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ABSTRACT

The existing theoretical analysis of microfinance focuses on the nature of the loan contract such as group liability. We draw attention to the role of missing or imperfect labor market in understanding some of the important 'second generation' debates in microfinance. Our analysis helps explain a number puzzles in microfinance such as (i) high repayment rates with high interest rates, (ii) difficulties in scaling up projects, (iii) conflicting views about interest rate elasticity of demand for microcredit. The analysis implies that while microcredit can play a vital role when labor markets are underdeveloped, demand for such loans may progressively decline as markets develop.

Key Words: Microfinance, Microcredit Puzzles, Labor Market, Missing Markets, High Interest Rate, Scaling Up, Interest Rate Elasticity of Microcredit, Progressive Lending, Structural Change

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(1) Introduction

Microfinance programs in developing countries have been enormously successful in providing credit to the poor women without any collateral who are largely bypassed by the conventional banks. Their success attracted the attention of both academic economists and policy practitioners around the world, and the flagship microfinance program Grameen Bank in Bangladesh and its founder Muhammad Yunus have been awarded Nobel peace prize in 2006. There is now a voluminous literature analyzing different aspects of the microfinance revolution that swept across the developing world in last thirty years (for an excellent recent survey, see Aghion and Morduch (2010)). The existing economic research on microfinance can be divided into two broad areas: (i) the theoretical analysis of the distinctive features of credit contracts (such as joint liability and dynamic incentives) with an emphasis on their implications for solving the adverse selection and moral hazard problems (see, for example, Stiglitz (1990), Besley and Coate (1995), Ghatak (2000), Aghion and Morduch (2000), Laffont and Rey (2003), Laffont and Guessen (2000)), and (ii) the empirical analysis that focuses on the evaluation of the effects of such programs on the welfare of the borrowers, especially the women (see, for example, Pitt and Khandker (1998), Banerjee et al (2009), Morduch and Roodman (2009), Kaboski and Townsend (2005, forthcoming), Emran et al. (2009)).

The theoretical literature on microfinance almost exclusively focuses on the role of missing credit market for poor women who lack any collaterizable assets. The poor households and, in particular poor women, in villages of developing countries, however, face a multitude of other missing or imperfect markets (where markets exist); missing labor market being one of the salient cases. It is important to understand the role of other missing markets, because if only the credit market is missing with all other markets functioning properly, the resulting resource allocation is Pareto-efficient. This paper explores the implications of missing (or imperfect) female labor market for the microfinance movement.[2] Our analysis shows that missing or imperfect labor market may be a key to understanding some of the most important and intensely debated issues facing the microfinance movement today, including the high interest rate, difficulties in scaling up small scale home-based microfinance activities to small and medium scale enterprises, and supposedly low interest rate elasticity of demand for microfinance loans.

The interest rates charged by the microfinance NGOs are much higher compared to the interest rates charged by formal banks; 30-60 percent annual interest rate is common in microfinance loans. In some instances, it can be more than 100 percent.[3] The critiques of high interest rates argue that these rates are 'usurious' (MFIs are 'neo-moneylenders' in this view), but the proponents point out that such high interest rates are necessary to recover the costs incurred in intensive village level administration of small scale loans. The

[2] Although we couch the discussion in terms of female labor market, the main conclusions are gender-neutral, as long as the labor market is missing or characterized by significant transactions costs.

[3] According to one source, the average microfinance interest rates in Asia- Pacific countries are between 30 percent to 70 percent (Fernando, 2006).

high interest rates charged in microcredit have become a focal point of recent debate, with policy makers in some countries imposing a ceiling on interest rates. The literature on high interest rates in microcredit has so far concentrated primarily on the question of why competition among NGOs is not driving down the interest rates. Our focus here is different: we are interested in understanding how poor women can repay these high interest rate loans even though they cannot reap any economies of scale (typical first loan is $50-$200, and repayment rate is more than 90 percent in most of the MFIs). How can micro activities such as backyard chicken raising yield more than 50-60 percent rate of return when the returns to large scale vertically integrated poultry farms are in the range of 20-30 percent?[4]

Interestingly, the recent estimates in fact show that the returns to capital can be very high in small and medium enterprises in developing countries (de Mel et al (2008, 2009), Banerjee and Duflo (2005, 2008)). But the evidence also shows that there are important heterogeneity in the returns; they depend on the gender and entrepreneurial ability. The returns to the investments undertaken by women is, in general, much lower than that to the investments undertaken by men, thus deepening the puzzle of millions of poor women successfully repaying high interest rate loans. The evidence also shows that the credit (grant) interventions fail to increase employment.[5] Also, as noted by Banerjee (2004) and Banerjee and Duflo (2005), persistent misallocation of capital can give rise to pockets of very high returns, even though the average rate of return to capital is not very high in a developing country. The difficulty in explaining the high repayment rates with high interest rates in microcredit programs arises from the fact that millions of poor women seem to generate very high returns to very small investments, the high returns are not confined to a subset of microentrepreneurs with exceptional ability. Although there can be alternative explanations for high rate of returns to micro investments, we investigate the possible role played by labor market imperfections. The analysis provided here complements the existing explanations that focus on other factors such as the shape of the production function and short gestation or production cycle (see Aghion and Morduch (2010), CGAP (1996)).[6]

[4]The available evidence on the returns to large and small scale poultry farming in developing countries shows that returns are much higher for large scale vertically integrated poultry farms (see, for example, Ara Begum (2005) on Bangladesh, NBARD (2005) on Uttar Pradesh, India). According to the estimates presented in an evaluation of poultry farming in 2005 by National Bank for Agriculture and Rural Development (NBARD) in Uttar Pradesh, India, net financial return is 14 percent for a 500 birds farm compared to 24 percent for a 1000 birds farm. There is also evidence that the net return is negative for small poultry farms.

[5]As we discuss later, this lack of employment effects is an implication of the theoretical analysis developed in this paper.

[6]Our focus here is on the returns to micro-investments. This assumes that the credit from MFIs goes to start a new business or to expand existing business (productive activity). However, as widely recognized in the literature, microcredit may be used for many other purposes, including weathering negative shocks (insurance market is missing), and to finance indivisible purchases such as consumer durables (missing consumer credit market). In such cases, the borrower presumably repays the loan by taping into other income sources.

An important argument against the microcredit programs is that they may trap entrepreneurs with small scale inefficient projects, and thus may hinder the structural change in the economy.[7] The microfinance programs have found it difficult to scale up the loans to make the transition from small scale household activities to medium and large scale operations.

The recent experience of some of the most prominent microcredit NGOs such as BRAC in Bangladesh shows that the scaling up of the loan size may not be easy, as most of the microentrepreneurs may not be willing to take larger loans at the going interest rate. For example, the small and medium enterprise (SME) loan program of BRAC failed to attract borrowers from the existing microcredit client pool. When the existing microcredit borrowers were allowed to take larger loans, to the surprise of BRAC loan officers, a large proportion of them declined it. This unwillingness (or inability) to scale up the investment projects appears especially puzzling when one tries to square it up with the presumed high rate of returns to the micro investments as discussed above. The results from our analysis show that, even in the absence of diminishing returns in the technology, a microentrepreneur may not find it profitable to expand the scale of operation beyond a threshold when the labor market is imperfect or missing. To be sure, the lack of demand for larger loans can also be due to other factors such as risk aversion in the absence of functioning insurance markets, and lack of demand for the products of microenterprises in isolated local markets.[8] Our analysis brings the focus on the role played by imperfect or missing labor market which has been largely ignored in both the academic and policy discussions on microcredit.

In recent years, a lot of discussion on microcredit has centered on the desirability of high interest rates for reducing dependence on donor subsidy in microcredit programs. More importantly, it has been widely argued by the microfinance NGOs and their supporters that such high interest rate *does not* have any significant negative effect on the borrowers. For the the poor clients served by the microfinance, the argument goes, it is the *access* not the *cost* (interest rate) that matters (see, for example, CGAP, 1996, Robinson, 2001). The implicit assumption being that the interest rate elasticity of demand for microcredit is close to zero.[9] If this assumption is correct, one can argue that a high interest rate is desirable for the expansion of microcredit coverage. However, this "practitioner's wisdom" of a close to zero interest rate elasticity appears rather unusual to an economist. In an interesting

[7] As the argument goes: no country can reach a per capita income of $10000 by raising chicken in the backyard, or making clothes in small scale handlooms (as is done in Grameen Check in Bangladesh).

[8] The MFIs are well aware of the implications of missing insurance markets and lack of market integration. For example, the BRAC in Bangladesh started a project to connect the microcredit borrowers who bought cows to the urban markets in Bangladesh. BRAC's project collects and pasteurizes the milk, and supplies it to the urban centers under their own brand name "Aarong Milk". BRAC started the Aarong Milk project after the borrowers complained that no one in the village wants to buy milk, but everyone wants to sell, thus causing a glut in the local market. But there were no private traders who came forward to fill in the missing marketing institutions.

[9] This argument is about efficiency costs of higher interest rate. Even with zero interest rate elasticity, the welfare of the existing borrowers are negatively affected when interest rate is increased.

paper, Dehejia et. al. (2007), in fact, show that the interest elasticity of microcredit loans is significantly negative. This poses the puzzle, then why the practitioners tend to believe that the interest rate elasticity is very low, practically close to zero? Our analysis provides a possible explanation of this disjoint between the "practitioner's wisdom" and the econometric evidence.

While the labor market is, in general, underdeveloped in the developing countries, characterized by significant unemployment and segmentation (Basu (1997), Ray (1998), Dasgupta (1993), Bardhan (1984), Mammen and Paxson (2000)), the formal labor market for women is essentially non-existent.[10] As noted by Mammen and Paxson (2000), "...there may be costs associated with women working outside of the domain of the family farm or nonfarm family enterprise. ...Custom and social norms may also limit the ability of women to accept paid employment, specially in manual jobs. Finally, off-farm jobs may be less compatible with child rearing, creating fixed costs of working offfarm" (P. 143). In addition, the lack of a well-developed market for prepared meals, and absence of mechanized substitutes for household work (such as dishwasher and laundry) may add to the cost of participation in the formal labor market by women (especially when the consumer credit for durable goods is missing, as is the case in rural areas of most of the developing countries). This implies that, in most of the cases, the household optimization treats female labor endowment as effectively non-traded.

Even where the market for female labor exists, the 'selling price' (i.e., the effective wage rate after netting out monetary and non-monetary costs of participating in the outside labor market) is, in general, much lower than the 'buying price' (i.e, the wage paid by the employer), due to the transaction costs.[11] The transactions costs include fixed costs associated with child rearing, and stigma because of social norms regarding women's participation in the formal labor market (such as *Purdah*) along with the usual search, information and monitoring costs (Sadoulet et. al., 1996, Amin, 1997). The existence of a transaction cost band implies that many households fall within the band, and the female labor endowment becomes non-tradable for such a household (i.e., household specific missing market for female labor).

Using a simple model that incorporates transaction costs in the labor market (missing market being the extreme case), and heterogeneity in the household's endowment of non-labor resources (land), we show that:

(i) the surprising credit worthiness of poor microcredit borrowers facing very high inter-

[10]For example, according to estimates based on Ghana Living Standards Survey (1998/99), less than one percent female have regular (formal) employment, and 56 percent are self-employed (Blunch (2006)). This includes both rural and urban households. The estimates reported by Mammen and Paxson (2000) for Cote d'Ivoire using 1988 Living standard measurement Survey indicate that "only 5.6 percent of the women did *any* work as employees" (italic in original).

[11]Note that women's wage is much lower compared to that for men to begin with. According to the estimates presented by Hossain and Bose (2004) for Bangladesh, women's average wage in agriculture was 58 percent of men's wage in 2000. When one factors in the costs of participation, the effective wage (selling price) becomes very low for women.

est rate may be explained in terms of labor market imperfections. The maximum interest rate that can be charged to a microentrepreneur without violating her participation constraint depends on two factors (a) the non-labor resource endowment of the household, and (b) the width of the transaction cost band in the labor market in her village.

(*ii*) the transition from small-scale home based activities to the medium and large scale operations may prove difficult, if not impossible. Even with a constant returns technology, the microentrepreneurs might not be willing to scale up their investment at a given interest rate. This lack of demand for larger loans can be understood in terms of either (a) a discontinuous increase in the wage rate faced by a household as it switches side in the labor market turning into a net demander, or (b) a market structure induced diminishing returns to capital for households that fall in the transaction cost band (see below).

(*iii*) consistent with the recent empirical evidence (Dehejia et. al., 2007), the interest rate elasticity of demand for microcredit may be significantly negative even though certain groups of borrowers do not reduce their demand for credit facing a higher interest rate (the practitioner's wisdom).

(*iv*) the effectiveness of *progressive lending* as an instrument of contract enforcement (dynamic incentives) is likely to depend on the household's location in the labor market with regards to the transaction cost band.

The analysis presented here has important implications for the appropriate role of microcredit in developing countries. Perhaps the most important implication is that, as women's labor market in developing countries become more developed, most of the collateral-poor women may find it more attractive to work in the labor market than become a microentreprenur that relies on the household labor. This means that while microcredit can play a vital role in creating economic opportunities for women when women's labor market is underdeveloped, it may lose its appeal in the longer term. In this sense, microcredit cannot be a long term development strategy.[12]

The rest of the paper is structured as follows. The next section lays out the basic model of the economy, for concreteness called "Grameen Economy".[13] Section (3) analyzes the logic of credit worthiness at extremely high interest rates by looking at the participation constraint of a household that critically depends on the non-labor resources available to a household and the structure of the labor market. We use the 'Neoclassical' labor market without any transaction costs as the benchmark. The following section (i.e., section 4) explains the puzzle of a lack of demand for larger loans by focusing on the diminishing returns to capital caused by the "non-traded" female labor. Section (5) discusses the

[12]However, microfinance movement has grown out of microcredit and has increasingly focused on a variety of products including savings and micro-insurance. For example, Grameen Bank offers education loans, and housing loans to its members. Explicit insurance features are built into the Grameen II program where a borrower facing a negative shock can renegotiate the repayment. It is possible that even in the longer term when both formal credit market deepens and women's labor market develops, microfinance may retain a niche market focusing on these products.

[13]In Bengali, "Grameen" means 'rural'. The most famous microfinance program "Grameen Bank" of Bangladesh thus means 'rural bank'.

response to a higher interest rate by households depending on their location relative to the transaction cost band in the labor market. Section (6) traces out the implications of a transaction cost band in the labor market for efficacy of dynamic incentive schemes that rely on loan size as a disciplining mechanism. The paper concludes with a summary of the results and a discussion of their implications for the appropriate role of microcredit in long run development of a developing economy.

(2) The Model

The Grameen economy consists of a continuum of households indexed by the non-labor resources owned by a household. For simplicity and concreteness, we lump together all the different non-labor resources and call it land (denoted as H). H is distributed uniformly over the unit interval $[0, 1]$.[14] This implies that we include the landless households as an equally important group.[15] To focus on the role of the labor market, and for the sake of tractability, we assume that there is no land market.[16] This can be thought of as only approximately valid, and can be partly justified in terms of the empirical evidence that the land market is very thin with little or no transactions in most of the developing countries (Hoff et al. (1993)). Each household is endowed with a fixed amount of female labor, denoted as L_f . The labor is supplied inelastically and thus we abstract from the labor-leisure trade-off.

We build the analysis on a simple general equilibrium model of households facing transactions costs in the female labor market. We adopt the standard approach to modeling transaction costs in terms of a transactions cost band that creates a wedge between the buying (paid by the employer) and selling (received by the household) price of female labor, with the buying price (denoted as $(1 + \phi_2)w$) higher than the selling price (denoted as $(1 - \phi_1)w$).[17] This approach to modeling transaction costs in a market owes its origin to the early contributions in the general equilibrium models with transaction cost such as Foley (1970), Hahn (1971), and is now widely used in the literature on agricultural household modeling (see, Singh et. al. 1986 for early contributions, and de Janvry and Sadoulet (1999) for a recent survey). On the supply side, the transaction costs (ϕ_1) reflect, among other things, the costs of information and search in the labor market. They also include, especially for women, more intangible costs of participating in the formal labor market arising from religious or social customs like *Purdah*.[18] An alternative interpretation, not

[14] This assumption about the distribution of resources in the economy is for simplicity and does not affect the central results of the paper.

[15] In more realistic case, the land distribution will have a mass point at zero, as the proportion of landless may be significant in a given developing country. However, the central results derived in the paper are not sensitive to such modification in the land distribution.

[16] When there is no credit available (i.e., no MFI operating in the village), a well functioning land market would lead to Pareto efficient allocation even if the labor market is missing. In this case, missing labor market has efficiency implications only if the land market is not working properly or completely missing.

[17] As noted by Foley (1970) in his seminal paper on general equilibrium model with transaction costs it is not possible to have an equilibrium with higher selling price.

[18] Although *Purdah* is usually associated with the veil a woman wears, as noted by Amin (1997), it is

pursued in this paper, is that ϕ_1 is the unemployment rate in an appropriate model of unemployment, such as search and/or efficiency wage (Mirrlees (1975), Stiglitz (1976)), and thus $(1-\phi_1)w$ can be interpreted as the expected wage faced by a household factoring in the unemployment rate when it looks for an outside employment. We leave the analysis of unemployment for a future occasion, and assume that the labor market clears at the equilibrium wage rate. On the demand side, the transaction cost in employing hired labor, ϕ_2, reflects the costs due to monitoring to control moral hazard. However, to make the central points of the paper, it suffices to focus on the transactions costs in the supply side of the market, and our analysis will thus ignore the demand side transactions costs in the labor market, and for rest of the paper we set $\phi_2 = 0$. To keep the model simple, we assume that the transaction costs are "iceberg costs" familiar from the economic geography (Fujita, Krugman, Venables (2001)). This allows us to ignore the complications that arise from the need for keeping track of the income generated in the "transactions sector" of the economy. We believe that this is an appropriate simplifying assumption for a developing economy where there is little or no specialized employment agencies that match the employer with a potential employee.[19]

There are two commodities that can be produced by a household: rice (denoted as 'a' for agriculture) and poultry (denoted as 'c' for chicken). The production of rice needs land and labor, while the production of poultry only requires capital and labor. The production functions are constant returns:

$$Q_a = H^{\alpha} L_{fa}^{1-\alpha} \; ; \; \alpha \in (0,1) \quad \text{and} \quad Q_c = K^{\gamma} L_{fc}^{1-\gamma} \; ; \; \gamma \in (0,1)$$

where K is the capital used in poultry production, and L_{fa} and L_{fc} are the labor used in the production of rice and poultry respectively.

The rice is chosen as the numeraire good, and the relative price of poultry is denoted as P_c. To simplify the analysis, we assume that both of the commodities are tradables and their prices are determined at the world market. A household maximizes its income given its land and labor endowment and given the price vector. The households do not have access to credit market in the absence of a microfinance NGO program.

We consider the effects of both small and large scale microcredit interventions in the Grameen economy. The "small intervention" analysis will be appropriate for the case where only a single household or a small proportion of households in the Grameen economy get microcredit, and thus there is no perceptible impact of the credit intervention on labor market equilibrium, and wage response is negligible. We can ignore the implications of general equilibrium wage response for such an analysis. The formal results below for the

better understood as a set of complex social norms that enforce women's economic and social seclusion and make it costly for them to participate in the market.

[19] An alternative approach to modeling imperfections is to specify the transaction costs in terms of labor used by the households in search, monitoring etc. For general equilibrium analysis that adopts this approach, see, for example, Kurz (1974), and for an interesting application to agrarian organization in developing countries, see Eswaran and Kotwal (1985)).

small intervention case are derived in the specific context of a marginal intervention for a single household, but the results are relevant for any intervention small enough to leave the equilibrium wage essentially unchanged. The formal analysis for the large scale intervention focuses on the case of global intervention where every household in the Grameen economy gets credit. The results and insights from this polar case are, however, useful for understanding the effects of any large scale intervention that affects the equilibrium wage significantly.[20]

Household Optimization

The household optimization depends on whether or not it has access to microcredit. A household with land H can potentially allocate its labor endowment (L_f) among alternative options: produce rice, produce chicken (if it gets credit), and sell labor to the market. Consider a household that participates in the microcredit program (K, r). Note that we assume that the household does not have a choice about the loan size k, and is offered a credit contract (K, r) as a take it or leave it. This is a good description of the microfinance credit market, especially for the first time borrowers. The optimization problem faced by a household is as follows:

$$Max_{L_{fa},L_{fc}} \quad Y = H^{\alpha} L_{fa}^{1-\alpha} + P_c K^{\gamma} L_{fc}^{1-\gamma} + \breve{w}\left[L_f - (L_{fa} + L_{fc})\right] - (1+r)K \qquad (1)$$

where $\breve{w}$ is shadow wage rate faced by the household and it depends on its location relative to the transaction cost band. If it is a net supplier of labor, then $\breve{w} = (1-\phi_1)\tilde{w}$, and $\breve{w} = \tilde{w}$ for a net buyer of labor from the market, and $\tilde{w}$ is market clearing wage rate. For a household that does not have access to microcredit $K = 0 = L_{fc}$, and for a landless household $H = 0$. Denote the optimal labor allocation choices by L_{fc}^* and L_{fa}^*. The household participates in a microcredit program (K, r), only if the maximum income is higher with the microcredit compared to the maximum income without microcredit. Define the following maximum income function:

$$Y^*(H, \breve{w}, K, r, P_c) = H^{\alpha}\left(L_{fa}^*\right)^{1-\alpha} + P_c K^{\gamma}\left(L_{fc}^*\right)^{1-\gamma} + \breve{w}\left[L_f - \left(L_{fa}^* + L_{fc}^*\right)\right] - (1+r)K \quad (2)$$

So a household H participates in the microcredit program (K, r), if the following holds:

$$Y^*(H, \breve{w}, K, r, P_c) \geq Y^*(H, \breve{w}, 0, r, P_c) \quad ; \text{Participation Constraint} \qquad (3)$$

Note that when labor market is missing, the shadow wage rates above will differ across two sides of inequality (3).

Labor Market Clearing

[20] Kaboski and Townsend (forthcoming) provide evidence that the large scale intervention in Thailand called Million Baht Fund affected the equilibrium wage significantly.

The equilibrium wage rate $\tilde{w}$ is determined from the following labor market clearing condition:

$$\int_0^1 \left[L_{fa}^*\left(\tilde{w}, H, \cdot\right) + L_{fc}^*\left(\tilde{w}, H, \cdot\right)\right] dH = L_f \tag{4}$$

(3) Economics of High Interest Rate

(3.1) Missing Female Labor Market

To understand the implications of heterogeneous shadow price of labor across different households in its pristine form, we first compare the two polar cases: (i) the missing labor market ($\phi_1 = 1$), and (ii) the Neoclassical labor market ($\phi_1 = 0$).[21] We show that a household will be willing to pay a higher interest rate when there is no labor market for female labor compared to a benchmark of the Neoclassical labor market if its land holding is smaller than a threshold and the loan size offered by the microfinance NGO is not too large. The results derived under the assumption of a missing female labor market, however, apply to the more general case where there are transaction costs in the labor market, and one is considering the households that fall within the transaction costs band.

Proposition 1(Marginal Intervention With a Missing Market)

Consider a marginal credit intervention by an NGO in the Grameen economy where a single household with land holding H gets credit $K > 0$. There exists critical thresholds $\hat{H} \in \left(0, \frac{1}{2}\right)$ and $\hat{K} > 0$ such that the maximum feasible interest rate (i.e., the interest rate an NGO can charge without violating the participation constraint) is higher if the female labor market is missing compared to the Neoclassical benchmark, if $H \leq \hat{H}$ and $K < \hat{K}$.

Proof:

By assumption, the credit intervention is marginal. So the market clearing wage rate before and after the credit intervention is same for the Neoclassical case (denoted as w^*). Denote the maximum interest rate the household H wants to pay when facing w^* in a zero transactions cost competitive labor market as $r^*(H)$ which is is determined by the participation constraint:

$$Y^*(H, w^*, K, r^*(H), P_c) = Y^*(H, w^*, 0, r^*(H), P_c) \tag{5}$$

$$\text{which implies:} \qquad r^*(H) = \gamma P_c^{\frac{1}{\gamma}} \left[\left(\frac{(1-\gamma)}{w^*}\right)^{\frac{1-\gamma}{\gamma}}\right] - 1 \tag{6}$$

$$\text{where } w^* = \frac{1-\alpha}{(2L_f)^{\alpha}} \tag{7}$$

[21] We emphasize here that even though a completely missing female labor market is clearly an abstraction, it is not an unrealistic one when only one percent of female labor have regular employment outside the household, as is the case in Ghana noted before.

Unsurprisingly, with a competitive labor market, the maximum interest rate does not depend on the land owned by a household.

In the missing market case, the household faces a shadow price for labor ($\breve{w}$) which changes after the credit intervention. Denote the shadow prices of female labor as λ_1 (no credit) and λ_2 (with credit). When the labor market is missing, the maximum interest rate a household H is willing to pay is denoted as $r^0(H)$ which is determined from the participation constraint:

$$r^0(H) = \frac{H\left[\left(\frac{1-\alpha}{\lambda_2}\right)^{\frac{1-\alpha}{\alpha}} - \left(\frac{1-\alpha}{\lambda_1}\right)^{\frac{1-\alpha}{\alpha}}\right]}{K} + P_c^{\frac{1}{\gamma}}\left(\frac{1-\gamma}{\lambda_2}\right)^{\frac{1-\gamma}{\gamma}} - 1 \tag{8}$$

The shadow prices λ_1 and λ_2 are determined by the following internal labor market clearing conditions:

$$\left(\frac{1-\alpha}{\lambda_1}\right)^{\frac{1}{\alpha}} H = L_f \tag{9}$$

$$\left(\frac{1-\alpha}{\lambda_2}\right)^{\frac{1}{\alpha}} H + \left(\frac{(1-\gamma)P_c}{\lambda_2}\right)^{\frac{1}{\gamma}} K = L_f \tag{10}$$

It is obvious from equations (9) and (10) above that $\lambda_2 > \lambda_1$.

Now consider the household with the lowest land size, i.e., a landless household ($H = 0$). In this case, a sufficient condition for $r^0(0) > r^*(0)$ to hold is that the loan size K satisfies the following:

$$K < \hat{K} = \gamma^{-\frac{1}{1-\gamma}}\left(\frac{1-\alpha}{(1-\gamma)2^{\alpha}P_c}\right)^{\frac{1}{\gamma}} L_f^{\frac{\gamma-\alpha}{\gamma}} \tag{11}$$

The above inequality follows from equations (6) and (8), and from the observation that the shadow prices for labor for a landless household can be solved as follows:

$$\lambda_1 = 0, \text{ and } \lambda_2 = [(1-\gamma)P_c]\left(\frac{K}{L_f}\right)^{\gamma} \tag{12}$$

For rest of the discussion here, assume that $K < \hat{K}$. Now we show that $r^0\left(\frac{1}{2}\right) < r^*\left(\frac{1}{2}\right)$ and thus $\hat{H} \in \left(0, \frac{1}{2}\right)$ where $\hat{H}$ such that $r^0\left(\hat{H}\right) = r^*\left(\hat{H}\right)$. To establish $r^0\left(\frac{1}{2}\right) < r^*\left(\frac{1}{2}\right)$, we rely on the observation that for a household $H = \frac{1}{2}$, the maximum interest rate household wants to pay is same for the following two cases: (i) missing market with marginal intervention and (ii) global intervention (where every household gets credit) in a Neoclassical labor market; i.e., $r^0\left(\frac{1}{2}\right) = r_g^*\left(\frac{1}{2}\right)$, where r_g^* denotes the maximum interest rate under a global microcredit intervention in a neoclassical labor market (see proposition

(3.a) below).[22] Then the proof follows from the observation that the maximum interest rate in a Neoclassical market is higher under marginal intervention compared to a global credit intervention, i.e., $r^*\left(\frac{1}{2}\right) > r_g^*(\frac{1}{2})$. This last inequality follows from equation (6) above, and from the fact that $w_g^* > w^*$, where w_g^* is equilibrium wage under global credit intervention.

Now it is easy to check that the following holds:

$$\frac{\partial r^*}{\partial H} = 0 \ \forall H \quad \text{and} \quad \frac{\partial r^0}{\partial H} < 0 \ \forall H \text{ , because } \lambda_2 > \lambda_1 \tag{13}$$

So it follows that $r^0(H) > r^*(H) \ \ \forall H \in (0, \hat{H})$. QED

Although it is not possible to get a closed form solution for the threshold landholding $\hat{H}$, we can derive a stricter bound $\tilde{H} < \hat{H}$ so that $\forall H < \tilde{H}$ we have $r^0(H) > r^*(H)$. The bound $\tilde{H}$ is defined as $\lambda_2(\tilde{H}) = w^*$. Intuitively, given the loan size K, the household $\tilde{H}$ is self-sufficient both under the missing market and a Neoclassical labor market. However, the reservation income is higher in the neoclassical case as $\lambda_1 < \lambda_2(\tilde{H}) = w^*$. From equations (7) and (10), we have the following:

$$\tilde{H} = \frac{1}{2} - K\left[P_c \frac{(1-\gamma)}{(1-\alpha)}\right]^{\frac{1}{\gamma}} (2L_f)^{\frac{\alpha-\gamma}{\gamma}} \tag{14}$$

Note that $\tilde{H} > 0$, if K is not too large.

Discussion on Proposition 1

Proposition (1) above provides us with the main results for understanding the willingness of poor women to take high interest rate microcredit loans and successfully repay them.[23] The intuition behind the results is simple. When the labor market is missing, the shadow wage of labor without credit is very low in a household when it owns little or no land (In our simple model shadow price of labor of landless household is zero). Access to microcredit enables the labor within the household to be productive, even though the outside labor market is missing. When a household considers an offer to join a microcredit program, it values labor at the very low shadow wage, and thus the net income gain from access to microcredit is much higher than would be indicated by the marginal product of capital in micro activities undertaken by poor women. The women are thus willing to pay very high interest rate for access to such loans.

The intuition behind the thresholds imposed on the land endowment and the loan size is as follows. The condition that $K < \hat{K}$ ensures that the loan size is not so high that it makes a landless household's shadow price of labor under missing market too high compared to

[22] Note that by definition the interest rate has to be low (if no price discrimination), or heterogeneous across households in a global credit intervention to satisfy the participation constraints.

[23] In this paper, we abstract away from the issues related to strategic default. We assume that the household do not repay only if it does not have enough returns to the project.

the neoclassical equilibrium wage. If $K > \hat{K}$, a landless household would hire labor from the market (under the Neoclassical case), because its shadow price of labor is now higher than the market equilibrium wage w^*. Thus, with $K > \hat{K}$, a landless household would reap higher income in a Neoclassical labor market, as it gains from the lower wage in the market compared to its shadow price (assuming that the shadow price with credit is high enough).

The condition that $H < \hat{H} < \frac{1}{2}$ captures the idea that the shadow price of labor before the credit intervention is low only for relatively land-poor households, and they have the most to gain from access to credit (especially because the MFIs do not price discriminate on the basis of non-labor resource endowment). Given any level of $K < \hat{K}$, there exists a household $H < \frac{1}{2}$, for which the credit intervention would make the shadow price of labor sufficiently higher than the Neoclassical equilibrium wage w^* so that the household's maximum income would be higher under the perfect market case. To see this note that the shadow price of labor for the household $H = \frac{1}{2}$ in the absence of credit is equal to the neoclassical equilibrium wage w^*, i.e, $\lambda_1\left(H = \frac{1}{2}\right) = w^*$. This implies that even an arbitrarily small amount of capital $K > 0$ would make its shadow price higher than w^*. The reservation income (maximum income in the absence of credit) is same for $H = \frac{1}{2}$ under both market structures, but, with credit, the household attains higher income under a Neoclassical market as it can hire more labor and expand poultry production. By continuity, it then follows that there exists a $\hat{H} \in (\tilde{H}, \frac{1}{2})$ such that credit intervention $(K < \hat{K})$ makes its shadow price higher than the Neoclassical wage, i.e, $\lambda_2\left(K, \hat{H}\right) > w^*$, and the shadow price without credit is lower, i.e, $\lambda_1(\hat{H}) < w^*$, so that the maximum interest rate the household $\hat{H}$ is willing to pay is same across missing labor market and the Neoclassical labor market. The upshot of the above discussion is that, as long as the loan size is not too large and the microcredit programs target relatively land-poor households, a microcredit borrower will be willing to pay higher interest rate when labor market is missing compared to the case when labor market is perfect with zero transactions costs.

The restrictions on the landholding and the loan size needed for the validity of proposition 1 are likely to be satisfied in a typical microcredit program. For example, a major eligibility criterion in the pioneering Grameen Bank microcredit program is that the household's land ownership can not exceed 0.5 acre, and the land ownership cut-off is 0.10 acre for the Targetting Ultrapoor Program of BRAC, the largest NGO in Bangladesh. The loan size in a typical microcredit program is also very small, usually in the range of US \$50- US \$200.

One interesting implication of the above analysis is that it is the poorest segment of the population (in terms of non-labor resource endowment) who are willing to pay the most for access to credit. This follows directly from the comparative static result that $\frac{dr^0}{dH} < 0$. There is some evidence that, in fact, it is the relatively land-poor households who participate in such programs (Khandker, 1998). This implication of the model, although intuitive, runs counter to the widely discussed observation that the standard microcredit

programs are unable to reach the poorest of the poor, i.e., the so-called "ultra poor".[24] We, however, note that the non-participation of ultra poor can be understood in terms of our model if we introduce heterogeneity in the labor endowment. If the 'effective' labor endowment varies across households due to differences in human capital, especially health (for example, nutrition efficiency wage effects), then the ultra poor can be thought of as the segment of population that lacks in effective labor endowment (bad health and low work capacity). A lower effective labor endowment implies that the maximum interest rate a household is willing to pay and still accept the membership of microfinance program is also lower. As a result, an ultra poor household might fail to participate in (or be excluded from) both the credit and labor markets.[25]

Global Credit Intervention With Missing Labor Market

The discussion so far focused on a case where the coverage of the credit intervention is small enough so that it does not affect the labor market equilibrium in the Neoclassical benchmark. This is probably a good description of the microfinance industry in many African countries where the MFI penetration is still very low. But in some countries such as Bangladesh and Bolivia, this assumption may not be tenable for a significant number of villages. In this section we analyze the maximum interest rates household wants to pay under the missing market and the Neoclassical market assuming that every household gets credit. The main results are stated below in proposition (2).

Proposition 2 **(Global Intervention with a Missing Labor Market)**

Consider the global intervention where a microfinance NGO provides credit $K > 0$ to every household in the Grameen economy. The maximum interest rate a household is willing to pay for microcredit membership under a missing labor market is

(2.*a*) *equal to the maximum interest rate under a Neoclassical labor market if* $H = \frac{1}{2}$;

(2.*b*) *higher than the maximum interest rate under a Neoclassical labor market if* $H < \frac{1}{2}$.

Proof:

(2.a) First, note that for a household with landholding $H = \frac{1}{2}$ the shadow wage rates λ_1 and λ_2 are equal to the corresponding Neoclassical market clearing wage rates (w^* and w_g^*). This can be seen by comparing the equations (9)-(10) to the following market clearing

[24] However, there is some recent evidence that shows that the standard microcredit programs in Bangladesh have reached significant numbers of ultra-poor. In a recent analysis using a large data set (more than 280000 households) from three districts in Northern Bangladesh, Berg and Emran (2011) find that among the ultra-poor (owning less than 0.10 acre of land), microfinance membership is almost 40 percent.

[25] For a formal treatment along these lines, see Emran et. al. (2009).

conditions under the Neoclassical case:

$$\left(\frac{1-\alpha}{w^*}\right)^{\frac{1}{\alpha}}\frac{1}{2} = L_f \quad (15)$$

$$\left(\frac{1-\alpha}{w_g^*}\right)^{\frac{1}{\alpha}}\frac{1}{2}+\left(\frac{(1-\gamma)P_c}{w_g^*}\right)^{\frac{1}{\gamma}}K = L_f \quad (16)$$

This implies that the household with $H=\frac{1}{2}$ is self-sufficient in labor in the Neoclassical case both before and after the credit intervention. As a consequence, it behaves as if the labor market is missing. This implies that the maximum interest rate the household wants to pay for the credit is same for the missing market and Neoclassical cases. QED

(2.b) First, we prove that for a household $H<\frac{1}{2}$ the shadow prices of labor with and without credit λ_2 and λ_1 satisfy the following:

$$\lambda_1 < w^* \;;\quad \lambda_2 < w_g^* \quad (17)$$

$$(\lambda_2-\lambda_1) > \left(w_g^*-w^*\right) \quad (18)$$

The inequalities in (17) follow directly from a comparison of the Neoclassical market clearing conditions and the self-sufficiency conditions (i.e., market clearing in the internal labor market) in case of the missing market.

To prove inequality (18), consider the household with $H=\frac{1}{2}-\epsilon$ where $\epsilon>0$ is arbitrarily small. For such a household, the inequality (18) follows from the observation that starting from the case $H=\frac{1}{2}$ (and thus $\lambda_1=w^*\;;\quad \lambda_2=w_g^*$), a marginal reduction in the landholding reduces the demand for labor in the "internal labor market" more in the absence of credit compared to the case of a microcredit intervention. This follows from the following (denoting the labor demand in the internal labor market by L_D^0):

$$\frac{\partial L_D^0(\text{no credit})}{\partial H}\mid_{H=\frac{1}{2}}=\left(\frac{1-\alpha}{w^*}\right)^{\frac{1}{\alpha}}>\left(\frac{1-\alpha}{w_g^*}\right)^{\frac{1}{\alpha}}=\frac{\partial L_D^0(\text{credit})}{\partial H}\mid_{H=\frac{1}{2}};\ \text{because } w_g^*>w^*$$

To restore balance in the internal labor market, the shadow price of labor has to decline more when there is no credit compared to the case with credit, thus yielding inequality (18). The argument now applies a fortiori when we start from any arbitrary $H\in\left(0,\frac{1}{2}\right)$.

Now note that we can treat a household under missing market as if it is facing the perfect labor market with the parametric market wage rates λ_1 and λ_2. This observation allows us to write the gap between the maximum interest rates a household H wants to pay under alternative labor market arrangements and a global credit intervention as follows:

$$r_g^0(H)-r_g^*(H) = \Omega_H+\Omega_K+\Omega_L \text{ where}$$

$$\Omega_H = \frac{\alpha H}{K}\left\{\left[\left(\frac{1-\alpha}{\lambda_2}\right)^{\frac{1-\alpha}{\alpha}}-\left(\frac{1-\alpha}{\lambda_1}\right)^{\frac{1-\alpha}{\alpha}}\right]-\left[\left(\frac{1-\alpha}{w_g^*}\right)^{\frac{1-\alpha}{\alpha}}-\left(\frac{1-\alpha}{w^*}\right)^{\frac{1-\alpha}{\alpha}}\right]\right\}<0$$

$$\Omega_K = \gamma P_c^{\frac{1}{\gamma}}\left\{\left(\frac{1-\gamma}{\lambda_2}\right)^{\frac{1-\gamma}{\gamma}}-\left(\frac{1-\gamma}{w_g^*}\right)^{\frac{1-\gamma}{\gamma}}\right\}>0\;;\ \Omega_L=\frac{L_f}{K}\left\{\left[\lambda_2-\lambda_1\right]-\left[w_g^*-w^*\right]\right\}>0$$

For a landless household, we have $\Omega_H = 0$ and thus $r_g^0(H=0) - r_g^*(H=0) > 0$. Now it is easy to check that the gap between the maximum interest rates $\left(r_g^0(H) - r_g^*(H)\right)$ declines monotonically as the land size increases, and by proposition (2.a), the gap becomes zero at $H = \frac{1}{2}$. This implies that $\left(r_g^0(H) - r_g^*(H)\right) > 0 \ \ \forall H < \frac{1}{2}$. QED

In intuitive terms Ω_H is the difference in maximum income between the missing market and the Neoclassical case due to agriculture (rice production), Ω_K is the difference attributable to microcredit financed activity (poultry production) and Ω_L shows the difference in income due to general equilibrium wage response through the labor market.

Discussion on Proposition 2

Proposition 2 tells us that, under global intervention (compared to a marginal intervention), households with relatively higher land endowment are willing to pay higher interest rate when labor market is missing (compared to the Neoclassical benchmark). To see this observe that $\tilde{H}_g = \frac{1}{2} > \hat{H}$, where $\tilde{H}_g$ is defined such that $\lambda_2\left(\tilde{H}_g\right) = w_g^*$, and $\hat{H}$ was defined earlier in the proof of proposition (1) above. So a household with land $H \in (\hat{H}, \frac{1}{2}]$ will be willing to pay higher interest rate for microcredit under missing market if the credit intervention is global, but would not pay higher interest rate if credit intervention is marginal. Although proposition 2 deals with the polar case of global intervention, the insight is more general. Let μ be the proportion of households covered by a microcredit intervention, and $w^*(\mu)$ the corresponding equilibrium wage (so that $w^*(\mu = 0) = w^*$ in the Neoclassical labor market). Define $\tilde{H}(\mu)$ such that $\lambda_2\left(\tilde{H}(\mu)\right) = w^*(\mu)$, then it is easy to show that $\frac{\partial\left(\tilde{H}(\mu)\right)}{\partial\mu} > 0$. Thus any intervention that increases the equilibrium wage would also make it worthwhile for some households with relatively better land endowment to pay higher interest rate for credit when labor market is missing (compared to a Neoclassical market), but not under marginal intervention that leaves wage undisturbed.

(3.2) Labor Market With A Transaction Cost Band

We now turn to the case where there is a market for female labor but there is a wedge between the buying and selling price due to transaction costs. The following Lemma on the relative magnitude of wage faced by the land poor households (neoclassical vs. transaction cost) will be useful for the results.

Lemma 1

$(1-\phi_1)\tilde{w} < w^*$, where the wage rate $\tilde{w}$ clears the labor market given the transaction costs $\phi_1 > 0$.

Proof:

See the appendix.

What Lemma 1 states is that the net wage rate faced by a household who is a net seller of labor in the market is lower when the female labor market is characterized by transaction costs $\phi_1 > 0$ compared to the Neoclassical labor market with zero transactions costs.

Proposition 3 **(Marginal Intervention With a Transaction Cost Band)**

Consider a marginal credit intervention in the Grameen economy characterized by transactions costs ϕ_1 in the female labor market where an NGO provides credit $K > 0$ to a single household with land size H. The maximum feasible interest rate (i.e., the interest rate the NGO can charge without violating the participation constraint) depends on the span of the transaction cost band and the location of the household relative to the band.

Assume that H is such that the household remains a net supplier of labor after the credit intervention. For such a household

(3.a) the maximum feasible interest rate under transactions cost $r_{ts}(H)$ is higher than the maximum interest rate under Neoclassical benchmark $r^*(H)$;

(3.b) the gap between the maximum interest rates i.e., $r_{ts}(H) - r^*(H)$ is a positive function of the transactions cost ϕ_1.

Proof:

Please see the appendix.

Discussion on Proposition 3

The intuition for proposition (3.a) is simple. For a household that remains a net seller of labor after the credit intervention in an imperfect labor market ($\phi_1 > 0$), the shadow price of labor is $(1-\phi_1)\tilde{w}$, both before and after the intervention. Now lemma 1 above establishes that $(1-\phi_1)\tilde{w} < w^*$. Thus the labor cost is lower in an imperfect market, and the household uses more labor in poultry production and reaps higher total profit given the same amount of credit. Thus a household is willing to pay higher interest rate under imperfect labor market, compared to the case of perfect labor market with zero transactions costs.

The result in proposition (3.b) is easy to understand once we establish that the net wage rate faced by a household that is a net seller in the market is a negative function of the transactions cost parameter ϕ_1 (see the formal proof in the appendix). A labor market characterized by higher transactions costs implies that the shadow price of labor is lower for a household that sells labor. Then the result follows from proposition (3.a).

Note also that a higher transactions cost implies that the shadow price of labor in the absence of credit (λ_1) for more households fall within the transactions cost band, i.e, the number of household such that $\lambda_1(H) \in [\,(1-\phi_1)\tilde{w}, \tilde{w}]$ is a positive function of transactions cost ϕ_1. This follows from the fact that $\frac{\partial \tilde{w}}{\partial \phi_1} > 0$ (see appendix) along with the result used above that the net wage rate $(1-\phi_1)\tilde{w}$ is a negative function of ϕ_1. For the set of households that fall within the transactions costs band, the analysis of maximum interest rate is given by the results in proposition (1) above. In the polar case, when $\phi_1 = 1$, there is no supply of labor to the market, and labor market breaks down completely, and we have exactly the set-up studied in proposition (1).

The above results are simple, but they have profound implications for the microcredit movement. Perhaps the most important implication comes out of proposition (3.*b*) which shows that a household will be willing to pay progressively *lower* interest rate for microcre-

dit membership as the labor market develops, and changes in social norms and technological improvements reduce the cost of women's labor force participation, and transaction costs ϕ_1 goes down as a result. Also, in our simple model, there is no role for human capital. But in a more general analysis, net return from participating in the labor market will go up as women acquire more human capital, thus making microcredit at high interest rates less attractive.

Observe that even though the proposition (3) above deals with the households that are net supplier of labor after the credit intervention, it is important from a policy perspective because such households constitute the bulk of microfinance target groups. Thus the implications derived from the analysis above are relevant for most of the microcredit borrowers, especially because we include the households that fall in the transactions cost band.

Microcredit Interventions With Initial Non-zero Coverage

Propositions (1)-(3) above deal with an initial equilibrium where there is no microcredit intervention. This might be a good approximation for many villages in Africa where microcredit coverage is low. But for many villages in countries such as Bangladesh, Bolivia, and India, it is more appropriate to think about an initial equilibrium were a significant proportion of households are already members of microcredit programs, ie., $\mu > 0$ in the initial equilibrium. It is thus important to understand the implications of new microcredit interventions in such a context.

Denote the initial microcredit coverage by μ_0 and the corresponding equilibrium wage in the Neoclassical market be $w^*(\mu_0)$. Now consider a marginal increase in the coverage where an MFI offers loan K to a household H which is currently not member of any microcredit program. The results above imply that a household with relatively higher land endowment will be willing to pay higher interest rate in an imperfect labor market when $\mu_0 > 0$ relative to the case considered earlier where $\mu_0 = 0$. This follows from the fact that the wage rate is higher with positive coverage in the initial Neoclassical equilibrium, i.e., $w^*(\mu_0) > w^*$ and $\frac{\partial \tilde{H}_0}{\partial \mu_0} > 0$, where $\tilde{H}_0$ is defined such that $\lambda_2(\tilde{H}_0) = w^*(\mu_0)$. Note that $\tilde{H}_0 = \tilde{H}$ when $\mu_0 = 0$ where $\tilde{H}$ was defined earlier in equation (14) above.

Since $\frac{\partial \tilde{H}_0}{\partial \mu_0} > 0$, households with progressively higher land endowment will remain net sellers of labor after becoming microfinance memebrs as μ_0 goes up. As a result, the set of households for which proposition (3) is valid would expand and include relatively land-rich households. We would thus expect to see the average microcredit borrower to become richer (in terms of land endowment) as microcredit coverage expands and the microfinance market matures in a country. This might be (incorrectly) interpreted as a "mission drift" on part of the MFIs, although the change in the composition of borrowers is not because the MFI has changed its objective function, but because of the change in the composition of the potential applicants for such loans.

A second important implication is that as the coverage increases (i.e, μ increases), the maximum interest rate a household H is willing to pay for microcredit in an imperfect

market goes down progressively, because the market clearing wage rate $\tilde{w}$ is higher in the initial equilibrium.

(4) Scaling Up: Obstacles to Transition to Medium and Large Scale

(4.1) The Problem of Lack of Demand for Larger Loans

The prospects for and constraints on the transition from small-scale home-based activities to medium and large scale operations in the microfinance programs have, over the years, attracted a lot of attention, especially from the practitioners. The issue is important and germane to the broader question of whether microfinance can be part of a development strategy that helps an economy achieve significant structural change. The critiques of the microfinance programs have noted that the small loan size typical in the microfinance programs is likely to constrain the microentrepreneurs to an inefficient scale of operation. There are two assumptions implicit in this argument. First, there is significant increasing returns in the projects undertaken by microcredit borrowers. The second underlying assumption is that the expansion of the investment activities are credit constrained. It is possible (may be plausible) that at least some of the activities undertaken by the microentrepreneurs exhibit increasing returns (Khandker (1998), Aghion and Morduch (2010)).

However, over last three decades, it has proven difficult to make the transition from the "backyard enterprises" to small and medium enterprises in most of the microcredit programs in poor developing countries. While loan ceilings imposed on the borrower can constrain the scale of her operation, our focus here is on the possibility that the borrowers might not demand larger loans when the labor market is missing or imperfect. The experience of some prominent microfinance organizations like BRAC in Bangladesh shows that the difficulties in scaling up the investment projects, at least for certain type of microentrepreneurs, might in fact be due to a lack of demand for larger loans rather than quantity rationing by the microfinance lenders. The evidence that a significant proportion of microentrepreneurs do not accept larger loans at the going interest rate seems puzzling. One can argue that such lack of demand for larger loans may be due to the nature of production function where very small loans yield extremely high returns (for example, Cobb-Douglas production function satisfying Inada conditions), but larger loans face strong diminishing returns (Aghion and Morduch (2010), CGAP (1996)). However, if the underlying technology is a constant returns one, a plausible assumption for activities such as poultry and livestock raising, and all other markets are competitive, it is not clear what is responsible for the diminishing returns to capital; a microentrepreneur should be able to scale up the project when offered larger amount of loans, by hiring all the inputs from the relevant markets. In other words, there is no obvious fixed factor that forces diminishing returns to capital.[26] This implies

[26] One can appeal to the fixity of innate entrepreneurial capability that can result in diminishing returns. While idiosyncratic and inalienable entrepreneurial capability can explain the (eventual) diminishing returns, an explanation based on it fails to account for the credit worthiness of millions of poor women in the villages of developing countries. It seems less than convincing that millions of women are endowed with extraordinary entrepreneurial capability to generate very high returns required for the repayment of

that the net rate of return on the investment should be independent of the scale, and depend only on the parametric input and output prices faced by the microentrepreneur.[27] Thus the demand for credit should be unbounded at the going interest rate as long as the unit cost of production is lower than the output price (with increasing returns, the argument holds a fortiori). Thus the entrepreneur should be *always* credit constrained (in terms of loan size). Our analysis can explain the puzzle of apparent 'absence of credit constraint' for certain households even though the production function is constant returns.

To focus on the issue of scaling up, in what follows, we assume that in setting the interest rate the microfinance NGO is dictated by the zero profit condition. The interest rate charged by the NGO is denoted as $\hat{r} = \mathring{r} + \theta$ where $\mathring{r}$ is the interest rate the NGO pays for its funds (in most cases subsidized by donors) and θ is the administration cost for per unit of loans. We denote a microcredit contract offered by an NGO by $(K, \hat{r})$ which specifies the loan size given the interest rate $\hat{r}$.

Proposition 4 **(Market Structure Induced Diminishing Returns to Capital)** *Assume that the labor market in the Grameen economy is characterized by transaction costs* ϕ_1 and a *microfinance NGO offers credit* $K > 0$ *to a single household with land size* $H \in \left(0, \ddot{H}\right)$ *where*

$$\ddot{H} \text{ such that } \lambda_1(\ddot{H}) = \tilde{w} \quad \Longrightarrow \ \ddot{H} = \frac{L_f}{\left(\frac{(1-\alpha)}{\tilde{w}}\right)^{\frac{1}{\alpha}}}$$

There exists threshold loan sizes $\bar{K}_d(H) > \tilde{K}_d(H) > 0$ *such that* $\forall K \in \left(\tilde{K}_d(H), \bar{K}_d(H)\right)$ *there is diminishing returns to capital. The loan size thresholds are a negative function of the landholding of a household.*

Proof:

The threshold loan sizes are determined by the following

$$\lambda_2(H, \tilde{K}_d) = (1-\phi_1)\tilde{w} \quad \text{and} \quad \lambda_2(H, \bar{K}_d) = \tilde{w}$$

The closed form solutions are:

$$\tilde{K}_d(H) = \frac{L_f - \Psi_a H}{\Psi_c} \ ; \ \bar{K}_d(H) = \frac{L_f - \tilde{\Psi}_a H}{\tilde{\Psi}_c} \tag{19}$$

$$\text{where } \tilde{\Psi}_a = \left(\frac{1-\alpha}{\tilde{w}}\right)^{\frac{1}{\alpha}} \text{ and } \tilde{\Psi}_c = \left(\frac{1-\gamma}{\tilde{w}}\right)^{\frac{1}{\gamma}} \tag{20}$$

$$\Psi_a = \left(\frac{1-\alpha}{(1-\phi_1)\tilde{w}}\right)^{\frac{1}{\alpha}} \text{ and } \Psi_c = \left(\frac{1-\gamma}{(1-\phi_1)\tilde{w}}\right)^{\frac{1}{\gamma}} \tag{21}$$

the high interest microcredit loans.

[27] In fact, one can argue that there is increasing returns in activities like poultry farming, because of fixed costs in both production and marketing. we discussed some evidence on increasing returns in integrated poultry farming earlier in the paper.

It follows immediately from equations (19) that the threshold loan size beyond which diminishing returns to capital set in is a negative function of the land endowment of a household. Also, note that the threshold loan sizes are higher when the microcredit intervention is global, as the equilibrium wage rate is higher in this case compared to the marginal intervention, i.e., $\tilde{w}_g > \tilde{w}$.

Discussion on Proposition 4

The basic insight behind the diminishing returns to capital is that when the shadow price of labor of a household falls inside the transaction costs band of the labor market, the female labor becomes a nontradable, and hence the fixed household endowment of female labor forces diminishing returns to capital. This can be seen most transparently in the case of a landless household, because then the poultry production function for a household inside the transaction cost band becomes

$$Q_c = K^{\gamma} \bar{L}_f^{1-\gamma} \; ; \gamma \in (0,1)$$

where we have put a upper bar on L_f to underscore that once the household has employed all its labor in poultry, it can not vary the amount of female labor at the going wage rate $(1-\phi_1)\tilde{w}$. This implies that the returns to capital declines as long as the household stays within the transaction cost band. We call this "market structure induced diminishing returns to capital" to emphasize that it is not a purely technological property due to the production function. To be sure, the household can hire female labor from the market, but only at the buying price $\tilde{w}$. This discontinuous jump in the effective wage rate implies that the microentrepreneur might find it unprofitable to accept a larger loan as the unit cost of production at $\tilde{w}$ might be more than the output price, even though it is profitable when the household is a net supplier of labor and thus the shadow price of labor is $(1-\phi_1)\tilde{w}$. Note that for a household which owns land and finds itself within the transaction cost band, the diminishing returns to capital in the poultry production is mitigated by an "internal labor market". The household keeps moving labor from rice farming to poultry production, and thus the amount of labor available to poultry production is not fixed, even though the total labor available to the household is fixed at the initial endowment as long as the household stays within the transaction cost band. However, there is diminishing returns to capital in the poultry production even for such a household because it increases the labor input less than proportionately.

Proposition 5 **(Lack of Demand for Larger Loans as a Constraint on Scaling Up)**

Assume that the transactions cost band in the labor market is such that the following holds:

$$\hat{r}^{\gamma} \left[(1-\phi_1)\, \tilde{w} \right]^{1-\gamma} < P_c < \hat{r}^{\gamma} \left[\tilde{w} \right]^{1-\gamma} \tag{22}$$

(5.a) *Then there exists a critical threshold of loan size $K^p(H, \hat{r})$ such that the household H declines the offer to become member of any credit program $(K, \hat{r})$ such that $K > K^p(H, \hat{r})$.*

(5.b) Consider a household with land size $H \geq 0$ who is already a member of the microcredit program $(K_0, \hat{r})$. Then there exists a maximum threshold of loan size $K^m(H, \hat{r})$ such that the household H declines any offer $(K, \hat{r})$ such that $(K > K^m(H, \hat{r}))$.

(5.c) The maximum loan size for a member of microfinance program is, in general, less than the maximum loan size for a prospective member, i.e., $K^m(H, \hat{r}) \leq K^p(H, \hat{r})$.

Proof and Discussion

First note that inequality (22) ensures that the demand for microcredit is not zero or unbounded. Since $\hat{r}^\gamma \left[(1-\phi_1)\tilde{w}\right]^{1-\gamma} < P_c$, a household finds it profitable to accept microcredit if it is a net supplier of labor. The second part of the inequality, i.e., $P_c < \hat{r}^\gamma \left[\tilde{w}\right]^{1-\gamma}$ implies that a household who is a net buyer of labor from the market makes loss by taking microcredit. As noted before, even a landless household becomes a net buyer of labor from the market when the loan size is large enough.

(5.a) The threshold loan size $K^p(H, \hat{r})$ is determined by the participation constraint:

$$H^\alpha \left(L_f - L_{fc}\right)^{1-\alpha} + P_c \left(K^p\right)^\gamma L_{fc}^{1-\gamma} - (1+\hat{r})K^p = H^\alpha L_{fa}^{1-\alpha} + (1-\phi_1)\tilde{w}\left[L_f - L_{fa}\right]$$

Since L_{fc}, the labor allocation to poultry, is a nonlinear function of K^p, it is, in general, not possible to derive explicit solution for K^p. Note that $K^p > \tilde{K}_d(H)$. However, $K^p \lesseqgtr \bar{K}_d(H)$.

(5.b) For a household H who is a member of a microcredit program $(K_0, \hat{r})$, the household accepts additional loan only if the current loan size K_0 is smaller than the loan size that maximizes its income when the household is within the transaction cost band and thus faces diminishing returns to capital. Denote the maximum income of a household H by $Y^0(H, \hat{r})$ where

$$Y^0(H, \hat{r}) = Max_{K, L_{fc}} \left\{H^\alpha \left(L_f - L_{fc}\right)^{1-\alpha} + P_c K^\gamma L_{fc}^{1-\gamma} - (1+\hat{r})K\right\}$$

Using the two first order conditions, we can solve for the following bound on the loan size for a household with landholding H:

$$K^m(H, \hat{r}) = L_f \left(\frac{1+\hat{r}}{\gamma P_c}\right)^{-\frac{1}{1-\gamma}} - \left(\frac{(1-\gamma)P_c}{1-\alpha}\right)^{\frac{-1}{\alpha}} \left(\frac{(1+\hat{r})}{\gamma P_c}\right)^{\frac{\gamma-\alpha}{\alpha(1-\gamma)}} H \tag{23}$$

This implies that if the microfinance NGO offers additional credit $\triangle K_0 > 0$ the household will decline the offer if the following holds:

$$K_0 + \triangle K_0 > K^m$$

If $K_0 \geqq K^m$ to begin with, the household rejects any offer to scale up the investment. In fact, such a household will contract the capital stock if possible.

(5.c) The proof follows immediately by observing that a new member will accept a loan size K^n where $K^n = K^m + \varepsilon$ where $\varepsilon > 0$ is small enough. This is so because the household

still makes positive total profit from poultry production (evaluated at the shadow price of labor) and gets a higher wage income as the shadow price of labor is higher. In fact, a household may accept the membership of a microcredit program $(K^n, \hat{r})$ even if it makes net loss from poultry production when evaluated at the shadow wage rate. This can be seen most transparently for a landless household. For a landless household, consider the case where it is offered a microcredit contract $(\acute{K}, \hat{r})$ such that $\nu(\acute{K}) = P_c - \hat{r}^{\gamma}\left[\lambda_2(\acute{K})\right]^{1-\gamma} < 0$ is arbitrarily small. So evaluated at the shadow wage rate, the household incurs loss from the microcredit operation. However, it is still possible that the net income is higher with microcredit compared to the case of pure wage labor. This happens when the following holds:

$$\left[\lambda_2(\acute{K}) - (1-\phi_1)\,\tilde{w}\right] L_f + \nu(\acute{K})\left(\acute{K}^{\gamma} L_f^{1-\gamma}\right) > 0$$

where the first term shows the gain income due to higher wage and the second term the loss in income from poultry production.

The proposition (5.c) is important because it shows that it is more difficult for a microfinance program to scale up the size of the investment projects of its current borrowers, and is consistent with the experience of BRAC SME program in Bangladesh mentioned before where most of the existing micro borrowers refused larger loan available under the SME program. The intuition for the result that the maximum loan size is lower for the existing members is that they protect the surplus they were getting from the membership. In contrast, the new members are willing to offer the total surplus generated by the microcredit intervention when considering the participation in such a program.

(5) The Puzzle of Interest Rate Elasticity

When the labor market is characterized by transactions costs, the interest rate elasticity of demand for microcredit becomes a non-linear function of a household's non-labor asset (land) with thresholds. This non-linearity is central to an understanding of the conflicting views about interest rate response of microcredit loans.

Proposition 6

(6.a) Consider a household with $H \in \left[0, \tilde{H}_{ts}\right]$ *who is a member of the credit program* $(K_0, \hat{r})$. *Assume that the relative price of poultry* P_c *satisfies the following:*

$$P_c > \hat{r}^{\gamma}\left[(1-\phi_1)\,\tilde{w}\right]^{1-\gamma} \tag{24}$$

A marginal increase in the interest rate $\hat{r}$ *does not reduce the demand for credit by household* H *if the initial price-cost margin is higher than* $\frac{\gamma}{\hat{r}}$.

(6.b) Consider a household $H > \tilde{H}_{ts}$ *who is a member of the credit program* $(K_0, \hat{r})$. *The effects of a higher interest rate on the credit demand of the household is* (i) *zero if* $K_0 \leq K^m(H, \hat{r}) + \frac{\partial K^m(H,\hat{r})}{\partial \hat{r}}$, (ii) *negative if* $K_0 = K^m(H, \hat{r})$ *and* $\alpha < \gamma$.

(6.c) Consider a Household with landholding H such that $K_0 = K^m(H, \hat{r})$, the interest rate elasticity of demand for microcredit is higher for a relatively poor household (in terms of land) if $\alpha > \gamma$.

Proof

(6.a) Denote the unit cost function of poultry production by $\tilde{C}(.)$. The proof follows from the observation that when the initial price cost margin $\frac{P_c - \tilde{C}((1-\phi_1)\tilde{w}, \hat{r})}{\tilde{C}((1-\phi_1)\tilde{w}, \hat{r})} > \frac{\gamma}{\hat{r}}$, a marginal increase in the interest rate does not violate inequality (24). This implies that a household $H \in \left[0, \tilde{H}_{ts}\right]$ remains credit constrained at the higher interest rate. It is not surprising that a credit constrained household does not respond to a higher interest rate by reducing its demand for credit. In fact, if a higher interest rate is accompanied by a marginally larger loan size offer by the NGO, the interest rate elasticity of such a household's demand for credit might appear to be *positive*. QED

(6.b) (i)The proof follows from the observation that when $K_0 \leq K^m(H, \hat{r}) + \frac{\partial K^m(H, \hat{r})}{\partial \hat{r}}$, the household remains credit constrained at the new higher interest rate. (ii) For a household with $K_0 = K^m(H, \hat{r})$, the loan size offered in the microcredit program is exactly equal to the optimal demand and a higher interest rate has an unambiguously negative effect on the optimal credit demand for all households if $\alpha < \gamma$ (see equation (23) above).

(6.c) When $\alpha > \gamma$, the result follows immediately from an inspection of equation (23) above.

Discussion on Proposition 6

Proposition (6.a) and (6.b)-(i) are interesting in that they provide a basis for the view common among practitioners that a higher interest rate may not adversely affect the demand for microcredit. The rest of the proposition (6) provides an explanation for two interesting conclusions due to Dehejia et. al. (2007): (a) the interest rate elasticity of microcredit demand is significantly negative, and (b) the interest rate elasticity of poorer borrowers is higher and as such a higher interest rate might have regressive effects in term of income distribution. Note that even though $\alpha < \gamma$ is a sufficient condition for negative interest rate elasticity $\forall H \in [0, 1]$, other parameter restrictions can be imposed to ensure that we have negative interest rate elasticity with $\alpha > \gamma$.

The interest rate elasticity in our model is nonlinear with thresholds. With constant returns technology, the response to a higher interest rate is zero for a household who is a net supplier of labor from the market, as long as the unit cost is lower than the price of output. This is consistent with the practitioner's observation that there is excess demand for 'membership' of microfinance NGOs even with the high interest rates charged.[28] The households falling in the transactions cost band, on the other hand, may be sensitive to a higher interest rate as they face diminishing returns to capital. They include the marginal

[28]The fact that interest rate elasticity is zero does not imply that there is no adverse effects of high interest rate on the welfare of the borrower (the net gain in income from participation decreases).

participants in the program and the current interest rate is just enough to satisfy their participation constraint. The households who are situated on their demand curve (marginal value product of capital) and get rent from the membership are also likely to be responsive to an interest rate increase as they try to protect the rent (profit). The econometric evidence presented by Dehejia et. al. (2007) can be understood as the response of the two latter groups of borrowers when interest rate is raised.

(6) Dynamic Incentives: Limits of Progressive Lending

The above results on the maximum loan size that the borrowers want to accept given an interest rate have profound implications for appropriate design of the dynamic incentives in microcredit programs. The recent literature such as Aghion and Morduch (2000, 2010) has highlighted the importance of progressive lending as a mechanism to deter borrower moral hazard. There has been a growing emphasis on the dynamic incentives recently, and pioneering programs like Grameen Bank in Bangladesh has shifted from the so-called "joint liability" schemes that harness peer monitoring and substitute social capital for physical collateral. In the recent Grameen II program, the joint liability applies only at the margin. Individual liability applies for the outstanding debt, but the members of a group gets a certain percentage increase in the loan ceiling only if *all* members of the group (and of the center) repay (Yunus, Grameen II). An implicit assumption underlying such dynamic incentive scheme is that the borrowers are credit constrained at the going interest rate. The above analysis shows that this might be a good description of households who are net suppliers of labor in the market. However, the households which fall in the transaction cost band may not demand larger loan size if it is bigger than a threshold. More importantly, such demand constraint is likely to be more binding for the existing microcredit borrowers as shown in proposition (5). Also, a larger loan size will push even the landless and labor abundant households into the transaction cost band and thus a larger loan size may lose its appeal. The efficacy of dynamic incentives in microcredit programs that rely on the larger loan size will, in general, depend on the structure of the labor market and the distribution of non-labor assets, as the endowment of non-labor resources determine the location of a household relative to the transaction cost band in the labor market.

Also, by assuming that the microfinance products are tradable goods, our analysis ignores the potential problem of lack of demand for these products. When the products produced by microcredit borrowers are non-traded goods, the general equilibrium effects resulting from the consumer side may make a larger loan less attractive especially when the preference is characterized by a non-homothetic utility function representing Engel effects. If there is a threshold of income below which the households demand for poultry is insignificant, then a microcredit intervention might shift the supply curve but demand may not increase significantly. If the village is not integrated with large urban markets, then this supply shift is likely to precipitate a collapse in the price of microfinance products. The price collapse (or a fear of price collapse) is likely to reduce the demand for larger loans even more.

(7) Conclusions

This paper, using a simple general equilibrium model where there are imperfections in the labor market provides explanations for some of the most widely discussed issues and puzzles in microfinance today. The main results are as follows.

First, the high rates of return to microcredit financed projects can be explained in terms of low shadow wage rates faced by households (especially women) when the labor market is missing or imperfect. The maximum interest rate a household is willing to pay for membership in a microcredit program is higher when the labor market is missing compared to the benchmark of a zero transactions costs labor market under two conditions: (i) if the loan size is not larger than a threshold and (ii) the land endowment of the household is smaller than a threshold. With a transactions cost band in the labor market, the maximum interest rate is higher than the Neoclassical benchmark for a household that remains a net supplier of labor to the market after the credit intervention. The maximum interest rate a land-poor household is willing to pay for microcredit membership is a positive function of the transactions costs in the labor market. Since the transactions cost is expected to decline over time due to technological and social changes, the maximum interest rate a microfinance NGO can charge will also decline progressively.

Second, the microentrepreneurs might not be interested in scaling up their investment projects as they face discontinuously higher wage rates for hiring labor from the market (compared to the shadow price of in-house labor). The scaling up and consolidation of microcredit projects into medium and large scale enterprises might also be constrained by the very fact that microcredit reduces the need for women to look for work outside the home, and thus might actually decelerate process of the development of a well-functioning labor market in a village.

A transaction cost band that drives a wedge between the buying and selling price of labor provides us with a plausible explanation for the divergent views regarding the interest sensitivity of microcredit loans. With constant returns technology, the interest rate elasticity is zero for a household who is a net supplier of labor from the market, as long as the unit cost is lower than the price of output. This is consistent with the practitioner's observation that there is excess demand for 'membership' of microfinance NGOs even with the high interest rates charged. The households falling in the transactions cost band, on the other hand, may be sensitive to a higher interest rate. They include the marginal participants in the program such that the current interest rate is just enough to satisfy their participation constraint. The inframarginal households who are already members of microcredit program also respond negatively as they try to protect the rent they get from the membership. The econometric evidence presented by Dehejia et. al. (2007) can be understood as the response of these last two groups of borrowers when the interest rate is raised.

Our analysis also have implications for the efficacy of progressive lending as an instrument of dynamic incentives for enforcement of the microfinance contracts. Progressive

lending can be very effective for a household that remains a net seller of labor to the market, as they prefer larger loans assuming that the unit cost of production is lower than the output price. However, some households (relatively better endowed with non-labor resources) are likely to find themselves situated in the transaction cost band in the labor market, and the lure of a larger loan size has little disciplining role for such a household if the diminishing returns to capital is strong enough. This sounds a cautionary note about the efficacy of the programs that rely heavily on the "loan size" as an incentive mechanism.

Perhaps the most important implication of the analysis developed in this paper is that microcredit may play a vital role in creating economic opportunities when the labor market is underdeveloped, but in the long run when labor market develops, and technological and social changes reduce the cost of women's participation in the labor market, the demand for such high interest rate micro loans will go down progressively.

Appendix

Proof of Lemma 1:

The equilibrium gross wage rate $\tilde{w}$ is determined from the following market clearing condition:

$$\left(\frac{1-\alpha}{(1+\phi_2)\tilde{w}}\right)^{\frac{1}{\alpha}} \frac{1-(H_{tp})^2}{2} + \left(\frac{1-\alpha}{(1-\phi_1)\tilde{w}}\right)^{\frac{1}{\alpha}} \frac{H_{ts}^2}{2} = L_f(1-H_{tp}+H_{ts}) \tag{25}$$

where

$$H_{tp} = \frac{L_f}{\left(\frac{(1-\alpha)}{(1+\phi_2)\tilde{w}}\right)^{\frac{1}{\alpha}}} \;\; ; \;\; H_{ts} = \frac{L_f}{\left(\frac{(1-\alpha)}{(1-\phi_1)\tilde{w}}\right)^{\frac{1}{\alpha}}} \tag{26}$$

So all households with land size $H < H_{ts}$ are the net suppliers of labor and all households with land size $H > H_{tp}$ are the net buyers, while for a household with $H \in [H_{ts}, H_{tp}]$ the market is missing and the household is self-sufficient in terms of labor. Denote the household that is self-sufficient in the Neoclassical case by H^*. It follows from the market clearing condition that

$$H^* = \frac{L_f}{\left(\frac{(1-\alpha)}{w^*}\right)^{\frac{1}{\alpha}}}$$

We show that the following holds: $\tilde{w} > w^*$ and $(1-\phi_1)\tilde{w} < w^*$. First, note that evaluated at $\tilde{w} = w^*$, equation (25) implies excess demand for labor. With $\phi_2 = 0$, the mass of households that demand labor from the market is unaffected (compared to the Neoclassical case) as can be seen from the fact that $\frac{H^*}{H_{tp}} = 1$ and the demand of each household remains same as before. The supply of labor to the market is, however, lower for two reasons: (i) H_{ts} decreases, i.e., some households that were net supplier of labor now fall within the transaction cost band (household specific missing market) and (ii) the households who remain net supplier after the intervention, they also supply less facing a lower net wage rate (i.e., it is more profitable to use labor within the household). So to restore market clearing it must be true that $\tilde{w} > w^*$. The statement that H_{ts} decreases relative to H^* follows from:

$$\frac{H^*}{H_{ts}} = \frac{\left(\frac{(1-\alpha)}{(1-\phi_1)w^*}\right)^{\frac{1}{\alpha}}}{\left(\frac{(1-\alpha)}{w^*}\right)^{\frac{1}{\alpha}}} > 1$$

Now consider the case when $\tilde{w} = \frac{w^*}{(1-\phi_1)}$. In this case, the supply of labor to the market remains unaffected. But with a higher wage rate $\tilde{w} > w^*$, the demand contracts, i.e., $(1-H_{tp})$ is smaller and the households who stay net demander of labor from the market

demand less as the wage rate is higher. The statement that $(1 - H_{tp})$ is smaller follows from:

$$\frac{H^*}{H_{tp}} = \frac{\left(\frac{(1-\phi_1)(1-\alpha)}{(1+\phi_2)w^*}\right)^{\frac{1}{\alpha}}}{\left(\frac{(1-\alpha)}{w^*}\right)^{\frac{1}{\alpha}}} < 1$$

So it must be true that $\tilde{w} < \frac{w^*}{(1-\phi_1)}$ which implies $(1-\phi_1)\tilde{w} < w^*$. QED

Proof of Proposition 3

(3.a) Under the assumption of marginal intervention, the credit does not affect the equilibrium wage rate, however it changes the shadow price of labor faced by the household. For a household H to remain a net seller of labor after the credit intervention, the following needs to be satisfied: $\lambda_2(H, K) < (1-\phi_1)\tilde{w}$. This implies the following inequality:

$$H < \tilde{H}_{ts} = \frac{L_f - K\Psi_c}{\Psi_a} \text{ where} \tag{27}$$

$$\Psi_a = \left(\frac{1-\alpha}{(1-\phi_1)\tilde{w}}\right)^{\frac{1}{\alpha}} \text{ and } \Psi_c = \left(\frac{1-\gamma}{(1-\phi_1)\tilde{w}}\right)^{\frac{1}{\gamma}} \tag{28}$$

Now the result follows from the observation that for any household that remains a net seller of labor after the credit intervention, the shadow price of labor in an imperfect market is $(1-\phi_1)\tilde{w}$ which is smaller than the neoclassical wage and thus return to poultry farming is higher in an imperfect labor market (from equation (6) above). QED.

(3.b) The proof follows from the claims that $\frac{\partial \tilde{w}}{\partial \phi_1} > 0$ and $\tilde{w} > (1-\phi_1)\frac{\partial \tilde{w}}{\partial \phi_1}$. It is easy to check from the market clearing condition (25) above that $\frac{\partial \tilde{w}}{\partial \phi_1} > 0$. The second inequality implies that the endogeneous wage response $\frac{\partial \tilde{w}}{\partial \phi_1}$ is not too strong and thus $\frac{\partial((1-\phi_1)\tilde{w})}{\partial \phi_1} < 0$. Assume that, to the contrary, the endogeneous wage response is strong enough to offset the direct negative effect of a higher transaction costs, i.e. $\frac{\partial((1-\phi_1)\tilde{w})}{\partial \phi_1} = 0$, thus implying that $(1-\phi_1)\frac{\partial \tilde{w}}{\partial \phi_1} = \tilde{w}$. In this case the labor demand and supply behavior of all the households with $H < H_{ts}$ (i.e., the households that are net seller of labor) remains unchanged following an increase in ϕ_1 but the households $H > H_{tp}$ (i.e., the households who are net buyers of labor) adjust to a higher wage rate given that $\frac{\partial \tilde{w}}{\partial \phi_1} > 0$. This however creates excess supply of labor in the market. This can be seen from the following:

$$\frac{\partial\left[\frac{\Psi_a\left(1-(H_{tp})^2\right)}{2} - L_f(1-H_{tp})\right]}{\partial \tilde{w}} = \frac{1}{2}\frac{\partial \Psi_a}{\partial \tilde{w}}\left[1 - \frac{L_f^2}{\Psi_a^2}\right] < 0$$

The above result follows from $\frac{\partial \Psi_a}{\partial \tilde{w}} < 0$ and $\Psi_a > L_f$. The last inequality holds as long as the total demand for labor by the households $H > H_{tp}$ is positive. The term

$\left[\frac{\Psi_a\left(1-(H_{tp})^2\right)}{2} - L_f(1-H_{tp})\right]$ shows the excess demand for labor by the households $H > H_{tp}$.
QED

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