BUFT Journal of Business & Economics (BJBE)
ISSN 2664-9942 (Print)
2024 Volume 5, Pg: 21-34
DOI: https://doi.org/10.58481/BJBE/2402

Discriminating Factors of Formal and Informal Micro-Credits Programs in Bangladesh: An Efficiency Approach

Dr. Md. Nazrul Islam[1*], Dr. Sabina Islam[2], Md. Shafayet Shahed Ornob[3]

ARTICLE INFO

Article History
Received : January 21, 2024
Accepted: April 16, 2024

Keywords:
Microcredit, Formal Credit, Informal Credit, Discriminant Analysis, Fisher's Linear Discriminant Function.

JEL Classification:
O15, G21

ABSTRACT

Purpose: The study aims to identify the factors influencing the choice of formal and informal micro-credits programs in poverty alleviation of Bangladesh especially in Haor area.

Methodology: The study has covered a total of 2340 households' respondents where 1560 actual micro-credit users and 780 eligible micro-credit users while they did not use micro-credits as control (50% of the cases) group for comparison purpose. The characteristics of control households are almost similar to the cases (micro-credits recipient) households. Total survey area has been divided into thirty clusters and the survey was made with a structured questionnaire to measure the impact on poverty of both types of credits and find out the dimensions of discrimination. The group means, pooled group correlation matrix, covariates for discrimination, and validation of two-group discriminant finally Fisher's linear discriminant function were used to reach in the conclusion.

Findings: The study identified that the installment types are the most important predictors in discriminating between formal and informal microcredits groups, followed by duration of loan, interest rate, gender of loan receivers, earning status of loan receivers, and regular income source in the households and so on and this is also confirmed by cross-validation analysis. Fisher's linear discriminant function forecasted that the new member with discriminant scores above 0.44 supposed to borrow from the informal sources however the members having below of the score will borrow from formal sources.

Practical Implications: The lenders will be able to design effective micro-credit programs considering the needs of the users.

Originality/Value: The research is the first attempt to identify the discriminating factors between formal and informal micro-credits with large volume of solid primary data.

Limitations: The study did not make any in-depth-interview regarding the issue.

1. Introduction

In Bangladesh there are 373 Haors (Wetland) and most of them are in the North-Eastern part of the country covering 19,998 sq. km of land and in total 3.56% area (CEGIS, 2012). The people of the *Haor*

* Corresponding Author
1. Professor, Department of Business Administration, Shahjalal University of Science and Technology, Sylhet-Bangladesh.Email: dnislam969-bus@sust.edu.
2. Professor, Department of Statistics, Shahjalal University of Science and Technology, Sylhet- Bangladesh. Email: sabina-sta@sust.edu.
3. Graduate Student, Department of Business Administration, Shahjalal University of Science and Technology, Sylhet- Bangladesh. Email: shafayetshahed@gmail.com.

area are below average than the remaining parts of the country. According to the report of the Haor Infrastructure and Livelihood Improvement Project, (Bylander, 2014) of the International Fund for Agricultural Development (IFAD) the long seasonality of wet monsoon (6-7 months from May to October) forces the Haor people to remain out of work for most of the times while about one-third of the people is extremely poor as they lie below the lower poverty line and only about 30% of them lays above the upper poverty line (Islam, 2014). Consequently, most of the of the Haor people suffer from food insecurity and other basic needs (Alam et al., 2018) and finally, they depend on borrowings from informal micro-credits suppliers for their livelihood as they are behind in access to formal banking services and micro-credit emerged as an easily accessible source of loans (Islam et al.,2024). However, the rate of interest on different types of micro-credits in Bangladesh is excessively high (Prince et al., 2020) and varied from 12.5% to 43% and in some cases, it rose to 110% (Hassan et al., 2015). The rate of interest for the informal micro-credits might be higher than for the formal micro-credits. As a result, the socioeconomic status of Haor people far lagging than the other parts of country (Islam et al., 2023). There are differences in respect of cost, terms, duration, receiving capacity, and availability between formal and informal sources. The study aimed to identify the causes of differences between these two types of micro-credits with solid ground-level data in terms of impact on poverty reduction of the Haor people.

Micro-credits have become a globally used term to me an very small-sized supervised loans with out any collateral originated in Bangladesh in 1983 by the Grameen Bank (Bateman, 2010). Subsequently, many commercial banks and NGOs introduced different types of micro-credits in different forms based on this system. The sources of micro-credits can be classified into formal and informal. The formal micro-credits are regulated by the country's banking and financial services acts/rules or regulations whereas informal micro-credits do no control by any formal organizations/institutions rather they are invisible in the eye of control. The informal micro-credits embrace all financial transactions taking place beyond countries' regulations of banking and other financial sectors and they include professional money lenders, part-time money lenders such as estate owners, traders, grain millers, small holder farmers, employers, relatives, friends, mobile bankers, credits unions, cooperative societies, etc. without the authoritative permission of the government body under the financial system (Aryeetey, 2005). Maximum relaxed units deal with explicit groups of individuals, confirming that only those who gratify diverse selection criteria are able to whichever payment with them or derive from them (Aryeetey, 2005).

In 1971 Bangladesh inherited a fragile credit and banking systems with 12 commercial banks having 1130 branches formally and also a very limited supply of informal sources consisting oflocal moneylenders, brokers, shopkeepers, and other types of lenders. A rapid change is seen in the formal credit system and right now there are 61 scheduled banks with more than 11000 branches under the control of Bangladesh Bank and 5 non-scheduled banks. Further, there are 34 financial institutions (FIs) in the country (Bangladesh Bank, 2021). In respect of formal micro-credits supply in addition to banks and FIs, there are 759 organizations with 20898 branches and 33.31 million service receivers controlled by Micro-credit Regulatory Authority (MRA) across the country (MRA, 2021). Though there has been a visible development in the formal micro-credits in Bangladesh, still now informal micro-credits continued to remain asthe major sources in the rural area specially in lagging areas like-Haor and Char areas. The credit supply system in the rural area of Bangladesh is still dominated by informal moneylenders whose share is about two-thirds of total credit in rural areas. Therefore, the characteristics of micro-credits are the key decision factor of choosing micro-credit of the users. The present study has determined the traits of both informal and formal micro-credits in terms of main socioeconomic factors like cost, duration, repayment system types and modes. As a result, the users would be able to choose the best one which is fitted to them.

The informal sources of micro-credits in the Haor area therefore the main sources of micro-credits. There are different types of informal micro-credits practicing in this area. The informal sources

of micro-credit can be grouped into- cash, non-cash, and a mix of both cash and non-cash. Cash credit can be classified into two types - interest-free and interest-bearing. The former includes- friends, relatives, neighbors, shop, chit fund, and the latter include - individual money lenders /investors, an informal group of farmers, fishermen, salaried employees, rickshaw pullers, petty traders, hawkers, shopkeepers, and other business agents the non-cash micro-credit can also be divided into interest-free and interest-bearing. The interest-free sources are- friends, relatives, and neighbors. Under this credit system, the borrowers get paddy or food items from the lenders for a certain period and repay the same amount on time. Crop sharing is another interest-free kind of loan where landless or marginal people cultivate the land of the landowners and give a portion of the crop to the landlord. Under the interest-bearing system, lenders lend a certain amount of paddy or food items in the crisis period of the borrower and get back more quantity of the item from the borrowers. The landlord and rich people are the main sources of this kind of loan. The third kind of micro-credit is paid in cash but repaid in kind where the borrowers borrowed cash for producing a crop or manufacture a product and are repaid in the form of a crop when the price of crop product is priced usually lower than the normal market rate at the time of getting cash credit. Another type of Haor loan is an undertaking to supply labor for the creditors' land. Under this system, small farmers, occupants, and landless laborers that do not have sufficient land use as security get advances in their crisis period from the landlord and repay the loan by working on their lands. At this time the labor is priced at a lesser rate than the market at the time of taking a loan. Another mode of the loan in Haor area is that the landless farmers get the right to produce/cultivate the land for a while in exchange for certain money and he owns the crops totally. The cost of production is incurred by the farmers (Uddin, 2020). Hence, there are mainly two types of micro-credits viz. formal and informal and there are various sources or modes of credits under both formal and informal micro-credits. Again, informal micro-credits can be classified into interest bearing and interest free. Therefore, cost or interest also varies from credit to credit. But ambiguity still exists in the empirical literature about whether the formal micro-credits outperform its informal counterpart in reducing poverty for a group of borrowers or for all.

The core objective of the present study is to explore the traits which varies between formal and informal micro-credits. The specific objectives are to:

(i) Show the empirical evidence of influencing factors that help to differentiate between formal and informal micro-credits to the users; and

(ii) Identify the appropriate type of micro-credit for the specificand suitable group of users.

2. Literature Review

A number of studies (Dhawan et al., 2022; Duong & Nghiem, 2022; Félix & Belo, 2019; Phan et al., 2023; Wahab et al., 2018) recognized that micro-credits play positive role on reducing poverty. Micro-credit enhance the self -help approach and heighten self-employment (Cons & Paprocki, 2010; Dhawan et al., 2022; Pal & Singh, 2021) and boost borrowing capacity of group and thus, improve repayment performance of borrowers (Agba et al., 2014), lessen discrimination in the humanity (Miled et al., 2022) and bring out them eager persons from the vulgarity of poverty (Khandker & Samad, 2014). The borrowers of micro-credits get training facilities on different soft and hard skills and in household level enhance the capacity to tackle risk (Karlan & Zinman, 2010). Micro-credits elevate found that micro-credit elevate the poor out of extreme poverty. Micro-credits act as a vehicle of savings (Choudhury et al., 2017; Kumburu & Pande, 2020; M. A. U. Rahman & Ley, 2020) and called an instrument of crisis management (Shahnaz et al., 2018), fuel household income, expenditures, savings and also the level of education (Choudhury et al., 2017; Qamar et al., 2017) and lift earning ability, payment scheme, member's cooperation, and well-being and improve significantly the total income after joining the program (Khanam et al., 2018; Terano et al., 2015). Access to microfinance increases women's informal borrowing for small consumption and increase entrepreneurs' income and innovation (Ahmed, Siwar, Aini, & Idris, 2011; Ahmed, Siwar, Aini, Idris, et al., 2011; Islam et al.,

2015), boost up the power of women in society (Al-Shami et al., 2017; Al-shami et al., 2018; Bhattacharjee, 2016; Hameed et al., 2019; M. M. Rahman et al., 2017). Access to credits and financial services to women makes economically, socially and politically empower themselves and improve their status and help entrepreneurs to attain highest academic qualification and help licensing of more financial institutions for women entrepreneurs, empowering women and meets emergency (Bhattacharjee, 2016; Mwongera, 2014), provides financial management skills and the group identity of the women borrowers and helps the development of rural women entrepreneurship in Bangladesh and subsequently, and empowers the women so women can also contribute in the economic growth (Muhammad et al., 2016). Micro-credits help to gather skills, utilization of the skills of the members/borrowers, educate their children and enhanced quality of life of the poor and enhance the capacity to fight against hunger and poverty alleviation (Muhammad et al., 2016). Planning Commission (2016) identified that Haor area of Bangladesh is furnished with valuable water vegetation and creatures and as a result recognized as an ecological and economic important area of the country. Sultana et al. (2023) found identified 40% of micro-credits receivers could not repay loan and fall in vicious cycle of credits in the Haor region of Bangladesh. Consulting Group to Assist the Poor (CGAP) identified that micro finance helps Haor people in keeping up their consumption steady, finance major expenses, and enable them to tackle the natural shocks (Rosenberg, 2010).

A number of researchers compared the impact of formal and informal micro-credits. Gichukiet al. (2014) found that micro and small enterprises easily access informal sources more than formal sources in terms of high cost, stern security requirements, and the disinclination of people for acting as underwriters, high dispensation fees, and the short reimbursement period. Berhanu et al. (2021) found that the benefits of formal and informal credits varied by the group of stakeholders. Phan Dinh Khoi (2023) examined the causes of households' borrowing decisions in terms of prescribed and relaxed micro-credits and micro-credits accessibility and found that informal micro-credits alter the households' decisions to obtain formal microcredit. It is worth noting that the environmental effects of microcredit are also substantial in ensuring environmental sustainability (Huybrechs et al., 2019; Shahidullah & Haque, 2014) and green transformation of business enterprises. The existing studies still failed to show any evidence to identify which type of micro-credits is suitable for which type of borrowers. However, the present study is an ample step to suggest the types of micro-credits corresponding to the types of borrowers or users.

3. Methodology

3.1 Sample and Sampling

Cluster-sampling design has been used in selecting sample size while the Haor-attached mouzas/unions have been treated as cluster and in total 30 clusters have been covered in the survey. Total 30 clusters are regarded as statistically representative sample of a population by internationally recognized survey designs, such as WHO's EPI cluster sampling design (Turner et al., 1996). The sample size has been determined using the formula[1] yields that at least 1544 targeted (micro-credits recipient) households are required to cover for the study. For rounding-up in clusters, the study increased the sample size from 1544 to 1560. The study has covered 780 households as control (50% of the cases) group. The characteristics of control households are almost similar to the cases (micro-credits recipient) households. As a result, the total sample size of the study was 2340 poor households. The study aims to identify the discriminating factors between formal and informal sources of microcredits. A survey was made with a structured questionnaire to measure the impact on poverty of both types of credits and find out the dimensions of discrimination.

3.2 Data Collection

The study is based on both primary and secondary data. The primary data has been collected from the micro-credit recipients (treatment group) as well as non-recipients (control group). A semi-structured

questionnaire has been used for collecting the data from both the treatment group and the control group where some parts were common for both and some parts were specific for a particular group.

3.3 Methods Data Analysis

The study used only Fisher's linear discriminant function to discriminate between formal and informal micro-credits.

3.3.1 Estimation of Fisher's linear discriminant function

This study also estimated the parameters of the Fisher's linear discriminant function for discriminating the formal and informal source of credits by the study variables. This study mainly examined three types of predictors for discriminating formal and informal sources. These are: individual level factors or the characteristics of the borrowers (loan receivers), their household characteristics, and finally micro-credits characteristics. The estimated Fisher's linear discrimination function is as follows (Malhotra, 2019)

D = -8.12 + 1.02×Sex + 0.01×Age + 0.17×Occupation + 0.03×Earning status - 0.06×Number of earner - 0.08×Dependency ratio + 0.22×Household's regular income source + 0.10×Asset index - 0.65×Toilet type + 0.01×Landholding + 0.01×Annual income + 0.01×Amount of loan + 1.59×Installment type + 0.04×Duration of loan + 0.03×Interest rate *(1)*

This function is used to predict or classify a new individual with the respective characteristics who are supposed to borrow from formal source or informal source.

3.3.2 Limitation of the Study

The study is confined to the estimation of Fisher's linear discriminant function which is well known to methods to analysis discrimination. Others methods like IDI (In-Depth-Interview) could be used to explore the real scenario and to cross check of the quantitative method but not adopted in the study.

4. Data Analysis and Findings

4.1 Group Means and Standard Deviation of the Predictors of the Discriminant Analysis

In this case total fifteen dimensions have been used to compare between formal and informal micro-credits as stated in table-1which identified the measure of dispersion by groups to recognize the variations among the predictors between formal and informal credits receiving status. In terms ofborrowers' age at inclusion to micro-credits, credit receivers of informal source are older than the credit receivers from formal source.

Table 1.

Group Means and Standard Deviation for Group Membership of Micro-Credits Receivers

List of predictors	Group means		Group standard deviation	
	Formal	Informal	Formal	Informal
Gender of loan receiver	0.64	0.87	0.48	0.34
Age of loan receiver	41.80	44.19	11.28	11.45
Occupation of loan receiver	2.73	2.38	1.20	1.21
Earning status of loan receiver	0.71	0.87	0.45	0.34
Number of earning members	1.59	1.81	1.00	1.05
Dependency ratio	0.75	0.81	0.58	0.73
Regular income source	1.48	1.65	0.50	0.48

[1] $n = \frac{p(1-p)Z^2}{(0.04\,p)^2} \times Deff$ where, p is the indicator percentage, Z is the value of normal variate with 95% confidence interval, 0.04p is the relative error margin and *Deff* is the design effect.

Asset index	0.02	-0.13	0.98	0.97
Type of used toilet	0.44	0.35	0.50	0.48
Total amount of land	67.29	80.75	112.39	112.20
Total annual income	105281.49	96233.18	58972.96	59387.91
Amount of received loan	34596.29	45474.61	40825.63	76125.59
Installment type	1.96	3.96	1.07	1.12
Duration of loan	11.86	21.25	3.51	22.80
Interest rate	17.77	26.00	7.55	19.12

Source: Authors' Calculation

The average number of earning members is slightly higher in informal micro-credits receiver households than that of formal micro-credit receivers. It appears from the group standard deviation that formal and informal micro- credits receiving groups are more widely spreader in case of gender, earning status, dependency ratio, amount of received loan, duration of loan and interest rate. The variations between the groups were observed more in the case of loan related factors. However, the average dependency ratio was estimated lower in formal micro- credit receiving households while standard deviation was estimated higher than that of informal source of micro- credit. The study also identifies that the mean difference between formal and informal micro- credit groups in case of loan related characteristics is smaller, but the standard deviation of these factors is relatively large. This finding initially indicates that the characteristics loan contributes more to discriminate formal and informal source of micro- credit.

4.2 Pooled Group Correlation Matrix

The pooled within group correlation matrix are calculated to identify the linear relationship among predictors as the initial or descriptive measure of multicollinearity. The correlation the gender and occupation, gender and earning status, and occupation and earning status have moderate correlation among the pair of all predators (table -2).

Table 2.
Within-groups Correlation Matrix of the Predictors

List of covariates	02.	03.	04.	05.	06.	07.	08.	09.	10.	11.	12.	13.	14.	15.
01. Gender	0.18	-0.70	0.68	0.01	0.02	-0.05	0.06	0.01	0.07	0.02	0.04	0.11	0.04	-0.05
02. Age		-0.12	0.05	0.22	-0.24	-0.05	0.24	0.02	0.18	0.16	0.07	0.03	0.03	-0.03
03. Occupation			-0.62	-0.08	-0.01	0.06	-0.09	-0.01	-0.21	0.02	-0.02	-0.09	-0.08	0.03
04. Earning status				0.25	0.03	-0.10	0.06	-0.06	0.06	-0.01	0.02	0.09	0.05	-0.03
05. No. of earner					-0.18	-0.07	0.22	-0.01	0.14	0.20	0.14	0.10	0.25	0.03
06. Dependency ratio						0.10	-0.22	-0.06	0.00	-0.09	0.00	0.05	0.09	0.04
07. Regular income source							-0.15	-0.15	0.07	-0.08	-0.06	0.11	0.11	-0.05
08. Asset index								0.05	0.25	0.29	0.06	-0.10	-0.10	-0.03
09. Toilet type									-0.03	0.09	0.07	0.08	0.10	-0.04
10. Landholding										0.21	0.09	0.08	0.06	-0.07
11. HH income											0.23	-0.04	0.10	-0.07
12. Loan												0.17	0.30	0.17
13. Installment type													0.23	0.21
14. Duration of loan														0.16
15. Interest rate														

Source: Authors Calculation

However, the correlation matrix indicates very weak correlations among the predictors for rest set of pair of predictors and the coefficient of correlation is estimated below 0.3 for all set of pairs. Marginally, multicollinearity is unlikely to be a problem for estimation as well as making conclusions for discriminating the formal and informal micro- credit receiving likelihoods.

4.3 Significance of Covariates for Discriminating Formal and Informal Credits Source

In discriminant analysis, Wilk's lambda provides a test for assessing the null hypothesis that the vectors of means of the measurements (predictors) are the same in the two groups (formal and informal). The lambda coefficient is defined as the proportion of the total variance in the discriminant scores not explained by differences among the groups, here 55.6% (table 3).

Table 3.
Test of Significance of Function and Equality of Group Means for Each Individual Predictor

Name of the predictor variables	Wilks' Lambda[a]	F-statistic	P-value
Test of function[b]	0.556	Chi-sq = 936.525	<0.01
Gender of loan receiver	0.952	81.302	<0.001
Age of loan receiver	0.991	14.409	<0.001
Occupation of loan receiver	0.984	26.473	<0.001
Earning status of loan receiver	0.973	43.798	<0.001
Number of earning members	0.99	15.424	<0.001
Dependency ratio	0.998	2.895	0.089
Regular income source	0.975	41.374	<0.001
Asset index	0.995	8.392	0.004
Type of used toilet	0.994	10.094	0.002
Total amount of land	0.997	4.648	0.031
Total annual income	0.995	7.587	0.006
Amount of received loan	0.992	13.582	<0.001
Installment type	0.592	1105.93	<0.001
Duration of loan	0.897	185.231	<0.001
Interest rate	0.913	153.155	<0.001
Model summary			
Eigen value	0.78		
Canonical correlation	0.666		
R^2 from canonical correlation	0.444		

[a]Wilks' l (U-statistic) and univariate F-ratio with 1 and 1605 degrees of freedom

[b]Wilks' l (U-statistic) and chi-square statistic tests the overall significance of function with 15 degrees of freedom

Source: Authors Generated

The formal test confirms that the sets of fifteen mean measurements differ significantly between the two sites (Chi-sq (15) = 936.525, $p<0.01$). The significance of the uni-variate F-ratios indicates that when the predictors are considered individually, is there any significantly difference between those who had been credited from formal sources and those who had been credited from informal sources. The study found that the mean dependency ratio significantly differentiates the formal micro- credit and informal micro- credit at 10% level of significance. Besides, average value of landholding indicate significantly differentiates the formal and informal micro- credit at 5% level of significance. However, rests of the covariates also significantly differentiate the formal and informal micro- credit receiving status at 1% or less than 1% level of significance. These tests provide validity

to proceed in the next level of discriminant analysis. Because there are two groups, only one discriminant function can be estimated using all predictors. The eigenvalue associated with this function is estimated at 0.786, which accounts for 100 percent of the explained variance. The canonical correlation associated with this function is estimated at 0.666. The square of the canonical correlation in discriminant analysis demonstrates the interesting finding focusing of model fitting ability. However, the value of 0.444 of the R2 from the estimated canonical correlation coefficient indicates that 44.4 percent of the variance in the dependent variable (credits type) is explained or accounted for by this model.

4.4 Estimation and Validation of Two-group Discriminant Analysis

The estimate of the coefficients for a certain variable depends on other variables included in the analysis. The sign of the coefficients indicates the effect of resulting variable on the formal and informal micro- credit receiving status. The unstandardized coefficients measure absolute magnitude of the impact of each predictor on the discriminating power of the dependent variable. The larger estimates of the unstandardized coefficients identified the more powerful or influential predictor for discriminating the formal and informal micro- credit types. The standardized coefficient is estimated because some of the predictor variables were in different scale or they are observed in different units. Besides the standardized coefficients are more prompt possessing the caveat of multicollinearity problem through implying the relative importance of each predictor for discriminating formal and informal micro- credit receiving status.

In addition, relatively large standardized coefficient demonstrates more discriminating power of the function as compared to the smaller standardized coefficients. These imply that the variable with relatively large estimates of the standardized coefficients is more important than the other coefficients. The coefficients of the model indicates that higher installment type (annual), more duration of loan, female loan receivers, earner loan receivers, households having regular income source, older loan receivers, households having more assets are more likely to receive the formal micro-credit than that of informal micro-credit (Table-4). However, smaller number of earning members in the borrower households, unhygienic toilet typeand lower dependency ratio is more likely to receive the loan from formal sources than that of informal micro-credit sources.

In addition, the canonical loadings or discriminant loadings are estimated to identify the magnitudes of the discriminating power of the predictors. These loadings measure the correlation between discriminating variables (study predictors) and the canonical discriminating functions which are presented at the structure matrix column in table-4.

Table 4.
Estimates of Two-Group Discriminant Analysis for Formal and Informal Credits

Discriminating variables[a]	Unstandardized coefficients[b]	Standardized coefficients[c]	Structure Matrix[d]
Installment type	0.802	0.867	0.930
Duration of loan	0.018	0.222	0.380
Interest rate	0.013	0.159	0.346
Gender of loan receiver	0.511	0.227	0.252
Earning status of loan receiver	0.015	0.006	0.185
Regular income source	0.109	0.054	0.180
Occupation of loan receiver	0.087	0.105	-0.144
Number of earning members	-0.028	-0.028	0.110
Age of loan receiver	0.005	0.061	0.106
Amount of received loan	0.001	-0.124	0.103

Type of used toilet	-0.327	-0.161	-0.089
Asset index	0.051	0.050	-0.081
Total annual income	0.001	-0.036	-0.077
Total amount of land	0.001	-0.015	0.060
Dependency ratio	-0.039	-0.024	0.048
Constant	-3.167	-	-

[a] Discriminating variable (predictors) are ordered by size of correlation within function to identify most contributor

[b] Coefficients are obtained from the original (unstandardized) set of predictors using canonical discriminant function

[c] Coefficients are obtained from the standardized set of predictors using canonical discriminant function

[d] Pooled within-groups correlations between discriminating variables and canonical discriminant functions, therefore called as canonical loadings or discriminant loadings

Source: Authors Calculation

In short, the discriminating loadings identified the most important predictor among predictors for discriminating the borrowing sources of micro-credits. Similarly, these estimates rank or order the predictors based on their discriminating power of the dependent variable. More precisely, installment types are the most important predictors in discriminating between formal and informal micro-credit groups, followed by duration of loan, interest rate, gender of the loan receivers, earning status of loan receivers, and regular income source in the households and so on. On the contrary, dependency ratio, household possession of land, households' total income is the least contributory predictor, however significant, for discriminating the borrowing source of micro-credits.In discriminant analysis, the validation of the model is grabbed using cross-validation approaches (Table-5). Generally, the discriminant analysis model splits the whole data sets into two equal parts in which first one is termed as estimation sample or analysis sample and rest one is termed as holdout or validation sample.

Table 5.

Validation of the Two-Group Discriminant Analysis Model

Prior probabilities based on groups (informal = 0.279, formal = 0.721)					
No cross-validation [a]	Type of credits		Predicted		Total
			Informal	Formal	
	Observed	Informal	240	209	449
		Formal	24	1134	1158
Leave one out cross-validation [b]	Type of credits		Predicted		Total
			Informal	Formal	
	Observed	Informal	239	210	449
		Formal	25	1133	1158

[a] Hit ratio of 0.855 measure that 85.5% of original grouped cases correctly classified

[b] Hit ratio of 0.854 measure that 85.4% of cross-validated (leave one out) grouped cases correctly classified

Source: Authors Calculation

On the other hand, leave one out cross-validation approach is also examined to estimate the accuracy of correct classification rate by splitting the samples equivalent to its size (n-term). Each time one sample is reserved for validation sample while the rest sample are used as the estimation sample and this process is repeated n-times holding each sample as validation sample. It is to be noted that the prior distribution is assumed equivalent to the sample estimate for each group of the dependent

variable rather than 0.5 for each group. Finally, the validation of the discriminant analysis is documented using the percentage of correct classification which is termed as hit ratio in discriminant analysis. However, there is no substantial improvement in the leave one out cross-validation approach as compared to the no cross-validation (Table-5). In addition, no cross-validation approach estimates that almost 86% of the original grouped cases such as formal and informal source of credits are correctly classified by the discriminant analysis model.

4.5 Estimation of Fisher's Linear Discriminant Function

The average of the group means commonly known as group centroids and the score or value obtain from Fisher's linear discriminant function are used and compared to allocate new members into a group. The average of the functions at group centroid is estimated at 0.44 (Table-6). Therefore, it is obvious that new members with discriminant scores above 0.44 supposed to borrow micro-credits form the informal sources otherwise he/she would be preferred to borrow from formal micro-credit source.

Table 6

Estimates of Fisher's Linear Discriminant Function by Two-Group Discriminant Analysis

Predictors	Informal	Formal	Fisher's discriminant function coefficients
(Constant)	-41.02	-32.90	-8.12
Gender of loan receiver	7.95	6.94	1.02
Age of loan receiver	0.38	0.37	0.01
Occupation of loan receiver	6.33	6.16	0.17
Earning status of loan receiver	10.00	9.97	0.03
Number of earning members	0.41	0.46	-0.06
Dependency ratio	2.97	3.04	-0.08
Regular income source	7.31	7.10	0.22
Asset index	-0.35	-0.45	0.10
Type of used toilet	3.05	3.70	-0.65
Total amount of land	0.01	0.01	<0.01
Total annual income	<0.01	<0.01	<0.01
Amount of received loan	<0.01	<0.01	<0.01
Installment type	2.18	0.58	1.59
Duration of loan	0.01	-0.03	0.04
Interest rate	0.19	0.17	0.03
General classification rule			
Functions at group centroids	1.43	-0.56	0.44

Source: Authors Calculation

5. Conclusion

The aim of the study was to identify the decimating factors that affect in selecting between formal and informal sources of micro-credits in Bangladesh. The forgoing analyses revealed that there is difference of standard deviation between formal and informal micro-credit credit receivers in respect of gender, earning status, dependency ratio, amount and duration of loan and interest rate. The pooled correlation identified that there is moderate correlation among gender and occupation, gender and earnings and occupation and earning status. The significance test clarified that the mean dependency ratio significantly distinguishes the formal micro-credits and informal micro-credits at 10% level of significance and average value of landholdings indicate significantly differentiates the formal and

informal micro-credits at 5% level of significance while the rests of the covariates also significantly differentiate at 1% or less than 1% level of significance. The analysis of discriminating factors showed that the installment types are the most important predictors in discriminating between formal and informal credits groups, followed by duration of loan, interest rate, gender of the loan receivers, earning status of loan receivers, and regular income source in the households and so onand thisis also confirmed by cross-validation analysis. Finally, we used Fisher's linear discriminant function to forecast the suitability of new members' sources of micro-credit and the function suggested that the new member with discriminant scores above 0.44 supposed to borrow from the informal sources however the members having below of the score will borrow from formal sources. There are some limitations of the study as it did not cover the IDI of any experts or stakeholders. These findings have practical implications for policymakers in redesigning the existing microcredit program for the economic betterment of Bangladesh especially for the Haor people who are deprived from the benefits as in the main part of Bangladesh

Acknowledgement: This paper is a part of the project funded by BANBEIS and the paper was presented in the ICASC, Bangladesh.

References

Agba, O., Ocheni, S., &Nkpoyen, F. (2014). Microfinance Credit Scheme and Poverty Reduction among Low-Income Workers in Nigerian. *Journal of Good Governance and Sustainable Development in Africa, 12*(1), 111.

Ahmed, F., Siwar, C., Aini, N., & Idris, H. (2011). Contribution of Rural Women to Family Income Through Participation in Microcredit: An Empirical Analysis. *American Journal of Applied Sciences, 8*(3), 238-245.

Ahmed, F., Siwar, C., Aini, N., Idris, H., & Begum, R. A. (2011). Impact of microcredit on poverty alleviation among rural women: A case study of Panchagarh District in Bangladesh. *African Journal of Business Management, 5*(16), 7111-7119. https://doi.org/10.5897/AJBM10.1319

Al-Shami, S. S. A., Majid, I., Mohamad, M. R., & Rashid, N. (2017). Household welfare and women empowerment through microcredit financing: Evidence from Malaysia microcredit. *Journal of Human Behavior in the Social Environment, 27*(8), 894-910. https://doi.org/10.1080/10911359.2017.1345341

Al-Shami, S. S. A., Razali, R. M., & Rashid, N. (2018). The Effect of Microcredit on Women Empowerment in Welfare and Decisions Making in Malaysia. *Social Indicators Research, 137*(3), 1073-1090. https://doi.org/10.1007/s11205-017-1632-2

Bangladesh Bank (2021), *Bangladesh Bank Annual Report 2020-2021.* (2021). Retrieved from https://www.bb.org.bd/en/index.php/publication/publictn/0/2

Aryeetey, E. (2005). Informal finance for private sector development in Sub-Saharan Africa. *Journal of Microfinance, ESR Review, 7*(1), 3.

Bateman, M. (2010). Why doesn't microfinance work?: *The destructive rise of local neoliberalism.* London, England: Bloomsbury Publishing.

Berhanu, A., Amare, A., Gurmessa, B., Bekele, Y., &Chalchisa, T. (2021). Does microcredit use helps farmers win battle against food insecurity: evidence from Jimma zone of Southwest Ethiopia. *Agriculture and Food Security, 10*(1), 1-17. https://doi.org/10.1186/s40066-021-00323-8

Bhattacharjee, P. (2016). Microcredit among Slum Women in Sylhet: A Qualitative Analysis. *International Journal of Social Work and Human Services Practice, 4*(2), 42-49. https://doi.org/10.13189/ijrh.2016.040202

Bylander, M. (2014). Borrowing Across Borders: Migration and Microcredit in Rural Cambodia. Develo*pment and Change, 45*(2), 284-307. https://doi.org/10.1111/dech.12080

The Center for Environmental and Geographic Information Services. (2012). Report of the The Master plan of Haor Area by The Ministry of Water Resources, *Government of the People's Republics of Bangladesh, Summery Report, 1.* Retrieved from https://dbhwd.portal.gov.bd/sites/default/files/files/dbhwd.portal.gov.bd/publications/baf5341d_f248_4e19_8e6d_e7ab44f7ab65/Haor%20Master%20Plan%20Volume%201.pdf.

Choudhury, A. H., Das, A., & Rahman, A. (2017). The Effectiveness of Micro-credit Programmes Focusing on Household Income, Expenditure and Savings: Evidence From Bangladesh. *Journal of Competitiveness, 9*(2), 34-44. https://doi.org/10.7441/joc.2017.02.03

Cons, J., & Paprocki, K. (2010). Contested Credit Landscapes: microcredit, self-help and self-determination in rural Bangladesh. *Third World Quarterly, 31*(4), 637-654. https://doi.org/10.1080/01436591003701141

Dhawan, S. M., Wilson, K., &Zademach, H. M. (2022). Formal Micro-Credit for Refugees: New Evidence and Thoughts on an Elusive Path to Self-Reliance. *Sustainability, 14*(17), 1-21. https://doi.org/10.3390/su141710469

Duong, H. A., & Nghiem, H. S. (2022). The impact of microfinance on poverty reduction in Vietnam: A dynamic panel-data analysis. *Poverty & Public Policy, 14*(4), 405-422. https://doi.org/10.1002/pop4.354

Félix, E. G. S., & Belo, T. F. (2019). The impact of microcredit on poverty reduction in eleven developing countries in south-east Asia. *Journal of Multinational Financial Management, 52-53* (December 2019), 100590. https://doi.org/10.1016/j.mulfin.2019.07.003

Garikipati, S. (2017). *The Impact of Microfinance on Poverty Alleviation: Making Sense of the Evidence. In Development Finance* (pp. 189-206).UK: Palgrave Macmillan. Retrieved from https://doi.org/10.1057/978-1-137-58032-0_7

Hameed, W. U., Ali Nisar, Q., Abbas, A., Waqas, A., & Saeed Meo, M. (2019). Microfinance Institutions as a Strategic Tool to Enhance Women's Career Development in Pakistan. *Asian Women, 35*(2), 93-128. https://doi.org/10.14431/aw.2019.06.35.2.93

Hassan, T., Azam, S.-E., & Sherazy, J. Al. (2015). *Institute of Microfinance (InM) report of the National Convention on Inclusive Finance in Bangladesh*. Retrieved from https://inm.org.bd/wp-content/themes/inm/pdf/Conference_Booklet_Inclusive_Finance.pdf

Huybrechs, F., Bastiaensen, J., & Van Hecken, G. (2019). Exploring the potential contribution of green microfinance in transformations to sustainability. *Current Opinion in Environmental Sustainability, 41*, 85-92. https://doi.org/10.1016/j.cosust.2019.11.001

Islam, A., Nguyen, C., & Smyth, R. (2015). Does microfinance change informal lending in village economies? Evidence from Bangladesh. *Journal of Banking and Finance, 50,* 141-156. https://doi.org/10.1016/j.jbankfin.2014.10.001

Islam, K. J. (2014). Does Microcredit Reduce Household Vulnerability to Poverty? Empirical Evidence from Bangladesh Khan Jahirul Islam 1. *Journal of Economics and Development Studies, 2*(2), 311-326

Islam, M. N., Islam , S., & Ornob , M. S. S. (2024). Comparative Impact of Formal and Informal Microcredits on Poverty Alleviation in the Haor Region of Bangladesh: A Socioeconomic Analysis. *Asian Journal of Economics, Business and Accounting, 24*(6), 371-388. https://doi.org/10.9734/ajeba/2024/v24i61368

Islam Md. Nazrul et.al (2023). Socio-economic Profile of Households in Haor Region of Bangladesh: A study on micro-credit perspective, *BUFT Journal of Business & Economics, 4*(1), 125-146. DOI: https://doi.org/10.58481/BJBE2308

Karlan, D., & Zinman, J. (2010). Expanding credit access: Using randomized supply decisions to estimate the impacts. *Review of Financial Studies, 23*(1), 433-464. https://doi.org/10.1093/rfs/hhp092

Khanam, D., Mohiuddin, M., Hoque, A., & Weber, O. (2018). Financing micro-entrepreneurs for poverty alleviation: a performance analysis of microfinance services offered by BRAC, ASA, and Proshika from Bangladesh. *Journal of Global Entrepreneurship Research, 8*(1). https://doi.org/10.1186/s40497-018-0114-6

Khandker, S. R., & Samad, H. A. (2014). Dynamic Effects of Microcredit in Bangladesh. (Policy Research Working Paperno6821).retrieved fromhttps://documents1.worldbank.org/curated/en/456521468209682097/pdf/WPS6821.pdf.

Kumburu, N. P., & Pande, V. (2020). Rural Transformation through Savings and Credit Cooperative Societies in Moshi District, Tanzania. In *The Palgrave Handbook of Agricultural and Rural Development in Africa (pp.* 313-338). Springer International Publishing. Retrieved from https://doi.org/10.1007/978-3-030-41513-6_15

Malhotra, N. K. (2019). *Marketing Research: An Applied Orientation.* London, England: Pearson. Retrieved from https://books.google.com.bd/books?id=eANNwAEACAAJ

Monirul Alam, G. M., Alam, K., & Mushtaq, S. (2018). Drivers of Food Security of Vulnerable Rural Households in Bangladesh. *South Asia Economic Journal, 19*(1), 43-63. https://doi.org/10.1177/1391561418761075

Miled, K. B. H., Younsi, M., &Landolsi, M. (2022). Does microfinance program innovation reduce income inequality? Cross-country and panel data analysis. *Journal of Innovation and Entrepreneurship, 11*(1), 7.

Microcredit Regulatory Authority (MRA). (2021). Annual Report-2020. Retrieved from https://mra.portal.gov.bd/sites/default/files/files/mra.portal.gov.bd/page/65ce1539_6986_43b1_b4c7_dde44450eac5/2024-02-14-05-59-54ac09fa8647ffc657158c9c24d7dc4d.pdf

Muhammad, R., Jafar, S., Hussain, S., Ahmed, W., Waqas, S. U., Latif, U., & Zhuang, P. (2016). Micro-Finance and Its Impacts on People and Societies. *Journal of Poverty, Investment and Development, 27*(2016), 53-57.

Mwongera, R. K. (2014). *Factors influencing access to micro-finance credit by young women entrepreneurs' projects in Athi-river, Machakos county, Kenya* (Masters Dissertation).Retrieved from http://erepository.uonbi.ac.ke/handle/11295/74318

Pal, A., & Singh, P. K. (2021). Do socially motivated self?help groups perform better? Exploring determinants of micro?credit groups' performance in Eastern India. *Annals of Public and Cooperative Economics, 92*(1), 119-146. https://doi.org/10.1111/apce.12304

Phan, C. T., Vo, T. T., & Vo, D. T. H. (2023). Can microcredit reduce vulnerability to poverty? Evidence from rural Vietnam. Review of *Development Economics, 27*(1), 608-629. https://doi.org/10.1111/rode.12951

Prince, S. A., Patel, S. S., Borman, T., &Fazari, H. S. Al. (2020). The impact of the microcredit interest rate on capital creation in Bangladesh. *J. for Global Business Advancement, 13*(6), 706. https://doi.org/10.1504/JGBA.2020.113125

Qamar, M. A. J., Masood, S., & Nasir, M. (2017). Impact of microfinance on the non-monetary aspects of poverty: evidence from Pakistan. *Quality and Quantity, 51*(2), 891-902. https://doi.org/10.1007/s11135-016-0317-2

Rahman, M. A. U., & Ley, A. (2020). Micro-credit vs. Group savings - different pathways to promote affordable housing improvements in urban Bangladesh. *Habitat International, 106*(August), 102292. https://doi.org/10.1016/j.habitatint.2020.102292

Rahman, M. M., Khanam, R., & Nghiem, S. (2017). The effects of microfinance on women's empowerment: New evidence from Bangladesh. *International Journal of Social Economics, 44*(12), 1745-1757. https://doi.org/10.1108/IJSE-02-2016-0070

Rosenberg, R. (2010). *Does Microcredit Really Help Poor People?* Retrieved from chrome-extension: //efaidnbmnnnibpcajpcglclefindmkaj/https://documents1.worldbank.org/curated/es/583741468155125944/pdf/566250BRI0Box353729B01PUBLIC10FN59.pdf

Shahnaz, F., Samin Rahman, G., & Humaira Sadaf, B. (2018). Impact of Microfinance on Informal Employment: The Case of Bangladesh. In *Journal of Accounting, 8*(3), 88-95.

Shahidullah, A., & Haque, C. (2014). Environmental Orientation of Small Enterprises: Can Microcredit-Assisted Microenterprises be "Green"? *Sustainability, 6*(6), 3232-3251. https://doi.org/10.3390/su6063232

Sultana, S., Jui, K. F., Moushumy, N. S., Siddika, H., & Rahman, M. A. (2023). An Analysis of Income Sources and Food Security Status in Haor Regions of Kishoregonj District, Bangladesh. *Asian Journal of Economics, Business and Accounting, 23*(19), 145-156. https://doi.org/10.9734/ajeba/2023/v23i191079

Terano, R., Mohamed, Z., & Jusri, J. H. H. (2015). Effectiveness of microcredit program and determinants of income among small business entrepreneurs in Malaysia. *Journal of Global Entrepreneurship Research, 5*(1). https://doi.org/10.1186/s40497-015-0038-3

Turner, A. G., Magnani, R. J., & Shuaib, M. (1996). A Not Quite as Quick but Much Cleaner Alternative to the Expanded Programme on Immunization (EPI) Cluster Survey Design. In *International Journal of Epidemiology O International Epidemiologies! Association, 25*(1). doi: 10.1093/ije/25.1.198

Uddin, Md. M. (2020). State of formal and informal credit markets in rural Bangladesh. In *The Economic Development of Bangladesh in the Asian Century. RoutledgeIn Routledge eBooks (pp.* 147-164).https://doi.org/10.4324/9781003088165-10

Wahab, H. A., Bunyau, W., & Rezaul Islam, M. (2018). Microcredit for rural poverty alleviation and social well-being: A study of Sabah, Malaysia. *Asian Social Work and Policy Review, 12*(1), 4-16. https://doi.org/10.1111/aswp.12133.