Social Capital Formation in an Imperfect Credit Market: Evidence from Sri Lanka

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Abstract

This study uses a unique long panel dataset from Sri Lanka to examine the mechanism of social capital formation in an imperfect credit market. The authors show that households in the face of credit constraints reduce the investment into social capital, such as expenses for ceremonies and participation in community works. The paper also finds that temporal declines in social capital investment persistently reduce the level of trust in the community. These findings imply the existence of a poverty trap, because the absence of a credit market access generates poor social capital which, in turn, leads to poor access to the informal credit market, causing further credit constraints.

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1. Introduction

Will the poorest of the poor, who are often excluded from formal credit and insurance market mechanisms, rely more on informal reciprocal arrangements through social capital than the rich do? Or, are the poor "too poor" to contribute to and benefit from effective social safety nets generated by social capital? With unique data from Sri Lanka, we aim to compare these two competing hypotheses empirically. More specifically, this study investigates of the nexus between social capital formation and imperfect credit market accessibility.

Social capital is defined as the informal forms of institutions and organizations that are based on social relationships, networks, and associations that create shared knowledge, mutual trust, social norms, and unwritten rules (Durlauf and Fafchamps, 2005). Economists and sociologists have been recognizing the important roles that social capital plays in reducing poverty and facilitating rural development (Grootaert and Van Bastelaer 2002; Hayami 2009; Putnam et al. 1993; Durlauf and Fafchamps 2005, Fafchamps 2004, Ishise and Sawada 2009, Knack and Keefer 1997). Narayan and Pritchett (1999) show that villages with more social capital are more likely to enjoy better public services, use advanced agricultural practices, and join in communal activities, and that these in turn increase individual income. Fafchamps and Minten (2002) find that traders with a stronger social network achieve higher profits by reducing transaction costs. Higher social capital also helps to solve the enforcement problem in the risk sharing arrangement, because it causes individuals to behave in a creditworthy manner (Karlan 2007, Paal and Wiseman 2009) and to recover from negative calamities quickly (Carter and Castillo 2005).

While a number of studies investigate these impacts of social capital, very few empirical studies establish a framework of social capital formation (Durlauf 2002, Durlauf and Fafchamps 2005, Miguel et al. 2006, Mobius 2001). Moreover, the literature typically employs cross-sectional variations to identify determinants of social capital using time-invariant characteristics of households and communities such as ethnicity and demographics (Alesina and La Ferrara 2002, Charles and Kline 2002). Yet analyses that do not consider investment patterns of social capital over time may generate misleading policy implications (Glaeser et al., 2002).

This study tries to bridge this gap in the literature by setting two goals. The first goal is to address the issue by examining the process of social capital formation over time. The paper focuses in particular on the impact of changes in the opportunity cost of social capital investment. This is important because small changes in individual characteristics and the opportunity cost can have large effects on the equilibrium level of social capital investment (Mobius 2001). Moreover, the opportunity costs change over time (Glaeser et al. 2002). To capture the degree of social capital investment, the authors follow Anderson et al. (2004) and employ the participation measure.

For the first goal, using a unique, long panel data set collected in Sri Lanka, this study investigates the impact of credit constraints on household resource allocation for social capital investment. This analysis will be important because the social capital may play an important role in compensating for the lack of formal credit and insurance markets, especially in developing countries (Fafchamps 2004). To control for the endogenous and unmeasurable stock of social capital, we utilize a randomized situation where the government used a lottery to distribute irrigated plots to farmers. Based on the result of the lottery, farmers were forced to relocate to different communities. Therefore, various characteristics of social capital are exogenous for households in this setting.

The impact of credit constraints on the patterns of social capital investments is an empirical

question. Facing negative income shocks, credit-constrained households may cope with such shocks by increasing labor supply (Heckman and MaCurdy 1980, Jacoby and Skoufias 1997, Kochar 1999; 2004, Morduch 1995, Rose 2001). If this is a major coping mechanism, credit-constrained individuals might spend more time on production activities than on social capital investments. On the other hand, households with poor access to a formal credit market might constantly invest in social capital to improve access to informal credit sources, because social capital enhances credit market accessibility through the social enforcement and social collateral mechanisms (Besley and Coate 1995, Karlan 2007, Karlan et al. 2008). Indeed, many previous studies show the importance of social networks in making available informal credit and other types of mutual insurance (Carter and Castillo 2005, Fafchamps and Gubert 2007, Fafchamps and Lund 2003, Ligon et al. 2002, Murgai et al. 2003).

The second goal of this study is to investigate the persistent effects of temporal change in social capital investments on the level of social capital stock. To do so, the authors estimate the impact of past credit constraints on the social capital among individuals. Previous studies show the persistent impact of credit and insurance market imperfection on physical and human assets (Banerjee et al. 2008, Dercon 2004, Hoddinott 2006, Quisumbing 2006). This study is one of the first attempts to examine the long-term impacts of credit constraints on the social capital.

It is shown that credit-constrained households tend to reduce their resource allocation for social capital investment, such as expenses for ceremonies and participation in community works. Moreover, the negative impact of temporal declines in the social capital investment persists: households that were credit constrained suffer from low levels of trust with villagers even five years later. The findings imply the existence of a poverty trap because the lack of credit market access generates poor social capital which, in turn, leads to poor access to informal credit market, exacerbating the credit constraints. This possibility of multiple equilibria underlines the importance of investigating the process of social capital formation, as Mobius (2001) claims.

This study begins with the first part of Section 2, which describes the study site, while the second part discusses the dataset. Section 3 examines the short-term impacts of credit constraints on social capital investment, while Section 4 considers the persistent impacts on social capital stock. Finally, we provide the conclusion of this paper.

2. Study Site and Data Description

2.1. Social Capital Formation in Sri Lanka

Previous case studies of Sri Lanka show that social capital among geographical community members plays important roles in economic development: it enhances community participation in public services (Isham and Kahkonen 2002), and encourages better management of communal resources (Uphoff and Wijayaratna 2000). Social capital is in general accumulated through informal organizations based on social networks and associations (Durlauf and Fafchamps 2005, pp1644). Given this, this study considers three types of activities as investment into social capital: expenses for community ceremonies, participation in community works, and participation in communal irrigation management.

In the context of Sri Lanka, villagers attend informal meetings, *Shramadana*, and allocate time to their communities. *Shramadana* refers to a free labor supply, and the meetings involve activities such as cleaning communal roads and irrigation canals, or preparing for religious festivals. Another opportunity to socialize with community members is farmer organizations, which are established in each branch canal (D-canal). The purposes of these organizations include problem-solving among farmers, the operation and maintenance of irrigation facilities, cooperative purchasing of farm inputs, cooperative shipping of products, loan arrangements to farmers, social activities to help villagers, and so forth. Residents in the canal area are required to join the organization and participate in the frequent meetings, although some households participate infrequently.

These meetings are important opportunities to communicate with other villagers and

accumulate social capital (Shoji et al. 2010). If community members cannot participate in the community works such as irrigation maintenance, they may hire workers to work informally on their behalf. There are no formal rules governing compensation for their absence. However, this arrangement is not always available because community members are sometimes required to vote or express their opinions directly at meetings. In these cases, a member of the household must participate in the meeting.

2.2. Study Site and Randomized Land Distribution

Our study area is Walawe Left Bank (hereafter, WLB) in southern Sri Lanka, where the government initiated the Walawe Left Bank Irrigation Upgrading and Extension Project with financial assistance from the Japanese government (JBIC Institute 2007). [1] Under this project, an old irrigation system was rehabilitated and a new irrigation system was constructed. The canal construction began in the north of WLB close to Uda Walawe reservoir in 1997 and gradually extended toward the south. By the end of 2008, almost all households acquired access to irrigation facilities. The government provided farmers with around 0.2 ha of land for residence, and around 1.0 ha of irrigated paddy field or around 0.8 ha of other food crop field. Farmers originally adopted the traditional shifting cultivation to cultivate the local variety Banana before the project started. The construction of new irrigation system, however, enabled them to cultivate paddy, sugarcane, onion, banana, and the like.

This area has a unique characteristic, in that major determinants of social capital at the community level – such as the timing for households to settle in the current community, its community size, access to irrigation system, neighborhood characteristics, and geographic characteristics – were exogenously determined for households.[2] In the process of project, the

[1] The population in the area is homogenous in terms of ethnicity and religions. Most households are Sinhalese and Buddhists.

[2] Using the same dataset, Aoyagi et al. (2010) and Shoji et al. (2010) conduct various tests for the exogeneity of these characteristics.

government used lotteries to distribute land for the settlement of around 30% of farmers. Based on the result of the lottery, they received plots regardless of their characteristics. Also, farmers were not allowed to exchange or sell the allocated land because they did not have ownership rights of the fields. This reduces the possibility of farmers moving to different communities after the relocation.

On the other hand, around 50% of household could claim their preferences on the location of the plot within the irrigation system, because they used to live in the area of new irrigation construction and were forced to relocate. However, the exact routes of irrigation canals were not known to households before the canal construction and thus, to the households, assignments of forced relocation due to canal construction were exogenously given. Hence, even in the case of the self-selected location choice among the forced relocators, their characteristics are not supposed to be different systematically from the rest of households.

2.3. Data Description

This study uses a uniquely collected long panel dataset from the WLB irrigation area. When interviewing 858 representative sample households, the WLB area was divided into five strata based on irrigation accessibility—Sevanagala (irrigated), Sevanagala (rainfed), Kiriibbanwewa, Sooriyawewa, and Extension areas. The Ridiyagama area from the right bank was also included as an old irrigated area. To select the sample, a multistage stratified random sampling strategy was used, based on a complete list of all households in the six strata (Sawada, et. al, 2010).

Household surveys for this study have been conducted seven times since 2001 until 2007. The first to third surveys were undertaken in June, August, and October 2001, respectively. The first survey was implemented specifically to obtain data for the previous rainy season from October 2000 until May 2001. Both the second and third surveys were designed to gather data for the dry season, but the questionnaire for the second survey was brief compared to the others and therefore this study does not use the data of the second wave. The fourth and fifth surveys were conducted in June and

October 2002, respectively, to capture information on the rainy and dry seasons in 2002. The sixth and the seventh surveys were conducted in 2007, and covered only 193 randomly selected households, out of 858 households in total.

This dataset has two distinctive properties. First, it includes a number of social capital investment questions, covering such topics as community work participation and expenses for community ceremonies. Furthermore, the two more recent surveys were distinguished from their first five predecessors by the addition of general social survey (GSS) questions on the social capital. We utilize the data from GSS questions as approximations of the stock of social capital.

The second distinction of the dataset is the availability of data on a direct indicator of credit constraints following the approach by Scott (2000). The definition of credit constraints in this study represents the excess demand for consumption and investment credit with respect to the overall market, including formal and informal lenders. As summarized in Figure 1, households were defined as facing the credit constraint either if they borrowed money but could not borrow as much as they wanted, or if they did not borrow from any sources because their credit applications were rejected, they feared default, or they lacked available credit sources. Also, households were credit unconstrained when they borrowed the required amount, or when they did not borrow because they did not have to. These questions were asked in each survey on the last crop season. This is a simplified version of the direct eliciting methodology (DEM) of Boucher et al. (2009). While this module is desirable, it is not available in regular household surveys (Scott 2000). Therefore, previous studies use the size of land holding or the income-assets ratio to approximate the extent of credit constraints (Zeldes 1989, Foster 1995). However, it is unlikely that a single variable can sufficiently approximate consumers' access to credit (Garcia et al. 1997, p.158). The questionnaires in this study carefully address the concern.

Table 1 presents the characteristics of the credit-constrained and credit-unconstrained observations separately. Around 15.8% of observations faced a binding credit constraint during the

surveys.[3] Panel A of the table shows that households with lower income are more likely to have binding credit constraints. Also, the amount of loans in the constrained group is less than the unconstrained for all credit sources, and interest rates higher.

Three social capital investment variables are considered. The first is the binary variable which takes unity if the household expends for ceremonies such as religious festivals, weddings, and funerals. The second indicator is the binary variable on participation in community work – such as meetings of the farmer organization, cleaning communal roads or taking part in religious festivals – as a broader measure of participation in the community. Finally, participation in irrigation maintenance is considered as a narrower measure focusing on production aspects. Shoji et al. (2010) find that, using the same data, patterns of participation in community works indeed depend on the benefits from and costs of social capital investment. Panel B of Table 1 shows that constrained households are less likely to expend for community ceremonies. It also appears in Panel B that households with poor access to irrigation and/or households whose fields were damaged by wild animals face binding credit constraints. The variable, *other shocks*, takes unity if the household are affected by drought, salinity, pests, and/or weeds.

3. Impact of Credit Constraints on Social Capital Investment

3.1 Estimation Methodology

This section seeks to show the short-term impact of credit constraints on the investment to social capital. This study investigates the issue by estimating the following recursive bivariate probit model:

[3] The autocorrelation of credit constraint status is 0.038 and the corresponding P-value is 0.058 (not reported). The correlation becomes even higher when the correlation between the rainy season and the next dry season is considered; the correlation coefficient is 0.060 and the P-value is 0.013. Out of 94 households who experienced the credit constraint during 2001 and 2002, 16.5% of households were still binding the credit constraint. In contrast, out of 99 households who did not experience the constraint during the time, 18.9% were binding credit constraints in 2007.

$$I_{ivt}^{j} = 1[C_{ivt}\,\alpha^{j} + X_{ivt}\,\beta^{j} + B_{vt}^{j} + \varepsilon_{ivt}^{j} > 0] \quad (1)$$

$$C_{ivt} = 1[Z_{ivt}\,\gamma^{j} + X_{ivt}\,\delta^{j} + B_{vt}^{j} + \omega_{ivt}^{j} > 0] \quad (2)$$

where, I_{ivt}^{j} is a binary variable that takes the value of one if household i in the block community v is involved in the social capital investment j (j = 1, 2, 3) during the period t and zero otherwise. C_{ivt} is also a binary variable which takes unity if household i binds the credit constraint during the period t. X_{ivt} denotes the other household characteristics; B_{vt}^{j} the block-period specific fixed effects; Z_{ivt} instrumental variables; and finally ε_{ivt}^{j} and ω_{ivt}^{j} are the residuals.

An obvious concern with this estimation model is the endogeneity of the credit constraint. The first concern is that of simultaneity: investment in social capital may affect credit access. Second is omitted variable bias, because there may be unmeasured variables that are correlated with both the investment in social capital and the credit constraint status. One such variable is the stock of social capital. The social capital plays the role of social collateral and affects household creditworthiness (Karlan 2007, Paal and Wiseman 2009). Given the difficulties in measuring social capital stock and the endogeneity of social capital, this study includes exogenous determinants of social capital in X_{ivt} such as the time since households moved to the current community, the community size, and distance to markets and cities. Also, the block-period specific fixed effects capture the social capital stock and other factors that could be correlated with both social capital investment and the credit constraint.

However, there is the potential to omit other factors correlated with both credit constraints and social capital investment, causing the estimation to be biased. Consequently, this model uses two sets of instruments: first, holdings of wristwatches and clocks, and, second, the interaction term produced with the binary variable of damage to the watch/clock-owner's land caused by wild animals. The choice of instruments is justified as follows: People are more likely to face credit constraints when they hold fewer liquid assets and encounter more negative shocks. Unanticipated

negative shocks increase demand for consumption credit during the crop season but not supply, causing credit constraints. However, these factors are unlikely to affect social capital investment directly.

In South Asia and at the study site, pawn shops often accept wristwatches and clocks as collateral. Unlike microcredit programs utilizing social networks, credit transactions through pawn shops are conducted individually based on the integrated credit market in Sri Lanka (Fernando 2003, UNDP 2006). The authors therefore employ these collateralizable assets as valid instruments.

There could, however, be a correlation with households' wealth level: wealthy households are likely to own more watches and their time allocation patterns may differ from those of poor households, violating the exclusion restriction. Another potential concern with the first instrument is that it could be correlated to the punctuality of the head of the household. If punctual individuals are more likely to own watches and are better at accumulating social capital, the use of our instruments would still violate the exclusion condition.

To address these potential concerns, this study controls for the other major physical and human asset holdings – land holdings and the education level of the household head – and for holdings of fixed and mobile phones in the covariate X. Compared to these major assets, wristwatches and clocks account for a very small proportion of total household assets. Furthermore, holdings of phones could be correlated more strongly than watches and clocks to the punctuality and social network of villagers, but Sri Lankans normally do not use cell phones as collateral. Therefore, the coefficient on fixed/mobile phones should capture the impact of punctuality and social networks. In sum, the instruments should reflect only liquidity rather than disparities in total asset endowments and/or punctuality. Further discussion of this issue can be found in Appendix A1.

Turning now to the second instrument, one of the biggest risks for farmers in the study villages is attacks by wild animals such as elephants (Table 1), which can destroy hectares of plots within hours. It is difficult for farmers to predict the attacks and to protect their plots from them.

They are therefore unpredictable and uncontrollable events for households.

However, negative shocks to their farming can reduce the marginal productivity of labor, directly affecting their time allocation even without binding credit constraints. To deal with the issue, this study employs only the interaction term between the shock variable and watch/clock holdings in instrument *Z*, while the shock variable itself is included in covariate *X*. The idea is that if the impact of shocks on investment patterns varies depending on liquid asset holdings, it is because of the difference in the possibility of binding credit constraints.

Moreover, an important feature of an animal attack is that it is an idiosyncratic event. Since the decision whether or not to attend social meetings depends on that of other villagers, the error term in equation (1) might be correlated to other villagers' behavior. This logic suggests that covariate shocks, correlated with the participation decisions of multiple community members, violate the exclusion restriction. Hence this study uses idiosyncratic animal shocks as a valid instrument. We also control for the other types of shocks – such as drought, salinity, pests, and weeds – in the covariate *X*. One concern with the logic is that farmers owning fields in remote areas may be more likely to face the shocks. For these households, attacks by wild animals could be a covariate shock. To address this concern, the study controls for the block-period specific fixed effects.

3.2. Estimation Results

To begin, three binary outcome variables regarding the investment in social capital are examined: (1) expenses for ceremonies such as religious festivals, weddings and funerals, (2) participation in community works such as cleaning communal roads and other community events, and (3) participation in the maintenance of communal irrigation canals. Overall, credit-constrained households are found to be less likely to be involved in these activities.

Table 2 presents the results of the equation (2) examining the determinants of credit constraint. The first columns of Panel A and B present the result of recursive bivariate probit

estimation whose outcome variables in equation (1) are the expenses for ceremonies and participation in irrigation management, respectively. The second and third columns show the result of the linear probability model with and without household-level fixed effects, respectively. Since some observations include missing values in data on the credit constraint indicator, the estimation of the first model uses only 3519 out of 3818 observations. Since social capital accumulation requires interaction among community members, the residuals might be correlated across households within the community. Also, household decisions are possibly correlated over time. Therefore, D-canal-level, cluster-adjusted robust standard errors are used to address the possible correlation of residuals within the canal across households and across periods.

The table shows the validity of the instrumental variables: estimated coefficients of the instruments are statistically significant and consistent with our expectation. Those with fewer liquid assets are more likely to face binding credit constraints and the probability is especially high when they face negative shocks. According to the first estimation model, without negative shocks by wild animals, households who hold wristwatches/clocks worth 270 rupees (the sample median) are 3.37% less likely to face binding credit constraints than those who do not hold any wristwatches/clocks. Without any liquid assets, experience of attacks by wild animals increases the probability of a binding credit constraint by 3.00%. However, when households hold liquid assets worth 270 rupees, negative shocks increase the probability by only 1.97%. As for the other coefficients, households with more land holdings are less likely to be credit constrained as expected. The results are robust to the inclusion of the household fixed effects.

Table 3 presents the results of the equation (1) evaluating the impact of credit constraints on social capital investment. In the third regression, the outcome variable is one if the household attends the communal irrigation maintenance. Therefore, the third model uses only 2397 observations with access to irrigated land.

The table shows that credit-constrained households are less likely to invest in social capital:

the coefficients on credit constraints show that constrained households are 50.3% less likely to expend for community ceremonies, 36.7% less likely to take part in other community works, and 13.2% less likely to participate in irrigation maintenance. While social capital is essential for economic development in the long run, vulnerable individuals who face binding credit constraints have to reduce the resource allocation for the investment. As for the other determinants of investment into social capital, the estimation results are unstable and different across the types of investment. The appendix A2 presents the results from the linear probability model with household-level fixed effects. It appears that the results shown in Table 3 are robust to the change in estimation models.

4. Persistent Effect of Credit Constraints on the Social Capital

The previous section shows that the credit constraint negatively affects the likelihood of social capital investment. Following this finding, it is critical to determine the importance of the temporal decline. To do this, the long-run effect of credit constraints on the relationships with the community members is examined. Five indicators are used to measure the stock of social capital and they are summarized in Table 4: general trust, trust in villagers, trust in business partners, availability of mutual assistance, and fairness. Another important component of social capital is the social capital to extended families. Although data on extended families is not available, this issue is addressed by examining general trust in addition to specific questions asking about the trust in geographic or business community members.

Table 4 shows that the level of trust among villagers is higher in the credit constrained group than it is in the unconstrained group. However, the difference in trust levels should not be interpreted as showing the average treatment effect of credit constraints. There could be a selection bias arising from endogenously binding credit constraints. To deal with the selection bias, the following model is used:

$$S_{iv2007}{}^{k} = 1[ExpC_{iv2001}\,\theta^{k} + X_{iv2001}\,\mu^{k} + B_{v}{}^{k} + \psi_{iv}{}^{k} > 0] \quad (3)$$

$$ExpC_{iv2001} = 1[Z_{iv2001}\,\pi^{k} + X_{iv2001}\,\sigma^{k} + B_{v}{}^{k} + \tau_{iv}{}^{k} > 0\,] \quad (4)$$

where, $S_{iv2007}{}^{k}$ are five binary variables of social capital stock reported in Table 4. Also, $ExpC_{iv2001}$ takes unity if household *i* has experienced binding credit constraints in at least one period during the surveys in 2001 and 2002. Note that, since the impact of past credit constraints on the current trust relationships is estimated, it alleviates the possibility of bias caused by the simultaneous decisions between the two.

Table 5 presents the persistent effects of credit constraints. Households who have been constrained during 2001 and 2002 are 48.5% less likely to trust the others. Similarly, credit constraints decline the trust in the other villagers and business partners, even five years later. It is clear that past declines in investment caused by credit constraint indeed persist.

As for the other coefficients, it is shown that the coefficients on access to irrigatoin and education are mainly negative, although these are not statistically significant. This is consistent with the fact shown in Table 4 that trust among villagers is higher in the credit constrained group: the positive correlation between the credit constraint and the trust is caused by the omitted wealth status, which is negatively correlated. Therefore, in controlling for the wealth level in Table 5, the negative impact of credit constraints on trust becomes evident.

Also, the negative coefficients of land holdings and education imply that even if one of the instruments, the holdings of watches and clocks, is correlated to the unobservable wealth level of households as suggested in Section 3.1, the violation of the exclusion restriction would not qualitatively affect the finding that credit-constrained households persistently achieve lower trust relationships. Since wealth level is negatively correlated to the trust, this violation would produce an upward bias. Therefore, the estimated impact of credit constraints could be considered to be the

lower bound of the actual impact.

5. Conclusion

This study examined the process of social capital formation under the framework of an imperfect credit market. If the credit market is less developed, negative shocks significantly change household behavior, such as the time allocation for various activities. The paper showed that the credit-constrained households had to reduce the resource allocation for social capital investment. It is also found that households who had past experience of credit constraints suffered from a low level of social capital. These findings imply that a cause of heterogeneous social capital level among community members may be the persistent effect of temporal declines in the social capital investment.

Given the positive correlation between trust and trustworthiness (Glaeser et al. 1999), these findings could imply a possible poverty trap, although this study does not find direct evidence. The credit constraints cause households to achieve low investment into social capital. Since the poor stock of social capital induces them to suffer from low trust with community members and therefore poor access to informal credit among villagers, households who have been credit constrained could be even more vulnerable to risks.

This negative cycle could spill over into the broader community in at least two ways. First, the absence of a member from a community meeting may reduce the returns from the meeting for the participants. This in turn could be a disincentive for other villagers to attend the meetings. Second, this study showed that households facing constraints are less likely to be involved in the maintenance of communal canals. This diminishes the productivity of irrigation infrastructure directly, again causing credit constraints. The possibility of multiple equilibria at the level of social capital emphasizes the importance of further studies to investigate the process of social capital formation, as

Mobius (2001) claims. These findings must be interpreted with caution, however, since they hinge on the validity of the identification strategy.

Appendices

A1: Correlation between Holdings of Watches/Clocks and the Unobservables

As described in Section 3, a concern in our identification strategy is the possibility of correlation between the instruments – particularly the holdings of watches and clocks – and household unobservable characteristics such as the stock of social capital. To address this potential problem, the correlation between the instrument and observed characteristics are examined.

The first column of Table A1 shows the correlation of the watch/clock holdings with 18 variables: four endogenous variables and 14 exogenous variables. In the second column, we regress the watch/clock holdings on the exogenous variables together with the block specific fixed effects. Importantly, the holdings are uncorrelated with the exogenous determinants of social capital such as the distance to the nearest market and city, years since the household settle in the current community, and the size of D-canal community. This suggests that the holdings of watches are not affected by the level of social capital. Furthermore, the holdings are negatively correlated with the credit constraint and positively correlated with three measures of social capital investment. These findings support the validity of our instrument.

A2: Robustness Check1 (Linear Probability Model with Households Fixed Effect)

Table A2 shows the result of the linear probability model with household-level fixed effects and an endogenous credit constraint variable. The results are qualitatively the same as the bivariate probit model reported in Table 3. The impact of credit constraint on the social capital investment is negative and statistically significant.

A3: Robustness Check2 (Unbalanced Panel)

As described in Section 2, the panel dataset is unbalanced. While the first five surveys include 858 households, the sixth and the seventh survey were conducted only for 193 randomly selected households from among the 858. Therefore, the authors also conducted a series of estimations without using the sixth and seventh waves. The estimation results are qualitatively similar, although they are not reported in tables. The credit constraints reduce the resource allocation for social capital investment.

A4: Nonrandomness of Irrigation

This study has examined the determinants of social capital investment and stock by considering that access to irrigation is exogenously determined. However, if this does not hold, the estimation results would suffer from severe bias. This concern is addressed by examining the determinants of the timing at which irrigated plots are received.

The authors estimate multinomial logit model whose dependent variable classifies the households into three groups: those who have access as of the beginning of rainy season 2001, as of the beginning of rainy season 2002, and those who do not have access as of rainy season 2002 yet. Given that access to infrastructure could affect various household characteristics in the long run and data was not collected before the irrigated plots were received, covariates considered to be almost time-invariant are used, including the age, education level, and gender of household head, and the number of males and females members aged sixteen and above. Table A3 reports the result. It shows that the data does not reject the possibility that the timing at which plots are received is uncorrelated with household characteristics. This result supports the estimation framework used in this study.

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Table 1: Summary Statistics by Credit Constraint Status

	Credit Constrained (Obs. = 572)			Credit Unconstrained (Obs. = 3038)			Mean Diff.
Variable	Obs	Mean	S.D.	Obs	Mean	S.D.	
Panel A: Income and Loan Transactions							
Adult equivalent seasonal agricultural income (Rs)	572	5213.0	12147.2	3038	6459.8	12432.2	**
Banks (Rs)	572	1979.02	10148.78	3038	3961.47	14522.14	***
Annual interest (if borrowed)	54	11.25	32.87	628	4.51	14.75	***
Moneylenders (Rs)	572	414.34	3427.33	3038	517.15	3307.70	
Annual interest (if borrowed)	19	129.89	45.24	179	64.56	60.23	***
Relatives (Rs)	572	405.16	2706.99	3038	887.33	6715.36	*
Annual interest (if borrowed)	31	15.13	23.81	217	8.35	16.25	**
Friends (Rs)	572	256.73	2326.88	3038	920.46	4753.88	*
Annual interest (if borrowed)	24	14.96	26.13	322	10.93	21.29	
Panel B: Social Capital Investment							
Expense for ceremonies (dummy)	572	0.53	0.50	3038	0.60	0.49	***
Participation in community works (dummy)	572	0.66	0.47	3038	0.66	0.47	
Participation in irrigation management (dummy)	358	0.26	0.44	2100	0.24	0.43	
Panel C: Household Characteristics							
Attacks by wild animals (dummy)	572	0.20	0.40	3038	0.16	0.37	*
Other shocks (dummy)	572	0.60	0.49	3038	0.62	0.49	
Size of irrigated land (ha)	572	1.34	1.30	3038	1.48	1.31	**

Size of nonirrigated land (ha)	572	1.19	1.42	3038	1.19	1.47	
Holdings of fixed/mobile phones (1000 Rs)	572	0.45	2.66	3038	0.52	2.80	
Number of males aged 16 or over	572	1.86	1.11	3038	1.85	1.03	
Number of females aged 16 or over	572	1.80	1.01	3038	1.78	1.02	
Number of children aged 15 or under	572	1.55	1.40	3038	1.40	1.34	**
Years of schooling of head	571	5.61	3.39	3036	5.85	3.39	
Age of head	571	49.37	12.95	3038	49.98	13.01	
Distance to daily market (km)	555	1.18	2.06	2966	1.27	2.13	
Distance to nearest city (km)	572	4.90	3.86	3038	5.01	4.10	
Years since settlement (years)	572	26.95	12.56	3038	28.04	13.25	**
Size of D-canal community (100 households)	572	1.15	0.34	3038	1.15	0.34	
Holdings of clocks/watches (1000 Rs)	572	0.34	0.42	3038	0.49	0.59	***

*** 1% significant, ** 5% significant, * 10% significant, respectively

Table 2: Determinants of Credit Constraints

	Full samples			Samples with access to irrigation		
	(1)	(2)	(3)	(1)	(2)	(3)
	Bivariate probit	LPM	LPM	Bivariate probit	LPM	LPM
	MEM	Coef.	Coef.	MEM	Coef.	Coef.
Instruments						
Holdings of watches/clocks	-0.130***	-0.084***	-0.103***	-0.089***	-0.063***	-0.090***
	(0.021)	(0.021)	(0.020)	(0.022)	(0.023)	(0.023)
(Holdings of watches/clocks) ^{2}	0.019***	0.013**	0.016***	0.013***	0.009	0.015**
	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Watches/clocks × wild animals	-0.038	-0.068***	-0.039**	-0.134**	-0.073**	-0.075***
	(0.029)	(0.025)	(0.016)	(0.054)	(0.029)	(0.022)
Attacks by wild animals	0.030*	0.033	0.032*	0.054**	0.019	0.042*
	(0.018)	(0.026)	(0.017)	(0.026)	(0.033)	(0.021)
Other shocks	-0.010	-0.012	-0.011	0.004	0.007	0.002
	(0.012)	(0.013)	(0.011)	(0.014)	(0.018)	(0.015)
Size of irrigated land	-0.010**	-0.012*	-0.008**	0.003	-0.010	0.002
	(0.004)	(0.007)	(0.004)	(0.006)	(0.008)	(0.006)
Size of nonirrigated land	-0.006	-0.018**	-0.010*	-0.010	-0.020***	-0.008
	(0.005)	(0.007)	(0.006)	(0.008)	(0.007)	(0.006)
Holdings of fixed/mobile phones	0.00001	0.003	0.0003	-0.0002	0.001	0.0002
	(0.00250)	(0.002)	(0.0026)	(0.0025)	(0.003)	(0.0023)
Number of males	0.011	0.022	0.010	0.012*	0.033*	0.012
	(0.008)	(0.017)	(0.008)	(0.007)	(0.018)	(0.008)
Number of females	0.008	0.034***	0.009	0.009	0.026	0.010
	(0.007)	(0.012)	(0.006)	(0.007)	(0.019)	(0.007)
Number of children	0.008*	0.013	0.008	0.008	0.020	0.008
	(0.005)	(0.013)	(0.005)	(0.006)	(0.022)	(0.007)
Years of schooling of head	-0.002	-0.010	-0.002	-0.004	-0.012	-0.004
	(0.002)	(0.009)	(0.002)	(0.003)	(0.013)	(0.003)
Age of head (1000 years)	0.451	1.407	0.276	0.622	4.368	0.512
	(0.654)	(2.605)	(0.644)	(0.699)	(3.613)	(0.761)
Distance to daily market	-0.004	-0.008**	-0.006**	-0.004	-0.005	-0.004
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)
Distance to nearest city	-0.001		-0.001	-0.0004		-0.001
	(0.002)		(0.002)	(0.0018)		(0.002)
Years since settlement	-0.0004		-0.0004	-0.001*		-0.001*
	(0.0006)		(0.0007)	(0.001)		(0.001)
Size of D-canal community	-0.007		-0.004	-0.022		-0.019
	(0.024)		(0.023)	(0.025)		(0.025)
Household fixed effects	No	Yes	No	No	Yes	No
F stat. for instruments	71.11***	8.84***	22.56***	38.41***	5.07***	19.68***
Obs.	3519	3511	3519	2397	2334	2397

All specifications include the period-block specific fixed effects. MEM denotes the marginal effect at the mean. Specification (1) and (4) are estimated with the impact of credit constraints on contribution to ceremonies and irrigation management (the first and third columns of Table 3, respectively). Cluster-adjusted robust standard errors are reported. *** 1% significant, ** 5% significant, * 10% significant, respectively

Table 3: Impact of Credit Constraint on Social Capital Investment: Bivariate Probit Models

	Ceremonies	Community works	Irrigation management
Credit constraint [endogenous]	-0.503***	-0.367**	-0.132**
	(0.042)	(0.159)	(0.054)
Attacks by wild animals	0.039*	-0.0001	0.001
	(0.021)	(0.0336)	(0.025)
Other shocks	0.052**	0.025	0.045*
	(0.021)	(0.024)	(0.024)
Size of irrigated land	0.012*	0.016**	-0.016
	(0.007)	(0.008)	(0.013)
Size of nonirrigated land	-0.009	0.008	-0.015
	(0.006)	(0.008)	(0.013)
Holdings of fixed/mobile phones	-0.001	-0.003	0.0001
	(0.003)	(0.004)	(0.0032)
Number of males	0.008	0.011	0.017**
	(0.011)	(0.008)	(0.008)
Number of females	0.019**	-0.006	-0.003
	(0.009)	(0.007)	(0.014)
Number of children	-0.003	0.010*	0.012
	(0.006)	(0.005)	(0.010)
Years of schooling of head	0.005*	0.006***	-0.005*
	(0.003)	(0.002)	(0.003)
Age of head (1000 years)	-0.275	0.222	-2.376**
	(0.864)	(0.655)	(0.985)
Distance to daily market	0.003	-0.009	0.006
	(0.004)	(0.006)	(0.004)
Distance to nearest city	0.00003	-0.001	-0.0004
	(0.00268)	(0.002)	(0.0033)
Years since settlement	-0.0004	0.001	-0.0003
	(0.0006)	(0.001)	(0.0012)
Size of D-canal community	0.036*	0.024	0.021
	(0.021)	(0.023)	(0.050)
Correlation of error terms (Chi^2)	18.74***	3.41*	3.38*
F stat. for first-stage instruments	71.11***	44.87***	38.41***
Obs.	3519	3519	2397

All specifications include the period-block specific fixed effects. Cluster-adjusted robust standard errors and conditional marginal effects at the mean when credit constraint = 0 are reported. *** 1% significant, ** 5% significant, * 10% significant, respectively

Table 4: Stock of Social Capital: Trust Relationships with Community Members

Social Capital Variable	Households with Experience of Credit Constraints in 2001&2002 Mean	S.D.	Households without Experience of Credit Constraints in 2001&2002 Mean	S.D.	
Trust (general):					
Generally speaking, would you say that most people can be trusted? 1 if Yes or No idea, 0 if No	0.596	0.493	0.545	0.500	
Trust (villagers):					
How much do you feel you can trust people in your village/neighborhood? 1 if They can be trusted, or No idea, 0 if You cannot be too careful.	0.670	0.473	0.535	0.501	*
Trust (business):					
How much do you feel you can trust your business partners/traders? 1 if They can be trusted, or No idea, 0 if You cannot be too careful.	0.500	0.503	0.545	0.500	
Assistance (general):					
Would you say that people try to be helpful? 1 if Yes or No idea, 0 if No	0.745	0.438	0.677	0.470	
Fairness (general):					
Do you think most people would try to be fair? 1 if Yes or No idea, 0 if No	0.383	0.489	0.465	0.501	
Obs.	94		99		

*** 1% significant, ** 5% significant, * 10% significant, respectively

Table 5: Persistent Effect of Credit Constraint on Trust Relationships

	Trust (general)	Trust (villagers)	Trust (business)	Assistance (general)	Fairness (general)
Credit constraint [endogenous]	-0.485***	-0.438***	-0.537***	0.075	-0.379
	(0.044)	(0.022)	(0.032)	(0.807)	(0.278)
Attacks by wild animals	0.137	0.072	0.082	-0.089	-0.022
	(0.093)	(0.082)	(0.101)	(0.211)	(0.070)
Other shocks	0.005	0.081	0.060	0.093	-0.150**
	(0.067)	(0.056)	(0.050)	(0.090)	(0.073)
Size of irrigated land	-0.058**	-0.045**	-0.037	0.016	-0.058**
	(0.029)	(0.023)	(0.030)	(0.105)	(0.023)
Size of nonirrigated land	-0.038*	-0.013	-0.012	0.002	-0.008
	(0.020)	(0.018)	(0.024)	(0.039)	(0.022)
Holdings of fixed/mobile phones	0.128***	0.121***	-0.166***	0.127	-0.158***
	(0.015)	(0.016)	(0.012)	(0.083)	(0.021)
Number of males	-0.017	-0.024	0.010	-0.012	0.031
	(0.027)	(0.030)	(0.031)	(0.044)	(0.038)
Number of females	0.012	0.022	-0.010	-0.011	0.038
	(0.034)	(0.030)	(0.032)	(0.042)	(0.034)
Number of children	-0.016	0.001	-0.002	-0.027	0.094***
	(0.011)	(0.016)	(0.020)	(0.064)	(0.034)
Years of schooling of head	-0.013	-0.012	-0.007	-0.006	0.002
	(0.009)	(0.009)	(0.007)	(0.011)	(0.013)
Age of head (1000 years)	-2.204	-2.241	-1.144	1.040	3.305
	(2.534)	(2.841)	(2.769)	(4.165)	(3.664)
Distance to daily market	0.008	-0.001	0.012	-0.006	-0.008
	(0.011)	(0.012)	(0.011)	(0.018)	(0.013)
Distance to nearest city	0.008	0.005	0.010	0.029	-0.043***
	(0.013)	(0.015)	(0.014)	(0.040)	(0.010)
Years since settlement	0.003	0.001	-0.002	-0.004	0.003
	(0.002)	(0.002)	(0.004)	(0.008)	(0.005)
Size of D-canal community	0.081	0.082	0.011	0.137	-0.166
	(0.066)	(0.054)	(0.073)	(0.147)	(0.117)
Correlation of error terms (Chi^2)	44.61***	41.61***	1.21	0.0002	0.62
F stat. for first-stage instruments	33.13***	19.67***	15.19***	15.61***	14.68***
Obs.	193	193	193	193	193

All specifications include the block fixed effects. Cluster-adjusted robust standard errors and conditional marginal effects at the mean when credit constraint = 0 are reported. *** 1% significant, ** 5% significant, * 10% significant, respectively.

Table A1: Correlation between watch/clock holdings and the other variables

	Correlation	OLS
Endogenous variables		
Expense for ceremonies	0.104***	
Participation in community works	0.070**	
Participation in irrigation management	0.010	
Credit constraint	-0.100***	
Exogenous variables		
Attacks by wild animals	-0.058*	-65.4
		(49.5)
Other shocks	0.046	49.0
		(29.2)
Size of irrigated land	0.183***	51.6***
		(13.2)
Size of nonirrigated land	-0.042	13.4
		(19.4)
Holdings of fixed/mobile phones	0.098***	9.7
		(7.6)
Number of males	0.192***	79.0**
		(33.4)
Number of females	0.075**	8.1
		(14.9)
Number of children	-0.085**	-13.7
		(14.5)
Years of schooling of head	0.034	3.3
		(5.8)
Age of head (1000 years)	0.081**	-1360.0
		(1491.9)
Distance to daily market #	-0.017	0.1
		(5.9)
Distance to nearest city #	-0.014	-2.9
		(5.3)
Years since settlement #	0.051	-1.6
		(1.4)
Size of D-canal community #	-0.056	-17.3
		(52.4)
H_0: Coefficients of determinants of social capital are zero (F stat)		0.53
Obs.		858

# denotes exogenous determinants of social capital. Cluster adjusted standard errors are in parentheses. *** 1% significant, ** 5% significant, * 10% significant, respectively. The OLS estimation includes the block fixed effects.

Table A2: Impact of Credit Constraint on Social Capital Investment:
IV Linear Probability Model

	Ceremonies		Community works		Irrigation management	
	(1)	(2)	(3)	(4)	(5)	(6)
Credit constraint [endogenous]	-0.707**	-1.048***	0.041	0.024	-0.872**	-0.494**
	(0.312)	(0.270)	(0.262)	(0.207)	(0.396)	(0.233)
Attacks by wild animals	0.022	0.054*	0.008	-0.006	-0.001	-0.003
	(0.034)	(0.033)	(0.029)	(0.025)	(0.040)	(0.028)
Other shocks	0.041	0.052**	-0.020	0.033*	0.024	0.048**
	(0.026)	(0.023)	(0.022)	(0.018)	(0.028)	(0.020)
Size of irrigated land	-0.005	0.008	0.013	0.023***	-0.012	-0.019*
	(0.014)	(0.010)	(0.012)	(0.008)	(0.019)	(0.010)
Size of nonirrigated land	-0.016	-0.016	0.005	0.012	-0.017	-0.014
	(0.013)	(0.010)	(0.011)	(0.008)	(0.016)	(0.010)
Holdings of fixed/mobile phones	-0.001	-0.001	0.002	-0.003	0.003	0.001
	(0.006)	(0.004)	(0.005)	(0.003)	(0.006)	(0.003)
Number of males	-0.032	0.012	0.020	0.009	0.021	0.016*
	(0.027)	(0.011)	(0.022)	(0.008)	(0.033)	(0.009)
Number of females	0.037	0.025**	-0.002	-0.009	0.060**	-0.001
	(0.027)	(0.011)	(0.023)	(0.008)	(0.029)	(0.009)
Number of children	0.023	0.001	0.014	0.008	0.041	0.016**
	(0.021)	(0.009)	(0.017)	(0.007)	(0.026)	(0.008)
Years of schooling of head	0.006	0.005	0.026**	0.007***	-0.028*	-0.006**
	(0.013)	(0.003)	(0.011)	(0.003)	(0.015)	(0.003)
Age of head (1000 years)	-3.201	-0.016	-0.588	0.141	-3.284	-2.167**
	(4.370)	(1.032)	(3.672)	(0.792)	(5.075)	(0.919)
Distance to daily market	0.003	-0.0003	-0.008	-0.007*	0.006	0.006
	(0.006)	(0.0052)	(0.005)	(0.004)	(0.006)	(0.005)
Distance to nearest city		-0.0004		-0.001		-0.001
		(0.0029)		(0.002)		(0.003)
Years since settlement		-0.001		0.001		-0.001
		(0.001)		(0.001)		(0.001)
Size of D-canal community		0.041		0.023		0.032
		(0.035)		(0.027)		(0.032)
Household fixed effects	Yes	No	Yes	No	Yes	No
Obs.	3511	3519	3511	3519	2334	2397
Overidentification test (Sargan stat.)	1.386	1.243	0.234	0.084	4.963*	3.700

All specifications include the block fixed effects. Eight households are dropped in the fixed effect model since they include only one observation available for estimation. The first stage estimations are reported in Table 2. Standard errors are reported. *** 1% significant, ** 5% significant, * 10% significant, respectively.

Table A3: Multinomial Logit Estimation for the Timing at Which Irrigated Plots Are Received

	Between rainy season 2001 and rainy season 2002		Before rainy season 2001		H_0: Coefficients are the same among the three regimes (Chi-2 is reported)
	Coef.	S.E.	Coef.	S.E.	
Age of head	0.110	(0.080)	0.237***	(0.051)	2.94*
Age squared	-0.001	(0.001)	-0.0016***	(0.0005)	1.98
Years of schooling of head	-0.016	(0.051)	0.038	(0.033)	1.31
Female head	-0.393	(0.539)	-0.318	(0.329)	0.02
Males over 16	0.143	(0.177)	0.178	(0.122)	0.05
Females over 16	0.142	(0.167)	0.016	(0.117)	0.79
Constant	-5.379***	(2.021)	-5.887	(1.185)	
Block level fixed effects	Yes		Yes		
N	858				
H_0: Coefficients are the same among the three regimes for all variables (Chi-2 is reported)	6.96				

The benchmark group is those who do not have access to irrigation yet as of rainy season 2002.
*** 1% significant, ** 5% significant, * 10% significant, respectively

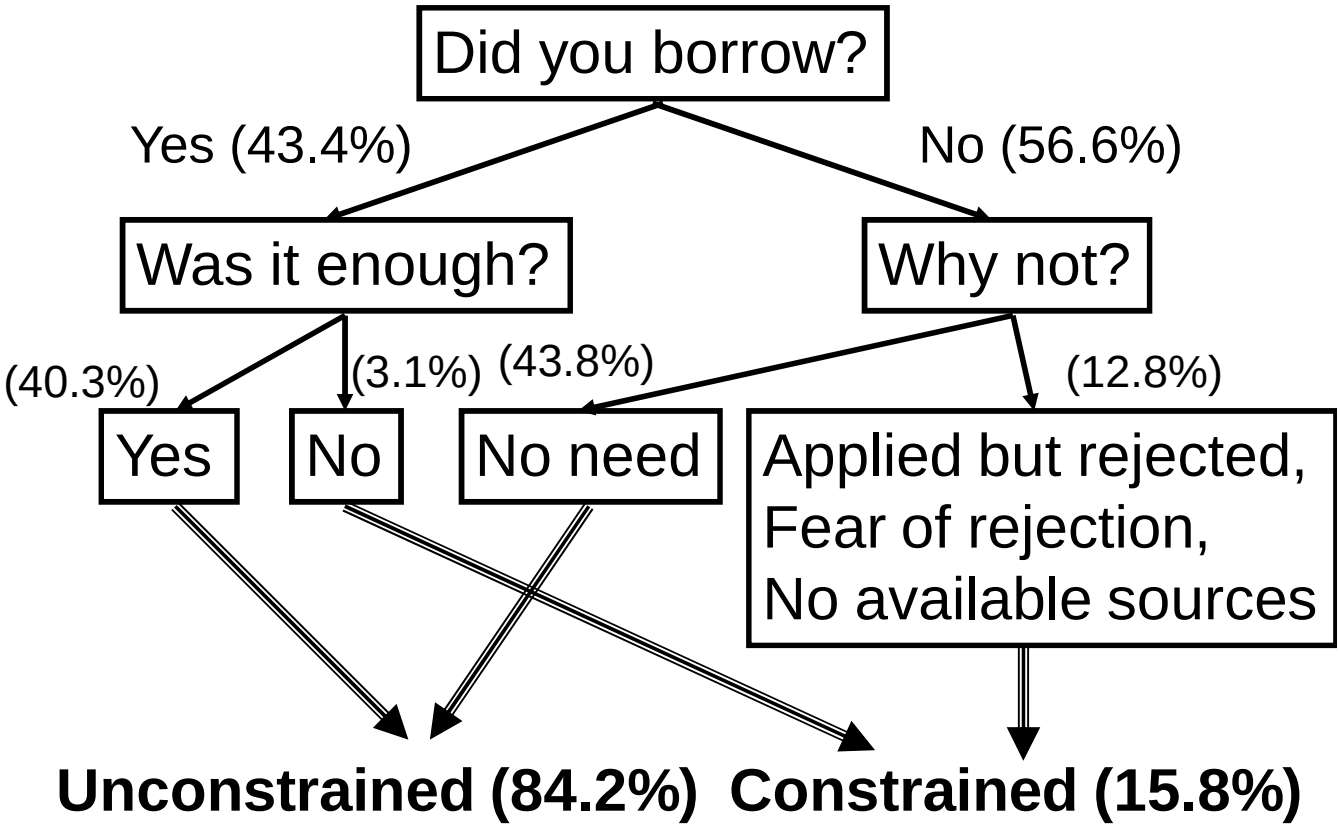

Figure 1: Questionnaire Design for the Credit Constraint Module