of female family labor in employer households, while the availability of male family labor is much more limited. Descriptive statistics at baseline show that the average female in a top rank household reports working for 812 hours per year while the average male reports working for 1771 hours. Hence, the opportunity cost of time for females in wealthy households is likely to be much lower relative to the opportunity cost of time for men in these households. In order to examine whether this mechanism could explain the difference in demand elasticities of demand for male vs female tied labor, I limit the sample to employer households and estimate a regression of the form (16) where the dependent variable is hours worked by female members of employer households and Z_{i0} is a dummy variable equal to 1 if the household employed any female from a selected-poor household at baseline. Table 12, column (1) shows the result. I find that there is a differential positive impact on the hours spent doing chores by female members of households that employed tied female workers from treated poor households at baseline. When I estimate the same specification for hours spent by employer females in income generating activities, I find a positive but insignificant differential effect on those that hired tied female workers from treated households at baseline. This suggests that instead of replacing the tied female workers with new ones, the employers may be replacing them with family labor which is likely to have lower cost. On the other hand, it may not be cheap to replace tied male workers with male family labor (given that the males in employer households are already working longer hours relative to females) and that may be the reason why the elasticity of demand for male tied laborers is low relative to the elasticity of demand for female tied workers.

An alternative mechanism that may explain why the returns to male tied labor is increasing while the returns to female tied labor remains relatively unchanged could be the differential importance of non-wage benefits for tied male and female workers. In particular, women in rural Bangladesh are much more constrained in terms of accessing services that require them to interact with others in social spaces. The institution of "purdah" that limits women's participation in social and economic systems in South Asia is well documented in sociological studies (e.g. Papanek (1973)). As a result, it is likely that female tied workers value non-wage benefits, such as receiving assistance from their employers to access services (e.g. healthcare, courts, markets) more than the male tied workers. In order to examine whether this mechanism may explain the findings, I use information on whether non-treated female respondents report visiting such spaces and conditional on visiting these places, whether they report receiving assistance from others in order to access services[25]. Column (2) of Table 12 shows the result of this exercise. I find that non-selected women who were in tied-labor contracts at baseline are 22% more likely to report

[25]More specifically, respondents were asked whether during the past 1 year they visited any of the following: health center, court, NGO office, livestock office, agricultural office, local markets. If they reported having visited any of these places, they were asked to report whether they received any assistance from others to access services (could be from other household members or individuals from outside the household)

receiving assistance from others during a visit to any of the reported social spaces. This suggests that the differential role of non-wage benefits for female tied workers could explain why the wage rate of female tied workers does not increase as much as the wages of male tied workers. However, this interpretation should be taken with some caution as I cannot identify whether this assistance was from their employers (as I do not have information on the identity of who the assistance was given by).

10 Conclusions

There is a large literature on the theory of labor tying in rural economies. The existence of tied labor in rural labor markets has been well documented, particularly in the context of South Asia. A tied labor contract involves a long term relationship between an employer and a worker, where the employer provides a low but steady wage to the worker (as opposed to a casual labor contract that yields a high return during the harvest season). As such, tied-labor is likely to be an important mechanism through which poor households in developing countries insure themselves against risks, yet recent empirical literature on informal insurance in developing countries has been dormant on the role of tied-labor. In this paper, I show that tied labor is an important channel through which the poor in rural Bangladesh insure themselves against fluctuations in their income and hence in their consumption. Furthermore, I exploit exogenous variation in the outside options of poor women provided by the randomized roll-out of BRAC's "ultra-poor" program that I was involved in evaluating between 2007 and 2009 in Bangladesh. The ultra-poor program transforms the self-employment opportunities of treated women through a combination of a large asset transfer with enterprise training and weekly visits by program officers.

In order to evaluate the effects of the program on the labor contracts of treated women, their spouses, and the rest of the community, I use a theoretical framework adapted form Bardhan (1983). The theoretical framework has 4 main predictions on the effects of the treatment: (1) In partial equilibrium, treated workers may be less likely to be working for a wage and less likely to be in tied labor contracts (2) If the supply of tied and casual labor in the village falls, the returns to both will increase. This will yield to an increase in the threshold level of outside option below which workers enter into tied-labor. (3) In general equilibrium, the program has ambigous effects on treated workers' participation in tied and casual employment. (4) Treated workers will be more likely to enter reciprocal transfer arrangements.

In line with prediction 1, I find that treated women are less likely to be working for a wage and they are less likely to be in tied labor contracts. This implies that the supply of both tied and casual female labor in the village is lower as a result of the treatment. Corresponding to prediction 2, I find that the return to casual female labor is increased, yet the return to tied female labor is unchanged. I provide evidence on two alternative channels that may explain this: First, the employers are substituting tied female labor with female family labor. Second, female workers who remain in tied labor are more likely to receive assistance in order to access public services

(which is likely to be part of their compensation from tied labor).

The effects on the spouses of treated women show that they are equally likely to be working for a wage as before, but they are less likely to be in tied labor. In line with this, the wages of tied male workers in the village increases but the wages of casual male workers is not affected.

Finally, I show that, in line with prediction 4, the treated households form food exchange links with wealthier households in the village and increase the reciprocity of their transactions. This suggests that poor households may not be able to smooth their consumption via reciprocal transfer arrangements as efficiently as the wealthier households in the village. As a result, an exogenous improvement in their self-employment opportunities that increases their expected income level allows them to switch from tied labor to reciprocal transfers as a consumption smoothing mechanism.

Taken all together, the findings imply that poor households in rural markets may be involved in second-best labor contracts to insure themselves against risks. An exogenous improvement in their wealth enables them to move to riskier but more productive labor opportunities while making them more likely to insure themselves via reciprocal transfer arrangements with other households in the village.

These findings have important policy implications. First, they imply that poor households in rural markets may be involved in tied labor contracts to insure themselves against risks. This creates a link between insurance and labor markets, which implies that policies that affect one of these markets is likely to have impact(s) on the other one. For example in the current study, an exogenous improvement in the outside option of the worker causes the link between her labor and insurance arrangements to get weaker, as she moves to riskier but more productive labor opportunities while increasing her participation in reciprocal transfer arrangements with other households in the village.

Second, my findings show that labor markets for wage-employment are highly segmented by gender in rural Bangladesh. As a result, the general equilibrium effects of the treatment on male and female workers are very different. An increase in self-employment opportunities benefits both males and females in treated households, as both sexes become involved in family-run businesses. The effects on the village labor market di er greatly by gender. Females both in treated and non-treated households benefit from a rise in wages which results from treated females reducing their labor supply. In contrast, males in non-treated households benefit mainly from the program enabling men to break tied contracts with employers. My results suggest that in evaluating the impacts of entrepreneurship and other programs, it is essential to carry out the analysis separately by gender as segmentation of labor markets in poor economies imply the effects will be very different.

Finally, the fact that female-headed households choose to remain in tied-labor arrangements, although they receive the same amount of wealth as male-headed households draws attention to the fact that household composition plays a very important role in insurance mechanisms. Households that are more vulnerable may prefer to remain in less productive labor arrangements to insure themselves against risks, even when they are made wealthier. This suggests that a more intensive

treatment (perhaps one that explicitly addresses insurance) may be required for such households, in order for them to take advantage of similar bene ts as less vulnerable households.

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Table 1 : Descriptives at Baseline

	Selected Poor	Non-selected Poor	Middle Class	Top Class
	(1)	(2)	(3)	(4)
Wealth	5635.3	13291.2	141287.8	853759.9
	(30046.0)	(64870.1)	(313143.2)	(973480.1)
Pce	3958.7	4258.5	5433.5	12002.0
	(2272.3)	(3049.5)	(5106.7)	(34611.4)
Male hh head	0.58	0.77	0.94	0.95
	(0.49)	(0.42)	(0.24)	(0.22)
Work for another hh	0.74	0.67	0.40	0.04
	(0.44)	(0.47)	(0.49)	(0.20)
Work for another	0.49	0.48	0.42	0.28
hh in same village	(0.50)	(0.50)	(0.49)	(0.45)
Receives food transfer	0.93	0.92	0.83	0.42
	(0.26)	(0.28)	(0.37)	(0.49)
Gives food transfer	0.44	0.53	0.70	0.81
	(0.50)	(0.50)	(0.46)	(0.39)
Can have at least	0.42	0.54	0.81	0.97
2 meals a day	(0.51)	(0.60)	(0.54)	(0.25)
N	6746	7757	7903	2407

Notes: Columns 1,2,3,4 give summary statistics at baseline for selected poor, non-selected poor (households that were ranked in the bottom wealth rank by the community but not chosen for treatment by the program), middle rank households and top rank households respectively. "Wealth" is total measure (in TAKAs) of household assets, including land, livestock, other productive assets and household durables. "Pce" is total annual per capita expenditure of the household, in Bangladeshi Takas (1 Taka=0.014 US Dollar as of 10/22/2010). "Male hh head" is the proportion of households that have a male household head. "Household size" is the number of household members. "Works for another hh" is the proportion of households where the main female respondent and/or the male household head works for another household. "Work for another hh in same village" is the proportion of households in which, conditional on working for another household, either the main female and/or the male household head works for another household in the same village. "Receives food transfer" is the proportion of households that reports ever having to receive rice or other food items from other households. "Gives food transfer" is the proportion of households that reports ever giving rice or other food items to other households. "Can have at least 2 meals a day" is the proportion of households that responded "Yes" to the question "Could your household afford two meals per day most of the time during last year?"

Table 2: Correlation of Wage Rate with Contract Type at Baseline

	Log earnings per hour	Log total daily wage	Log daily wage in cash	Log daily wage in kind
	(1)	(2)	(3)	(4)
tied worker	-0.045**	-0.042**	-0.323***	0.235***
	(0.019)	(0.021)	(0.078)	(0.073)
log wealth	0.020***	0.014***	0.008	-0.004
	(0.004)	(0.004)	(0.017)	(0.014)
cons	1.696***	3.615***	2.795***	2.484***
	(0.058)	(0.060)	(0.222)	(0.216)
N	2447	2396	2391	2391

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to selected poor households at baseline. "Tied worker" is a dummy variable equal to 1 if any of the main female's or the male household head's employers is reported as a food borrowing source in times of need. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 3: Seasonality in Wage Earnings at Baseline

	Log Wage Earnings of selected-poor females	Log Wage Earnings of selected-poor males
	(1)	(2)
peak season	0.602***	0.427***
	(0.052)	(0.047)
lean season	-1.825***	-1.563***
	(0.091)	(0.121)
tied	0.108	-0.019
	(0.084)	(0.098)
peak × tied	0.003	-0.024
	(0.078)	(0.080)
lean × tied	0.412***	0.248
	(0.126)	(0.209)
total effect for tied workers at peak season	0.112*	-0.042
	(0.064)	(0.097)
total effect for tied workers at lean season	0.520***	0.229
	(0.143)	(0.232)
N	5499	2673

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to selected poor households at baseline. Dependent variable in columns 1 and 2 are the log monthly earnings of the main female and household head respondents, respectively. "peak season" is a dummy =1 if the observation was recorded at months 2 or 8 according to the Bengali calender. "lean season" is a dummy =1 if the observation was recorded in months 5, 6, 7 according to the Bengali calender. "tied" is a dummy =1 if respondent's household borrows food from her/his employer(s) during times of need. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 4: Effects on Participation of Treated Women in Wage Employment

	Extensive Margin: Whether respondent works for a wage	Intensive Margin: Hours spent in wage employment
	(1)	(2)
treatment	0.028*	-0.079
	(0.017)	(23.606)
post	-0.008	-73.902***
	(0.012)	(18.219)
treat × post	-0.047***	-72.195***
	(0.017)	(22.593)
cons	0.468***	646.531***
	(0.031)	(42.603)
N	13490	13490

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to selected poor households. The dependent variable in column 1 is a dummy variable equal to 1 if the main female respondent in the household reports working for another household within the same village. The dependent variable in column 2 is total hours the main female respondent spent working for other households within the village, conditional on working for another households within the village. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from the followup survey. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 5: Effects on Labor Contracts of Women in Treated Households

	Tied-Labor	Wage per Hour	Wage per Hour	Volatility	Volatility
	(1)	(2)	(3)	(4)	(5)
treatment	-0.024	-0.114	0.078	-0.022	-0.022
	(0.023)	(0.202)	(0.191)	(0.018)	(0.019)
post	-0.006	0.004	0.230	-0.052***	-0.040***
	(0.023)	(0.190)	(0.179)	(0.014)	(0.016)
treat × post	-0.053*	0.723***	0.571**	-0.030	-0.026
	(0.031)	(0.277)	(0.291)	(0.020)	(0.021)
treat × post × tied at base			0.378		-0.030
			(0.596)		(0.040)
total effect for			0.949*		-0.057
workers tied at base			(0.542)		(0.037)
N	3389	3389	3389	3367	3367

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to females in selected poor households who work for another household in either survey wave. The dependent variable in column 1 is a dummy variable equal to 1 if the female respondent in the household reports an employer as a source of food transfers in times of need. The dependent variable in columns 2 and 3 is her wage earnings per hour. The dependent variable in columns 4 and 5 is the ratio of her monthly wage earnings during the month in which her wage earnings were minimum to her earnings during the month in which her wage earnings were maximum. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from followup survey. "tied at base" is a dummy equal to 1 if the respondent was in a tied labor contract at baseline. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 6: Heterogeneity in Effects on Labor Contracts of Women in Treated Households

Panel A: Female-Headed Treated Poor

	Tied-Labor	Wage per Hour	Wage per Hour	Volatility	Volatility
	(1)	(2)	(3)	(4)	(5)
treat	-0.042	-0.175	0.070	-0.020	-0.008
	(0.029)	(0.284)	(0.265)	(0.023)	(0.024)
post	-0.018	-0.043	0.255	-0.060***	-0.046**
	(0.027)	(0.275)	(0.252)	(0.018)	(0.019)
treat × post	0.042	1.030**	0.972**	-0.036	-0.044*
	(0.038)	(0.456)	(0.489)	(0.025)	(0.026)
treat × post × tied at base			-0.406		0.016
			(0.936)		(0.056)
total effect for			0.566		-0.028
workers tied at base			(0.812)		(0.053)
N	1847	1847	1847	1832	1832

Panel B: Male-Headed Treated Poor

	Tied-Labor	Wage per Hour	Wage per Hour	Volatility	Volatility
	(1)	(2)	(3)	(4)	(5)
treatment	-0.006	-0.071	0.034	-0.022	-0.039
	(0.034)	(0.208)	(0.222)	(0.021)	(0.025)
post	0.037	0.031	0.138	-0.039**	-0.034
	(0.037)	(0.213)	(0.218)	(0.019)	(0.023)
treat × post	-0.090**	0.430*	0.241	-0.028	-0.011
	(0.044)	(0.261)	(0.277)	(0.025)	(0.030)
treat × post × tied at base			1.046*		-0.069
			(0.587)		(0.049)
total effect for			1.286**		-0.079**
workers tied at base			(0.552)		(0.039)
N	1542	1542	1542	1535	1535

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to females in selected poor households who work for another household in either survey wave. Sample is divided into female vs male-headed households in Panels A and B respectively. The dependent variable in column 1 is a dummy variable equal to 1 if the female respondent in the household reports an employer as a source of food transfers in times of need. The dependent variable in columns 2 and 3 is her wage earnings per hour. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from followup survey. "tied at base" is a dummy equal to 1 if the respondent was in a tied labor contract at baseline. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 7: Effects on Participation of Men in Treated Households in Wage Employment

	Extensive Margin: Whether respondent works for a wage	Intensive Margin: Hours spent in wage employment
	(1)	(2)
treatment	0.008	-2.733
	(0.017)	(32.037)
post	-0.041**	-114.593***
	(0.018)	(30.265)
treat × post	0.009	15.023
	(0.022)	(36.538)
cons	0.250***	1540.729***
	(0.038)	(79.961)
N	7472	7472

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to selected poor households. The dependent variable in column 1 is a dummy variable equal to 1 if the male household head respondent in the household reports working for another household within the same village. The dependent variable in column 2 is total hours the male household head respondent spent working for another household within the same village, conditional on working for any other household within the village. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from followup survey. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 8: Effects on Labor Contracts of Males in Treated Households

	Tied-Labor	Wage per Hour	Wage per Hour	Volatility	Volatility
	(1)	(2)	(3)	(4)	(5)
treatment	0.005	-0.322	-0.219	-0.007	-0.011
	(0.028)	(0.202)	(0.214)	(0.018)	(0.019)
post	0.014	0.332*	0.357*	-0.050***	-0.049***
	(0.036)	(0.199)	(0.211)	(0.017)	(0.018)
treat × post	-0.085**	0.444*	0.294	-0.020	-0.013
	(0.043)	(0.266)	(0.274)	(0.021)	(0.022)
treat × post × tied at base			1.060*		-0.057
			(0.623)		(0.056)
total effect for			1.354**		-0.070
workers tied at base			(0.611)		(0.053)
N	1611	1528	1528	1510	1510

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to males in selected poor households who work for another household in either survey wave. The dependent variable in column 1 is a dummy variable equal to 1 if an employer of the male respondent in the household is reported as a source of food transfers in times of need. The dependent variable in columns 2 and 3 is his wage earnings per hour. The dependent variable in columns 4 and 5 is the ratio of his monthly wage earnings during the month in which his wage earnings were minimum to his earnings during the month in which her wage earnings were maximum. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from followup survey. "tied at base" is a dummy equal to 1 if the respondent was in a tied labor contract at baseline. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 9: Effects on Labor Contracts of Women in Non-Treated Households

	Tied-Labor	Wage per Hour	Wage per Hour	Volatility	Volatility
	(1)	(2)	(3)	(4)	(5)
treatment	-0.020	-0.505*	-0.455*	-0.002	-0.004
	(0.027)	(0.289)	(0.235)	(0.017)	(0.019)
post	-0.007	-0.364*	-0.251	-0.045***	-0.039***
	(0.022)	(0.214)	(0.203)	(0.012)	(0.013)
treat × post	-0.035	0.869***	0.904***	-0.026	-0.028
	(0.031)	(0.320)	(0.293)	(0.019)	(0.021)
treat × post × tied at base			-0.608		0.026
			(0.779)		(0.043)
total effect for			0.296		-0.002
workers tied at base			(0.771)		(0.039)
N	2975	2975	2975	2953	2953

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to females in non-selected poor households who work for another household in either survey wave. The dependent variable in column 1 is a dummy variable equal to 1 if the female respondent in the household reports an employer as a source of food transfers in times of need. The dependent variable in columns 2 and 3 is her wage earnings per hour. The dependent variable in columns 4 and 5 is the ratio of her monthly wage earnings during the month in which her wage earnings were minimum to her earnings during the month in which her wage earnings were maximum. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from followup survey. "tied at base" is a dummy equal to 1 if the respondent was in a tied labor contract at baseline. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 10: Effects on Labor Contracts of Men in Non-Treated Households

	Tied-Labor	Wage per Hour	Wage per Hour	Volatility	Volatility
	(1)	(2)	(3)	(4)	(5)
treatment	-0.035	-0.360**	-0.273	0.019	0.015
	(0.024)	(0.160)	(0.170)	(0.019)	(0.020)
post	-0.045**	0.600***	0.613***	-0.057***	-0.060***
	(0.021)	(0.152)	(0.157)	(0.014)	(0.016)
treat × post	0.001	0.336	0.244	-0.028	-0.025
	(0.030)	(0.216)	(0.222)	(0.021)	(0.022)
treat × post × tied at base			0.829*		0.005
			(0.470)		(0.061)
total effect for			1.073**		-0.020
workers tied at base			(0.479)		(0.060)
N	2502	2357	2357	2327	2327

Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. Sample is restricted to males in non-selected poor households who work for another household in either survey wave. The dependent variable in column 1 is a dummy variable equal to 1 if an employer of the male respondent in the household is reported as a source of food transfers in times of need. The dependent variable in columns 2 and 3 is his wage earnings per hour. The dependent variable in columns 4 and 5 is the ratio of his monthly wage earnings during the month in which his wage earnings were minimum to his earnings during the month in which her wage earnings were maximum. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from followup survey. "tied at base" is a dummy equal to 1 if the respondent was in a tied labor contract at baseline. All regressions control for the following variables: a dummy for whether the religion of the household head was Islam, whether the respondent was undernourished at baseline (BMI<18.5), log of baseline household wealth, whether the respondent reported being able to read and write at baseline, number of under 10 household members, average wealth class of the respondent's employer(s), whether the survey month was "kartik" (lean season)

Table 11: Wealth and Reciprocity of Food Exchange Links

	Log Wealth	Reciprocity	Reciprocity with top class	Reciprocity with middle class	Reciprocity with non-selected poor	Reciprocity with selected poor
	(1)	(2)	(3)	(4)	(5)	(6)
treatment	-0.047***	0.001	-0.064***	-0.017	-0.019	0.055
	(0.016)	(0.020)	(0.023)	(0.021)	(0.028)	(0.040)
post	0.079***	0.046***	0.051**	0.052***	0.004	0.024
	(0.010)	(0.013)	(0.020)	(0.014)	(0.021)	(0.033)
treat × post	0.045***	0.068***	0.104***	0.057***	0.109***	0.033
	(0.013)	(0.017)	(0.027)	(0.019)	(0.028)	(0.039)
N	12405	12329	3035	9465	4185	2560
Sample	Selected poor	Selected poor	Selected poor	Selected poor	Selected poor	Selected poor

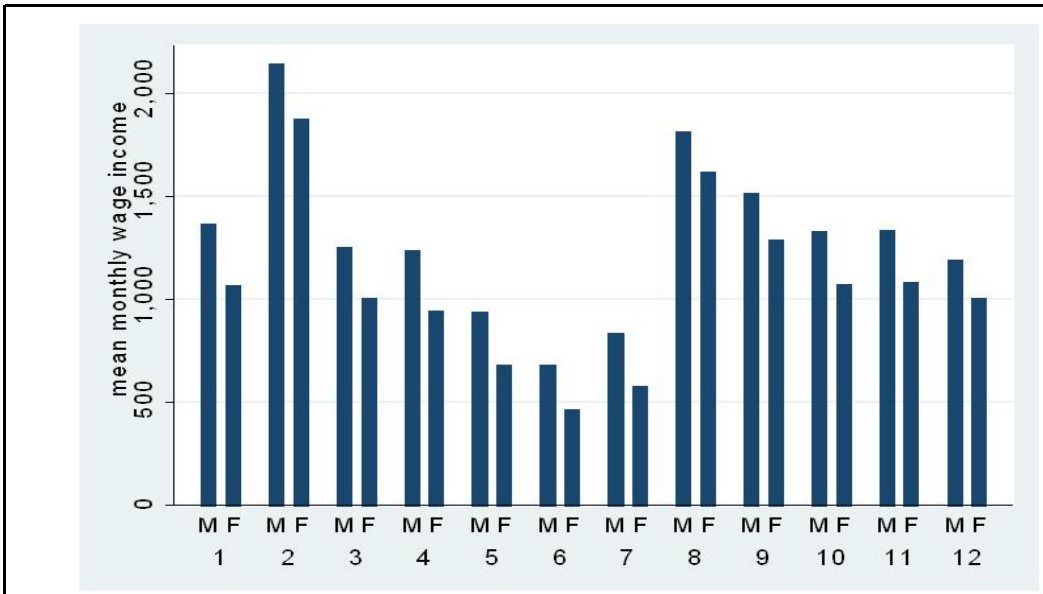
Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from followup survey. Sample is restricted to selected poor households in all the regressions. The dependent variable in column 1 is the log average wealth (total value of household assets) of the households that the respondent's household exchanges (either transfers to or receives transfers from) food with, where wealth is as measured at baseline census. The dependent variable on column 2 is the proportion of food exchange links that the respondent's household receives food from (in times of need), that are also reported as links her household transfers food to. The dependent variable on columns 3, 4, 5 and 6 are the proportion of top class, middle class, non-selected poor and selected poor (respectively) food exchange links that the respondent's household receives food from, that are also reported as links her household transfers food to.

Table 12: Mechanisms

	Mechanism 1: Hours spent in chores by employer females	Mechanism 2: Assistance received by non-selected women
	(1)	(2)
treatment	-0.721	0.057
	(27.942)	(0.045)
post	-3.639	0.078**
	(24.011)	(0.040)
treat × post	-82.948**	-0.041
	(33.288)	(0.057)
treat × post × "tied at base"	367.531**	0.262***
	(183.159)	(0.101)
total effect for "tied at base"	284.584	0.222**
	(183.193)	(0.096)
N	10086	2308
Sample	Employers	Non-selected poor

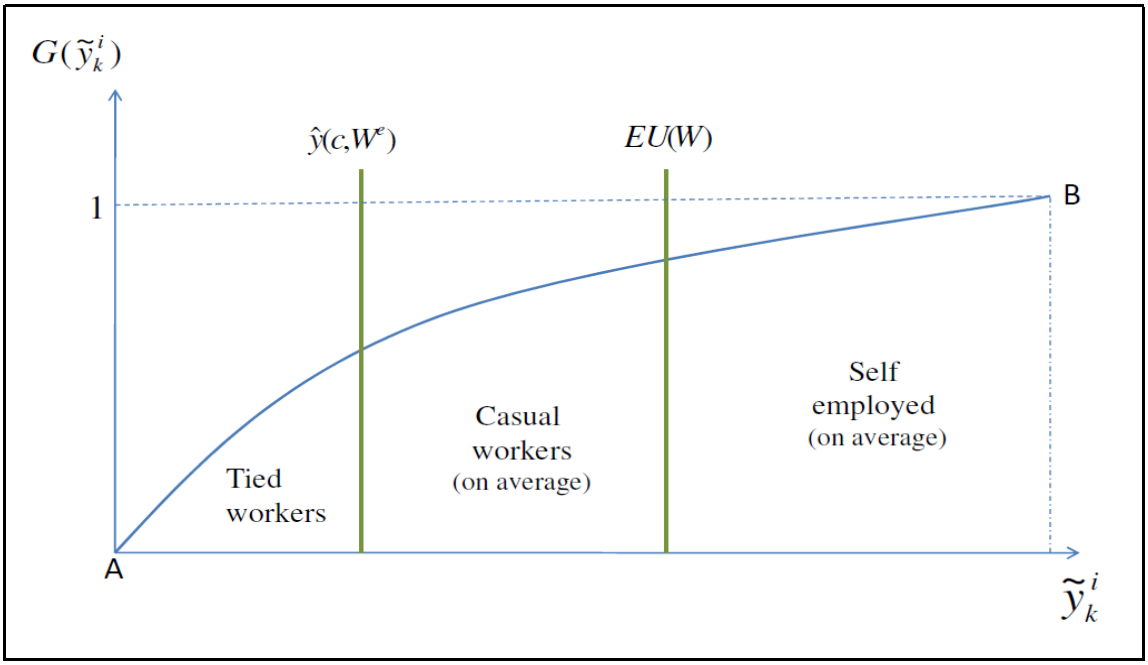
Notes: *** stands for p-value<0.01, ** stands for p-value< 0.05, * stands for p-value< 0.10. Standard errors are clustered at spot level. "treat" is a dummy variable =1 if the observation is from a treatment village. "post" is a dummy variable =1 if the observation if from followup survey. In Column 1, the sample is restricted to households that report employing another household within the same village in either survey wave. The dependent variable is total number of hours spent doing household chores by the main female respondent during the past year. "tied at base" is a dummy variable equal to 1 if the household employed any treated poor female as a tied worker at baseline. In Column 2, the sample is restricted to non-selected poor females who report visiting any of the following places during the past year: local market, local health center, NGO office, court, livestock office, agricultural office. The dependent variable in column 2 is a dummy variable equal to 1 if the respondent reports receiving any assistance while visiting any of the mentioned places. "tied at base" is a dummy variable equal to 1 if the main female respondent in the household was working as a tied worker for another household at baseline.

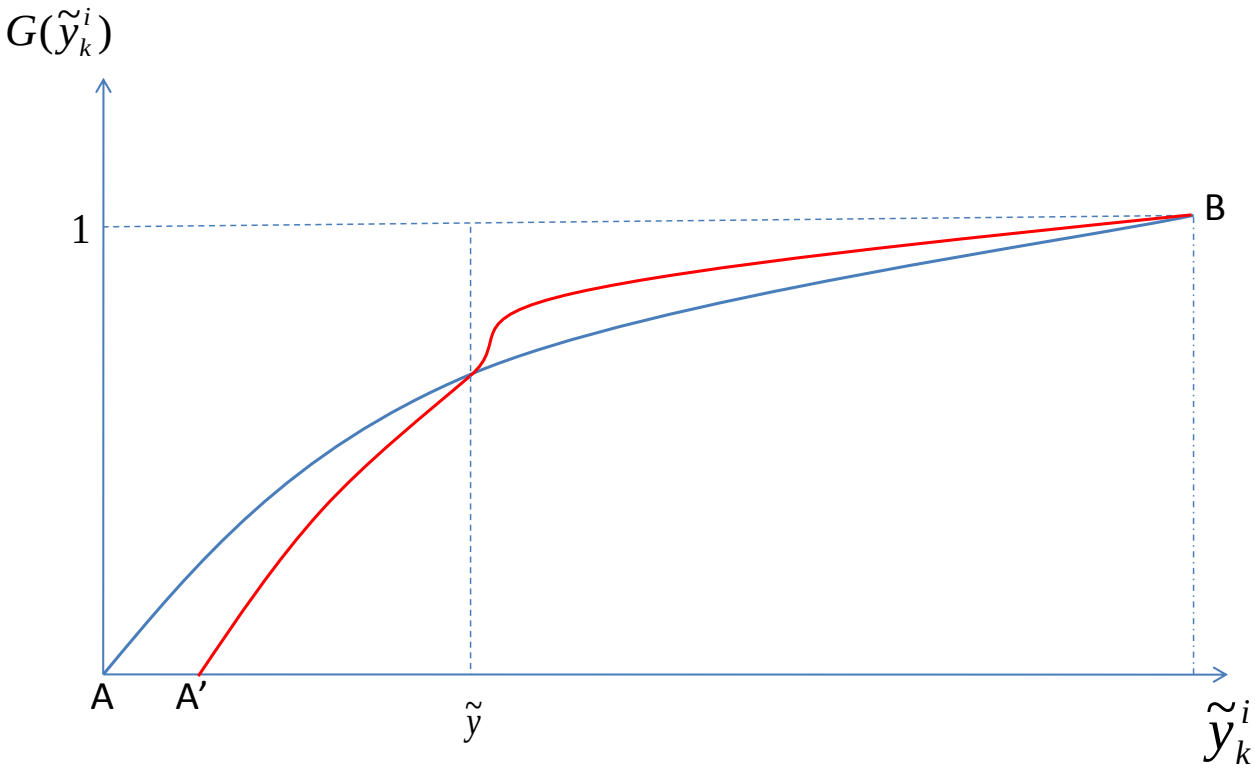
Figure 1: Monthly Wage Income Profiles at Baseline



Notes: This figure shows the monthly earnings from wage employment for male and female workers respectively. Every bar labeled "M" gives the mean total wage income of male household heads from wage employment in a given month. Every bar labeled "F" gives the mean total wage income of main female respondents from wage employment in a given month. Sample is restricted to baseline observations.

Figure 2: Occupational Choice of Workers in Equilibrium

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A Appendix Tables

Table B1: Characteristics of Selected Poor by HH Head Gender

	Male-headed poor	Female-headed poor	Difference p-value
	(1)	(2)	(3)
Wealth	6367.6	4617.7	0.01
	(28994.3)	(31426.0)	
Pce	3784.7	4209.9	0.05
	(1998.1)	(2597.7)	
Household size	4.10	2.08	0.00
	(1.44)	(1.25)	
Working-age member	2.62	1.57	0.00
	(0.95)	(0.86)	
Main female literate	0.10	0.03	0.00
	(0.30)	(0.17)	
Main female undernourished	0.51	0.55	0.00
	(0.50)	(0.50)	
Can have at least	0.45	0.37	0.00
2 meals a day	(0.52)	(0.51)	
N	3923	2823	

Notes: Summary statistics for selected poor households at baseline provided. In Column 1, the sample is restricted to male-headed selected poor households and in Column 2 to female-headed selected poor households. Column 3 provides the p-values associated for a test of mean differences for each characteristic for the two sub-samples.

Table C2: Normalized Differences Between Selected-Poor in Treatment and Control Villages at Baseline

	Mean		Std Deviation		No of observations		**Normalized Difference**
	Treatment	Control	Treatment	Control	Treatment	Control	
	(1)	(2)	(3)	(4)	(5)	(6)	**(7)**
wealth (total value of hh assets)	14703.64	9372.19	27504.39	74769.41	7735	5755	**0.07**
pce (total annual expenditure per capita)	4018.44	3746.56	2402.25	2263.91	7271	5254	**0.08**
calories pc (calories consumed per day per capita in the last 3 days)	854.50	839.37	362.44	399.32	7279	5254	**0.03**
respondent undernourished (whether BMI of main female respondent under 18.5)	0.52	0.47	0.50	0.50	7735	5755	**0.07**
respondent literate (self-reported)	0.08	0.07	0.28	0.25	7735	5755	**0.04**
household head male	0.62	0.51	0.48	0.50	7735	5755	**0.16**
no of household members	3.54	3.23	1.72	1.77	7735	5755	**0.12**
whether household receives any government benefits	0.24	0.21	0.43	0.41	7735	5755	**0.04**
whether any member of the household was self-employed for any business activity	0.83	0.71	0.37	0.46	7735	5755	**0.21**
total hours main female respondent spent on business activities during past year	1286.40	1224.95	834.49	877.74	7735	5755	**0.05**
whether main female or male hh head was employed by any other hh	0.70	0.71	0.46	0.45	7735	5755	**-0.02**
proportion of employers that were in same village	0.44	0.42	0.47	0.47	5435	4111	**0.02**
whether main female was in a tied labor contract	0.22	0.26	0.41	0.44	2630	1915	**-0.06**
average earnings per hour of the main female from wage employment	5.90	5.75	3.84	3.44	1966	1532	**0.03**
ratio of minimum to maximum monthly earnins of the main female	0.10	0.13	0.24	0.25	1959	1516	**-0.08**
total hours spent by male hh head on business activities	1649.17	1575.54	1030.52	1001.12	7735	5755	**0.05**
average earnings per hour of the male hh head from wage employment	9.82	9.54	7.11	5.11	1042	606	**0.03**
ratio of minimum to maximum monthly earnins of the male hh head	0.09	0.10	0.19	0.19	1034	596	**-0.04**

Notes: Sample restricted to selected poor households at baseline. Column 1 provides the mean of the relevant variable for households in treatment villages. Column 2 gives the mean of the relevant variable for households in control villages. Column 3 gives the standard deviation of the relevant variable for households in treatment villages. Column 4 gives the standard deviation of the relevant variable for households in control villages. Column 5 gives the number of observations of the relevant variable for households in treatment villages. Column 6 gives the number of observations of the relevant variable for households in control villages. Column 7 gives the normalized differences between treatment and control variables where the statistic is calculated according to Imbens and Wooldridge (2009). As a rule of thumb, if the absolute value of the normalized difference is less than 0.25 the difference is not significant.

Table C3: Normalized Differences Between Non-Selected Poor in Treatment and Control Villages at Baseline

	Mean		Std Deviation		No of observations		Normalized Difference
	Treatment	Control	Treatment	Control	Treatment	Control	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
wealth (total value of hh assets)	15934.00	20182.36	66238.58	102468.90	7362	8150	**-0.03**
pce (total annual expenditure per capita)	4040.66	3995.19	3151.65	2852.85	6747	7547	**0.01**
calories pc (calories consumed per day per capita in the last 3 days)	833.63	829.49	319.69	350.09	6756	7547	**0.01**
respondent undernourished (whether BMI of main female respondent under 18.5)	0.43	0.40	0.50	0.49	7362	8150	**0.04**
respondent literate (self-reported)	0.15	0.17	0.36	0.38	7362	8150	**-0.04**
household head male	0.75	0.78	0.43	0.41	7362	8150	**-0.04**
no of household members	3.77	3.85	1.73	1.67	7362	8150	**-0.03**
whether household receives any government benefits	0.19	0.18	0.39	0.38	7362	8150	**0.03**
whether any member of the household was self-employed for any business activity	0.81	0.84	0.39	0.37	7362	8150	**-0.06**
total hours main female respondent spent on business activities during past year	933.04	979.18	786.29	788.80	7362	8150	**-0.04**
whether main female or male hh head was employed by any other hh	0.65	0.67	0.48	0.47	7362	8150	**-0.03**
proportion of employers that were in same village	0.42	0.41	0.47	0.46	4801	5476	**0.02**
whether main female was in a tied labor contract	0.20	0.23	0.40	0.42	2261	2514	**-0.05**
average earnings per hour of the main female from wage employment	6.00	6.23	4.32	3.65	1452	1609	**-0.04**
ratio of minimum to maximum monthly earnins of the main female	0.10	0.10	0.23	0.22	1447	1591	**0.00**
total hours spent by male hh head on business activities	1564.37	1698.32	1075.41	1065.08	7362	8150	**-0.09**
average earnings per hour of the male hh head from wage employment	11.72	10.10	40.53	7.79	1167	1414	**0.04**
ratio of minimum to maximum monthly earnins of the male hh head	0.11	0.10	0.21	0.20	1147	1399	**0.04**

Notes: Sample restricted to non-selected poor households at baseline. Column 1 provides the mean of the relevant variable for households in treatment villages. Column 2 gives the mean of the relevant variable for households in control villages. Column 3 gives the standard deviation of the relevant variable for households in treatment villages. Column 4 gives the standard deviation of the relevant variable for households in control villages. Column 5 gives the number of observations of the relevant variable for households in treatment villages. Column 6 gives the number of observations of the relevant variable for households in control villages. Column 7 gives the normalized differences between treatment and control variables where the statistic is calculated according to Imbens and Wooldridge (2009). As a rule of thumb, if the absolute value of the normalized difference is less than 0.25 the difference is not significant.

Table C4: Components of BRAC's Ultra-Poor Program

First six months of the program	Selection
	Training
	Asset transfer
	One to one individual follow-up and close supervision of the beneficiaries by porgram officers
	Social development and health services
2nd six months of the program	Training/refreshers
	Asset transfer
	One to one individual follow-up and close supervision of the beneficiaries by porgram officers
	Group formation
	Informal group discussions (social awareness, education, health education)
	Social development and health services
3rd six months of the program	Refreshers training
	Individual follow-up
	Informal groups discussions (social awareness, health education, group dynamics, use of loan and savings, loan procedure, group cohesion)
	Confidence building training
	Social development and health services
4th six months of the program	Formal weekly group meetings
	Loan activities
	Savings activities
	Follow up in groups

Source: Matin et al. (2008)

Appendix Proofs

Proposition 1 *If* $u(W(A)) \leq \widetilde{y}$ *then* $\frac{dW}{d\lambda} \geq 0$, $\frac{dz}{d\lambda} \geq 0$ *and* $\frac{d\widehat{y}}{d\lambda} \geq 0$.

Proof. Totally differentiating the system of equations given by (10), (11) and (12):

$$\Omega_{3\times 3} \cdot \begin{bmatrix} dW \\ dz \\ d\widehat{y} \end{bmatrix} = \begin{bmatrix} 0 \\ NG_{\lambda}(u(W)) \\ \frac{\beta}{1-\beta^2}\left(F'(\frac{NG(\widehat{y})}{x})\frac{N}{x}G_{\lambda}(\widehat{y})\widehat{y}\right) \end{bmatrix} \cdot d\lambda \tag{1}$$

where

$$\Omega = \begin{bmatrix} -\frac{\beta}{1-\beta^2}\int\limits_{\frac{NG(\widehat{y})}{x}}^{\overline{A}} dF(A) & \frac{1}{1-\beta} & 0 \\ -NG'\left(u(W)\right)u'(W) & 0 & 0 \\ \int\limits_{\frac{NG(\widehat{y})}{x}}^{\overline{A}} u'(W)dF(A) & \frac{u'(z)}{1-\beta} & -\left[\frac{1}{1-\beta^2}+\frac{\beta}{1-\beta^2}\left(F'(\frac{NG(\widehat{y})}{x})\frac{NG'(\widehat{y})}{x}\widehat{y}+F(\frac{NG(\widehat{y})}{x})\right)\right] \end{bmatrix} \tag{2}$$

The first row, second and third rows of Ω are derived by totally differentiating equations (10), (11) and (12) respectively (see Appendix for the derivation of Ω). The inverse matrix of Ω is given by:

$$\Omega^{-1} = \begin{pmatrix} 0 & \frac{-1}{NG'(u(W))u'(W)} & 0 \\ 1-\beta & \frac{\frac{\beta(1-\beta)}{1-\beta^2}\int\limits_{\frac{NG(\widehat{y})}{x}}^{\overline{A}} dF(A)}{-NG'(u(W))u'(W)} & 0 \\ -\frac{u'(z)}{\left[\frac{1}{1-\beta^2}+\frac{\beta}{1-\beta^2}\left(F'(\frac{NG(\widehat{y})}{x})\frac{NG'(\widehat{y})}{x}\widehat{y}+F(\frac{NG(\widehat{y})}{x})\right)\right]} & \mu & \frac{-1}{\left[\frac{1}{1-\beta^2}+\frac{\beta}{1-\beta^2}\left(F'(\frac{NG(\widehat{y})}{x})\frac{NG'(\widehat{y})}{x}\widehat{y}+F(\frac{NG(\widehat{y})}{x})\right)\right]} \end{pmatrix} \tag{3}$$

where

$$\mu = \frac{\left[-\frac{\beta}{1-\beta^2}u'(z)\int\limits_{\frac{NG(\widehat{y})}{x}}^{\overline{A}} dF(A) - \int\limits_{\frac{NG(\widehat{y})}{x}}^{\overline{A}} u'(W)dF(A)\right]}{NG'\left(u(W)\right)u'(W)\left[\frac{1}{1-\beta^2}+\frac{\beta}{1-\beta^2}\left(F'(\frac{NG(\widehat{y})}{x})\frac{NG'(\widehat{y})}{x}\widehat{y}+F(\frac{NG(\widehat{y})}{x})\right)\right]} \tag{4}$$

This implies that

$$\begin{pmatrix} dW \\ dz \\ d\widehat{y} \end{pmatrix} = \Omega^{-1} \cdot \begin{pmatrix} 0 \\ NG_{\lambda}(u(W)) \\ \frac{\beta}{1-\beta^2}\left(F'(\frac{NG(\widehat{y})}{x})\frac{N}{x}G_{\lambda}(\widehat{y})\widehat{y}\right) \end{pmatrix} \cdot d\lambda \tag{5}$$

Hence

$$\frac{dW}{d\lambda} = -\frac{1}{NG'\left(u(W)\right)u'(W)} NG_\lambda(u(W)) \tag{6}$$

$$\frac{dz}{d\lambda} = -\frac{\int_{\frac{\beta(1-\beta)}{1-\beta^2}}^{\overline{A}} dF(A)}{\frac{NG(\widehat{y})}{x}} NG_\lambda(u(W)) \tag{7}$$

$$\frac{d\widehat{y}}{d\lambda} = \mu \cdot NG_\lambda(u(W)) + \frac{-\beta\left(F'(\frac{NG(\widehat{y})}{x})\frac{N}{x}G_\lambda(\widehat{y})\widehat{y}\right)}{\left[1+\beta\left(F'(\frac{NG(\widehat{y})}{x})\frac{NG'(\widehat{y})}{x}\widehat{y} + F(\frac{NG(\widehat{y})}{x})\right)\right]} \tag{8}$$

Note that by definition of the shift λ, $G_\lambda(u(W)) \leq 0$ for $u(W) \leq 0$. This implies that $\frac{dW}{d\lambda} \geq 0$ and $\frac{dz}{d\lambda} \geq 0$.

To evaluate the sign of $\frac{d\widehat{y}}{d\lambda}$, note that $\mu \leq 0$. Hence, for $u(W) \leq \widetilde{y}$, the first term in (8) will be non-negative. To evaluate the sign of the second term in (8), note that $u(W(A)) > \widehat{y}$, hence for $u(W) \leq \widetilde{y}$ it must be the case that $\widehat{y} < \widetilde{y}$ and $G_\lambda(\widehat{y}) \leq 0$. Therefore the second term in (8) is also non-negative. This implies that $\frac{dW}{d\lambda} \geq 0$. ■