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INSTITUTIONAL CONSTRAINTS AND CREDITS IN INDIA: PANEL CONDITIONAL FIXED EFFECTS LOGISTIC REGRESSION ESTIMATION OF HOUSEHOLD CHOICE OF BORROWING

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Abstract: Financial inclusion drives by the RBI and the government aim to include the weaker and vulnerable sections of the population in the services provided by the financial sector with access and at affordable costs. Still, a majority lack access to the financial sector services, especially banking services, and the thieving business of the informal credit sources testifies to the weaknesses of the formal financial sector in India. The formal banking institutions, even with nil or low rates of interest, are constrained by quantity rationing due to the high transaction cost of smaller-size credit demand and the inability of the poor to provide collateral security and surety. The legal and documentation procedures of the banks and the easy accessibility of the informal sources for the borrower, mainly the local moneylenders, dictate the household's decision to borrow from informal sources even at higher interest rates. The extent of such formal credit quantity rationing is analysed in this paper using the IHDS-I and II (2004-05 and 2011-12) data and applying the panel conditional fixed effects logistic regression model. The panel estimates of this study show that, even with low interest rates, there exists quantity rationing in credit by the formal bank lending in India. Further, households borrow from informal sources at much higher interest rates, due to proximity with local moneylenders. Though present, the extent of credit rationing in the formal sector in India is minimal.

Keywords: Financial inclusion, credit access, institutional and informal credit, quantity rationing, panel conditional fixed effects logistic regression

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INTRODUCTION

The term financial inclusion gained currency in international policy forms since the early 1990s with the success of the microfinance approach and the vast and improved services of the financial institutions. In the 1960s, the Reserve Bank of India initiated some form of financial inclusion with priority sector lending, lead bank schemes, regional rural banks, service area approach, and the like. However, the concept of financial inclusion as has been widely understood has been fully recognised with a mention about the same in the RBI's2005-06 annual policy statement and the self-help group-bank linkage programme initiatives. In fact, the National Democratic Alliance Government's flagship programmes Pradhan Mantri Jan Dhan Yojana (PMJDY 2014) and Jan Dhan Aadhaar Mobile (JAM) are primarily designed to enhance financial inclusion by providing access to financial services to the weaker sections of India's population. In fact, the 2016 Economic Survey articulates the PMJDY and JAM trinity and the 2016 demonetisation moves as drives for financial inclusion and formalisation of banking integration of the public.

The Rangarajan Committee on Financial Inclusion (2008) defines financial inclusion as "the process of ensuring access to financial services and timely and adequate credit where needed by vulnerable groups such as weaker sections and low-income groups at an affordable cost" (Government of India, 2008, p.35). The Raghuram Rajan Committee on Financial Sector Reforms (2009) defines financial inclusion as "universal access to a wide range of financial services at a reasonable cost. These include not only banking products but also other financial services such as insurance and equity products" (Raghuram Rajan, 2009, p.50). The objective of universal access to various financial services under PMJDY has been promoted by providing individuals with bank accounts without any minimum balance requirement, mostly in a public sector bank. Since then, a larger number of bank accounts for the poor and marginal sections of the population have been opened under this scheme. Thus, the financial inclusion drive provides access to the financial sector for the marginalised and formal finance-deprived sections of society.

However, such financial inclusion drives do not mean the mere opening of formal bank accounts. The success of the financial inclusion move greatly depends on the availability of credit to weaker sections and low-income vulnerable groups at affordable interest rates. During the 1950s and 1970s, households were more reliant for borrowings on informal sources like moneylenders, unauthorised

lending services, friends, family etc. But after the 1970s, with the nationalisation of commercial banks and the establishment of cooperative societies, the trend of borrowing has changed. Borrowing from formal sources has increased whereas borrowing from informal sources has gone down. However, the dependence for borrowings on informal sources has been rising since the 1990s as a result of the corporatisation of commercial banks as well as the financial markets deregulation as part of the 1990 economic reforms.

Thus, the fact seems to be contrary to the objective of financial inclusion. Still, a majority of the population is not brought under financial inclusion and they depend on the same old modes like moneylenders and borrowing at high interest rates. A look into the breakup of the sources of credit of individuals belonging to various income quartiles throws greater light on the poor state of affairs in financial inclusion drives in India. The figures presented in Table 1 show that the non-formal sources are the main source for the low-income groups. Nearly 80% of individuals in lower income quartiles borrow from friends/relatives and moneylenders. Though about one-third of the highest income quartile borrows from friends/relatives, the source of credit from moneylenders is only 15%. But, for about 80% of individuals in the top two income quartiles, formal banks are the main sources of borrowing. The role of SHGs and microfinance institutions as sources of credit is rather limited even among the low-income quartiles. Table 1 also shows that, as income increases, the share of total borrowings from moneylenders steadily declines from 39.8% to 14.8% while that of institutional banks increases from 9.6% to 45.8%.

Table 1: Sources of Credit by Income Quartiles

Credit source	*Percentage of persons in income quartile availed credit in the past two years*			
	Lowest	*Second*	*Third*	*Highest*
Relatives/friends	39.2	34.4	33.2	32.0
Moneylenders	39.8	33.2	25.8	14.8
Banks	9.6	20.7	33.3	45.8
Self-help groups	9.7	8.4	3.3	3.4
Cooperative societies	5.4	4.9	6.5	7.4
Chit funds	1.6	1.9	1.5	1.2
Microfinance institutions	1.1	1.4	1.2	0.9
Others	1.0	0.9	0.8	1.4

Source: Planning Commission: Invest India Incomes and Savings Survey (IISS).

As Table 2 reveals, despite the RBI's mandate of the peer-to-peer lending norm that the maximum rate of interest that can be charged on a loan not to exceed 21 per cent per annum, about 67%, 50%, 45% and 35% of individuals belonging to the lowest income quartile, second income quartile, third income quartile and the highest income quartile respectively borrow at over 24% interest per annum. These facts show the presence of unregulated sources that lend at higher interest rates, despite the availability of credit at lower rates from formal credit institutions such as commercial banks, microfinance institutions and cooperative societies. Thus, from Tables 1 and 2, it can be inferred that, in contrast to the aims of financial inclusion, the sources of credit for low-income groups are mainly non-formal, like moneylenders, who charge high interest rates for credits availed.

Table 2: Interest Rates by Income Quartiles

Income quartile	*Percentage of persons paying interest (percent per annum)*			
	≤12	*13-24*	*25-36*	*>36*
Lowest	16	16.9	18.7	48.4
Second	22.8	18.8	18.7	39.7
Third	29.1	26.1	18.7	26.2
Highest	40.4	24.5	11.7	23.4
Total	22.6	19.4	17.7	40.4

Source: Planning Commission: Invest India Incomes and Savings Survey (IISS).

The presence of sizable non-formal lending at exorbitantly high rates of interest is not peculiar to India but to the whole of the developing world. To address this issue, the state governments in India have enacted laws that lead to punitive actions against the lenders who charge over the specified rates such as the Kerala Prohibition of Charging Exorbitant Interest Act, 2012 and the Tamil Nadu Money Lenders Ac, 1957. The very persistence of the informal credit alongside the credit market points to the fact that mere punitive actions are insufficient to resolve the problem. Therefore, the existence of informal lending and the associated high interest rates is to be understood with the constraints on the working of formal sector sources of credit in India.

In the credit market, commercial banks constitute a significant part of the financial system in India. Other formal credit market agencies also cater sizable credit needs of the population. However, commercial banks, as they care about profits, generally provide credit of large sums and the formal agencies satisfy

specific purpose credits. Moreover, these formal institutions require collateral security and surety for the credit. The weaker strata of society cannot provide the type of collateral that commercial banks and formal agencies need to sanction credit. Moreover, due to the high transaction costs involved in handling transactions of smaller size credits, the banks and formal agencies are reluctant to provide credit of smaller amounts and to weaker sections. In the formal sector credits, the costs of acquiring credit worthiness of potential borrowers of small amounts, screening the borrowers and the subsequent monitoring of the borrowed credits are substantial. This leads the formal credit markets to the problems of adverse selection and moral hazard. This problem of small-size credits is widely recognised as the credit market's "quantity rationing" (Stiglitz and Weiss, 1981). Moreover, there may not be higher returns on investments in economic and investment activities with such small size by the poor income groups for whom the formal agencies have to lend at lower interest rates as compared to the investment activities of higher income groups (Conning and Udry, 2007). Hence, the formal credit agencies may not be willing to advance credit to the poor and weaker sections. Therefore, the financial inclusion drive towards the vulnerable groups through, for example, PMJDY may be insufficient in resolving the problem of informal sector lending in India.

To mend the gaps in formal banking sector credits, many alternative non-bank financial institutions especially to provide credit to the poor and weaker sections like government credit programmes, cooperative societies, self-help groups and microfinance schemes have evolved, somewhat similar to the banking sector but without their stringent rules and regulations. However, these institutions also face the problems of small-size loans and credit rationing like bank credit. Once again, the poor are compelled to depend on informal sources, like local moneylenders and relatives/friends, who charge high interest rates. Guirkinger (2008) argues that money lenders have greater access to information about the financial status of the borrower which allows them to have greater control over screening and monitoring as well as collateral requirements potentially overcoming adverse selection. Though cooperative societies, non-governmental organisations (NGOs) and self-help groups (SHGs) do not fall under the informal credit category, their proximity with the borrowers allows them to access as much information as the moneylenders. Also, unlike the moneylenders the lending rates are lower with these non-banking financial institutions.

Thus, despite the availability of relatively cheap credit from formal banking as well as formal non-banking financial sources, the existence of a huge and sustained demand for informal sources of credit is truly a puzzling phenomenon. The literature shows that the demand for informal credit may be spillover in nature (Bell, Srinivasan and Udry, 1997) or a deliberate choice by the household (Kochar, 1997). The inability to provide collateral security or surety for the loan can also result in quantity rationing in formal credit markets (Stiglitz and Weiss, 1981). Since the source of credit is a result of demand-side and supply-side interactions in the credit market, the problem is to be approached from both sides. Hence, this paper analyses the determinants of credit source of households in India, using the India Human Development Survey data (IHDS-I 2004-05 and IHDS-II 2011-12) and applying the panel conditional fixed effects logistic model.

LITERATURE REVIEW

Before analysing the determinants of the source of credit for households, the concept of quantity rationing needs to be understood as it is perceived that the demand for informal credit may spill over in nature due to quantity rationing in formal markets. Rationing refers neither to limited credit nor to credit from a credit source though the specific interest rate charged by the source could be paid by the borrower. In the context of this study, it refers to not obtaining credit from banks despite being able to pay the interest rates charged by the banks. This concept has been studied, both theoretically and empirically, and most studies carried out are pertaining to credit markets in developing economies. Literature points out that rationing is of three types namely quantity rationing, risk rationing and transaction cost rationing. Of the three, quantity rationing is given greater importance and it refers to the smaller size of the loan sought as the prime source for the formal lenders denying a loan or a borrower voluntarily opting out of the formal credit market. Theoretically, Stiglitz and Weiss (1981) argue that endogenous quantity rationing may arise because formal lenders have limited local information and thus rely on collateral to overcome moral hazard and adverse selection intrinsic in credit transactions.

Zeller (1994) discusses the quantity rationing in formal and informal credit sectors in Madagascar, Africa. The source of credit depends on the purpose of the loan and its relationship with the repayment rate. Also, the

occupation of the borrower determines the size of borrowing as well as the capacity to repay.

Kochar (1997), using a subset of the All-India Debt and Investment Survey 1981-1982 survey data of Northern Uttar Pradesh, examines the formal rural credit market quantity rationing employing the methods of univariate, bivariate and trivariate logistic regressions with three different assumptions. The demand for credit from a formal source is measured by the loan application and the access to credit is defined as the sanction of a loan by the formal credit institution which is analysed by the bivariate probit model. The estimated coefficient of interest rate for access is an insignificant 0.0045 and for demand is a significant 0.1224, showing a positive effect of interest rates on both access and demand for credit in formal institutions of credit. Kochar also observes that the choice of non-formal credit by households is a deliberate choice as it is cheap compared to formal credit sources. Therefore, the informal credit demand is not to be perceived as spillover demand which is a result of rationing in formal credit markets.

Guirkinger (2008) examines the coexistence of formal and informal credit markets, for primary survey data from Peru of two rounds - 1997 and 2003 - for a sample of 499 households, applying random effects logistic regression. As data contains information on the borrower's source of credit and the type of credit rationing, the issue of quantity rationing in the formal credit sector is directly analysed. The coefficient on quantity rationing is 1.64 and is statistically significant showing the positive impact of credit rationing on the household's credit source being the informal source. Therefore, Guirkinger (2008) concludes that the presence of quantity rationing in the formal credit sector of Peru.

Wydick, Hayes and Kempf (2011) investigate the role of social capital in access to credit in Rural Guatemala using primary survey data conducted in 2004 and the multinomial logit method. The paper argues that social networks facilitate households to secure loans from different sources. In the empirical analysis, the social capital is measured by church membership, for its effect on the household's ability to obtain a loan. The estimated multinomial logit results show that membership in a church committee, indicating the effect of social networks, has a significant positive impact of 1.843 on obtaining credit from microfinance institutions.

Campero and Kaiser (2013) anlyse the awareness and use of formal and informal credit institutions in Mexico using Mexican Family Life Survey data for the period 2004-05, employing a two-stage multinomial probit method. The empirical results show that the average schooling of the head and the presence of a spouse have a significant coefficient of 0.0467 for the awareness of the existence of banks and a significant 0.0321 coefficient for savings banks. Similarly, the log of annual incomes of the households had a significant positive impact on the awareness of formal credit sources. The estimated coefficients are 0.186 and 0.173 for banks and savings banks respectively, both significant at 1% level.

Kumar et al. (2017) examine the access to institutional credit and non-institutional credits in India, using the NSSO National Farmers Survey, 2013 data. They report that the access probability for formal institutional credit increases with increasing farmer education. The estimated coefficients are 0.39, 0.61, and 0.87 respectively for primary, higher secondary and graduate levels of education, all significant at 1% level. The measure of household income, log of per capita monthly expenditure, shows a positive effect, 0.29, significant at 1% level, on the probability of access to formal institutional credit. The reported coefficient is.

Thus, both demand and supply side influences determine the access as well as the demand for borrowing from a credit source. The size of the loan, the purpose of the loan, interest rate, awareness, access, household income and education, repayment capacity and social networks are some of the factors that significantly affect household demand as well as access to formal credit sources. Therefore, this paper tries to examine does quantity rationing matters in the household choice of informal institutional credit. Whether the proximity of the household with the informal credit sources influences the demand for credit in these households is also analysed. Further, the role of other environmental factors on the household credit source is also investigated.

DATA AND METHODOLOGY

In the empirical analysis, this paper uses the two rounds of Indian Human Development Survey (IHDS) data conducted jointly by the University of Maryland and the National Council for Applied Economic Research (NCAER). The IHDS is a nationally representative, multi-topic survey spanning across

1503 villages and 971 urban neighbourhoods in India. The 2004-05 first round of the IHDS survey covered 41,544 households and the second round was conducted in 2011-12 covering 42,152 households, with a re-interview of about 83% of the households interviewed in the 2004-05 first round. Combining the two rounds of the IHDS surveys allows the construction of a panel dataset combining the two rounds of data and a panel data analysis. As the objective is to analyse the effects of the determinants of household choice of credit source, all those households that have taken loans in both surveys have been considered. A total of 23,008 households that borrowed both in 2004-05 and 2011-12 from any one of the sources, consisting of 8,2225 households that borrowed from formal sources and 14,783 households that borrowed from informal sources is the database for this study.

Figure 1 presents the shares of the sources of credit for households in the sample. Among the sources of household borrowings, commercial banks constitute the single largest share which stands at 30.67% of borrowings in both the years 2004-05 and 2011-12. However, it is only one-third of the total credits by households. Still, the share of loans from moneylenders and relatives stands at 27.92% and 27.63% respectively, together constitute well above one-half of total borrowings of households. Another 8.07% of borrowings are from employees and others who also fall under the informal sources category. Thus, the informal sources of credit constitute nearly two-thirds of the credit sources, a result that is also corroborated by the AIDIS data. In total, the informal sources constitute 64.25% of the borrowings while the formal sources constitute only 35.75% of the same. It is appalling that the cooperatives, NGOs, SHGs and government programs put together constitute only 5.08% of household borrowings. These non-banking institutions are capable of overcoming moral hazard and selection bias in credit because of their nearness to the borrowers. However, the share of their lending has been abysmally low. Overall, the large share of borrowings from informal sources shows formal sector quantity rationing and inadequacies in catering to the demand for credit by the households. Therefore, households source credit from informal sources, even though the interest rates are high.

In the empirical analysis, credit source is the dependent variable in the analysis and it is treated as a dichotomous variable. Formal credit source is assigned value one, while informal credit sources are taken as zero. The

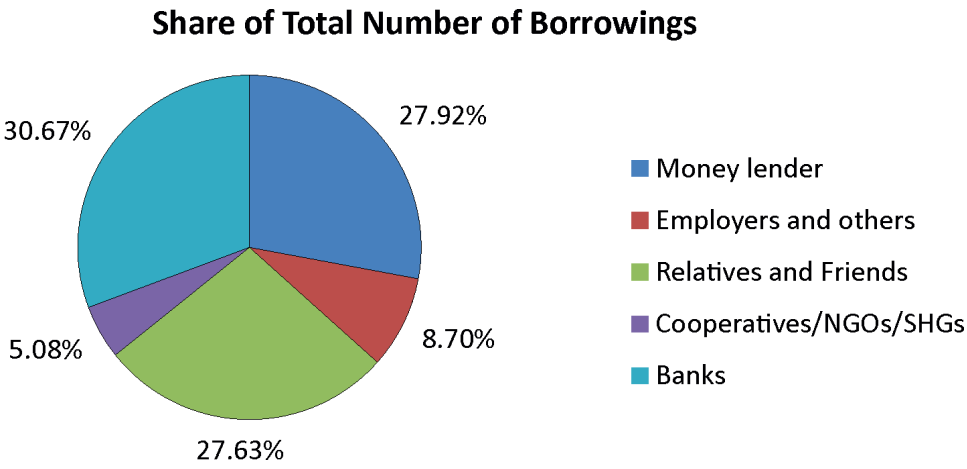


Figure 1: Sources of Credit for Households in India

Source: IHDS - Round I (2004-05) and Round II (2011-12).

independent variables are household income, credit size, interest rate, education, social network, purpose of the loan, occupation and residence of the borrowers. The variable quantity rationing is measured by the loan amount and membership in NGOs, co-operative societies or SHGs is used to capture the impact of social networks. The purpose of loans is classified into four categories viz. personal, housing, education and business loans, and are used as dummy variables. The occupation of the household is classified into five categories viz. salaried professional, agriculture and allied activities, organised business, wage labourers and others, and treated as dummy variables.

Table 3 presents the average credit amount and the average interest rates on the loans from the credit sources. Overall, the average credit amount is Rs. 48,590 and the mean interest rate is 19.72%. The average loan amount from formal sources is higher than the loan size from informal sources and the interest rate is lower for formal credit than for informal credit. The moneylenders charge an interest of 42% while the bank interest rate is only 11%. The loan amount from moneylenders is about one-third of the size of credit from commercial banks, showing the presence of credit rationing. However, the moneylenders charge three times more than the formal financial institutions. It seems that credit sources like employers and relatives/friends are more reliable as sizable amounts are borrowed with moderate interest rates from these informal sources, the interest rate falling between the interest rates of formal sources and

moneylenders. Overall, the sizable informal credit, though costlier than formal credit, is due to quantity rationing in the formal sources and the proximity of informal sources to households.

Table 3: Average Size of Credit and Interest Rate by Sources of Credit

Source	*Size of credit (Rs. 000s)*	*Interest rate (%)*
Moneylenders	28.17	41.90
Employers and others	34.87	15.50
Relatives and friends	23.27	13.87
Cooperatives/NGOs/SHGs	44.61	11.54
Banks	94.55	11.02
Total	48.59	19.72

Table 4 presents the summary statistics of the variables used in the empirical analysis. The source-wise mean and standard deviations are reported for continuous variables, while the proportions are reported for the qualitative variables like formal and informal sector borrowers. Table 4 indicates that a majority of households, about 65%, availed credit from informal sources, whereas only 35% of households borrowed from formal sources. On average, the formal sector loans are much larger than the loans informal sector borrowings. The standard deviations of the loan amount from these two sources also differ significantly. The large variance of the formal source borrowings points to the existence of significant quantity rationing. Also, the mean as well as the deviation of the total household income for the formal sources are observed to be larger than the average and the deviation of the same for informal sources. Those who borrowed from formal sources have more years of education, 10.25 years, while that of the informal credit source is 8.44.

Table 4: Averages and Proportions of Variables

Variable	*Informal credit*	*Formal credit*
Continuous variables - Mean and standard deviation		
Size of the credit (Rs. 000s)	26.9 (84.2)	87.5 (589.5)
Total household income (Rs.000s)	40.2 (51.4)	82.2 (159.9)
Education (in years)	8.44 (3.49)	10.25 (3.67)
Interest rate (per annum)	25.85 (26.33)	11.08 (5.88)
Qualitative variables - Share of total borrowings (%)		
Membership in cooperative society or NGO or SHG		
Member	50.85	49.15

Variable	*Informal credit*	*Formal credit*
Not a member	65.38	35.45
Credit purpose		
Education loan	55.47	44.53
Housing/land loan	58.96	41.04
Business /agriculture loan	40.96	59.04
Consumption loan	78.61	21.39
Residence		
Rural	64.11	35.89
Urban	64.77	35.23
Occupation		
Salaried/professional	54.96	45.04
Wage labourer	76.87	23.13
Agriculture and allied worker	54.81	45.19
Organised business	51.55	48.45
Others	59.42	40.58
Number of observations	14,783	8,225

The average rate of the interest rate charged by the informal sources is more than double (25.85) the interest rate of formal sources (11.08). As noted in Table 3, the average lending rate of moneylenders stood at 42% per annum. The IHDS data shows that the informal sector credit is costlier than the formal sources, contrary to Kochar (1997) who reports that some of the informal sources may give loans at cheaper rates and the household makes a deliberate choice of borrowing. Though 65% of the households who are not members in none of the formal or informal networks borrowed from informal credit sources, the observation that about 50% of the households who are members of mainly the cooperative societies or SHGs/NGOs borrowed from formal sources suggests that formal membership households exploit social capital in securing credit from formal sources. Table 4 shows that only 21% of the consumption loans are obtained from a formal credit source, whereas 59% of the business or agriculture loans, which are investments, are obtained from formal sources. However, education loans and land development loans of the formal banking sector have not penetrated the credit market.

Due to greater economic activity in urban areas, awareness about banking and increased concentration of banks, the accessibility and transaction costs for those households applying for a loan are lower than those of rural households. It is to bridge this gap that the RBI has made efforts such as establishing RRBs

and lead banks. Yet, the share of informal borrowings in the urban areas and the share of that in rural areas are similar and sizable- 35%. Table 4 also shows that about 40 to 50% of households belonging to various occupations borrow from formal sources. But, the condition for poor wage earners is pathetic in that only 23% of the wage labourers could borrow from formal sources, and for 77% of labour households moneylenders and local sources are the only viable and dependable sources of credit. The pathetic situation of the wage labourers can be attributed to the absence of collateral security, surety, small credit size and illiteracy. Thus, it is the poor sections of society that pay the unbearable interest rate to the usurious moneylenders.

PANEL DATA METHODS

As the dependent variable, the source of credit is qualitative in nature and data relates to two time periods 2004-05 and 2011-12, this paper uses the panel data logistic regression approach. The panel logistic regression equation is expressed as,

$$y_{it} = \beta' x_{it} + \varepsilon_{it} \qquad i = 1, \ldots, n \quad t = 1,2 \tag{1}$$

where y is the binary dependent variable and x is the set of explanatory variables, ε_{it} is the stochastic disturbance term, and i and t represent observations and time periods respectively. As the dependent variable is dichotomous, estimating equation (1) directly by the maximum likelihood method requires the assumption that the errors in the two time periods u_{i1} and u_{i2} are uncorrelated. However, in panel data, there is within within-group correlation between the error terms and no correlation between groups. Hence, to control for the unobserved heterogeneity and resolve the issue of correlated error terms, panel estimations follow the fixed effects and random effects models. Writing $\varepsilon_{it} = u_{it} + v_i$ where u_{it} is the usual error term and v_i is the unobserved time-invariant individual heterogeneity, the assumption on the relationship between v_i and x_{it} decides the appropriate method of estimation viz. fixed effects or random effects model.

CONDITIONAL FIXED EFFECTS LOGISTIC REGRESSION METHOD

When the unobserved individual heterogeneity v_i is correlated with the independent variables x_{it}, the fixed effects logistic regression is to be used. The fixed effects panel model is specified as,

$$y_{it} = \alpha_i d_i + \beta' x_{it} + u_{it} \tag{2}$$

where d_i is a dummy representing an individual in the sample, and α_i captures the individual time-invariant heterogeneity in the panel model. The panel log-likelihood function is constructed by taking the product of the individual probabilities and subsequently taking a natural log of the product.

$$Prob(y_{it} = 1|x_{it}) = \frac{e^{\alpha_i + \beta' x_{it}}}{1 + e^{\alpha_i + x_{it}'\beta}} \tag{3}$$

$$L = \prod_i \prod_t (P_{it})^{y_{it}} (1 - P)^{1 - y_{it}} \tag{4}$$

$$ln\ L = \sum_{i=1}^{n} \sum_{t=1}^{T_i} ln\ P(y_{it}|\alpha_i + \beta' x_{it}) \tag{5}$$

The log-likelihood function (equation 5) is maximised and the estimates of the parameters are obtained. However, the fixed effects method requires that (n+k) number of parameters need to be estimated, as a constant term α_i is to be estimated for each individual in the sample, apart from the usual k number of coefficients per variable in the model. As the number of cross-section units in the panel increases with fewer time periods, the number of parameters α_i also increases. Therefore, the data requires more time periods in order to ensure that the estimates for the constant terms are consistent. When the sample size is small, estimates of β are biased, as the α estimates are inconsistent, leading to the incidental parameters problem (Hsiao, 2003).

To free the panel model from the incidental parameters problem, Chamberlain (1980) proposes the maximisation of a conditional likelihood function. The conditional likelihood function is given by,

$$L^c = \prod_{i=1}^{n} Prob\left(Y_{i1} = y_{i1}, Y_{i2} = y_{i2}, \dots, Y_{iT_i} = y_{iT_i} \middle| \sum_{t=1}^{T_i} y_{it}\right) \tag{6}$$

$$f(y_{i1}, \dots y_{iT} | \Sigma_t\, y_{it}) = \sqrt{T}(2\pi)^{-(T-1)/2} \sigma^{-(T-1)} \exp\{-\tfrac{1}{2\sigma^2} \Sigma_t [(y_{it} - \bar{y_i}) - \beta'(x_{it} - \bar{x_i})]^2\} \tag{7}$$

As the *i* term in L^c is just one in any of the alternatives, when taken logs it drops out as it contributes nothing to the conditional likelihood function.

For a balanced panel, Chamberlain (1980) suggests the likelihood function,

$$L_i = \Sigma_i \ln[\exp(\beta' \Sigma_t\, x_{it} y_{it}) \Sigma_{b \in B_i} \exp(\beta' \Sigma_t\, x_{it} b_t) \tag{8}$$

where $B_i = \{b = (b_1, b_2) | b_t = 0\ or\ 1\ and\ \Sigma_t\, b_t = \Sigma_t\, y_{it}\}$ (9)

Suppose, there is a pair of observations for an individual i for two periods with $y_{i1} = 0$ and $y_{i2} = 1$. Then, the conditional probability is given by,

$$Prob(0,1|sum = 1) = \frac{Prob(0,1 \text{ and } sum=1)}{Prob(sum=1)} = \frac{Prob(0,1)}{Prob(0,1)+Prob(1,0)} \quad (10)$$

which can be expressed as,

$$Prob(0,1|sum = 1) = \frac{\frac{1}{1+e^{\alpha_i+\beta' x_{i1}}}\frac{e^{\alpha_i+\beta' x_{i2}}}{1+e^{\alpha_i+x'_{i2}\beta}}}{\frac{1}{1+e^{\alpha_i+\beta' x_{i1}}}\frac{e^{\alpha_i+\beta' x_{i1}}}{1+e^{\alpha_i+\beta' x_{i2}}} + \frac{e^{\alpha_i+\beta' x_{i2}}}{1+e^{\alpha_i+\beta' x_{i1}}}\frac{1}{1+e^{\alpha_i+\beta' x_{i2}}}} \quad (11)$$

$$Prob(0,1|sum = 1) = \frac{e^{\beta' x_{i2}}}{e^{\beta' x_{i1}}+e^{\beta' x_{i2}}} \quad (12)$$

The coefficient vectors are obtained by maximizing the conditional likelihood function.

RANDOM EFFECTS LOGISTIC REGRESSION METHOD

When the unobserved individual heterogeneity v_i is uncorrelated with the independent variables x_{it}, the fixed effects logistic regression is to be used. The random effects panel model is specified as,

$$y_{it} = \beta' x_{it} + (u_{it} + v_i) \quad (13)$$

The assumptions on ε_{it}, u_{it}, v_i and x_{it} are,

$$E[u_{it}|X] = 0;\ Cov[u_{it}, u_{js}|X] = Var[u_{it}|X] = 1 \quad if\ i = j\ and\ t = s;\ 0\ otherwise$$

$$E[v_i|X] = 0;\ Cov[v_i, v_j|X] = Var[v_i|X] = \sigma_v^2 \quad if\ i = j;\ 0\ otherwise$$

$$Cov[u_{it}, v_j|X] = 0 \quad for\ all\ i, t, j$$

Then,

$$E[\varepsilon_{it}|X] = 0$$

$$Var[\varepsilon_{it}|X] = \sigma_u^2 + \sigma_v^2 = 1 + \sigma_v^2$$

$$Corr[\varepsilon_{it}, \varepsilon_{is}|X] = \rho = \frac{\sigma_v^2}{1+\sigma_v^2}$$

where X is the matrix of all the exogenous independent variables for all the observations i across time periods t.

The new free parameter in the model is $\sigma_v^2 = \rho/(1+\rho)$. Conditional on common v_i and the ε's are independent, maximising the likelihood function produces the parameter estimates of the model. The conditional likelihood function is given by,

$$L_i = P\left[y_{i1}, \ldots, y_{iT_i} | X\right] = \int_{-\infty}^{+\infty}\left[\prod_{t=1}^{T_i} Prob(Y_{it} = y_{it} | x_{it}'\beta + v_i) f(v_i) dv_i\right] \tag{14}$$

Specifying a distribution for equation (13) and solving it by Butler and Moffit (1982) method, produces the estimated vector of coefficients as,

$$\hat{\beta} = arg.\max \int_{-\infty}^{+\infty}\left[\prod_{t=1}^{T_i} Prob(Y_{it} = y_{it} | x_{it}'\beta + v_i) f(v_i) dv_i\right] \tag{15}$$

HAUSMAN SPECIFICATION TEST

The fixed effects approach treats the individual heterogeneity to be correlated with the independent variables in the model, whereas uncorrelatedness between individual heterogeneity and the independent variables is assumed for the random effects approach. Both the fixed effects and random effects estimators are consistent when the independent variables and the individual heterogeneity are uncorrelated. However, in the presence of correlation, the fixed effects estimator is alone consistent. The specification test due to Hausman (1978) tests for orthogonality i.e. whether the covariance of an efficient estimator with its difference from an inefficient estimator is zero.

Therefore, the Hausman specification test in essence is to test the covariance matrix of the difference vector $\left[\hat{\beta}_{CML} - \hat{\beta}_{ML}\right]$ for statistical significance,

$$Var\left[\hat{\beta}_{CML} - \hat{\beta}_{ML}\right] = Var\left[\hat{\beta}_{CML}\right] + Var\left[\hat{\beta}_{ML}\right] - Cov\left[\hat{\beta}_{CML}, \hat{\beta}_{ML}\right] - Cov\left[\hat{\beta}_{ML} - \hat{\beta}_{CML}\right] \tag{16}$$

$$Cov\left[(\hat{\beta}_{CML} - \hat{\beta}_{ML}), \hat{\beta}_{ML}\right] = Cov\left[\hat{\beta}_{CML} - \hat{\beta}_{ML}\right] - Var\left[\hat{\beta}_{ML}\right] = 0 \tag{17}$$

$$Cov\left[\hat{\beta}_{CML} - \hat{\beta}_{ML}\right] = Var\left[\hat{\beta}_{ML}\right] \tag{18}$$

$$Var\left[\hat{\beta}_{CML} - \hat{\beta}_{ML}\right] = Var\left[\hat{\beta}_{CML}\right] - Var\left[\hat{\beta}_{ML}\right] = \Omega \tag{19}$$

The chi-squared test is based on the Wald criterion,

$$W = \chi^2[K-1] = \left[\hat{\beta}_{CML} - \hat{\beta}_{ML}\right]' \Omega^{-1} \left[\hat{\beta}_{CML} - \hat{\beta}_{ML}\right] \tag{20}$$

where Ω is the estimated covariance matrix.

The logistic regression is basically non-linear, and therefore, the logistic estimates do not have the same constant effect throughout the distribution. Hence, the marginal effect i.e. $\hat{\beta}$ of x_{it} on y_{it} varies over the distribution as the estimated curve is non-linear. For estimation purposes, the logistic regression curve is linearised by taking the log of odds of the dependent variable, thereby making it difficult to interpret the coefficients straightaway. Therefore, the marginal effects based on the mean are inappropriate, and the marginal effect of a variable j in the logistic regression is calculated as $\hat{\beta}_j P_i(1-P_i)$ where P_i is the probability. While the evaluation of P_i involves all variables in the model, the rate of change in the probability y=1 when a regressor changes by a unit is given by,

$$Marginal\ effect = Prob[Y = 1|\bar{x}, d = 1] - Prob[Y = 1|\bar{x}, d = 0] \quad (21)$$

where $\bar{x}$ denotes the mean of the determining variables in the model.

EMPIRICAL ANALYSIS

Given the main objective of this paper which is to identify the variables and estimate their effects on the source of credit for households, the probability of credit from a source, formal or informal, is taken as a dichotomous variable i.e. y=1 or 0 and the dependent variable is measured as logits or the log of odds ratio. Table 5 presents the summary statistics of the variables used in the empirical analysis. About 36% of households borrowed from formal sources, thus, a majority have obtained from informal sources. The average credit size is Rs.48,590 and the annual interest rate paid by the households is on average Rs.19.72 on the credit. The standard deviation of both variables is substantial showing wide variations both in loan amount and interest rates across the sources. It is to be recalled that the variable formal sector institutional quantity rationing is measured by the loan amount borrowed from such institutions. About 29% of households are members of cooperatives or NGOs or SHGs. Nearly 28% of households borrowed for business/agriculture, while another 15% availed of loans for housing or land purchase. For about 40% of households, agriculture is the primary occupation.

Table 5: Descriptive Statistics of Variables

Variable	*Description*	*Mean*	*S.D.*
Creditsource	If credit sourced from formal institutions =1, 0 otherwise	0.36	0.48
Irate	Annual rate of interest charged on the credit (in%)	19.72	21.74
Loanamt	Credit amount measured in 2004-05 constant prices adjusted with GDP deflator (in Rs.000)	48.59	360.07
HHinc	Total of all incomes of all the individuals in a household from various sources measured in 2004-05 constant prices adjusted with GDP deflator (in Rs.000)	55.22	106.05
Edu	Education by the most literate individual in the household (years)	9.18	3.68
Urban	Urban=1, 0 otherwise (Census 2001 and Census 2011 based)	0.22	0.41
Member	Membership in any of three cooperative, NGO or SHG group = 1, 0 otherwise	0.29	0.46
Lnedu	If loan is for education = 1, 0 otherwise	0.04	0.19
Lnbusiness	If loan is for business/agriculture = 1, 0 otherwise	0.28	0.45
Lnhouse	If loan is for housing/land purchase = 1, 0 otherwise	0.15	0.36
Osalary	If occupation is salary employed = 1, 0 otherwise	0.11	0.32
Oagri	If occupation is agriculture = 1, 0 otherwise	0.40	0.49
Obusiness	If occupation is business = 1, 0 otherwise	0.03	0.16
Other	If other occupations = 1, 0 otherwise	0.04	0.20
N	No. of observations	23,008	

Both the panel conditional logistic fixed effects and random effects models are estimated and the results are presented in Table 7. The estimating panel logistic regression equation is specified as,

$$Creditsource_{it} = \beta_1 (Irate_{it}) + \beta_3 (Loanamt_{it}) + \beta_4 (HHinc_{it}) + \beta_5 (Edu_{it}) + \beta_6 (Urban_{it}) + \beta_7 (Member_{it}) + \beta_8 (Lnedu_{it}) + \beta_9 (Lnbusiness_{it}) + \beta_{10} (Lnhouse_{it}) + \beta_{11} (Osalary_{it}) + \beta_{12} (Oagri_{it}) + \beta_{13} (Obusiness_{it}) + \beta_{14}(Oother_{it}) + \lambda_i + u_{it} \quad (21)$$

where λ_i indicates the individual effects. Application of the Hausman specification test suggests that the appropriate model is the fixed effects logistic regression model. The Hausman specification test rejects the null hypothesis that the random effects model is the appropriate model at 5% level of significance. Therefore, the conditional fixed effects logistic regression estimates are only discussed and the maximum likelihood results of the random effects model are

presented only for comparison. Further, as the estimated coefficients indicate the effect of the variables on the probability, the more relevant marginal effects are interpreted.

The estimated results presented in Table 7 show that credit size has a statistically significant positive effect on borrowing loans from the formal credit source. The estimated marginal effect is 0.2% showing that with an increase in the demand for credit by Rs.1000, the probability that the household avails a loan from a formal source increases by 0.002. Therefore, it can be inferred that credit size has a very low impact on the formal source of credit, showing the presence of formal banking sector quantity rationing. This observation is in conformity with the observations in the literature (Guirkinger, 2006). Further, the negligible impact of the demand for credit size on formal sector lending shows the ineffectiveness of the microfinance initiatives of governments and the priority sector lending policy of the RBI as a method of financial inclusion.

Table 6: Panel Logistic Regression Estimates of Source of Credit in India

Dependent variable: Source of credit

Variable	*Conditional fixed effects model*		*Random effects model*	
	Coefficient	*Marginal effect*	*Coefficient*	*Marginal effect*
Irate	-0.0525* (0.00)	-0.0051* (0.00)	-0.6166* (0.00)	-0.0151* (0.00)
Loanamt	0.0024* (0.00)	0.0002* (0.00)	0.0006* (0.00)	0.0016* (0.00)
HHinc	0.004* (0.00)	0.0004* (0.00)	0.0047* (0.00)	0.0011* (0.00)
Edu	0.1294* (0.00)	0.0125* (0.00)	0.0775* (0.00)	0.0190* (0.00)
Urban	1.129* (0.004)	0.0879* (0.00)	-0.1484** (0.018)	-0.0362** (0.017)
Member	0.9923* (0.00)	0.0875* (0.00)	0.4831* (0.00)	0.1194* (0.00)
Lnhouse	0.6483* (0.00)	0.0532* (0.00)	0.8402* (0.00)	0.2069* (0.00)
Lnedu	0.9029* (0.00)	0.0637* (0.00)	0.8009* (0.00)	0.1970* (0.00)
Lnbusiness	1.0529* (0.00)	0.0936* (0.00)	1.5337* (0.00)	0.3656* (0.00)
Osalary	0.2138 (0.24)	0.0195 (0.21)	0.1876** (0.014)	0.0464** (0.014)
Oagri	0.0087 (0.94)	0.0008 (0.95)	0.2912 (0.00)	0.7158 (0.00)
Obusiness	0.133 (0.61)	0.0122 (0.59)	0.3218(0.004)	0.1037 (0.004)
Oother	-0.1518 (0.57)	-0.0155 (0.59)	0.3218 (0.004)	0.0800 (0.004)

Variable	*Conditional fixed effects model*		*Random effects model*	
	Coefficient	*Marginal effect*	*Coefficient*	*Marginal effect*
Observations	3350		13333	
Number of groups	1675		9196	
Log-likelihood	-821.43		-6878.35	
Prob>Chi2 [Wald chi2]	0.000		0.000	
Hausman Test – Prob>Chi2			0.000	

Note: p-values in the parentheses. * p<0.01, ** p<0.05, *** p<0.1

The presence of formal sector quantity rationing is the reason for households to turn towards informal sources for their credit needs, which is also confirmed by the estimated significant negative effect of interest rates on formal sector credit. An increase in interest rate reduces the probability of credit by 0.5%, in conformity with the results in the literature (Kochar, 1997). This implies that though the interest rate charged by the formal sources is relatively low, the cost of credit in addition to the transaction costs arising from the administrative delays in procedures sends a disincentive signal for the household to apply for formal credit and for the banks to sanction the loan. Even increasing household income may not be sufficient to provide collateral to the formal sector credit, as the estimated coefficient on household income shows. Though significantly positive, the probability that the household borrows a loan from a formal source increases only by 0.04% for an increase in household income. All these results show the presence of a significant presence of formal institutional quantity rationing in credit, and the small size of loan amounts demanded may not be feasible for formal institutional credits. Hence, households borrow from local informal sources such as moneylenders and relatives even at higher interest rates.

On the other hand, the increase in the education of household members increases the probability of credit from formal sources. The coefficient on years of education of the highest educated individual in the household is significantly positive. This points out that education promotes financial literacy and awareness of formal credit among households as noted by Campero and Kaiser (2013). Likewise, membership in a cooperative society or NGO or SHG

has the greatest effect on borrowing from a formal sector credit institution. The probability of borrowing from a formal institutional source increases by a significant 8% when the household is a member of such organisations as compared to non-memberships. Since these organisations play a dual role in both offering credit and enhancing the social networking of households, membership plays a crucial role in a household obtaining formal credit. Thus, access to formal credit sources is significantly influenced by social capital, as observed by Wydick et al. (2011).

As compared to borrowers in rural areas, there is a greater chance that borrowers in urban areas have formal credit as their credit source. The probability that a household sources loans from formal sources is greater by 8% in urban areas as compared to rural areas. This further indicates the claim that environmental factors and awareness play a greater role in obtaining credit from a formal source. With respect to the purpose of credit, with consumption loans being the reference category, it is found that housing loans, business loans and education loans increase the probability of the credit source being formal institutions by 5%, 6% and 9% respectively, results in line with Zeller's (1994) argument that purpose of credit impacts the repaying rate and consequently the source of credit.

For occupation categories, though the estimated coefficients are positive, none of the variables are statistically significant. However, the results suggest that, as compared to wage labourers, other categories have a greater probability of borrowing from formal sources. As indicated in the preceding paragraphs, providing the required collateral and sureties for obtaining credit from the formal sector financial institutions is beyond the capacity of wage labour. Moreover, the demand for a small size of credit by the wage-labourer is constrained by high transaction costs associated with formal institutional sources and therefore quantity rationing in credit by the formal institutions to these sections of the population is applied. Further, with poor education and the absence of social networking, inadequate information and ill awareness of the credit availability in formal institutions is poor for wage labour. The proximity of wage labour to the moneylenders and other informal sources with easy access and repayment conditions, though he has to pay a much higher interest rate on the credit, provides much incentive for the potential borrower to source credit from them.

CONCLUSION

The financial sector that provides credit to the public in India consists of both formal and informal sources. The formal sector institutions provide credit at low interest rates, but with collateral and surety, while the informal sources extend credit more on the basis of proximity and high interest rates. Generally, the household demand for loans is constrained by some institutional requirements which operate from the supply side and the inability of households to acquire the necessary information on the access and eligibility criteria that operate from the demand side factors. Moreover, the small size of credit demand necessarily involves transaction costs for the formal sector sources leading to quantity rationing, while the same increases the prospects of informal sector borrowings with less monitoring and enforcement costs for the local moneylenders and relatives/friends.

This paper attempts to understand whether quantity rationing operates in formal credit institutions in India. Towards this objective, this paper uses the IHDS-I and II (2004-05 and 2011-12) data and applies the panel fixed effects logistic regression models. This paper uses the size of credit as a measure of formal institutional quantity rationing. Along with quantity rationing, interest rate is used as the determinant of sources of credit. The estimated fixed effects results of this study show that the probability of borrowing from formal institutional sources is influenced by quantity rationing as well as interest rates. Though the interest rates are low in the formal sector, to some extent quantity rationing is present in the formal sector lending in India due to the small size of demand for credit and the absence of collateral security and surety. Due to this, the households borrow from informal sources at much higher interest rates, where proximity and information flow are the main determinants of lending by local moneylenders and relatives. Further, the size of credit, household income, education, urban residence, membership in NGO/SHG or co-operatives and loan purpose have significant positive effects on obtaining credit from formal sources by the households. Overall, the study shows that formal institutional quantity rationing, though present in India, is minimal. Due to this and the inability to provide collateral even for small amounts of loans, households turn to informal sources paying higher interest rates due to the proximity of these non-formal sources.

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