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Microcredit Programs in Bangladesh:

Assessing Performance of Participating Women

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Abstract

This paper studies the determinants of women's economic performance in microcredit programs. These determinants are in the form of different types of characteristics of women: their own characteristics (age, schooling etc) or the characteristics of the household or village they live in. Using data from three microcredit programs in Bangladesh, this paper shows how these different characteristics influence economic success of women in microcredit programs. One obstacle to measure the effect of observed characteristics is the problem of omitted variable bias, typically caused by unavailability of data on unobserved ability of individuals. Usually instrumental variable technique is employed to tackle this problem. In the absence of suitable instruments, this study finds information about unobserved ability from the marriage market. It is argued that marriage market interaction between potential husband and wife provides information about unobserved characteristics of individuals. It is found that incorporating estimates of women's unobserved characteristics significantly changes the estimated effect of women's observed characteristics and substantially removes the omitted variable bias. Therefore, we gain a better understanding of women's performance in the microcredit programs by combining information from marriage market and microcredit programs.

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I. Introduction

Microcredit programs have attracted much attention from researchers since their inception. These are small-scale credit programs that provide production credit and other services to rural poor. In recent years, many government and nongovernment organizations in low-income countries have introduced credit programs such as these, targeted to the poor. Many of these programs specifically target women on the basis of the view that they are more likely to be credit-constrained than men, have restricted access to the wage labor market, and have inequitable share of power in household decision making. It has been also found that providing credit to women rather than men has a greater impact on different household choice variables, such as household expenditure, status of children's schooling or health etc [*Pitt and Khandker (1998), Pitt, Khandker, Mckernan, Latif (2001)*].

Even though overwhelming majority of participants are women (over 80 percent), there has not been any comprehensive study that investigates the determinants of economic performance of these women in these credit programs. These determinants can be in the form of different type of characteristics of women: their own characteristics (age, schooling etc) and the characteristics of the household or village they live in. This paper looks into this issue using data on three group-based credit programs (Grameen Bank, Bangladesh Rural Advancement Committee (BRAC), and Bangladesh Rural Development Board's (BRDB) Rural Development RD-12 program).

All three of these microcredit programs in Bangladesh work exclusively with the poor. Although sequence of delivery and the provision of inputs vary a little from program to program, all three programs essentially offer production credit to the landless rural poor (defined as those who own less than half an acre of land) formed into a group, using peer monitoring as a substitute for physical collateral. Loans are given to individual group members, but the whole group becomes ineligible for further loans if any member defaults. The groups meet weekly to make repayments on their loans as well as mandatory contributions to savings and insurance funds. These microcredit programs also provide noncredit services in areas such as consciousness-raising, training for skill development, literacy, bank rules, investment

strategies, health, schooling, civil responsibilities, and alteration of the attitude of and toward women.[1]

Currently, most of the research on the effect of microcredit programs on women's welfare focuses on the effectiveness of microcredit programs on reducing fertility among women [*Amin, Hill, Li (1995), Hashemi, Schuler, Riley (1997)*]. Some papers discuss the impact of these credit programs on empowerment of women in household [*Amin, Hill, Li (1995), Hashemi, Schuler, Riley (1996)*].

To my best knowledge, so far, no paper has attempted to analyze the determinants of economic success of participating women in these credit programs. In this paper, an attempt has been made to fill that breach in current literature. A typical problem to estimate the impact of schooling and similar type of variable is that these variables are influenced by unobserved ability of individuals, which results in biased estimates (commonly known as omitted variable bias). Usually in the literature, this problem is tackled by finding suitable instruments. But finding suitable instruments are often difficult due to data unavailability and even when data are available, instruments are often questionable. A different method has been employed in this paper to overcome this problem. Majority of the women who participated in these microcredit programs are married and we argue that their marriage history helps to find information regarding their unobserved ability or characteristics.[2]

In marriage market, unobserved characteristics are as important as observed ones in selecting future spouse. Those unobserved characteristics are more important for women than men. Men's eligibility is more or less exposed by their earning capability or amount of household wealth they accumulated. On the other hand, woman's participation in wage market or attainment of schooling is very limited in a typical South Asian village for the conservative nature of the society. Therefore, women's beauty, intelligence or skill at household works, which are all unobservable, might become important factors in finding suitable matches. We argue that this

[1] For more on micro credit programs in Bangladesh see Khandker (1998)

[2] Here "observed" or "unobserved" term is used from the viewpoint of the researcher. The researcher might have data regarding schooling, marital age etc but it is highly unlikely that there would data available for intelligence, beauty and others.

matching process between potential husband and wife helps to reveal the information regarding women's unobserved characteristics.

In this study, it is demonstrated that inclusion of estimates of unobserved characteristics from marriage market, in some cases, significantly alters the magnitude of impact of observed characteristics on the women's economic success. There is also evidence that these unobserved characteristics play an important role in the economic performance of these women. Formally, this paper shows that the characteristics that helped these women get a better quality husband in the marriage market also helped them performing better in the credit market. Available econometric tests also show the absence of endogeneity after inclusion of unobserved characteristics

Knowledge about the determinants that affect women's performance in microcredit programs might be helpful for policy makers. For example, it is found in this paper that the presence of health center enhances women's performance by more than 90 percent. This information is useful as microcredit programs not only provide credits, they also provide other non-credit services, such as social awareness, adult education programs. The evidence in this paper indicate that policy makers might also want to focus more on health related issues in their non-credit services to have greater effectiveness of the microecredit programs.

The remainder of this paper is organized in the following manner. Section II discusses different suitable measures to evaluate women's performance in microcredit programs and Section III presents models on marriage market. Section IV contains a description of the structural model and the estimation procedure and Section V describes the data.. Section VI discusses econometric results and section VII draws conclusion.

II Evaluating women's performance: Suitable Measures

The main objective of this paper is to analyze the determinants of women's success in microcredit programs. Success is measured by increase in welfare. For measuring welfare, ideally we would like a survey-based measure that represents the individual welfare measures of economic theory. Particularly useful here is the concept of

money metric utility where the indifference curves of individual preference orderings are labeled by the amount of money needed to reach them at some fixed set of prices. In order to avoid the specification of a parametric utility function, money metric utility can be approximated by real income or real expenditure: the two leading candidates for practical welfare measures. However, there are other possibilities, indicators of nutritional status being perhaps the most important, and even if we settle on income or expenditures, there are many other questions that have to be settled before going on to compute the measures.

Whether the welfare measure is income or consumption, it becomes difficult to measure it for a single member in a household. Typically, microcredit programs allow one individual from each household to join and in most cases it is the female members. It is difficult to find evidence of economic success of participants by looking at just household income or expenditure that involves other members.

A possible way to identify individual welfare impact might be to look into some specific expenditures and asset accumulation within household. There is an increasingly convincing set of studies in economics and sociology literature, which suggests that the marginal effect of income in the hands of women is different from income in the hands of men. This result implies incomplete income pooling within the household and is a refutation of a model of intrahousehold resource allocation that would have us believe that household members maximize a single welfare function, the so-called 'unitary' model of the household (Alderman et al., 1995; Behrman, 1997).

The idea that men and women spend income from own-earnings in different ways is not new. Together, papers by Kumar (1979) and Guyer (190) document this phenomenon over a wide range of settings and times. Why do men and women tend to spend income differently? Societal and cultural norms may assign women the role of 'gate keepers' in which they ensure that household members' especially children, receive an adequate share of available food. Alternatively, women may prefer to spend more on children's daily need because they spend more time with them. Women may also face different constraints than men. To minimize the competing demands on their time, for example, women may spend more on food because they

purchase more expensive calories that take less time to prepare. Finally, women and men may have different income flows and thus different transaction costs. In other words, since women's income tends to come more frequently and in smaller amounts, it may be more readily spent on household daily subsistence needs than lumpier seasonal income, which tends to come to men and is likely to be spent on more expensive items (Hamilton et al., 1984).

Shultz (1990) found that in Thailand, an increase in a woman's unearned income from outside the household will have a larger negative effect on the probability that she joins the labor force than does an equal increase in her husband's unearned outside income. According to Browning et al. (1992), in Canada the shares of the family budget devoted to men's clothing and to women's are positively related to the shares of family income earned respectively by men and women. Using data from a household survey from the Cote d'Ivoire, Hoddinott and Haddad (1995) report that increases in the proportion of cash income accruing to women significantly raise the budget share of food and lower those of alcohol and cigarettes. Thomas (1990) found evidence that in Brazilian families, income of the mother has a much stronger positive effect on fertility and on measures of child health such as calorie intake, weight, height, and survival probability than income of the father.

From the description of existing literature above, couple of findings are evident: (a) income-earning women spends differently than income-earning man in the same household (b) women's increase in income manifests mainly by expenditures on child care and daily needs (both food and non-food items). If women participate in a microcredit program and achieve sustained increase in their income, then increased spending on the above-mentioned items might reflect that increase in income. Therefore, these expenditures and assets would be reasonable indicators of women's performance in the microcredit programs. Following are the three variables, which have been used in this paper, to represent women's performance in microcredit programs:

1. Non- agricultural assets

This variable measures the current value of non-agricultural assets (equipment and goods) that the program participants were able to accumulate after joining

microcredit programs. This measure is available for each adult member of a household. During the time of survey each member is asked how much assets he/she accumulated after joining microcredit programs. Following are the types of assets included in this category: gold or silver jewelry, household/kitchen utensils, furniture, processing equipment, tools like spade, hammer etc.

2. Food expenditures

This measures the value of normal daily food consumption in a household. Average daily food expenditure is around 40 Taka (official currency of Bangladesh).

3. Total non-food expenditures

This measures the value of expenditures incurred by households on non-food items in the last four months from the time of survey. In the data, expenditures on different categories are mentioned. For this paper's purpose only those expenditures, which are supposed to be more influenced by increased income of women (as suggested above), have been included. These expenditures mainly include: expenditures on childcare, home improvement, medicine, fuel, book/stationary.

We discuss in detail in Section IV what are the determinants that might affect the above mentioned indicators of women's performance. Before that, in Section III, we discuss the marriage market for these women who participate in microcredit programs. It has been already mentioned that finding unobserved characteristics of women are important to find accurate estimates of observed characteristics. The next section, which deals with the marriage market involving these women, is going to discuss the procedure to uncover these unobserved characteristics.

III. Marriage Market and Mating Function

A. Background

Many social scientists have considered how an individual selects a mate based on a set of the prospective mate's characteristics, such as age, education, and physical attractiveness. Evidence from these studies suggests that people want a mate with traits similar to their own (similar age, similar education, even similar weight). The main exception applies to labor-market traits such as earnings or hours. Theories regarding the sexual division of labor suggest that members of a couple will exhibit a

specialization of these traits (Becker 1974). Becker (1974,1991) modeled the process of selecting a mate as similar to the process of selecting a consumer good designed to increase a person's level of happiness or utility. An individual maximizes his or her utility by selecting a mate based on the set of characteristics that the prospective mate possesses. According to Becker (1991), higher-quality men and women marry each other rather than selecting lower-quality mates when these qualities are complements: a superior woman raises the productivity of a superior man and vice versa. The mating of likes or unlikes is optimal as traits are complements or substitutes, because superior persons reinforce each other when traits are complements and offset each other when traits are substitutes.

Becker's work on marriage left a huge trail of literature. Klawitter (1995) sampled couples from the 1990 census, finding evidence of positive assortative mating for age, race, and education across types of couples. With regard to education, Mare (1991) found that homogamy (a similarity between a matching of spouses' characteristics) has increased from the 1930s through the 1980s. Other researchers have found evidence of positive assortative mating among married couples for earnings (Nakosteen and Zimmer 2001), physical attractiveness (Stevens, Owens and Schaefer 1990). South (1991) found that men value the youthfulness and physical attractiveness of their potential marriage partners more than women do.

It is obvious by now that literature on matching generally provides substantial evidence of positive assortative mating on a variety of attributes and limited evidence of negative assortative mating. Most of these studies used correlation coefficient for their analysis. But simple correlations do not always reveal the whole story, as other variables that might influence marital decisions, are not controlled in that setting. Suppose we go with the theory that man usually seeks for younger women. But he might settle for a slightly older woman if he finds her other attributes more attractive, e.g. she might have above average education.

The marriage pattern in which spouses' characteristics are dissimilar but in which low values on one characteristic are offset by high values on another characteristic can be explained by "exchange theory" (Edwards 1969). Exchange theory focuses on the interpersonal relationships involved in the marriage choice

process and on the resources – both assets and liabilities – of potential partners. A major assumption is that potential spouses are rational and goal-oriented individuals attempting to maximize the gain (or utility) in mate selection while minimizing any costs. One outcome is an equilibrium in which spouses tend to be matched evenly on important characteristics, resulting in high levels of homogamy. Nonetheless, the prevalence of homogamy is reduced by the ability of potential spouses to trade or exchange equivalent but different resources in the marriage market.

In accordance with this exchange theory, to formulate a relationship between the characteristics of husband and wife, ideal way would be to set up a regression equation where husband/wife's characteristics are determined by his/her spouse. The same theory also applies to assortative mating: to find evidence of assortative mating it is not sufficient to regress corresponding characteristics of male and female participants in the marriage market. The other variables that affect the process of choosing mate should be also included to control for other influences. In marriage market literature, this relationship between spouse characteristics is termed as mating function. The next subsection will illustrate a simple marriage market model from which it would be possible to derive the mating function.

B. A simple marriage market model

This subsection deals with a simple model of marriage market. This model is useful in the sense that it provides a theoretical basis for the mating function. Rao and Deolalikar (1998) presents this model in a paper that empirically explores the extent of assortative mating and influence of personal and family traits in determining pecuniary exchanges between families at the time of marriage. Given that marriage in rural South Asia is largely an alliance between two families, the wife household typically undertakes a search for a husband for its daughter. Both individual traits (such as beauty, intelligence and schooling) and family background (such as wealth, father's occupation and caste) are given consideration in the search for a 'perfect' husband. In the large majority of marriages, a dowry is negotiated and paid by the wife's household to the husband's household, the value of which depends upon the traits of the husband, the bride, and their respective households.

To model the demand for husband traits, it is assumed the wife household's utility function is defined over the traits of the potential husband and his parental household:

$$U = U(\Omega_h, H_h, X), \qquad U' > 0, U'' < 0 \tag{1}$$

where the subscript *h* refers to the husband, and

Ω = vector of individual traits

H = vector of parental household traits

X = consumption of a composite good (having a price of unity)

The wife household is assumed to maximize the utility function (1) subject to a budget constraint that includes the dowry payments made to the husband household, viz.:

$$X + D(\Omega_h, H_h, \Omega\ , H) = Y \tag{2}$$

$$\partial D / \partial \Omega_h > 0, \quad \partial D / \partial H_h > 0, \quad \partial D / \partial \Omega < 0, \quad \partial D / \partial H < 0,$$

where,

Y = exogenous (non dowry-related) income of the wife's household,

D = dowry given by the wife household

Solution of the first order conditions and the budget constraint for all the endogenous variables yields the wife household's reduced-form demand for husband's traits:

$$\Omega_h = \Omega_h(\Omega, H, Y), \tag{3}$$

Equation (3) is a general functional form of the mating function discussed above. These mating functions can be used to uncover the unobserved characteristics of participating women in the microcredit programs. It can be argued that residuals from these mating functions can be used as a proxy for the unobserved characteristics of women. Section IV will examine this procedure in detail where econometric specifications will be discussed.

IV. Econometric Specification

A. Mating function

This section starts by specifying the mating function described in the previous section [equation 3]. In linear form the mating function for the husband can be written as the function of observed and unobserved characteristics of his wife (and her household):

$$CH_h = \alpha + \beta_1 SC_w + \beta_2 MA_w + \beta_3 HH + \mu_w + \varepsilon \qquad (4)$$

CH_h	=	A vector of husband's Characteristics (e.g. his schooling, amount of assets)
SC_w	=	Wife's Schooling
MA_w	=	Wife's age at first marriage
HH	=	Characteristics of bride's parents (father's education, occupation etc)
u_w	=	a vector of dimensions of wife's unobserved characteristics, including attributes or endowments such as attractiveness, intelligence or skills at household works
ε	=	A vector of i.i.d. disturbance terms with zero means

Following two variables are used to represent husband's desirable characteristics (CH_h)as a potential spouse in the marriage market. One is in the form of human capital: i.e. husband's schooling, and the other is in the form of physical capital: i.e. husband's accumulated asset[3]. Consequently, equation (4) represents a bivariate linear regression model.

Among the explanatory variable, first, let us consider the case of observed characteristics of wife. We have already seen in section II that marriage market theories imply positive assortative mating in complementary characteristics among the matches. As education is considered to be a complementary good (educated spouses reinforces each other's capabilities), one would expect wife's schooling to be positively related with husband's schooling.

[3] Husband's accumulated asset is the sum of land and non-land assets in his possession. Examples of non-land assets might be house, agricultural tools etc.

Younger wife's are in general preferable for various reasons, e.g., they are more attractive, more fecund etc. Therefore, husband with higher quality should be matched with younger wife and the older wives might be left with low quality husband i.e., husband with less schooling or less assets. But there is a conflicting marriage market theory about the existence of pay-offs to search in the market (Keeley 1977). That is postponement of marriage results in a better spouse. According to this theory, it can be predicted that the higher the marital age, the higher is the possibility of getting a husband with better quality. Hence, there is an ambiguity regarding the sign of the coefficient of MA_W (β_2).

Wife's parental household might have some impact on the determination husband's characteristics. In this analysis, wife's father's education and profession have been included. If father's education/occupation implies how wealthy he is, then it might be an important determinant of husband's characteristics. It can be expected that wealthy father can afford higher quality husband for his daughter by offering higher pay-off to groom or groom's family (e.g. offering higher dowry).

B. Specification of women's performance equation

In section II, we have discussed the nature of the variables by which women's performance in the microcredit programs would be evaluated. But until now it has not been mentioned what would be framework under which the determinants of their performance would be analyzed. From the description of the variables found in section II, we get the impression that these performance indicator variables are mainly in the form of consumption goods (durable or non-durable). Any household consumption pattern would be determined by the following consumption function:

$C = C(p, Y)$

where p = price and Y= income of the household. In a household where wife is participating in microcredit programs, Y has two sources, wife's earning (Y_w) from micro-credit programs and husband's earnings (Y_h) from labor market or farm/non-farm activities. As male members generally have access to labor market, husband's earning is determined by the labor market condition. Women generally do not have access to wage market due to the conservative nature of the society. Wife's earning is primarily dependent on microcredit programs and determined by the amount of

credit she has access to, the length of her participation in the microcredit programs and the observed and unobserved characteristics of herself and the household and the village she lives in. As a result,

$Y_w = Y_w(Cr, Lm, O_w, u_w, HH, Vill)$

where Cr = Amount of credit accumulated, Lm = Duration of participation in the program, O_w = observed characteristics of wife, u_w = unobserved characteristics of wife, HH= household characteristics and $Vill$ = village characteristics. As a result, the consumption function would be in the following form,

$C = C(Cr, O_w, U_w, HH, Vill).$

The prices (p) are represented by the village characteristics and the husband's income (Y_h) would be represented by household characteristics.

The econometric specification of the above mentioned consumption function would be the following equation:

$$C = \delta_0 + \delta_1 SC_w + \delta_2 Age_w + \delta_3 Cr + \delta_4 Lm + \delta_5 HH + \delta_6 Vill + \delta_7 \hat{\xi} + \varepsilon_2 \qquad (5)$$

where

Age_w = Age of women participating

$\hat{\xi}$ = Estimated residuals from mating function

Among the explanatory variables vector, $\hat{\xi}$ are representing the unobserved characteristics of the women - derived from the residuals of mating function in equation (4). Except Cr and Lm, all other explanatory variables are representing individual, household or village characteristics. The critical point of this equation is that unobserved characteristics of the woman are expected to have important effects on her performance in the microcredit programs.

The econometric issue that arises is regarding the validity of using residuals from marriage market equations as the dimensions of women's unobserved characteristics. The residuals from the marriage market equation, which is the difference between the actual level of husband's characteristics and their expected levels, approximates dimension's of women's unobserved characteristics with a random error component that is unforeseen by the marriage market participants.

Regressing variables that represent women's performance on this calculated residual of the marriage market equations estimate the impact of women's unobserved characteristics on these variables. But since the calculated residual measures the unobserved characteristics with error, the estimate is biased toward zero.[4]

Though biased, it can be shown that these residuals are consistent representation of unobserved characteristics of individuals and households. The residuals in equation (4), ε, are white noise errors by Gauss-Markov OLS assumption. Since $\xi = \mu_w + \varepsilon$ from equation (4) and the elements of ε with zero mean, $P\lim \xi = P\lim \mu_w$, so ξ is a consistent representation of μ_w.[5]

The use of unobserved characteristics in equation (5) is supposed to mitigate the problem of omitted variable bias that would have been present otherwise. Omitted variable bias arises because the schooling variable is supposed to be correlated with the error term because of unobserved ability influencing the amount of schooling one receives. The same problem arises with the accumulated credit variable. The amount of credit a woman can accumulate depends on how productive she is with credit that she receives from these programs. Her productivity in part depends on unobserved characteristics. In other words, credit might also be an endogenous variable. Endogeneity of the credit and schooling variable might not arise when the full specification in equation (5) is used. In that specification, unobserved effects are controlled for and therefore, there exists lesser chance of correlation between accumulated credit/schooling and the error term. A test for endogeneity of these variables would be provided in the Section VI. But before going onto those results, a brief description of the data is provided in the next section.

[4] Rosenszweig and Schultz (1983) made a similar argument in estimating health technology equation. They argued that residuals from birth weight production function contain exogenous child health endowment effect and an error component.

[5] See Behrman, Birdshall and Deolalikar (1995) for a similar case where they derived man's unobserved characteristics from the residuals in wife's characteristics equations.

V. Description of the data

The data comes from a multi-purpose household survey, which was conducted in 87 villages of 29 thanas (subdistricts) in rural Bangladesh, during the year of 1991-92. The sample consists of 29 thanas randomly drawn from 391 thanas in Bangladesh, of which 24 had one (or more) of the three credit programs understudy in operation, while 5 thanas had none of them. See Table 1 for the distribution of the three microcredit programs among 87 villages.

Three villages in each program thana were then randomly selected from a list of villages, supplied by the program's local office, in which the program had been in operation for at least three years. A household census was conducted in each village to classify households as target (i.e., those who qualify to join a program) or non-target households, as well as to identify program participating and non-participating households among the target households. A stratified random sampling technique was used to over-sample households participating in one of the credit programs and target nonparticipating households. Of the 1798 households sampled, 1,538 were target households and 260 non-target households. Among the target households, 905 households (59 percent) were credit program participants. This survey was conducted three times over the crop cycle year 1991-92 to match the three crop seasons, and information on village-level prices and wages was collected in the same manner.

For the objective of this paper, it suffices to pay attention to only those women who participated in the microcredit programs. Table 2 describes the observed characteristics of these women and also the characteristics of the household or village they live in. The sample of individuals aged between 15-64 is middle aged: mean age is around 35 years. The educational level is very low, averaging merely one year. The highest education of the household head is 1.7 years of schooling. On the average a participant has been in the program for more than 4 years. Around 11 percent of household does not have any spouse present in the household.

The explanatory variables also include availability of rural health center (10 percent), family planning center (18 percent). They also include the village-level prices of major commodities and the wages of male and female labor. The distance

of a finished road from a village is on the average 11 kilometer. Around half of the villages have access to electricity.

Table 3 has summary statistics for the dependent variables used in regression equation (4) and (5).

Table 1
Distribution of villages by credit program and group type

	BRAC	BRDB	GB	None	Total
Female only	7	3	12	0	22
Male only	0	9	1	0	10
Female and male	17	12	11	0	40
No program	0	0	0	15	15
Total	24	24	24	15	87

Note – Sample size is 87 villages, 1775 households, and 9215 individuals

Table 2
Means and standard deviations of Independent variables

(N = 877)

Independent Variable	*Mean*	*Standard Deviation*
Schooling of Woman aged 15 and above (years)	0.898	1.864
Age	34.741	10.173
Length of participation (in Months)	52.422	21.617
Accumulated credit from microcredit programs (Taka)	12314.580	9370.727
Distance to parental household (in Kilometer)	11.586	38.477
Highest grade completed by Household Head	1.702	2.780
Percentage of Adult female present in the household	0.526	0.150
Availability of rural health center	0.092	0.289
Availability of family planning center	0.183	0.387
Distance to finished road	2.118	3.002
Price of rice	10.488	1.097
Price of flour	9.110	1.087
Price of hen egg	2.443	1.704
Price of Salt	6.301	0.855
Availability of electricity	0.492	0.500

Note – Sample size is 87 villages, 1775 households, and 9215 individuals

Table 3

Means and standard deviations of dependent variables

(N =877)

Dependent variables from equation (4)	*Mean*	*Standard Deviatibon*
Husband's Schooling (Years)	5.48	17892.3
Husband's total assets (Taka)	72001.04	3.125
Dependent variables from equation (5)		
Total non-food expenditure in last four months (Taka)	613.831	1151.418
Daily Food expenditure (Taka)	38.916	20.915
Total non-agricultural assets after joining program (Taka)	1123.569	2425.714

VI. Results

Table 4 presents estimates of the determinants of husband's characteristics in the mating function in equation (4). It presents estimates for the equations of husband's schooling and total assets accumulated. These estimates can be interpreted in the following manner.

First, wife's schooling is significantly and positively related to her husband's schooling and total assets. Assortative mating on schooling is strong, with one year increase in wife's schooling, husband's schooling increases by about 0.63 year[6]. For every additional year of wife's schooling, there also is a significant increase (12.6 percent increase) in the amount of husband's total asset. As husband's assets and wife's schooling can also be considered complementary goods, this result can count as another example of positive assortative mating between marital partners.

As for the marital age of wives, there seem to be significant relationship between wife's age at first marriage and husband's schooling. The significant positive coefficient implies that women marrying at higher age get husbands with higher schooling. This happens probably because women postpone their marriage to get higher schooling and then also choose husband with more schooling [Rosenzweig and Boulier (1984)]. For husband's asset, wife's marital age does not have any significant impact.

The characteristics of wife's parental household seem to be important too in mate selection. Father's education is significantly related to both husband's schooling and accumulated assets. More educated father might pay more attention to improve child quality by providing more education. Father's education also seems to be significantly related to the asset of his daughter's prospective husband. In short, father with higher education provides signal that his offspring is likely to be of higher quality. As a result, his daughter is rewarded in the marriage market with higher quality of husband. In father's occupation category, only big business holder can significantly influence the quality of their daughter's prospective husband.

[6] In some analysis, tobit estimation is employed when schooling variable is a dependent variable and significant amount of individual report no schooling. But here, for husband's schooling only six individual report no schooling among 877 observations. Therefore, I use conventional OLS estimation.

Table 4

Estimates of Husband's Schooling, Total Assets

	Husband's Schooling (OLS)		Log of Total Assets (OLS)	
	Estimates	t-ratio	Estimates	t-ratio
Intercept	0.678	0.61	9.658	16.8
Wife's Schooling	0.638	10.46	0.126	3.49
Wife's Age at First Marriage	0.14	1.95	0.011	0.30
Father's Education	0.161	4.35	0.066	3.20
Whether wife's father is in				
Agriculture	-0.892	-0.775	-0.578	-0.023
small business	0.702	1.36	0.471	0.67
Big business	1.230	1.983	0.890	2.342
Others	0.923	1.03	1.85	0.00

Table 5 reports the estimates of women's main three performance indicators: non-agricultural assets, non-food expenditures and food expenditures. For each category, there are two types of estimates. Column (1) is OLS and column (2) is also OLS but after incorporating unobserved characteristics represented by the residuals obtained from mating function equations.

Among the explanatory variables, both column (1) and column (2) estimates of schooling are showing that another year increase in schooling increases women's performance in terms of non-agricultural assets. In column (2) estimate, another year of schooling increases non-agricultural assets by around 45 percent. Interestingly, estimates coming out of column (2) are much larger than the other estimate (almost seven times higher). For non-food and food expenditures, the effect of schooling is not that strong.

Among other explanatory variables, e.g. age, only column (2) estimate of non-agricultural assets is showing negative impact of aging process on women's performance: around 3 percent decrease in assets if women get older by a year. Others estimates show insignificant result. It might indicate that younger women are more successful in the micro credit programs in terms of asset accumulation and that is not surprising as these programs are more or less labor-intensive programs. For food and non-food expenditures, on the other hand, it shows positive effect. The reason probably is, as women's grow older, their family might also grow bigger and so does their spending on expenditures. Hence, it is not clear whether older women are doing better or it is simply the effect of bigger family.

The duration of being member in the programs has positive and significant effect on women's performance only in column (2) estimates of non-agricultural assets. Other significant estimates are not strong enough, though some of those estimates are showing negative effects. For accumulated credit, an increase in one thousand taka loan, increases accumulated assets by 7.5 percents in column (2) which is double the amount estimated by OLS in column 1 (3.1 percent). Food and non-food expenditures show smaller but statistically significant impacts.

Table 5

Determinants of women's performance

Independent variables	Log of Non-agricultural assets (OLS)		Log of Non-food expenditure (OLS)		Log of Food expenditure (OLS)	
	Estimates (1)	Estimates (2)	Estimates (1)	Estimates (2)	Estimates (1)	Estimate (2)
Intercept	3.258 (6.96)	9.563 (10.33)	5.385 (16.38)	4.944 (8.38)	2.660 (15.17)	2.661 (11.08)
Schooling	0.067 (4.26)	0.440 (3.92)	0.038 (3.33)	0.041 (1.94)	0.013 (2.09)	0.015 (1.71)
Age (years)	0.005 (1.73)	-0.029 (-3.03)	0.003 (1.79)	0.011 (2.46)	0.007 (6.75)	0.015 (8.31)
How long member (Months)	-0.007 (-4.12)	0.017 (3.23)	0.003 (3.01)	0.013 (1.64)	-0.002 (-3.7)	.004 (4.59)
Accumulated credit	0.031 (7.42)	0.075 (6.58)	0.024 (6.96)	0.014 (2.36)	0.011 (5.71)	0.006 (2.34)
Member of BRDB	-0.301 (-3.27)	-0.302 (-1.42)	0.100 (1.55)	0.101 (0.91)	0.078 (2.26)	0.061 (1.36)
Member of BRAC	0.437 (5.81)	0.704 (3.59)	0.084 (1.44)	0.153 (1.47)	0.070 (2.27)	0.100 (2.36)
Round 2 Dummy	0.265 (3.81)	0.083 (0.64)	-0.077 (-1.57)	-0.106 (-1.32)	0.072 (2.76)	0.077 (2.35)
Round 3 Dummy	0.251 (3.1)	0.280 (1.71)	-0.736 (-12.85)	-0.902 (-9.41)	0.020 (0.67)	-0.123 (-3.17)
Household Characteristics						
Husband's assets	0.018 (7.23)	0.022 (1.02)	0.214 (3.19)	0.083 (3.19)	0.120 (6.14)	0.240 (6.14)
Highest education for household head	0.086 (8.23)	0.073 (3.23)	0.023 (3.07)	0.001 (0.05)	0.005 (1.25)	0.002 (0.48)
Percentage adult female present in the household	-0.306 (-1.8)	-.334 (-3.75)	-0.773 (-5.81)	-0.048 (-0.15)	-0.736 (-10.39)	-0.281 (-2.18)
Village Characteristics						
Any Rural health center?	0.169 (1.83)	0.941 (4.25)	-0.459 (-5.66)	0.267 (2.26)	-0.120 (-2.76)	0.300 (6.26)
Family planning center?	-0.254 (-2.92)	1.639 (7.89)	0.183 (2.65)	0.547 (5.85)	0.113 (3.08)	0.257 (6.77)

Distance to finished road	0.089 (9.06)	-0.227 (-6.05)	-0.009 (-1.34)	0.050 (3.41)	0.005 (1.25)	0.010 (1.7)
Price of Rice	-0.119 (-3.54)	0.056 (0.87)	0.055 (2.23)	-0.029 (-0.72)	0.023 (1.72)	0.023 (1.38)
Price of Flour	0.350 (11.08)	-0.010 (-1.47)	0.074 (3.27)	0.178 (4.54)	0.051 (4.22)	0.047 (2.97)
Price of egg	-0.044 (-3.19)	-	-0.041 (-3.23)	-0.050 (-2.54)	-0.010 (-1.48)	0.009 (1.08)
Price of salt	-0.097 (-2.84)	-	-0.113 (-4.59)	-0.128 (-3.07)	0.027 (2.09)	0.000 (-0.02)
electricity	0.424 (7.06)	-	0.295 (6.67)	0.370 (4.55)	0.131 (5.56)	0.136 (4.12)
Residual from Husband's schooling equation		0.520 (4.28)		-		-
Residuals from husband's asset equation		0.390 (5.1)		0.180 (5.29)		0.076 (5.48)

Note. – Figures in Parentheses are t-ratios

* Estimates not available

The membership dummies of three programs gives some important results. To compare between these three programs, Grameen Bank has been chosen as the base. In column (2), assets estimates show that, compared to Grameen Bank members, BRAC members on the average accumulate 70 percent more assets, spend 15 percent and 10 percent more on non-food and food expenditures respectively. This result is a little bit surprising. Grameen bank is widely considered the most recognized and effective micro credit program but with this evidence that idea is being contradicted and shows BRAC members are outperforming Grameen members. On the other hand, compared to Grameen Bank member, BRDB members accumulate 30 percent less assets.

Also included are the round dummies to account for the three rounds of surveys performed to collect the data. These rounds of surveys mainly takes into account seasonalities influenced by crop cycles. In the case of asset accumulation, there seem to be no significant impact when unobservable effects are taken into account. But there are drastic reductions in both food and non-food expenditures in round 2 and round 3 compared to round 1. This is not surprising as round 2 and round 3 are leaner seasons compared to round 1, when household income depending heavily on crop cycles suffers more.

Among other household characteristics, the schooling of household head seems to have significant impact on women's performance. Additional year of schooling of household head increases asset accumulation by seven percent, whereas impact on food and non-food expenditures is minor. On the other hand, increase in the percentage of adult female in household seems to be negatively affecting women's performance. The reason might be, most of the times when other female is present, she is in the form of either mother-in-law or another wife. Socio-culturally wife does not have good relationship with them due to several conflicts of interest and probably this affects productivity.

Among the village characteristics, presence of a rural health center considerably increases women's performance, which is not surprising as better health definitely increases productivity of work force in general. Interesting thing is the magnitude of increase. Women on the average accumulate 94 percent more assets

than those women who does not have any rural health center present in their village. It also helps women to increase their expenditure on food and non-food items. Among other village characteristics, the higher the distance to finished road, the lower the asset accumulation, which is not surprising as transportation is very important and it raises the production cost. And it also raises food and non-food expenditure as price of the products usually rise with transportation cost. Most of the prices (price for rice, egg etc) show positive relation with food and non-food expenditures for obvious reason. With the presence of electricity, asset accumulation increases by almost 42 percent when electricity is present, non-food and food expenditure rises by 37 and 13 percent respectively. With the presence of electricity, it gives women the opportunity to use advance technology in their production and thus they become more productive.

The crucial aspect of these estimates is the impact of unobservable characteristics. The residual from husband's schooling equation implies that, one unit increase in the unobservable characteristics which allows the wife's to get a husband with schooling level one year higher, also helps her to accumulate 52 percent more assets after joining the micro credit programs[7]. In the same manner, the residual from husband's asset equation implies that, one unit increase in the unobservable characteristics which allows the wife to get a husband with one percent more assets, also helps her to accumulate 39 percent more assets after joining the micro credit programs. It has been already mentioned that we have to be cautious about these results for being biased due to the presence of measurement error associated with these unobservable characteristics. Even then, the highly statistical significance of these measures and their positive impact on all three measures of performance indicators underscores the importance of unobservable characteristics in the microcredit programs.

In appendix A, figure 1 and 2 plots the residuals from the husband's schooling and assets equation against women's accumulated non-agricultural assets. Those two figures clearly shows positive relation between these residuals and women's asset

[7] Since this is a vector unobserved variables, the units can be selected so that the coefficients are equal to one

accumulations. It implies that women accumulate more assets if they have more of those unobserved characteristics that helped them get a better husband in the marriage market. Figure 4 and 6 shows the same positive relationship between the residuals from the husband's asset equation and food and non-food expenditures. On the other hand, figure 3 and 5 shows no clear relationship between the residuals from the schooling equation and food and non-food expenditures. Probably that is the reason why residuals from schooling equation drop out in the regression involving food and non-food expenditure. Therefore, estimates for these residuals are unavailable in Table (5).

Specification Tests

Table B1 and B2 in Appendix B provide some specification tests for both marriage market equations and women's performance equations. These equations have underlying statistical assumptions, which have to be satisfied before any inference can be drawn.[8] For testing the normality assumption both Skewness-Kurtosis (D'Agostino and Balanger 1990) and Swilk (Shapiro and Wilk 1965) test have been employed. For testing linearity and homoskedasticiy, RESET type tests have been employed. In the case of testing linearity, Ramsey Reset test (Ramsey 1969) and for testing homoskedasticity Cook-Weisberg test (Cook and Weisberg 1983) has been used. None of the p-values shows any serious departures from these assumptions.

Now to test for the presence of endogeneity after incorporating the residuals in estimates (2), Hausman test for endogeneity is employed (Hausman 1978). As already mentioned, the variables that are prone to be endogenous are schooling and accumulated credit. For each suspected endogenous variable, we obtain the reduced form residuals. Then, we test join significance of these residuals in the structural equation, using an F test. In Table 6, these Hausman tests reveal that for estimate (1) for all three performance indicator variable, there is a strong presence of endogeneity – high value of F-statistic implying we can reject the null hypothesis of no endogeneity. On the other hand, for estimates (2), these tests reveal very moderate presence of endogeneity. It would be fair to say that estimated residuals from the marriage market equations sufficiently capture unobserved characteristics of women.

[8] For details see Spanos (1986, 1999).

Table 6
Results for Hausman Tests of endogeneity

	Log of Non-agricultural assets	Log of Non-food expenditure	Log of Food expenditure
Estimates (1)	3.912	2.946	5.132
Estimates (2)	1.123	0.923	1.760

VI. Concluding Remarks

The main objective in this paper was to determine the important factors that contribute to women's economic success in microcredit programs. Main focus was on finding accurate estimates of women's economic performance by controlling for the unobserved ability of these women.

The information about women's unobserved characteristics has been derived from marriage market interaction. It was argued that residuals from the mating function (where husband's characteristics are determined by wife's observed and unobserved characteristics) provide a consistent representation of wife's unobserved characteristics. These residuals from the marriage market are used in the wife's performance indicator equation along with her observed characteristics.

Observed characteristics like schooling, duration of membership, different program membership and others were found to have significant impact on the accumulated asset. Some of these results have important implications for microcredit programs.

The finding that women's accumulated assets increase by more than ninety percent with the presence of a rural health center is significant for non-credit service of these microcredit programs.

The finding that women's asset accumulation declines with increase in the percentage of adult women present in the household. It has been already mentioned, for socio-cultural reason, women might not perform well while other women are present in the household who are not participants. This evidence might encourage policy makers to include more than one female member from households where other adult female members are present.

One of the surprising results is the finding that BRAC members are outperforming Grameen Bank member in all three measures of economic performance. Future research might be directed at looking at the mechanisms of these different credit programs individually which might give more insight into understanding important aspects of microcredit programs.

It has been also found that unobserved characteristics (represented by the residuals from marriage market) have significant effect on these women's performance and the presence of them sometimes significantly changes the magnitude of the effect and sometimes even the direction of the change. Therefore, assessing women's performance only on the basis of observed characteristics might lead to erroneous conclusion. We gain a better understanding of women's performance in the microcredit programs by combining information from both marriage market and microcredit programs.

The finding that unobserved characteristics are important might also validate the group-based nature of these credit programs where members are aware of these unobserved characteristics of each other and try to form a group with members who have the higher quality of these characteristics.

It has been also found that impact of participating in the credit programs as measured by the accumulated credit is considerably less compared to other variables. The effect of credit is about seven percent increase in assets accumulation whereas it was found that schooling, some household and village characteristics and importantly unobserved effects have caused well over 40 percent increase in assets. This might imply that the credit programs gives the women a outlet to generate income but while they are in the program, other characteristics are more important than merely the amount of credit they have access to.

Appendix A : Plots of residuals and Women's performance

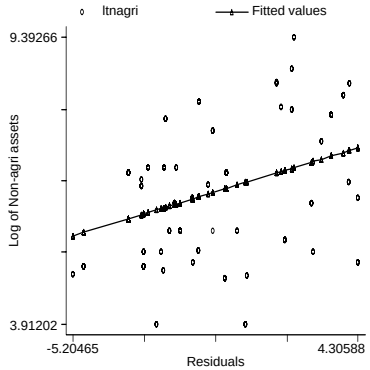

Figure1:Non-agri assets & schooling residuals

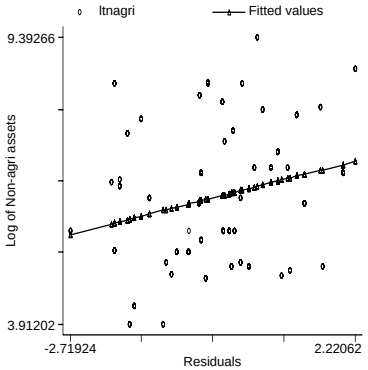

Figure2:Non-agri assets & asset residuals

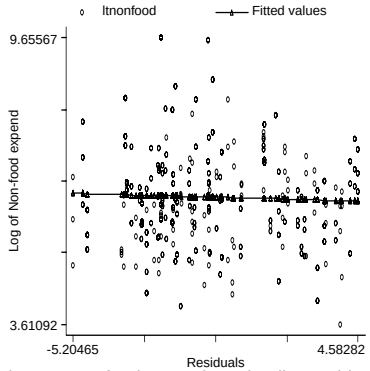

Figure3:Non-food expend & schooling residuals

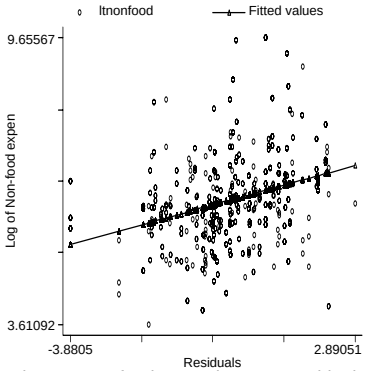

Figure4:Non-food expend & asset residuals

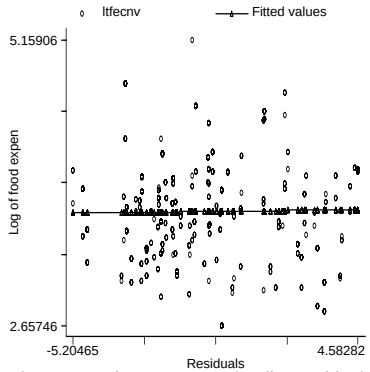

Figure5:Food expense & schooling residuals

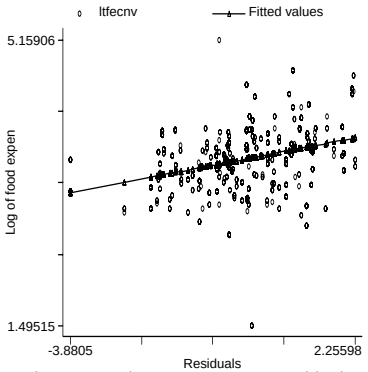

Figure6:Food expense & asset residuals

Appendix B

Table B1 : Misspecification Tests for Marriage Market equations

	Husband's Schooling equation	Husband's Asset equation
	P-value	P-value
Normality Tests		
(a) Skewness-Kurtosis	0.992	0.183
Skewness	0.991	0.180
Kurtosis	0.995	0.158
(b) Shapiro-Wilk	0.999	0.359
RESET Test for Linearity	0.078	0.048
Cook-Weisberg Test for Homosekdasticiy	0.221	0.1080

Table B2 : Misspecification Tests for Women's Performance equations

	Non-agricultural assets	Non-Food Expenditures	Food Expenditures
	P-value	P-value	P-value
Normality Tests			
(a) Skewness-Kurtosis	0.292	0.381	0.312
Skewness	0.761	0.118	0.669
Kurtosis	0.125	0.851	0.925
(b) Shapiro-Wilk	0.298	0.953	0.123
RESET Test for Linearity	0.273	0.248	0.981
Cook-Weisberg Test for Homosekdasticiy	0.122	0.108	0.528

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